GeoBASIC FOR TPS1100

User Manual

Version 2.10

Heerbrugg, Switzerland

1 INTRODUCTION

GeoBASIC is a programming language for LEICA theodolites and their simulation on personal computers. The core language appears similar to today's common Windows BASIC dialects, thereby it is easy to learn and use. However, GeoBASIC's main power lies in its ability to use many of the existing theodolite subsystems and dialogs, just by calling an appropriate built-in function: for setting parameters, measuring, geodesy mathematics, and many things more. These tools at hand, the programmer can quickly and flexibly build sophisticated geodesy applications.

The user manual first describes the installation of GeoBASIC on a PC (*Chapter 2*). Then, after learning how to create an GeoBASIC application (*Chapter 3*), it will be shown how to actually load and execute a program on a LEICA theodolite (*Chapter 4*) and on the Windows simulation *(Chapter 5)*.

As these technicalities are mastered, the main topic is programming in GeoBASIC. This manual will give you several hints on typical GeoBASIC programming (*Chapter 8*), and introduces you to the design and programming of the theodolite user interface and refined GeoBASIC concepts (*Chapter 9*).

Finally, GeoBASIC example programs are presented (*Chapter 10)*. The reader will find a sample code for measuring and computing the mean value of several horizontal angles. Moreover some introductory examples are given to tell how special problems can be treated.

Note	All the details of the GeoBASIC language and system functions are composed in the "GeoBASIC Reference Manual".

2 INSTALLATION

The requirements for using GeoBASIC are a Personal Computer based on an Intel 486 processor or higher and at least 8MB of main memory. The installation of the whole development environment occupies about 10 MB of disk space, excluding the PDF version of the manual. The delivered software needs Microsoft Win95, Win98 or WinNT to run successfully.

2.1 SETUP

The following directory structure is created during the installation per default. Notice that the location of this directory tree is user definable. Hence it is not a granted to be exactly that location. Notice also that the CodeConverter application is installed in a separate Setup installation procedure.

```
…+-SurveyOffice
    |
    +-UserTools
    |  |
    |  +-TPS1100Tools
    |  |  |
    |  |  + - CodeConverter
    |  |  + - GBSamples
    |  |  |
```

Content of the directories (only the main objects are listed):

- `TPS1100Tools\`

`TPS1100.exe`	TPS Simulator for TPS1100 Series
`GBStudio.exe`	GeoBASIC IDE application
`GBI_1100_xxx.prg`	GeoBASIC Interpreter for TPS1100 series *)
…	and maybe several more tools, help files or DLL’s

- `CodeConverter\`

`CGB_Dlg.exe`	CODE to GeoBASIC converter
`Code_ex1.cod`	CODE sample
`GBC_xxx.exe`	GeoBASIC Compiler for TPS1000 series *)
`GBI_xxx.prg`	GeoBASIC Interpreter for TPS1000 series *)
`GBI_1100_xxx.prg`	GeoBASIC Interpreter for TPS1100 series *)

- …
  Several TPS1100Sim specific directories which contain language files, code lists, configurations and things like that.

* xxx means: i.e. 210 for Release 2.10

Loading the GeoBASIC Interpreter:

The GeoBASIC Interpreter will be loaded automatically with the loading of the first application into the theodolite using the Software Upload for TPS1100. Hence you have to copy the GeoBASIC Interpreter (GBI_TPS1100_xxx.prg) into the same directory as the application before loading it. Otherwise you will get an error message. (For details, please see Chapter 4.1 Loading a GeoBASIC program or 5.3 Loading and executing GeoBASIC programs)

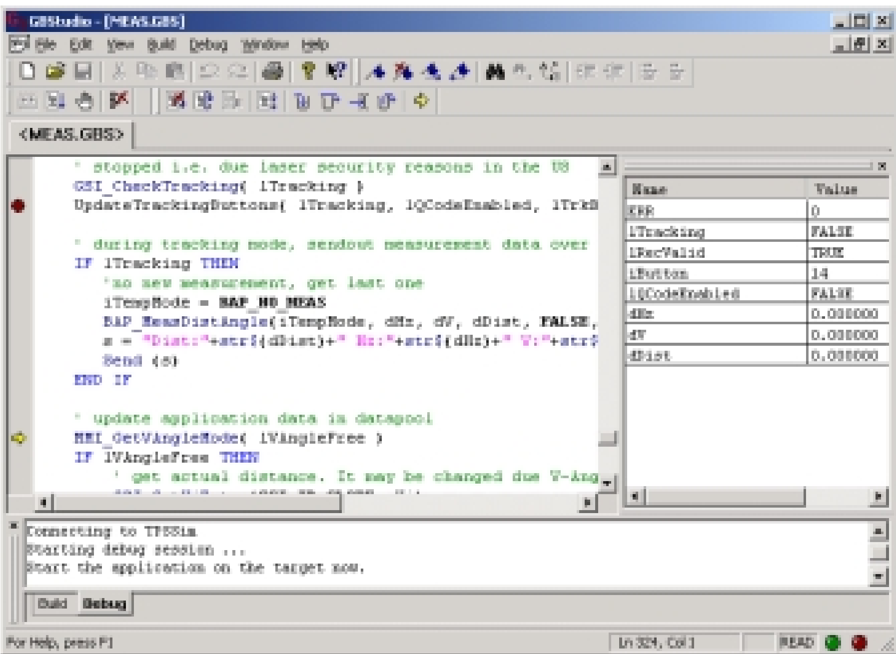
3 Creating a GeoBASIC Application

Starting from the specification of a GeoBASIC application, several steps have to be performed until the program can be executed on the theodolite or by simulation:

1. Write the program,
2. compile the program,
3. load the program, either onto the simulation or the theodolite, and
4. start the execution of it.
5. if the execution fails, start a debugging session.

3.1 GBSTUDIO DEVELOPMENT ENVIRONMENT

GBStudio is an integrated development environment and includes a source editor, compiler, project handling and a source level debugger. It is able to debug GeoBASIC 2.10 applications for TPS1100 series total stations. Both, the TPS simulator and the TPS device as the execution platform are supported.



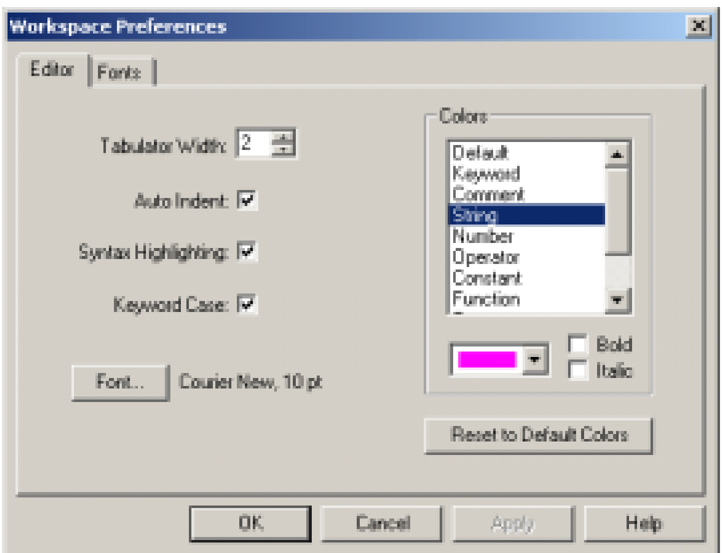
GBStudio contains several views for different purposes. The main source view is for showing/editing source files. The 'Open Files'-tab can be used to switch quickly between different source windows. Toolbars help the user to start actions with one mouse click. The 'Build/Output'-window is used to display informative messages of the compiler and during the debugging session for the user.

Use the integrated help system to get more descriptive explanations of what can be done with GBStudio. You can invoke the Help documentation by either using the context-help-cursor (Edit toolbar) or the shortcut F1, which opens the content page.

3.1.1 The Editor

It establishes a modern programming language editor, which supports syntax and keyword highlighting, multilevel undo/redo, Intellisense and Tooltip info, Bookmarks, indent and outdent of a block of source lines, and several other features.

The 'Workspace Preferences'-dialog can be used to customize the features, which should be active during debugging.



To choose a different font use the ‘Font …’-buttons in the ‘Font’-tab, which will offer a dialog to choose one of the installed fonts on the system. Fonts can be chosen separately for the Editor window, Build/Debug output window and for the Watch Variable window.

3.1.2 The Compiler

The source-file has to be *compiled* before it can be *loaded* and *executed*. Compiling the source file with the GeoBASIC compiler results into 3 files, one for the executable object itself (file extension “`.gba`”; i.e. `sample.gba`), one for the language data (file extension “`.lng`”; i.e. `sample.lng`) and a debug-info file (file extension “`.gbd`”; i.e. `sample.gbd`). The first two files are necessary to execute the program, either on a LEICA theodolite or with the simulator on a personal computer. The debug-info file is necessary for debugging a program using GBStudio. See the following diagram:

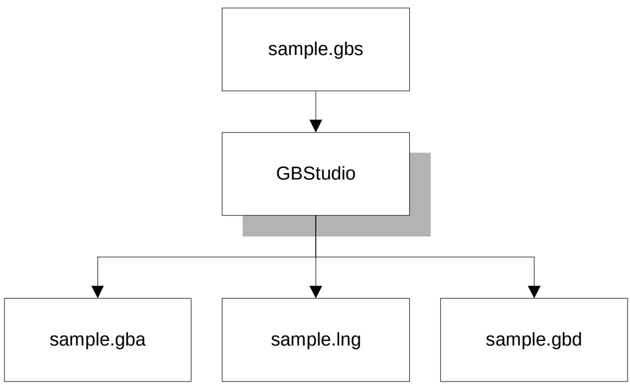
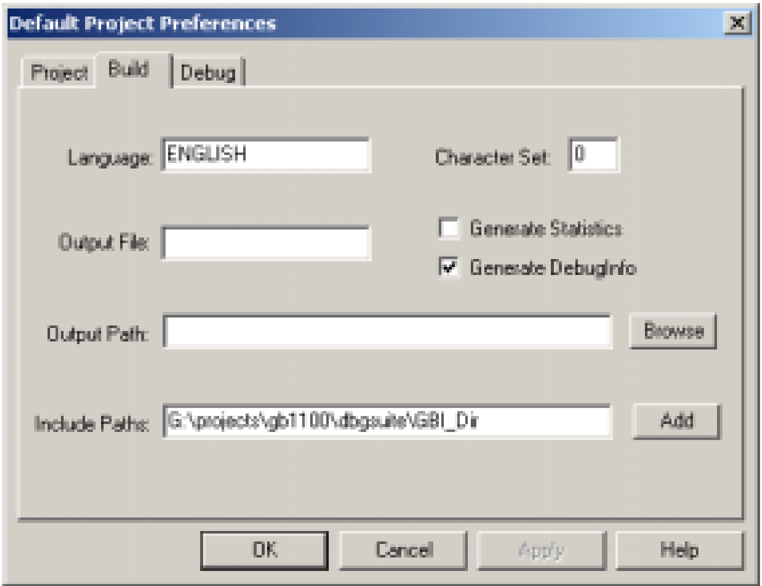


Diagram: Compiling a GeoBASIC program

The compiler is fully integrated in the development environment. The compilation of the source file is just one mouse click away. If an error occurs the editor will place the cursor automatically at the position of the error in the source window. Use Ctrl-F1 to get a more descriptive explanation of what caused the failure of the compilation process.

Depending on the compiler settings also the debug info file is generated which is necessary for debugging the application.

Depending on the selected project type, use either the ‘Default Project Preferences’-dialog or the ‘Project Preferences’-dialog to set the build options for the compiler.



The compiler understands the following options:

Setting	**Meaning**
Language	The language on which the resulting application is based on. The default is ENGLISH, other languages are FRENCH, GERMAN, etc.
Character Set	The character set on which the application is based on. The default character set is 0.
Output File	The name of the resulting applications file name. If it is empty, the resulting files get the same file base name as the source code file.

Output Path	The path where the compiler places the generated application files. The default is the source directory, where the compiler gets the GeoBASIC source file. The path has to be absolute and has to end with a "\"-character.
Include Paths	Set one or more directory-paths for include files. The directory path must not have a "\" character at the end.
Generate Statistics	Enable this flag, if you want the compiler to generate some statistical information about the compiled application.
Generate Debug Info	Enable this flag, if you want the compiler to generate a debug info file, which is necessary to debug the application

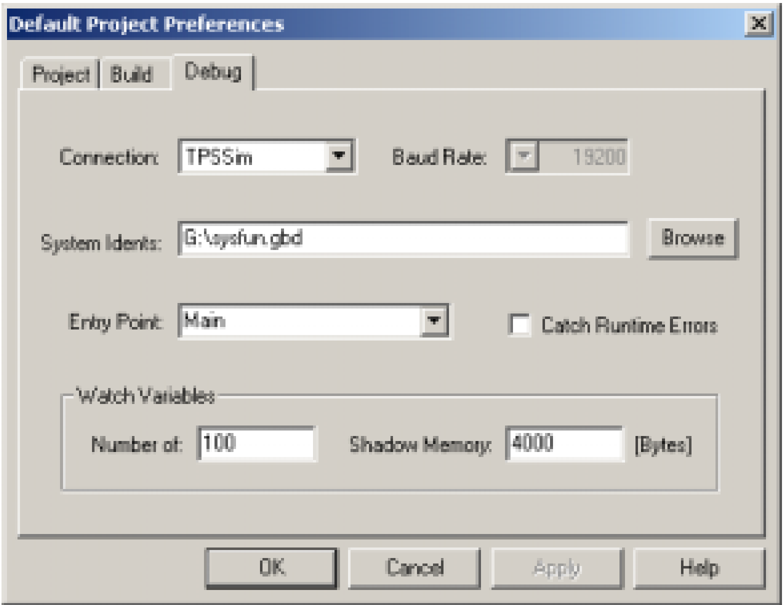
3.1.3 The Debugger

The debugger enables the programmer to debug GeoBASIC applications at source level. Operations like Step, Step Over, Run, Set breakpoints and watching the values of variables and some more operations are implemented.

To find errors in the source code an error catcher has been implemented which stops the execution of the application once the Err-variable changes its value. The error catching mechanism can be enabled and disabled during the debugging session at the needs of the developer.

The generated files include time stamp information. With this information GBStudio is able to check if all involved objects are synchronous to each other. This feature also enables GBStudio to debug an application, which may be in use for some time already. The only precondition, which has to be met is, that all files have to be saved for this purpose. Once the source code file changes debugging can only be started if the application is compiled anew. This means also that the application has to be loaded freshly onto hardware, which then initializes all its values. This feature is very valuable if a tested application shows error only after weeks or months of usage.

Depending on the selected project, use either the “Default Project Preferences” dialog or the “Project Preferences” dialog to set the build options for the debugging session.



For debugging the following values can be set:

Setting	Meaning
Connection	This setting determines the execution platform and if TPS over a serial line is served, which COM port should be used for communication.
Baud Rate	Is available only if one of the serial communication lines has been chosen. Choose an appropriate Baud rate.
System Idents	Determines the location of the system specific symbols file. Click on the “Browse…” button to get a file chooser dialog.

Entry Point	Since every loadable application on the TPS may have more than one entry point, one has to select a valid entry point of the application. This value can be entered before the debug info has been loaded, or after the debug info load operation. In the latter case choose the entry point by selecting an item from the drop down list.
Catch Runtime Errors	Enable this flag to catch runtime errors.
Number of Watch Variables	Select a value between 1 and 1000 watch variables. The number determines the table size on the server side. This value heavily influences the performance of certain debug operations. If you don’t a big number, then choose a smaller number for better performance.
Size of Shadow Memory	Select a value between 100 and 10000 Bytes. This will be the size of the shadow memory, where the server will keep a backup copy of the registered variables.

3.1.4 The Interpreter and the Firmware

Both have been adapted to provide all the additional functionality. Hence only firmware releases 2.10 and newer support GeoBASIC debugging with GBStudio. Please notice, that GBStudio cannot handle the TPS device state “Sleep Mode” correctly. Please disable the sleep feature of the TPS firmware if you want to avoid tedious timeout errors in GBStudio.

3.2 TYPICAL DEVELOPMENT CYCLE

3.2.1 Open or Create a GeoBASIC main source file

Use the Open File command to open an existing GeoBASIC main source file or create a new file with the document type GBS.

If you choose to open an already existing project, then the defined main source file should be opened automatically.

3.2.2 Edit the application.

Type in or change an existing GeoBASIC application source code. Please, refer also to the GeoBASIC reference manual for a complete description of syntax and semantics of GeoBASIC and how to write applications in GeoBASIC.

The editor is capable of automatically correcting the case of keywords. If one types a blank after a keyword this features take place automatically. Switch this feature off in the Workspace Preferences dialog if you don’t want to use this feature.

CTRL-SPACE opens a drop down list of system-defined functions. This can be used to quickly select a system function. When the opening parenthesis is typed the parameter list will be showed as a tool tip and a reminder what the compiler expects. Use SHIFT-CTRL-SPACE anytime to open up this tool tip again. The displayed parameter list depends on the cursor position and moreover on the system function identifier just before the current cursor.

Note:	Define also an entry point (GLOBAL SUB definition) of the application, which you can choose later to debug. This is the only identifier in a GeoBASIC application, which is case-sensitive. Make sure this entry point is linked to a menu item on the TPS user interface. Otherwise it will not be possible to debug the application (with the exception of the “BasicCodeProgram” type of application).

Save your changes by using CTRL-S or the Save command from the File menu.

3.2.3 Build the application

Press function key F7 or use the Build command from either the Build menu or Build toolbar.

If an error occurs, then the editor will place the cursor automatically near the location of the error. Correct the error and recompile it. Repeat these steps until your application compiles without any errors. Use CTRL-F1 if you want to get some more information on the last error occurred.

Note	The usage of the compiler is protected by a hardware key. Without the right hardware key it is not possible to execute the compiler successfully. If the hardware key is not installed properly or it does not contain the license for the compiler then an error message will be displayed and execution will be terminated.

3.2.4 Start debugging

To start the debug session, choose the platform (TPS simulator or TPS instrument) and specific settings, you want to use, in the Project Preferences dialog. Make also sure the entry point of the application is set properly in the preferences dialog.

1. Switch on the debugging platform.
2. When using the TPS device:

   Load the GeoBASIC interpreter.
3. Load the application you want to debug. (For details, please see Chapter 4.1 Loading a GeoBASIC program or 5.3 Loading and executing GeoBASIC programs)

Note:	The application must have been build with ‘’Generate Debug Info’’ enabled.

Note: GBStudio uses the TPS device when the GSI settings are active. The GeoCOM online mode is *not supported* during the debugging process. Make sure the GSI communication settings are:

19200 Baud,
No-Protocol,
8 Data Bits,
No-Parity,
CR/LF as terminator.

GBStudio *cannot* handle the sleep state of the TPS device correctly. Make sure the ''Sleep after …''-mode is disabled.

The application source and the generated files must be synchronous, hence a source file, which has been changed, after the application has been built, cannot be debugged.

Start debugging by pressing the Start button on the Build toolbar or use the corresponding menu located command.

Start the application on the platform. The editor should now get a small mark (in the shape of an right sided arrow) on the left edge of the main source file window, which points to the very first executable statement of this entry point of the application.

3.2.5 Debugging

Use the commands of the Debug menu or toolbar to step through the application, set breakpoints, catch errors and watch variables as they change during the debugging process.

In the watch variable view you will be able to edit either the identifier of the watch variable entry or the value itself, if the debugging process is in a HALT state.

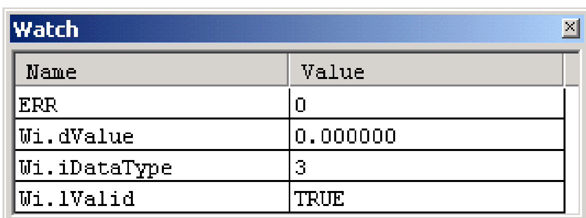
Note:	Changing the value of a string reference parameter is possible too. Since the actual, maximum length of the variable (behind the reference) is unknown, the debugger is unable to protect the memory area following the string variable. Hence, if you change the value of a string reference parameter, be sure that the number of added characters is less than or equal to the declared length.

3.2.6 Stop debugging

Choose the Stop Debugging command to stop the debugging process. Just in case the application is executing a system function, then the debug server will not be able to terminate the application immediately. Instead the application will be terminated after the system call returns. Nevertheless, GBStudio can terminate the debugging session on the client side.

3.2.7 Watch Variables and Quick Watches

Watch variables can be added to the Watch Variable view by selecting a variable identifier and pressing the shortcut Ctrl-W.



Use the Quick Watch command if you don’t want to add the variable to the Watch Variable view. Instead the value will be printed into the Debug Output window.

Once added to the window it is possible to change either the identifier name or the value of it (if the point of execution is in the scope of the variable). Use a Double-Click on the identifier or the value to enter the edit mode.

Note:	The identifier name is bound to the current context, which is determined by the selection you made. To choose the same identifier name from a different context one has to select the identifier in the correct context.

Valid watch variable expressions may be of the following form only:

Variable Expression	Example
VariableIdent	s, Err, line
StructIdent.Element	CurrPt.dHz, GMCircle.Center.dHeight,
	ArrayIdent(NumConstant)
	arr(2), field(17,3)

All other possible text strings cannot be handled correctly in the current implementation and will be rejected for registration therefore.

Include exclusively expressions with numerical constants.

3.3 PROJECT HANDLING

GBStudio knows two different categories of projects, which are valid exclusively. First the default project, which is valid for any valid GBS-file. And second the so-called ‘named’ projects, which have the application specific information stored in a file. It should be emphasized that the default project only stores the settings of one project (similar to one main source file) at a time. Once the user chooses another main source file, he has to make sure that the default preferences are set appropriately. E.g., if the two source files have different application entry points, the user has to set it up accordingly.

The default project is active if the user doesn’t choose a project explicitly. Instead the user will just open a plain GeoBASIC source code file.

3.4 COMMON PROBLEMS

The most common problems, which may arise, are:

- GBStudio is not able to establish a connection to the GeoBASIC Debug Server.
  Solution: In the case of debugging with the simulator make sure the TPS simulator is running and “Switched On”. In the case of the TPS device make sure the right COM port has been chosen, the cables are connected and the communication settings are equal on both sides. Notice, that GBStudio only supports serial settings with 8 Bit, 1 Stop Bit, no Parity Bit and CR/LF as a packet terminator. Only the Baud Rate may vary.
- The application, which should be debugged, and/or the interpreter are not loaded.
  Solution: Load interpreter and/or application first, before you start debugging.
- The program source files are out of synchronicity with the compiled application.
  Solution: Recompile and reload the GeoBASIC application.
- The Debug Session cannot be started, because the system predefined symbol file could not be found.
  Solution: Use the “Project Preferences” dialog, Debug-Tab, to specify path and file name of the system predefined symbols.
- The Debug Session cannot be started, because no valid entry point has been chosen.
  Solution: Use the “Project Preferences” dialog, Debug-Tab, to specify a valid entry point. Valid entry points are defined in the source code as “GLOBAL SUB …” procedure names. Notice: the predefined entry points Install, Init and Stop are not valid entry points.
- During debugging a Step-Into an Include source file doesn’t open the source file and show the next statement. Or the compiler reports the error that he can’t open an Include file.
  Solution: Make sure that the “Project Preferences” dialog, Build-Tab, field “Include Directories”, contains the right path, where GBStudio can find the include source file.
- The second registering of a variable doesn’t show the associated value. Notice, a variable can be registered only once.
- During debugging the code source cannot be edited. We disabled this during the debug session to keep the source and the loaded application

synchronous. Stop the debug session to be able to edit the code source again.

- **The debug session hangs**. Conceptually it may happen that a notify message get lost from the server to the client. Then it might be possible that the “Stop Debug” and “Break” buttons are enabled only. Since the debug server has sent the notify message it waits for the next command. And because the client has missed the notification, it thinks the last command is still being under execution and waits for the never incoming notification.
  Solution. Use the “Break” button to check the current state. If the last command has been finished and above situation was the reason then this initiate a new notification of the current state.

3.5 COMPILER LIMITATIONS

The GeoBASIC programmer has to keep some limitations for his applications:

- One simple procedure or function may not contain more than 10 kB of code.
- The maximum size of an application (including memory space) is limited by the free memory size of the theodolite only. If no other applications are loaded there should be free memory up to several hundred kB on a theodolite.
- An application may not have more than 64kB of string literal in total.
- The number of global identifiers is limited to 3000.
- The overall maximum number of identifiers limits the number of local identifiers, which are about 60000.

4 EXECUTING A GEOBASIC PROGRAM ON THE THEODOLITE

As described in the Chapter 3.1.2 The Compiler, compiling a GeoBASIC program results in at least two files, the executable program itself and the language data. Before a program can be executed, these two files have to be loaded into the theodolite first. With the help of the Leica Survey Office Software Upload the two files can be loaded into TPS-memory and run automatically the install procedure of the GeoBASIC program. The install procedure has to take care of adding an item to a menu which links an external procedure of the GeoBASIC program (`Global Sub`) to an item in a menu list. Additional to this static link there is a more flexible concept to install an application via a user (definable) configuration. For further explanations how to install an GeoBASIC application read Chapter 9.3.

If the menu item is added to a menu you can choose it to run a GeoBASIC program.

4.1 LOADING A GEOBASIC PROGRAM

GeoBASIC programs can be loaded into the theodolite using the Software Upload program from the Open Survey Suite. The procedure for loading a GeoBASIC application is as follows:

1. Verify that a serial link between PC and theodolite is established.
2. Switch theodolite into GeoCOM online mode.
3. Start Software Upload program.
4. Press <Transfer Files...> in <Utilities> menu of Software Upload.
5. Choose <Application Program> as Component Type.
6. Select directory which contains the loadable program (`*.gba`).
7. Choose language if the application supports multiple languages.
8. Select the application in the <Components> window.
9. Press <Transfer>.

Detailed explanations may be found in the documentation of Leica Survey Office - Software Upload.

GeoBASIC programs can also be loaded from the PC-Card into the theodolite using the build-in application loader. For details, please see description in the theodolite documentation.

Note	Loading a program with identical names for module and external procedures as an already loaded program replaces this program and all its associated text modules in memory and the items in the menu list. Hence, transferring of more than one program with the *same* application name may cause unwanted effects.

Note	For the build-in loader from the PC-Card, the files (*.GBA und *.lng) must be stored in the PC-Card folder “\TPS\APPL”. If necessarily, the GeoBASIC interpreter (gbi_xxx.prg) is loaded automatically from the same folder.

5 EXECUTING A GEOBASIC PROGRAM ON THE SIMULATIOR

5.1 GENERAL

The TPS1100 simulation supports, among other features, the execution and debugging of GeoBASIC applications. The simulation may run in one of two modes:

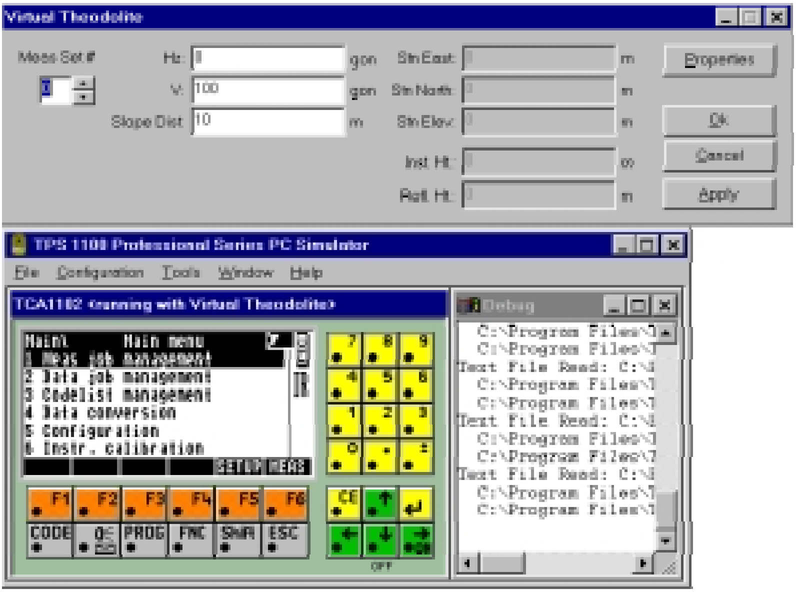
- GeoCOM mode
- SWTheo mode

Running in GeoCOM mode the simulation operates the (hardware) theodolite connected to the PC via a serial port and uses it as a sensor device. In SWTheo mode, user triggered commands are redirected to the software simulation of the theodolite.

5.2 USER INTERFACE

The TPS1100 simulation main window contains two windows and a dialog box on start-up: the „`TPS1100`“ window and the „`Debug`“ window (see below). The TPS1100 window contains a replication of the (hardware) TPS1100 theodolite‘s user interface. In the „Debug“ window, debug information are displayed. It is recommended to have always the debug window opened because some of the statements in the GeoBASIC source code (like the WRITE statement) might cause printing text into the „Debug“ window.

The dialog box is called “Virtual Theodolite” and is used to type in raw measurement data for the simulation of measurements. See also section 5.6.2 for further explanations.



5.3 LOADING AND EXECUTING GEOBASIC PROGRAMS

The procedure for loading a GeoBASIC application is as follows:

1. Make sure the simulation is turned on.
2. Choose the „Load Basic Application“ entry from the „File“ menu.
3. Choose a desired GeoBASIC executable (extension .gba) and press the „Open“ button.

If the application could be loaded successfully, it can be executed by choosing the menu item (or in the special case of a code program the CODE button in MEAS-mode), which has been added by the Install routine of the application. There is also a more flexible possibility to install the application via a user (definable) configuration. Refer to Chapter 9.3.2 for more information.

If the menu item “Load Basic Application …” is disabled (grey) then make sure no GeoBASIC application is running and maybe it’s necessary to press once or twice the ESC button of the TPS simulator.

5.4 CONFIGURATION OF THE SIMULATOR

The simulation is configurable via the „Configuration“ menu of the simulation main window. Here, the beep may be toggled using the „Beep On“ entry. A check mark left to the „Beep On” indicates whether it is turned on or off. The „Instr. Connection …“ entry opens a dialog to configure the communication parameters for GeoCOM mode and to switch between GeoCOM and SWTheo mode as shown in the following figure.

Paths can be set for text management, GSI data, code list, GeoBASIC programs and configuration data in the dialog opened by the „Data Path“ menu entry.

It is highly recommended to set the paths, if they are not already set, to the following values:

Path	Recommended value
Language Files	`TPS1100Tools\TextDB`
GSI and Log Files	`TPS1100Tools\GSI`
Internal Code List	`TPS1100Tools\CodeList`
External Code List	`TPS1100Tools\CodeListPcCard`
Basic Programs Path	`TPS1100Tools\GBSamples`
Configuration Data Path	`TPS1100Tools\Config`

5.5 GEOCOM MODE

5.5.1 Running the simulation in GeoCom mode

To switch to and run in GeoCOM mode follow this procedure:

1. Switch off simulation by single clicking under the down cursor of the TPS1100 window if not already off.
2. Verify that a serial link between PC and theodolite is established.
3. Switch off hardware theodolite if not already off or switch into GeoCOM online mode.
4. Select the appropriate communication parameters and „GeoCom“ in „Instr. Connection …“ dialog (see above) of the simulation. Confirm with the „OK“ button.
5. Start the simulation again using the „ON“ button of the TPS1100 window.

The simulation now tries to communicate with the theodolite. If a connection can be established, and the port you have chosen was „COM1“, the title of the TPS1100 window will be „TPS 1100 <running, GeoCom on com1:>“.

Otherwise a dialog enables the user to choose whether other communication configurations should be tested or not. Notice that this may take up to one minute.

If no connection could be established, the SWTheo is activated instead of GeoCOM after displaying a message box.

5.6 SWTHEO MODE

The software theodolite (Virtual Theodolite, SWTheo) is an emulation of a (hardware) theodolite. Its properties may be accessed via the „Meas Data Input…“ entry in the „Configuration“ menu while the simulation is running in SWTheo mode. Otherwise this menu entry is disabled.

5.6.1 Running the simulation in SWTheo mode

The procedure for switching to and running the simulation in SWTheo mode is as follows:

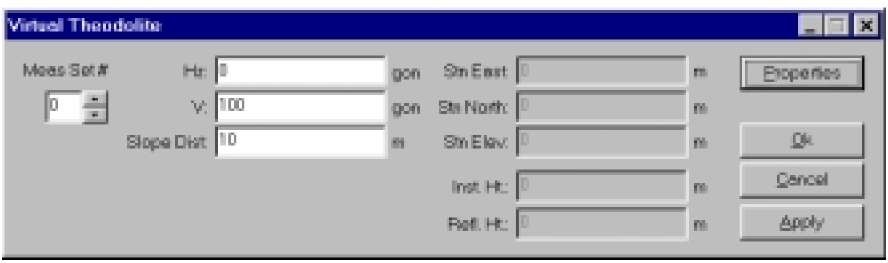
1. Switch off the simulation by single clicking under the down cursor of the TPS1100 window if it is not off already.
2. Open the GeoCOM dialog via the „Configuration“ menu.
3. Disable the GeoCOM enable box. Confirm with the „Ok“ button.
4. Start the simulation using the „ON” button in the TPS1100 window.

5.6.2 User Interface

There are two dialogs to access the SWTheo from the simulation. The first one is called SWTheo dialog with the caption „Virtual Theodolite“ contains fields to change raw sensor data of the SWTheo as well as station data. This dialog is opened from the “Configuration” menu as stated above. The second dialog called SWTheo properties dialog (caption „Virtual Theodolite Properties“) may be triggered from the SWTheo dialog.

5.6.2.1 SWTheo Dialog

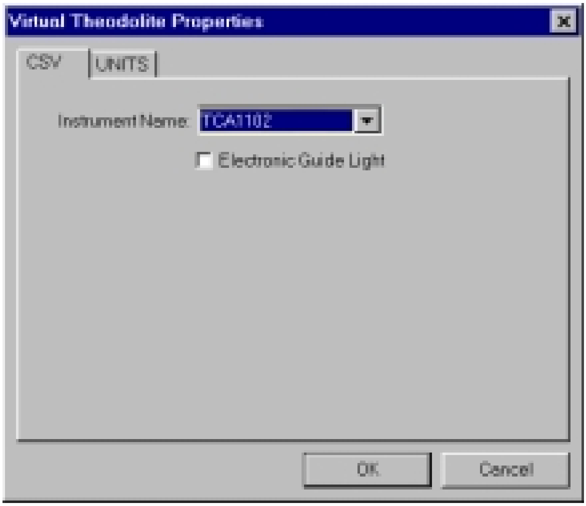
The dialog acts as the connection between the SWTheo and its virtual environment. Here, horizontal angle (Hz), vertical angle (V), and slope distance (Dist) to a virtual reflector as well as station data (N0, H0, E0), reflector (Hr) and instrument height (Hi) may be set. User input has to be confirmed using the “Set Data” button to take effect. Pressing the “Properties” button opens the Subsystems dialog.



Notice also that it is possible to define several sets of values. Choose a set by selecting the corresponding number off the measurement set. The values will be stored until they are changed.

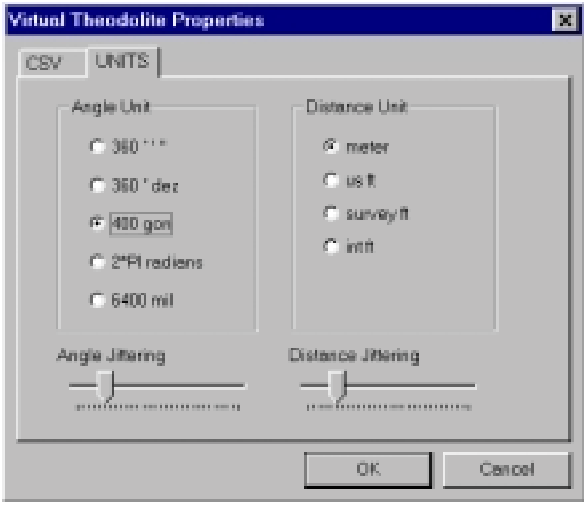
5.6.2.2 SWTheo properties dialog

The SWTheo properties dialog is a tabbed dialog as shown below. Here you can set some basic values.



The „Units“ tab depicted in the last figure enables the user to choose between several display units for the SWTheo dialogs. Please notice these values do not change the settings of the simulation.

“Jittering” is supported for angles and distances. This functionality is applied by alternately adding and subtracting random values in a range depending on the angle and distance sliders, respectively. The jittering amplitude increases from left to right position of the slider. If the sliders are in their leftmost position, there is no jittering applied to the virtual sensor data.



5.7 COMMONLY ASKED QUESTIONS AND ANSWERS

Q:

After starting the simulation and turning on in SWTheo mode , the text „xxx“ will be displayed as the title of some or all of the function buttons. How can I avoid this problem?

A:

Some or all of the text data base files are not contained in the directory referenced by „Text Management Data Path“. Use the „Data Paths“ entry of the „Configuration“ menu to set it accordingly.

Q:

After loading a GeoBASIC program, the expected menu item does not appear in the dialog. What did I wrong?

A:

The menu manager needs an event to reread the menu definition. Press the ESC key to rebuild the menu.

6 ADDITIONAL DEBUGGING FUNCTIONS

There are a few additional features, which may be helpful while debugging the program.

For the simulator:

- The command `Write` writes the given argument to the debug window. This will have no effects on the TPS.
- The same is valid for `Send`, because it will be redirected to the debug window. But, of course, on TPS it will send data over the data link.
- If an error occurs then a message will be written to the debug window, showing the error code and the name of the system routine, which caused the error.

For the simulator and the TPS:

- `MMI_PrintStr` can be used to display and track results and errors.

See also the list of return codes in the appendix of the Reference Manual.

7 MULTIPLE LANGUAGE SUPPORT

The TPS 1100 series system software supports internationalisation in such a way that text fragments are handled extra to an application. Accessing these fragments will be done internally by tokens. GeoBASIC supports this technique in certain system calls. Anytime a system routine is called which needs a `_Token` instead of a string then this token will be added to the text token database. The compiler handles this automatically for the programmer and produces the already mentioned `lng`-file.

This text token database is the basis for supporting multiple languages. With the Text Utility you can produce new text token databases (`mxx`-files) in other languages. Loading the derived `lxx`-files on the TPS system for enabling the user to choose between the provided languages. (‘`xx`’ stands for the language abbreviation.)

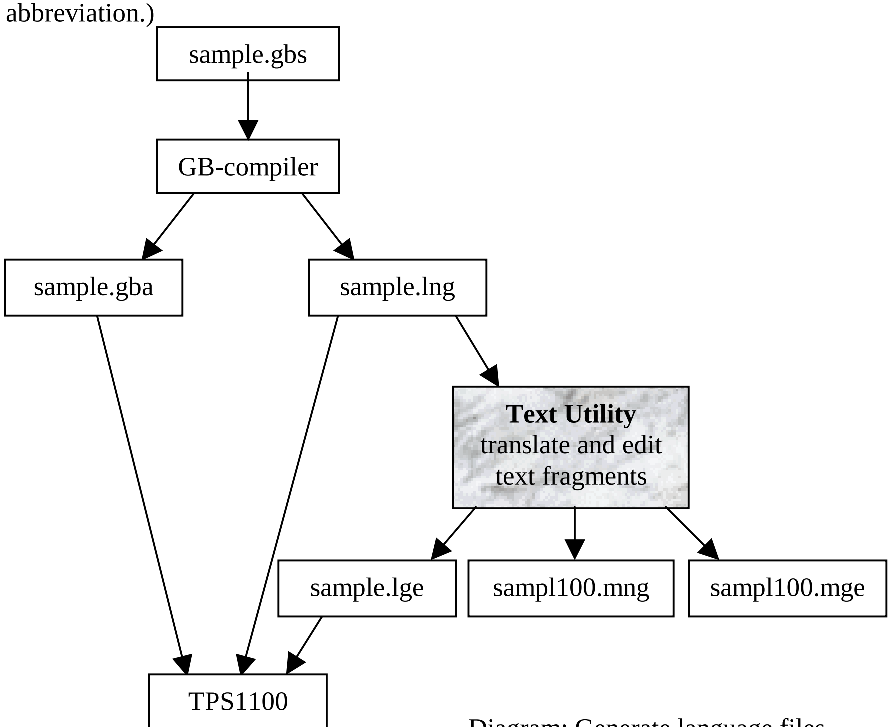


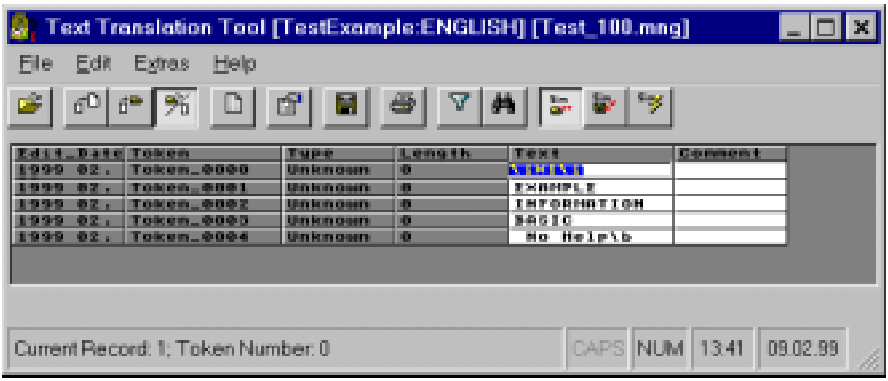
Diagram: Generate language files.

Strings which are not passed to a `_Token` parameter can not be handled with the Text Utility. They are hard coded into program object code. The only way to internationalise them is to use `MMI_GetLangName` to select an appropriate text string in GeoBASIC code separated by a conditional statement.

See sample file "`language.gbs`".

7.1 TEXT UTILITY

The TPS1100/1000 Text Utility (Text Translation Tool) supports GeoBASIC text files. This section describes the most important steps of generating multiple language files. The following picture shows the Text Utility after the import of a GeoBASIC text file:



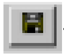
7.1.1 Generating new language files

For creating a multiple language application, the following steps are necessary:

1. After starting the Text Utility press the  -button, select GeoBASIC Text Files (*.l??) in the choice list “File of type:” and open the generated `*.lng` file (i.e. `sample.lng`). Answer the question “Do you want to convert this file?” with YES. In the next dialog you can specify the path and the version of the text database which is generated from the `*.lng` file (i.e. `sampl100.mng`). The version is automatically included at the end of the file name. Press OK to start the conversion.
2. Press the  -button, select a language in the choice list “New language”, enter the path of the new language database and press OK to start the

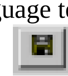
generation of the new language database (i.e. `sampl100.mge`). Now translate the text in column "Text".

Note	Do not edit the first token with the text "i\X1\i". This string is needed by the GeoBASIC Interpreter. Also the special strings for MMI_INVERSE_ON ("\aR+\a") and MMI_INVERSE_OFF ("\aR-\a") must be left unchanged.

After the translation press the -button, select the path and enter the name of the loadable language file and press OK to start the generation of the file (i.e. `sample.lge`).

7.1.2 Updating translated language files

After changing the GeoBASIC source file and re-compiling it, the following steps for updating the translated language files are necessary:

1. Press the -button again and open the generated `*.lng` file (i.e. `sample.lng`). The version of the text database which is generated must be increased (i.e. `sampl101.mng`).
2. Press the -button and open the target language you want to update (i.e. `sampl100.mge`). Edit the target language text column (indicated with T1). After updating the whole column press -button to generate the new loadable language file.

8 Typical GeoBASIC Programming

In this chapter some advice is given on how to program in GeoBASIC. The main attention is given to the user dialog — which is probably the most theodolite-specific part in GeoBASIC programming (besides using the system functions). Afterwards a proposal for naming conventions for GeoBASIC identifiers is given.

Note	To make programs easy and intuitive to use, the programmer should follow the given "standards" rather strictly. Moreover (s)he should have a basic understanding of the way how topographical surveying and mapping is actually performed.

8.1 THE TEXT DIALOG

8.1.1 The objects of the text dialog

The following text dialog is not a practical example, it shows only the most important text dialog objects:

Dialog line	**Object name**
<BASIC\ Text Dialog Objects>	Caption line: It is composed of the short caption ”BASIC” and the caption ”Text Dialog Objects”.
<I am a text dialog object.>	String
<10587>	Integer value

<90478.568>	Double (floating point) value without unit
<50.000 g>	Double (floating point) value with unit: If the type of the double value is `Angle, Distance, Subdistance,` ect. the according unit is printed automatically
<List Item 1 ▾ >	List: It is for selecting an item among several with the cursor keys
<CONT>	Button: The buttons inform the user about the functionality of the function key (F1..F6).

8.1.2 Creating a text dialog

A new text dialog is created by `MMI_CreateTextDialog`.

```
MMI_CreateTextDialog(6, "BASIC", "Text Dialog Objects",
                     "My help text.")
```

A text dialog with a short caption, here "`BASIC`", and a caption "Text Dialog Objects" is created. There is a total of 27 characters for the three parts, i.e. short caption, separation character ('\' printed automatically) and caption. 6 lines (start counting from the first line below the caption – which is 0 – up to line 5) can be used. All lines are empty after the creation. The help text is set to "`My help text.`" — it is shown when the user presses Shift-F1 and the help functionality of the theodolite is enabled.

8.1.3 Representation of the dialog objects

For every input and output the position on the display must be specified. The display is organized in lines and columns. The left upper position has line and column number 0. The line number is rising down and the column number is rising to the right. A display line is 29 characters wide. At most 6 lines are visible at any time, if the dialog contains more lines (up to 12 are possible) it is scrolled when necessary.

For floating point input/output a kind (for instance horizontal angle, distance, etc.) can be specified. Data is automatically transformed to the unit associated to the

kind according to the theodolite settings. Unit conversions are done by the system, all values with units defined in basic are considered to have to SI units. (See Chapter 9.1)

All numeric output appears right aligned in their field (specified by coordinates and length). String output appears left aligned.

Each input/output routine needs a parameter `lValid` which defines if the value of the object is valid or not. If a value is not valid five dashes are displayed instead of the value.

Every numeric input/output needs a parameter `iLen` which determines the total character length of the field. If the length is to short for the representation of the numeric value, the field will be filled with the character ‘x’.

8.1.4 Output in text dialog

- Strings:
  ```
  MMI_PrintStr(0, 0, “I am a text dialog object.”, TRUE)
  ```
  Parameters: column, line, string, lValid

- Integer values:
  ```
  MMI_PrintInt(10, 1, 10, 10578, TRUE)
  ```
  Parameters: column, line, iLen, integer value, lValid

- Double (floating point) values without unit:
  ```
  MMI_PrintVal(10, 2, 10, 3, 90478.568, TRUE,
               MMI_DEFAULT_MODE)
  ```
  Parameters: column, line, iLen, decimals, double value, lValid, Mode

- Double (floating point) values with unit:
  ```
  DIM hz AS Angle
  hz = PI/4
  MMI_PrintVal(10, 3, 8, 3, hz, TRUE, MMI_DIM_ON)
  ```
  Parameters: column, line, iLen, decimals, double value, lValid, Mode

8.1.5 Input in text dialog

Input is roughly dual to the output, except that the input functions return the button id of the button that terminated the edit process. For all numeric values there are the minimum and maximum values defined. The value is only valid, if it is between them.

- Strings:
```
MMI_InputStr(17, 3, 10, sInput, lValid, iButtonId)
```
  Parameters: column, line, string variable, lValid, button
- Integer values:
```
MMI_InputInt(24, 4, 4, 100, 200, iValue, lValid,
             iButtonId)
```
  Parameters: column, line, iLen, minimum value, maximum value, integer variable, lValid, button
- Double (floating point) values without unit:
```
MMI_InputVal(19, 4, 8, 2, 0, 399.99, MMI_DEFAULT_MODE,
             dValue, lValid, iButtonId)
```
  Parameters: column, line, iLen, decimals, minimum value, maximum value, mode, double variable, lValid, button
- Double (floating point) values with unit:
```
MMI_InputVal(19, 4, 8, 2, 0, 399.99, MMI_DIM_ON,
             dValue, lValid, iButtonId)
```
  Parameters: column, line, iLen, decimals, minimum value, maximum value, mode, double variable, lValid, button

- List: Lists take a variable of a predefined type as parameter.

  ```
  TYPE ListArray (25) AS String30 END
  ```

  This definition determines the maximum number of entries in a list to be 25, each one is a string of type String30. We create a list with 4 items and use the second entry as default (initial selection).

  ```
  DIM aList    AS ListArray
  DIM iIndex  AS Integer

  aList(1) = “List Item 1”
  aList(2) = “List Item 2”
  aList(3) = “List Item 3”
  aList(4) = “List Item 4”
  iIndex = 2
  MMI_InputList(8, 4, 12, 4, MMI_DEFAULT_MODE, aList,
                iIndex, lValid, iButtonId)
  ```

  Parameters: column, line, iLen, number of items, mode, list variable, index, lValid, button

8.2 THE GRAPHICS DIALOG

8.2.1 Positioning on the display

Every graphics function needs the position on the display. The graphics display is organized in x- (horizontal) and y-pixels (vertical). The left upper position has x-pixel and y-pixel number 0. The x-pixel number is rising to the right and the y-pixel number is rising down. The size of the display is 232 times 48 pixels.

8.2.2 Creating a graphics dialog

Calling MMI_CreateGraphDialog creates a new graphics dialog.

```
MMI_CreateGraphDialog("BASIC", "Graphics Dialog",
                      "My help text.")
```

A graphics dialog with short caption "BASIC" and caption "Graphics Dialog" is created. The help text is set to "`My help text.`" — it is shown when the user presses Shift-F1 and the help functionality of the theodolite is enabled.

8.2.3 Graphics functions

After having created the graphics dialog, the graphics functions may be used. (E.g. `MMI_DrawLine`, `MMI_DrawCircle`, `MMI_DrawText`, etc. See the "Reference Manual" for a detailed description.)

8.2.4 Deleting a dialog

When a dialog is not used any more it must be deleted. The name of the dialog deletion procedure is for text, measurement and graphics dialogs the same:

```
MMI_DeleteDialog()
```

8.2.5 Mixing text and graphics dialogs

There can be only one text dialog at a time, i.e. an existing text dialog must be deleted with `MMI_DeleteDialog` before a new one can be created with `MMI_CreateTextDialog`.[1] The same holds for a graphics dialog (with the appropriate creation procedures).

But a graphics dialog may be opened while a text dialog is active. (Note: The reverse is not the case: a text dialog may not be opened while a graphics dialog is open.) If a text dialog and a graphics dialog are open, the graphics dialog has priority, i.e. all future function calls are related to the graphics dialog (until it is closed). For example, `MMI_AddButton` (see below) will add the button to the graphics dialog, and all the display functions must be for graphic dialogs (such as `MMI_DrawCircle`, etc.).

8.2.6 Adding buttons

The user may add buttons to a dialog. (These buttons will be added to the *defined buttons* of the dialog.) When adding a button it must be specified what text should be displayed for that button. Such a text can be up to five characters long and is displayed centred above the button.

Each button has an identification associated. This button id is needed

[1] An existing text dialog is deleted automatically if a new text dialog is created.

- for specifying which button is to add in `MMI_AddButton`, and
- checking what button was pressed or that is returned from a system function.

Example:

We add the F1-button to the currently opened dialog, giving the meaning "`CONT`" to it.

```
MMI_AddButton( MMI_F1_KEY, "CONT" )
```

Note	The button id's are defined as constants in the compiler.

8.2.7 Responding to buttons

There are two procedures for coping with button presses:

- `MMI_CheckButton` queries whether there was a button pressed or not, and
- `MMI_GetButton` retrieves a pressed button. If there was no button pressed it waits until one is pressed. The second parameter to `MMI_GetButton` (the in-parameter `bAllKey`) determines what buttons are accepted:
  - If it is `TRUE`, any button is accepted.
  - If it is `FALSE`, only ESC, or a defined button (added with `MMI_AddButton`) are accepted.

Example:

The example does some work in a loop until Shift-F6 is pressed. As long as there is no button pressed, the display is constantly updated (e.g. the current angles from the theodolite are displayed). If there is a button pressed, this button is handled.

```
'bDone must be initialized
bDone = FALSE
DO WHILE NOT bDone     'as long as the job is not done
   'check for defined buttons and get its id
   MMI_GetButton( buttonId, FALSE )
   SELECT CASE buttonId       'handle it
   CASE MMI_F4_KEY
      'handle MMI_F4_KEY
   CASE MMI_SHF6_KEY
      bDone = TRUE            'that’s it,
                              'terminate loop
   CASE '…
      'here go the other handled keys
   ELSE
      'here go the unhandled keys
   END SELECT
   'update the display
LOOP
```

8.2.8 Standard key binding

It is clear that for the user it is important that the same name[2] — and moreover the same key — always has the same meaning associated (at least conceptually). An exception is the F1-key, its meaning is not the same in a measurement dialog and in a configuration dialog. In the following table there are the standard key bindings with the caption, the text which is displayed above the keys:

Key	Caption	Action
F1 in measurement dialog	ALL	Does first DIST, then REC. (See below)
F1 in configuration dialog	CONT	Continues to the logically following dialog.

[2] For instance, the user of a LEICA theodolite assumes that DIST takes the distance (with the common dialogs), ALL does DIST and then REC, etc.

Key	Caption	Action
F2	DIST	Start distance measurement.
F3	REC	Records the previously measured / computed data.
SHIFT-F1	HELP	Displays a help text if the theodolite help functionality is enabled. This key is provided and handled completely by the system, it is not accessible from GeoBASIC.
SHIFT-F6	QUIT	Terminates an application.
ESC		Cancels an input or goes a step back. GeoBASIC applications should handle it.
CODE		Shows the coding dialog.

8.3 NAMING CONVENTIONS

We propose some naming conventions for GeoBASIC. More extensive conventions can be found in the naming conventions for Microsoft Access (which are tied closely to Visual Basic conventions).[3]

8.3.1 Variable names

Variable names of simple types (i.e. all the scalar types and strings) may be *tagged* to indicate their type. Prefixes are always lowercase so your eye goes past them to the first uppercase letter — where the *base name* begins. If the base name consists of more than one word, upper case letters within the name are used to distinguish its parts.

Note	These naming conventions carry only a semantics for the programmer, not for the compiler.

[3] See "Naming Conventions for Microsoft Access, the Leszynski/Reddick Guidelines for Access", Microsoft Development Library 1995.

The **base name** succinctly describes the object. For example, `PointNumber` or just `PointNo` for the number of a point. Object **tags** are short abbreviations and simplifications describing the type of the object. For example, the tag '`i`' in `iPointNo` denotes that the type of the variable is `Integer`. The following table lists the tags for the GeoBASIC types.

type	**tag**
`Integer`	`i`
`Logical`	`l`
`Double`	`d`
`Distance`	`d`
`Subdistance`	`d`
`Angle`	`d`
`Pressure`	`d`
`Temperature`	`d`
`String`	`s`

Note that all types which represent floating point numbers are tagged by '`d`'. This is because operations valid for the type `Double` are also valid for the other `d`–tagged types.

If there are several similar object names, a **qualifier** may follow the name and further clarify it. For example if we kept two special point numbers, one for the first point and one for the last, the variable names would be the (qualified) variables `iPointNoFirst` and `iPointNoLast`.

Structure types do not have a default prefix, if needed the (abbreviated) type name could be used. For *arrays* the base name itself could contain the information that the variable names an array.

For *global variables* an additional prefix '`g`' might be useful.

8.3.2 Constants and user-defined types

Constants begin with an upper case character. If constants contain only upper case characters (as most of the predefined constants do) the underscore '_' is used to separate parts of the name. Often constants can be grouped together, then a prefix is used to denote their common criterion. For example the return codes use RC, as in `RC_OK, RC_ABORT`, etc.

Mostly constants are globally defined. For *local constants* an additional prefix `'loc'` might be useful.

User defined types begin with an upper case character. Use the postfix '`_TYPE`', `'_Type'` or '`Type`' (according to the naming convention used for the type name itself) appended to the type name to denote that it is a type structure. Alternatively, you can use a prefix '`T`'. (For types these conventions are useful since GeoBASIC is not case sensitive. Hence, for example, if there is a type `Date` no variable can be named `date`. If the type has the name `TDate` or `Date_Type` or `DateType`, there can.) As for local constants, *local types* might be prefixed with `'loc'`.

8.3.3 Procedures

A procedure name begins with an upper case letter and succinctly describes the action that is performed. Variables that denote parameters passed to a function or subroutine (in the parentheses after the function/subroutine name) should be well documented, also indicating whether they act as *input*, *output*, or *input and output* parameters.

8.3.4 Keywords

GeoBASIC keywords are all in upper case letters. For example, `DIM`, `FOR`, `LOOP`, `FUNCTION`, etc.

8.3.5 Labels

For error labels (ON ERROR GOTO) we use the function/subprocedure name with the qualifier `'_Err'` appended.

```
SUB LabelExample ()
   'code of the procedure

LabelExample_Err:
   SELECT CASE ERR
      'handle specific errors here
   CASE ELSE
      'generic error handler here
   END SELECT
END LabelExample
```

8.3.6 Remark on naming conventions

Naming conventions never replace the judicious use of comments in your GeoBASIC program code. Naming conventions are an extension of, not a replacement for, good program-commenting techniques.

Formulating, learning, and applying a consistent naming style require a significant initial investment of time and energy. However, you will be amply rewarded when you return to your application a year later to do maintenance or when you share your code with others. Once you implement standardised names, you will quickly grow to appreciate the initial effort you made.

To complete the discussion about naming conventions, we mention the use of program headers:

In every function/subprocedure there should be a header describing, at a minimum, purpose, and parameters passed and/or returned. (In addition there might be comments, the author's name, last revision date, notes, etc.)

9 REFINED GEOBASIC CONCEPTS

In GeoBASIC several concepts are implemented to utilise and standardise programming and applications.

9.1 UNITS

Working with units always gives rise to the problem that different users want to work with different units. In geodesy, take the vertical angle as an example: some surveyors measure in Gon, some in radians, others in percentages. And, in addition to the unit-problem, there is the question where to fix the zero point of some scale. Again for the vertical angle example: some surveyors want to have zenith angles, some nadirs, some something in between.

To cope with this situation there is a fine automatic unit handling system built in the theodolite system, and the GeoBASIC programmer can take full advantage of it. All that has to be done in a GeoBASIC program, is to keep all values in SI units and, when a value has to be displayed specify what kind of value it is: a horizontal angle, a vertical angle, a distance, a temperature, etc. All the formatting, together with choice of the right representation (the user may define this in his theodolite system configuration with which the GeoBASIC programmer is not concerned), and displaying the unit after the value are handled automatically. (Of course the programmer can also decide *not* to use this automation and handle everything on his own. But values obtained from the system will be in SI units anyway.)

9.1.1 What the GeoBASIC programmer has to do

- Use SI units throughout the program. All computations are done with values in SI units.
- When displaying, specify the correct data type i.e. `Distance` for the value is displayed. See description of the `MMI_PrintVal` function in the "Reference Manual".

We will give an example of measuring an horizontal angle, computing the difference to a given angle, and displaying the difference on the display. (Note that we use the `GetAngleHz` routine from the `MeanHz` program (see 10.1), and we assume that a text dialog has been opened properly. The angle difference is normalised to the range 0 to $2\times\pi$.)

Example

```
DIM dHz1      AS Angle    'first horizontal angle
DIM dHz2      AS Angle    'second horizontal angle
DIM lValidHz2 AS Logical  'indicator if second
                          '  angle is valid
DIM dDiffHz   AS Angle    'the difference of the
                          '  angles

'assume dHz1 is initialized here to an angle
'in radians

GetAngleHz( dHz2, lValidHz2 )

dDiffHz = dHz1 - dHz2
GM_AdjustAngleFromZeroToTwoPi( dDiffHz )

MMI_PrintVal( 20, 0, 8, 3, dDiffHz, lValidHz2,
              MMI_DIM_ON )
```

The output is as follows:

- If the `GetAngleHz` routine returned a valid angle, also the difference `dDiffHz` will be valid (this is why `lValidHz2` is used in the `MMI_PrintVal` function). In this case the angle will be formatted in an 8 character wide field with 3 decimals, afterwards the unit according the theodolite system configuration will be displayed.
  Assume that `gon` is set and the angle difference was 1.5473452 radians, then at position 20 in line 0 the output will be «`  98,507 g`».
- If the angle returned from `GetAngleHz` was not valid, five dashes will be displayed «`   ----- g`».

9.1.2 What the user/surveyor has to do

The user has to set up the units, in which he want to work, in the theodolite system configuration. All outputs that use the theodolite system will automatically be formatted according to this setting.

9.2 THE USER MEASUREMENT DIALOG

The User Measurement Dialog (sometimes referred as MDlg) standardises the visualisation of the measurement values in GeoBASIC. Each value (i.e. vertical angle, horizontal distance) has a predefined output format. Thus the GeoBASIC

programmer has only to define, on which line a value should be displayed. All lines begin with a brief description of the value.

For example (Output of the horizontal distance):

```
«Horiz.Dist:     158.287 m»
```

Additionally the measurement parameters and (self-definable) application parameters can be displayed in the measurement dialog. Thus a user is able to change measurement parameters immediately and without leaving the dialog. All measurement values and measurement parameters are saved in the theodolite's data pool as system parameters.

We distinguish between measurement and application parameters. The former are defined by the system in it's meaning and data type. The letter can be defined freely by the user. Please refer to Appendix H in the reference manual for a list of all system and application parameters, which can be used in a measurement dialog.

9.2.1 Configuration of the User Measurement Dialog

Before using the measurement dialog we have to define its contents. There are 3 types of possible entries:

- System parameters:
  The routine `GSI_SetLineMDlg` places a system parameter (measurement value or measurement settings) on a line.
- Pure text line:
  The routine `GSI_SetLineMDlgText` places any text on a line.
- Application parameters:
  The routine `GSI_SetLineMDlgPar` places a (self-definable) application parameter on a line.

Note	The user measurement dialog configuration is automatically initialised with the entries of the first system measurement dialog.

Thus all lines which are not configured by the GeoBASIC programmer shows the same parameters as the first system measurement dialog. For further explanations how to configure the user measurement dialog read the description of the 3 system functions (`GSI_SetLineMDlg`, `GSI_SetLineMDlgText`, `GSI_SetLineMDlgPar`) in the reference manual.

9.2.2 Creating the User Measurement Dialog

After the definition of the content GSI_CreateMDlg analogous to the creation of a text dialog creates the user measurement dialog. For adding buttons to the dialog use `MMI_AddButton`.

9.2.3 Executing the User Measurement Dialog

In the following example a measurement dialog is created with the horizontal angle on line 2 and the buttons “DIST” on F2-key and “QUIT” on SHIFT-F6-key. All other lines are predefined by the system. After the creation of the dialog the measured values will be updated in a loop:

```
'Change line 2
GSI_SetLineMDlg(2, GSI_PAR_AngleHz)
GSI_CreateMDlg (2, "MEAS", "Measurement Test",
                "Measurement Help...")
'Addition of buttons
MMI_AddButton(MMI_F2_KEY, "DIST")
MMI_AddButton(MMI_SHF6_KEY, "QUIT")
lDone = FALSE
DO WHILE NOT lDone
  GSI_UpdateMeasurement(TMC_AUTO_INC, WAITTIME,
                        lRecValid, iCode, FALSE)
  GSI_UpdateMDlg(iButton)
  SELECT CASE iButton
  CASE MMI_F2_KEY
    'DIST Button --> meas a distance and angles
    BAP_MeasDistAngle(iDistMode, dHz, dV, dDist, TRUE,
                      MEAS)
  CASE '..
    'handle other keys
  CASE MMI_ESC_KEY, MMI_SHF6_KEY
    'done --> exit this routine
    lDone = TRUE
  END SELECT
LOOP 'end measurement loop
'delete measurement dialog
MMI_DeleteDialog()
```

The routine `GSI_UpdateMeasurement` updates the measurement values in the theodolite data pool. `GSI_UpdateMDlg` updates the user measurement dialog with the new values and returns the pressed button. For further explanations read the description of these system routines in the reference manual.

If the user measurement dialog is not used any more it must be deleted with `MMI_DeleteDialog`.

See the example program MEAS.GBS for a typical usage of the user measurement dialog.

9.2.4 Mixing the User Measurement Dialog with Other Dialogs

There can be only one user measurement dialog at a time, i.e. an existing user measurement dialog must be deleted with `MMI_DeleteDialog` before a new one can be created with `GSI_CreateMDlg`. If a user measurement dialog is active, no text dialog can be opened and vice versa.

But a graphics dialog may be opened while a user measurement dialog is active.

Note	The reverse is not the case: a user measurement dialog may not be opened while a graphics dialog is open. If a user measurement dialog and a graphics dialog are open, the graphics dialog has priority, i.e. all future function calls are related to the graphics dialog until it is closed.

9.3 TPS1100 CONFIGURABILITY

In general, each part of an application, which should be accessible from outside, has to be of the form '`GLOBAL SUB`'. These points are known as entry points and can be used in two ways. First they can be linked to a menu item (of the a system), and second they can be described as configuration item.

9.3.1 Adding the program in a System Menu

The easier way to access an entry point of an application is to link it to a menu item during the installation phase. Please refer to the Reference Manual `MMI_CreateMenuItem` for further explanations.

9.3.2 Import the program in a User Configuration

The TPS1100 series theodolites support the concept of individual configurations. In a configuration the user can define his own dialogs or menus and link them to certain events (i.e. pressing the PROG key or Power ON). If the event occurs then the linked dialog or the menu will be displayed. The user can create and change his configuration on the PC with the Customisation Tool.

The import of a GeoBASIC program in a user configuration means, that an external GeoBASIC routine is linked with an item of a user defined menu, a button of a user defined dialog or directly with an event. If either the event occurs or the button is pressed or the menu item is selected, then the linked external routine is executed. For the import of a GeoBASIC program the Customisation Tool needs a special file named APPInfo-file with the necessary information about the program.

The usage of the APPInfo-file in the Customisation Tool:

- Start the Customisation Tool
- Open a configuration file, appropriate text- and definition files
- Choose Import Application from the file menu
- Check the box named with the program name (i.e. AppInfoExample)
- Press the OK button

Now the globally accessible subroutines may be added to menus, buttons, etc. simply by using drag and drop.

Generate the AppInfo-file
The AppInfo-file is automatically generated during compilation, if there is a application information (short AppInfo) section in the GeoBASIC source file.

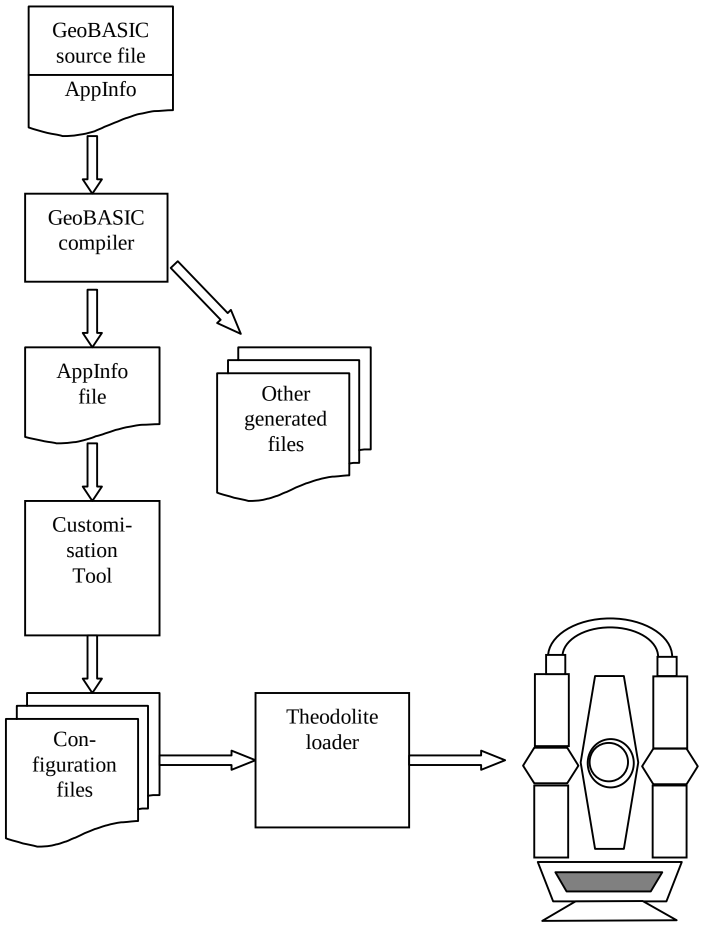
Note	The AppInfo-section has to occur at the end of the source code. The AppInfo-section is optional; if there is no AppInfo-section in the GeoBASIC source file, the AppInfo-file generation is omitted. The global routine “`Install`“ is optional, since any global routine may be associated with a menu entry, using the AppInfo-file via the Customisation Tool.

The following GeoBASIC sample code illustrates the usage of the AppInfo-section in a GeoBASIC source file. See also the sample program `AppInfoTest.gbs`.

```
PROGRAM AppInfoExample

'-------------------------------------------------------
GLOBAL SUB GlobalSub1
  Dim dummy As Integer
  MMI_WriteMsgStr("AppInfoExample.", "GlobalSub1 in
                  AppInfoExample called", MMI_MB_OK,
                  dummy)
END GlobalSub1

'-------------------------------------------------------
GLOBAL SUB GlobalSub2
  Dim dummy As Integer
  MMI_WriteMsgStr("AppInfoExample.", "GlobalSub2 in
                  AppInfoExample called", MMI_MB_OK,
                  dummy)
END GlobalSub2

END AppInfoExample

'Application Information for Config Tool
'---------------------------------------
APPINFO

  GENERAL
    SET Author    "Leica AG, CH - Heerbrugg"
    SET Desc      "AppInfo Example Application"
    SET TheoModel "TCA1100"
  END GENERAL

  ENTRYPOINT GlobalSub1
    SET CapLg "Global Sub 1"
    SET CapSh "GSUB1"
    SET Desc  "test of appinfo subroutine 1"
  END GlobalSub1

  ENTRYPOINT GlobalSub2
    SET CapLg "Global Sub 2"
    SET CapSh "GSUB2"
    SET Help  "displays a message and exits"
  END GlobalSub2

END APPINFO
```

The global subroutines `GlobalSub1` and `GlobalSub2` are indicated as entry points for the import in a user configuration. Refer to Chapter 2.11 in the Reference Manual for a description of the syntax in BNF-form.

The following figure depicts the whole scenario, from the generation of the AppInfo file over the import in a user (definable) configuration to the loading of the configuration into the theodolite:



9.4 INTERAPPLICATION-CALL

The inter-application-call makes it possible to call a subroutine in another GeoBASIC program. With this concept the GeoBASIC programmer can use the same subroutine in several programs.

9.4.1 Definition of a subroutine for Interapplication-Call

If a subroutine should be called by another application, it must be defined as a global subroutine.

Example:

```
PROGRAM IAC2
GLOBAL SUB InterAppEntry
  DIM iButton  AS INTEGER
  MMI_WriteMsgStr("Welcome in IAC2","IAC2", MMI_MB_OK,
                  iButton)
END InterAppEntry
END IAC2
```

9.4.2 Call the global subroutine

Before calling the global subroutine, the GeoBASIC programmer has to check with `CSV_LibCallAvailable` if the subroutine is available. That usually means if it is loaded or not. Is the subroutine available, he can invoke it with `CSV_LibCall`.

Example:

```
DIM lAvailable  AS LOGICAL
'Check if global subroutine is available
CSV_LibCallAvailable("IAC2","InterAppEntry", lAvailable)
IF lAvailable
  'available, call global subroutine
  CSV_LibCall("IAC2", "InterAppEntry", "BASIC")
END IF
```

See the example program IAC.GBS and IAC2.GBS for a typical usage of inter-application-call. For further explanations read the description of `CSV_LibCall` and `CSV_LibCallAvailable` in the reference manual.

9.5 SYSTEM FUNCTION CALL

If a theodolite user creates his own configuration on the PC with the Customisation Tool, he has a wide selection of predefined system functions which he can add to menus, buttons, etc. After the loading of the configuration he calls the system functions by selecting the appropriate menu item or button.

The GeoBASIC programmer has the same possibilities. With the routine `CSV_SysCall` he can call the system functions in his programs. Because some system functions do not run on every theodolite type, there is a routine

CSV_SysCallAvailable, which returns if the system function can be executed.

Example:

```
DIM lAvailable AS Logical
CSV_SysCallAvailable(CSV_SFNC_PositCompassDlg,
                     lAvailable)
IF lAvailable
  CSV_SysCall(CSV_SFNC_PositCompassDlg)
END IF
```

If the system function CSV_SFNC_PositCompassDlg can be executed (RCS mode is activ), then the dialog RCS orientation with a compass is displayed. For further explanations read the function descriptions of CSV_SysCall and CSV_SysCallAvailable in the reference manual. In Appendix H of the reference manual there is a list of all system functions.

9.6 SYSTEM EVENT GENERATION

Every configuration for a TPS1100 series theodolite is event driven. The user or the system itself generates an event (e.g. the user has pressed the PROG key or the initialisation sequence is finished) and the configuration functionality executes then the linked action (menu, dialog, macro, application or system function).

A GeoBASIC program can generate all events, which can occur in the theodolite system software, also. To generate a system event the same functions can be used as for calling system functions. The routine CSV_SysCall is used for the generation of system events. The routine CSV_SysCallAvailable returns TRUE, if there is an action linked to the requested event <u>and</u> the action can be executed.

Example:

```
DIM lItemDefined AS Logical
CSV_SysCallAvailable(CSV_EFNC_CompensatorSetting,
                     lItemDefined)
IF lItemDefined
  CSV_SysCall(CSV_EFNC_CompensatorSetting)
END IF
```

If a configuration item is defined for the system event CSV_EFNC_ CompensatorSetting (compensator setting event; usually connected to a compensator setting dialog) CSV_EFNC_CompensatorSetting is generated and the appropriate system function, application, macro, dialog or menu is

executed. For further explanations read the function description of `CSV_SysCall` and `CSV_SysCallAvailable` in the reference manual. In Appendix H of the reference manual there is a list with all system events.

10 GeoBASIC Sample Programs

10.1 MEANHZ — MEAN VALUE OF HORIZONTAL ANGLE MEASUREMENTS

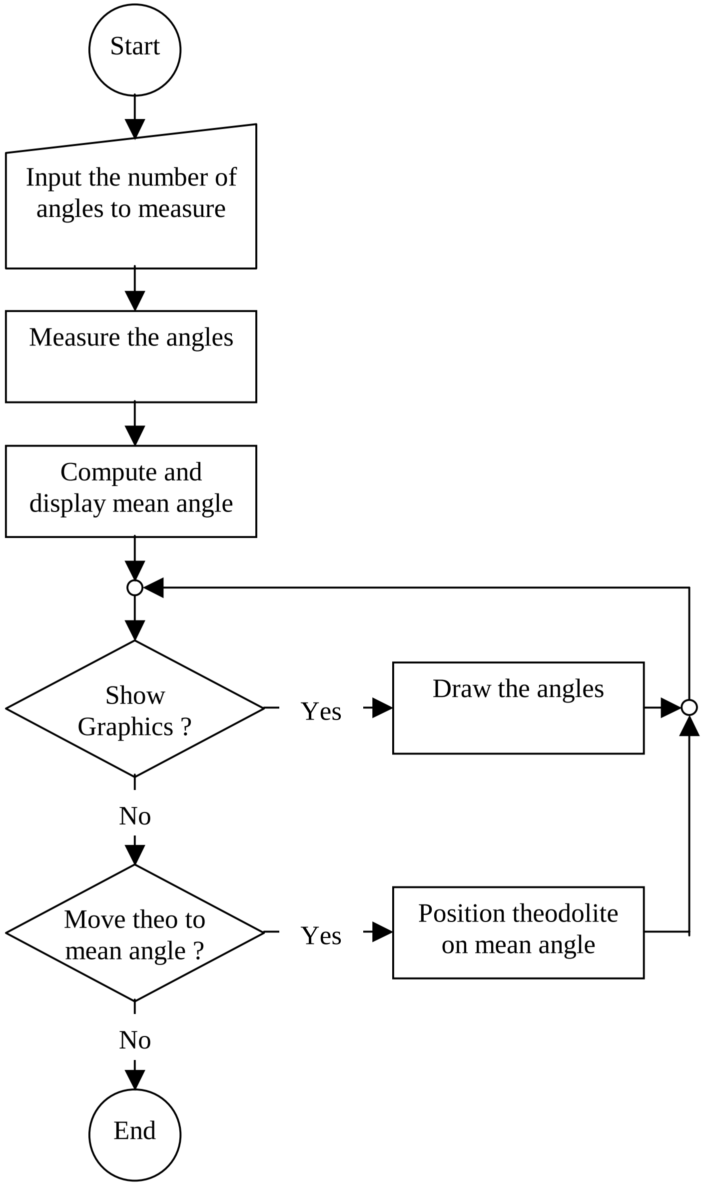
10.1.1 Program description

The program "`MeanHz`" measures a number of horizontal angles and computes its arithmetic mean value. The measured angles and the mean angle can then be displayed graphically.

Program flow:

First, the user may enter the number of horizontal angles he wants to measure. (The number of angles must be within a certain range.) Then the angles are measured — each time the REC key is pressed the current horizontal angle is recorded.

As soon as the requested number of angles is measured, the mean angle is computed and displayed. Now the user has the choice either to display the angles graphically, to move the theodolite to the computed mean angle or to quit the program. (The program can be terminated with the ESC button or the QUIT button on shift-F6 at any time.)


Start
Input the number of angles to measure
Measure the angles
Compute and display mean angle
Show Graphics ?
Yes
Draw the angles
No
Move theo to mean angle ?
Yes
Position theodolite on mean angle
No
End

10.1.2 Source code listing

See example file "meanhz.gbs"

```
PROGRAM Mean
'
' Sample application for building the mean value of angles
' -------------------------------------------------------
' Measures a user defined number of horizontal angles and calculate
' the mean angle. The measured and the mean angle can also be
' displayed graphically.
'
' GeoBASIC 1.0 for TPS1100 Series Instruments
' (c) Leica AG, CH - Heerbrugg 1998
'---------------------------------------------------------------------
' Global Declarations
CONST MaxNoHz       = 9        'Maximum number of angles that can be
                               'measured
CONST CaptionShort  = "MEAN"   'Short caption (displayed lefthand, in
                               'top line)

'Type to store the angles (for graphics)
TYPE DIM
  TAngles (MaxNoHz) AS Angle
END

DIM fId  AS FileId             'File identification

'---------------------------------------------------------------------
-----
GLOBAL SUB Install
'          -------
' Description
'    Adds the program into the theodolite's PROG menu. The program's
'    (application's) name is 'Mean', the global routine to start is
'    'Main' and the program menu item will be named 'MEAN HZ'.

   MMI_CreateMenuItem( "Mean", "Main", MMI_MENU_PROGMENU, "MEAN HZ")

END Install
```

```
SUB RecordValue (dHz As Angle, byVal dMean As Angle)
'   -----------
' Description
'    Writes the value to data link and file.
'
DIM sVal1   As String30
```

```
DIM sVal2   As String30
DIM sOut    As String255

ON Error Resume Next                        'Ignore all errors

  MMI_FormatVal(MMI_FFORMAT_HZANGLE, 10, 2, dHz,   TRUE,
                MMI_DEFAULT_MODE, sVal1)
  MMI_FormatVal(MMI_FFORMAT_HZANGLE, 10, 2, dMean, TRUE,
                MMI_DEFAULT_MODE, sVal2)

  sOut = "hz: " + sVal1 +  "mean: "+ sVal2   'Compute output text

  'Write to data link and file
  Send(sOut)
  Print(fId, sOut)

END RecordValue

'---------------------------------------------------------------------
SUB GetAngleHz ( dHz AS Angle, lValid AS Logical)
'   ----------
' Description
'    Measures the horizontal angle 'valid' indicates if the dHz is
'    valid.
'
' Parameters
'    OUT: dHzOUT, lValid
'
DIM theoAngle   AS TMC_Angle_Type        'The measured values
DIM iInfo       AS Integer               'Return code

ON Error Resume Next                     'Ignore all errors

   'get angle
   TMC_GetAngle( theoAngle, iInfo )

   IF (Err = RC_OK) THEN
     lValid = TRUE
     dHz    = theoAngle.dHz
   ELSE
     lValid = FALSE
   END IF
END GetAngleHz
'---------------------------------------------------------------------
SUB ShowGraphics( byVal iNoPoints AS Integer, angles AS TAngles,
                  byVal dMean AS Angle )
'   ------------
' Description
'    Displays the measured and the mean horizontal angles
'    graphically.
'
' Parameters
'    IN: iNoPoints, angles, dMean
'
DIM iX       AS Integer   'x coordinate
```

```
DIM iY       AS Integer   'y coordinate
DIM iButton  AS Integer   'button id

CONST CX       = 90             'display center x coordinate
CONST CY       = 24             'display center y coordinate
CONST DL       = 20             'length of line
CONST HELPTEXT = "Visualizes the angles with lines from the
                 station. "   +
                 "The computed mean angle is shown by the longer
                 line. " +
                 "The north angle is 0."

  MMI_CreateGraphDialog( CaptionShort, "PICTURE", HELPTEXT )

  'Draw center and circle
  MMI_DrawCircle( CX, CY,  3,  3, MMI_NO_BRUSH, MMI_PEN_BLACK )
  MMI_DrawCircle( CX, CY, DL, DL, MMI_NO_BRUSH, MMI_PEN_BLACK )

  'Draw lines for angles (there are iNoPoints angles)
  DO WHILE iNoPoints > 0

    'compute the line
    iX = INT( DL * SIN(angles(INT(iNoPoints))) )
    iY = INT( DL * COS(angles(INT(iNoPoints))) )

    MMI_DrawLine( CX, CY, CX+iX, CY-iY, MMI_PEN_BLACK )

    iNoPoints = iNoPoints - 1

  LOOP

  'Draw line for dMean
  iX = INT( (DL+4) * SIN(dMean) )
  iY = INT( (DL+4) * COS(dMean) )
  MMI_DrawLine( CX, CY, CX+iX, CY-iY, MMI_PEN_DASHED )

  'Wait for key press and finish dialog
  MMI_AddButton( MMI_F5_KEY, "END" )
  MMI_GetButton( iButton, FALSE )

  MMI_DeleteDialog()

END ShowGraphics

'---------------------------------------------------------------------
GLOBAL SUB Main
'          ----
' Description
'   Reads the number of points to be measured. Measures these points,
'   calculates the mean value and shows the result or moves (if
'   motorized) the TPS tocalulcated position.
'
DIM iNoPoints    AS Integer       'number of points to measure
DIM iCurrNo      AS Integer       'current point number
DIM lNoOk        AS Logical       'TRUE if no of points are valid
```

```
DIM lHzOk         AS Logical       'TRUE if measured hz is valid
DIM dHz           AS Angle         'measured hz
DIM storeHz       AS TAngles       'array of measured angles
DIM dMean         AS Angle         'calculated mean angle
DIM lKeyPressed   AS Logical       'TRUE if button pressed
DIM iButton       AS Integer       'id of pressed button
DIM Family        AS TPS_Fam_Type  'this data structure is used to
store
                                   'information about the system

ON Error Resume Next           'ignore errors

   'check which type of instrument is active and open file
   CSV_GetInstrumentFamily( Family  )
   IF ( Family.lSimulator ) THEN
     Open( "C:\\results.txt", "Append", fId, 0 )
   ELSE
     Open( "A:\\results.txt", "Append", fId, 0 )
   END IF


   'set up dialog and input iNoPoints
   MMI_CreateTextDialog ( 6, "MEAN", "HZ MEAN VALUE",
                         "Compute mean HZ for a number of
                          measurements." )

   ' ******************************
   ' *      read in iNoPoints      *
   ' ******************************

   iNoPoints = 3
   lNoOk     = TRUE
   MMI_PrintStr( 0, 0, "No of points:", TRUE )
   MMI_AddButton( MMI_F1_KEY, "CONT" )
   MMI_AddButton( MMI_SHF6_KEY, "QUIT" )
   MMI_InputInt( 26, 0, 2, 1, MaxNoHz, MMI_DEFAULT_MODE, iNoPoints,
                 lNoOk, iButton )

   'setup rest of dialog
   iCurrNo = 1
   MMI_PrintStr( 0, 1, "Curr. point :", TRUE )
   MMI_PrintVal( 26, 1, 2, 0, iCurrNo, TRUE, MMI_DEFAULT_MODE )
   MMI_PrintStr( 0, 2, "HZ          :", TRUE )
   MMI_AddButton( MMI_F3_KEY, "REC" )

   'init mean value
   dMean = 0.0

   'get iNoPoints points (abort if ESC or QUIT is pressed)
   DO WHILE (iCurrNo <= iNoPoints) AND (iButton <> MMI_ESC_KEY) AND
            (iButton <> MMI_SHF6_KEY)

      MMI_PrintVal( 26, 1, 2, 0, iCurrNo, lNoOk, MMI_DEFAULT_MODE )

      MMI_CheckButton( lKeyPressed )
```

```
    IF lKeyPressed THEN

       MMI_GetButton( iButton, FALSE )

       SELECT CASE iButton
         CASE MMI_F3_KEY, MMI_F1_KEY
            GetAngleHz( dHz, lHzOk )

            storeHz(iCurrNo) = dHz
            dMean            = dMean + dHz

            'if REC pressed record values
            IF iButton = MMI_F3_KEY THEN
               RecordValue(dHz, dMean/iCurrNo)
            END IF

            iCurrNo = iCurrNo + 1

       END SELECT

    ELSE

       'update display
       GetAngleHz( dHz, lHzOk )
       MMI_PrintVal( 20, 2, 8, 3, dHz, lHzOk, MMI_DEFAULT_MODE )

    END IF
 LOOP


 '***************************
 '*      show results       *
 '***************************

 'if execution should procede
 IF (iButton <> MMI_ESC_KEY) AND (iButton <> MMI_SHF6_KEY) THEN

    'setup new buttons
    MMI_DeleteButton( MMI_F1_KEY )
    MMI_DeleteButton( MMI_F3_KEY )
    MMI_AddButton( MMI_F3_KEY, "SHOW" )
    MMI_AddButton( MMI_F4_KEY, "EXIT" )
    MMI_AddButton( MMI_F5_KEY, "GOTOM" )

    'compute mean value
    dMean = dMean / iNoPoints
    MMI_PrintStr( 0, 3, "Mean HZ     :", TRUE )
    MMI_PrintVal( 20, 3, 8, 3, dMean, TRUE, MMI_DEFAULT_MODE )

    DO WHILE (iButton <> MMI_ESC_KEY) AND (iButton <> MMI_SHF6_KEY)
             AND (iButton <> MMI_F4_KEY)

       MMI_GetButton( iButton, FALSE )
```

```
         SELECT CASE iButton

           CASE MMI_F3_KEY
              ShowGraphics( iNoPoints, storeHz, dMean )

           'move theo to the computed mean horizontal angle
           CASE MMI_F5_KEY
              BAP_PosTelescope(BAP_POSIT_HZ, BAP_POS_MSG, dMean, 0,
                               0.1, 0.1)

         END SELECT

      LOOP

   END IF

   'clean up text dialog
   MMI_DeleteDialog()

   'close output file
   Close(fId)

END Main


END Mean
```

10.2 SAMPLE PROGRAMS

These code samples gives you some help for building your first applications. Each of them should give you some hints in a specific problem domain.

- `appinfotest.gbs` This example shows the use of the application information section in the GeoBASIC source file.
- `codefunc.gbs` An example of a program which will be called, when the *Code*-key has been pressed.
- `cursor.gbs` Cursor control in a dialog.
- `error_ha.gbs` This program shows how error handling changes execution of a program.
- `language.gbs` Take this program as an example to support multiple language applications. Two language files and its text databases are provided to see how multilingual support works.
- `meanhz.gbs` This sample shows the calculation of the mean value of horizontal angle measurements, see Chapter 10.1.

- `meas.gbs` A simple example how to measure with BAP-functions, including Quick-Coding
- `meas_od.gbs` A simple example how to measure and how to record data in an own data-format, including Quick-Coding
- `stringer.gbs` This example shows in which situations typical errors may occur.
- `test.gbs` An empty frame for building up a GeoBASIC application.
- `tracking.gbs` This program shows possible techniques to take advantage of the measurement facilities.
- `menu.gbs` A simple menu handler.
- `dirlist.gbs` This example shows how to get PC card information and how to read a directories content.
- `inclmain.gbs` This example shows the usage of an include file.
- `iac.gbs` An example for an interapplication call.

11 PORTING A TPS1000 ORIGINATED PROGRAM

The implementation of the TPS1100 theodolite series includes several new concepts compared to the firmware of TPS1000 theodolites. To follow up these new concepts and to take care of functionality that has been changed or removed in the implementation of TPS1100 firmware, GeoBASIC programs, once developed for TPS1000 hardware, cannot be compiled without changing the source code.

In this chapter we will cover this subject and we try to give some guidelines to help the developer to port the source code onto the new platform. During the design phase of GeoBASIC for TPS1100 systems we took certain care to make the migration as smooth as possible. Although all programs' source code has to be changed, the effort to port it will be for the most applications not that high.

In the very end this means also that the developer has to maintain two source code bases.

11.1 TPS1100 HARDWARE RELATED CHANGES

11.1.1 Display Line Length

The TPS1100 series instruments use a different liquid crystal display. The difference means also that one can use only 29 characters per line. To be 'independent' of the display length we defined the string type `DisplayLine`. It does not contain the string length in the name, hence this should help in future to port applications. To be compatible with older, TPS1000 GeoBASIC programs we did not change all `String30` declarations. Of course only 29 characters will be printed out to the display.

11.1.2 Keyboard

The number of keys has been reduced, there is no `CONT`-Key any longer. Remove all `MMI_CONT_KEY` appearances in the source code. We deleted the definition of this constant to make it more obvious to the programmer that he has to change the source code and think about any button assignments.

11.2 CHANGES TO THE SIMULATOR

Now TPSSim supports GeoBASIC programs larger than 64 KB. A restriction, which turned out in the past, bothered the most of the GeoBASIC program developers. We would like to point out that the SWTheo extension enables the programmer to influence the execution of a program. With specific dialogs the programmer gets the possibility to set or change certain (measurement) values. We hope this helps a lot to simulate a more realistic TPS environment and makes it almost obsolete to have an instrument at your hand to test your application. Of course, still the final test of an application has to be done on an instrument. See also the documentation of TPSSim for further explanations.

11.3 NEW CONSTRUCTS IN GB_1100

Due to some requests we added a few new constructs to GeoBASIC for TPS1100 instruments.

11.3.1 #include Statement

It is now possible to include a GeoBASIC source file in another one. Nevertheless only one level of inclusion is allowed.

11.3.2 MID$ statement

Mid$'s implementation has been extended. Now Mid$ can be used to assign a character or a substring to another string at a certain position. In this way single characters of a string can be set or replaced.

Examples:

```
T = “abcdef”
Mid$(t, 2, 1) = "+"              results in “a+cdef”
Mid$(t, 4)    = "------------"   results in “a+c------------”
```

11.3.3 Application Info

A general concept of configurability has been introduced for the TPS1100 family of instruments. This gives totally new customisation possibilities into the hand of

the developer and more to the customer support. Up to a certain degree GeoBASIC supports this configurability. For example an assignment of a GeoBASIC program to a menu item can be changed by the new configuration utilities. Or it can be assigned to a function key.

To support these new features we extended the concept of the program by a section that describes the attributes of it.

This (informational) section can be appended optionally at the end of the source file. See the extra explanation of it to get further information about it.

11.4 GEOBASIC SOURCE CHANGES

Many GB programs have a similar structure. Therefore it does not surprise that many programs have to be rewritten in the same way to be compilable and executable for TPS1100 GeoBASIC.

11.4.1 General Dialog Changes

The `CONT` key does not exist any more on the TPS1100 instruments. Scan your source code for `MMI_CONT_KEY` and replace it by a function key. The TPS1100 guidelines use `MMI_F1_KEY` normally for the `CONT` key functionality. This might make it necessary to change your function key layout. Look at the existing dialogs to get an idea and to be more consistent to the built-in dialogs, to which function keys which functionality has been assigned.

In certain circumstances, where no function keys were left, the `ESC` key was the only way to leave a dialog. Normally `ESC` leaves a dialog with leaving values untouched.

`MMI_SHIFT_ESC_KEY` will not be supported any more. Instead one has to assign QUIT to (normally) Shift-F6. Quit leaves the whole application.

Note	'Old' versions of constants and functions are left aligned. Newer versions or replacements have been shifted to right. The listed changes are ordered in an assumed importance.

TPS1000	**TPS1100**

`MMI_DeleteGraphDialog()`
`MMI_DeleteTextDialog()`
`GSI_DeleteMeasDlg()`
	replaced by `MMI_DeleteDialog()`

Please notice that GB-TPS1000 supports conceptually 2(3) dialogs at once; a text or a graphics dialog and in parallel a customisable measurement dialog - `MDlg`.

A typical application may create a text dialog and link a graphics dialog to a menu button. Notice, that both dialogs exist at the same time and distinguish this situation from another, where the text dialog will be deleted before the graphical dialog will be created. In the former case one can go back to the text dialog without recreating it. In the latter the text dialog has to be rebuilt. In GB_TPS1100 text and measurement dialog are mutually exclusive.

See the following scheme for a graphical explanation. "()" denotes a dialog.

TPS1000	TPS1100
(Text) and (MeasDlg) | (Graphic) Graphic overrides Text and may have it's own buttons. The other way around is not possible At the same time a MeasDlg may be defined.	(Text or MDlg) | (Graphic) Graphic overrides Text <u>or</u> MDlg. Text and MDlg are mutually exclusive. Only one can be defined at once. All three dialog types may have their own buttons.

Deleted:
`GSI_CreateMeasDlg()`
`GSI_DefineMeasDlg()`
`GSI_DeleteMeasDlg()`
`GSI_GetDialogMask()`
`GSI_SetDialogMask()`
`GSI_UpdateMeasDlg()`
	Replaced by a more general concept – see the reference manual for `GSI_*MDlg-` routines.
	New routines are:
	`GSI_SetLineMDlg ()`
	`GSI_SetLineMDlgPar ()`
	`GSI_SetLineMDlgText ()`
	`GSI_GetLineSysMDlg ()`
	`GSI_SetLineSysMDlg ()`
	`GSI_CreateMDlg ()`
	`GSI_UpdateMDlg ()`

11.4.2 Recording Format Settings

Deleted:
`GSI_GetRecFormat()`
`GSI_SetRecFormat()`
	Replaced by (extended):
	`GSI_GetRecMask ()`
	`GSI_SetRecMask ()`

11.4.3 System Dialog Calls

Replacements for old dialog invocation calls:

`GSI_CommDlg ()`	`CSV_SysCall ( CSV_EFNC_GeoComSetup, Caption )`

`GSI_SelectTemplateFiles()`
`and`
`GSI_Setup ()`
	`CSV_SysCall ( CSV_EFNC_Setup, Caption )`

`GSI_StationData ()`	`CSV_SysCall ( CSV_EFNC_SetStation, Caption )`
`GSI_TargetDlg ()`	`CSV_SysCall ( CSV_EFNC_TargetData, Caption )`

11.4.4 EDM Mode Changes

Replacement for `EDM_MODE` by the extended `BAP_SetMeasPrg ()`.

TMC_GetEDMMode () TMC_SetEDMMode ()	BAP_SetMeasPrg () BAP_GetMeasPrg ()
Deleted EDM modes:	New defined modes:
EDM_SINGLE_STANDARD EDM_SINGLE_EXACT EDM_SINGLE_FAST EDM_CONT_STANDARD EDM_CONT_EXACT EDM_CONT_FAST EDM_UNDEFINED	BAP_RED_TRK_DIST BAP_SINGLE_REF_STANDARD BAP_SINGLE_REF_FAST BAP_SINGLE_REF_VISIBLE BAP_SINGLE_RLESS_VISIBLE BAP_CONT_REF_STANDARD BAP_CONT_REF_FAST BAP_CONT_RLESS_VISIBLE BAP_AVG_REF_STANDARD BAP_AVG_REF_VISIBLE BAP_AVG_RLESS_VISIBLE

11.4.5 Interface Changes

The following routines got a new interface.

```
GSI_ImportCoordDlg ()
GSI_ManCoordDlg ()
```

Refer to the reference manual to get the new interfaces.

11.4.6 Deleted and Added Identifiers and Types:

TPS1000	**TPS1100**
Deleted:	New:
CSV_MAX_USERS CSV_ILLEGAL_USERNR RC_CSV_ILLEGAL_USERNR	CSV_WITH_REFLECTOR CSV_WITHOUT_REFLECTOR

Deleted	
EDM_COMERR EDM_NOSIGNAL	

EDM_PPM_MM EDM_METER_FEET EDM_ERR12 EDM_DIL99	

	New: MMI_SHIFT_CODE_KEY For MMI_SetAngleRelation() MMI_HANGLE_CLOCKWISE_SOUTH Changed to return code: MMI_UNDEF_LANG For MDlg routines: MMI_FFORMAT_STRING New date format: MMI_DATE_JP

Deleted: MMI_MENU_EXTRA MMI_MENU_CONFIG	New: MMI_MENU_PROGRAMS MMI_MENU_PROGMENU MMI_MENU_AUTOEXEC

	New GSI_ID values: GSI_ID_SHZ GSI_ID_CD_DSC GSI_ID_PTCD_DSC GSI_ID_PV_CD GSI_ID_PV_PTCD GSI_ID_ACT_PTID GSI_ID_BACKID GSI_ID_APP_DATA0 GSI_ID_APP_DATA1 GSI_ID_APP_DATA2 GSI_ID_APP_DATA3 GSI_ID_APP_DATA4 GSI_ID_APP_DATA5 GSI_ID_APP_DATA6 GSI_ID_APP_DATA7

	GSI_ID_APP_DATA8 GSI_ID_APP_DATA9 GSI_ID_APP_DATA10 GSI_ID_APP_DATA11 GSI_ID_FS_SCALE New GSI_POINT_TYPE: GSI_BACKSIGHT GSI_POINT_CODE

	GSI_PAR_* parameters see GSI system functions.

Deleted: TPS1100 TPS1700 TPS1800 TPS5000 TPS2003	New: TPS1102 TPS1103 TPS1105

Old TPS_FAM_Type:	New TPS_FAM_Type:
iClass	iClass
lEDMBuiltIn	lEDMBuiltIn (always TRUE)
lEDMTypeII	lEDMTypeII (always FALSE)
	lEDMTypeIII (always TRUE)
	lEDMReflectorless
lMotorized	lMotorized
lATR	lATR
lEGL	lEGL
lDBVersion	
lDiodeLaser	
lLaserPlummet	lLaserPlummet
	lAutoCollimation
lSimulator	lSimulator

	New: BAP_PRISM_MINI

Deleted: `GSI_DLG_ID_LIST`	

	New: `TMC_RED_TRK_DIST`

11.4.7 Changes in System Functions

Deleted, because there is no equivalent function at the TPS1100 series instruments:

```
BAP_GetFunctionality (), BAP_SetFunctionality ()
BAP_SetFunctionalityDlg ()
CSV_GetCurrentUser (), CSV_SetCurrentUser ()
CSV_GetDL (), CSV_SetDL ()
CSV_GetUserInstrumentName ()
CSV_SetUserInstrumentName ()
CSV_GetUserName (), CSV_SetUserName ()
GSI_GetStdRecMask ()
GSI_GetStdRecMaskAll ()
GSI_GetStdRecMaskCartesian ()
```

Replaced by equivalent functions:

```
GSI_WiDlg ()
GSI_StartDisplay ()
GSI_GetStdDialogMask ()
```

Enhanced in certain ways. See the extended identifiers and constants above or refer to the reference manual:

`WI`-values

```
CSV_GetPrismType (), CSV_SetPrismType ()
CSV_GetInstrumentFamily ()
GetMemoryCardInfo ()
MMI_GetAngleRelation (), MMI_SetAngleRelation ()
MMI_SetDateFormat (), MMI_GetDateFormat ()
```

New functions see reference manual for further details:

```
MMI_CreateGBMenuStr ()
MMI_CreateGBMenuItemStr ()
GSI_SetDataPath ()
GSI_GetDataPath ()
CSV_SetTargetType ()
CSV_GetTargetType ()
```

Interapplication and system calls

```
CSV_SysCallAvailable ()
CSV_SysCall ()
CSV_LibCall ()
CSV_LibCallAvailable ()
```

11.4.8 Returncodes

Their definitions have been coupled totally to the definitions of the TPS1100 firmware. Please refer to the Appendix F in the reference manual for a detailed listing.

12 GEOBASIC RELEASES

12.1 CHANGES IN GEOBASIC RELEASE 1.30

The Release 1.30 of GeoBASIC contains several new subroutines. It reflects user requests and improvements in the TPS1100 Series firmware Release 2.0.

Note:	This GeoBASIC Release 1.30 needs at least the **TPS1100 Series firmware Release 2.0.**

The following paragraph shows the changed items. For a detailed explanation, please see the “GeoBASIC Reference Manual”

12.1.1 New functions in Release 1.30

`BAP_SearchPrism`	search prism
`CSV_CheckAltUserTask`	returns if an alternative user task was running (i.e. FNC or PROG was pressed)
`CSV_GetTemperature`	returns the internal instrument temperature
`CSV_ResetAltUserTask`	resets the "WasRunning"-flag
`GSI_CheckTracking`	returns if distance tracking is running
`GSI_ExecQCoding`	executes Quick-Coding with/without recording
`GSI_ExecuteAutoDist`	starts a distance measurement after changing the distance mode (new buttons in FNC menu)
`GSI_GetMDlgNr`	returns the current measurement display number
`GSI_GetQCodeAvailable`	' returns if a valid code-list for Quick-Coding is selected
`GSI_GetRecMaskNr`	returns the current recording mask
`GSI_GetRecOrder`	returns the recording order measurement-code or code-measurement block
`GSI_GetWiEntryText`	Get coding text-data from the Theodolite data pool

GSI_SelectCode	select a code-list-code, but without recording it (allows the recording in another format)
GSI_SetMDlgNr	changes the measurement dialog (used i.e. for >DISP buttons)
GSI_SetQCodeMode	enables Quick-Coding
GSI_SetRecMaskNr	changes the recording mask
GSI_SetRecOrder	defines the recording order
MMI_GetVAngleMode	returns if the V-angle is running (even if a valid distance is available)
MMI_SetVangleMode	defines the V-angle mode
TMC_GetAtmCorr	Gets the atmosphere part of distance measurement corrections
TMC_GetGeomProjection	Gets the projection part of distance measurement corrections
TMC_GetGeomReduction	Gets the reduction to the reference part of distance measurement corrections
TMC_GetInclineStatus	returns the inclination status (i.e. ready for recording)
TMC_SetAtmCorr	Sets the atmosphere part of distance measurement corrections
TMC_SetGeomProjection	Sets the projection part of distance measurement corrections
TMC_SetGeomReduction	Sets the reduction to the reference part of distance measurement corrections

12.1.2 New constants in Release 1.30

```
GSI_GET_NEXT
GSI_MAX_DLG_LINES
GSI_MAX_MDLG_MASKS
GSI_MAX_REC_MASKS
GSI_MAX_REC_WI
GSI_MULTI_REC
GSI_NO_FILE_CHANGE
GSI_SEARCH_FROM_END
TPS1101
```

12.1.3 New datatypes in Release 1.30

```
HzAngle
VAngle
TMC_GEOM_PROJECTION_Type
TMC_GEOM_REDUCTION_Type
TMC_ATM_TEMPERATURE_Type
```

12.1.4 New CSV_SysCall constants in Release 1.30

```
CSV_SFNC_CheckOrientation
CSV_SFNC_CurrentSetPpmDlg
CSV_SFNC_DefSearchAreaDlg
CSV_SFNC_LoadApplDlg
CSV_SFNC_LoadSysLangDlg
CSV_SFNC_SetDefaultSearchRange
CSV_SFNC_ToggleMeasPrgFastRapidTrk
CSV_SFNC_ToggleMeasPrgRefRL
CSV_SFNC_ToggleMeasPrgStdTracking
CSV_SFNC_ToggleSearchArea
CSV_SFNC_ToggleVAngleMode
```

12.2 CHANGES IN GEOBASIC RELEASE 2.10

The Release 2.10 of GeoBASIC contains the first edition of the integrated development environment GBStudio.

It contains also a few minor bug fixes.

Note:	This GeoBASIC Release 2.10 needs at least the **TPS1100 Series firmware Release 2.10** or the TPS1100 Series Simulator 2.10.

Note:	GeoBASIC applications, compiled with GeoBASIC 1.30, are also executable on the **TPS1100 Series firmware Releases 2. 10**. For running these applications, the GeoBASIC interpreter 1.30 must be loaded. There is no debugging-support for GBStudio! **Different Releases** of GeoBASIC applications on the same instrument **are not supported!**

1 INTRODUCTION

GeoBASIC is a programming language for LEICA theodolites and their simulation on personal computers. The core language appears similar to today's common Windows BASIC dialects, thereby it is easy to learn and use. However, GeoBASIC's main power lies in its ability to use many of the existing theodolite subsystems and dialogs, just by calling an appropriate built-in function: for setting parameters, measuring, geodesy mathematics, and many things more. These tools at hand, the programmer can quickly and flexibly build sophisticated geodesy applications.

The user manual first describes the installation of GeoBASIC on a PC (*Chapter 2*). Then, after learning how to create an GeoBASIC application (*Chapter 3*), it will be shown how to actually load and execute a program on a LEICA theodolite (*Chapter 4*) and on the Windows simulation *(Chapter 5)*.

As these technicalities are mastered, the main topic is programming in GeoBASIC. This manual will give you several hints on typical GeoBASIC programming (*Chapter 8*), and introduces you to the design and programming of the theodolite user interface and refined GeoBASIC concepts (*Chapter 9*).

Finally, GeoBASIC example programs are presented (*Chapter 10)*. The reader will find a sample code for measuring and computing the mean value of several horizontal angles. Moreover some introductory examples are given to tell how special problems can be treated.

Note	All the details of the GeoBASIC language and system functions are composed in the "GeoBASIC Reference Manual".

2 INSTALLATION

The requirements for using GeoBASIC are a Personal Computer based on an Intel 486 processor or higher and at least 8MB of main memory. The installation of the whole development environment occupies about 10 MB of disk space, excluding the PDF version of the manual. The delivered software needs Microsoft Win95, Win98 or WinNT to run successfully.

2.1 SETUP

The following directory structure is created during the installation per default. Notice that the location of this directory tree is user definable. Hence it is not a granted to be exactly that location. Notice also that the CodeConverter application is installed in a separate Setup installation procedure.

```
…+-SurveyOffice
      |
      +-UserTools
      |  |
      |  +-TPS1100Tools
      |  |  |
      |  |  + - CodeConverter
      |  |  + - GBSamples
      |  |  |
```

Content of the directories (only the main objects are listed):

- `TPS1100Tools\`

`TPS1100.exe`	TPS Simulator for TPS1100 Series
`GB_IDE.exe`	GeoBASIC IDE application
`GBI_1100_101.prg`	GeoBASIC Interpreter for TPS1100 series
…	and maybe several more tools

- `CodeConverter\`

`CGB_Dlg.exe`	CODE to GeoBASIC converter
`Code_ex1.cod`	CODE sample
`GBC_229.exe`	GeoBASIC Compiler for TPS1000 series
`GBI_229.prg`	GeoBASIC Interpreter for TPS1000 series
`GBI_1100_101.prg`	GeoBASIC Interpreter for TPS1100 series

- …
  Several TPS1100Sim specific directories which contain language files, code lists, configurations and things like that.

Loading the GeoBASIC Interpreter:

The GeoBASIC Interpreter will be loaded automatically with the loading of the first application into the theodolite using the Software Upload for TPS1100. Hence you have to copy the GeoBASIC Interpreter (GBI_TPS1100_101.prg) into the same directory as the application before loading it. Otherwise you will get an error message.

3 CREATING A GEOBASIC APPLICATION

Starting from the specification of a GeoBASIC application, several steps have to be performed until the program can be executed on the theodolite or by simulation:

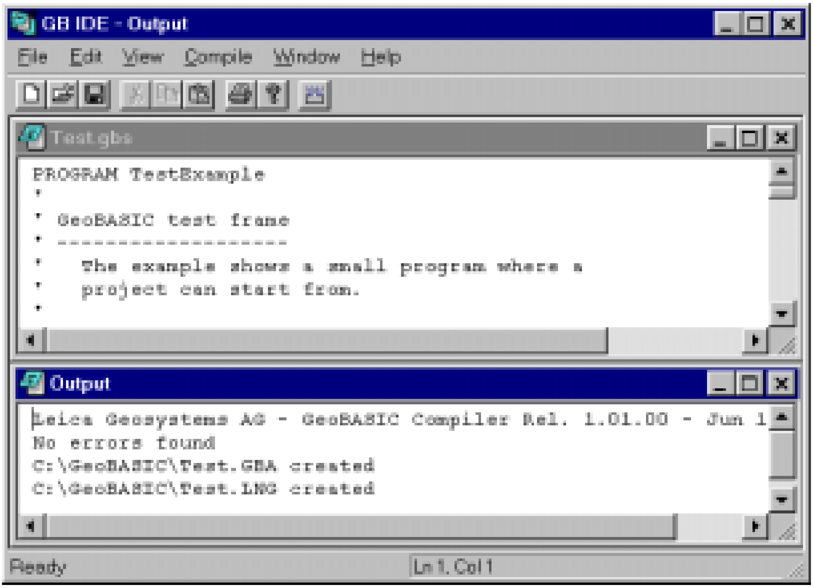
1. Write the program,
2. compile the program,
3. load the program, either onto the simulation or the theodolite, and
4. start the execution of it.

3.1 GEOBASIC IDE

While processing step 1 (write the program) and step2 (compile the program) the programmer is supported by the windows tool GeoBASIC IDE (Integrated Development Environment).

3.1.1 Writing a GeoBASIC source-file

The GeoBASIC IDE offers a simple text editor, with it the programmer can work on the source-files directly without using an external editor. After starting the GeoBASIC IDE application select the NEW-button () to create a new source-file (i.e. sample.gbs) or the OPEN-button () to change an existing one. The usage of the IDE editor is identical to the most Windows text editors. See the next picture of the IDE of how it looks like.



3.1.2 Compiling a GeoBASIC program

The source-file has to be *compiled* before it can be *loaded* and *executed*. Compiling the source file with the GeoBASIC compiler results into two files, one for the executable object itself (file extension "`.gba`"; i.e. `sample.gba`) and one for the language data (file extension "`.lng`"; i.e. `sample.lng`). These two files are necessary to execute the program, either on a LEICA theodolite or with the simulator on a personal computer. See the following diagram:

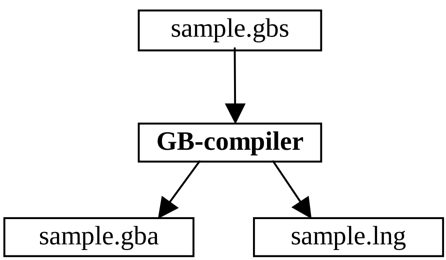
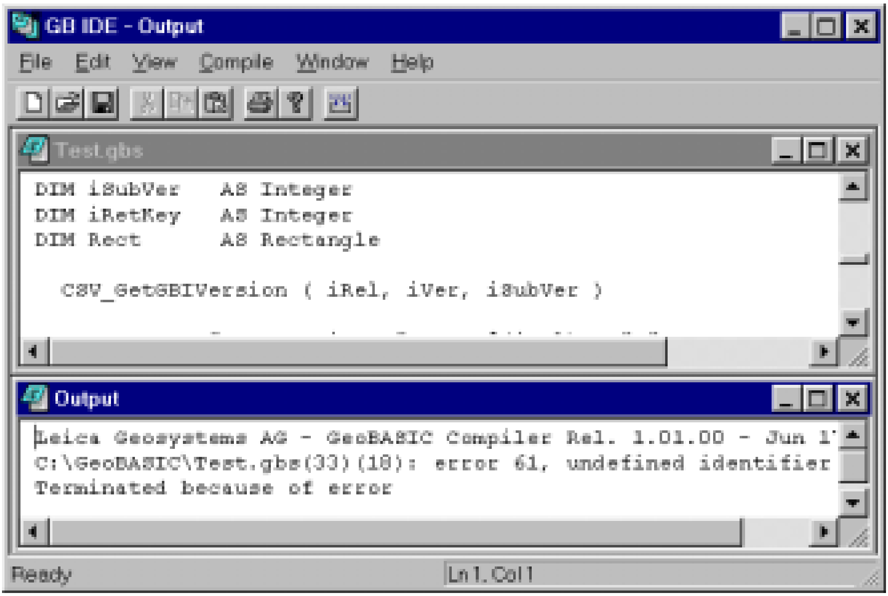


Diagram: Compiling a GeoBASIC program

The GeoBASIC compiler is integrated in GeoBASIC IDE. The following picture shows the IDE after a successful compilation of `Meanhz.gbs`:

The Compilation is started either by selecting <Compile Program> in the <Compile>-menu, pressing Ctrl+F7 or clicking COMPILE-button (). In any case the selected window determines which source-file has to be compiled.

During the compilation process the compiler checks for a correct program. If the compiler recognises an error it produces an error message in the output window and the compilation is stopped. The following window shows a stop during compilation of `Test.gbs` because of the undefined identifier “Rectangle”:



In the output window the line (i.e. 33) and column (i.e. 18) of the program, where the error occurred, is displayed. Additional the cursor is moved on this position in the program. The error identification number (i.e. 61) references to further explanations. Set cursor on the line with the error number and use the shortcut <Shift-F1> to get a more detailed explanation of the error. Select <How To Use> in the <Help>-menu for a list of all error codes and a detailed information about the whole IDE functionality.

In the case that a semantic condition could not be met the line and column position might be not correct. E.g. the source of lines 18 and 19:

```
18:  s = 3.1 + "hello"      ' this line is semantically
                            ' not correct
19:  MMI_PrintStr(0, 0, "input text:", TRUE)
```

generates the following error message in the output window:

```
C:\GeoBASIC\Samples\Meanhz.gbs(19)(3): error 25, type
mismatch
```

This seems to be not correct but it's a follow-up of the fact that the semantic information is available only if the last statement is processed to the end of it. Hence the next symbol has been already got from the input symbol stream. Therefore, the symbol pointer points to the next symbol. In our example it is the call of a system subroutine. Be aware of this fact if you track back an error.

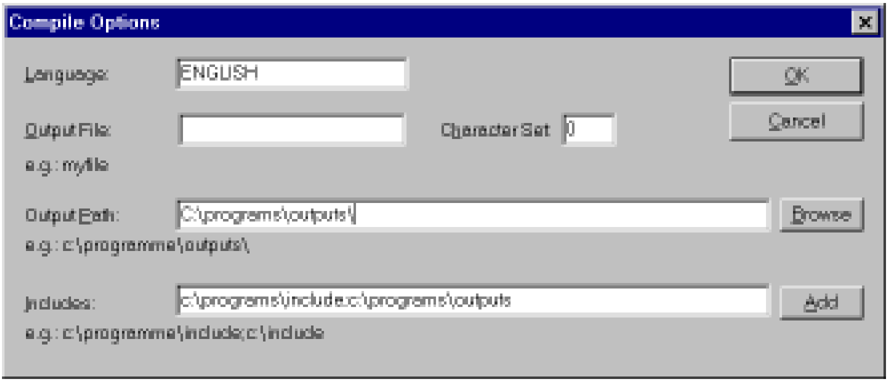
The GeoBASIC programmer has to keep some limitations for his applications:

- One simple procedure or function may not contain more than 10 kB of code.
- The maximum size of an application (including memory space) is limited by the free memory size of the theodolite only. If no other applications are loaded there should be free memory up to several hundred kB on a theodolite.
- An application may not have more than 64kB of string literal in total.
- The number of global identifiers is limited to 3000.
- The overall maximum number of identifiers limits the number of local identifiers, which is about 60000.

Note	The usage of the compiler is protected by a hardware key. Without the right hardware key it is not possible to execute the compiler successfully. If the hardware key is not installed properly or it does not contain the license for the compiler then an error message will be displayed and execution will be terminated.

Compile Options

The Selection of <Compile Options> in the <Compile>-menu displays the following dialog box:



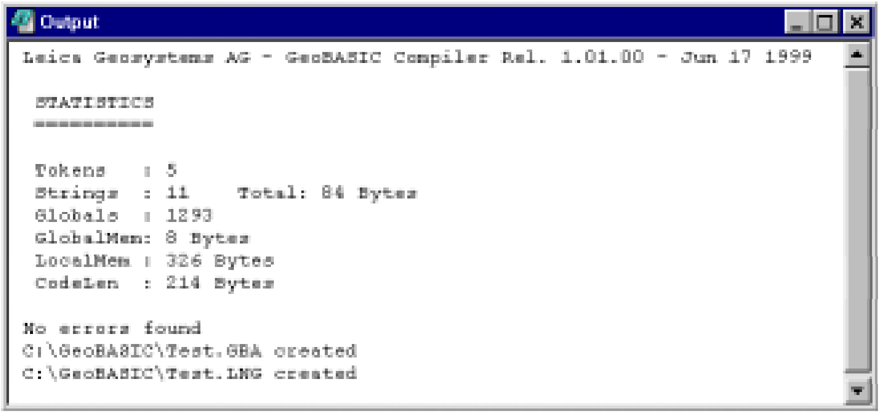
A GeoBASIC programmer has to make the following settings before the first compilation:

- Language:
  Set the application’s language. Default is ENGLISH.
- Character Set:
  Set the application’s character set. Default is 0.
- Output File:
  Set the name of the resulting applications file name. If it is empty, the resulting files get the same name as the source-file but with different file-extensions (normally).
- Output Path:
  Set the path where the compiler places the generated application files. The default is the source directory, where the compiler gets the GeoBASIC source program. The path has to be absolute and has to end with a "\" character.
- Include Path:
  Set one or more directory-paths of include files. The directory path must not have a "\" character at the end.

The IDE is capable to remember the last settings and the opened files. They will be restored/reopened at the next start

Statistics

If the <Statistics>-item in the <Compile>-menu is checked the compiler will generate statistical information about the application which will be printed into the Output window:



The following information will be given:

- Tokens: Number of Tokens of the text database. They will be written into the `*.lng`-file.
- Globals: Number of global objects, for example data types, subroutines, and so on.
- GlobalMem: Maximum global memory needed during runtime.
- LocalMem: Maximum local memory needed during runtime per application invocation.
- CodeLen: Length of produced code, excluding the string table.

The total of all memory sizes will give the size of the necessary memory to run the application.

Note	Your GeoBASIC source files must have been compiled without errors in order to be loadable.

3.2 THE GEOBASIC INTERPRETER

The GeoBASIC interpreter is a program that "understands" the compiler-generated object file and executes it. In the windows simulation, the interpreter is already included. In the theodolite however, the interpreter will be loaded automatically with the loading of the first application into the theodolite using the Software Upload for TPS1100. (Hence the interpreter must be in the same directory as the application.)

4 EXECUTING A GEOBASIC PROGRAM ON THE THEODOLITE

As described in the Chapter 3.1.2, compiling a GeoBASIC program results in two files, the executable program itself and the language data. Before a program can be executed, these two files have to be loaded into the theodolite first. With the help of the Leica Survey Office Software Upload the two files can be loaded into TPS-memory and run automatically the install procedure of the GeoBASIC program. The install procedure has to take care of adding an item to a menu which links an external procedure of the GeoBASIC program (`Global Sub`) to an item in a menu list. Additional to this static link there is a more flexible concept to install an application via a user (definable) configuration. For further explanations how to install an GeoBASIC application read Chapter 9.3.

If the menu item is added to a menu you can choose it to run a GeoBASIC program.

4.1 LOADING A GEOBASIC PROGRAM

GeoBASIC programs can be loaded into the theodolite using the Software Upload program from the Open Survey Suite. The procedure for loading a GeoBASIC application is as follows:

1. Verify that a serial link between PC and theodolite is established.
2. Switch theodolite into GeoCOM online mode.
3. Start Software Upload program.
4. Press <Transfer Files...> in <Utilities> menu of Software Upload.
5. Choose <Application Program> as Component Type.
6. Select directory which contains the loadable program (`*.gba`).
7. Choose language if the application supports multiple languages.
8. Select the application in the <Components> window.
9. Press <Transfer>.

Detailed explanations may be found in the documentation of Leica Survey Office - Software Upload.

Note	Loading a program with identical names for module and external procedures as an already loaded program replaces this program and all its associated text modules in memory and the items in the menu list. Hence, transferring of more than one program with the *same* application name may cause unwanted effects.

5 EXECUTING A GEOBASIC PROGRAM ON THE SIMULATION

5.1 GENERAL

The TPS1100 simulation supports, among other features, the execution and debugging of GeoBASIC applications. The simulation may run in one of two modes:

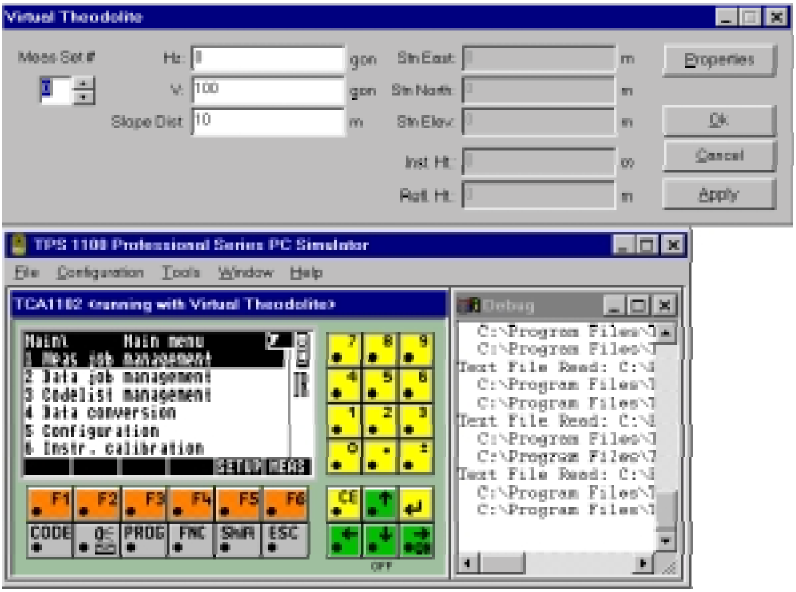
- GeoCOM mode
- SWTheo mode

Running in GeoCOM mode the simulation operates the (hardware) theodolite connected to the PC via a serial port and uses it as a sensor device. In SWTheo mode, user triggered commands are redirected to the software simulation of the theodolite.

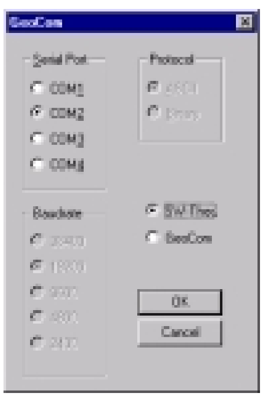
5.2 USER INTERFACE

The TPS1100 simulation main window contains two windows and a dialog box on start-up: the „`TPS1100`“ window and the „`Debug`“ window (see below). The TPS1100 window contains a replication of the (hardware) TPS1100 theodolite‘s user interface. In the „Debug“ window, debug information are displayed. It is recommended to have always the debug window opened because some of the statements in the GeoBASIC source code (like the WRITE statement) might cause printing text into the „Debug“ window.

The dialog box is called “Virtual Theodolite” and is used to type in raw measurement data for the simulation of measurements. See also section 5.4.3 for further explanations.



The simulation is configurable via the „Configuration“ menu of the simulation main window. Here, the beep may be toggled using the „Beep On“ entry. A check mark left to the „Beep On” indicates whether it is turned on or off. The „Instr. Connection …“ entry opens a dialog to configure the communication parameters for GeoCOM mode and to switch between GeoCOM and SWTheo mode as shown in the following figure.



Paths can be set for text management, GSI data, code list, GeoBASIC programs and configuration data in the dialog opened by the „Data Path“ menu entry.

It is highly recommended to set the paths, if they are not already set, to the following values:

Path	Recommended value
Language Files	`TPS1100Tools\TextDB`
GSI and Log Files	`TPS1100Tools\GSI`
Internal Code List	`TPS1100Tools\CodeList`
External Code List	`TPS1100Tools\CodeListPcCard`
Basic Programs Path	`TPS1100Tools\GBSamples`
Configuration Data Path	`TPS1100Tools\Config`

5.3 GEOCOM MODE

5.3.1 Running the simulation in GeoCom mode

To switch to and run in GeoCOM mode follow this procedure:

1. Switch off simulation by single clicking under the down cursor of the TPS1100 window if not already off.
2. Verify that a serial link between PC and theodolite is established.
3. Switch off hardware theodolite if not already off or switch into GeoCOM online mode.
4. Select the appropriate communication parameters and „GeoCom“ in „Instr. Connection …“ dialog (see above) of the simulation. Confirm with the „OK“ button.
5. Start the simulation again using the „ON“ button of the TPS1100 window.

The simulation now tries to communicate with the theodolite. If a connection can be established, and the port you have chosen was „COM1“, the title of the TPS1100 window will be „TPS 1100 <running, GeoCom on com1:>“.

Otherwise a dialog enables the user to choose whether other communication configurations should be tested or not. Notice that this may take up to one minute.

If no connection could be established, the SWTheo is activated instead of GeoCOM after displaying a message box.

5.4 SWTHEO MODE

The software theodolite (Virtual Theodolite, SWTheo) is an emulation of a (hardware) theodolite. Its properties may be accessed via the „Meas Data Input…“ entry in the „Configuration“ menu while the simulation is running in SWTheo mode. Otherwise this menu entry is disabled.

5.4.1 Running the simulation in SWTheo mode

The procedure for switching to and running the simulation in SWTheo mode is as follows:

1. Switch off the simulation by single clicking under the down cursor of the TPS1100 window if it is not off already.
2. Open the GeoCOM dialog via the „Configuration“ menu.
3. Disable the GeoCOM enable box. Confirm with the „Ok“ button.
4. Start the simulation using the „ON” button in the TPS1100 window.

5.4.2 Loading and executing GeoBASIC programs

The procedure for loading a GeoBASIC application is as follows:

1. Make sure the simulation is turned on.
2. Choose the „Load Basic Application“ entry from the „File“ menu.
3. Choose a desired GeoBASIC executable (extension .gba) and press the „Open“ button.

If the application could be loaded successfully, it can be executed by choosing the menu item (or in the special case of a code program the CODE button in MEAS-mode), which has been added by the Install routine of the application. There is also a more flexible possibility to install the application via a user (definable) configuration. Refer to Chapter 9.3.2 for more information.

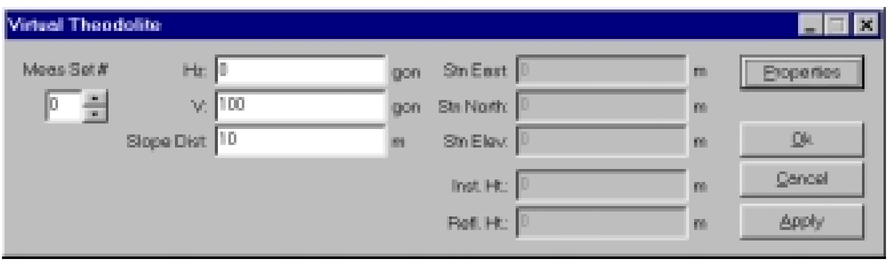
If the menu item “Load Basic Application …” is disabled (grey) then make sure no GeoBASIC application is running and maybe it’s necessary to press once or twice the ESC button of the TPS simulator.

5.4.3 User Interface

There are two dialogs to access the SWTheo from the simulation. The first one is called SWTheo dialog with the caption „Virtual Theodolite“ contains fields to change raw sensor data of the SWTheo as well as station data. This dialog is opened from the “Configuration” menu as stated above. The second dialog called SWTheo properties dialog (caption „Virtual Theodolite Properties“) may be triggered from the SWTheo dialog.

5.4.3.1 SWTheo Dialog

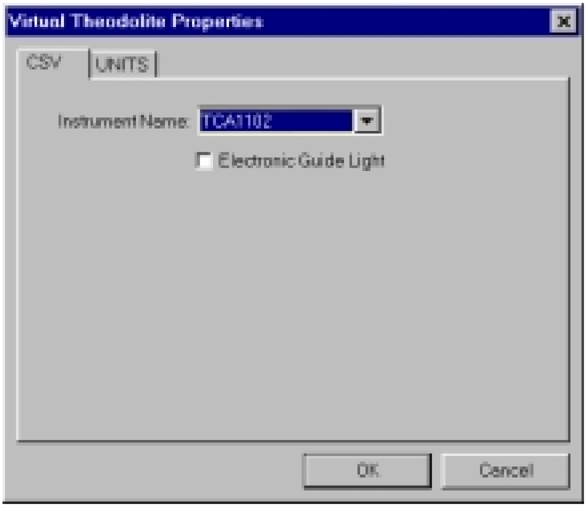
The dialog acts as the connection between the SWTheo and its virtual environment. Here, horizontal angle (Hz), vertical angle (V), and slope distance (Dist) to a virtual reflector as well as station data (N0, H0, E0), reflector (Hr) and instrument height (Hi) may be set. User input has to be confirmed using the “Set Data” button to take effect. Pressing the “Properties” button opens the Subsystems dialog.



Notice also that it is possible to define several sets of values. Choose a set by selecting the corresponding number off the measurement set. The values will be stored until they are changed.

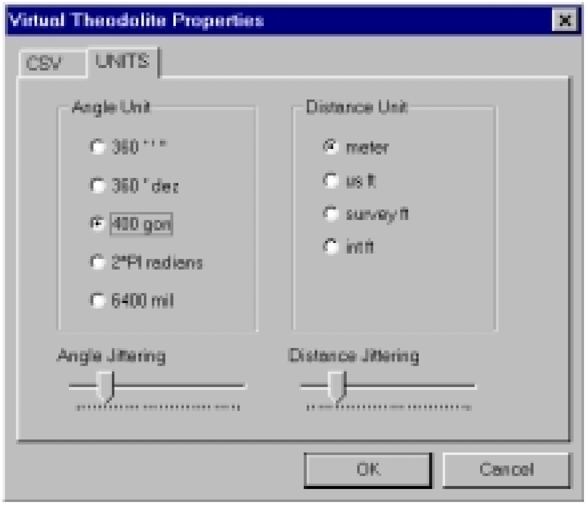
5.4.3.2 SWTheo properties dialog

The SWTheo properties dialog is a tabbed dialog as shown below. Here you can set some basic values.



The „Units“ tab depicted in the last figure enables the user to choose between several display units for the SWTheo dialogs. Please notice these values do not change the settings of the simulation.

“Jittering” is supported for angles and distances. This functionality is applied by alternately adding and subtracting random values in a range depending on the angle and distance sliders, respectively. The jittering amplitude increases from left to right position of the slider. If the sliders are in their leftmost position, there is no jittering applied to the virtual sensor data.



5.5 COMMONLY ASKED QUESTIONS AND ANSWERS

Q:

After starting the simulation and turning on in SWTheo mode , the text „xxx“ will be displayed as the title of some or all of the function buttons. How can I avoid this problem?

A:

Some or all of the text data base files are not contained in the directory referenced by „Text Management Data Path“. Use the „Data Paths“ entry of the „Configuration“ menu to set it accordingly.

Q:

After loading a GeoBASIC program, the expected menu item does not appear in the dialog. What did I wrong?

A:

The menu manager needs an event to reread the menu definition. Press the ESC key to rebuild the menu.

6 DEBUGGING GEOBASIC Programs

The debugging facilities of the GeoBASIC development environment are somewhat limited. Although, there are a few features, which may be helpful while debugging the program.

For the simulator:

- The command `Write` writes the given argument to the debug window. This will have no effects on the TPS.
- The same is valid for `Send`, because it will be redirected to the debug window. But, of course, on TPS it will send data over the data link.
- If an error occurs then a message will be written to the debug window, showing the error code and the name of the system routine, which caused the error.

For the simulator and the TPS:

- `MMI_PrintStr` can be used to display and track results and errors.

See also the list of return codes in the appendix of the Reference Manual.

7 Multiple Language Support

The TPS 1100 series system software supports internationalisation in such a way that text fragments are handled extra to an application. Accessing these fragments will be done internally by tokens. GeoBASIC supports this technique in certain system calls. Anytime a system routine is called which needs a `_Token` instead of a string then this token will be added to the text token database. The compiler handles this automatically for the programmer and produces the already mentioned `lng`-file.

This text token database is the basis for supporting multiple languages. With the Text Utility you can produce new text token databases (`mxx`-files) in other languages. Loading the derived `lxx`-files on the TPS system for enabling the user to choose between the provided languages. (‘`xx`’ stands for the language abbreviation.)

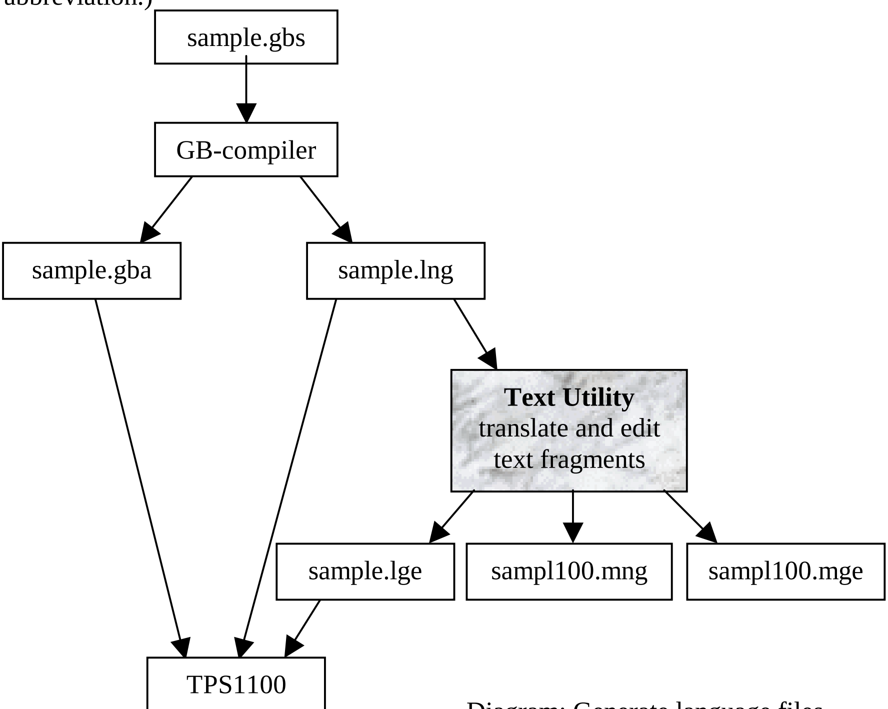


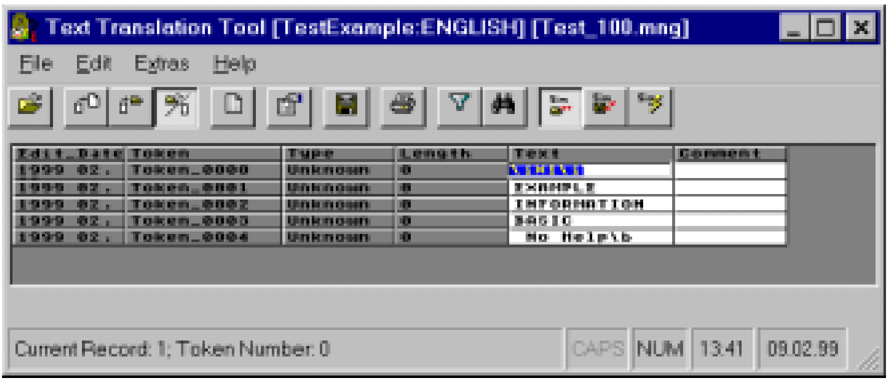
Diagram: Generate language files.

Strings which are not passed to a `_Token` parameter can not be handled with the Text Utility. They are hard coded into program object code. The only way to internationalise them is to use `MMI_GetLangName` to select an appropriate text string in GeoBASIC code separated by a conditional statement.

See sample file "`language.gbs`".

7.1 TEXT UTILITY

The TPS1100/1000 Text Utility (Text Translation Tool) supports GeoBASIC text files. This section describes the most important steps of generating multiple language files. The following picture shows the Text Utility after the import of a GeoBASIC text file:



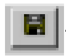
7.1.1 Generating new language files

For creating a multiple language application, the following steps are necessary:

1. After starting the Text Utility press the  -button, select GeoBASIC Text Files (*.l??) in the choice list "File of type:" and open the generated `*.lng` file (i.e. `sample.lng`). Answer the question "Do you want to convert this file?" with YES. In the next dialog you can specify the path and the version of the text database which is generated from the `*.lng` file (i.e. `sampl100.mng`). The version is automatically included at the end of the file name. Press OK to start the conversion.
2. Press the  -button, select a language in the choice list "New language", enter the path of the new language database and press OK to start the

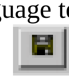
generation of the new language database (i.e. `sampl100.mge`). Now translate the text in column “Text”.

Note	Do not edit the first token with the text “i\X1\i”. This string is needed by the GeoBASIC Interpreter. Also the special strings for MMI_INVERSE_ON (“\aR+\a”) and MMI_INVERSE_OFF (“\aR-\a”) must be left unchanged.

After the translation press the -button, select the path and enter the name of the loadable language file and press OK to start the generation of the file (i.e. `sample.lge`).

7.1.2 Updating translated language files

After changing the GeoBASIC source file and re-compiling it, the following steps for updating the translated language files are necessary:

1. Press the -button again and open the generated `*.lng` file (i.e. `sample.lng`). The version of the text database which is generated must be increased (i.e. `sampl101.mng`).
2. Press the -button and open the target language you want to update (i.e. `sampl100.mge`). Edit the target language text column (indicated with T1). After updating the whole column press -button to generate the new loadable language file.

8 TYPICAL GEOBASIC PROGRAMMING

In this chapter some advice is given on how to program in GeoBASIC. The main attention is given to the user dialog — which is probably the most theodolite-specific part in GeoBASIC programming (besides using the system functions). Afterwards a proposal for naming conventions for GeoBASIC identifiers is given.

Note	To make programs easy and intuitive to use, the programmer should follow the given "standards" rather strictly. Moreover (s)he should have a basic understanding of the way how topographical surveying and mapping is actually performed.

8.1 THE TEXT DIALOG

8.1.1 The objects of the text dialog

The following text dialog is not a practical example, it shows only the most important text dialog objects:

Dialog line	**Object name**
<BASIC\ Text Dialog Objects>	Caption line: It is composed of the short caption ”BASIC” and the caption ”Text Dialog Objects”.
<I am a text dialog object.>	String
<10587>	Integer value

<90478.568>	Double (floating point) value without unit
<50.000 g>	Double (floating point) value with unit: If the type of the double value is `Angle, Distance, Subdistance,` ect. the according unit is printed automatically
<List Item 1 ▼ >	List: It is for selecting an item among several with the cursor keys
<CONT>	Button: The buttons inform the user about the functionality of the function key (F1..F6).

8.1.2 Creating a text dialog

A new text dialog is created by `MMI_CreateTextDialog`.

```
MMI_CreateTextDialog(6, "BASIC", "Text Dialog Objects",
                     "My help text.")
```

A text dialog with a short caption, here "`BASIC`", and a caption "Text Dialog Objects" is created. There is a total of 27 characters for the three parts, i.e. short caption, separation character ('\' printed automatically) and caption. 6 lines (start counting from the first line below the caption – which is 0 – up to line 5) can be used. All lines are empty after the creation. The help text is set to "`My help text.`" — it is shown when the user presses Shift-F1 and the help functionality of the theodolite is enabled.

8.1.3 Representation of the dialog objects

For every input and output the position on the display must be specified. The display is organized in lines and columns. The left upper position has line and column number 0. The line number is rising down and the column number is rising to the right. A display line is 29 characters wide. At most 6 lines are visible at any time, if the dialog contains more lines (up to 12 are possible) it is scrolled when necessary.

For floating point input/output a kind (for instance horizontal angle, distance, etc.) can be specified. Data is automatically transformed to the unit associated to the

kind according to the theodolite settings. Unit conversions are done by the system, all values with units defined in basic are considered to have to SI units. (See Chapter 9.1)

All numeric output appears right aligned in their field (specified by coordinates and length). String output appears left aligned.

Each input/output routine needs a parameter `lValid` which defines if the value of the object is valid or not. If a value is not valid five dashes are displayed instead of the value.

Every numeric input/output needs a parameter `iLen` which determines the total character length of the field. If the length is to short for the representation of the numeric value, the field will be filled with the character 'x'.

8.1.4 Output in text dialog

- Strings:
  ```
  MMI_PrintStr(0, 0, "I am a text dialog object.", TRUE)
  ```
  Parameters: column, line, string, lValid
- Integer values:
  ```
  MMI_PrintInt(10, 1, 10, 10578, TRUE)
  ```
  Parameters: column, line, iLen, integer value, lValid
- Double (floating point) values without unit:
  ```
  MMI_PrintVal(10, 2, 10, 3, 90478.568, TRUE,
               MMI_DEFAULT_MODE)
  ```
  Parameters: column, line, iLen, decimals, double value, lValid, Mode
- Double (floating point) values with unit:
  ```
  DIM hz AS Angle
  hz = PI/4
  MMI_PrintVal(10, 3, 8, 3, hz, TRUE, MMI_DIM_ON)
  ```
  Parameters: column, line, iLen, decimals, double value, lValid, Mode

8.1.5 Input in text dialog

Input is roughly dual to the output, except that the input functions return the button id of the button that terminated the edit process. For all numeric values there are the minimum and maximum values defined. The value is only valid, if it is between them.

- Strings:
```
MMI_InputStr(17, 3, 10, sInput, lValid, iButtonId)
```
  Parameters: column, line, string variable, lValid, button
- Integer values:
```
MMI_InputInt(24, 4, 4, 100, 200, iValue, lValid,
             iButtonId)
```
  Parameters: column, line, iLen, minimum value, maximum value, integer variable, lValid, button
- Double (floating point) values without unit:
```
MMI_InputVal(19, 4, 8, 2, 0, 399.99, MMI_DEFAULT_MODE,
             dValue, lValid, iButtonId)
```
  Parameters: column, line, iLen, decimals, minimum value, maximum value, mode, double variable, lValid, button
- Double (floating point) values with unit:
```
MMI_InputVal(19, 4, 8, 2, 0, 399.99, MMI_DIM_ON,
             dValue, lValid, iButtonId)
```
  Parameters: column, line, iLen, decimals, minimum value, maximum value, mode, double variable, lValid, button

- List: Lists take a variable of a predefined type as parameter.
```
TYPE ListArray (25) AS String30 END
```
  This definition determines the maximum number of entries in a list to be 25, each one is a string of type String30. We create a list with 4 items and use the second entry as default (initial selection).
```
DIM aList    AS ListArray
DIM iIndex  AS Integer

aList(1) = “List Item 1”
aList(2) = “List Item 2”
aList(3) = “List Item 3”
aList(4) = “List Item 4”
iIndex = 2
MMI_InputList(8, 4, 12, 4, MMI_DEFAULT_MODE, aList,
              iIndex, lValid, iButtonId)
```
  Parameters: column, line, iLen, number of items, mode, list variable, index, lValid, button

8.2 THE GRAPHICS DIALOG

8.2.1 Positioning on the display

Every graphics function needs the position on the display. The graphics display is organized in x- (horizontal) and y-pixels (vertical). The left upper position has x-pixel and y-pixel number 0. The x-pixel number is rising to the right and the y-pixel number is rising down. The size of the display is 232 times 48 pixels.

8.2.2 Creating a graphics dialog

Calling MMI_CreateGraphDialog creates a new graphics dialog.
```
MMI_CreateGraphDialog("BASIC", "Graphics Dialog",
                      "My help text.")
```
A graphics dialog with short caption "BASIC" and caption "Graphics Dialog" is created. The help text is set to "`My help text.`" — it is shown when the user presses Shift-F1 and the help functionality of the theodolite is enabled.

8.2.3 Graphics functions

After having created the graphics dialog, the graphics functions may be used. (E.g. `MMI_DrawLine`, `MMI_DrawCircle`, `MMI_DrawText`, etc. See the "Reference Manual" for a detailed description.)

8.2.4 Deleting a dialog

When a dialog is not used any more it must be deleted. The name of the dialog deletion procedure is for text, measurement and graphics dialogs the same:

```
MMI_DeleteDialog()
```

8.2.5 Mixing text and graphics dialogs

There can be only one text dialog at a time, i.e. an existing text dialog must be deleted with `MMI_DeleteDialog` before a new one can be created with `MMI_CreateTextDialog`.[1] The same holds for a graphics dialog (with the appropriate creation procedures).

But a graphics dialog may be opened while a text dialog is active. (Note: The reverse is not the case: a text dialog may not be opened while a graphics dialog is open.) If a text dialog and a graphics dialog are open, the graphics dialog has priority, i.e. all future function calls are related to the graphics dialog (until it is closed). For example, `MMI_AddButton` (see below) will add the button to the graphics dialog, and all the display functions must be for graphic dialogs (such as `MMI_DrawCircle`, etc.).

8.2.6 Adding buttons

The user may add buttons to a dialog. (These buttons will be added to the *defined buttons* of the dialog.) When adding a button it must be specified what text should be displayed for that button. Such a text can be up to five characters long and is displayed centred above the button.

Each button has an identification associated. This button id is needed

[1] An existing text dialog is deleted automatically if a new text dialog is created.

- for specifying which button is to add in `MMI_AddButton`, and
- checking what button was pressed or that is returned from a system function.

Example:

We add the F1-button to the currently opened dialog, giving the meaning "`CONT`" to it.

```
MMI_AddButton( MMI_F1_KEY, "CONT" )
```

Note	The button id's are defined as constants in the compiler.

8.2.7 Responding to buttons

There are two procedures for coping with button presses:

- `MMI_CheckButton` queries whether there was a button pressed or not, and
- `MMI_GetButton` retrieves a pressed button. If there was no button pressed it waits until one is pressed. The second parameter to `MMI_GetButton` (the in-parameter `bAllKey`) determines what buttons are accepted:
  - If it is `TRUE`, any button is accepted.
  - If it is `FALSE`, only ESC, or a defined button (added with `MMI_AddButton`) are accepted.

Example:

The example does some work in a loop until Shift-F6 is pressed. As long as there is no button pressed, the display is constantly updated (e.g. the current angles from the theodolite are displayed). If there is a button pressed, this button is handled.

```
'bDone must be initialized
bDone = FALSE
DO WHILE NOT bDone     'as long as the job is not done
   'check for defined buttons and get its id
   MMI_GetButton( buttonId, FALSE )
   SELECT CASE buttonId       'handle it
   CASE MMI_F4_KEY
      'handle MMI_F4_KEY
   CASE MMI_SHF6_KEY
      bDone = TRUE            'that's it,
                              'terminate loop
   CASE '…
      'here go the other handled keys
   ELSE
      'here go the unhandled keys
   END SELECT
   'update the display
LOOP
```

8.2.8 Standard key binding

It is clear that for the user it is important that the same name[2] — and moreover the same key — always has the same meaning associated (at least conceptually). An exception is the F1-key, its meaning is not the same in a measurement dialog and in a configuration dialog. In the following table there are the standard key bindings with the caption, the text which is displayed above the keys:

Key	Caption	Action
F1 in measurement dialog	ALL	Does first DIST, then REC. (See below)
F1 in configuration dialog	CONT	Continues to the logically following dialog.

[2] For instance, the user of a LEICA theodolite assumes that DIST takes the distance (with the common dialogs), ALL does DIST and then REC, etc.

Key	Caption	Action
F2	DIST	Start distance measurement.
F3	REC	Records the previously measured / computed data.
SHIFT-F1	HELP	Displays a help text if the theodolite help functionality is enabled. This key is provided and handled completely by the system, it is not accessible from GeoBASIC.
SHIFT-F6	QUIT	Terminates an application.
ESC		Cancels an input or goes a step back. GeoBASIC applications should handle it.
CODE		Shows the coding dialog.

8.3 NAMING CONVENTIONS

We propose some naming conventions for GeoBASIC. More extensive conventions can be found in the naming conventions for Microsoft Access (which are tied closely to Visual Basic conventions).[3]

8.3.1 Variable names

Variable names of simple types (i.e. all the scalar types and strings) may be *tagged* to indicate their type. Prefixes are always lowercase so your eye goes past them to the first uppercase letter — where the *base name* begins. If the base name consists of more than one word, upper case letters within the name are used to distinguish its parts.

Note	These naming conventions carry only a semantics for the programmer, not for the compiler.

[3] See "Naming Conventions for Microsoft Access, the Leszynski/Reddick Guidelines for Access", Microsoft Development Library 1995.

The **base name** succinctly describes the object. For example, `PointNumber` or just `PointNo` for the number of a point. Object **tags** are short abbreviations and simplifications describing the type of the object. For example, the tag '`i`' in `iPointNo` denotes that the type of the variable is `Integer`. The following table lists the tags for the GeoBASIC types.

type	**tag**
`Integer`	`i`
`Logical`	`l`
`Double`	`d`
`Distance`	`d`
`Subdistance`	`d`
`Angle`	`d`
`Pressure`	`d`
`Temperature`	`d`
`String`	`s`

Note that all types which represent floating point numbers are tagged by '`d`'. This is because operations valid for the type `Double` are also valid for the other `d`–tagged types.

If there are several similar object names, a **qualifier** may follow the name and further clarify it. For example if we kept two special point numbers, one for the first point and one for the last, the variable names would be the (qualified) variables `iPointNoFirst` and `iPointNoLast`.

Structure types do not have a default prefix, if needed the (abbreviated) type name could be used. For *arrays* the base name itself could contain the information that the variable names an array.

For *global variables* an additional prefix '`g`' might be useful.

8.3.2 Constants and user-defined types

Constants begin with an upper case character. If constants contain only upper case characters (as most of the predefined constants do) the underscore '_' is used to separate parts of the name. Often constants can be grouped together, then a prefix is used to denote their common criterion. For example the return codes use RC, as in `RC_OK, RC_ABORT`, etc.

Mostly constants are globally defined. For *local constants* an additional prefix `'loc'` might be useful.

User defined types begin with an upper case character. Use the postfix '`_TYPE`', `'_Type'` or '`Type`' (according to the naming convention used for the type name itself) appended to the type name to denote that it is a type structure. Alternatively, you can use a prefix '`T`'. (For types these conventions are useful since GeoBASIC is not case sensitive. Hence, for example, if there is a type `Date` no variable can be named `date`. If the type has the name `TDate` or `Date_Type` or `DateType`, there can.) As for local constants, *local types* might be prefixed with `'loc'`.

8.3.3 Procedures

A procedure name begins with an upper case letter and succinctly describes the action that is performed. Variables that denote parameters passed to a function or subroutine (in the parentheses after the function/subroutine name) should be well documented, also indicating whether they act as *input*, *output*, or *input and output* parameters.

8.3.4 Keywords

GeoBASIC keywords are all in upper case letters. For example, `DIM`, `FOR`, `LOOP`, `FUNCTION`, etc.

8.3.5 Labels

For error labels (ON ERROR GOTO) we use the function/subprocedure name with the qualifier `'_Err'` appended.

```
SUB LabelExample ()
   'code of the procedure

LabelExample_Err:
   SELECT CASE ERR
      'handle specific errors here
   CASE ELSE
      'generic error handler here
   END SELECT
END LabelExample
```

8.3.6 Remark on naming conventions

Naming conventions never replace the judicious use of comments in your GeoBASIC program code. Naming conventions are an extension of, not a replacement for, good program-commenting techniques.

Formulating, learning, and applying a consistent naming style require a significant initial investment of time and energy. However, you will be amply rewarded when you return to your application a year later to do maintenance or when you share your code with others. Once you implement standardised names, you will quickly grow to appreciate the initial effort you made.

To complete the discussion about naming conventions, we mention the use of program headers:

In every function/subprocedure there should be a header describing, at a minimum, purpose, and parameters passed and/or returned. (In addition there might be comments, the author's name, last revision date, notes, etc.)

9 REFINED GEOBASIC CONCEPTS

In GeoBASIC several concepts are implemented to utilise and standardise programming and applications.

9.1 UNITS

Working with units always gives rise to the problem that different users want to work with different units. In geodesy, take the vertical angle as an example: some surveyors measure in Gon, some in radians, others in percentages. And, in addition to the unit-problem, there is the question where to fix the zero point of some scale. Again for the vertical angle example: some surveyors want to have zenith angles, some nadirs, some something in between.

To cope with this situation there is a fine automatic unit handling system built in the theodolite system, and the GeoBASIC programmer can take full advantage of it. All that has to be done in a GeoBASIC program, is to keep all values in SI units and, when a value has to be displayed specify what kind of value it is: a horizontal angle, a vertical angle, a distance, a temperature, etc. All the formatting, together with choice of the right representation (the user may define this in his theodolite system configuration with which the GeoBASIC programmer is not concerned), and displaying the unit after the value are handled automatically. (Of course the programmer can also decide *not* to use this automation and handle everything on his own. But values obtained from the system will be in SI units anyway.)

9.1.1 What the GeoBASIC programmer has to do

- Use SI units throughout the program. All computations are done with values in SI units.
- When displaying, specify the correct data type i.e. `Distance` for the value is displayed. See description of the `MMI_PrintVal` function in the "Reference Manual".

We will give an example of measuring an horizontal angle, computing the difference to a given angle, and displaying the difference on the display. (Note that we use the `GetAngleHz` routine from the `MeanHz` program (see 10.1), and we assume that a text dialog has been opened properly. The angle difference is normalised to the range 0 to $2\times\pi$.)

Example

```
DIM dHz1      AS Angle    'first horizontal angle
DIM dHz2      AS Angle    'second horizontal angle
DIM lValidHz2 AS Logical  'indicator if second
                          '  angle is valid
DIM dDiffHz   AS Angle    'the difference of the
                          '  angles

'assume dHz1 is initialized here to an angle
'in radians

GetAngleHz( dHz2, lValidHz2 )

dDiffHz = dHz1 - dHz2
GM_AdjustAngleFromZeroToTwoPi( dDiffHz )

MMI_PrintVal( 20, 0, 8, 3, dDiffHz, lValidHz2,
              MMI_DIM_ON )
```

The output is as follows:

- If the `GetAngleHz` routine returned a valid angle, also the difference `dDiffHz` will be valid (this is why `lValidHz2` is used in the `MMI_PrintVal` function). In this case the angle will be formatted in an 8 character wide field with 3 decimals, afterwards the unit according the theodolite system configuration will be displayed.
  Assume that `gon` is set and the angle difference was 1.5473452 radians, then at position 20 in line 0 the output will be «`  98,507 g`».
- If the angle returned from `GetAngleHz` was not valid, five dashes will be displayed «`   ----- g`».

9.1.2 What the user/surveyor has to do

The user has to set up the units, in which he want to work, in the theodolite system configuration. All outputs that use the theodolite system will automatically be formatted according to this setting.

9.2 THE USER MEASUREMENT DIALOG

The User Measurement Dialog (sometimes referred as MDlg) standardises the visualisation of the measurement values in GeoBASIC. Each value (i.e. vertical angle, horizontal distance) has a predefined output format. Thus the GeoBASIC

programmer has only to define, on which line a value should be displayed. All lines begin with a brief description of the value.

For example (Output of the horizontal distance):

```
«Horiz.Dist:     158.287 m»
```

Additionally the measurement parameters and (self-definable) application parameters can be displayed in the measurement dialog. Thus a user is able to change measurement parameters immediately and without leaving the dialog. All measurement values and measurement parameters are saved in the theodolite's data pool as system parameters.

We distinguish between measurement and application parameters. The former are defined by the system in it's meaning and data type. The letter can be defined freely by the user. Please refer to Appendix H in the reference manual for a list of all system and application parameters, which can be used in a measurement dialog.

9.2.1 Configuration of the User Measurement Dialog

Before using the measurement dialog we have to define its contents. There are 3 types of possible entries:

- System parameters:
  The routine `GSI_SetLineMDlg` places a system parameter (measurement value or measurement settings) on a line.
- Pure text line:
  The routine `GSI_SetLineMDlgText` places any text on a line.
- Application parameters:
  The routine `GSI_SetLineMDlgPar` places a (self-definable) application parameter on a line.

Note	The user measurement dialog configuration is automatically initialised with the entries of the first system measurement dialog.

Thus all lines which are not configured by the GeoBASIC programmer shows the same parameters as the first system measurement dialog. For further explanations how to configure the user measurement dialog read the description of the 3 system functions (`GSI_SetLineMDlg`, `GSI_SetLineMDlgText`, `GSI_SetLineMDlgPar`) in the reference manual.

9.2.2 Creating the User Measurement Dialog

After the definition of the content GSI_CreateMDlg analogous to the creation of a text dialog creates the user measurement dialog. For adding buttons to the dialog use `MMI_AddButton`.

9.2.3 Executing the User Measurement Dialog

In the following example a measurement dialog is created with the horizontal angle on line 2 and the buttons “DIST” on F2-key and “QUIT” on SHIFT-F6-key. All other lines are predefined by the system. After the creation of the dialog the measured values will be updated in a loop:

```
'Change line 2
GSI_SetLineMDlg(2, GSI_PAR_AngleHz)
GSI_CreateMDlg (2, "MEAS", "Measurement Test",
                "Measurement Help...")
'Addition of buttons
MMI_AddButton(MMI_F2_KEY, "DIST")
MMI_AddButton(MMI_SHF6_KEY, "QUIT")
lDone = FALSE
DO WHILE NOT lDone
  GSI_UpdateMeasurement(TMC_AUTO_INC, WAITTIME,
                        lRecValid, iCode, FALSE)
  GSI_UpdateMDlg(iButton)
  SELECT CASE iButton
  CASE MMI_F2_KEY
    'DIST Button --> meas a distance and angles
    BAP_MeasDistAngle(iDistMode, dHz, dV, dDist, TRUE,
                      MEAS)
  CASE '..
    'handle other keys
  CASE MMI_ESC_KEY, MMI_SHF6_KEY
    'done --> exit this routine
    lDone = TRUE
  END SELECT
LOOP 'end measurement loop
'delete measurement dialog
MMI_DeleteDialog()
```

The routine `GSI_UpdateMeasurement` updates the measurement values in the theodolite data pool. `GSI_UpdateMDlg` updates the user measurement dialog with the new values and returns the pressed button. For further explanations read the description of these system routines in the reference manual.

If the user measurement dialog is not used any more it must be deleted with `MMI_DeleteDialog`.

See the example program MEAS.GBS for a typical usage of the user measurement dialog.

9.2.4 Mixing the User Measurement Dialog with Other Dialogs

There can be only one user measurement dialog at a time, i.e. an existing user measurement dialog must be deleted with `MMI_DeleteDialog` before a new one can be created with `GSI_CreateMDlg`. If a user measurement dialog is active, no text dialog can be opened and vice versa.

But a graphics dialog may be opened while a user measurement dialog is active.

Note	The reverse is not the case: a user measurement dialog may not be opened while a graphics dialog is open. If a user measurement dialog and a graphics dialog are open, the graphics dialog has priority, i.e. all future function calls are related to the graphics dialog until it is closed.

9.3 TPS1100 CONFIGURABILITY

In general, each part of an application, which should be accessible from outside, has to be of the form '`GLOBAL SUB`'. These points are known as entry points and can be used in two ways. First they can be linked to a menu item (of the a system), and second they can be described as configuration item.

9.3.1 Adding the program in a System Menu

The easier way to access an entry point of an application is to link it to a menu item during the installation phase. Please refer to the Reference Manual `MMI_CreateMenuItem` for further explanations.

9.3.2 Import the program in a User Configuration

The TPS1100 series theodolites support the concept of individual configurations. In a configuration the user can define his own dialogs or menus and link them to certain events (i.e. pressing the PROG key or Power ON). If the event occurs then the linked dialog or the menu will be displayed. The user can create and change his configuration on the PC with the Customisation Tool.

The import of a GeoBASIC program in a user configuration means, that an external GeoBASIC routine is linked with an item of a user defined menu, a button of a user defined dialog or directly with an event. If either the event occurs or the button is pressed or the menu item is selected, then the linked external routine is executed. For the import of a GeoBASIC program the Customisation Tool needs a special file named APPInfo-file with the necessary information about the program.

The usage of the APPInfo-file in the Customisation Tool:

- Start the Customisation Tool
- Open a configuration file, appropriate text- and definition files
- Choose Import Application from the file menu
- Check the box named with the program name (i.e. AppInfoExample)
- Press the OK button

Now the globally accessible subroutines may be added to menus, buttons, etc. simply by using drag and drop.

Generate the AppInfo-file
The AppInfo-file is automatically generated during compilation, if there is a application information (short AppInfo) section in the GeoBASIC source file.

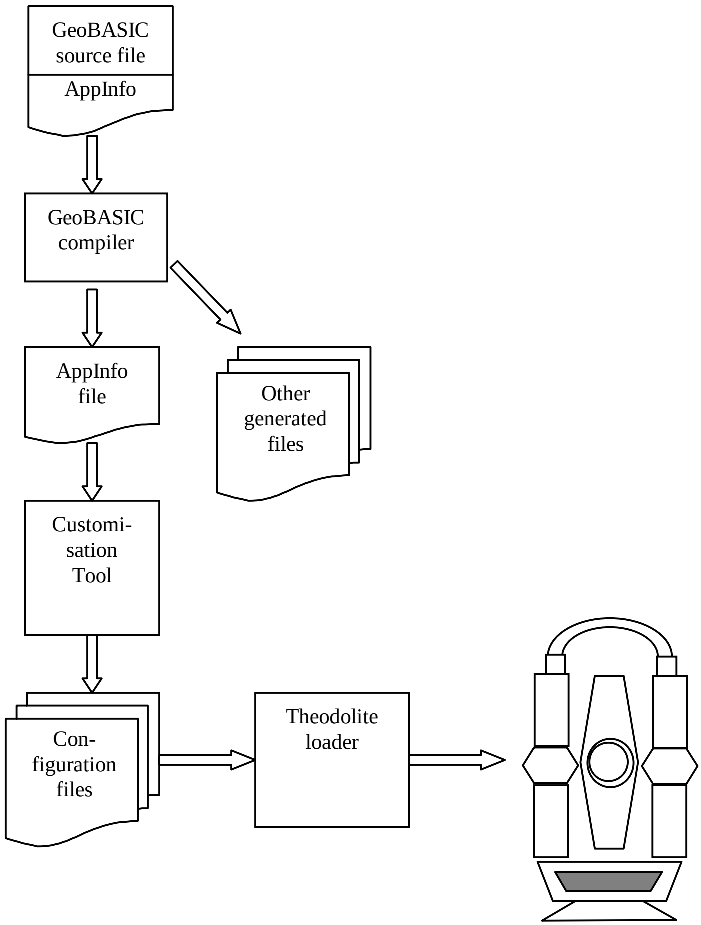
Note	The AppInfo-section has to occur at the end of the source code. The AppInfo-section is optional; if there is no AppInfo-section in the GeoBASIC source file, the AppInfo-file generation is omitted. The global routine “`Install`“ is optional, since any global routine may be associated with a menu entry, using the AppInfo-file via the Customisation Tool.

The following GeoBASIC sample code illustrates the usage of the AppInfo-section in a GeoBASIC source file. See also the sample program `AppInfoTest.gbs`.

```
PROGRAM AppInfoExample

'-------------------------------------------------------
GLOBAL SUB GlobalSub1
  Dim dummy As Integer
  MMI_WriteMsgStr("AppInfoExample.", "GlobalSub1 in
                  AppInfoExample called", MMI_MB_OK,
                  dummy)
END GlobalSub1

'-------------------------------------------------------
GLOBAL SUB GlobalSub2
  Dim dummy As Integer
  MMI_WriteMsgStr("AppInfoExample.", "GlobalSub2 in
                  AppInfoExample called", MMI_MB_OK,
                  dummy)
END GlobalSub2

END AppInfoExample

'Application Information for Config Tool
'---------------------------------------
APPINFO

  GENERAL
    SET Author    "Leica AG, CH - Heerbrugg"
    SET Desc      "AppInfo Example Application"
    SET TheoModel "TCA1100"
  END GENERAL

  ENTRYPOINT GlobalSub1
    SET CapLg "Global Sub 1"
    SET CapSh "GSUB1"
    SET Desc  "test of appinfo subroutine 1"
  END GlobalSub1

  ENTRYPOINT GlobalSub2
    SET CapLg "Global Sub 2"
    SET CapSh "GSUB2"
    SET Help  "displays a message and exits"
  END GlobalSub2

END APPINFO
```

The global subroutines `GlobalSub1` and `GlobalSub2` are indicated as entry points for the import in a user configuration. Refer to Chapter 2.11 in the Reference Manual for a description of the syntax in BNF-form.

The following figure depicts the whole scenario, from the generation of the AppInfo file over the import in a user (definable) configuration to the loading of the configuration into the theodolite:



9.4 INTERAPPLICATION-CALL

The inter-application-call makes it possible to call a subroutine in another GeoBASIC program. With this concept the GeoBASIC programmer can use the same subroutine in several programs.

9.4.1 Definition of a subroutine for Interapplication-Call

If a subroutine should be called by another application, it must be defined as a global subroutine.

Example:

```
PROGRAM IAC2
GLOBAL SUB InterAppEntry
  DIM iButton  AS INTEGER
  MMI_WriteMsgStr("Welcome in IAC2","IAC2", MMI_MB_OK,
                  iButton)
END InterAppEntry
END IAC2
```

9.4.2 Call the global subroutine

Before calling the global subroutine, the GeoBASIC programmer has to check with `CSV_LibCallAvailable` if the subroutine is available. That usually means if it is loaded or not. Is the subroutine available, he can invoke it with `CSV_LibCall`.

Example:

```
DIM lAvailable  AS LOGICAL
'Check if global subroutine is available
CSV_LibCallAvailable("IAC2","InterAppEntry", lAvailable)
IF lAvailable
  'available, call global subroutine
  CSV_LibCall("IAC2", "InterAppEntry", "BASIC")
END IF
```

See the example program IAC.GBS and IAC2.GBS for a typical usage of inter-application-call. For further explanations read the description of `CSV_LibCall` and `CSV_LibCallAvailable` in the reference manual.

9.5 SYSTEM FUNCTION CALL

If a theodolite user creates his own configuration on the PC with the Customisation Tool, he has a wide selection of predefined system functions which he can add to menus, buttons, etc. After the loading of the configuration he calls the system functions by selecting the appropriate menu item or button.

The GeoBASIC programmer has the same possibilities. With the routine `CSV_SysCall` he can call the system functions in his programs. Because some system functions do not run on every theodolite type, there is a routine

CSV_SysCallAvailable, which returns if the system function can be executed.

Example:

```
DIM lAvailable AS Logical
CSV_SysCallAvailable(CSV_SFNC_PositCompassDlg,
                     lAvailable)
IF lAvailable
  CSV_SysCall(CSV_SFNC_PositCompassDlg)
END IF
```

If the system function CSV_SFNC_PositCompassDlg can be executed (RCS mode is activ), then the dialog RCS orientation with a compass is displayed. For further explanations read the function descriptions of CSV_SysCall and CSV_SysCallAvailable in the reference manual. In Appendix H of the reference manual there is a list of all system functions.

9.6 SYSTEM EVENT GENERATION

Every configuration for a TPS1100 series theodolite is event driven. The user or the system itself generates an event (e.g. the user has pressed the PROG key or the initialisation sequence is finished) and the configuration functionality executes then the linked action (menu, dialog, macro, application or system function).

A GeoBASIC program can generate all events, which can occur in the theodolite system software, also. To generate a system event the same functions can be used as for calling system functions. The routine CSV_SysCall is used for the generation of system events. The routine CSV_SysCallAvailable returns TRUE, if there is an action linked to the requested event and the action can be executed.

Example:

```
DIM lItemDefined AS Logical
CSV_SysCallAvailable(CSV_EFNC_CompensatorSetting,
                     lItemDefined)
IF lItemDefined
  CSV_SysCall(CSV_EFNC_CompensatorSetting)
END IF
```

If a configuration item is defined for the system event CSV_EFNC_ CompensatorSetting (compensator setting event; usually connected to a compensator setting dialog) CSV_EFNC_CompensatorSetting is generated and the appropriate system function, application, macro, dialog or menu is

executed. For further explanations read the function description of `CSV_SysCall` and `CSV_SysCallAvailable` in the reference manual. In Appendix H of the reference manual there is a list with all system events.

10 GeoBASIC Sample Programs

10.1 MEANHZ — MEAN VALUE OF HORIZONTAL ANGLE MEASUREMENTS

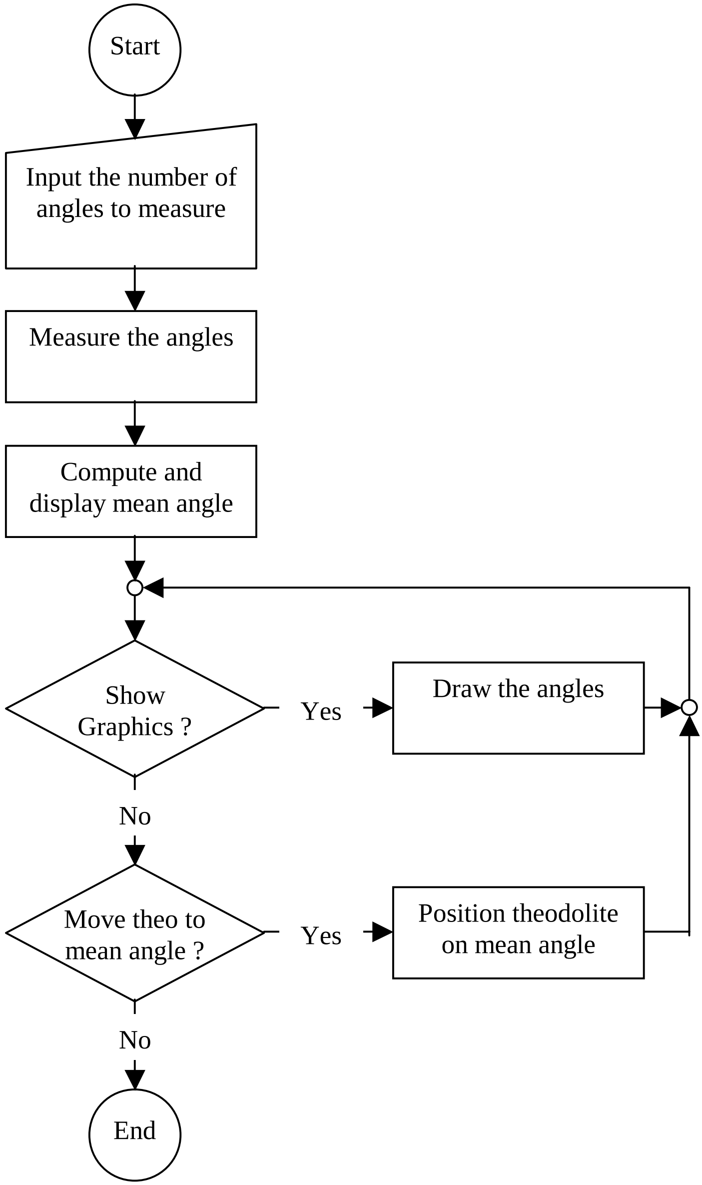
10.1.1 Program description

The program "`MeanHz`" measures a number of horizontal angles and computes its arithmetic mean value. The measured angles and the mean angle can then be displayed graphically.

Program flow:

First, the user may enter the number of horizontal angles he wants to measure. (The number of angles must be within a certain range.) Then the angles are measured — each time the REC key is pressed the current horizontal angle is recorded.

As soon as the requested number of angles is measured, the mean angle is computed and displayed. Now the user has the choice either to display the angles graphically, to move the theodolite to the computed mean angle or to quit the program. (The program can be terminated with the ESC button or the QUIT button on shift-F6 at any time.)


Start
Input the number of angles to measure
Measure the angles
Compute and display mean angle
Show Graphics ?
Yes
Draw the angles
No
Move theo to mean angle ?
Yes
Position theodolite on mean angle
No
End

10.1.2 Source code listing

See example file "meanhz.gbs"

```
PROGRAM Mean
'
' Sample application for building the mean value of angles
' -------------------------------------------------------
' Measures a user defined number of horizontal angles and calculate
' the mean angle. The measured and the mean angle can also be
' displayed graphically.
'
' GeoBASIC 1.0 for TPS1100 Series Instruments
' (c) Leica AG, CH - Heerbrugg 1998
'---------------------------------------------------------------------
' Global Declarations
CONST MaxNoHz       = 9        'Maximum number of angles that can be
                               'measured
CONST CaptionShort  = "MEAN"   'Short caption (displayed lefthand, in
                               'top line)

'Type to store the angles (for graphics)
TYPE DIM
  TAngles (MaxNoHz) AS Angle
END

DIM fId  AS FileId             'File identification

'---------------------------------------------------------------------
-----
GLOBAL SUB Install
'          -------
' Description
'    Adds the program into the theodolite's PROG menu. The program's
'    (application's) name is 'Mean', the global routine to start is
'    'Main' and the program menu item will be named 'MEAN HZ'.

   MMI_CreateMenuItem( "Mean", "Main", MMI_MENU_PROGMENU, "MEAN HZ")

END Install
```

```
SUB RecordValue (dHz As Angle, byVal dMean As Angle)
'   -----------
' Description
'    Writes the value to data link and file.
'
DIM sVal1   As String30
```

```
DIM sVal2   As String30
DIM sOut    As String255

ON Error Resume Next                        'Ignore all errors

  MMI_FormatVal(MMI_FFORMAT_HZANGLE, 10, 2, dHz,   TRUE,
                MMI_DEFAULT_MODE, sVal1)
  MMI_FormatVal(MMI_FFORMAT_HZANGLE, 10, 2, dMean, TRUE,
                MMI_DEFAULT_MODE, sVal2)

  sOut = "hz: " + sVal1 +  "mean: "+ sVal2   'Compute output text

  'Write to data link and file
  Send(sOut)
  Print(fId, sOut)

END RecordValue

'---------------------------------------------------------------------
SUB GetAngleHz ( dHz AS Angle, lValid AS Logical)
'   ----------
' Description
'    Measures the horizontal angle 'valid' indicates if the dHz is
'    valid.
'
' Parameters
'    OUT: dHzOUT, lValid
'
DIM theoAngle   AS TMC_Angle_Type         'The measured values
DIM iInfo       AS Integer                'Return code

ON Error Resume Next                      'Ignore all errors

   'get angle
   TMC_GetAngle( theoAngle, iInfo )

   IF (Err = RC_OK) THEN
     lValid = TRUE
     dHz    = theoAngle.dHz
   ELSE
     lValid = FALSE
   END IF
END GetAngleHz
'---------------------------------------------------------------------
SUB ShowGraphics( byVal iNoPoints AS Integer, angles AS TAngles,
                  byVal dMean AS Angle )
'   ------------
' Description
'    Displays the measured and the mean horizontal angles
'    graphically.
'
' Parameters
'    IN: iNoPoints, angles, dMean
'
DIM iX       AS Integer   'x coordinate
```

```
DIM iY       AS Integer   'y coordinate
DIM iButton  AS Integer   'button id

CONST CX       = 90             'display center x coordinate
CONST CY       = 24             'display center y coordinate
CONST DL       = 20             'length of line
CONST HELPTEXT = "Visualizes the angles with lines from the
                 station. "   +
                 "The computed mean angle is shown by the longer
                 line. " +
                 "The north angle is 0."

  MMI_CreateGraphDialog( CaptionShort, "PICTURE", HELPTEXT )

  'Draw center and circle
  MMI_DrawCircle( CX, CY,  3,  3, MMI_NO_BRUSH, MMI_PEN_BLACK )
  MMI_DrawCircle( CX, CY, DL, DL, MMI_NO_BRUSH, MMI_PEN_BLACK )

  'Draw lines for angles (there are iNoPoints angles)
  DO WHILE iNoPoints > 0

    'compute the line
    iX = INT( DL * SIN(angles(INT(iNoPoints))) )
    iY = INT( DL * COS(angles(INT(iNoPoints))) )

    MMI_DrawLine( CX, CY, CX+iX, CY-iY, MMI_PEN_BLACK )

    iNoPoints = iNoPoints - 1

  LOOP

  'Draw line for dMean
  iX = INT( (DL+4) * SIN(dMean) )
  iY = INT( (DL+4) * COS(dMean) )
  MMI_DrawLine( CX, CY, CX+iX, CY-iY, MMI_PEN_DASHED )

  'Wait for key press and finish dialog
  MMI_AddButton( MMI_F5_KEY, "END" )
  MMI_GetButton( iButton, FALSE )

  MMI_DeleteDialog()

END ShowGraphics

'---------------------------------------------------------------------------
GLOBAL SUB Main
'          ----
' Description
'   Reads the number of points to be measured. Measures these points,
'   calculates the mean value and shows the result or moves (if
'   motorized) the TPS tocalulcated position.
'
DIM iNoPoints    AS Integer       'number of points to measure
DIM iCurrNo      AS Integer       'current point number
DIM lNoOk        AS Logical       'TRUE if no of points are valid
```

```
DIM lHzOk        AS Logical       'TRUE if measured hz is valid
DIM dHz          AS Angle         'measured hz
DIM storeHz      AS TAngles       'array of measured angles
DIM dMean        AS Angle         'calculated mean angle
DIM lKeyPressed  AS Logical       'TRUE if button pressed
DIM iButton      AS Integer       'id of pressed button
DIM Family       AS TPS_Fam_Type  'this data structure is used to
store
                                  'information about the system

ON Error Resume Next          'ignore errors

   'check which type of instrument is active and open file
   CSV_GetInstrumentFamily( Family  )
   IF ( Family.lSimulator ) THEN
     Open( "C:\\results.txt", "Append", fId, 0 )
   ELSE
     Open( "A:\\results.txt", "Append", fId, 0 )
   END IF


   'set up dialog and input iNoPoints
   MMI_CreateTextDialog ( 6, "MEAN", "HZ MEAN VALUE",
                         "Compute mean HZ for a number of
                          measurements." )

   ' ******************************
   ' *      read in iNoPoints      *
   ' ******************************

   iNoPoints = 3
   lNoOk     = TRUE
   MMI_PrintStr( 0, 0, "No of points:", TRUE )
   MMI_AddButton( MMI_F1_KEY, "CONT" )
   MMI_AddButton( MMI_SHF6_KEY, "QUIT" )
   MMI_InputInt( 26, 0, 2, 1, MaxNoHz, MMI_DEFAULT_MODE, iNoPoints,
                 lNoOk, iButton )

   'setup rest of dialog
   iCurrNo = 1
   MMI_PrintStr( 0, 1, "Curr. point :", TRUE )
   MMI_PrintVal( 26, 1, 2, 0, iCurrNo, TRUE, MMI_DEFAULT_MODE )
   MMI_PrintStr( 0, 2, "HZ          :", TRUE )
   MMI_AddButton( MMI_F3_KEY, "REC" )

   'init mean value
   dMean = 0.0

   'get iNoPoints points (abort if ESC or QUIT is pressed)
   DO WHILE (iCurrNo <= iNoPoints) AND (iButton <> MMI_ESC_KEY) AND
            (iButton <> MMI_SHF6_KEY)

      MMI_PrintVal( 26, 1, 2, 0, iCurrNo, lNoOk, MMI_DEFAULT_MODE )

      MMI_CheckButton( lKeyPressed )
```

```
   IF lKeyPressed THEN

      MMI_GetButton( iButton, FALSE )

      SELECT CASE iButton
        CASE MMI_F3_KEY, MMI_F1_KEY
           GetAngleHz( dHz, lHzOk )

           storeHz(iCurrNo) = dHz
           dMean            = dMean + dHz

           'if REC pressed record values
           IF iButton = MMI_F3_KEY THEN
              RecordValue(dHz, dMean/iCurrNo)
           END IF

           iCurrNo = iCurrNo + 1

      END SELECT

   ELSE

      'update display
      GetAngleHz( dHz, lHzOk )
      MMI_PrintVal( 20, 2, 8, 3, dHz, lHzOk, MMI_DEFAULT_MODE )

   END IF
LOOP


'***************************
'*      show results      *
'***************************

'if execution should procede
IF (iButton <> MMI_ESC_KEY) AND (iButton <> MMI_SHF6_KEY) THEN

   'setup new buttons
   MMI_DeleteButton( MMI_F1_KEY )
   MMI_DeleteButton( MMI_F3_KEY )
   MMI_AddButton( MMI_F3_KEY, "SHOW" )
   MMI_AddButton( MMI_F4_KEY, "EXIT" )
   MMI_AddButton( MMI_F5_KEY, "GOTOM" )

   'compute mean value
   dMean = dMean / iNoPoints
   MMI_PrintStr( 0, 3, "Mean HZ     :", TRUE )
   MMI_PrintVal( 20, 3, 8, 3, dMean, TRUE, MMI_DEFAULT_MODE )

   DO WHILE (iButton <> MMI_ESC_KEY) AND (iButton <> MMI_SHF6_KEY)
            AND (iButton <> MMI_F4_KEY)

      MMI_GetButton( iButton, FALSE )
```

```
         SELECT CASE iButton

           CASE MMI_F3_KEY
              ShowGraphics( iNoPoints, storeHz, dMean )

           'move theo to the computed mean horizontal angle
           CASE MMI_F5_KEY
              BAP_PosTelescope(BAP_POSIT_HZ, BAP_POS_MSG, dMean, 0,
                               0.1, 0.1)

         END SELECT

      LOOP

   END IF

   'clean up text dialog
   MMI_DeleteDialog()

   'close output file
   Close(fId)

END Main


END Mean
```

10.2 SAMPLE PROGRAMS

These code samples gives you some help for building your first applications. Each of them should give you some hints in a specific problem domain.

- `appinfotest.gbs` This example shows the use of the application information section in the GeoBASIC source file.
- `codefunc.gbs` An example of a program which will be called, when the *Code*-key has been pressed.
- `cursor.gbs` Cursor control in a dialog.
- `error_ha.gbs` This program shows how error handling changes execution of a program.
- `language.gbs` Take this program as an example to support multiple language applications. Two language files and its text databases are provided to see how multilingual support works.
- `meanhz.gbs` This sample shows the calculation of the mean value of horizontal angle measurements, see Chapter 10.1.

• `meas.gbs`	A simple example how to measure with BAP-functions, including Quick-Coding
• `meas_od.gbs`	A simple example how to measure and how to record data in an own data-format, including Quick-Coding
• `stringer.gbs`	This example shows in which situations typical errors may occur.
• `test.gbs`	An empty frame for building up a GeoBASIC application.
• `tracking.gbs`	This program shows possible techniques to take advantage of the measurement facilities.
• `menu.gbs`	A simple menu handler.
• `dirlist.gbs`	This example shows how to get PC card information and how to read a directories content.
• `inclmain.gbs`	This example shows the usage of an include file.
• `iac.gbs`	An example for an interapplication call.

11 PORTING A TPS1000 ORIGINATED PROGRAM

The implementation of the TPS1100 theodolite series includes several new concepts compared to the firmware of TPS1000 theodolites. To follow up these new concepts and to take care of functionality that has been changed or removed in the implementation of TPS1100 firmware, GeoBASIC programs, once developed for TPS1000 hardware, cannot be compiled without changing the source code.

In this chapter we will cover this subject and we try to give some guidelines to help the developer to port the source code onto the new platform. During the design phase of GeoBASIC for TPS1100 systems we took certain care to make the migration as smooth as possible. Although all programs' source code has to be changed, the effort to port it will be for the most applications not that high.

In the very end this means also that the developer has to maintain two source code bases.

11.1 TPS1100 HARDWARE RELATED CHANGES

11.1.1 Display Line Length

The TPS1100 series instruments use a different liquid crystal display. The difference means also that one can use only 29 characters per line. To be 'independent' of the display length we defined the string type `DisplayLine`. It does not contain the string length in the name, hence this should help in future to port applications. To be compatible with older, TPS1000 GeoBASIC programs we did not change all `String30` declarations. Of course only 29 characters will be printed out to the display.

11.1.2 Keyboard

The number of keys has been reduced, there is no `CONT`-Key any longer. Remove all `MMI_CONT_KEY` appearances in the source code. We deleted the definition of this constant to make it more obvious to the programmer that he has to change the source code and think about any button assignments.

11.2 CHANGES TO THE SIMULATOR

Now TPSSim supports GeoBASIC programs larger than 64 KB. A restriction, which turned out in the past, bothered the most of the GeoBASIC program developers. We would like to point out that the SWTheo extension enables the programmer to influence the execution of a program. With specific dialogs the programmer gets the possibility to set or change certain (measurement) values. We hope this helps a lot to simulate a more realistic TPS environment and makes it almost obsolete to have an instrument at your hand to test your application. Of course, still the final test of an application has to be done on an instrument. See also the documentation of TPSSim for further explanations.

11.3 NEW CONSTRUCTS IN GB_1100

Due to some requests we added a few new constructs to GeoBASIC for TPS1100 instruments.

11.3.1 #include Statement

It is now possible to include a GeoBASIC source file in another one. Nevertheless only one level of inclusion is allowed.

11.3.2 MID$ statement

Mid$'s implementation has been extended. Now Mid$ can be used to assign a character or a substring to another string at a certain position. In this way single characters of a string can be set or replaced.

Examples:

```
T = “abcdef”
Mid$(t, 2, 1) = "+"              results in “a+cdef”
Mid$(t, 4)    = "------------"   results in “a+c------------”
```

11.3.3 Application Info

A general concept of configurability has been introduced for the TPS1100 family of instruments. This gives totally new customisation possibilities into the hand of

the developer and more to the customer support. Up to a certain degree GeoBASIC supports this configurability. For example an assignment of a GeoBASIC program to a menu item can be changed by the new configuration utilities. Or it can be assigned to a function key.

To support these new features we extended the concept of the program by a section that describes the attributes of it.

This (informational) section can be appended optionally at the end of the source file. See the extra explanation of it to get further information about it.

11.4 GEOBASIC SOURCE CHANGES

Many GB programs have a similar structure. Therefore it does not surprise that many programs have to be rewritten in the same way to be compilable and executable for TPS1100 GeoBASIC.

11.4.1 General Dialog Changes

The `CONT` key does not exist any more on the TPS1100 instruments. Scan your source code for `MMI_CONT_KEY` and replace it by a function key. The TPS1100 guidelines use `MMI_F1_KEY` normally for the `CONT` key functionality. This might make it necessary to change your function key layout. Look at the existing dialogs to get an idea and to be more consistent to the built-in dialogs, to which function keys which functionality has been assigned.

In certain circumstances, where no function keys were left, the `ESC` key was the only way to leave a dialog. Normally `ESC` leaves a dialog with leaving values untouched.

`MMI_SHIFT_ESC_KEY` will not be supported any more. Instead one has to assign QUIT to (normally) Shift-F6. Quit leaves the whole application.

Note	'Old' versions of constants and functions are left aligned. Newer versions or replacements have been shifted to right. The listed changes are ordered in an assumed importance.

TPS1000	**TPS1100**

`MMI_DeleteGraphDialog()`
`MMI_DeleteTextDialog()`
`GSI_DeleteMeasDlg()`
	replaced by `MMI_DeleteDialog()`

Please notice that GB-TPS1000 supports conceptually 2(3) dialogs at once; a text or a graphics dialog and in parallel a customisable measurement dialog - `MDlg`.

A typical application may create a text dialog and link a graphics dialog to a menu button. Notice, that both dialogs exist at the same time and distinguish this situation from another, where the text dialog will be deleted before the graphical dialog will be created. In the former case one can go back to the text dialog without recreating it. In the latter the text dialog has to be rebuilt. In GB_TPS1100 text and measurement dialog are mutually exclusive.

See the following scheme for a graphical explanation. "()" denotes a dialog.

TPS1000	TPS1100
(Text) and (MeasDlg) | (Graphic) Graphic overrides Text and may have it's own buttons. The other way around is not possible At the same time a MeasDlg may be defined.	(Text or MDlg) | (Graphic) Graphic overrides Text or MDlg. Text and MDlg are mutually exclusive. Only one can be defined at once. All three dialog types may have their own buttons.

Deleted:
`GSI_CreateMeasDlg()`
`GSI_DefineMeasDlg()`
`GSI_DeleteMeasDlg()`
`GSI_GetDialogMask()`
`GSI_SetDialogMask()`
`GSI_UpdateMeasDlg()`
	Replaced by a more general concept – see the reference manual for `GSI_*MDlg-` routines.
	New routines are:
	`GSI_SetLineMDlg ()`
	`GSI_SetLineMDlgPar ()`
	`GSI_SetLineMDlgText ()`
	`GSI_GetLineSysMDlg ()`
	`GSI_SetLineSysMDlg ()`
	`GSI_CreateMDlg ()`
	`GSI_UpdateMDlg ()`

11.4.2 Recording Format Settings

Deleted:
`GSI_GetRecFormat()`
`GSI_SetRecFormat()`
	Replaced by (extended):
	`GSI_GetRecMask ()`
	`GSI_SetRecMask ()`

11.4.3 System Dialog Calls

Replacements for old dialog invocation calls:

`GSI_CommDlg ()`	`CSV_SysCall (`
	`CSV_EFNC_GeoComSetup,`
	`Caption )`

`GSI_SelectTemplateFiles()`
`and`
`GSI_Setup ()`
	`CSV_SysCall (`
	`CSV_EFNC_Setup,`
	`Caption )`

`GSI_StationData ()`	`CSV_SysCall (`
	`CSV_EFNC_SetStation,`
	`Caption )`

`GSI_TargetDlg ()`	`CSV_SysCall (`
	`CSV_EFNC_TargetData,`
	`Caption )`

11.4.4 EDM Mode Changes

Replacement for EDM_MODE by the extended BAP_SetMeasPrg ().

TMC_GetEDMMode () TMC_SetEDMMode ()	BAP_SetMeasPrg () BAP_GetMeasPrg ()
Deleted EDM modes:	New defined modes:
EDM_SINGLE_STANDARD EDM_SINGLE_EXACT EDM_SINGLE_FAST EDM_CONT_STANDARD EDM_CONT_EXACT EDM_CONT_FAST EDM_UNDEFINED	BAP_RED_TRK_DIST BAP_SINGLE_REF_STANDARD BAP_SINGLE_REF_FAST BAP_SINGLE_REF_VISIBLE BAP_SINGLE_RLESS_VISIBLE BAP_CONT_REF_STANDARD BAP_CONT_REF_FAST BAP_CONT_RLESS_VISIBLE BAP_AVG_REF_STANDARD BAP_AVG_REF_VISIBLE BAP_AVG_RLESS_VISIBLE

11.4.5 Interface Changes

The following routines got a new interface.

GSI_ImportCoordDlg ()
GSI_ManCoordDlg ()

Refer to the reference manual to get the new interfaces.

11.4.6 Deleted and Added Identifiers and Types:

TPS1000 **TPS1100**

Deleted:	New:
CSV_MAX_USERS CSV_ILLEGAL_USERNR	CSV_WITH_REFLECTOR CSV_WITHOUT_REFLECTOR
RC_CSV_ILLEGAL_USERNR	

Deleted	
EDM_COMERR EDM_NOSIGNAL	

EDM_PPM_MM EDM_METER_FEET EDM_ERR12 EDM_DIL99	

	New: MMI_SHIFT_CODE_KEY For MMI_SetAngleRelation() MMI_HANGLE_CLOCKWISE_SOUTH Changed to return code: MMI_UNDEF_LANG For MDlg routines: MMI_FFORMAT_STRING New date format: MMI_DATE_JP

Deleted: MMI_MENU_EXTRA MMI_MENU_CONFIG	New: MMI_MENU_PROGRAMS MMI_MENU_PROGMENU MMI_MENU_AUTOEXEC

	New GSI_ID values: GSI_ID_SHZ GSI_ID_CD_DSC GSI_ID_PTCD_DSC GSI_ID_PV_CD GSI_ID_PV_PTCD GSI_ID_ACT_PTID GSI_ID_BACKID GSI_ID_APP_DATA0 GSI_ID_APP_DATA1 GSI_ID_APP_DATA2 GSI_ID_APP_DATA3 GSI_ID_APP_DATA4 GSI_ID_APP_DATA5 GSI_ID_APP_DATA6 GSI_ID_APP_DATA7

	GSI_ID_APP_DATA8 GSI_ID_APP_DATA9 GSI_ID_APP_DATA10 GSI_ID_APP_DATA11 GSI_ID_FS_SCALE New GSI_POINT_TYPE: GSI_BACKSIGHT GSI_POINT_CODE

	GSI_PAR_* parameters see GSI system functions.

Deleted: TPS1100 TPS1700 TPS1800 TPS5000 TPS2003	New: TPS1102 TPS1103 TPS1105

Old TPS_FAM_Type:	New TPS_FAM_Type:
iClass	iClass
lEDMBuiltIn	lEDMBuiltIn (always TRUE)
lEDMTypeII	lEDMTypeII (always FALSE)
	lEDMTypeIII (always TRUE)
	lEDMReflectorless
lMotorized	lMotorized
lATR	lATR
lEGL	lEGL
lDBVersion	
lDiodeLaser	
lLaserPlummet	lLaserPlummet
	lAutoCollimation
lSimulator	lSimulator

	New: BAP_PRISM_MINI

Deleted: `GSI_DLG_ID_LIST`	

	New: `TMC_RED_TRK_DIST`

11.4.7 Changes in System Functions

Deleted, because there is no equivalent function at the TPS1100 series instruments:

```
BAP_GetFunctionality (), BAP_SetFunctionality ()
BAP_SetFunctionalityDlg ()
CSV_GetCurrentUser (), CSV_SetCurrentUser ()
CSV_GetDL (), CSV_SetDL ()
CSV_GetUserInstrumentName ()
CSV_SetUserInstrumentName ()
CSV_GetUserName (), CSV_SetUserName ()
GSI_GetStdRecMask ()
GSI_GetStdRecMaskAll ()
GSI_GetStdRecMaskCartesian ()
```

Replaced by equivalent functions:

```
GSI_WiDlg ()
GSI_StartDisplay ()
GSI_GetStdDialogMask ()
```

Enhanced in certain ways. See the extended identifiers and constants above or refer to the reference manual:

`WI`-values

```
CSV_GetPrismType (), CSV_SetPrismType ()
CSV_GetInstrumentFamily ()
GetMemoryCardInfo ()
MMI_GetAngleRelation (), MMI_SetAngleRelation ()
MMI_SetDateFormat (), MMI_GetDateFormat ()
```

New functions see reference manual for further details:

```
MMI_CreateGBMenuStr ()
MMI_CreateGBMenuItemStr ()
GSI_SetDataPath ()
GSI_GetDataPath ()
CSV_SetTargetType ()
CSV_GetTargetType ()
```

Interapplication and system calls

```
CSV_SysCallAvailable ()
CSV_SysCall ()
CSV_LibCall ()
CSV_LibCallAvailable ()
```

11.4.8 Returncodes

Their definitions have been coupled totally to the definitions of the TPS1100 firmware. Please refer to the Appendix F in the reference manual for a detailed listing.

12 Changes in GeoBASIC Release 1.30

The Release 1.30 of GeoBASIC contains several new subroutines. It reflects user requests and improvements in the TPS1100 Series firmware Release 2.0.

Note:	This GeoBASIC Release needs at least the **TPS1100 Series firmware Release 2.0.**

The following paragraph shows the changed items. For a detailed explanation, please see the "GeoBASIC Reference Manual"

12.1.1 New functions in Release 1.30

`BAP_SearchPrism`	search prism
`CSV_CheckAltUserTask`	returns if an alternative user task was running (i.e. FNC or PROG was pressed)
`CSV_GetTemperature`	returns the internal instrument temperature
`CSV_ResetAltUserTask`	resets the "WasRunning"-flag
`GSI_CheckTracking`	returns if distance tracking is running
`GSI_ExecQCoding`	executes Quick-Coding with/without recording
`GSI_ExecuteAutoDist`	starts a distance measurement after changing the distance mode (new buttons in FNC menu)
`GSI_GetMDlgNr`	returns the current measurement display number
`GSI_GetQCodeAvailable`	' returns if a valid code-list for Quick-Coding is selected
`GSI_GetRecMaskNr`	returns the current recording mask
`GSI_GetRecOrder`	returns the recording order measurement-code or code-measurement block
`GSI_GetWiEntryText`	Get coding text-data from the Theodolite data pool

`GSI_SelectCode`	select a code-list-code, but without recording it (allows the recording in another format)
`GSI_SetMDlgNr`	changes the measurement dialog (used i.e. for >DISP buttons)
`GSI_SetQCodeMode`	enables Quick-Coding
`GSI_SetRecMaskNr`	changes the recording mask
`GSI_SetRecOrder`	defines the recording order
`MMI_GetVAngleMode`	returns if the V-angle is running (even if a valid distance is available)
`MMI_SetVangleMode`	defines the V-angle mode
`TMC_GetAtmCorr`	Gets the atmosphere part of distance measurement corrections
`TMC_GetGeomProjection`	Gets the projection part of distance measurement corrections
`TMC_GetGeomReduction`	Gets the reduction to the reference part of distance measurement corrections
`TMC_GetInclineStatus`	returns the inclination status (i.e. ready for recording)
`TMC_SetAtmCorr`	Sets the atmosphere part of distance measurement corrections
`TMC_SetGeomProjection`	Sets the projection part of distance measurement corrections
`TMC_SetGeomReduction`	Sets the reduction to the reference part of distance measurement corrections

12.1.2 New constants in Release 1.30

```
GSI_GET_NEXT
GSI_MAX_DLG_LINES
GSI_MAX_MDLG_MASKS
GSI_MAX_REC_MASKS
GSI_MAX_REC_WI
GSI_MULTI_REC
GSI_NO_FILE_CHANGE
GSI_SEARCH_FROM_END
TPS1101
```

12.1.3 New datatypes in Release 1.30

```
HzAngle
VAngle
TMC_GEOM_PROJECTION_Type
TMC_GEOM_REDUCTION_Type
TMC_ATM_TEMPERATURE_Type
```

12.1.4 New CSV_SysCall constants in Release 1.30

```
CSV_SFNC_CheckOrientation
CSV_SFNC_CurrentSetPpmDlg
CSV_SFNC_DefSearchAreaDlg
CSV_SFNC_LoadApplDlg
CSV_SFNC_LoadSysLangDlg
CSV_SFNC_SetDefaultSearchRange
CSV_SFNC_ToggleMeasPrgFastRapidTrk
CSV_SFNC_ToggleMeasPrgRefRL
CSV_SFNC_ToggleMeasPrgStdTracking
CSV_SFNC_ToggleSearchArea
CSV_SFNC_ToggleVAngleMode
```

GeoBASIC FOR TPS1100

Reference Manual

Version 2.10

1 INTRODUCTION

GeoBASIC is a programming language for LEICA theodolites and their simulation on personal computers. The core language appears similar to today's common Windows BASIC dialects, thereby it is easy to learn and use. However, GeoBASIC's main power lies in its ability to use many of the existing theodolite subsystems and dialogs, just by calling an appropriate built-in function: for setting parameters, measuring, geodesy mathematics, and many things more. These tools at hand, the programmer can quickly and flexibly build sophisticated geodesy applications.

The user manual first describes the installation of GeoBASIC on a PC (*Chapter 2*). Then, after learning how to create an GeoBASIC application (*Chapter 3*), it will be shown how to actually load and execute a program on a LEICA theodolite (*Chapter 4*) and on the Windows simulation *(Chapter 5)*.

As these technicalities are mastered, the main topic is programming in GeoBASIC. This manual will give you several hints on typical GeoBASIC programming (*Chapter 8*), and introduces you to the design and programming of the theodolite user interface and refined GeoBASIC concepts (*Chapter 9*).

Finally, GeoBASIC example programs are presented (*Chapter 10)*. The reader will find a sample code for measuring and computing the mean value of several horizontal angles. Moreover some introductory examples are given to tell how special problems can be treated.

Note	All the details of the GeoBASIC language and system functions are composed in the "GeoBASIC Reference Manual".

2 INSTALLATION

The requirements for using GeoBASIC are a Personal Computer based on an Intel 486 processor or higher and at least 8MB of main memory. The installation of the whole development environment occupies about 10 MB of disk space, excluding the PDF version of the manual. The delivered software needs Microsoft Win95, Win98 or WinNT to run successfully.

2.1 SETUP

The following directory structure is created during the installation per default. Notice that the location of this directory tree is user definable. Hence it is not a granted to be exactly that location. Notice also that the CodeConverter application is installed in a separate Setup installation procedure.

```
…+-SurveyOffice
      |
      +-UserTools
      |  |
      |  +-TPS1100Tools
      |  |  |
      |  |  + - CodeConverter
      |  |  + - GBSamples
      |  |  |
```

Content of the directories (only the main objects are listed):

- `TPS1100Tools\`

`TPS1100.exe`	TPS Simulator for TPS1100 Series
`GBStudio.exe`	GeoBASIC IDE application
`GBI_1100_xxx.prg`	GeoBASIC Interpreter for TPS1100 series *)
…	and maybe several more tools, help files or DLL's

- `CodeConverter\`

`CGB_Dlg.exe`	CODE to GeoBASIC converter
`Code_ex1.cod`	CODE sample
`GBC_xxx.exe`	GeoBASIC Compiler for TPS1000 series *)
`GBI_xxx.prg`	GeoBASIC Interpreter for TPS1000 series *)
`GBI_1100_xxx.prg`	GeoBASIC Interpreter for TPS1100 series *)

- …
  Several TPS1100Sim specific directories which contain language files, code lists, configurations and things like that.

* xxx means: i.e. 210 for Release 2.10

Loading the GeoBASIC Interpreter:

The GeoBASIC Interpreter will be loaded automatically with the loading of the first application into the theodolite using the Software Upload for TPS1100. Hence you have to copy the GeoBASIC Interpreter (GBI_TPS1100_xxx.prg) into the same directory as the application before loading it. Otherwise you will get an error message. (For details, please see Chapter 4.1 Loading a GeoBASIC program or 5.3 Loading and executing GeoBASIC programs)

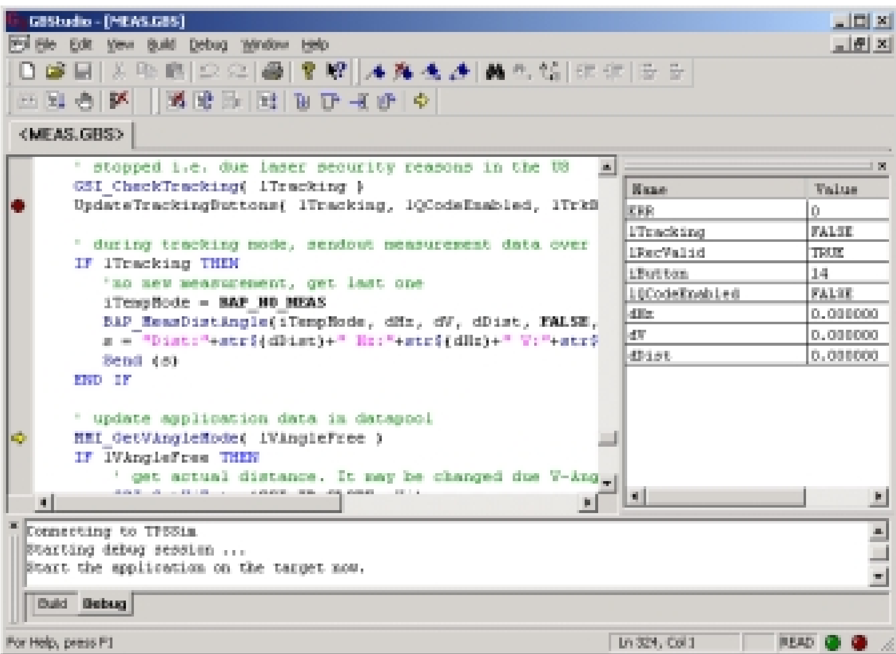
3 CREATING A GEOBASIC APPLICATION

Starting from the specification of a GeoBASIC application, several steps have to be performed until the program can be executed on the theodolite or by simulation:

1. Write the program,
2. compile the program,
3. load the program, either onto the simulation or the theodolite, and
4. start the execution of it.
5. if the execution fails, start a debugging session.

3.1 GBSTUDIO DEVELOPMENT ENVIRONMENT

GBStudio is an integrated development environment and includes a source editor, compiler, project handling and a source level debugger. It is able to debug GeoBASIC 2.10 applications for TPS1100 series total stations. Both, the TPS simulator and the TPS device as the execution platform are supported.



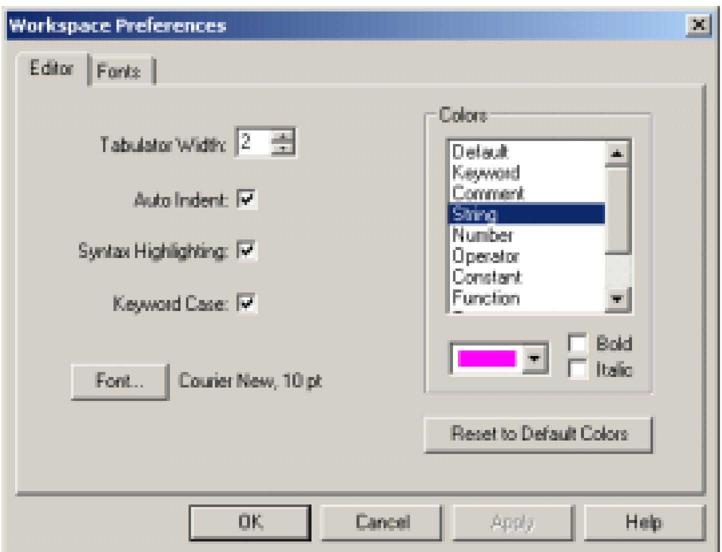
GBStudio contains several views for different purposes. The main source view is for showing/editing source files. The ‘Open Files’-tab can be used to switch quickly between different source windows. Toolbars help the user to start actions with one mouse click. The ‘Build/Output’-window is used to display informative messages of the compiler and during the debugging session for the user.

Use the integrated help system to get more descriptive explanations of what can be done with GBStudio. You can invoke the Help documentation by either using the context-help-cursor (Edit toolbar) or the shortcut F1, which opens the content page.

3.1.1 The Editor

It establishes a modern programming language editor, which supports syntax and keyword highlighting, multilevel undo/redo, Intellisense and Tooltip info, Bookmarks, indent and outdent of a block of source lines, and several other features.

The ‘Workspace Preferences’-dialog can be used to customize the features, which should be active during debugging.



To choose a different font use the 'Font …'-buttons in the 'Font'-tab, which will offer a dialog to choose one of the installed fonts on the system. Fonts can be chosen separately for the Editor window, Build/Debug output window and for the Watch Variable window.

3.1.2 The Compiler

The source-file has to be *compiled* before it can be *loaded* and *executed*. Compiling the source file with the GeoBASIC compiler results into 3 files, one for the executable object itself (file extension "`.gba`"; i.e. `sample.gba`), one for the language data (file extension "`.lng`"; i.e. `sample.lng`) and a debug-info file (file extension "`.gbd`"; i.e. `sample.gbd`). The first two files are necessary to execute the program, either on a LEICA theodolite or with the simulator on a personal computer. The debug-info file is necessary for debugging a program using GBStudio. See the following diagram:

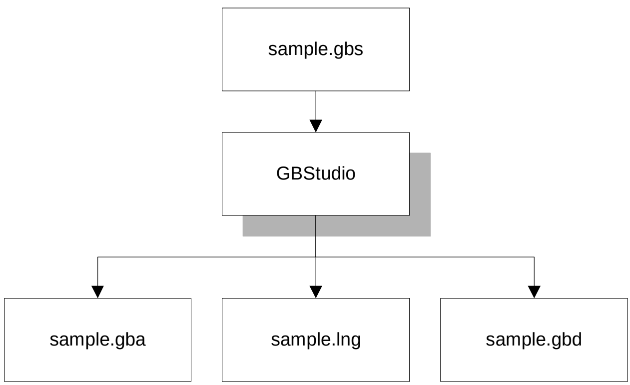
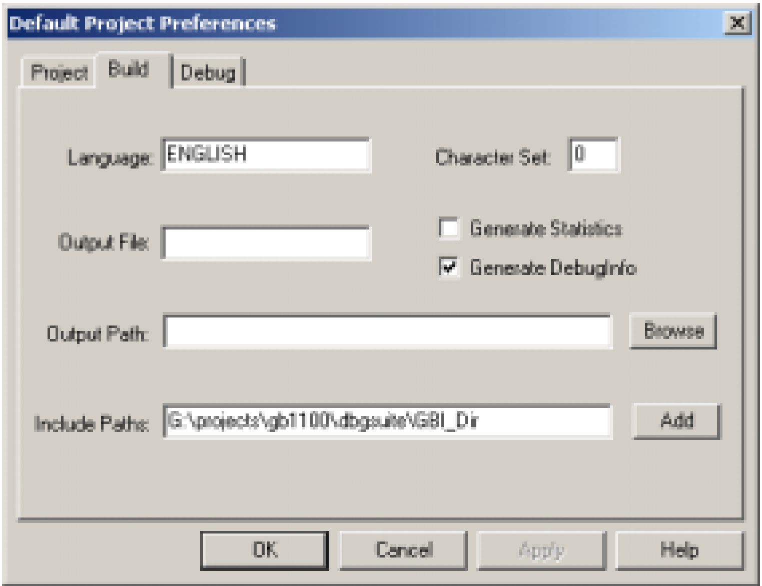


Diagram: Compiling a GeoBASIC program

The compiler is fully integrated in the development environment. The compilation of the source file is just one mouse click away. If an error occurs the editor will place the cursor automatically at the position of the error in the source window. Use Ctrl-F1 to get a more descriptive explanation of what caused the failure of the compilation process.

Depending on the compiler settings also the debug info file is generated which is necessary for debugging the application.

Depending on the selected project type, use either the 'Default Project Preferences'-dialog or the 'Project Preferences'-dialog to set the build options for the compiler.



The compiler understands the following options:

Setting	**Meaning**
Language	The language on which the resulting application is based on. The default is ENGLISH, other languages are FRENCH, GERMAN, etc.
Character Set	The character set on which the application is based on. The default character set is 0.
Output File	The name of the resulting applications file name. If it is empty, the resulting files get the same file base name as the source code file.

Output Path	The path where the compiler places the generated application files. The default is the source directory, where the compiler gets the GeoBASIC source file. The path has to be absolute and has to end with a "\"-character.
Include Paths	Set one or more directory-paths for include files. The directory path must not have a "\" character at the end.
Generate Statistics	Enable this flag, if you want the compiler to generate some statistical information about the compiled application.
Generate Debug Info	Enable this flag, if you want the compiler to generate a debug info file, which is necessary to debug the application

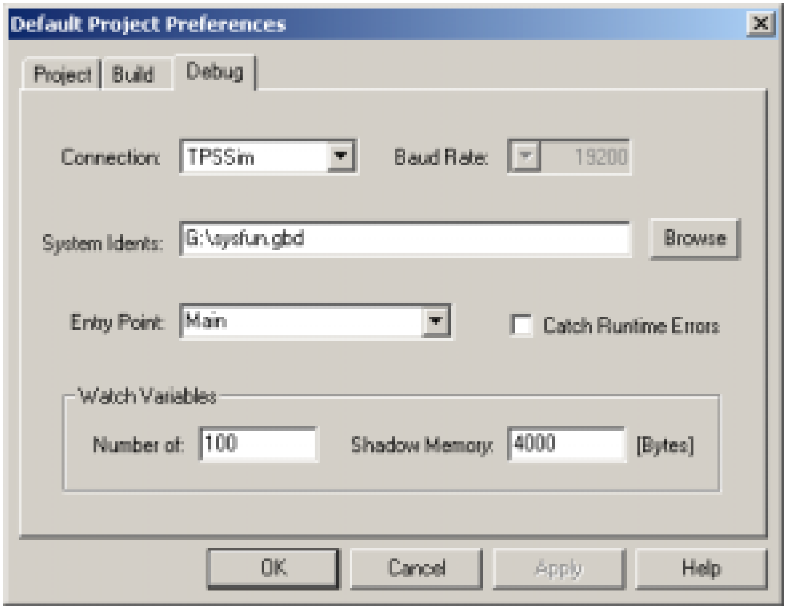
3.1.3 The Debugger

The debugger enables the programmer to debug GeoBASIC applications at source level. Operations like Step, Step Over, Run, Set breakpoints and watching the values of variables and some more operations are implemented.

To find errors in the source code an error catcher has been implemented which stops the execution of the application once the Err-variable changes its value. The error catching mechanism can be enabled and disabled during the debugging session at the needs of the developer.

The generated files include time stamp information. With this information GBStudio is able to check if all involved objects are synchronous to each other. This feature also enables GBStudio to debug an application, which may be in use for some time already. The only precondition, which has to be met is, that all files have to be saved for this purpose. Once the source code file changes debugging can only be started if the application is compiled anew. This means also that the application has to be loaded freshly onto hardware, which then initializes all its values. This feature is very valuable if a tested application shows error only after weeks or months of usage.

Depending on the selected project, use either the “Default Project Preferences” dialog or the “Project Preferences” dialog to set the build options for the debugging session.



For debugging the following values can be set:

Setting	**Meaning**
Connection	This setting determines the execution platform and if TPS over a serial line is served, which COM port should be used for communication.
Baud Rate	Is available only if one of the serial communication lines has been chosen. Choose an appropriate Baud rate.
System Idents	Determines the location of the system specific symbols file. Click on the “Browse…” button to get a file chooser dialog.

Entry Point	Since every loadable application on the TPS may have more than one entry point, one has to select a valid entry point of the application. This value can be entered before the debug info has been loaded, or after the debug info load operation. In the latter case choose the entry point by selecting an item from the drop down list.
Catch Runtime Errors	Enable this flag to catch runtime errors.
Number of Watch Variables	Select a value between 1 and 1000 watch variables. The number determines the table size on the server side. This value heavily influences the performance of certain debug operations. If you don’t a big number, then choose a smaller number for better performance.
Size of Shadow Memory	Select a value between 100 and 10000 Bytes. This will be the size of the shadow memory, where the server will keep a backup copy of the registered variables.

3.1.4 The Interpreter and the Firmware

Both have been adapted to provide all the additional functionality. Hence only firmware releases 2.10 and newer support GeoBASIC debugging with GBStudio. Please notice, that GBStudio cannot handle the TPS device state “Sleep Mode” correctly. Please disable the sleep feature of the TPS firmware if you want to avoid tedious timeout errors in GBStudio.

3.2 TYPICAL DEVELOPMENT CYCLE

3.2.1 Open or Create a GeoBASIC main source file

Use the Open File command to open an existing GeoBASIC main source file or create a new file with the document type GBS.

If you choose to open an already existing project, then the defined main source file should be opened automatically.

3.2.2 Edit the application.

Type in or change an existing GeoBASIC application source code. Please, refer also to the GeoBASIC reference manual for a complete description of syntax and semantics of GeoBASIC and how to write applications in GeoBASIC.

The editor is capable of automatically correcting the case of keywords. If one types a blank after a keyword this features take place automatically. Switch this feature off in the Workspace Preferences dialog if you don’t want to use this feature.

CTRL-SPACE opens a drop down list of system-defined functions. This can be used to quickly select a system function. When the opening parenthesis is typed the parameter list will be showed as a tool tip and a reminder what the compiler expects. Use SHIFT-CTRL-SPACE anytime to open up this tool tip again. The displayed parameter list depends on the cursor position and moreover on the system function identifier just before the current cursor.

Note:	Define also an entry point (GLOBAL SUB definition) of the application, which you can choose later to debug. This is the only identifier in a GeoBASIC application, which is case-sensitive. Make sure this entry point is linked to a menu item on the TPS user interface. Otherwise it will not be possible to debug the application (with the exception of the “BasicCodeProgram” type of application).

Save your changes by using CTRL-S or the Save command from the File menu.

3.2.3 Build the application

Press function key F7 or use the Build command from either the Build menu or Build toolbar.

If an error occurs, then the editor will place the cursor automatically near the location of the error. Correct the error and recompile it. Repeat these steps until your application compiles without any errors. Use CTRL-F1 if you want to get some more information on the last error occurred.

Note	The usage of the compiler is protected by a hardware key. Without the right hardware key it is not possible to execute the compiler successfully. If the hardware key is not installed properly or it does not contain the license for the compiler then an error message will be displayed and execution will be terminated.

3.2.4 Start debugging

To start the debug session, choose the platform (TPS simulator or TPS instrument) and specific settings, you want to use, in the Project Preferences dialog. Make also sure the entry point of the application is set properly in the preferences dialog.

1. Switch on the debugging platform.
2. When using the TPS device:

   Load the GeoBASIC interpreter.
3. Load the application you want to debug. (For details, please see Chapter 4.1 Loading a GeoBASIC program or 5.3 Loading and executing GeoBASIC programs)

Note:	The application must have been build with ‘’Generate Debug Info’’ enabled.

Note: GBStudio uses the TPS device when the GSI settings are active. The GeoCOM online mode is *not supported* during the debugging process. Make sure the GSI communication settings are:

- 19200 Baud,
- No-Protocol,
- 8 Data Bits,
- No-Parity,
- CR/LF as terminator.

GBStudio *cannot* handle the sleep state of the TPS device correctly. Make sure the ‘’Sleep after …’’-mode is disabled.

The application source and the generated files must be synchronous, hence a source file, which has been changed, after the application has been built, cannot be debugged.

Start debugging by pressing the Start button on the Build toolbar or use the corresponding menu located command.

Start the application on the platform. The editor should now get a small mark (in the shape of an right sided arrow) on the left edge of the main source file window, which points to the very first executable statement of this entry point of the application.

3.2.5 Debugging

Use the commands of the Debug menu or toolbar to step through the application, set breakpoints, catch errors and watch variables as they change during the debugging process.

In the watch variable view you will be able to edit either the identifier of the watch variable entry or the value itself, if the debugging process is in a HALT state.

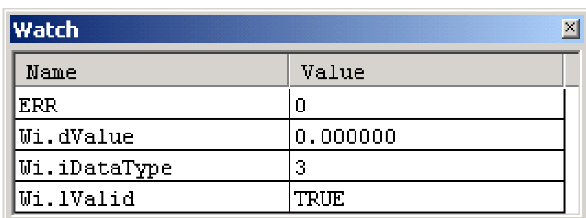
Note:	Changing the value of a string reference parameter is possible too. Since the actual, maximum length of the variable (behind the reference) is unknown, the debugger is unable to protect the memory area following the string variable. Hence, if you change the value of a string reference parameter, be sure that the number of added characters is less than or equal to the declared length.

3.2.6 Stop debugging

Choose the Stop Debugging command to stop the debugging process. Just in case the application is executing a system function, then the debug server will not be able to terminate the application immediately. Instead the application will be terminated after the system call returns. Nevertheless, GBStudio can terminate the debugging session on the client side.

3.2.7 Watch Variables and Quick Watches

Watch variables can be added to the Watch Variable view by selecting a variable identifier and pressing the shortcut Ctrl-W.


Watch

Name	Value
ERR	0
Wi.dValue	0.000000
Wi.iDataType	3
Wi.lValid	TRUE

Use the Quick Watch command if you don't want to add the variable to the Watch Variable view. Instead the value will be printed into the Debug Output window.

Once added to the window it is possible to change either the identifier name or the value of it (if the point of execution is in the scope of the variable). Use a Double-Click on the identifier or the value to enter the edit mode.

Note:	The identifier name is bound to the current context, which is determined by the selection you made. To choose the same identifier name from a different context one has to select the identifier in the correct context.

Valid watch variable expressions may be of the following form only:

Variable Expression	Example
VariableIdent	s, Err, line
StructIdent.Element	CurrPt.dHz, GMCircle.Center.dHeight,
	ArrayIdent(NumConstant)
	arr(2), field(17,3)

All other possible text strings cannot be handled correctly in the current implementation and will be rejected for registration therefore.

Include exclusively expressions with numerical constants.

3.3 PROJECT HANDLING

GBStudio knows two different categories of projects, which are valid exclusively. First the default project, which is valid for any valid GBS-file. And second the so-called ‘named’ projects, which have the application specific information stored in a file. It should be emphasized that the default project only stores the settings of one project (similar to one main source file) at a time. Once the user chooses another main source file, he has to make sure that the default preferences are set appropriately. E.g., if the two source files have different application entry points, the user has to set it up accordingly.

The default project is active if the user doesn’t choose a project explicitly. Instead the user will just open a plain GeoBASIC source code file.

3.4 COMMON PROBLEMS

The most common problems, which may arise, are:

- GBStudio is not able to establish a connection to the GeoBASIC Debug Server.
  Solution: In the case of debugging with the simulator make sure the TPS simulator is running and “Switched On”. In the case of the TPS device make sure the right COM port has been chosen, the cables are connected and the communication settings are equal on both sides. Notice, that GBStudio only supports serial settings with 8 Bit, 1 Stop Bit, no Parity Bit and CR/LF as a packet terminator. Only the Baud Rate may vary.
- The application, which should be debugged, and/or the interpreter are not loaded.
  Solution: Load interpreter and/or application first, before you start debugging.
- The program source files are out of synchronicity with the compiled application.
  Solution: Recompile and reload the GeoBASIC application.
- The Debug Session cannot be started, because the system predefined symbol file could not be found.
  Solution: Use the “Project Preferences” dialog, Debug-Tab, to specify path and file name of the system predefined symbols.
- The Debug Session cannot be started, because no valid entry point has been chosen.
  Solution: Use the “Project Preferences” dialog, Debug-Tab, to specify a valid entry point. Valid entry points are defined in the source code as “GLOBAL SUB …” procedure names. Notice: the predefined entry points Install, Init and Stop are not valid entry points.
- During debugging a Step-Into an Include source file doesn’t open the source file and show the next statement. Or the compiler reports the error that he can’t open an Include file.
  Solution: Make sure that the “Project Preferences” dialog, Build-Tab, field “Include Directories”, contains the right path, where GBStudio can find the include source file.
- The second registering of a variable doesn’t show the associated value. Notice, a variable can be registered only once.
- During debugging the code source cannot be edited. We disabled this during the debug session to keep the source and the loaded application

synchronous. Stop the debug session to be able to edit the code source again.

- **The debug session hangs**. Conceptually it may happen that a notify message get lost from the server to the client. Then it might be possible that the “Stop Debug” and “Break” buttons are enabled only. Since the debug server has sent the notify message it waits for the next command. And because the client has missed the notification, it thinks the last command is still being under execution and waits for the never incoming notification.
  Solution. Use the “Break” button to check the current state. If the last command has been finished and above situation was the reason then this initiate a new notification of the current state.

3.5 COMPILER LIMITATIONS

The GeoBASIC programmer has to keep some limitations for his applications:

- One simple procedure or function may not contain more than 10 kB of code.
- The maximum size of an application (including memory space) is limited by the free memory size of the theodolite only. If no other applications are loaded there should be free memory up to several hundred kB on a theodolite.
- An application may not have more than 64kB of string literal in total.
- The number of global identifiers is limited to 3000.
- The overall maximum number of identifiers limits the number of local identifiers, which are about 60000.

4 EXECUTING A GEOBASIC PROGRAM ON THE THEODOLITE

As described in the Chapter 3.1.2 The Compiler, compiling a GeoBASIC program results in at least two files, the executable program itself and the language data. Before a program can be executed, these two files have to be loaded into the theodolite first. With the help of the Leica Survey Office Software Upload the two files can be loaded into TPS-memory and run automatically the install procedure of the GeoBASIC program. The install procedure has to take care of adding an item to a menu which links an external procedure of the GeoBASIC program (`Global Sub`) to an item in a menu list. Additional to this static link there is a more flexible concept to install an application via a user (definable) configuration. For further explanations how to install an GeoBASIC application read Chapter 9.3.

If the menu item is added to a menu you can choose it to run a GeoBASIC program.

4.1 LOADING A GEOBASIC PROGRAM

GeoBASIC programs can be loaded into the theodolite using the Software Upload program from the Open Survey Suite. The procedure for loading a GeoBASIC application is as follows:

1. Verify that a serial link between PC and theodolite is established.
2. Switch theodolite into GeoCOM online mode.
3. Start Software Upload program.
4. Press <Transfer Files...> in <Utilities> menu of Software Upload.
5. Choose <Application Program> as Component Type.
6. Select directory which contains the loadable program (`*.gba`).
7. Choose language if the application supports multiple languages.
8. Select the application in the <Components> window.
9. Press <Transfer>.

Detailed explanations may be found in the documentation of Leica Survey Office - Software Upload.

GeoBASIC programs can also be loaded from the PC-Card into the theodolite using the build-in application loader. For details, please see description in the theodolite documentation.

Note	Loading a program with identical names for module and external procedures as an already loaded program replaces this program and all its associated text modules in memory and the items in the menu list. Hence, transferring of more than one program with the *same* application name may cause unwanted effects.

Note	For the build-in loader from the PC-Card, the files (*.GBA und *.lng) must be stored in the PC-Card folder “\TPS\APPL”. If necessarily, the GeoBASIC interpreter (gbi_xxx.prg) is loaded automatically from the same folder.

5 EXECUTING A GEOBASIC PROGRAM ON THE SIMULATIOR

5.1 GENERAL

The TPS1100 simulation supports, among other features, the execution and debugging of GeoBASIC applications. The simulation may run in one of two modes:

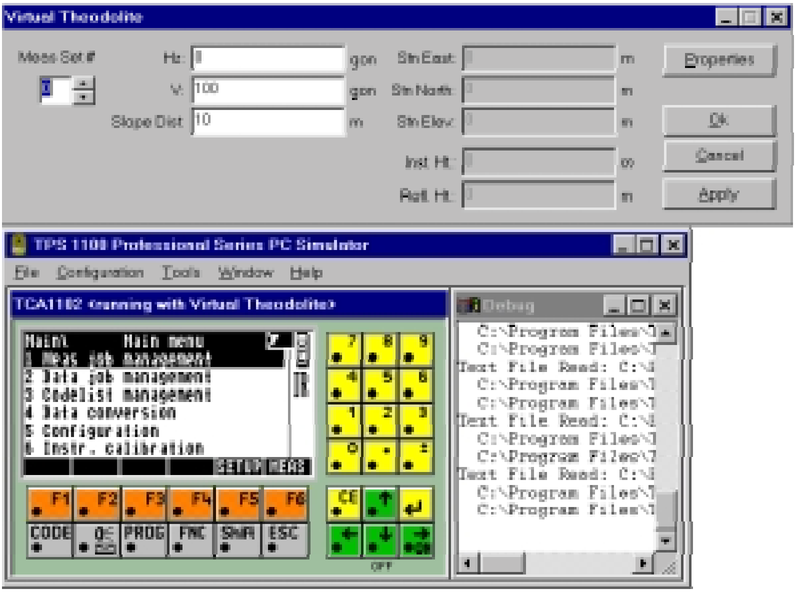
- GeoCOM mode
- SWTheo mode

Running in GeoCOM mode the simulation operates the (hardware) theodolite connected to the PC via a serial port and uses it as a sensor device. In SWTheo mode, user triggered commands are redirected to the software simulation of the theodolite.

5.2 USER INTERFACE

The TPS1100 simulation main window contains two windows and a dialog box on start-up: the „`TPS1100`“ window and the „`Debug`“ window (see below). The TPS1100 window contains a replication of the (hardware) TPS1100 theodolite‘s user interface. In the „Debug“ window, debug information are displayed. It is recommended to have always the debug window opened because some of the statements in the GeoBASIC source code (like the WRITE statement) might cause printing text into the „Debug“ window.

The dialog box is called “Virtual Theodolite” and is used to type in raw measurement data for the simulation of measurements. See also section 5.6.2 for further explanations.



5.3 LOADING AND EXECUTING GEOBASIC PROGRAMS

The procedure for loading a GeoBASIC application is as follows:

1. Make sure the simulation is turned on.
2. Choose the „Load Basic Application“ entry from the „File“ menu.
3. Choose a desired GeoBASIC executable (extension .gba) and press the „Open“ button.

If the application could be loaded successfully, it can be executed by choosing the menu item (or in the special case of a code program the CODE button in MEAS-mode), which has been added by the Install routine of the application. There is also a more flexible possibility to install the application via a user (definable) configuration. Refer to Chapter 9.3.2 for more information.

If the menu item “Load Basic Application …” is disabled (grey) then make sure no GeoBASIC application is running and maybe it’s necessary to press once or twice the ESC button of the TPS simulator.

5.4 CONFIGURATION OF THE SIMULATOR

The simulation is configurable via the „Configuration“ menu of the simulation main window. Here, the beep may be toggled using the „Beep On“ entry. A check mark left to the „Beep On” indicates whether it is turned on or off. The „Instr. Connection …“ entry opens a dialog to configure the communication parameters for GeoCOM mode and to switch between GeoCOM and SWTheo mode as shown in the following figure.

Paths can be set for text management, GSI data, code list, GeoBASIC programs and configuration data in the dialog opened by the „Data Path“ menu entry.

It is highly recommended to set the paths, if they are not already set, to the following values:

Path	**Recommended value**
Language Files	`TPS1100Tools\TextDB`
GSI and Log Files	`TPS1100Tools\GSI`
Internal Code List	`TPS1100Tools\CodeList`
External Code List	`TPS1100Tools\CodeListPcCard`
Basic Programs Path	`TPS1100Tools\GBSamples`
Configuration Data Path	`TPS1100Tools\Config`

5.5 GEOCOM MODE

5.5.1 Running the simulation in GeoCom mode

To switch to and run in GeoCOM mode follow this procedure:

1. Switch off simulation by single clicking under the down cursor of the TPS1100 window if not already off.
2. Verify that a serial link between PC and theodolite is established.
3. Switch off hardware theodolite if not already off or switch into GeoCOM online mode.
4. Select the appropriate communication parameters and „GeoCom“ in „Instr. Connection …“ dialog (see above) of the simulation. Confirm with the „OK“ button.
5. Start the simulation again using the „ON“ button of the TPS1100 window.

The simulation now tries to communicate with the theodolite. If a connection can be established, and the port you have chosen was „COM1“, the title of the TPS1100 window will be „TPS 1100 <running, GeoCom on com1:>“.

Otherwise a dialog enables the user to choose whether other communication configurations should be tested or not. Notice that this may take up to one minute.

If no connection could be established, the SWTheo is activated instead of GeoCOM after displaying a message box.

5.6 SWTHEO MODE

The software theodolite (Virtual Theodolite, SWTheo) is an emulation of a (hardware) theodolite. Its properties may be accessed via the „Meas Data Input…“ entry in the „Configuration“ menu while the simulation is running in SWTheo mode. Otherwise this menu entry is disabled.

5.6.1 Running the simulation in SWTheo mode

The procedure for switching to and running the simulation in SWTheo mode is as follows:

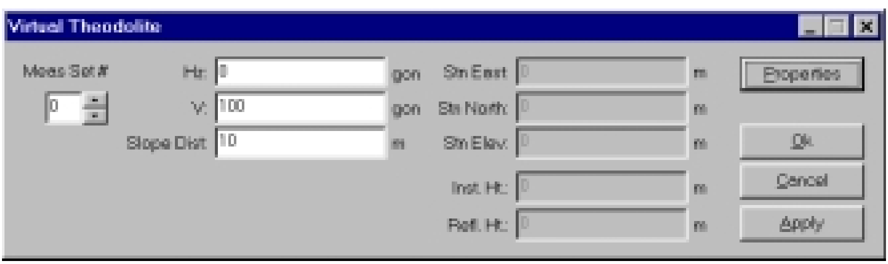
1. Switch off the simulation by single clicking under the down cursor of the TPS1100 window if it is not off already.
2. Open the GeoCOM dialog via the „Configuration“ menu.
3. Disable the GeoCOM enable box. Confirm with the „Ok“ button.
4. Start the simulation using the „ON” button in the TPS1100 window.

5.6.2 User Interface

There are two dialogs to access the SWTheo from the simulation. The first one is called SWTheo dialog with the caption „Virtual Theodolite“ contains fields to change raw sensor data of the SWTheo as well as station data. This dialog is opened from the “Configuration” menu as stated above. The second dialog called SWTheo properties dialog (caption „Virtual Theodolite Properties“) may be triggered from the SWTheo dialog.

5.6.2.1 SWTheo Dialog

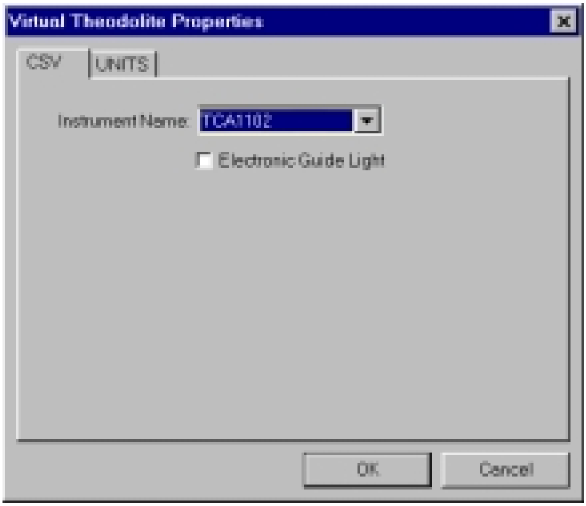
The dialog acts as the connection between the SWTheo and its virtual environment. Here, horizontal angle (Hz), vertical angle (V), and slope distance (Dist) to a virtual reflector as well as station data (N0, H0, E0), reflector (Hr) and instrument height (Hi) may be set. User input has to be confirmed using the “Set Data” button to take effect. Pressing the “Properties” button opens the Subsystems dialog.



Notice also that it is possible to define several sets of values. Choose a set by selecting the corresponding number off the measurement set. The values will be stored until they are changed.

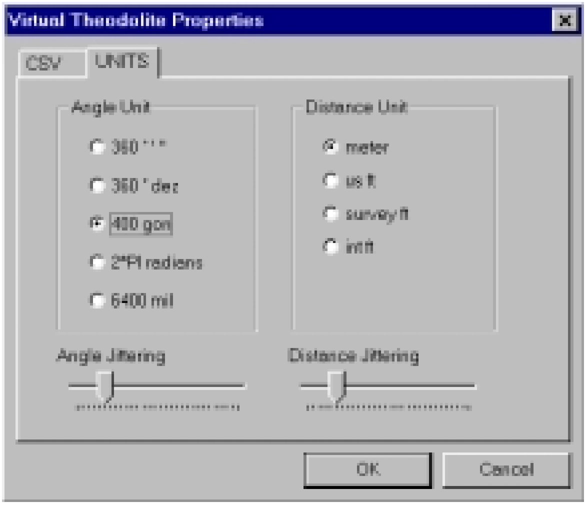
5.6.2.2 SWTheo properties dialog

The SWTheo properties dialog is a tabbed dialog as shown below. Here you can set some basic values.



The „Units“ tab depicted in the last figure enables the user to choose between several display units for the SWTheo dialogs. Please notice these values do not change the settings of the simulation.

“Jittering” is supported for angles and distances. This functionality is applied by alternately adding and subtracting random values in a range depending on the angle and distance sliders, respectively. The jittering amplitude increases from left to right position of the slider. If the sliders are in their leftmost position, there is no jittering applied to the virtual sensor data.



5.7 COMMONLY ASKED QUESTIONS AND ANSWERS

Q:

After starting the simulation and turning on in SWTheo mode , the text „xxx“ will be displayed as the title of some or all of the function buttons. How can I avoid this problem?

A:

Some or all of the text data base files are not contained in the directory referenced by „Text Management Data Path“. Use the „Data Paths“ entry of the „Configuration“ menu to set it accordingly.

Q:

After loading a GeoBASIC program, the expected menu item does not appear in the dialog. What did I wrong?

A:

The menu manager needs an event to reread the menu definition. Press the ESC key to rebuild the menu.

6 ADDITIONAL DEBUGGING FUNCTIONS

There are a few additional features, which may be helpful while debugging the program.

For the simulator:

- The command `Write` writes the given argument to the debug window. This will have no effects on the TPS.
- The same is valid for `Send`, because it will be redirected to the debug window. But, of course, on TPS it will send data over the data link.
- If an error occurs then a message will be written to the debug window, showing the error code and the name of the system routine, which caused the error.

For the simulator and the TPS:

- `MMI_PrintStr` can be used to display and track results and errors.

See also the list of return codes in the appendix of the Reference Manual.

7 MULTIPLE LANGUAGE SUPPORT

The TPS 1100 series system software supports internationalisation in such a way that text fragments are handled extra to an application. Accessing these fragments will be done internally by tokens. GeoBASIC supports this technique in certain system calls. Anytime a system routine is called which needs a `_Token` instead of a string then this token will be added to the text token database. The compiler handles this automatically for the programmer and produces the already mentioned `lng`-file.

This text token database is the basis for supporting multiple languages. With the Text Utility you can produce new text token databases (`mxx`-files) in other languages. Loading the derived `lxx`-files on the TPS system for enabling the user to choose between the provided languages. (‘`xx`’ stands for the language abbreviation.)

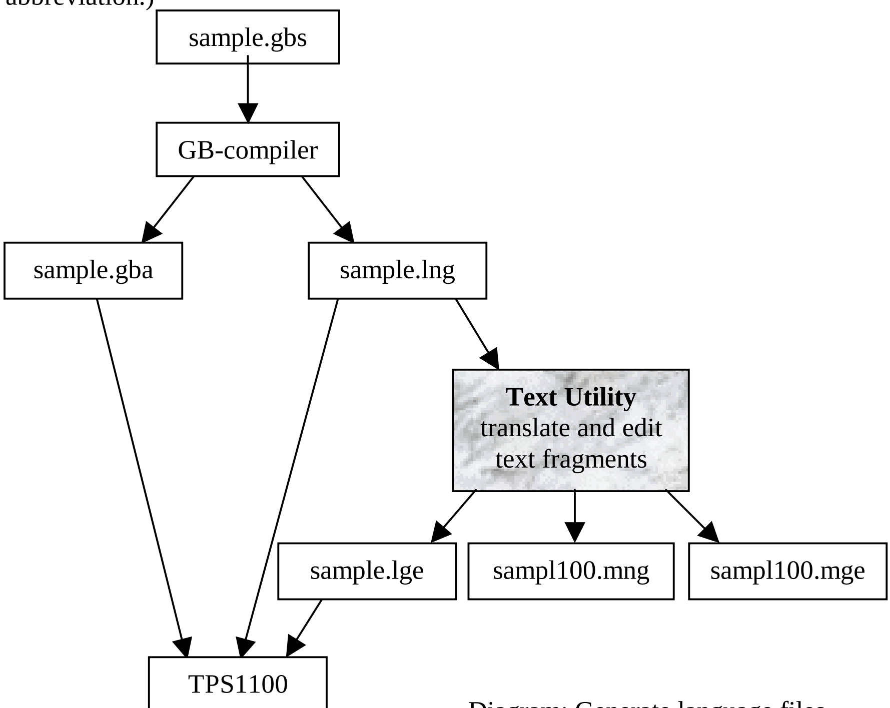


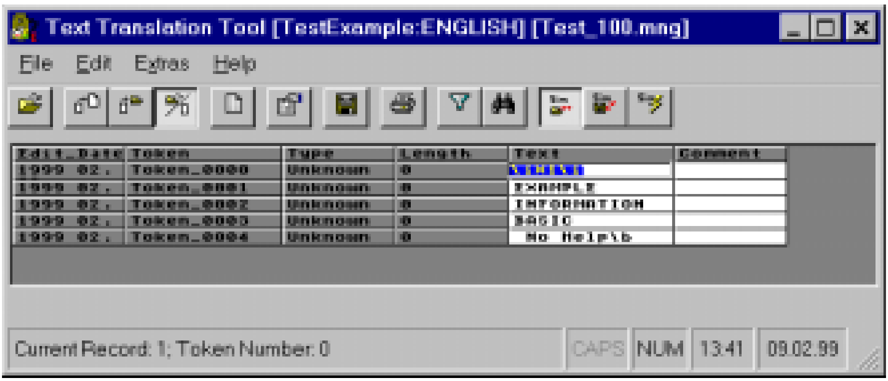
Diagram: Generate language files.

Strings which are not passed to a `_Token` parameter can not be handled with the Text Utility. They are hard coded into program object code. The only way to internationalise them is to use `MMI_GetLangName` to select an appropriate text string in GeoBASIC code separated by a conditional statement.

See sample file "`language.gbs`".

7.1 TEXT UTILITY

The TPS1100/1000 Text Utility (Text Translation Tool) supports GeoBASIC text files. This section describes the most important steps of generating multiple language files. The following picture shows the Text Utility after the import of a GeoBASIC text file:



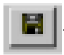
7.1.1 Generating new language files

For creating a multiple language application, the following steps are necessary:

1. After starting the Text Utility press the -button, select GeoBASIC Text Files (*.l??) in the choice list "File of type:" and open the generated `*.lng` file (i.e. `sample.lng`). Answer the question "Do you want to convert this file?" with YES. In the next dialog you can specify the path and the version of the text database which is generated from the `*.lng` file (i.e. `sampl100.mng`). The version is automatically included at the end of the file name. Press OK to start the conversion.
2. Press the -button, select a language in the choice list "New language", enter the path of the new language database and press OK to start the

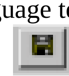
generation of the new language database (i.e. `sampl100.mge`). Now translate the text in column “Text”.

Note	Do not edit the first token with the text “i\X1\i”. This string is needed by the GeoBASIC Interpreter. Also the special strings for MMI_INVERSE_ON (“\aR+\a”) and MMI_INVERSE_OFF (“\aR-\a”) must be left unchanged.

After the translation press the -button, select the path and enter the name of the loadable language file and press OK to start the generation of the file (i.e. `sample.lge`).

7.1.2 Updating translated language files

After changing the GeoBASIC source file and re-compiling it, the following steps for updating the translated language files are necessary:

1. Press the -button again and open the generated `*.lng` file (i.e. `sample.lng`). The version of the text database which is generated must be increased (i.e. `sampl101.mng`).
2. Press the -button and open the target language you want to update (i.e. `sampl100.mge`). Edit the target language text column (indicated with T1). After updating the whole column press -button to generate the new loadable language file.

8 TYPICAL GEOBASIC PROGRAMMING

In this chapter some advice is given on how to program in GeoBASIC. The main attention is given to the user dialog — which is probably the most theodolite-specific part in GeoBASIC programming (besides using the system functions). Afterwards a proposal for naming conventions for GeoBASIC identifiers is given.

Note	To make programs easy and intuitive to use, the programmer should follow the given "standards" rather strictly. Moreover (s)he should have a basic understanding of the way how topographical surveying and mapping is actually performed.

8.1 THE TEXT DIALOG

8.1.1 The objects of the text dialog

The following text dialog is not a practical example, it shows only the most important text dialog objects:

Dialog line	**Object name**
<BASIC\ Text Dialog Objects>	Caption line: It is composed of the short caption ”BASIC” and the caption ”Text Dialog Objects”.
<I am a text dialog object.>	String
<10587>	Integer value

<90478.568>	Double (floating point) value without unit
<50.000 g>	Double (floating point) value with unit: If the type of the double value is `Angle, Distance, Subdistance,` ect. the according unit is printed automatically
<List Item 1 ▼ >	List: It is for selecting an item among several with the cursor keys
<CONT>	Button: The buttons inform the user about the functionality of the function key (F1..F6).

8.1.2 Creating a text dialog

A new text dialog is created by `MMI_CreateTextDialog`.

```
MMI_CreateTextDialog(6, "BASIC", "Text Dialog Objects",
                     "My help text.")
```

A text dialog with a short caption, here "`BASIC`", and a caption "Text Dialog Objects" is created. There is a total of 27 characters for the three parts, i.e. short caption, separation character ('\' printed automatically) and caption. 6 lines (start counting from the first line below the caption – which is 0 – up to line 5) can be used. All lines are empty after the creation. The help text is set to "`My help text.`" — it is shown when the user presses Shift-F1 and the help functionality of the theodolite is enabled.

8.1.3 Representation of the dialog objects

For every input and output the position on the display must be specified. The display is organized in lines and columns. The left upper position has line and column number 0. The line number is rising down and the column number is rising to the right. A display line is 29 characters wide. At most 6 lines are visible at any time, if the dialog contains more lines (up to 12 are possible) it is scrolled when necessary.

For floating point input/output a kind (for instance horizontal angle, distance, etc.) can be specified. Data is automatically transformed to the unit associated to the

kind according to the theodolite settings. Unit conversions are done by the system, all values with units defined in basic are considered to have to SI units. (See Chapter 9.1)

All numeric output appears right aligned in their field (specified by coordinates and length). String output appears left aligned.

Each input/output routine needs a parameter `lValid` which defines if the value of the object is valid or not. If a value is not valid five dashes are displayed instead of the value.

Every numeric input/output needs a parameter `iLen` which determines the total character length of the field. If the length is to short for the representation of the numeric value, the field will be filled with the character ‘x’.

8.1.4 Output in text dialog

- Strings:
  ```
  MMI_PrintStr(0, 0, “I am a text dialog object.”, TRUE)
  ```
  Parameters: column, line, string, lValid

- Integer values:
  ```
  MMI_PrintInt(10, 1, 10, 10578, TRUE)
  ```
  Parameters: column, line, iLen, integer value, lValid

- Double (floating point) values without unit:
  ```
  MMI_PrintVal(10, 2, 10, 3, 90478.568, TRUE,
               MMI_DEFAULT_MODE)
  ```
  Parameters: column, line, iLen, decimals, double value, lValid, Mode

- Double (floating point) values with unit:
  ```
  DIM hz AS Angle
  hz = PI/4
  MMI_PrintVal(10, 3, 8, 3, hz, TRUE, MMI_DIM_ON)
  ```
  Parameters: column, line, iLen, decimals, double value, lValid, Mode

8.1.5 Input in text dialog

Input is roughly dual to the output, except that the input functions return the button id of the button that terminated the edit process. For all numeric values there are the minimum and maximum values defined. The value is only valid, if it is between them.

- Strings:
```
MMI_InputStr(17, 3, 10, sInput, lValid, iButtonId)
```
  Parameters: column, line, string variable, lValid, button
- Integer values:
```
MMI_InputInt(24, 4, 4, 100, 200, iValue, lValid,
             iButtonId)
```
  Parameters: column, line, iLen, minimum value, maximum value, integer variable, lValid, button
- Double (floating point) values without unit:
```
MMI_InputVal(19, 4, 8, 2, 0, 399.99, MMI_DEFAULT_MODE,
             dValue, lValid, iButtonId)
```
  Parameters: column, line, iLen, decimals, minimum value, maximum value, mode, double variable, lValid, button
- Double (floating point) values with unit:
```
MMI_InputVal(19, 4, 8, 2, 0, 399.99, MMI_DIM_ON,
             dValue, lValid, iButtonId)
```
  Parameters: column, line, iLen, decimals, minimum value, maximum value, mode, double variable, lValid, button

- List: Lists take a variable of a predefined type as parameter.

  ```
  TYPE ListArray (25) AS String30 END
  ```

  This definition determines the maximum number of entries in a list to be 25, each one is a string of type String30. We create a list with 4 items and use the second entry as default (initial selection).

  ```
  DIM aList    AS ListArray
  DIM iIndex  AS Integer

  aList(1) = “List Item 1”
  aList(2) = “List Item 2”
  aList(3) = “List Item 3”
  aList(4) = “List Item 4”
  iIndex = 2
  MMI_InputList(8, 4, 12, 4, MMI_DEFAULT_MODE, aList,
                iIndex, lValid, iButtonId)
  ```

  Parameters: column, line, iLen, number of items, mode, list variable, index, lValid, button

8.2 THE GRAPHICS DIALOG

8.2.1 Positioning on the display

Every graphics function needs the position on the display. The graphics display is organized in x- (horizontal) and y-pixels (vertical). The left upper position has x-pixel and y-pixel number 0. The x-pixel number is rising to the right and the y-pixel number is rising down. The size of the display is 232 times 48 pixels.

8.2.2 Creating a graphics dialog

Calling MMI_CreateGraphDialog creates a new graphics dialog.

```
MMI_CreateGraphDialog("BASIC", "Graphics Dialog",
                      "My help text.")
```

A graphics dialog with short caption "BASIC" and caption "Graphics Dialog" is created. The help text is set to "`My help text.`" — it is shown when the user presses Shift-F1 and the help functionality of the theodolite is enabled.

8.2.3 Graphics functions

After having created the graphics dialog, the graphics functions may be used. (E.g. `MMI_DrawLine`, `MMI_DrawCircle`, `MMI_DrawText`, etc. See the "Reference Manual" for a detailed description.)

8.2.4 Deleting a dialog

When a dialog is not used any more it must be deleted. The name of the dialog deletion procedure is for text, measurement and graphics dialogs the same:

```
MMI_DeleteDialog()
```

8.2.5 Mixing text and graphics dialogs

There can be only one text dialog at a time, i.e. an existing text dialog must be deleted with `MMI_DeleteDialog` before a new one can be created with `MMI_CreateTextDialog`.[1] The same holds for a graphics dialog (with the appropriate creation procedures).

But a graphics dialog may be opened while a text dialog is active. (Note: The reverse is not the case: a text dialog may not be opened while a graphics dialog is open.) If a text dialog and a graphics dialog are open, the graphics dialog has priority, i.e. all future function calls are related to the graphics dialog (until it is closed). For example, `MMI_AddButton` (see below) will add the button to the graphics dialog, and all the display functions must be for graphic dialogs (such as `MMI_DrawCircle`, etc.).

8.2.6 Adding buttons

The user may add buttons to a dialog. (These buttons will be added to the *defined buttons* of the dialog.) When adding a button it must be specified what text should be displayed for that button. Such a text can be up to five characters long and is displayed centred above the button.

Each button has an identification associated. This button id is needed

[1] An existing text dialog is deleted automatically if a new text dialog is created.

- for specifying which button is to add in `MMI_AddButton`, and
- checking what button was pressed or that is returned from a system function.

Example:

We add the F1-button to the currently opened dialog, giving the meaning "`CONT`" to it.

```
MMI_AddButton( MMI_F1_KEY, "CONT" )
```

Note	The button id's are defined as constants in the compiler.

8.2.7 Responding to buttons

There are two procedures for coping with button presses:

- `MMI_CheckButton` queries whether there was a button pressed or not, and
- `MMI_GetButton` retrieves a pressed button. If there was no button pressed it waits until one is pressed. The second parameter to `MMI_GetButton` (the in-parameter `bAllKey`) determines what buttons are accepted:
  – If it is `TRUE`, any button is accepted.
  – If it is `FALSE`, only ESC, or a defined button (added with `MMI_AddButton`) are accepted.

Example:

The example does some work in a loop until Shift-F6 is pressed. As long as there is no button pressed, the display is constantly updated (e.g. the current angles from the theodolite are displayed). If there is a button pressed, this button is handled.

```
'bDone must be initialized
bDone = FALSE
DO WHILE NOT bDone     'as long as the job is not done
   'check for defined buttons and get its id
   MMI_GetButton( buttonId, FALSE )
   SELECT CASE buttonId       'handle it
   CASE MMI_F4_KEY
      'handle MMI_F4_KEY
   CASE MMI_SHF6_KEY
      bDone = TRUE            'that’s it,
                              'terminate loop
   CASE '…
      'here go the other handled keys
   ELSE
      'here go the unhandled keys
   END SELECT
   'update the display
LOOP
```

8.2.8 Standard key binding

It is clear that for the user it is important that the same name[2] — and moreover the same key — always has the same meaning associated (at least conceptually). An exception is the F1-key, its meaning is not the same in a measurement dialog and in a configuration dialog. In the following table there are the standard key bindings with the caption, the text which is displayed above the keys:

Key	**Caption**	**Action**
F1 in measurement dialog	ALL	Does first DIST, then REC. (See below)
F1 in configuration dialog	CONT	Continues to the logically following dialog.

[2] For instance, the user of a LEICA theodolite assumes that DIST takes the distance (with the common dialogs), ALL does DIST and then REC, etc.

Key	**Caption**	**Action**
F2	DIST	Start distance measurement.
F3	REC	Records the previously measured / computed data.
SHIFT-F1	HELP	Displays a help text if the theodolite help functionality is enabled. This key is provided and handled completely by the system, it is not accessible from GeoBASIC.
SHIFT-F6	QUIT	Terminates an application.
ESC		Cancels an input or goes a step back. GeoBASIC applications should handle it.
CODE		Shows the coding dialog.

8.3 NAMING CONVENTIONS

We propose some naming conventions for GeoBASIC. More extensive conventions can be found in the naming conventions for Microsoft Access (which are tied closely to Visual Basic conventions).[3]

8.3.1 Variable names

Variable names of simple types (i.e. all the scalar types and strings) may be *tagged* to indicate their type. Prefixes are always lowercase so your eye goes past them to the first uppercase letter — where the *base name* begins. If the base name consists of more than one word, upper case letters within the name are used to distinguish its parts.

Note	These naming conventions carry only a semantics for the programmer, not for the compiler.

[3] See "Naming Conventions for Microsoft Access, the Leszynski/Reddick Guidelines for Access", Microsoft Development Library 1995.

The **base name** succinctly describes the object. For example, `PointNumber` or just `PointNo` for the number of a point. Object **tags** are short abbreviations and simplifications describing the type of the object. For example, the tag '`i`' in `iPointNo` denotes that the type of the variable is `Integer`. The following table lists the tags for the GeoBASIC types.

type	**tag**
`Integer`	`i`
`Logical`	`l`
`Double`	`d`
`Distance`	`d`
`Subdistance`	`d`
`Angle`	`d`
`Pressure`	`d`
`Temperature`	`d`
`String`	`s`

Note that all types which represent floating point numbers are tagged by '`d`'. This is because operations valid for the type `Double` are also valid for the other `d`–tagged types.

If there are several similar object names, a **qualifier** may follow the name and further clarify it. For example if we kept two special point numbers, one for the first point and one for the last, the variable names would be the (qualified) variables `iPointNoFirst` and `iPointNoLast`.

Structure types do not have a default prefix, if needed the (abbreviated) type name could be used. For *arrays* the base name itself could contain the information that the variable names an array.

For *global variables* an additional prefix '`g`' might be useful.

8.3.2 Constants and user-defined types

Constants begin with an upper case character. If constants contain only upper case characters (as most of the predefined constants do) the underscore '_' is used to separate parts of the name. Often constants can be grouped together, then a prefix is used to denote their common criterion. For example the return codes use RC, as in `RC_OK, RC_ABORT`, etc.

Mostly constants are globally defined. For *local constants* an additional prefix `'loc'` might be useful.

User defined types begin with an upper case character. Use the postfix '`_TYPE`', `'_Type'` or '`Type`' (according to the naming convention used for the type name itself) appended to the type name to denote that it is a type structure. Alternatively, you can use a prefix '`T`'. (For types these conventions are useful since GeoBASIC is not case sensitive. Hence, for example, if there is a type `Date` no variable can be named `date`. If the type has the name `TDate` or `Date_Type` or `DateType`, there can.) As for local constants, *local types* might be prefixed with `'loc'`.

8.3.3 Procedures

A procedure name begins with an upper case letter and succinctly describes the action that is performed. Variables that denote parameters passed to a function or subroutine (in the parentheses after the function/subroutine name) should be well documented, also indicating whether they act as *input*, *output*, or *input and output* parameters.

8.3.4 Keywords

GeoBASIC keywords are all in upper case letters. For example, `DIM`, `FOR`, `LOOP`, `FUNCTION`, etc.

8.3.5 Labels

For error labels (ON ERROR GOTO) we use the function/subprocedure name with the qualifier `'_Err'` appended.

```
SUB LabelExample ()
   'code of the procedure

LabelExample_Err:
   SELECT CASE ERR
      'handle specific errors here
   CASE ELSE
      'generic error handler here
   END SELECT
END LabelExample
```

8.3.6 Remark on naming conventions

Naming conventions never replace the judicious use of comments in your GeoBASIC program code. Naming conventions are an extension of, not a replacement for, good program-commenting techniques.

Formulating, learning, and applying a consistent naming style require a significant initial investment of time and energy. However, you will be amply rewarded when you return to your application a year later to do maintenance or when you share your code with others. Once you implement standardised names, you will quickly grow to appreciate the initial effort you made.

To complete the discussion about naming conventions, we mention the use of program headers:

In every function/subprocedure there should be a header describing, at a minimum, purpose, and parameters passed and/or returned. (In addition there might be comments, the author's name, last revision date, notes, etc.)

9 REFINED GEOBASIC CONCEPTS

In GeoBASIC several concepts are implemented to utilise and standardise programming and applications.

9.1 UNITS

Working with units always gives rise to the problem that different users want to work with different units. In geodesy, take the vertical angle as an example: some surveyors measure in Gon, some in radians, others in percentages. And, in addition to the unit-problem, there is the question where to fix the zero point of some scale. Again for the vertical angle example: some surveyors want to have zenith angles, some nadirs, some something in between.

To cope with this situation there is a fine automatic unit handling system built in the theodolite system, and the GeoBASIC programmer can take full advantage of it. All that has to be done in a GeoBASIC program, is to keep all values in SI units and, when a value has to be displayed specify what kind of value it is: a horizontal angle, a vertical angle, a distance, a temperature, etc. All the formatting, together with choice of the right representation (the user may define this in his theodolite system configuration with which the GeoBASIC programmer is not concerned), and displaying the unit after the value are handled automatically. (Of course the programmer can also decide *not* to use this automation and handle everything on his own. But values obtained from the system will be in SI units anyway.)

9.1.1 What the GeoBASIC programmer has to do

- Use SI units throughout the program. All computations are done with values in SI units.
- When displaying, specify the correct data type i.e. `Distance` for the value is displayed. See description of the `MMI_PrintVal` function in the "Reference Manual".

We will give an example of measuring an horizontal angle, computing the difference to a given angle, and displaying the difference on the display. (Note that we use the `GetAngleHz` routine from the `MeanHz` program (see 10.1), and we assume that a text dialog has been opened properly. The angle difference is normalised to the range 0 to $2\times\pi$.)

Example

```
DIM dHz1       AS Angle     'first horizontal angle
DIM dHz2       AS Angle     'second horizontal angle
DIM lValidHz2 AS Logical   'indicator if second
                            '  angle is valid
DIM dDiffHz    AS Angle     'the difference of the
                            '  angles

'assume dHz1 is initialized here to an angle
'in radians

GetAngleHz( dHz2, lValidHz2 )

dDiffHz = dHz1 - dHz2
GM_AdjustAngleFromZeroToTwoPi( dDiffHz )

MMI_PrintVal( 20, 0, 8, 3, dDiffHz, lValidHz2,
              MMI_DIM_ON )
```

The output is as follows:

- If the `GetAngleHz` routine returned a valid angle, also the difference `dDiffHz` will be valid (this is why `lValidHz2` is used in the `MMI_PrintVal` function). In this case the angle will be formatted in an 8 character wide field with 3 decimals, afterwards the unit according the theodolite system configuration will be displayed.
  Assume that `gon` is set and the angle difference was 1.5473452 radians, then at position 20 in line 0 the output will be « `  98,507 g`».
- If the angle returned from `GetAngleHz` was not valid, five dashes will be displayed « `   ----- g`».

9.1.2 What the user/surveyor has to do

The user has to set up the units, in which he want to work, in the theodolite system configuration. All outputs that use the theodolite system will automatically be formatted according to this setting.

9.2 THE USER MEASUREMENT DIALOG

The User Measurement Dialog (sometimes referred as MDlg) standardises the visualisation of the measurement values in GeoBASIC. Each value (i.e. vertical angle, horizontal distance) has a predefined output format. Thus the GeoBASIC

programmer has only to define, on which line a value should be displayed. All lines begin with a brief description of the value.

For example (Output of the horizontal distance):

```
«Horiz.Dist:     158.287 m»
```

Additionally the measurement parameters and (self-definable) application parameters can be displayed in the measurement dialog. Thus a user is able to change measurement parameters immediately and without leaving the dialog. All measurement values and measurement parameters are saved in the theodolite's data pool as system parameters.

We distinguish between measurement and application parameters. The former are defined by the system in it's meaning and data type. The letter can be defined freely by the user. Please refer to Appendix H in the reference manual for a list of all system and application parameters, which can be used in a measurement dialog.

9.2.1 Configuration of the User Measurement Dialog

Before using the measurement dialog we have to define its contents. There are 3 types of possible entries:

- System parameters:
  The routine `GSI_SetLineMDlg` places a system parameter (measurement value or measurement settings) on a line.
- Pure text line:
  The routine `GSI_SetLineMDlgText` places any text on a line.
- Application parameters:
  The routine `GSI_SetLineMDlgPar` places a (self-definable) application parameter on a line.

Note	The user measurement dialog configuration is automatically initialised with the entries of the first system measurement dialog.

Thus all lines which are not configured by the GeoBASIC programmer shows the same parameters as the first system measurement dialog. For further explanations how to configure the user measurement dialog read the description of the 3 system functions (`GSI_SetLineMDlg`, `GSI_SetLineMDlgText`, `GSI_SetLineMDlgPar`) in the reference manual.

9.2.2 Creating the User Measurement Dialog

After the definition of the content GSI_CreateMDlg analogous to the creation of a text dialog creates the user measurement dialog. For adding buttons to the dialog use `MMI_AddButton`.

9.2.3 Executing the User Measurement Dialog

In the following example a measurement dialog is created with the horizontal angle on line 2 and the buttons “DIST” on F2-key and “QUIT” on SHIFT-F6-key. All other lines are predefined by the system. After the creation of the dialog the measured values will be updated in a loop:

```
'Change line 2
GSI_SetLineMDlg(2, GSI_PAR_AngleHz)
GSI_CreateMDlg (2, "MEAS", "Measurement Test",
                "Measurement Help...")
'Addition of buttons
MMI_AddButton(MMI_F2_KEY, "DIST")
MMI_AddButton(MMI_SHF6_KEY, "QUIT")
lDone = FALSE
DO WHILE NOT lDone
  GSI_UpdateMeasurement(TMC_AUTO_INC, WAITTIME,
                        lRecValid, iCode, FALSE)
  GSI_UpdateMDlg(iButton)
  SELECT CASE iButton
  CASE MMI_F2_KEY
    'DIST Button --> meas a distance and angles
    BAP_MeasDistAngle(iDistMode, dHz, dV, dDist, TRUE,
                      MEAS)
  CASE '..
    'handle other keys
  CASE MMI_ESC_KEY, MMI_SHF6_KEY
    'done --> exit this routine
    lDone = TRUE
  END SELECT
LOOP 'end measurement loop
'delete measurement dialog
MMI_DeleteDialog()
```

The routine `GSI_UpdateMeasurement` updates the measurement values in the theodolite data pool. `GSI_UpdateMDlg` updates the user measurement dialog with the new values and returns the pressed button. For further explanations read the description of these system routines in the reference manual.

If the user measurement dialog is not used any more it must be deleted with `MMI_DeleteDialog`.

See the example program MEAS.GBS for a typical usage of the user measurement dialog.

9.2.4 Mixing the User Measurement Dialog with Other Dialogs

There can be only one user measurement dialog at a time, i.e. an existing user measurement dialog must be deleted with `MMI_DeleteDialog` before a new one can be created with `GSI_CreateMDlg`. If a user measurement dialog is active, no text dialog can be opened and vice versa.

But a graphics dialog may be opened while a user measurement dialog is active.

Note	The reverse is not the case: a user measurement dialog may not be opened while a graphics dialog is open. If a user measurement dialog and a graphics dialog are open, the graphics dialog has priority, i.e. all future function calls are related to the graphics dialog until it is closed.

9.3 TPS1100 CONFIGURABILITY

In general, each part of an application, which should be accessible from outside, has to be of the form ‘`GLOBAL SUB`’. These points are known as entry points and can be used in two ways. First they can be linked to a menu item (of the a system), and second they can be described as configuration item.

9.3.1 Adding the program in a System Menu

The easier way to access an entry point of an application is to link it to a menu item during the installation phase. Please refer to the Reference Manual `MMI_CreateMenuItem` for further explanations.

9.3.2 Import the program in a User Configuration

The TPS1100 series theodolites support the concept of individual configurations. In a configuration the user can define his own dialogs or menus and link them to certain events (i.e. pressing the PROG key or Power ON). If the event occurs then the linked dialog or the menu will be displayed. The user can create and change his configuration on the PC with the Customisation Tool.

The import of a GeoBASIC program in a user configuration means, that an external GeoBASIC routine is linked with an item of a user defined menu, a button of a user defined dialog or directly with an event. If either the event occurs or the button is pressed or the menu item is selected, then the linked external routine is executed. For the import of a GeoBASIC program the Customisation Tool needs a special file named APPInfo-file with the necessary information about the program.

The usage of the APPInfo-file in the Customisation Tool:

- Start the Customisation Tool
- Open a configuration file, appropriate text- and definition files
- Choose Import Application from the file menu
- Check the box named with the program name (i.e. AppInfoExample)
- Press the OK button

Now the globally accessible subroutines may be added to menus, buttons, etc. simply by using drag and drop.

Generate the AppInfo-file
The AppInfo-file is automatically generated during compilation, if there is a application information (short AppInfo) section in the GeoBASIC source file.

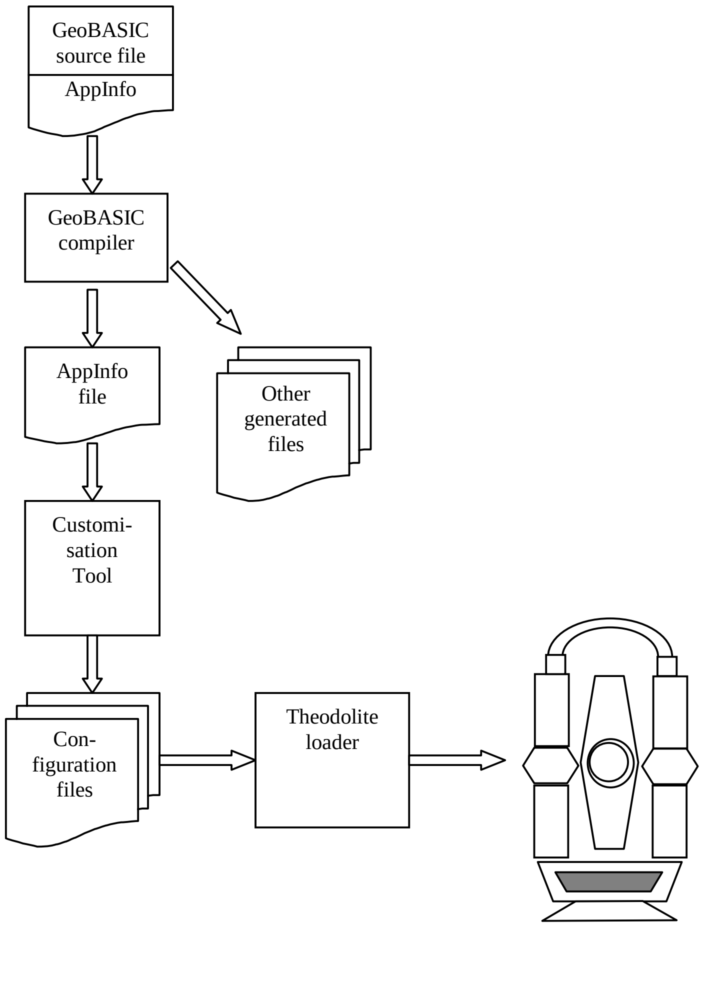
Note	The AppInfo-section has to occur at the end of the source code. The AppInfo-section is optional; if there is no AppInfo-section in the GeoBASIC source file, the AppInfo-file generation is omitted. The global routine "`Install`" is optional, since any global routine may be associated with a menu entry, using the AppInfo-file via the Customisation Tool.

The following GeoBASIC sample code illustrates the usage of the AppInfo-section in a GeoBASIC source file. See also the sample program `AppInfoTest.gbs`.

```
PROGRAM AppInfoExample

'-------------------------------------------------------
GLOBAL SUB GlobalSub1
  Dim dummy As Integer
  MMI_WriteMsgStr("AppInfoExample.", "GlobalSub1 in
                  AppInfoExample called", MMI_MB_OK,
                  dummy)
END GlobalSub1

'-------------------------------------------------------
GLOBAL SUB GlobalSub2
  Dim dummy As Integer
  MMI_WriteMsgStr("AppInfoExample.", "GlobalSub2 in
                  AppInfoExample called", MMI_MB_OK,
                  dummy)
END GlobalSub2

END AppInfoExample

'Application Information for Config Tool
'---------------------------------------
APPINFO

  GENERAL
    SET Author    "Leica AG, CH - Heerbrugg"
    SET Desc      "AppInfo Example Application"
    SET TheoModel "TCA1100"
  END GENERAL

  ENTRYPOINT GlobalSub1
    SET CapLg "Global Sub 1"
    SET CapSh "GSUB1"
    SET Desc  "test of appinfo subroutine 1"
  END GlobalSub1

  ENTRYPOINT GlobalSub2
    SET CapLg "Global Sub 2"
    SET CapSh "GSUB2"
    SET Help  "displays a message and exits"
  END GlobalSub2

END APPINFO
```

The global subroutines `GlobalSub1` and `GlobalSub2` are indicated as entry points for the import in a user configuration. Refer to Chapter 2.11 in the Reference Manual for a description of the syntax in BNF-form.

The following figure depicts the whole scenario, from the generation of the AppInfo file over the import in a user (definable) configuration to the loading of the configuration into the theodolite:



9.4 INTERAPPLICATION-CALL

The inter-application-call makes it possible to call a subroutine in another GeoBASIC program. With this concept the GeoBASIC programmer can use the same subroutine in several programs.

9.4.1 Definition of a subroutine for Interapplication-Call

If a subroutine should be called by another application, it must be defined as a global subroutine.

Example:

```
PROGRAM IAC2
GLOBAL SUB InterAppEntry
  DIM iButton  AS INTEGER
  MMI_WriteMsgStr("Welcome in IAC2","IAC2", MMI_MB_OK,
                  iButton)
END InterAppEntry
END IAC2
```

9.4.2 Call the global subroutine

Before calling the global subroutine, the GeoBASIC programmer has to check with `CSV_LibCallAvailable` if the subroutine is available. That usually means if it is loaded or not. Is the subroutine available, he can invoke it with `CSV_LibCall`.

Example:

```
DIM lAvailable  AS LOGICAL
'Check if global subroutine is available
CSV_LibCallAvailable("IAC2","InterAppEntry", lAvailable)
IF lAvailable
  'available, call global subroutine
  CSV_LibCall("IAC2", "InterAppEntry", "BASIC")
END IF
```

See the example program IAC.GBS and IAC2.GBS for a typical usage of inter-application-call. For further explanations read the description of `CSV_LibCall` and `CSV_LibCallAvailable` in the reference manual.

9.5 SYSTEM FUNCTION CALL

If a theodolite user creates his own configuration on the PC with the Customisation Tool, he has a wide selection of predefined system functions which he can add to menus, buttons, etc. After the loading of the configuration he calls the system functions by selecting the appropriate menu item or button.

The GeoBASIC programmer has the same possibilities. With the routine `CSV_SysCall` he can call the system functions in his programs. Because some system functions do not run on every theodolite type, there is a routine

CSV_SysCallAvailable, which returns if the system function can be executed.

Example:

```
DIM lAvailable AS Logical
CSV_SysCallAvailable(CSV_SFNC_PositCompassDlg,
                     lAvailable)
IF lAvailable
  CSV_SysCall(CSV_SFNC_PositCompassDlg)
END IF
```

If the system function CSV_SFNC_PositCompassDlg can be executed (RCS mode is activ), then the dialog RCS orientation with a compass is displayed. For further explanations read the function descriptions of CSV_SysCall and CSV_SysCallAvailable in the reference manual. In Appendix H of the reference manual there is a list of all system functions.

9.6 SYSTEM EVENT GENERATION

Every configuration for a TPS1100 series theodolite is event driven. The user or the system itself generates an event (e.g. the user has pressed the PROG key or the initialisation sequence is finished) and the configuration functionality executes then the linked action (menu, dialog, macro, application or system function).

A GeoBASIC program can generate all events, which can occur in the theodolite system software, also. To generate a system event the same functions can be used as for calling system functions. The routine CSV_SysCall is used for the generation of system events. The routine CSV_SysCallAvailable returns TRUE, if there is an action linked to the requested event and the action can be executed.

Example:

```
DIM lItemDefined AS Logical
CSV_SysCallAvailable(CSV_EFNC_CompensatorSetting,
                     lItemDefined)
IF lItemDefined
  CSV_SysCall(CSV_EFNC_CompensatorSetting)
END IF
```

If a configuration item is defined for the system event CSV_EFNC_ CompensatorSetting (compensator setting event; usually connected to a compensator setting dialog) CSV_EFNC_CompensatorSetting is generated and the appropriate system function, application, macro, dialog or menu is

executed. For further explanations read the function description of `CSV_SysCall` and `CSV_SysCallAvailable` in the reference manual. In Appendix H of the reference manual there is a list with all system events.

10 GeoBASIC Sample Programs

10.1 MEANHZ — MEAN VALUE OF HORIZONTAL ANGLE MEASUREMENTS

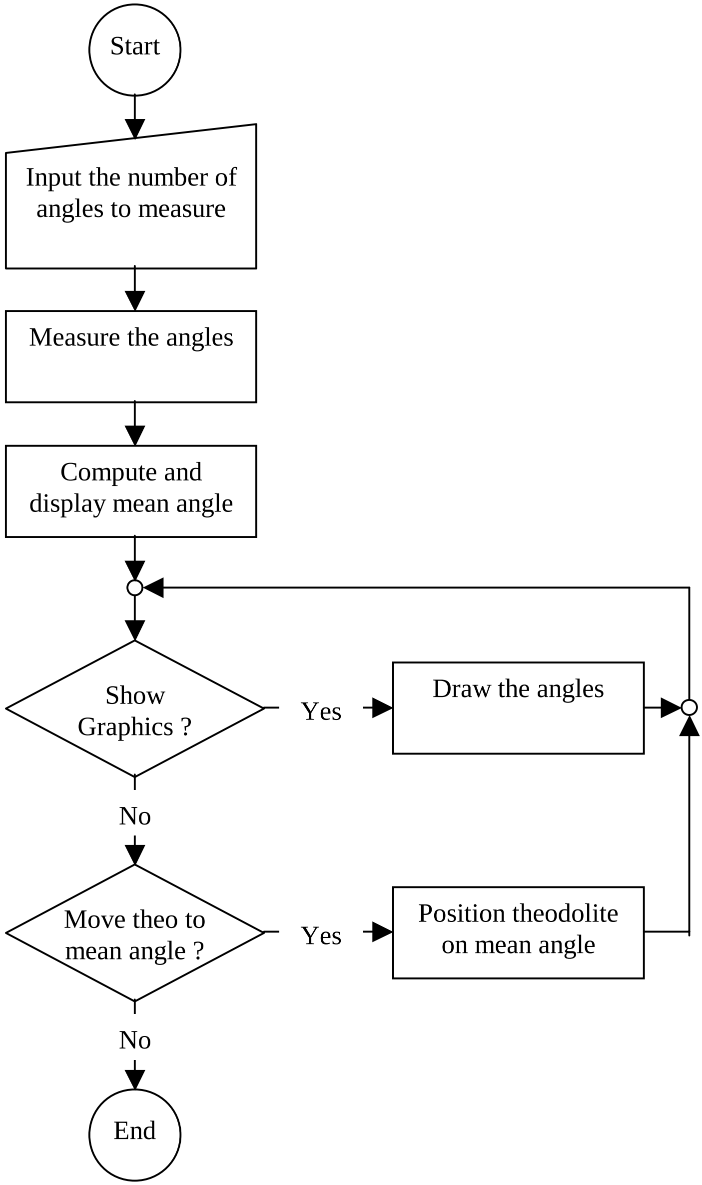
10.1.1 Program description

The program "`MeanHz`" measures a number of horizontal angles and computes its arithmetic mean value. The measured angles and the mean angle can then be displayed graphically.

Program flow:

First, the user may enter the number of horizontal angles he wants to measure. (The number of angles must be within a certain range.) Then the angles are measured — each time the REC key is pressed the current horizontal angle is recorded.

As soon as the requested number of angles is measured, the mean angle is computed and displayed. Now the user has the choice either to display the angles graphically, to move the theodolite to the computed mean angle or to quit the program. (The program can be terminated with the ESC button or the QUIT button on shift-F6 at any time.)


Start
Input the number of angles to measure
Measure the angles
Compute and display mean angle
Show Graphics ?
Yes
Draw the angles
No
Move theo to mean angle ?
Yes
Position theodolite on mean angle
No
End

10.1.2 Source code listing

See example file "meanhz.gbs"

```
PROGRAM Mean
'
' Sample application for building the mean value of angles
' -------------------------------------------------------
' Measures a user defined number of horizontal angles and calculate
' the mean angle. The measured and the mean angle can also be
' displayed graphically.
'
' GeoBASIC 1.0 for TPS1100 Series Instruments
' (c) Leica AG, CH - Heerbrugg 1998
'-------------------------------------------------------------------
' Global Declarations
CONST MaxNoHz       = 9        'Maximum number of angles that can be
                               'measured
CONST CaptionShort  = "MEAN"   'Short caption (displayed lefthand, in
                               'top line)

'Type to store the angles (for graphics)
TYPE DIM
  TAngles (MaxNoHz) AS Angle
END

DIM fId  AS FileId             'File identification

'-------------------------------------------------------------------
-----
GLOBAL SUB Install
'          -------
' Description
'    Adds the program into the theodolite's PROG menu. The program's
'    (application's) name is 'Mean', the global routine to start is
'    'Main' and the program menu item will be named 'MEAN HZ'.

   MMI_CreateMenuItem( "Mean", "Main", MMI_MENU_PROGMENU, "MEAN HZ")

END Install
```

```
SUB RecordValue (dHz As Angle, byVal dMean As Angle)
'   -----------
' Description
'    Writes the value to data link and file.
'
DIM sVal1   As String30
```

```
DIM sVal2   As String30
DIM sOut    As String255

ON Error Resume Next                        'Ignore all errors

  MMI_FormatVal(MMI_FFORMAT_HZANGLE, 10, 2, dHz,   TRUE,
                MMI_DEFAULT_MODE, sVal1)
  MMI_FormatVal(MMI_FFORMAT_HZANGLE, 10, 2, dMean, TRUE,
                MMI_DEFAULT_MODE, sVal2)

  sOut = "hz: " + sVal1 +  "mean: "+ sVal2   'Compute output text

  'Write to data link and file
  Send(sOut)
  Print(fId, sOut)

END RecordValue

'---------------------------------------------------------------------
SUB GetAngleHz ( dHz AS Angle, lValid AS Logical)
'   ----------
' Description
'    Measures the horizontal angle 'valid' indicates if the dHz is
'    valid.
'
' Parameters
'    OUT: dHzOUT, lValid
'
DIM theoAngle   AS TMC_Angle_Type        'The measured values
DIM iInfo       AS Integer               'Return code

ON Error Resume Next                     'Ignore all errors

   'get angle
   TMC_GetAngle( theoAngle, iInfo )

   IF (Err = RC_OK) THEN
     lValid = TRUE
     dHz    = theoAngle.dHz
   ELSE
     lValid = FALSE
   END IF
END GetAngleHz
'---------------------------------------------------------------------
SUB ShowGraphics( byVal iNoPoints AS Integer, angles AS TAngles,
                  byVal dMean AS Angle )
'   ------------
' Description
'    Displays the measured and the mean horizontal angles
'    graphically.
'
' Parameters
'    IN: iNoPoints, angles, dMean
'
DIM iX       AS Integer   'x coordinate
```

```
DIM iY       AS Integer   'y coordinate
DIM iButton  AS Integer   'button id

CONST CX       = 90             'display center x coordinate
CONST CY       = 24             'display center y coordinate
CONST DL       = 20             'length of line
CONST HELPTEXT = "Visualizes the angles with lines from the
                 station. "   +
                 "The computed mean angle is shown by the longer
                 line. " +
                 "The north angle is 0."

  MMI_CreateGraphDialog( CaptionShort, "PICTURE", HELPTEXT )

  'Draw center and circle
  MMI_DrawCircle( CX, CY,  3,  3, MMI_NO_BRUSH, MMI_PEN_BLACK )
  MMI_DrawCircle( CX, CY, DL, DL, MMI_NO_BRUSH, MMI_PEN_BLACK )

  'Draw lines for angles (there are iNoPoints angles)
  DO WHILE iNoPoints > 0

    'compute the line
    iX = INT( DL * SIN(angles(INT(iNoPoints))) )
    iY = INT( DL * COS(angles(INT(iNoPoints))) )

    MMI_DrawLine( CX, CY, CX+iX, CY-iY, MMI_PEN_BLACK )

    iNoPoints = iNoPoints - 1

  LOOP

  'Draw line for dMean
  iX = INT( (DL+4) * SIN(dMean) )
  iY = INT( (DL+4) * COS(dMean) )
  MMI_DrawLine( CX, CY, CX+iX, CY-iY, MMI_PEN_DASHED )

  'Wait for key press and finish dialog
  MMI_AddButton( MMI_F5_KEY, "END" )
  MMI_GetButton( iButton, FALSE )

  MMI_DeleteDialog()

END ShowGraphics

'---------------------------------------------------------------------
GLOBAL SUB Main
'          ----
' Description
'   Reads the number of points to be measured. Measures these points,
'   calculates the mean value and shows the result or moves (if
'   motorized) the TPS tocalulcated position.
'
DIM iNoPoints    AS Integer       'number of points to measure
DIM iCurrNo      AS Integer       'current point number
DIM lNoOk        AS Logical       'TRUE if no of points are valid
```

```
DIM lHzOk        AS Logical       'TRUE if measured hz is valid
DIM dHz          AS Angle         'measured hz
DIM storeHz      AS TAngles       'array of measured angles
DIM dMean        AS Angle         'calculated mean angle
DIM lKeyPressed  AS Logical       'TRUE if button pressed
DIM iButton      AS Integer       'id of pressed button
DIM Family       AS TPS_Fam_Type  'this data structure is used to
store
                                  'information about the system

ON Error Resume Next          'ignore errors

   'check which type of instrument is active and open file
   CSV_GetInstrumentFamily( Family  )
   IF ( Family.lSimulator ) THEN
     Open( "C:\\results.txt", "Append", fId, 0 )
   ELSE
     Open( "A:\\results.txt", "Append", fId, 0 )
   END IF


   'set up dialog and input iNoPoints
   MMI_CreateTextDialog ( 6, "MEAN", "HZ MEAN VALUE",
                         "Compute mean HZ for a number of
                          measurements." )

   ' ******************************
   ' *      read in iNoPoints      *
   ' ******************************

   iNoPoints = 3
   lNoOk     = TRUE
   MMI_PrintStr( 0, 0, "No of points:", TRUE )
   MMI_AddButton( MMI_F1_KEY, "CONT" )
   MMI_AddButton( MMI_SHF6_KEY, "QUIT" )
   MMI_InputInt( 26, 0, 2, 1, MaxNoHz, MMI_DEFAULT_MODE, iNoPoints,
                 lNoOk, iButton )

   'setup rest of dialog
   iCurrNo = 1
   MMI_PrintStr( 0, 1, "Curr. point :", TRUE )
   MMI_PrintVal( 26, 1, 2, 0, iCurrNo, TRUE, MMI_DEFAULT_MODE )
   MMI_PrintStr( 0, 2, "HZ          :", TRUE )
   MMI_AddButton( MMI_F3_KEY, "REC" )

   'init mean value
   dMean = 0.0

   'get iNoPoints points (abort if ESC or QUIT is pressed)
   DO WHILE (iCurrNo <= iNoPoints) AND (iButton <> MMI_ESC_KEY) AND
            (iButton <> MMI_SHF6_KEY)

      MMI_PrintVal( 26, 1, 2, 0, iCurrNo, lNoOk, MMI_DEFAULT_MODE )

      MMI_CheckButton( lKeyPressed )
```

```
    IF lKeyPressed THEN

       MMI_GetButton( iButton, FALSE )

       SELECT CASE iButton
         CASE MMI_F3_KEY, MMI_F1_KEY
            GetAngleHz( dHz, lHzOk )

            storeHz(iCurrNo) = dHz
            dMean            = dMean + dHz

            'if REC pressed record values
            IF iButton = MMI_F3_KEY THEN
               RecordValue(dHz, dMean/iCurrNo)
            END IF

            iCurrNo = iCurrNo + 1

       END SELECT

    ELSE

       'update display
       GetAngleHz( dHz, lHzOk )
       MMI_PrintVal( 20, 2, 8, 3, dHz, lHzOk, MMI_DEFAULT_MODE )

    END IF
 LOOP


 '***************************
 '*      show results       *
 '***************************

 'if execution should procede
 IF (iButton <> MMI_ESC_KEY) AND (iButton <> MMI_SHF6_KEY) THEN

    'setup new buttons
    MMI_DeleteButton( MMI_F1_KEY )
    MMI_DeleteButton( MMI_F3_KEY )
    MMI_AddButton( MMI_F3_KEY, "SHOW" )
    MMI_AddButton( MMI_F4_KEY, "EXIT" )
    MMI_AddButton( MMI_F5_KEY, "GOTOM" )

    'compute mean value
    dMean = dMean / iNoPoints
    MMI_PrintStr( 0, 3, "Mean HZ     :", TRUE )
    MMI_PrintVal( 20, 3, 8, 3, dMean, TRUE, MMI_DEFAULT_MODE )

    DO WHILE (iButton <> MMI_ESC_KEY) AND (iButton <> MMI_SHF6_KEY)
             AND (iButton <> MMI_F4_KEY)

       MMI_GetButton( iButton, FALSE )
```

```
         SELECT CASE iButton

           CASE MMI_F3_KEY
              ShowGraphics( iNoPoints, storeHz, dMean )

           'move theo to the computed mean horizontal angle
           CASE MMI_F5_KEY
              BAP_PosTelescope(BAP_POSIT_HZ, BAP_POS_MSG, dMean, 0,
                               0.1, 0.1)

         END SELECT

      LOOP

   END IF

   'clean up text dialog
   MMI_DeleteDialog()

   'close output file
   Close(fId)

END Main


END Mean
```

10.2 SAMPLE PROGRAMS

These code samples gives you some help for building your first applications. Each of them should give you some hints in a specific problem domain.

- `appinfotest.gbs` This example shows the use of the application information section in the GeoBASIC source file.
- `codefunc.gbs` An example of a program which will be called, when the *Code*-key has been pressed.
- `cursor.gbs` Cursor control in a dialog.
- `error_ha.gbs` This program shows how error handling changes execution of a program.
- `language.gbs` Take this program as an example to support multiple language applications. Two language files and its text databases are provided to see how multilingual support works.
- `meanhz.gbs` This sample shows the calculation of the mean value of horizontal angle measurements, see Chapter 10.1.

• `meas.gbs`	A simple example how to measure with BAP-functions, including Quick-Coding
• `meas_od.gbs`	A simple example how to measure and how to record data in an own data-format, including Quick-Coding
• `stringer.gbs`	This example shows in which situations typical errors may occur.
• `test.gbs`	An empty frame for building up a GeoBASIC application.
• `tracking.gbs`	This program shows possible techniques to take advantage of the measurement facilities.
• `menu.gbs`	A simple menu handler.
• `dirlist.gbs`	This example shows how to get PC card information and how to read a directories content.
• `inclmain.gbs`	This example shows the usage of an include file.
• `iac.gbs`	An example for an interapplication call.

11 PORTING A TPS1000 ORIGINATED PROGRAM

The implementation of the TPS1100 theodolite series includes several new concepts compared to the firmware of TPS1000 theodolites. To follow up these new concepts and to take care of functionality that has been changed or removed in the implementation of TPS1100 firmware, GeoBASIC programs, once developed for TPS1000 hardware, cannot be compiled without changing the source code.

In this chapter we will cover this subject and we try to give some guidelines to help the developer to port the source code onto the new platform. During the design phase of GeoBASIC for TPS1100 systems we took certain care to make the migration as smooth as possible. Although all programs' source code has to be changed, the effort to port it will be for the most applications not that high.

In the very end this means also that the developer has to maintain two source code bases.

11.1 TPS1100 HARDWARE RELATED CHANGES

11.1.1 Display Line Length

The TPS1100 series instruments use a different liquid crystal display. The difference means also that one can use only 29 characters per line. To be 'independent' of the display length we defined the string type `DisplayLine`. It does not contain the string length in the name, hence this should help in future to port applications. To be compatible with older, TPS1000 GeoBASIC programs we did not change all `String30` declarations. Of course only 29 characters will be printed out to the display.

11.1.2 Keyboard

The number of keys has been reduced, there is no `CONT`-Key any longer. Remove all `MMI_CONT_KEY` appearances in the source code. We deleted the definition of this constant to make it more obvious to the programmer that he has to change the source code and think about any button assignments.

11.2 CHANGES TO THE SIMULATOR

Now TPSSim supports GeoBASIC programs larger than 64 KB. A restriction, which turned out in the past, bothered the most of the GeoBASIC program developers. We would like to point out that the SWTheo extension enables the programmer to influence the execution of a program. With specific dialogs the programmer gets the possibility to set or change certain (measurement) values. We hope this helps a lot to simulate a more realistic TPS environment and makes it almost obsolete to have an instrument at your hand to test your application. Of course, still the final test of an application has to be done on an instrument. See also the documentation of TPSSim for further explanations.

11.3 NEW CONSTRUCTS IN GB_1100

Due to some requests we added a few new constructs to GeoBASIC for TPS1100 instruments.

11.3.1 #include Statement

It is now possible to include a GeoBASIC source file in another one. Nevertheless only one level of inclusion is allowed.

11.3.2 MID$ statement

Mid$’s implementation has been extended. Now Mid$ can be used to assign a character or a substring to another string at a certain position. In this way single characters of a string can be set or replaced.

Examples:

```
T = “abcdef”
Mid$(t, 2, 1) = "+"              results in “a+cdef”
Mid$(t, 4)    = "------------"   results in “a+c------------”
```

11.3.3 Application Info

A general concept of configurability has been introduced for the TPS1100 family of instruments. This gives totally new customisation possibilities into the hand of

the developer and more to the customer support. Up to a certain degree GeoBASIC supports this configurability. For example an assignment of a GeoBASIC program to a menu item can be changed by the new configuration utilities. Or it can be assigned to a function key.

To support these new features we extended the concept of the program by a section that describes the attributes of it.

This (informational) section can be appended optionally at the end of the source file. See the extra explanation of it to get further information about it.

11.4 GEOBASIC SOURCE CHANGES

Many GB programs have a similar structure. Therefore it does not surprise that many programs have to be rewritten in the same way to be compilable and executable for TPS1100 GeoBASIC.

11.4.1 General Dialog Changes

The `CONT` key does not exist any more on the TPS1100 instruments. Scan your source code for `MMI_CONT_KEY` and replace it by a function key. The TPS1100 guidelines use `MMI_F1_KEY` normally for the `CONT` key functionality. This might make it necessary to change your function key layout. Look at the existing dialogs to get an idea and to be more consistent to the built-in dialogs, to which function keys which functionality has been assigned.

In certain circumstances, where no function keys were left, the `ESC` key was the only way to leave a dialog. Normally `ESC` leaves a dialog with leaving values untouched.

`MMI_SHIFT_ESC_KEY` will not be supported any more. Instead one has to assign QUIT to (normally) Shift-F6. Quit leaves the whole application.

Note	'Old' versions of constants and functions are left aligned. Newer versions or replacements have been shifted to right. The listed changes are ordered in an assumed importance.

TPS1000	**TPS1100**

`MMI_DeleteGraphDialog()`
`MMI_DeleteTextDialog()`
`GSI_DeleteMeasDlg()`
	replaced by `MMI_DeleteDialog()`

Please notice that GB-TPS1000 supports conceptually 2(3) dialogs at once; a text or a graphics dialog and in parallel a customisable measurement dialog - `MDlg`.

A typical application may create a text dialog and link a graphics dialog to a menu button. Notice, that both dialogs exist at the same time and distinguish this situation from another, where the text dialog will be deleted before the graphical dialog will be created. In the former case one can go back to the text dialog without recreating it. In the latter the text dialog has to be rebuilt. In GB_TPS1100 text and measurement dialog are mutually exclusive.

See the following scheme for a graphical explanation. "()" denotes a dialog.

TPS1000	TPS1100
(Text) and (MeasDlg) | (Graphic) Graphic overrides Text and may have it's own buttons. The other way around is not possible At the same time a MeasDlg may be defined.	(Text or MDlg) | (Graphic) Graphic overrides Text or MDlg. Text and MDlg are mutually exclusive. Only one can be defined at once. All three dialog types may have their own buttons.

Deleted:
`GSI_CreateMeasDlg()`
`GSI_DefineMeasDlg()`
`GSI_DeleteMeasDlg()`
`GSI_GetDialogMask()`
`GSI_SetDialogMask()`
`GSI_UpdateMeasDlg()`
	Replaced by a more general concept – see the reference manual for `GSI_*MDlg-` routines.
	New routines are:
	`GSI_SetLineMDlg ()`
	`GSI_SetLineMDlgPar ()`
	`GSI_SetLineMDlgText ()`
	`GSI_GetLineSysMDlg ()`
	`GSI_SetLineSysMDlg ()`
	`GSI_CreateMDlg ()`
	`GSI_UpdateMDlg ()`

11.4.2 Recording Format Settings

Deleted:
`GSI_GetRecFormat()`
`GSI_SetRecFormat()`
	Replaced by (extended):
	`GSI_GetRecMask ()`
	`GSI_SetRecMask ()`

11.4.3 System Dialog Calls

Replacements for old dialog invocation calls:

`GSI_CommDlg ()`	`CSV_SysCall ( CSV_EFNC_GeoComSetup, Caption )`

`GSI_SelectTemplateFiles()`
and
`GSI_Setup ()`
	`CSV_SysCall ( CSV_EFNC_Setup, Caption )`

`GSI_StationData ()`	`CSV_SysCall ( CSV_EFNC_SetStation, Caption )`
`GSI_TargetDlg ()`	`CSV_SysCall ( CSV_EFNC_TargetData, Caption )`

11.4.4 EDM Mode Changes

Replacement for `EDM_MODE` by the extended `BAP_SetMeasPrg ()`.

TMC_GetEDMMode () TMC_SetEDMMode ()	BAP_SetMeasPrg () BAP_GetMeasPrg ()
Deleted EDM modes:	New defined modes:
EDM_SINGLE_STANDARD EDM_SINGLE_EXACT EDM_SINGLE_FAST EDM_CONT_STANDARD EDM_CONT_EXACT EDM_CONT_FAST EDM_UNDEFINED	BAP_RED_TRK_DIST BAP_SINGLE_REF_STANDARD BAP_SINGLE_REF_FAST BAP_SINGLE_REF_VISIBLE BAP_SINGLE_RLESS_VISIBLE BAP_CONT_REF_STANDARD BAP_CONT_REF_FAST BAP_CONT_RLESS_VISIBLE BAP_AVG_REF_STANDARD BAP_AVG_REF_VISIBLE BAP_AVG_RLESS_VISIBLE

11.4.5 Interface Changes

The following routines got a new interface.

```
GSI_ImportCoordDlg ()
GSI_ManCoordDlg ()
```

Refer to the reference manual to get the new interfaces.

11.4.6 Deleted and Added Identifiers and Types:

TPS1000	**TPS1100**
Deleted:	New:
CSV_MAX_USERS CSV_ILLEGAL_USERNR RC_CSV_ILLEGAL_USERNR	CSV_WITH_REFLECTOR CSV_WITHOUT_REFLECTOR

Deleted	
EDM_COMERR EDM_NOSIGNAL	

EDM_PPM_MM EDM_METER_FEET EDM_ERR12 EDM_DIL99	

	New: MMI_SHIFT_CODE_KEY For MMI_SetAngleRelation() MMI_HANGLE_CLOCKWISE_SOUTH Changed to return code: MMI_UNDEF_LANG For MDlg routines: MMI_FFORMAT_STRING New date format: MMI_DATE_JP

Deleted: MMI_MENU_EXTRA MMI_MENU_CONFIG	New: MMI_MENU_PROGRAMS MMI_MENU_PROGMENU MMI_MENU_AUTOEXEC

	New GSI_ID values: GSI_ID_SHZ GSI_ID_CD_DSC GSI_ID_PTCD_DSC GSI_ID_PV_CD GSI_ID_PV_PTCD GSI_ID_ACT_PTID GSI_ID_BACKID GSI_ID_APP_DATA0 GSI_ID_APP_DATA1 GSI_ID_APP_DATA2 GSI_ID_APP_DATA3 GSI_ID_APP_DATA4 GSI_ID_APP_DATA5 GSI_ID_APP_DATA6 GSI_ID_APP_DATA7

	GSI_ID_APP_DATA8 GSI_ID_APP_DATA9 GSI_ID_APP_DATA10 GSI_ID_APP_DATA11 GSI_ID_FS_SCALE New GSI_POINT_TYPE: GSI_BACKSIGHT GSI_POINT_CODE

	GSI_PAR_* parameters see GSI system functions.

Deleted:	New:
TPS1100	TPS1102
TPS1700	TPS1103
TPS1800	TPS1105
TPS5000	
TPS2003	

Old TPS_FAM_Type:	New TPS_FAM_Type:
iClass	iClass
lEDMBuiltIn	lEDMBuiltIn (always TRUE)
lEDMTypeII	lEDMTypeII (always FALSE)
	lEDMTypeIII (always TRUE)
	lEDMReflectorless
lMotorized	lMotorized
lATR	lATR
lEGL	lEGL
lDBVersion	
lDiodeLaser	
lLaserPlummet	lLaserPlummet
	lAutoCollimation
lSimulator	lSimulator

	New: BAP_PRISM_MINI

Deleted: `GSI_DLG_ID_LIST`	

	New: `TMC_RED_TRK_DIST`

11.4.7 Changes in System Functions

Deleted, because there is no equivalent function at the TPS1100 series instruments:

```
BAP_GetFunctionality (), BAP_SetFunctionality ()
BAP_SetFunctionalityDlg ()
CSV_GetCurrentUser (), CSV_SetCurrentUser ()
CSV_GetDL (), CSV_SetDL ()
CSV_GetUserInstrumentName ()
CSV_SetUserInstrumentName ()
CSV_GetUserName (), CSV_SetUserName ()
GSI_GetStdRecMask ()
GSI_GetStdRecMaskAll ()
GSI_GetStdRecMaskCartesian ()
```

Replaced by equivalent functions:

```
GSI_WiDlg ()
GSI_StartDisplay ()
GSI_GetStdDialogMask ()
```

Enhanced in certain ways. See the extended identifiers and constants above or refer to the reference manual:

`WI`-values

```
CSV_GetPrismType (), CSV_SetPrismType ()
CSV_GetInstrumentFamily ()
GetMemoryCardInfo ()
MMI_GetAngleRelation (), MMI_SetAngleRelation ()
MMI_SetDateFormat (), MMI_GetDateFormat ()
```

New functions see reference manual for further details:

```
MMI_CreateGBMenuStr ()
MMI_CreateGBMenuItemStr ()
GSI_SetDataPath ()
GSI_GetDataPath ()
CSV_SetTargetType ()
CSV_GetTargetType ()
```

Interapplication and system calls

```
CSV_SysCallAvailable ()
CSV_SysCall ()
CSV_LibCall ()
CSV_LibCallAvailable ()
```

11.4.8 Returncodes

Their definitions have been coupled totally to the definitions of the TPS1100 firmware. Please refer to the Appendix F in the reference manual for a detailed listing.

12 GEOBASIC RELEASES

12.1 CHANGES IN GEOBASIC RELEASE 1.30

The Release 1.30 of GeoBASIC contains several new subroutines. It reflects user requests and improvements in the TPS1100 Series firmware Release 2.0.

Note:	This GeoBASIC Release 1.30 needs at least the **TPS1100 Series firmware Release 2.0.**

The following paragraph shows the changed items. For a detailed explanation, please see the “GeoBASIC Reference Manual”

12.1.1 New functions in Release 1.30

`BAP_SearchPrism`	search prism
`CSV_CheckAltUserTask`	returns if an alternative user task was running (i.e. FNC or PROG was pressed)
`CSV_GetTemperature`	returns the internal instrument temperature
`CSV_ResetAltUserTask`	resets the "WasRunning"-flag
`GSI_CheckTracking`	returns if distance tracking is running
`GSI_ExecQCoding`	executes Quick-Coding with/without recording
`GSI_ExecuteAutoDist`	starts a distance measurement after changing the distance mode (new buttons in FNC menu)
`GSI_GetMDlgNr`	returns the current measurement display number
`GSI_GetQCodeAvailable`	' returns if a valid code-list for Quick-Coding is selected
`GSI_GetRecMaskNr`	returns the current recording mask
`GSI_GetRecOrder`	returns the recording order measurement-code or code-measurement block
`GSI_GetWiEntryText`	Get coding text-data from the Theodolite data pool

`GSI_SelectCode`	select a code-list-code, but without recording it (allows the recording in another format)
`GSI_SetMDlgNr`	changes the measurement dialog (used i.e. for >DISP buttons)
`GSI_SetQCodeMode`	enables Quick-Coding
`GSI_SetRecMaskNr`	changes the recording mask
`GSI_SetRecOrder`	defines the recording order
`MMI_GetVAngleMode`	returns if the V-angle is running (even if a valid distance is available)
`MMI_SetVangleMode`	defines the V-angle mode
`TMC_GetAtmCorr`	Gets the atmosphere part of distance measurement corrections
`TMC_GetGeomProjection`	Gets the projection part of distance measurement corrections
`TMC_GetGeomReduction`	Gets the reduction to the reference part of distance measurement corrections
`TMC_GetInclineStatus`	returns the inclination status (i.e. ready for recording)
`TMC_SetAtmCorr`	Sets the atmosphere part of distance measurement corrections
`TMC_SetGeomProjection`	Sets the projection part of distance measurement corrections
`TMC_SetGeomReduction`	Sets the reduction to the reference part of distance measurement corrections

12.1.2 New constants in Release 1.30

```
GSI_GET_NEXT
GSI_MAX_DLG_LINES
GSI_MAX_MDLG_MASKS
GSI_MAX_REC_MASKS
GSI_MAX_REC_WI
GSI_MULTI_REC
GSI_NO_FILE_CHANGE
GSI_SEARCH_FROM_END
TPS1101
```

12.1.3 New datatypes in Release 1.30

```
HzAngle
VAngle
TMC_GEOM_PROJECTION_Type
TMC_GEOM_REDUCTION_Type
TMC_ATM_TEMPERATURE_Type
```

12.1.4 New CSV_SysCall constants in Release 1.30

```
CSV_SFNC_CheckOrientation
CSV_SFNC_CurrentSetPpmDlg
CSV_SFNC_DefSearchAreaDlg
CSV_SFNC_LoadApplDlg
CSV_SFNC_LoadSysLangDlg
CSV_SFNC_SetDefaultSearchRange
CSV_SFNC_ToggleMeasPrgFastRapidTrk
CSV_SFNC_ToggleMeasPrgRefRL
CSV_SFNC_ToggleMeasPrgStdTracking
CSV_SFNC_ToggleSearchArea
CSV_SFNC_ToggleVAngleMode
```

12.2 CHANGES IN GEOBASIC RELEASE 2.10

The Release 2.10 of GeoBASIC contains the first edition of the integrated development environment GBStudio.

It contains also a few minor bug fixes.

Note:	This GeoBASIC Release 2.10 needs at least the **TPS1100 Series firmware Release 2.10** or the TPS1100 Series Simulator 2.10.

Note:	GeoBASIC applications, compiled with GeoBASIC 1.30, are also executable on the **TPS1100 Series firmware Releases 2. 10**. For running these applications, the GeoBASIC interpreter 1.30 must be loaded. There is no debugging-support for GBStudio! **Different Releases** of GeoBASIC applications on the same instrument **are not supported!**

1. CONTENT OF REFERENCE MANUAL

2. GeoBasic Constructs

2.1 GENERAL

2.1.1 Syntax and Notation - BNF

The syntax and semantics of GeoBASIC are based on modern Basic implementations (like Visual Basic from Microsoft). The syntax in this manual is given in BNF - Bachus Naur Normal Form.

BNF knows the following elements to describe a syntax definition:

- *Reserved words, operators and delimiters:*
  They are printed in **BOLD** letters and enclosed in double quotes " ". They have to be written as given (except that upper and lower case letters are equivalent).
- Square brackets [ ] :
  They designate an *optional* part, hence such a part may be omitted.
- Curly braces { } :
  Enclose elements which may occur 0 or more times.
- Round parentheses ( ) :
  They contain a list of *alternatives* separated by a vertical bar | , from which one has to be chosen.
- The abstraction character ::= :
  This sign binds a concrete structure of syntactical elements to an abstract concept of it.

For example see the following syntax description:

VariableDeclaration	::=	"**DIM**" Name [SubscriptList] "**AS**" DataType
DataType	::=	(DataTypeName | "**STRING**" "*" Length)
SubscriptList	::=	"**(**" UpperBound { "**,**" UpperBound } "**)**"
UpperBound	::=	IntegerConstant
Length	::=	IntegerConstant

This syntax describes all possible variants of variable declarations. It contains reserved words (**STRING**), delimiters ("**(**","**)**") alternative and optional parts. Examples of concrete sentences are:

```
DIM  i      AS Integer
DIM  a(10)  AS Double
DIM  s      AS String*10
```

Reserved words in the text are written in **BOLD** letters, but without quotes. References to GeoBASIC code are written in `Courier`.

2.1.2 Examples

In some examples, definitions made in preceding examples, are used. Variable declarations are used before they are introduced formally, details can be found in Section 2.3.2 on Declaration of Variables.

2.1.3 Declarations and Statements

Declarations and statements are normally terminated by "end-of-line" (carriage return) or by a comment (see next Section 2.1.4); nevertheless, long declarations and statements may be spread over several lines. Type (structure) and routine declarations and structured statements will always occupy several lines. A single line may never contain more than one declaration or statement.

2.1.4 Comments

Comments may be added at the end of a statement line. A comment is introduced by an apostrophe ('), and all characters to the right of it up to the end of the line are ignored by the compiler. The comment is terminated by the end of the line; for longer comments, simply use another apostrophe on the next line. Comments may stand by themselves on a line.

Examples:

- Comments may take the whole line.

```
'This is a comment line.
'The comment may continue on the next line.
```

- Typically comments give more meaning to the program code. (The exact meaning of the GeoBASIC code is not of importance here, you will learn about it later in this manual.)

```
'declare variables
DIM iFirstPoint    AS Integer 'the number of the
                              '  first point
DIM lButtonPressed AS Logical 'indicates whether
                              '  a button was
                              '  pressed

'initialize the variables
iFirstPoint = 1               'the first point
                              '  has the number 1
```

- Comments may give additional information and structure the program code.

```
'=====================================================
'Program name : Athletics Distance Measurement
'Creation date: April 2, 1996
'Copyright    : Leica, Switzerland
'=====================================================

'-----------------------------------------------------
'this comment says that this is the last example
'for comments
'-----------------------------------------------------
```

Note	Comments should explain what is going on in the program without having to work through the program code. They are intended for humans trying to understand the program.

2.1.5 Names

Names (*identifiers*) may be up to 40 characters long. They must begin with a letter and may contain letters, digits, the $-sign, and the underscore character (_). Upper and lower case letters are not distinguished. The reserved words cannot be used as names (see Appendix C for the list of reserved words and Appendix E for predefined identifiers). All user-defined names must be declared before they are used in a program.

The scope of names follows the usual rules for block structured languages, i.e. all names declared at the program level are known and unable from the point of their declaration, unless an object is hidden by a locally defined object of the same name. Names declared at the local (subroutine or function) level are known and unable inside the subroutine or function only, from the point of their declaration through the end of the routine.

In general global objects with the same name as local objects are hidden by the local objects and *not* visible within the local scope. Despite this rule variable and constant names may not get the same name as global type names.

Field names within structures are local to the structure and can be accessed only through the name of the structure variable; thus, for field names there can never be a name conflict with either globally or locally declared objects, or indeed with field names of other structures.

In the following syntax definitions, all terms containing "`Name`", such as `VariableName`, `TypeName`, etc. signify a name according to this definition.

Note	In certain cases the length of names should be no longer than 18 characters. E.g. for using `MMI_CreateMenuItem` the programmer has to provide a global program name (the application name) and a subroutine name. If you plan to use the program with other languages than the default language, then you have to use a tool to edit and translate the tokens which are used in the program. This tool supports only names up to 18 characters for the application name. Hence the application name and global subroutine names have been limited to 18 characters.

2.1.6 Numbers

Numeric constants are written in the usual way, i.e.

1. *integers* consist of digits only, and
2. *floating point numbers* of any type contain a decimal point and/or an exponent part (so-called scientific notation or E-format). The exponent part consists of the letter 'E' or 'e' followed by a – possibly signed – integer value.

Examples:

- **Integer**

integer	meaning
`0`	**0**
`4711`	**4711**
`49882`	**49882**
`0001`	**1**

- **Floating point**

floating point	meaning
`0.0`	**0.0**
`3.141593`	**3.141593**
`.25`	**0.25**
`6.`	**6.0**

- **Floating point (E-format)**

floating point (E)	meaning
`6E3`	**6000.0**
`7.2e-5`	**0.000072**
`.62e+3`	**620.0**
`3.E2`	**300.0**

Note Numbers without a comma are of type `Integer`, numbers with a comma or `E` in it are of a floating point type. Hence `0` and `0.0` are of different types.
Numbers which may get only positive values are not supported in GeoBASIC. Hence distance variables may get negative values also. The programmer has to take care of that.

2.1.7 Strings and Tokens

Strings (of characters) may be 0 to 255 characters long and are enclosed in a pair of double quotes (" "). Any printable character may be included; lower and upper case letters are distinguished. If a double quote is to be part of the string, it must be written twice. The character-set is described in Appendix E.

Special characters are supported by the notation ‘\d255’ which represents one character that has the decimal value composed by the three digits. The special character ‘\d000’ is not part of the supported character set, because it’s internal use is to terminate the string. Only decimal values of characters between 1 and 255 are supported.

Due to the notation of special characters a ‘\’ has to be written as ‘\\’.

Examples:

- The smallest string is the empty string. Then follow one character strings.

```
""            'the empty string
" "           'a string containing one blank
"a"           'a string containing the character a
```

- Normally, strings are somewhat larger.

```
"This is a string."      'a string with
                         '17 characters
```

- Strings can contain special characters.

```
"Slope distance: \d001"  'a string with a
                         'special character
```

- Strings can also contain quotes.

```
"The states are ""0"" and ""1""" 'a string
                                 ' containing
                                 ' double quotes
```

- The last example prints as «`The states are "0" and "1"`».

Token

The TPS-1100 series system software implements a special facility to support different natural languages for the user interface. This feature is based on token processing. With GeoBASIC we can simulate this by passing tokens to system software routines. In the documentation parameters of this type are denoted by the data type `_Token`. Actual values of such parameters must be of type string literal or string constant.

Note	Neither variables nor string expressions are allowed as actual values for parameters of type _Token.

Examples:

- A typical example would be to create a dialog with graphical output capabilities.

```
'a string constant
CONST Help_Token = "This function defines "+
                   "the standard " +
                     "graph dialog."

MMI_CreateGraphDialog ("GRAPH",
                       "Graphical Sit.",
                       Help_Token)
```

- Variables and string expressions are not allowed as actual parameters. Therefore the following example is multiple *erroneous* in the call of `CreateGraphDialog`, because there are tokenizable strings allowed only.

```
DIM Help_Token AS String255
DIM capt       AS String20

capt = "GRAPH"
HelpToken = "This function defines the "
            "standard graph dialog." 'a string
                                     'constant
MMI_CreateGraphDialog(capt, "Graphical"+" sit.",
                      Help_Token)    'error!!!
```

2.1.8 Logical Values

Logical values are written as `TRUE` or `FALSE`. They are *predefined names* (not reserved words) and can be used wherever logical constants are allowed. As usual for names, upper and lower case letters are not distinguished.

2.2 DATA TYPES

There are two kinds of data types in GeoBASIC: simple and composite.

2.2.1 Simple data types

The simple data types are:

1. `Integer`
2. `Logical`
3. `Double`, `Distance`, `Subdistance`, `Angle`, `VAngle`, `HzAngle`, `Pressure`, `Temperature`

- The values of type `Integer` are the signed 31-bit integer numbers, from -2147483648 to 2147483647.
- Variables of type `Logical` can take on the values `TRUE` and `FALSE`. They are used in logical expressions, they can be assigned, and they can be passed as parameters.
- The other predefined simple types are all the same as `Double`; their values are the floating point numbers. The different names are provided for correct displaying of its units and dimension. Within the theodolite Firmware SI units are used (Meter, radians, hPa and Celsius).

2.2.2 Composite data types

In addition to the predefined (simple) types, there are three composite data types available:

1. String
2. Array
3. Structure

A variable of type `String` can contain a string of some maximum length which is specified in the declaration of the variable (see Section 2.3.2 on Declaration of Variables). The values of type `String` are described in Section 2.1.7 on Strings.

2.2.3 Declaration of Arrays

An array consists of a fixed number of values of the *same* type, organised in one or more dimensions (vector, matrix, three-dimensional array, etc.) and is declared as follows.

Syntax:

```
ArrayDeclaration ::=  "TYPE" "DIM" Name SubscriptList "AS"
                           DataType
                      "END" [ Name ]
DataType         ::=  ( DataTypeName | "STRING" "*" Length )
SubscriptList    ::=  "(" UpperBound { "," UpperBound } ")"
UpperBound       ::=  IntegerConstant
Length           ::=  IntegerConstant
```

- A variable of type "Name" will consist of an array of as many dimensions as there are *bounds* specified. The upper bounds must be positive integer constants.
- *Subscripting* starts at 1; thus each dimension has "UpperBound" entries. Each element of the array will be of the data type specified.
- An individual element is *accessed* by giving its subscripts (coordinates) as expressions (see Section 2.4 on Variables).
- For assignment and parameter passing, the variable may also be used as a whole. Other operations can only be performed on the individual elements; in particular, comparison of entire arrays is not possible.

Examples:

♦ Declare a type for an array that contains two integers, and a variable of that type.

```
TYPE DIM MyFirstArrayType ( 2 ) AS Integer END
DIM MyFirstArray AS MyFirstArrayType
```

♦ Now we can access the two components as individual variables.

```
MyFistArray(1) = 10
MyFistArray(2) = 20

MyFirstArray(1) = MyFirstArray(2) DIV MyFirstArray(1)
```

The first element of the array now contains the value $\frac{20}{10} = 2$.

- ♦ We can also use variables for the index; assume we had declared an integer variable `iIndex`.

```
DIM iIndex AS Integer
iIndex = 2

MyFirstArray( iIndex ) = 5
```

- ♦ And even more complicated, the index variable may of course be an indexed variable.

```
iIndex = 1
MyFirstArray( iIndex ) = MyFirstArray( MyFirstArray(
iIndex ) )
```

Note	For keeping track of value changes it is often convenient to draw a table with pencil and paper. But as a rule, a program should always be written and commented so well that is immediately clear what is done when reading the program.

State	MyFirstArray(1)	MyFirstArray(2)	iIndex
1	10	20	–
2	2	20	–
3	2	20	2
4	2	5	2
5	2	5	1
6	5	5	1

- ♦ Array variables of the same type can be assigned as a whole, no matter how complex they are. This is equivalent to assigning all elements separately.

```
DIM A1 AS MyFirstArrayType
DIM A2 AS MyFirstArrayType

A1(1) = 1
A1(2) = 2

A2 = A1       'equivalent to
              '  A2(1) = A1(1)
```

```
                 '  A2(2) = A1(2)
```

Note	Neither the compiler nor the interpreter does any index-overflow checking. Hence overwriting of data outside an array may occur and may cause severe errors, if indexes are use that is bigger than the defined upper bounds.

- Arrays cannot be compared directly — it must be done element by element. Often it is useful to declare constants for the upper bound of an array. (For a description of the `IF` and `WHILE` statement see Sections 2.6.2.1 and 2.6.3.1. respectively.)

```
CONST MaxNoOfHeights AS Integer = 10 'want to have
                                     ' 10 heights
TYPE DIM HeightArrayType(MaxNoOfHeights) AS Double END

DIM HeightArray1 AS HeightArrayType   'first array
                                      ' of heights
DIM HeightArray2 AS HeightArrayType   'second array
                                      ' of heights
DIM iIndex       AS Integer           'index for
                                      ' comparing
DIM lEqual       AS Logical           'indicator for
                                      ' comparing

'now compare the arrays
lEqual = TRUE       'so far everything was equal
iIndex = 1          'start with the first element

'compare the elements, stop at the first difference
DO WHILE lEqual AND (iIndex <= MaxNoOfHeights)
   lEqual = (HeightArray1( iIndex ) =
             HeightArray2( iIndex ))
   iIndex = iIndex + 1

LOOP
'do some action according to the result of the
'comparison
IF lEqual THEN
   'yes, they are equal
ELSE
   'no, they are not equal;
   'the first difference is at position iIndex - 1
END IF
```

- Now declare some larger arrays.

```
TYPE DIM DoubleArrayType ( 20 ) AS Double END
```

```
TYPE DIM StringArrayType ( 35 ) AS String*10 END
TYPE DIM ArrayArrayType  (  5 ) AS DoubleArrayType END
```

The last example shows that arrays can be nested: the five elements of `ArrayArrayType` are arrays itself. But there is also a direct way of declaring multidimensional arrays.

```
TYPE DIM MatrixType ( 5 , 20 ) AS Angle END
```

A variable of `MatrixType` will denote a 5 by 20 matrix of angles (floating point).

- ♦ In closing let us compare the access to elements of the two multidimensional arrays.

```
DIM ArrayArray AS ArrayArrayType
DIM Matrix     AS MatrixType

ArrayArray(1)( 1) =   1.0
ArrayArray(1)(20) =  20.0
ArrayArray(5)(20) = 100.0

Matrix( 1,  1 )   =   1.0
Matrix( 1, 20 )   =  20.0
Matrix( 5, 20 )   = 100.0
```

2.2.4 Declaration of Structures

A structure (a structured type, also known as a "record" in other languages) consists of a number of values of possibly *different* types and is declared as follows:

Syntax:

```
TypeDeclaration      ::=  "TYPE"  Name
                               { ElementName "AS"
                               DataTypeName }
                          "END"  [ Name ]
```

- A variable of type "Name" will consist of elements (fields, components) which can be accessed by their element name as given in the type declaration (see Section 2.4 on Variables).

- For assignment and parameter passing, the variable may also be used as a whole. Other operations can only be performed on the individual elements; in particular, comparison of entire structures is not possible.

Example:

- ♦ We declare a type for Cartesian coordinates in the space.

```
TYPE CartesianPointType
   iNumber AS Integer   'number of the coordinate
   dNorth  AS Distance  'north coordinate
   dEast   AS Distance  'east coordinate
   dHeight AS Distance  'height coordinate
END CartesianPointType
```

- ♦ A variable of type `CartesianPointType` will consist of the four components `iNumber`, `dNorth`, `dEast`, and `dHeight`. `iNumber` is an integer for a point number, the others are floating point values (doubles) for the coordinates in the space.
- ♦ We declare two variables of `CartesianPointType` and initialise the first point's components to the origin.

```
DIM Point1 AS CartesianPointType
DIM Point2 AS CartesianPointType

Point1.iNumber  = 1
Point1.dNorth   = 0.0
Point1.dEast    = 0.0
Point1.dHeight  = 0.0
```

- ♦ As with arrays, we can assign a whole structure at once. This is equivalent to assigning each of the components.

```
Point2 = Point1   'equivalent to
                  ' Point2.iNumber = Point1.iNumber
                  ' Point2.dNorth  = Point1.dNorth
                  ' Point2.dEast   = Point1.dEast
                  ' Point2.dHeight = Point1.dHeight
```

- ♦ Now we set `Point2`'s values. Since it is initialised we only need to say where it differs from `Point1`.

```
Point2.iNumber  = 2
Point2.dNorth   = 1.0
Point2.dEast    = 1.0
```

- ♦ And we can, for instance, compute the distance between `Point1` and `Point2`. (`Sqr` computes the square root, and `^2` squares its argument.)

```
DIM dDistance AS Distance

dDistance = Sqr((Point2.dNorth  - Point1.dNorth )^2 +
                (Point2.dEast   - Point1.dEast  )^2 +
                (Point2.dHeight - Point1.dHeight)^2)
```

♦ A record type can itself be the type of a record component, or the type of elements of an array.

```
TYPE LineType
   StartPoint AS CartesianPointType
   EndPoint   AS CartesianPointType
END LineType

TYPE DIM PointArrayType (5) AS CartesianPointType END

TYPE SomeMeasurementType
   BaseLine       AS LineType
   MeasuredPoints AS PointArrayType
END SomeMeasurementType
```

♦ The access to nested structures is done as follows.

```
DIM Measurement AS SomeMeasurementType

'set the base line
Measurement.BaseLine.StartPoint = Point1
Measurement.BaseLine.EndPoint   = Point2

'set the first point of the measurement
Measurement.MeasuredPoint(1).iNumber = 1
Measurement.MeasuredPoint(1).dNorth  = 1.6
Measurement.MeasuredPoint(1).iEast   = 5.3
Measurement.MeasuredPoint(1).iHeight = 3.9
```

2.2.5 Predefined Structured Types

GeoBASIC provides for the inclusion of system routine calls a set of predefined structured types (strings, arrays, and structures). The definitions of such predefined types are implemented in the GeoBASIC compiler and accessible to the programmer as any other defined types. One example is `GM_Point_Type` which denotes a GeoMath point data type. Normally they are explained at the beginning of a subsection.

2.3 DATA DECLARATIONS

2.3.1 Declaration of Constants

Syntax:

ConstantDeclaration ::= "**CONST**" Name ["**AS**" DataType]
"=" Expression

The expression is evaluated at compile time and must therefore contain constants only. All GeoBASIC operators may be used, including comparisons and logical operators, but no functions. The name of the constant can subsequently be used wherever a constant of this type is allowed. It is known only inside the unit in which it was declared.

The optional type specification is used to specify an explicit type, e.g. for values of one of the specialities of `Double`.

In the definitions in the remainder of this document, wherever "Constant" is used in a term, either alone or with a qualifier, such as `IntegerConstant` etc., either an explicitly written constant as defined in Sections 2.1.6 on

Numbers, 2.1.7 on Strings, 2.1.8 on Logical Values, or the name of a declared constant is required.

Examples:

♦ In GeoBASIC the constant `Pi` is predefined. The definition corresponds to the following constant declaration in the main program.

```
CONST Pi = 3.1415926
```

Note	It is recommended always to specify the type of the constant, even if it is not required by the compiler.

```
CONST Pi AS Double = 3.1415926 'declare Pi as Double
                               ' explicitely
```

♦ Also string constants can be declared. They may even extend over several lines of code.

```
CONST sProgramTitle = "ATHLETICS DISTANCE MEASURENENT"
```

```
CONST sHelpText = "This is the help text of the "   +
                  "athletics program. As you can "  +
                  "see it can extend over several " +
                  "lines."
```

- When declaring constants, the built in arithmetic may be used (but no function calls).

```
CONST TwoPi AS Double = 2.0*Pi
```

2.3.2 Declaration of Variables

Syntax:

VariableDeclaration	::=	"**DIM**" Name [SubscriptList] "**AS**" DataType
DataType	::=	(DataTypeName | "**STRING**" "*****" Length)
SubscriptList	::=	"**(**" UpperBound { "**,**" UpperBound } "**)**"
UpperBound	::=	IntegerConstant
Length	::=	IntegerConstant

There are no implicit variable types; all variables used by the program must be explicitly declared to be of a certain data type, whose name may be one of the predefined types (see Section 2.2 on Data Types) or a previously declared array or structure type name (see Section 2.2.3 on Declaration of Arrays, and 2.2.4 on Declaration of Structures). Alternatively, array variables may be declared directly, as explained in the following paragraph.

If a subscript list is specified with the variable name, the variable will denote an array of as many dimensions as there are bounds specified. The upper bounds must be positive integer constants. Subscripting always starts at 1; thus each dimension has "UpperBound" entries. Each element of the array will be of the data type specified.

Variables are known only inside the unit where they are declared.

For string variables and arrays of strings, "Length" specifies the maximum number of characters the variable or the array element is to hold and must be a positive integer constant. Parts of a string may be accessed and manipulated through standard functions (See 2.7.2.1 Standard Function Calls.)

String variables are handled differently if they were declared in global and local scopes. If a string variable is declared globally, then it will be initialised only once, after the program has been loaded. After that point the variable will not be touched again from the environment and it keeps the value the last time assigned to it. A local string variable will be initialised each time the surrounding subroutine (or function) is entered.

Note	The declaration of a variable does not assign any value to it. The value of a variable that is read before the first assignment to it has been performed is undefined.

Examples:

- First we declare and initialise variables of simple types.

```
DIM iSum      AS Integer
DIM dDistance AS Distance
DIM dHz       AS Angle

iSum      =   0
dDistance =   0.0
dHz       = 100.0
```

- Then we declare variables composite types.

```
DIM StartPoint AS CartesianPointType
DIM BaseLine   AS LineType
DIM PointArray AS PointArrayType
```

- Arrays can be declared directly.

```
DIM NameList    ( 8 )      AS String * 50
DIM AngleMatrix ( 5 , 20 ) AS Angle
DIM PointArray2 ( 5 )      AS CartesianPoint
```

Note	If all bounds and the element type of two array variables match, they are considered to be of the same type, hence they can be assigned to each other. For example, the variables `PointArray` and `PointArray2` can be assigned to each other.

2.3.2.1 The Variable Err

The predefined integer variable `Err` can in principle be accessed like any other integer variable. Its main purpose, however, is to contain the error code returned by an external routine called from a GeoBASIC module. Furthermore, at termination of the module's execution, the current contents of `Err` will be passed back to the system as the module's return code. For details on error handling, see Section 2.8 on Error Handling.

2.4 VARIABLES

This section describes the access to variables. Their declaration is described in Section 2.3.2.

Simple variables are accessed by their name. Composite variables (strings, arrays, and structures) can also be accessed by their name, but only for the operations of assignment (see Section 2.6.1.1 on The Assignment Statement) or parameter passing (see Section 2.7.2 on Routine Calls). Often, however, their individual constituents will be selected and operated one by one of the operations available for data of that type.

Syntax:

```
Variable                ::=  VariableName { Selector }
Selector                ::=  ( ArraySelector | FieldSelector )
ArraySelector           ::=  "(" SubscriptExpression
                                  { "," SubscriptExpression } ")"
FieldSelector           ::=  "." ElementName
SubscriptExpression     ::=  IntegerExpression
```

An element of a one-dimensional array is accessed with a subscript expression given between parentheses. The expression must be of type `Integer` and must evaluate to a value between 1 and the upper bound of the array (bounds inclusive).

Note	There is no check performed whether the subscript is within bounds, neither at compile time nor at run time.

To access an element of a multidimensional array, as many subscript expressions are needed as there are dimensions.

An element (field) of a structure is accessed by its name.

Examples for valid variable access (assuming appropriate type definitions)

♦ Variables of simple types.

variable	type
`iSum`	`Integer`
`dAngleDifference`	`Angle`
`dHorizontalDistance`	`Distance`
`lValidPoint`	`Logical`

♦ Variables of compound types.

variable	with component/element	type
`Point1`		`CartesianPointType`
	`Point1.iNumber`	`Integer`
	`Point1.dEastY`	`Double`
`ArrayArray`		`ArrayArrayType`
	`ArrayArray(1)`	`DoubleArray`
	`ArrayArray(1)(1)`	`Double`
`Matrix`		`MatrixType`
	`Matrix( 1, 1 )`	`Double`
	`Matrix( x, y )`	`Double`
	(with x and y integer variables within the bounds)	

For further examples see Sections 2.2.3 on Declaration of Arrays, 2.2.4 on Declaration of Structures, and 2.3.2 on Declaration of Variables.

2.5 EXPRESSIONS

Syntax:

```
Expression        ::=  LogicalTerm { "OR" LogicalTerm }
LogicalTerm       ::=  LogicalFactor { "AND" LogicalFactor }
LogicalFactor     ::=  { "NOT" } LogicalPrimary
LogicalPrimary    ::=  SimpleExpression [ RelationOperator
                              SimpleExpression ]
RelationOperator  ::=  ( "=" | "<>" | ">" | "<" | ">=" | "<=" )
SimpleExpression  ::=  [ AddOperator ] Term
                             { AddOperator Term }
AddOperator       ::=  ( "+" | "-" )
Term              ::=  Factor { MultOperator Factor }
MultOperator      ::=  ( "*" | "/" | "\" | "MOD" )
Factor            ::=  Primary [ "^" Factor ]
Primary           ::=  ( Variable | Constant | FunctionCall |
```

"(" Expression ")")

The operators have their usual meaning, as found in many programming languages. The logical operators **OR**, **AND**, and **NOT** stand for the inclusive logical or, the logical and, and the logical not. The relational operators =, <>, >, <, >=, <= stand for "equal to", "not equal to", "greater than", "less than", "greater than or equal to", and "less than or equal to", respectively. The arithmetic operators +, -, *, /, \, **MOD** and ^ stand for addition, subtraction, multiplication, floating point division, integer division, remainder, and power, respectively.

Aside from its use as arithmetic addition operator, the + operator is also used for string concatenation.

The syntax for the expressions reflects the precedence of the operators; thus, the logical **OR** operator has the lowest precedence, since both `LogicalTerms` are evaluated before the or takes place. The parameters of function calls are evaluated before the function itself. Functions and parenthesised expressions are evaluated before any operations involving them. All operations on the same level are evaluated from left to right, with the exception of powers, which are evaluated from right to left, i.e. `x^3^2` is the same as `x^(3^2)` (= `x^9`) and not `(x^3)^2` (= `x^6`) . Multiplication, division, and remainder are evaluated before addition and subtraction. Arithmetic operations and string concatenation are performed before comparisons, and comparisons before logical operations. In logical operations, **NOT** is performed before **AND**, which is performed before **OR**.

Note	In case of doubt about the precedence, or to make the intention clear to the reader, parentheses are recommended.

Examples

- First we declare some variables that will be used.

```
DIM a AS Double
DIM b AS Double
DIM c AS Double
DIM i AS Integer
DIM j AS Integer
DIM k AS Integer
DIM x AS Logical
DIM y AS Logical
DIM z AS Logical
DIM s AS String20
```

- The implicit precedence of the expression in the left column is shown in the right column explicitly.

expression	precedence made explicit
`a + 3 * b`	`a + (3*b)`
`a / b * c`	`(a/b) * c`
`a ^ 3 ^ b`	`a^(3^b)`
`i \ j \ k`	`(i \ j) \ k`
`x or y and z`	`x or (y and z)`
`x and y = z`	`x and (y = z)`
`a * F( -b + 1) / 2`	`(a * ( F( (-b) + 1) ) ) / 2`

where `F` is a function (see Section 2.7 on Routines; this example is only included for completeness);

- Now we show some examples for the type conversion.

Expression	value	result type
`7 / 3`	`2.33333333`[1]	`Double`
`7 \ 3`	`2`	`Integer`
`7 mod 3`	`1`	`Integer`
`"Geo" + "BASIC"`	`"GeoBASIC"`	`String`

2.5.1 Type Compatibility

Note that not all types of operands can be combined with all operations. The rules are as follows.

2.5.1.1 Addition, subtraction, multiplication (+, -, *):

Both operands must be of a numeric type (`Integer`, `Double`, or any of the various specialities of `Double`). If both are of the same type, the result is also of that type, otherwise it is of type `Double`.

Note	The `+` operator is also used for string concatenation, see below.

[1] The actual value depends on the hardware.

2.5.1.2 Division (/):

Both operands must be of a numeric type (`Integer`, `Double`, or any of the various specialities of `Double`). The result is always of type `Double`. If the value of the denominator is zero, the division is not performed and an error results, which will cause an enabled error handler to become active.

2.5.1.3 Integer division, remainder (\., mod):

Both operands must be of type `Integer`, and the result is also of type `Integer`. If the value of the denominator is zero, the division is not performed and an error results, which will cause an enabled error handler to become active.

2.5.1.4 Exponentiation (^):

Both operands must be of a numeric type (`Integer`, `Double`, or any of the various specialities of `Double`). The result is always of type `Double`. If the exponent is `0`, the result is `1.0` for all values of the base. If the base is negative, the exponent must have an integer value, otherwise a domain error occurs.

2.5.1.5 Relational operators (=, <>, >, <, >=, <=):

Both operands must be either of a numeric type (`Integer`, `Double`, or any of the various specialities of `Double`), or both `Logical`, or both strings. The result is always of type `Logical`.

For numerical operands, the relations are the usual. For logical operands, `FALSE` is less than `TRUE`. For strings, the ASCII code sequence is used, so that e.g. "`0`" < "`1`" < "`A`" < "`Z`" < "`a`" < "`z`". Comparison of strings proceeds character by character from left to right, and the first unequal pair determines which string is less. Comparison also ends when an "end-of-string" is found; in this case, if both strings are of the same length they are equal, otherwise the shorter is less than the longer. Note that strings of different length can never be equal, but a shorter string can be greater than a longer one.

2.5.1.6 Logical operations:

The logical operators (`not`, `and`, `or`) require their operands (one for `not`, two for `and` and `or`) to be of type `Logical`. The result is, of course, also of type `Logical`.

2.5.1.7 String concatenation (+):

Both operands must be string expressions, and the result is again a string, whose length is the sum of the lengths of the two operands and must be less than 256. If string manipulation functions are used in string expressions, all intermediate results from concatenation or string generation must be less than 256 characters long.

Examples

- Now we show some examples for string comparison.

expression	value
`"Sun" < "Sunny"`	TRUE
`"Sun" > "Moon"`	TRUE
`"Sun" <> "Sun "`	TRUE
`"Sun" > "Sun "`	FALSE
`"Sun" > "Sun"`	FALSE
`"Sun" < "Sun"`	FALSE
`"Sun" = "Sun"`	TRUE
`" " > ""`	TRUE

2.6 STATEMENTS

Syntax:

```
StatementSequence  ::=  { [ ErrorLabel ] Statement }
ErrorLabel         ::=  HandlerLabel ":"
Statement          ::=  ( SequentialStatement |
                              SelectionStatement |
                              LoopStatement |
                              OnErrorStatement |
                              ExitStatement |
                              IOStatement )
```

The error label is used in conjunction with the `ON-ERROR`-statement, see Section 2.8; it must be written on a line by itself, i.e. the statement following it must be on a new line.

2.6.1 Sequential Statements

Syntax:

```
SequentialStatement  ::=  ( Assignment | SubroutineCall )
Assignment           ::=  Variable "=" Expression
```

2.6.1.1 The Assignment Statement

The expression is evaluated and the result is assigned to the variable. The type of the variable and the type of the expression must be the same, unless they are of a simple type. In this case they must either be both of a numeric type (`Integer`, `Double`, or any of the various specialities of `Double`), or both of type `Logical`. If the variable is of type `Integer`, the expression must also be of type `Integer`. If the variable is one of the `Double` types and the expression is `Integer`, the result is converted to `Double` before being assigned.

If the variable is an array element, the subscript expression is evaluated before the expression on the right hand side. (This will matter only if functions with side effects are evaluated, which should be avoided.)

A structure variable can be assigned to another one, provided they are both of the same structure type (same name). An array variable can be assigned to another one if both are of the same type (same name) or if they have the same "shape" (the same number of dimensions and the same number of elements in corresponding dimensions) and if their elements are of the same type.

Examples:

- Compute the east coordinate of `Point1` out of the east coordinate of `Point2`.
  ```
  Point1.dEast = 2.5 * Point2.dEast
  ```

- The following assignment with `i` and `j` in the appropriate bounds may occur in some matrix computation.
  ```
  Matrix(i, j) = ( Matrix(i+1, j)+Matrix(i-1, j) ) / 2.0
  ```

- Next, the matrix is assigned to itself. (Note that it is an assignment, not a Boolean expression.)
  ```
  Matrix = Matrix
  ```
- Often a logical variable (`lDone`) has to be set according to some condition. `x` and `y` must be comparable.

```
lDone = (x > y)
```

♦ In closing a unit is appended to a string `s`.

```
s = s + " cm"
```

For subroutine calls see Section 2.7.2.

2.6.2 Selection Statements

Syntax:

```
SelectionStatement   ::=  ( IfStatement | SelectStatement )
IfStatement          ::=  "IF" Condition "THEN"
                               StatementSequence
                          { "ELSEIF" Condition "THEN"
                               StatementSequence }
                          [ "ELSE"
                               StatementSequence ]
                          "END IF"
Condition            ::=  LogicalExpression
SelectStatement      ::=  "SELECT CASE" Expression
                          { "CASE" ConstantList
                               StatementSequence }
                          [ "CASE ELSE"
                               StatementSequence ]
                          "END SELECT"
ConstantList         ::=  Constant { "," Constant }
```

2.6.2.1 The IF-Statement

The conditions are evaluated one after the other. As soon as one is found that results in the value `TRUE`, the statement sequence following the corresponding `THEN` is executed and no further conditions are evaluated. If no condition evaluates to `TRUE`, then the statement sequence after `ELSE` is executed, if there is an `ELSE`, otherwise nothing is done. In any case, execution continues with the statement following `END IF`.

Examples:

- If a is greater than b, Stat1 will be executed. If a is smaller than b, Stat2 will be executed. The ELSE case means that neither a is greater b, nor a is smaller b — hence a equals b. In that case Stat3 is executed.

```
IF a > b THEN
   Stat1
ELSEIF a < b THEN
   Stat2
ELSE 'a = b
   Stat3
END IF
```

Note	In general the branch conditions in the IF-Statement must neither be exclusive nor complete. Hence the compiler will not check if any branch is accessible.

- The built in function Abs computes the absolute value of a number, i.e. takes a number and computes its value as a non-negative integer ("forgets its sign"). It can be written as the following program that does nothing if x is already non-negative, and converts x to a positive number if the current value is negative. The empty ELSE case can be omitted.

```
IF x < 0 THEN
   x = -x
END IF
```

- Another example is given in the next Section 2.6.2.2 on The SELECT-Statement.

2.6.2.2 The SELECT-Statement

The expression is evaluated and compared to the constants. If a constant equal to the value of the expression is found, the corresponding statement sequence is executed. If no constant equals the expression and there is a CASE ELSE, the statement sequence following this is executed, otherwise nothing more is done. Execution then continues with the statement after END SELECT.

The expression and the constants must be of a simple type or strings, and the constants should all have different values. The order of the constants in the list, and the order of the lists in the SELECT-statement is irrelevant as far as the effect of the statement is concerned; however, the constants will be checked for equality in the order in which they appear, so if the most frequent case is put first, this will likely result in faster execution.

There is no check to assure that the constants are all different. If there is more than one constant equal to the value of the expression, the first one will always be selected; the other cases will therefore be inaccessible.

Example:

- Assume that the sum of the variables `a` and `b` denotes an integer, and we want to check if this number is a prime number smaller than 10, a prime number between 10 and 20, or not a prime number at all.

```
SELECT CASE a+b
CASE 2, 3, 5, 7
   Stat1
CASE 11, 13, 17, 19
   Stat2
CASE ELSE
   Stat3
END SELECT
```

- Note that if had used a nested `IF` statement, we would have to write a lot of comparisons that make the code much less readable. (Further, if we do a straight forward transformation from `SELECT` to `IF`, the selection expression is evaluated more than once, in the general case.)

```
IF (a+b)=2 OR (a+b)=3 OR (a+b)=5 OR (a+b)=7 THEN
   Stat1
ELSEIF (a+b)=11 OR (a+b)=13 OR (a+b)=17 OR (a+b)=19 THEN
   Stat2
ELSE
   Stat3
END IF
```

2.6.3 Iteration Statements

Syntax:

LoopStatement	::=	(WhileLoop | UntilLoop | ForLoop)
WhileLoop	::=	"**DO**" ["**WHILE**" Condition]
		StatementSequence
		"**LOOP**"
UntilLoop	::=	"**DO**"
		StatementSequence
		"**LOOP**" ["**UNTIL**" Condition]
ForLoop	::=	"**FOR**" CounterName "=" Start "**TO**"

```
                              Finish [ "STEP" Step ]
                              StatementSequence
                          "NEXT" [ CounterName ]
Condition            ::=  LogicalExpression
Start                ::=  IntegerExpression
Finish               ::=  IntegerExpression
Step                 ::=  IntegerExpression
ExitStatement        ::=  ( LoopExit | RoutineExit )
LoopExit             ::=  "EXIT"
```

2.6.3.1 The WHILE-Loop

If there is a condition, it is evaluated. If this yields `TRUE`, the statement sequence is executed once, then the condition is re-evaluated. This continues until the condition evaluates to `FALSE`, whereupon execution continues with the statement following the loop.

If the condition yields `FALSE` the first time, the statement sequence is not executed at all, and execution continues immediately with the statement following the loop.

If there is no condition specified, the loop can only be left through an `EXIT`-statement (see the note on the Exit-Statement at the end of this section), or through the occurrence of a run time error.

An example is given after the description of the `UNTIL`-loop below.

2.6.3.2 The UNTIL-Loop

The statement sequence is executed, then the condition, if there is one, is evaluated. If this yields `FALSE`, the statement sequence is executed again, then the condition is re-evaluated. This continues until the condition evaluates to `TRUE`, whereupon execution continues with the statement following the loop.

If no condition is specified, the loop can only be left through an `EXIT`-statement (see the note on the Exit-Statement at the end of this section), or through the occurrence of a run time error.

The statement sequence is executed at least once.

Examples:

- Assume, for instance, the following variable declarations.

```
CONST iMaxIndex AS Integer = 10
```

```
DIM dSum           AS Double  'for the summation
DIM iIndex         AS Integer 'the running index
DIM iLastIndex     AS Integer 'index of last element
                              '  to add
DIM NumberArray (iMaxIndex) AS Double
                              'array with the numbers
```

Then the following `WHILE` loop sums up `iLastIndex` (≤ `iMaxIndex`) numbers of the array `NumberArray`. The resulting sum will be in `dSum`.

```
dSum   = 0   'so far the sum is zero
iIndex = 1   'the first index is 1

DO WHILE iIndex <= iLastIndex  'as long as we are
                               '  not at the end
   dSum = dSum + NumberArray(iIndex) 'add the
                                     ' current element
   iIndex = iIndex + 1         'compute next index
LOOP
```

- Every `WHILE` loop can be transformed in an equivalent `UNTIL` loop and vice versa. Have a look at the following `UNTIL` version of the summation.

```
dSum   = 0   'so far the sum is zero
iIndex = 1   'the first index is 1


DO                                   'loop
   dSum = dSum + NumberArray(iIndex) 'add the current
                                     ' element
   iIndex = iIndex + 1               'next index
LOOP UNTIL iIndex > iLastIndex       'until we exceed
                                     ' the last index
```

- These two loops (the `WHILE` and `UNTIL` version) perform exactly the same computation for `iLastIndex > 0`. But for `iLastIndex <= 0`, `dSum` remains `0` and `iIndex` remains `1` in the `WHILE` example, while in the `UNTIL` version `dSum` is set to the value of `NumberArray(1)`, and `iIndex` is incremented once.

2.6.3.3 The FOR-Loop

The three `Integer` expressions (`Start`, `Finish`, `Step`) are evaluated at the outset. If the `Step` part is omitted, `Step` is set to `+1` by default. The values thus obtained for `Finish` and `Step` are used throughout execution of the `FOR`-loop, which means that they do not change even if their constituent variables should change their values inside the `FOR`-loop.

Note	If the value of `Step` is `0`, the loop can only be left through an `EXIT`-statement (see the note on the Exit-Statement below) or through the occurrence of a run time error.

The `Start` value is assigned to the counter. Before each execution of the loop, the counter is compared to the `Finish` value. If the value of `Step` is positive and the counter is smaller or equal to `Finish`, or if the value of `Step` is negative and the counter is greater or equal to `Finish`, another iteration takes place, otherwise the loop terminates and the statement following it is executed. At the end of each iteration, the counter is incremented by `Step` (which means a decrement for a negative value of `Step`). Like the `WHILE`-loop, a `FOR`-loop may be executed zero times.

Note	The counter name must be an `Integer` variable declared in the same routine as the `FOR`-loop (i.e. it must be a local variable). Within the loop it can be accessed for reading only; changes to it by the statements inside the loop are not allowed.

The execution of the `FOR`-loop can be described as follows:

```
FOR iIndex = iStart TO iFinish STEP iDelta
   Statements
NEXT iIndex
```

The following `WHILE` loop is equivalent to the `FOR` loop.

```
'evaluate the bounds at the outset
iIndex           = iStart
iFinishEvaluated = iFinish
iDeltaEvaluated  = iDelta

DO WHILE (iDeltaEvaluated >= 0 AND
            iIndex <= iFinishEvaluated) OR
         (iDeltaEvaluated <  0 AND
            iIndex >= iFinishEvaluated)
   ' Statements
   iIndex = iIndex + iDeltaEvaluated
LOOP
```

Example:

- We present the previous example of the `WHILE` loop now as a `FOR` loop. They performs exactly the same calculation, for all values of `iLastIndex`.

```
dSum = 0
FOR iIndex = 1 to iLastIndex
   dSum = dSum + NumberArray(iIndex)
NEXT iIndex
```

Note on the loop EXIT-Statement

All three loops — the `WHILE` loop, the `UNTIL` loop, and the `FOR` loop — may contain one or more loop-exit-statements. If one of these is executed, the loop terminates immediately and the statement following it is executed. An `EXIT`-statement always exits only the innermost loop containing it.

2.7 ROUTINES

2.7.1 Routine Declaration

Routines come in two flavours: subroutines and functions. Functions return a value and normally cause no change to the variables of their environment, while subroutines often change their environment. Because they are quite similar, they are described together.

Syntax:

```
RoutineDeclaration      ::= ( SubroutineDeclaration |
                                FunctionDeclaration )
SubroutineDeclaration   ::= [ "GLOBAL" ] "SUB"
                                SubroutineName [ ParameterList ]
                                Body
                                "END" [ SubroutineName ]
FunctionDeclaration     ::= "FUNCTION" FunctionName
                                ParameterList "AS" DataTypeName
                                Body
                                "END" [ FunctionName ]
ParameterList           ::= "(" [ ParameterSpecification { ","
                                ParameterSpecification } ] ")"
```

```
ParameterSpecification ::= [ "BYVAL" ] ParameterName "AS"
                               DataTypeName
Body                   ::= { CVTDeclaration | LabelDeclaration }
                               CodePart
CVTDeclaration         ::= ( ConstantDeclaration |
                               VariableDeclaration |
                               TypeDeclaration )
CodePart               ::= StatementSequence
ExitStatement          ::= ( LoopExit | RoutineExit )
RoutineExit            ::= "EXIT" ( "SUB" | "FUNCTION" )
```

Routines that will be called from the TPS-1100-System, so-called *modules*, must be declared with the keyword `GLOBAL`. They must be parameter-less subroutines (*not* functions), and they should return an error code in the predefined integer variable `Err`. (See also Section 2.3.2.1 on The Variable `Err`, and Section 2.8 on Error Handling.)

Global subroutine may have a length up to 18 characters.

The names of the parameters in the parameter list can be used inside the routine like variables of the specified type. When the routine is called (executed), actual variables or expressions will be substituted for them. A parameter specified as `byVal` must not be a structure or an array and can be replaced by a variable or an expression; the parameter behaves like a variable initialised to the value of the expression. Parameters *not* specified as `byVal` must be replaced by a variable (of the correct type); any manipulations performed on the parameter are actually performed on the substituted variable.

Functions usually have one or more parameters; if a function has no parameters, the parentheses must still be written. On the other hand, if a subroutine has no parameters, the parentheses may be omitted.

The declaration part of a routine contains local declarations of constants, types, variables, and labels, which will not be known outside the routine.

The code part of a routine contains the statements which are executed when the routine is called.

The code part of a function should contain at least one assignment statement of the form

```
FunctionName  =  Expression
```

When control returns to the point of call, the value last assigned to the function name will be the value returned by the function. If no such assignment is made before control returns, the return value of the function is undefined.

Both the declaration and the code part may use the names that are known in the environment of the routine, i.e. the globally declared objects, provided their declaration preceded (in the source text) the current routine.

Note on the routine EXIT-Statement

The code part of a routine may contain one or more routine-exit-statements, which are written as `EXIT SUB` or `EXIT FUNCTION` for a subroutine or a function, respectively. If one of these is executed, execution of the routine terminates at that point and control passes back to the point where the routine was called. If no such `EXIT`-statement is executed, control returns to the point of call when the `END` of the routine is encountered.

Examples:

- The subroutine `SquareAndCube` takes a `Double` as first argument (the parameter variable `dX`) and returns the square and cube of this first argument in the second (`dSquare`) and third (`dCube`) one.

```
SUB SquareAndCube( byVal dX      AS Double,
                         dSquare AS Double,
                         dCube   AS Double )
'description: the argument dX is squared and cubed
'  and returned in dSquare and dCube, respectively;

   dSquare = dX * dX
   dCube   = dX * dSquare
END SquareAndCube
```

- The function `AverageAngle` takes a `Matrix` of type `MatrixType` as argument and returns the average of the matrix elements.

```
CONST n AS Integer = 5  ' matrix dimension 1
CONST m AS Integer = 20 ' matrix dimension 2
TYPE DIM MatrixType (n,m) AS Double END

FUNCTION AverageAngle( Matrix AS MatrixType ) AS Angle
'description: Matrix is a n by m array of Angle
'  (for the declaration see Section 2.2.3)
'return: the average of all its elements

DIM dSum AS Angle    'sum of the angles
DIM i    AS Integer  'index in the first dimension
DIM j    AS Integer  'index in the second dimension

   dSum = 0          'init the sum to 0
```

```
      FOR i = 1 to n    'for all elem. in the first dim.
         FOR j = 1 to m 'for all elem. in the second dim.
            dSum = dSum + Matrix(i, j) 'sum up the elem.
         NEXT j
      NEXT i
      AverageAngle = dSum / (n*m) 'assign the mean as
                                  ' return value
   END AverageAngle
```

- The next example shows a possible use of the `EXIT SUB` statement, and the difference to the loop `EXIT` statement.

```
   SUB RoutineWithExit
   'description: demonstrates EXIT SUB and EXIT

   DIM i     AS Integer
   DIM lOk   AS Logical
   DIM lCond AS Logical
   ...

      lOk = TRUE

      DO WHILE lOk
         FOR i = 1 TO n
            'do something

            IF Error() THEN
               EXIT SUB      ' terminates the subroutine
            END IF

            IF lCond then
               EXIT          ' terminates the loop
            END IF
         NEXT i
         'this will be executed after "EXIT" but
         ' not after "EXIT SUB"
      LOOP

   END RoutineWithExit
```

2.7.2 Routine Calls

Syntax:

SubroutineCall ::= ["**CALL**"] SubroutineName
[ActualParameterList]

```
FunctionCall            ::= FunctionName  ActualParameterList
ActualParameterList   ::= "("  [  Expression  {  ","  Expression  }  ]  ")"
```

A subroutine call is a statement by itself and can be written wherever statements are allowed, while a function call is (part of) an expression and can be written wherever expressions are allowed. Standard functions are called like user-defined functions.

When a subroutine or function call is encountered, control passes to the called routine. The parameters of the routine are replaced by the expressions in one of two ways, depending on the specification of the parameter.

If the parameter was specified as `byVal`, the expression is evaluated and the resulting value is passed to the routine as the initial value of the corresponding parameter. If the parameter was *not* specified as `byVal`, the expression *must* be a variable of the type specified in the parameter list (possibly an element of a composite variable), and it is passed "by reference", i.e. for this call it takes the place of the parameter in the routine. Any assignment to the parameter becomes an assignment to the actual variable.

Note once again, that variables, including local ones, are not initialised by the compiler. The value of a variable that has not been explicitly assigned a value is undefined.

Note	Generic string parameters which are passed by reference are not checked for overwriting length limits. Hence overwriting of subsequent data may happen if the programmer does not care of this limits. E.g. if the program assigns a string which is longer than the data area where the reference is pointing to. Passing an actual parameter to a typed string parameter (e.g. String30) by reference is limited so far as the actual string parameter has to be of larger or equal length than the formal string parameter. This avoids overwriting of subsequent data.

2.7.2.1 Standard Function Calls

A standard function is called like any user-defined function, as part of an expression, returning a value whose type depends on the function and sometimes on the parameters. Unlike user-defined functions, some standard functions are "overloaded", i.e. they can take parameters of different types, or a varying number of them. For a list of the available standard functions, see Section Standard functions.

2.7.2.2 External Routine Calls

GeoBASIC provides interfaces to external functions, e.g. system routine calls to get a distance. Such routines can be called like any user defined subroutine. They can takes value and reference parameters of any known type. A speciality of external routines is the fact that they return an error code, which is stored in the predefined variable `Err` upon return (see Section 2.3.2 on Declaration of Variables). Special actions may be taken by the GeoBASIC module if the error code is not RC_OK; details are given in the following Section 2.8 on Error Handling.

2.8 ERROR HANDLING

Syntax:

```
LabelDeclaration    ::=  "LABEL" HandlerLabel
OnErrorStatement    ::=  "ON ERROR" ( "RESUME NEXT" |
                              "GOTO" ( HandlerLabel | "0" ) )
HandlerLabel        ::=  Name
ErrorLabel          ::=  HandlerLabel ":"
```

An `ErrorLabel` is used to mark a part of the code and is written on a separate line before the first statement that is to be executed as part of that particular error handler (see also Section 2.6 on Statements). All labels must be declared in the routine in which they label a statement, i.e. the scope of the label is the routine code. An "`ON ERROR GOTO` label" statement must appear in the same routine as the specified label. The other two "`ON ERROR`" statements may appear anywhere.

The predefined variable `Err` is used to signal run-time errors; its value changes in one of three ways.

1) An external TPS-1100 system software routine is called. Upon return `Err` is always set to the routine's return code. Normally this is 0 (= OK); a non-zero value means that an error has occurred during the execution of the external routine.
2) A run-time error occurs during the execution of GeoBASIC code (e.g. division by zero, illegal instruction).
3) The GeoBASIC module explicitly assigns a value to `Err`.

In the first two cases, error handling takes place (if `Err <> 0`) according to the choice then in effect, see below. In the third case, error handling *does not* take place; execution continues normally, regardless of the error handling choice.

Run-time errors can be handled by the GeoBASIC module in one of the following three ways.

a) Control is passed to an error handler label. This method is chosen by executing `ON ERROR GOTO LAB`, where `LAB` is the label of the statement to which control is to be passed. Leaving the active routine will reset the value of `Err` to Zero.

b) Execution of a GeoBASIC program is terminated immediately after an error occurs. This method is chosen by executing `ON ERROR GOTO 0`. This is also the default choice, active at the start of the GeoBASIC module.

c) Execution continues with the statement after the call, i.e. the error condition is ignored. This method is chosen by executing `ON ERROR RESUME NEXT`. The value of `Err` will be kept if the routine returns to the caller.

In methods a) and c) the variable `Err` is set to the return code and can be inspected by the program. In method b) `Err` is set as well, but the program terminates execution. Control and the error code will be passed to the point of the TPS-1100 system where the interpreter has been called.

The activation of an error handler takes place when the execution of an `ON ERROR` - condition has been passed. `ON ERROR` - conditions may be defined anywhere in a statement sequence. Passing such a statement resets the value of `Err` to Zero. In this way, the GeoBASIC programmer has the possibility to control the behaviour of execution depending on the point of execution.

For more information, see the examples below.

CAUTION It is entirely the application programmer's responsibility to make sure that no nonsense results from the use of error handler labels. Particular attention should be paid to the following points.

- If a label is reached in the normal course of code execution, the statements following it will be executed as if the label were not present.
- If "`GOTO` label" (method a) has been chosen and an error occurs, control will be transferred to that label even when the label is inside a structured statement or in a different routine.

- If control is transferred from outside to a label inside a structured statement, this may have undefined consequences, e.g. in case of a `FOR`-statement. Such transfers must be avoided.

Note	`ERROR`, `GOTO`, and `RESUME` are not reserved words, but `ON` is.

Examples:

♦ First, a simple example. An error will be ignored and passed to the caller.

```
SUB ABC
  ON ERROR RESUME NEXT
  ...  'statements
  CALL ExternalSystemRoutine (..)
  ...  'statements
END ABC
```

♦ The next example shows an external system routine call. If an error occurs, then the statements in `ErrLab` may make some changes and try the execution again. If the error occurs a second time, the program aborts immediately.

```
SUB Dispatch
  LABEL ErrLab
  ...  'statements
    ON ERROR GOTO ErrLab

    CALL ExternalSystemRoutine (..)
    EXIT
ErrLab:
    ... 'make changes
    ON ERROR GOTO 0  'abort next time
    CALL ExternalSystemRoutine (..)
    ...  'statements
END Dispatch
```

- The third example handles an error not caused by an external routine (division by zero).

```
SUB MatrixInversion
   LABEL Singular
   DIM i AS Integer
   DIM p AS Double
   ...
   ON ERROR GOTO Singular
   FOR i = 1 TO n
      ...
      p = 1 / a (r, c)     'may divide by zero
      ...
   NEXT i
EXIT SUB
Singular:
   ... 'output error message
END MatrixInversion
```

- Please see also the sample program `error_ha.gbs`.

2.9 THE PROGRAM

A GeoBASIC program (a loader object) has a structure similar to that of a routine. It has no parameters and no code, but it may contain declarations for common constants, types, and variables, and it contains routine declarations, among them at least one `GLOBAL` subroutine (module).

Syntax:

```
Program       ::=  "PROGRAM"  ProgramName
                        { CVTDeclaration | RoutineDeclaration }
                   "END"  [ ProgramName ]
```

The constant, type, and variable declarations (`CVTDeclaration`) that are global to the entire program are written on this level, as are all routine declarations. These comprise the `GLOBAL` subroutines, i.e. the GeoBASIC modules that can be called from "outside" (from the system), and all local subroutines and functions, which are not accessible from outside.

Global routines (modules) with the names "`Stop`", "`Init`", and "`Install`" have a special function within the TPS-1100-System. ("`Stop`" and "`Init`" are reserved names for future using). From the GeoBASIC viewpoint, however, they are declared like any other `GLOBAL` subroutine.

The program name may have up to 18 characters.

2.10 OUTPUT TO THE DISPLAY

Input and output to the display device is not handled by GeoBASIC directly; instead, necessary system routines are called. However, for testing purposes, it is often convenient to have some rudimentary output facilities. GeoBASIC provides a `WRITE`-statement for this purpose. The simple types (`Integer`, `Double`, `Logical`) and strings can be written one per call.

2.10.1 Write

Note	During execution of a GeoBASIC program on TPS-1100 system a `WRITE` - statement has no effect at all. The described behaviour can be observed only if the program is executed on the TPS-Simulator.

Syntax:

IOStatement ::= "**WRITE**" Expression

On output, the evaluated expression is written on one line, terminated by return / new line.

Numeric values are written in a standard format, which for doubles depends on the value. No blanks are output before or after the number.

Logical values are written as `T` (true) or `F` (false), again without surrounding blanks.

Strings are written as they are, without surrounding quotes or blanks. Output strings may contain any printable characters, including blanks and tabs.

A WRITE-call closes the output with CR-LF automatically.

Examples:

- We do some output.

```
WRITE 3 * 6
WRITE 1e3
WRITE 2 > 3
WRITE "this is it"
```

This will print as

```
18
1000
false
this is it
```

2.11 APPINFO-DEFINITION

The AppInfo-definition is an optional compiler-directive which activates the generation of the AppInfo-file during the compilation. The AppInfo-definition has to occur at the end of the source code. Refer to chapter 9.3.2 in the user manual for a description of the AppInfo-functionality.

2.11.1 Syntax in BNF

All entries embraced by curly braces are optional. Also, the AppInfo-section as a whole is optional.

Abbreviations used in the following Syntax:

Abbreviation	**Meaning**
GlobalSubName	Name of a global subroutine
StringConstant	String constant
CapLg	Caption Long: Application name for a menu item
CapSh	Caption Short: Application name for a button
Desc	Description in Customization Tool
Help	Help Text
TheoModel	Theodolite Model
Author	Author of the GeoBASIC Program

Syntax:

AppInfo
::= "**APPINFO** "
[GeneralSection]
{ GlobalSubSection }
"**END**" "**APPINFO**"

GeneralSection
::= "**GENERAL**"
{ GeneralSectionEntry }
"**END**" "**GENERAL**"

GlobalSubSection
::= "**ENTRYPOINT**" GlobalSubName
{ GlobalSubSectionEntry }
"**END**" [GlobalSubName]

GeneralSectionEntry
::= "**SET**"
GeneralSectionKey
StringConstant

GlobalSubSectionEntry
::= "**SET**"
GlobalSubSectionKey
StringConstant

GeneralSectionKey
::= "**AUTHOR**" **|**
"**DESC**" **|**
"**THEOMODEL**"

GlobalSubSectionKey
::= "**CAPSH**" **|**
"**DESC**" **|**
"**HELP**"

Example:

```
'Application Information for Config Tool
```

```
'----------------------------------------
APPINFO

  GENERAL
    SET Author    "Leica AG, CH - Heerbrugg"
    SET Desc      "AppInfo Example Application"
    SET TheoModel "TCA1100"
  END GENERAL



  ENTRYPOINT GlobalSub1
    SET CapLg "Global Sub 1"
    SET CapSh "GSUB1"
    SET Desc  "test of appinfo subroutine 1"
  END GlobalSub1

  ENTRYPOINT GlobalSub2
    SET CapLg "Global Sub 2"
    SET CapSh "GSUB2"
    SET Help  "displays a message and exits"
  END GlobalSub2

END APPINFO
```

See explanations of the example in section 9.3.2 of the user manual.

2.12 IN-/OUTPUT TO FILES

The I/O-routines to files are realised as external routines. Therefore, all the rules explained in chapter 2 have to be applied to the description here too.

Note	Taking off the PC-Card from the theodolite will dismount it and close all open files internally. Automatic reopening of previously opened files will not be supported. A subsequent access to an expected open file will yield into the return code `FIL_NO_STORAGE_MEDIUM_IN_DEVICE`. If the PC-Card will be removed during a file operation then this may cause severe errors on the PC-Card's own file system structures. Loss of data might happen and even more the PC-Card's files-system might be destroyed, leading to unpredictable behaviour of subsequent file operations. Let the user be warned that the card will not be removed during file operations. In the TPS1100 series theodolites 2 types of PC-Cards, SRAM- (static ram) and ATA-Flash-Cards, are supported. **It is highly recommended to group file accesses together and keep a file open during the access only, immediately followed by a close of the file. This will lead to a less vulnerable application.**

Note	A directory separator has to be written as `"\\"` in GeoBASIC.

2.12.1 Summarising Lists of Types and Procedures

2.12.1.1 Types

type name	**description**
`FILE_EXT_Type`	A filename inclusive the extension (exclusive path).
`FILE_STAT_Type`	Specific data about a file.
`FileId`	File identification.
`FileName`	String of 64 characters. Contains a file path and file name.
`MEM_CARD_INFO_Type`	Information about the PC card.

2.12.1.2 Procedures

procedure name	description
`ChDir`	Changes the current directory to a given drive and directory.
`Close`	Close a file.
`CurDir$`	Delivers the current directory including the drive.
`Eof`	Examines if end-of-file has been reached.
`FileCopy`	Copies a file's contents to another.
`GetDirectoryList`	Get a directory list of entries.
`GetFileStat`	Get information about a file.
`GetInt, GetDouble, GetLogical, GetString`	Reads a value in binary mode from a file.
`GetMemoryCardInfo`	Get information about the current mounted PC card.
`Input`	Reads ASCII text from a file in sequential mode
`Kill`	Removes a given file.
`MkDir`	Creates a directory in the current directory.
`Open`	Open a file in a specific mode.
`Print`	Writes ASCII text into a file in sequential mode.
`PutInt, PutDouble, PutLogical, PutString`	Writes a value in binary mode into a file.
`RenameDir`	Renames a directory.
`RenameFile`	Renames a file.
`RmDir`	Removes the given directory.
`Seek`	Positions the file pointer to a specific byte location.
`Tell`	Delivers the current file pointer.

2.12.2 File Operation Data Structures

2.12.2.1 MEM_CARD_INFO_Type – PC Card information

```
TYPE MEM_CARD_INFO_Type
  sLabel             AS String11
  iSize              AS Integer
  iFree              AS Integer
  iMCKind            AS Integer
```

sLabel AS String11	name of card	
iSize AS Integer	total capacity in Bytes	
iFree AS Integer	free capacity in Bytes	
iMCKind AS Integer	memory medium	
	Valid mediums:	**Meaning:**
	MC_SRAM_DISK	static ram
	MC_FLASH_ATA_DISK	flash disk
	MC_UNKNOWN	unknown medium
lWriteProtected AS Logical	TRUE if write protected	

```
END MEM_CARD_INFO_Type
```

2.12.2.2 FILE_STAT_Type – File specific data

```
TYPE FILE_STAT_Type
```

sFileName AS FILE_EXT_Type	file name inclusive extension
DateTime AS Date_Time_Type	structure with date and time, for the definition refer to CSV_GetDateTime
iSize AS Integer	file size
lReadOnly AS Logical	TRUE if read only
lSubDir AS Logical	TRUE if entry is a subdirectory
lArchive AS Logical	TRUE if archive flag is set

```
END FILE_STAT_Type
```

2.12.3 Open

Description Opens a file.
Record oriented file operations are not supported yet

Declaration

```
Open( byVal sFileName AS FileName,
      byVal sMode     AS String20,
            FileId    AS FileId,
      byVal iRecLen   AS Integer )
```

Remarks

The Function attempts to open the file given in `sFileName` with mode `sMode`. If the procedure is successful a valid file descriptor is returned. This file descriptor is used for all successive operations on the opened file. The device of the PC-Card, which is also the default device, is `"A:"`. An Open will not change the default device nor the default directory.
Directories included in `sFileName` must exist already. The `FileId` will be determined automatically. There is no need at all to handle the value of `FileId` directly! No white spaces (spaces, tabs, etc.) may be included in `sFileName.`

Note	If the device is not mounted, an error code will be returned. The `iRecLen` parameter will be ignored, hence it has no effect at all. Its usage is reserved for future purposes. Access modes may not be mixed, hence opening for `Input` <u>and</u> `Output` does not work. A maximum of 20 files can be opened simultaneously.

Parameters

`sFileName`	`in`	File path and name of the file to be opened (`"A:\\dir\\filename.ext"`, up to 100 characters).
`sMode`	`in`	Access mode – `"Input"` - Opens a text file for reading. The file must exist. – `"Output"` - Creates a text new file for writing or truncates it to zero if it

exists.

– `"Append"` - Opens an existing text file at the end of it (EOF). If the file does not exist, it will be created
– `"InBin"` - Opens a binary file for reading.
– `"OutBin"` - Creates a binary file for writing. If it exists then the file will be truncated to zero length.
– `"UpdateBin"` - Opens a binary file for reading and writing. After a successful open the file pointer points to the beginning of the file. If the file does not exist it will be created.

`FileId`	`out`	Unique file-id (output).
`iRecLen`	`in`	The record length is set to a default of 1 byte in any case.

See Also `Close, Input, Print`

Error Codes

`RC_OK`	file opened successfully
`BAS_FIL_INV_MODE`	invalid access mode (see par. `sMode`)
`BAS_FIL_ILL_NAME`	illegal file name specified
`BAS_FIL_TABLE_FULL`	the internal file id table is full
`RC_FIL_MEMORY_FAILED`	Error in internal memory allocation. May be during open access of a non existing directory.
`RC_FIL_FATAL_ERROR`	other fatal error
	device errors
`RC_FIL_FAT_ERROR`	fatal error in accessing the file allocation table

RC_FIL_ILLEGAL_ DRIVE	illegal drive specified
RC_FIL_NO_ STORAGE_MEDIUM_ IN_DEVICE	No memory card inserted or it has been removed and put in again. Further file operations are not save.
RC_FIL_PATTERN_ DOES_NOT_MATCH	directory error
RC_FIL_FILNAME_ NOT_FOUND	tried to access a non-existing file

Example Open a file in "`Output`" access mode for writing.

```
DIM FileId AS FileId
```

```
Open("A:\\test.dat", "Output", FileId, 0 )
```

2.12.4 Close

Description Closes a file.

Declaration `Close( byVal fileId AS FileId )`

Remarks Closes the file as represented by the file descriptor.

Parameters

FileId	in	Unique file-id returned by `Open`.

See Also `Open, Print, Input`

Error Codes

RC_OK	file closed successfully
RC_FIL_MEMORY_ FAILED	Error in internal memory allocation. May be during open access of a non existing directory.
RC_FIL_FATAL_ ERROR	other fatal error
	device errors
RC_FIL_FAT_ERROR	Fatal error in accessing the file

	allocation table.
`RC_FIL_ILLEGAL_ DRIVE`	Illegal drive.
`RC_FIL_WRITE_TO_ MEDIUM_FAILED`	Unspecified error on writing to a file.
`RC_FIL_NO_ STORAGE_ MEDIUM_ IN_DEVICE`	No memory card inserted or it has been removed and put in again. Further file operations are not save.
	file errors
`RC_FIL_INVALID_ FILE_DESCR`	file descriptor is not valid. May occur e.g. if closed twice.

Example Close a file. The `fileId` has to be returned (by `Open`):

```
DIM FileId AS FileId

Open("A:\\test.dat", "Output", FileId, 0 )
'do some work
Close( FileId )
```

2.12.5 Input

Description Read a string from file.

Declaration

```
Input( byVal FileId  AS FileId,
             sData   AS String255,
             iSize   AS Integer )
```

Remarks The functions read a string from the file identified by `FileId`. `iSize` determines how many characters have to be read from the file at a maximum. If the line terminator occurs before `iSize` characters has been read, than `sData` will contain only characters up to the terminator. The current file pointer will be set to the position after the terminator. The line terminator will never be included in the resulting string. The line terminator will be expected as `"CR/LF".` End-of-file (EOF) can be examined by calling `Eof()`. `iSize`, if greater, will be reset to 255 characters without notification to the caller.

Note	The file must have been opened successfully in access mode "Input".

Parameters

`FileId`	`in`	Unique file-id returned by `Open.`	
`sData`	`out`	The read data.	
`iSize`	`inout`	in:	Number of bytes to be read.
		out:	Number of bytes actually read from file.

See Also `Open`
`Close`
`Print`

Error Codes

`RC_OK`	data read successfully
`RC_FIL_MEMORY_FAILED`	Error in internal memory allocation. May be during open access of a non existing directory.
	device errors
`RC_FIL_FAT_ERROR`	fatal error in accessing the file allocation table
`RC_FIL_NO_STORAGE_MEDIUM_IN_DEVICE`	No memory card inserted or it has been removed and put in again. Further file operations are not save.
	file errors
`BAS_FIL_ILL_OPER`	Illegal file operation. Operation and access mode do not correspond.
`RC_FIL_INVALID_FILE_DESCR`	illegal file descriptor used

Example Read a string from a file in "`Input`" access mode.

```
DIM FileId     AS FileId
DIM sFileinput AS String255
```

```
DIM iLen       AS Integer

ON ERROR RESUME NEXT
Open("A:\\test.dat", "Input", FileId, 0 )
'read 10 characters from current file pointer
iLen = 10
Input( FileId, iFileinput, iLen )
IF (iLen <> 10) THEN
  'Error or EOF occured, or EOL reached earlier
END IF
Close(FileId)
```

2.12.6 Print

Description Write a string to a file.

Declaration

```
Print( byVal FileId AS FileId,
       byVal sData  AS String255 )
```

Remarks The function writes a string to the file specified by `FileId`. The actual string determines the numbers of characters which will be written to the file. The printed string will include the line terminator at the end, which will be in any case `"CR/LF"`.

Note	The file must have been opened in access modes "Output" or "Append". Each Print prints the line terminator to the file automatically.

Parameters

`FileId`	in	Unique file-id returned by `Open.`
`sData`	in	The data to be written (of the specified type).

See Also `Open`
`Close`
`Input`

Error Codes

`RC_OK`	data written

RC_FIL_MEMORY_ FAILED	Error in internal memory allocation. May be during open access of a non existing directory.
	device errors
RC_FIL_FAT_ERROR	fatal error in accessing the file allocation table
RC_FIL_WRITE_TO_ MEDIUM_FAILED	unspecified error on writing to a file
RC_FIL_MEDIUM_ FULL	medium is full
RC_FIL_NO_ STORAGE_MEDIUM_ IN_DEVICE	No memory card inserted or it has been removed and put in again. Further file operations are not save.
	file errors
RC_FIL_INVALID_ FILE_DESCR	illegal file descriptor used
BAS_FIL_ILL_OPER	illegal file operation, hence using it on a file which has not been opened in sequential OUTPUT or APPEND mode.

Example Write a string to an "`Output`" file. The `FileId` has to be defined (used by `Open`):

```
DIM FileId      AS FileId

Open ( "A:\\test.txt", "OUTPUT", FileId, 1 )
Print( FileId, "distance measuring" )
Close( FileId )
```

2.12.7 Get – values

Description Read a value from file in binary mode.

Declaration

```
GetByte    ( byVal     FileId   AS FileId,
                       iVal     AS Integer )
GetInt     ( byVal     FileId   AS FileId,
                       iVal     AS Integer )
GetDouble ( byVal      FileId   AS FileId,
                       dVal     AS Double )
GetLogical( byVal      FileId   AS FileId,
                       lVal     AS Logical )
GetString ( byVal      FileId   AS FileId,
                       szVal    AS String255,
                       iLen     AS Integer )
```

Remarks

These functions read a value from the file identified by `FileId`. The values will not be interpreted at all. Only logical values will be transformed to the internal coding. `iLen` gives the maximum number of characters to be read. `iLen`, if greater, will be reset to 255 characters without notification to the caller. End of file can be recognised by calling `Eof`(). If end of file has been reached then it is not guaranteed that the returned value is valid.

Note	The file must have been opened successfully in access mode "`InBin`" or "`UpdateBin`". The binary values will be interpreted in standard DOS format. `GetString` reads as many characters as asked. If the read string contains a `0x00`-byte (internal terminator) then successive string operations will interpret the string up to this terminator.

Parameters

`FileId`	`in`	Unique file-id returned by `Open.`	
Procedure	**Field**	**Type**	**Meaning**
`GetByte`	`iVal`	out	1 byte binary integer (will be expanded to an Integer), returns a value between 0 and 255.
`GetInt`	`iVal`	out	4 byte binary integer.
`GetDouble`	`dVal`	out	8 byte binary double float.
`GetLogical`	`lVal`	out	1 byte: 0 - FALSE else - TRUE

`GetString`	`szVal`	out	`iLen` characters read
	`iLen`	In out	`iLen` characters to be read. Returns actual length of read data. EOF may be a reason which reduces this value.

See Also `Open`
`Close`
`Put – values`

Error Codes

`RC_OK`	data read successfully
`RC_FIL_ MEMORY_FAILED`	Error in internal memory allocation. May be during open access of a non existing directory.
	device errors
`RC_FIL_FAT_ERROR`	fatal error in accessing the file allocation table
`RC_FIL_NO_ STORAGE_MEDIUM_ IN_DEVICE`	No memory card inserted or it has been removed and put in again. Further file operations are not save.
	file errors
`BAS_FIL_ILL_OPER`	illegal file operation, hence using it on a file which has not been opened in `InBin` or `UpdateBin` mode.
`RC_FIL_INVALID_ FILE_DESCR`	illegal file descriptor used

Example The example copies a file.

```
DIM  iFId1   AS  FileId
DIM  iFId2   AS  FileId
DIM  i       AS  Integer

Open ( "A:\\source.txt", "InBin",  iFId1, 1 )
Open ( "A:\\target.txt", "OutBin", iFId2, 1 )
IF EOF(iFileId1) THEN
```

```
    GetByte ( iFId1, i )
    DO WHILE NOT Eof(iFId1)
      PutByte ( iFid2, i )
      GetByte ( iFId1, i )
    LOOP
    PutByte ( iFid2, i )
  ELSE
  ' empty file
ENDIF
Close( iFId1 )
Close( iFId2 )
```

2.12.8 Put – values

Description Put a value to file in binary mode.

Declaration

```
PutByte    ( byVal FileId  AS FileId,
                   iVal    AS Integer )
PutInt     ( byVal FileId  AS FileId,
                   iVal    AS Integer )
PutDouble  ( byVal FileId  AS FileId,
                   dVal    AS Double )
PutLogical( byVal FileId  AS FileId,
                   lVal    AS Logical )
PutString  ( byVal FileId  AS FileId,
                   szVal   AS String255,
                   iLen    AS Integer )
```

Remarks These functions write a value to the file identified by `FileId`. The values will not be interpreted at all. Only logical values will be transformed to the external coding. `iLen` gives the maximum number of characters to be written. If `iLen` is greater than the actual length, then the string will be filled up with '\0'-characters. If `iLen` is greater than 255, then it will be reset to 255. If less than 0 then it will be reset to 0.

Note	The file must have been opened successfully in access mode "`OutBin`" or "`UpdateBin`". The binary values will be written in standard DOS format.

Parameters

`FileId`	`in`	Unique file-id returned by `Open.`

Procedure	**Field**	**Type**	**Meaning**
`PutByte`	`iVal`	in	1 byte binary integer, only the lowest order byte will be taken of the input parameter.
`PutInt`	`iVal`	in	4 byte binary integer.
`PutDouble`	`dVal`	in	8 byte binary double float.
`PutLogical`	`lVal`	in	1 byte: FALSE - 0 TRUE - 1
`PutString`	`szVal`	in	String to be written. `iLen` characters will Note: if `len(szVal) > iLen` then `szVal` will be cut off. If `Len(szVal) < iLen` then `szVal` will filled up with `0x00`-characters.
	`iLen`	in	`iLen` characters to be written.

See Also `Open`
`Close`
`Get – values`

Error Codes

`RC_OK`	data written successfully
`RC_FIL_MEMORY_ FAILED`	Error in internal memory allocation. May be during open access of a non existing directory.
	device errors

`RC_FIL_FAT_ERROR`	fatal error in accessing the file allocation table
`RC_FIL_NO_STORAGE_MEDIUM_IN_DEVICE`	No memory card inserted or it has been removed and put in again. Further file operations are not save.
	file errors
`BAS_FIL_ILL_OPER`	illegal file operation, hence using it on a file which has not been opened in `OutBin` or `UpdateBin` mode.
`RC_FIL_INVALID_FILE_DESCR`	illegal file descriptor used
`RC_FIL_NO_MORE_ROOM_ON_MEDIUM`	memory device is full

Example see Get-values example

2.12.9 Tell

Description Delivers the current position of the file pointer.

Declaration

```
Tell( byVal FileId AS FileId,
            iPos   AS Integer )
```

Remarks The procedure returns the current byte position of the file pointer which has been set by the last read or write operation. `iPos` will get 1 for the first byte.

> **Note** Other than read and write operations `Tell` do not set the file pointer. Hence after opening a file in `APPEND` mode `Tell` will yield into 1, since the file pointer has not been set so far.

Parameters

`FileId`	`in`	Unique file-id returned by `Open.`
`iPos`	`out`	The current byte file position.

See Also `Open`
`Seek`

Error Codes

RC_OK	operation successfully finished
RC_FIL_MEMORY_ FAILED	Error in internal memory allocation. May be during open access of a non existing directory.
	device errors
RC_FIL_FAT_ERROR	fatal error in accessing the file allocation table
RC_FIL_NO_ STORAGE_MEDIUM_ IN_DEVICE	No memory card inserted or it has been removed and put in again. Further file operations are not save.
	file errors
RC_FIL_INVALID_ FILE_DESCR	illegal file descriptor used

2.12.10 Seek

Description Sets the current position of the file pointer.

Declaration

```
Seek( byVal FileId AS FileId,
      byVal iPos   AS Integer )
```

Remarks The procedure sets the current byte position of the file pointer where the next file operation has to take place. `FIL_EOF` may be used for `iPos` to set the file pointer to end-of-file. If `iPos` is greater than the length of the file no return code will be produced. The file pointer will be set to end-of-file.

Note	Seek may be used on files only which have been opened successfully with access modes "`Input`", "`InBin`" or "`UpdateBin`".

Parameters

`FileId`	`in`	Unique file-id returned by `Open.`
`iPos`	`in`	The current byte file position to be set. Must be greater 1 or FIL_EOF.

See Also `Open`
`Tell`

Error Codes

`RC_OK`	operation successfully finished
`RC_FIL_MEMORY_FAILED`	Error in internal memory allocation. May be during open access of a non existing directory.
	device errors
`RC_FIL_FAT_ERROR`	fatal error in accessing the file allocation table
`RC_FIL_NO_STORAGE_MEDIUM_IN_DEVICE`	No memory card inserted or it has been removed and put in again. Further file operations are not save.
	file errors
`RC_FIL_INVALID_FILE_DESCR`	illegal file descriptor used
`BAS_FIL_ILLEGAL_POSITION`	illegal file position, hence < 1
`BAS_FIL_ILL_OPER`	illegal file operation, hence using it on a file opened in sequential OUTPUT or APPEND mode.

Example Getting the length of a text file.

```
DIM FileId   AS FileId
DIM nLen     AS Integer

Open ( "A:\\test.txt", "INPUT", FileId, 1 )
Seek (FileId , FIL_EOF)
Tell (FileId , nLen)    'one more than the length
nLen = nLen - 1         'the length of the file
Close( FileId )
```

2.12.11 Eof() (standard function)

Description Examines if end-of-file has been reached.

Declaration `Eof( byVal FileId AS FileId ) AS Logical`

Remarks The function examines if end-of-file has been reached by the last file operation.

Parameters

`FileId`	`in`	Unique file-id returned by `Open.`
`Eof`	`return`	`TRUE` if end-of-file.

See Also `Open`, `Input`

Error Codes

`RC_OK`	operation successfully finished
`RC_FIL_MEMORY_FAILED`	Error in internal memory allocation. May be during open access of a non existing directory.
	device errors
`RC_FIL_FAT_ERROR`	fatal error in accessing the file allocation table
`RC_FIL_NO_STORAGE_MEDIUM_IN_DEVICE`	No memory card inserted or it has been removed and put in again. Further file operations are not save.
	file errors
`RC_FIL_INVALID_FILE_DESCR`	illegal file descriptor used

Example Opens a file in current directory on default drive. Inputs data and examines if EOF has been reached.

```
DIM FileId        AS FileId
DIM sIn           AS String255
DIM nLen          AS Integer

Open ( "test.txt", "INPUT", FileId, 1)
DO WHILE NOT Eof(FileId)
  nLen = 255
  Input(FileId, sIn, nLen)
  'process in-data
LOOP
```

2.12.12 CurDir$

Description Get current directory.

Declaration `CurDir$( szcurDir AS FileName )`

Remarks The procedure gets the absolute path of the current directory.

> **Note** Since on TPS only memory card device A:\\ will be supported only paths with drive A: will be returned.

Parameters

`szcurDir`	`out`	The current directory and drive.

See Also `ChDir`, `MkDir`

Error Codes

`RC_OK`	operation successfully finished
`RC_FIL_MEMORY_FAILED`	Error in internal memory allocation. May be during open access of a non existing directory.
	device errors
`RC_FIL_FAT_ERROR`	fatal error in accessing the file

	allocation table
RC_FIL_NO_ STORAGE_MEDIUM_ IN_DEVICE	No memory card inserted or it has been removed and put in again. Further file operations are not save.

2.12.13 ChDir

Description Changes the current directory.

Declaration `ChDir( byVal szName AS FileName )`

Remarks After calling `ChDir` all subsequent file operations will occur in the current directory if no absolute path is given.

Note	On TPS only the memory card device will be supported. Hence only paths with drive A: will be supported.

Parameters

szName	in	Name of the next directory.

See Also CurDir$, MkDir, RmDir

Error Codes

RC_OK	current directory changed
RC_FIL_MEMORY_ FAILED	Error in internal memory allocation. May be during open access of a non existing directory.
	device errors
RC_FIL_FAT_ERROR	fatal error in accessing the file allocation table
RC_FIL_NO_ STORAGE_MEDIUM_ IN_DEVICE	No memory card inserted or it has been removed and put in again. Further file operations are not save.

2.12.14 MkDir

Description Creates a directory entry.

Declaration `MkDir( byVal szName AS FileName )`

Remarks If `szName` contains a relative path to the directory then it will be created relative to the current directory. Given an absolute path `MkDir` will create the directory at the absolute position.

Note	On TPS only the memory card device will be supported.

Parameters

`szName`	`in`	Name of the file to be created.

See Also `CurDir$`, `ChDir`, `RmDir`

Error Codes

`RC_OK`	directory created
`RC_FIL_MEMORY_ FAILED`	Error in internal memory allocation. May be during open access of a non existing directory.
	device errors
`RC_FIL_FAT_ERROR`	fatal error in accessing the file allocation table
`RC_FIL_NO_ STORAGE_MEDIUM_ IN_DEVICE`	No memory card inserted or it has been removed and put in again. Further file operations are not save.
`RC_FIL_NO_ MAKE_DIRECTORY`	directory could not be created, because, for example, the directory

exists already

2.12.15 RmDir

Description Removes a directory.

Declaration `RmDir( byVal szName AS FileName )`

Remarks The procedure removes a directory with name `szName`. `szName` will be interpreted either as relative to current directory or absolute.

Note	The directory must exist and must be empty.

Parameters

`szName`	`in`	Name of the directory.

See Also `CurDir$`, `MkDir`

Error Codes

`RC_OK`	directory removed
`RC_FIL_MEMORY_FAILED`	Error in internal memory allocation. May be during open access of a non existing directory.
	device errors
`RC_FIL_FAT_ERROR`	fatal error in accessing the file allocation table
`RC_FIL_NO_STORAGE_MEDIUM_IN_DEVICE`	No memory card inserted or it has been removed and put in again. Further file operations are not save.

2.12.16 Kill

Description Deletes an existing file.

Declaration `Kill( byVal szName AS FileName )`

Remarks The name may be given relative to the current directory or absolute.

Note	The file must exist.

Parameters

`szName`	`in`	Name of the file to be deleted.

See Also `Open`
`RmDir`

Error Codes

`RC_OK`	file removed
`RC_FIL_MEMORY_ FAILED`	Error in internal memory allocation. May be during open access of a non existing directory.
	device errors
`RC_FIL_FAT_ERROR`	fatal error in accessing the file allocation table
`RC_FIL_NO_ STORAGE_MEDIUM_ IN_DEVICE`	No memory card inserted or it has been removed and put in again. Further file operations are not save.
`RC_FIL_FILNAME_ NOT_FOUND`	the given file has not been found

2.12.17 GetMemoryCardInfo

Description Get information about the memory card.

Declaration

```
GetMemoryCardInfo
         (MCInfo AS MEM_CARD_INFO_Type)
```

Remarks The function returns the label, the total capacity, the free capacity and the memory medium of the current mounted PC card. It also get the information if the current mounted PC card is write protected or not.

TPS_Sim	On the simulator the requested drive will be derived from the current setting of GSI data path. Since Win95/WinNT support disk sizes larger than 2GB any capacity between 2 and 4 GB will returned as a negative number. Any capacity above 4GB will be returned as –1.

Parameters

`MCInfo`	`out`	Information about the current mounted PC card.

See Also -

Error Codes

`RC_OK`	Successfully completed.
	device errors
`RC_FIL_NO_STORAGE_MEDIUM_IN_DEVICE`	No memory card inserted or it has been removed and put in again.

Example see example `dirlist.gbs`

2.12.18 GetFileStat

Description Get specific data about a file.

Declaration

```
GetFileStat
    ( byVal sFileName As FileName,
            FStat     As FILE_STAT_Type )
```

Remarks The function returns data about a file. This function follows the same pattern matching rules as `GetDirList`.

TPS_Sim	DOS handles the root directory differently to subdirectories. Therefore calling this function with "." in the root and ".." in a subdirectory of root will cause an error on the simulator.

Parameters

`sFileName`	`in`	Pattern for the requested file.
`FStat`	`out`	Specific data of a file which matches the pattern given in `sFileName`.

See Also -

Error Codes

`RC_OK`	Successfully completed.
`RC_FIL_MEMORY_ FAILED`	Error in internal memory allocation. Maybe because of an access of a non existing directory or drive.
	device errors
`RC_FIL_NO_ STORAGE_MEDIUM_ IN_DEVICE`	No memory card inserted or it has been removed and put in again.
`RC_FIL_INVALID_ PATH`	The given file name pattern does not conform to file path rules.
`RC_FIL_PATTERN_ DOES_NOT_MACTH`	The given file name pattern does not match against any directory entry.

Example see example `dirlist.gbs`

2.12.19 GetDirectoryList

Description Get a list of entries of the given directory.

Declaration

```
GetDirectoryList
    ( byVal sPattern As FileName,
      byVal lInclDir As Logical,
            DirList  As ListArray,
            iItems   As Integer )
```

Remarks The function returns a list filled with directory entries of the given directory which match the given file name pattern. If `lInclDir` is `TRUE` all subdirectory entries in this directory will be included in the list. The current implementation of `ListArray` contains `LIST_ARRAY_MAX_ELEMENT` elements. If the directory contains more entries then the last list entry will have `“---more ---“` assigned to. Pattern matching characters are all valid file name characters, “*” and “?”. The former matches one or more characters and the latter matches exactly one character. For further information please refer to a DOS reference guide.
For the definition of `ListArray` refer to `MMI_InputList`.

Note	As a valid drive specification only `“A:\\”` is allowed. Hidden and system flagged files will be ignored for the entry list.

Parameters

`sPattern`	`in`	Pattern for the requested files.
`lInclDir`	`in`	TRUE: include subdirectories, FALSE: list files only.
`DirList`	`out`	List of directory entries.
`iItems`	`out`	Actual number of items, list length.

See Also -

Error Codes

`RC_OK`	Successfully completed.

`RC_FIL_MEMORY_FAILED`	Error in internal memory allocation. Maybe because of an access of a non existing directory or drive.
	device errors
`RC_FIL_NO_STORAGE_MEDIUM_IN_DEVICE`	No memory card inserted or it has been removed and put in again.
`RC_FIL_INVALID_PATH`	The given file name pattern does not conform to file path rules.
`RC_FIL_PATTERN_DOES_NOT_MACTH`	The given file name pattern does not match against any directory entry.

Example see example `dirlist.gbs`

2.12.20 FileCopy

Description Copies a file's contents to another.

Declaration

```
FileCopy( byVal sSrc As FileName,
          byVal sDot AS FileName )
```

Remarks This function copies the contents of the source file (first parameter) to the destination file. The source and destination patterns *must* be absolute for it to be guaranteed to work! No wildcards are allowed in the names of the source or destination paths. The name of the file in the source path is *not* used for the destination name when the destination only has a directory path: this is an error as no destination file has been explicitly named!

Parameters

`sSrc`	`in`	Absolute path of source file.
`sDot`	`in`	Absolute path of destination file.

See Also -

Error Codes

`RC_OK`	Successfully completed.

RC_FIL_MEMORY_ FAILED	Error in internal memory allocation. Maybe because of an access of a non existing directory or drive.
RC_FIL_INVALID_ PATH	If path is not existent.

Example

```
FileCopy("A:\\test.gsi", "A:\\GSI\\data_1.gsi")
```

2.12.21 RenameFile

Description Renames a file.

Declaration

```
RenameFile( byVal sOldName As FileName,
            byVal sNewName AS FileName )
```

Remarks This function renames the file `sOldName` to `sNewName`. There should be no previous object (file or directory) with the new name. Absolute and relative paths can be used. A file cannot be moved from one directory to another.

Parameters

sOldname	in	Existing file name (with path).
sNewName	in	New name for file (with path).

See Also -

Error Codes

RC_OK	Successfully completed.
RC_FIL_RENAME_ FILE_FAILED	File `sOldname` not found or `sNewName` exists already.
RC_FIL_MEMORY_ FAILED	Error in internal memory allocation. Maybe because of an access of a non existing directory or drive.
RC_FIL_INVALID_ PATH	If path is not existent.

Example `RenameFile("A:\\test.gsi", "A:\\test_1.gsi")`

2.12.22 RenameDir

Description Renames a directory.

Declaration

```
RenameDir( byVal sOldName As FileName,
           byVal sNewName AS FileName )
```

Remarks This function renames an existing directory to that given in `sNewName`. There should be no previous object (file or directory) with the new name. Absolute and relative paths can be used, but they must be already in existence. A directory cannot be moved from one root path to another.

Parameters

sOldname	in	Existing directory name (with path).
sNewName	in	New name for directory (with path).

See Also -

Error Codes

RC_OK	Successfully completed.
RC_FIL_RENAME_ DIR_FAILED	Directory `sOldname` not found or `sNewName` exists already.
RC_FIL_MEMORY_ FAILED	Error in internal memory allocation. Maybe because of an access of a non existing directory or drive.

Example `RenameDir("A:\\GSI", "A:\\GSI_1")`

2.13 COMMUNICATION FUNCTIONS

2.13.1 Send

Description Sends a string to the serial interface. The actual settings will be used to send data over the serial line.

Declaration `Send( byVal sMessage  AS String255 )`

Remarks The routine `Send` sends a message with a maximal length of 255 characters to the serial line. No formatting at all will be done but a TPS predefined terminator at the end will be added automatically to the message.

Note	The data-link must be active. The parameters for the transmission can be set in the GSI communications dialog.

TPS_Sim	Executing a GeoBASIC program on the TPS-Simulator redirects the communication stream to the debug window.

Parameters

`sMessage`	`in`	The message string.

See Also `Receive`
`COM_SetTimeOut`

Error Codes

`RC_OK`	Send has been completed successfully.

Example The example uses the routine `Send` to send a message.

```
Send("This is a message for the routine " +
     "Send." )
```

2.13.2 Receive

Description Receives a string from the serial interface. The actual settings will be used to receive data from the serial line.

Declaration

```
Receive( sMessage AS String255,
         nLength  AS Integer )
```

Remarks The routine `Receive` reads a message with a maximal length of 255 characters from the serial line. No formatting at all will be done. The routine will return from execution when either `nLength` characters or the pre set terminator has been received or the pre set time-out has been reached. An eventually received terminator will be excluded in the received message.

Note	The data-link must be active. The parameters for the transmission can be set in the GSI communications dialog. If time-out is reached, less characters than requested (even Zero) may be received. If `nLength` > 255 then it will be limited to 255 automatically without notification of the caller.

TPS_Sim	Calling `Receive` on the TPS-Simulator has no effects.

Parameters

`sMessage`	`out`	The received message string.	
`nLength`	`inout`	In:	The maximum number of characters to be received.
		Out:	The actual number of characters received.

See Also `Send`
`COM_SetTimeOut`

Error Codes

`RC_OK`	Receive has been completed successfully.
`COM_OVERRUN`	More characters than requested has been accounted in the internal buffer. Additional characters will be deleted and cannot be retrieved by a subsequent call.
`COM_TIME_OUT`	Time-out has been reached.

Example The example calls a procedure to process a successful received string. If the reception has not been completed successfully then nothing will be done. The time-out period will be set to 1 second.

```
DIM  iSize AS Integer
DIM  sIn AS  String255

ON ERROR RESUME NEXT
COM_SetTimeOut (1)
iSize = 255
Receive (sIn, iSize)
IF Err = RC_OK THEN
  ProcessString (sIn)
END IF
```

2.13.3 COM_SetTimeOut

Description Sets the current time-out value for `Receive` operations.

Declaration `COM_SetTimeOut ( byVal nSec  AS Integer )`

Remarks `nSec` will be interpreted as seconds. The time-out value will be valid until it will be set anew. If set to Zero then `Receive` will not wait until it receives any character(s). Rather it will return immediately after calling. Then handling of input has to be done by the programmer.

Note	The data-link must be active. The time-out from the TPS system will be saved and set back when the GeoBASIC program terminates.

> This procedure has no effect if it is called on the TPS-Simulator.

Parameters

`nSec`	`in`	Negative:	Unlimited wait (blocking behaviour).
		Zero:	Polling of data.
		Positive:	Wait time in seconds until the execution of `Receive` times out.

See Also `Send`
`Receive`

Error Codes

`RC_OK`	Completed successfully.

Example See the example for Receive statement.

2.13.4 COM_ExecCmd

Description Executes a defined GeoCOM Remote Procedure.

Declaration

```
COM_ExecCmd ( byVal szPacket  AS String255,
              lStop           AS Logical )
```

Remarks The string `szPacket` will be parsed and executed. The format has to follow the text format of a GeoCOM Remote Procedure Call. See the dedicated documentation for further format information. `szPacket` can be a string which has been previously received via the data-link. `lStop` will be set to `TRUE` if and only if the GeoCOM RPC was either a ‘Go Local’ or ‘Stop’ command (RPC numbers 1 and 2). Once a GeoCOM has been recognised then the result will be sent back via the data link (conforming to the RPC format of GeoCOM).

TPS_Sim	This procedure has no effect if it is called on the TPS-Simulator.

Parameters

`szPacket`	`in`	The string that should be interpreted as a Remote procedure call.
`lStop`	`out`	Will be set to `TRUE` if and only if the command can be successfully parsed and if it is a 'Go Local' (1) command.

See Also `Receive`

Error Codes

`RC_OK`	Completed successfully.
`RC_INVPARAM`	The string in `szPacket` does not contain a valid Remote procedure call.

Example This example polls the serial line and if it receives a Command then it executes it.

```
DIM iSize AS Integer
DIM sIn   AS String255
DIM lStop AS Integer



ON ERROR RESUME NEXT
COM_SetTimeOut (0)      ' do not wait
iSize = 255             ' try to get whole string
Receive (sIn, iSize)
IF Err = RC_OK AND iSize > 0 THEN
  COM_ExecCmd( sIn, lStop )
END IF
```

3 TPS 1100 SYSTEM AND GEOBASIC

This chapter describes the relationship of the GeoBASIC interpreter and the TPS system itself.

3.1 APPLICATIONS ON THE TPS SYSTEM

The TPS1100 series have the possibility to store and execute external programs. Loading such a program stores it in the internal memory of the theodolite. After loading the program it has to be made accessible for the user. This has to be done by creating a menu item and associate it with a global subroutine. In general this will be done during the finalisation process of loading the program by executing the *Install* routine of a program. The Install routine is reserved for such purposes and will be called automatically by the loader. After connecting a program to a menu item the program itself can be executed by choosing just this item from the menu.

Additional to this static link of a program to a menu item there are two other possibilities to install a GeoBASIC application on the TPS system:

- Install as 'Coding'-application
- Import of the application in a user configuration

3.2 'CODING'-APPLICATIONS ON THE TPS SYSTEM

With the *Coding* functionality an application does not need to be connected to a menu item. A Coding program will be invoked when the `CODE` button has been pressed, hence has not be connected to a menu item. Although the global subroutine *Install* has to exist because it is called anyway, but, of course, it may be empty.

A GeoBASIC program for the Coding functionality must have the name `BasicCodeProgram` and the subroutine which is called then must have the name `BasicCodeSub`.

The TPS system allows to handle not only a GeoBASIC program for the coding functionality. Since there exist three possible locations, the TPS system follows a default ordering rule to invoke one of the programs. First it checks if there is an appropriate set up GeoBASIC program. If yes, it will be executed, otherwise it examines the codelist management if a codelist is selected. If yes, then the codelist will be opened, otherwise the standard coding will be activated.

Note	At any time only one GeoBASIC Coding program can be loaded on the TPS system. It must have the predefined names, otherwise it will not be recognised.

3.3 IMPORT OF THE APPLICATION IN A USER CONFIGURATION

The TPS1100 series theodolites supports the loading of individual configurations, with it a user can define his own dialogs and menus. If the user imports a GeoBASIC application into the special configuration definition tool, called Customization Tool, he can insert a global subroutine into his own menus and dialogs. To use this possibility for the installation of a GeoBASIC application the menu or dialog item must be defined in a special section named `APPINFO` at the end of the source code. Refer to chapter 9.3.2 in the user manual for a detailed description of this functionality.

3.4 EVENTS

The configuration functionality of the TPS1100 series is event driven. If a user has defined his own dialogs or menus in a configuration, he can link it with a special event (i.e. the user has pressed the PROG key or the initialisation sequence is finished). If the event occurs, the connected action will be performed, for example the linked dialog or the menu will be displayed. With the routine `CSV_SysCall` all events defined in the theodolite system software can be generated by a GeoBASIC program. For more information about event generation refer to Chapter 9.6 in the user manual.

3.5 A FRAMEWORK FOR AN APPLICATION

In the following chapters standard functions and system functions are described. Almost every such description contains a small example. However, most examples are not ready to compile and run on your LEICA theodolite or PC simulation without setting up a proper program environment.

To keep the examples small, but nevertheless demonstrate some functionality, we now give a general schema for running most of the examples. Just insert the example code at the indicated location, and the program is ready to compile, link, and run. See also the file `test.gbs` as it is provided as an example in the samples directory.

The necessary environment

- provides the global installation routine `Install` that links the program into a theodolites menu,
- creates and deletes a text dialog for textual input and output (in this example up to 5 lines can be used)
- provides a function `Test` that may contain the example program,
- calls the function `Test` to run the example program, and
- waits for a key press after the function `Test` has terminated.

```
PROGRAM TestExample       'program to test the examples
'
' GeoBASIC test frame
' -------------------
'   The example shows a small program frame for the
'   beginning of a project.
'   (c) Leica AG, CH - Heerbrugg 1999
'-----------------------------------------------------
GLOBAL SUB Install
'          -------
' Description
'   Install it in the program menu.
'
  MMI_CreateMenuItem ( "TestExample", "Main",
                       MMI_MENU_PROGRAMS, "EXAMPLE" )
END Install
'-----------------------------------------------------
SUB Test
'   ----
       '=============================================
       '         INSERT YOUR SAMPLE CODE HERE
       '=============================================
END Test
'-----------------------------------------------------
GLOBAL SUB Main
'          ----
' Description
'   Small program frame with an empty text dialog.
'
CONST iLines  AS Integer = 5    'display: 5 lines
                                '   can be used

DIM iButton   AS Integer        'for the button pressed

MMI_CreateTextDialog( iLines, "BASIC",
                      "EXAMPLE", " No Help ")

Test()                          'call the test routine

MMI_GetButton( iButton, TRUE ) 'wait for a key press
MMI_DeleteTextDialog()

END Main

END TestExample
```

3.6 GLOBAL RETURN CODES

In this section the general return codes are briefly described. Note that function specific return codes are found in the function description, and that details on error handling are found in Chapter 2.8.

Global Return Codes.

1. After a standard function or system function is called, the GeoBASIC variable `ERR` contains its *return code*. If everything went smoothly, it is set to the predefined constant `RC_OK`, and normal program execution goes on. However, if there was an error, `ERR` is set to the corresponding error code. (Therefore, we will rather use the term *ERROR CODES* for values other than `RC_OK`.)
2. Every function may have a set of possible error codes defined. If the result of a function is not `RC_OK`, the variable `ERR` will contain one of those error codes, describing the function's termination condition.
3. If the error handling is active (`ON ERROR GOTO`, see Chapter Error Handling), any error code will start the error handler after return from the erroneous function.
4. Usually error codes are grouped by the subsystem to which they are meaningful to (for example `TMC_…` for measurement error codes like `TMC_ANGLE_ERROR`, `TMC_DIST_ERROR,` etc.), but some error codes are generally applicable, for example if there has been a fatal error, an abort, etc.

A summary of all return codes is listed in Appendix F.

Here these general return codes are listed. Note that they will not be mentioned in the description of the standard functions and system functions explicitly unless they have a non-standard or more refined meaning.

Predefined Constant	**Value**	**Meaning**
RC_OK	0	successful termination
RC_UNDEFINED	1	undefined result, unknown error
RC_IVPARAM	2	invalid parameter
RC_IVRESULT	3	invalid result
RC_FATAL	4	fatal error
RC_NOT_IMPL	5	not implemented
RC_TIME_OUT	6	time out
RC_SET_INCOMPL	7	parameter setup for subsystem is incomplete
RC_ABORT	8	function aborted
RC_NOMEMORY	9	not enough memory
RC_NOTINIT	10	subsystem not initialized
RC_SHUT_DOWN	12	subsystem is down
RC_SYSBUSY	13	system busy
RC_HWFAILURE	14	hardware failure (fatal)
RC_ABORT_APPL	15	Abort Application (Shift-Esc)
RC_LOW_POWER	16	Insufficient power level
RC_IVVERSION	17	Invalid version of file, ...
RC_BATT_EMPTY	18	Battery empty
RC_NO_EVENT	20	no event pending
RC_OUT_OF_TEMP	21	out of temperature range
RC_INSTRUMENT_TILT	22	instrument tilting out of range
RC_COM_SETTING	23	communication error
RC_NO_ACTION	24	RC_TYPE Input 'do no action'
RC_SLEEP_MODE	25	Instrument run into sleep mode

4 REMARKS ON THE DESCRIPTION

In the following two chapters all functions known to GeoBASIC are described. In this chapter you will read how this description is organised.

4.1 STRUCTURE OF THE DESCRIPTION

We describe the structure of the system top-down:

1. first the *system as a whole,*
2. then we describe the common parts of *all sections*,
3. and at last a *single function/procedure description*.

4.1.1 The whole system

The description of the whole system is split up into several sections, each describing

- GeoBASIC built-in functions (such as Section Standard functions),
- extensions to GeoBASIC (such as Section Geodesy Mathematics), or a
- theodolite subsystem (such as the whole Chapter System Functions, for example Section MMI Functions describing the man machine interface).

4.1.2 The Sections

A section description consists of (at most) four parts.

1. The *name* of the section.
2. *Lists* of types, functions, procedures, and constants defined in the section.
3. Definition of *types*.
4. Declaration of *functions*, *procedures*, and *constants*.

We now explain these four parts in more detail.

Note	The identifiers in the examples of this section are stylised. Section 4.2 shows a “real“ example, annotated with some explanations given in this section.

4.1.2.1 Name of a section

The *name* of a section describes the section as a whole. It can be considered the smallest class under which all the types, functions, procedures, and constants can be grouped. For example,

6.1 MMI FUNCTIONS

4.1.2.2 Lists of identifiers

Then, *lists* of all identifiers that are defined in the section are given. First for types, then for functions/procedures, and at last for the constants. All lists are sorted by name. The schema is as follows.

Summarising Lists of Types, Procedures, and Constants

Types

type name	**description**
`Some_New_Type`	Brief description of the type.
`Some_Other_New_Type`	Brief description of the type.
…	…

Functions

function name	**description**
`Some_New_Function`	Brief description of the function.
…	…

Procedures

procedure name	**description**
`Some_New_Procedure`	Brief description of the procedure.
…	…

Constants

constant name	**description**
`Some_New_Constant`	Brief description of the constant.
…	…

4.1.2.3 Type definitions

After the lists, the *type definitions* are given. In the example (below) it can be seen that first the new type name and its intended usage is mentioned. In the description part, the type will be described in words. Then its definition follows, giving every component its type and a more detailed description.

New_Type - Here stands what it is used for

Description Here the new type is described.

```
TYPE New_Type
  Component1 ItsType   description of Component1
  Component2 ItsType   description of Component2
  Component3 ItsType   description of Component3
END New_Type
```

4.1.2.4 Function/procedure description

Then the *function/procedure descriptions* follow. (See Section 4.1.3 below.)

Note	Not every section has *all* these four components. Only those parts will be given that actually have entries. (Empty ones are omitted.)

4.1.3 The function/procedure descriptions

We treat functions and procedures together since they only differ in the return value (procedures do not return a value, whereas functions do).

A function/procedure description consists of (at most) eight parts.

1. The function/procedure *name*.
2. The *description*.
3. The *declaration*.
4. *Remarks*.
5. A detailed *parameter description*.
6. Listing of the *error codes*.
7. Cross reference (*see also*).
8. An *example*.

Details:

- Ad 1) First, the function/procedure name is given. For example,

EXAMPLE_SomeFunction

- Ad 2) Then a description follows, describing the function's/procedure's task. For example,

  Description Here the function/procedure is described.

- Ad 3, 4) Afterwards the interface declaration and remarks are given. A note may supplement the presentation. Additional a remark for the simulator may be given which is valid only for the TPS simulator. For example,

Declaration
```
EXAMPLE_Some_Function(
   byVal dParameter AS double,
         sParameter AS String255,
         iParameter AS Integer )
```

Remarks Remarks concerning `EXAMPLE_Some_Function`.

Note	Here come some important notes.

TPS_Sim	Has no effect.

- Ad 5, 6) Now more details of the interface are described: the parameters and the error codes (see also Section Global Return Codes). While doing so, also predefined constants (for parameter values or error codes) are mentioned. For example,

Parameters

`dParameter`	`in`	description of `dParameter`
`sParameter`	`in`	description of `sParameter`
`iParameter`	`out`	description of `iParameter`; possible values for `iParameter`:

value	meaning
`value 1`	meaning 1
`value 2`	meaning 2
…	…

Error Codes

`ErrorCode1`	description of `ErrorCode1`
`ErrorCode2`	description of `ErrorCode2`
…	…

♦ Ad 7, 8) In the end a cross reference and an example of the use of the defined function is given (see also Section Putting the examples to work). For example,

See Also `SomeOtherFunction1`
`SomeOtherFunction2`
Some other chapter in the reference

Example Description of the example.

```
Example source code.
```

Note	Not every description has *all* these components. Only those parts will be given that actually have entries. (Empty ones are omitted.)

The following picture in Section 4.2 shows an annotated example of a procedure description.

4.2 EXAMPLE OF A DESCRIPTION

name of function

4.2.1 TMC_GetAngle

description

Description Measure angles.

function declaration

parameter list

Declaration

```
TMC_GetAngle( Angle       AS TMC_ANGLE,
              iReturnCode AS Integer )
```

remarks

Remarks The function measures the horizontal and vertical angle….

example note

Note The measure program must have been started

Parameters

`Angle`	out	result of measuring the angle
`iReturnCode`	out	return code, see Error Codes

parameter name

pass direction

parameter explanation

See Also `TMC_DoMeasure`

cross reference

explanation of error codes

Return Codes

constants for error codes

`RC_OK`	angle OK
`TMC_ANGLE_ERROR`	no inclination measuring possible (no results)
`. . .`	

Example Read the currently valid angle.

```
DIM Angle AS Double
DIM RetCode AS Integer
TMC_GetAngle( Angle, RetCode )
```

example program

5. STANDARD FUNCTIONS

All but one of the standard functions available in GeoBASIC belong to one of four groups: numeric to numeric, string to numeric, numeric to string, and string to string.

Note: Where string subscripts are used, indexing always starts at 1, as for arrays in GeoBASIC.

5.1 NUMERIC TO NUMERIC

5.1.1 Abs - Absolute value

`Abs(X)` yields the absolute value of the expression `X`. The expression must be of a numeric type (`Integer`, `Double` or its variations). The result is of the same type as `X`.

Examples:

```
Abs (-4.6) -> 4.6
Abs (5)    -> 5
```

5.1.2 Int - Integer part

`Int(X)` yields the integer part of the expression `X`. The expression must be of a numeric type (`Integer`, `Double` or its variations). The result is of type `Integer`.

Examples:

```
Int (5.2) -> 5
Int (5.8) -> 5
Int (-5.5) -> -5
```

5.1.3 Round - Round

`Round(X)` yields the value of the expression `X` rounded to the nearest integer. Values halfway between two integers are always rounded away from zero. The expression must be of a numeric type (`Integer`, `Double` or its variations). The result is of type `Integer`.

Examples:

```
Round (5.2)  -> 5        Round (5.8) -> 6
Round (5.5)  -> 6        Round (6.5) -> 7
Round (-5.2) -> -5       Round (-5.8) -> -6
Round (-5.5) -> -6       Round (-6.5) -> -7
```

5.1.4 Sgn - Sign

`Sgn(X)` yields the sign of the value of the expression `X`. Positive values yield +1, negative values -1, and a zero value yields 0. The expression must be of a numeric type (`Integer`, `Double` or its variations). The result is of type `Integer`.

Examples:

```
Sgn (5.2) -> 1
Sgn (-4) -> -1
Sgn (0) -> 0
```

5.2 STRING TO NUMERIC

5.2.1 Asc - ASCII code of a character

`Asc(S)` yields the value of the first (or only) character of the string expression `S`. The result is of type `Integer`.

Examples:

```
Asc ("*")      -> 42
Asc ("Alpha") -> 65
```

5.2.2 InStr - Index of a substring inside a string

`InStr(S1,S2)` looks for the substring `S2` inside the string `S1` and yields either the index of the first character where `S2` starts in `S1`, or 0 if `S2` cannot be found. Upper and lower case characters are considered distinct. Both parameters must be string expressions. The result is of type `Integer`.

Examples:

```
InStr ("Bananas", "na")  -> 3
InStr ("Bananas", "nas") -> 5
InStr ("Bananas", "Na")  -> 0
```

`InStr(K,S1,S2)` works like `InStr(S1,S2)` but looks for `S2` only at the K-th character and beyond. `S1` and `S2` must be string expressions, `K` must be an expression of type `Integer`. The result is of type `Integer`.

Examples:

```
InStr (3, "Bananas", "na") -> 3
InStr (4, "Bananas", "na") -> 5
InStr (6, "Bananas", "na") -> 0
```

5.2.3 Len - Length of a string

`Len(S)` yields the length of the string expression `S`, i.e. the number of characters in `S` (not counting the terminating zero). The result is of type `Integer`.

Examples:

```
Len ("Bananas")  -> 7
Len ("A + B = ") -> 8
Len ("")         -> 0
```

5.2.4 Val - Numerical value of a string

`Val(S)` yields the value of the string expression `S` interpreted as a numeric constant. `S` may contain leading blanks, one sign, a decimal point, and a power of ten part with or without sign. Blanks within the number are not allowed. Interpretation ends with the first character that cannot be part of a legal GeoBASIC numeric constant representation. If `S` does not represent a number, the result of `Val(S)` is 0. The result is of always of type `Double`.

Examples:

```
Val ("1.5")       ->       1.5
Val (" +7.3e-4")  ->       0.00073
Val ("-2E5xyz")   -> -200000.0
Val ("X")         ->       0.0
Val ("  -3")      ->      -3.0
```

5.3 NUMERIC TO STRING

5.3.1 Chr$ - Character from ASCII code

`Chr$(N)` yields a string of length one, consisting of the character whose ASCII code is the value of the expression `N`. The result is of type `string * 1`.

Example:

```
Chr$ (42) -> "*"
```

5.3.2 String$ - String from fill character

`String$(N,X)` yields a string consisting of `N` identical characters. This character is either the first character of the string expression `X`, or the character whose ASCII code is the value of the integer expression `X`. The result is of type `String`.

Examples:

```
String$ (6, 42)    -> "******"
String$ (5, "/")   -> "/////"
String$ (4, "abc") -> "aaaa"
```

5.3.3 Str$ - String from a numerical value

`Str$(X)` yields the string representing (in a fixed format) the value of the expression `X`. The expression must be of a numeric type (`Integer`, `Double` or its variations). The result is of type `string * n`, where n is the length of the resulting string.

Examples:

```
Str$ (6)          -> "6"
Str$ (-5.88)      -> "-5.88"
Str$ (0.00000042) -> "4.2e-07"
```

5.3.4 SFormat Function

Description Generate a string using a value according to a C-format specification.

Syntax

```
SFormat( byVal sFormatStr AS String,
         byVal iValue     AS Integer )
         AS String

SFormat( byVal sFormatStr AS String,
         byVal dValue     AS Double  )
         AS String

SFormat( byVal sFormatStr AS String,
         byVal lValue     AS Logical )
         AS String
```

Remarks The first argument is an input parameter and must contain a valid format specification for `value`. It has to follow the general rules of GeoBASIC strings and may be of any string type.

The second argument `value` can be any valid numeric (integer, double) or logical expression.
A double value larger than 10^{250} with „%f" formatting will result in the string `"xxxxxxxxxx"`, since the value can be transformed to a maximum of 250 characters only.

Note	The format string and the value argument must match. `sFormatStr255` may contain only one `"%"`. More than one `"%"` are not allowed and may lead to unpredictable behaviour. Other than the here explained formatting sequences are not allowed and may lead to unpredictable behaviour. The computed result cannot be larger than 255 characters long in any case.

General format specification:

`"%[flags][width][.precision][l]type"`

`flags`	`-`	left justify (default: right justify)
	`+`	prefix the output value with a sign ("`+`" / "`-`") (default: sign only for neg. numbers)
	`0`	if width is prefixed with "0", zeros are added until the minimum width is reached. If specified with integer type, it is ignored (default: no padding)
	blank `''`	the value will be prefixed with a blank if positive, instead of sign (default: no padding blank for sign)
	#	when used with `e`, `E` or `f` format type, the flag forces the output value to contain a decimal point in all cases; for `g`, `G` format type, it prevents in addition the truncation of trailing zeros (default: decimal point appears only if digits follow, for `g`, `G` trailing zeros are truncated). ignored for decimal types
`width`	Optional number that specifies the minimum number of characters printed. If the generated string is bigger then all characters are printed.	
`precision`	Optional number that specifies the minimum number of characters printed for all or part of the output field, or minimum number of digits printed for integer values. Can cause truncation of output.	

`type`

Integer types

character	output format
`ld, li`	signed decimal long integer
`lu`	unsigned decimal long integer
`lo`	unsigned octal long integer
`lx`	unsigned hexadecimal long integer, using "abcdef"
`lX`	unsigned hexadecimal. long integer, using "ABCDEF"

Double types

character	output format
`lf`	signed value having the form `[-]dddd.dddd`, where `dddd` is one or more digits. Only values in between $\pm 10^{250}$ can be formatted.
`le`	signed value having the form `[-]d.dddd e` [sign]`ddd`, where *d* is a single digit, `ddd` are exactly 3 digits.
`lE`	identical to `le`, exponent character *E* instead of *e*
`lg`	signed value printed in `f` or `e` format, whichever is more compact for the given value and precision
`lG`	identical to `"lg"`, except that `lG`, rather than `lg`, introduces the exponent (where appropriate)

Data Type (`value`)	Format Specification
`Integer`	any format specification that can be used for a 4-byte value (type long in ANSI-C), see description above For more detailed descriptions, please refer to the format spec. in the description of the ANSI-C-function "`sprintf`") `"...%ld..."` is recommended.
`Double`	8-byte value (double in ANSI-C), see description above `"...%lf..."` is recommended.
`Logical`	the following two formats are implemented: – `"...%s..."`: Generate a string ("T" / "F") – `"...%d..."`: Generate a number (1 / 0)

See Also ANSI-C function `sprintf` format specifications.

Example The example uses the `SFormat` function to generate strings.

```
sFormatVal = SFormat( "Double = %lf", 3.5e-4 )
         ' sFormatVal -> "Double = 0.000350"

sFormatVal = SFormat( "Integer = %ld", -10 )
         ' sFormatVal -> "Integer = -10"

sFormatVal = SFormat( "Logical = %s", TRUE )
         ' sFormatVal -> "Logical = T"

sFormatVal = SFormat( "Hex = %lX", 15 )
         ' sFormatVal -> "Hex = F"

sFormatVal = SFormat( "Octal = %lo", 15 )
         ' sFormatVal -> "Octal = 17"

sFormatVal = SFormat( "Double=%.6lf",1111.12345)
         ' sFormatVal -> "Double = 1111.123450"

sFormatVal = SFormat("Double=%+.6lf",1111.12345)
         ' sFormatVal -> "Double=+1111.123450"
```

5.4 STRING TO STRING

5.4.1 UCase$ - Change to upper case

`UCase$(S)` yields the string expression `S` with all lower case letters "a" to "z" replaced by their upper case. Any other character is unchanged. The result is of type `string * n`, where n is the length of `S`.

Examples:

```
UCase$ ("Start")          -> "START"
UCase$ ("kürzer/länger?") -> "KüRZER/LäNGER?"
                             (umlaut unchanged!)
```

5.4.2 LCase$ - Change to lower case

`LCase$(S)` yields the string expression `S` with all upper case letters "A" to "Z" replaced by their lower case. Any other character is unchanged. The result is of type `string * n`, where n is the length of `S`.

Examples:

```
LCase$ ("START") -> "start"
LCase$ ("GRÖSSER?") -> "grÖsser?"  (umlaut unchanged!)
```

5.4.3 LTrim$ - Trim blanks from the left

`LTrim$(S)` yields the value of the string expression `S` with all leading blanks removed. The result is of type `string * n`, where `n` = (length of `S`) - (number of blanks).

Example:

```
LTrim$ ("   Stop   ") -> "Stop   "
```

5.4.4 RTrim$ - Trim blanks from the right

`RTrim$(S)` yields the value of the string expression `S` with all trailing blanks removed. The result is of type `string * n`, where `n` = (length of `S`) - (number of blanks).

Example:

```
RTrim$ ("   Stop   ") -> "   Stop"
```

5.4.5 Left$ - Left substring

`Left$(S,N)` yields the substring consisting of the first `N` characters of the string expression `S`. `N` must be an expression of type `Integer`. The result is of type `string * N`.

Example:

```
Left$ ("Railwaytrack", 4) -> "Rail"
```

5.4.6 Right$ - Right substring

`Right$(S,N)` yields the substring consisting of the last `N` characters of the string expression `S`. `N` must be an expression of type `Integer`. The result is of type `string * N`.

Example:

```
Right$ ("Railwaytrack", 5) -> "track"
```

5.4.7 Mid$ - Substring anywhere

`Mid$(S,K,N)` yields the substring consisting of `N` characters of the string expression `S`, starting at the `K`-th character. `K` and `N` must be expressions of type `Integer`. The length of the resulting string is `N`. If parameter `N` is omitted, the substring runs to the end of `S`.

Examples:

```
Mid$ ("Railwaytrack", 5, 3) -> "way"
Mid$ ("Railwaytrack", 9) -> "rack"
```

`Mid$` can also be used to assign a character or a substring to another string at a certain place. With `Mid$(S,K,N) = T` single characters of a string can be set or replaced. If the length of `T` is higher than `N`, only the first `N` characters of `T` are set in `S`. Is parameter `N` omitted, the whole substring `T` will be inserted in `S` (if the length of `S` this allows).

Examples:

```
s = "123456789"
Mid$ (s, 2, 3) = "abcde"
' 3 characters (2..4) are replaced
' s -> "1abc56789"

s = "123456789"
Mid$ (s, 2, 7) = "abcde"
' 5 characters (2..6) are replaced
' s -> "1abcde789"

s = "123456789"
Mid$ (s, 2) = "abcde"
' 5 characters (2..6) are replaced
' s -> "1abcde789"
```

5.5 STANDARD MATHEMATICS FUNCTIONS

5.5.1 Summarising List of Mathematics Functions

function name	**description**
`Atn`	Returns the arcs tangent of a number.
`Cos`	Returns the cosine of an angle.
`Exp`	Returns e (the base of natural logarithms) raised to a power.
`Log`	Returns the natural logarithm of a number.
`Rnd`	Returns a random number in a user-defined value-range.
`Sin`	Returns the sine of an angle.
`Sqr`	Returns the square root of a number.
`SRnd`	Initialises the random-number generator.
`Tan`	Returns the tangent of an angle.

5.5.2 Remark on the Conversion of Angles

GeoBASIC computes in SI units, for angles this means in radians. The conversion from grad to radians and vice versa is described next.

Let the variable *halfCircle* be 200 gon. (For decimal degrees, *halfCircle* is 180 degrees. The value in the variable *grad* must be in the corresponding degree units.)

$$\text{radians} = \frac{\text{grad} \times \pi}{\text{halfCircle}} \qquad \text{grad} = \frac{\text{radians} \times \text{halfCircle}}{\pi}$$

Another way to convert angles is to use the geodesy mathematics conversion function. For example to convert `dDegree` decimal degrees to radians (the result will be in `dRadian`), use the following function call. (See section 5.6.24 for a detailed description.)

```
GM_ConvertAngle( GM_DEGREE_DEZ, dDegree, GM_RADIANS,
                 dRadian, iReturnCode )
```

See Also Geodesy Mathematical Formulas: Section on "Conversion of Angles".

5.5.3 Atn Function

Description Returns the arcs tangent of a number.

Declaration `Atn( dAngle AS Double ) AS Double`

Remarks The argument `dAngle` can be any valid numeric expression. The return type of `Atn` is `Double`.

The `Atn` function takes the ratio (a floating point number) of two sides of a right triangle and returns the corresponding angle. The ratio is the length of the side opposite to the angle divided by the length of the side adjacent to the angle. (The hypotenuse is not involved.)
The result's unit is radians. It is in the floating point range
$-\frac{\pi}{2}$ to $\frac{\pi}{2}$.

Note	`Atn` is the inverse trigonometric function of `Tan`. Do not confuse arcus tangent with the cotangent, which is simply the multiplicative inverse of a tangent (i.e. $\frac{1}{\text{Tan}}$).

See Also `Cos, Sin, Tan`
Remark on the Conversion of Angles (5.5.2)

Example The example uses `Atn` to compute Pi. By definition, `Atn(1)` is $\frac{\pi}{4}$ radians (that equals 50 grad or 45 degrees).

```
DIM dMyPi AS Double          ' Declare variables.
dMyPi = 4 * Atn(1)           ' Calculate Pi.
WRITE "Pi is equal to " + str$(dMyPi)
```

5.5.4 Cos Function

Description Returns the cosine of an angle.

Declaration `Cos( dAngle AS Double ) AS Double`

Remarks The argument `dAngle` can be any valid numeric expression measured in radians. The return type of `Cos` is `Double`.

The `Cos` function takes an angle and returns the ratio of two sides of a right triangle: of the length of the side adjacent to the angle to the length of the hypotenuse.

The result is in the floating point range -1.0 to 1.0.

See Also `Atn`
`Sin`
`Tan`
Remark on the Conversion of Angles (5.5.2)

Example The example uses `Cos` to calculate the cosine of an angle with a user-specified number of degrees.

```
DIM dDegrees AS Double      'Declare variables
DIM dRadians AS Double

dDegrees = 45.0
dRadians = dDegrees * (Pi / 180.0)
                           'Convert to radians.
WRITE  "The cosine of a "  +
        Str$(dDegrees) +
        " degree angle is " +
        Str$(Cos(dRadians))
```

5.5.5 Exp Function

Description Returns e (the base of natural logarithms) raised to a power.

Declaration `Exp( dPower AS Double ) AS Double`

Remarks The argument `dPower` can be any valid numeric expression. The return type of `Exp` is `Double`.

e is the exponential constant (base of natural logarithms), with numerical value $e = e^1$ = `Exp(1)` = 2.71828…

Note	Exp is the inverse function of the Log function and is sometimes referred to as the antilogarithm.

See Also `Log`,

Example The example uses `Exp` to compute the value of e. `Exp(1)` is e raised to the power of 1.

```
' Exp(x) is e ^x so Exp(1) is e ^1 or e.
DIM dValueOfE AS Double    ' Declare variables.

dValueOfE = Exp(1) ' Calculate value of e.
WRITE "The value of e is " + Str$(dValueOfE)
```

5.5.6 Log Function

Description Returns the natural logarithm of a number.

Declaration `Log( dNumber AS Double ) AS Double`

Remarks The argument `dNumber` can be any valid numeric expression that denotes a value greater than zero. The return type of `Log` function is `Double`.

The natural logarithm is the logarithm to the base e. e is the exponential constant (base of natural logarithms), with numerical value e = 2.71828…

You can calculate base-n logarithms (logarithms to the base n) for any number x by dividing the natural logarithm of x by the natural logarithm of n as follows:

$Log_n(x)$ = Log(x) / Log(n)

It holds that $n^{Log_n(x)} = x$.

The following example illustrates a function that calculates base-10 logarithms:

```
Function Log10( dX AS Double ) As Double
  Log10 = Log(dX) / Log(10)
End Log10
```

The more general function `LogN` takes the base as an additional argument:

```
Function LogN( iBase AS Integer, dX AS Double )
As Double
  LogN = Log(dX) / Log(iBase)
End LogN
```

See Also `Exp`

Example The example calculates the value of e, then uses the `Log` function to calculate the natural logarithm of e to the third power.

```
DIM dValueOfE AS Double   ' Declare variables.

dValueOfE = Exp(1)
WRITE Str$(Log(dValueOfE ^ 3))
```

5.5.7 Sin Function

Description Returns the sine of an angle.

Declaration `Sin( dAngle AS Double ) AS Double`

Remarks The argument `dAngle` can be any valid numeric expression measured in radians. The return type of `Sin` is `Double`.

The `Sin` function takes an angle and returns the ratio of two sides of a right triangle: of the length of the side opposite to the angle to the length of the hypotenuse.

The result is in the floating point range -1.0 to 1.0.

See Also `Atn`
`Cos`
`Tan`
Remark on the Conversion of Angles (5.5.2)

Example In the example the user can enter a slope distance and a zenith angle. Out of this the horizontal length is computed and displayed.

```
DIM dSlopeDist AS Distance      'slop distance
DIM dZenith    AS Angle         'zenith angle
DIM dHorizDist AS Distance      'computed
horizontal distance
DIM iButton    AS Integer       'button id

PrintStr( 0, 0, "Slope dist.:" )
InputVal( 19, 0, MMI_FFORMAT_DISTANCE, 8, 2,
          dSlopeDist, TRUE, 0.0, 10000.0,
          iButton )
PrintStr( 0, 1, "Zenith angle:" )
InputVal( 19, 1, MMI_FFORMAT_ANGLE, 8, 3,
          dZenith, TRUE, 0.0, 2*Pi, iButton )

dHorizDist = dSlopeDist * Sin( dZenith )
PrintStr( 0, 2, "Horiz. Dist:" )
PrintVal( 19, 2, 8, 2, dHorizDist,
          TRUE, MMI_DIM_ON )
```

5.5.8 Sqr Function

Description Returns the square root of a number.

Declaration `Sqr( dNumber AS Double ) AS Double`

Remarks The argument `dNumber` can be any valid numeric expression that denotes a value greater than or equal to zero. The return type of `Sqr` is `Double`.

Example The example uses `Sqr` to calculate the square root of a user-supplied number.

```
DIM dNumber AS Double    ' Declare variables.

dNumber = 2.0
IF dNumber < 0.0 THEN
    WRITE "Cannot determine the square root " +
          "of a negative number!"
  ELSE
    WRITE "The square root of " + Str$(Number)+
          " is " + Str$(Sqr(dNumber)) + "."
    END IF
```

5.5.9 Tan Function

Description Returns the tangent of an angle.

Declaration `Tan( dAngle AS Double ) AS Double`

Remarks The argument `dAngle` can be any valid numeric expression measured in radians. The return type of `Tan` is `Double`.

The `Tan` function takes an angle and returns the ratio of two sides of a right triangle: of the length of the side opposite the angle to the length of the side adjacent to the angle.

`Mind that Tan` is not defined for `dAngle` $= \frac{\pi}{2}$ and `dAngle` $= -\frac{\pi}{2}$.

See Also `Atn`
`Cos`
`Sin`
Remark on the Conversion of Angles (5.5.2),

Example The example uses `Tan` to calculate the tangent of an angle with a user-specified number of degrees.

```
DIM dDegrees AS Double  ' Declare variables.
DIM dRadians AS Double

dDegrees = 45.0
dRadians = dDegrees * (Pi / 180) ' Convert to
                                 '   radians.
Write( "The tangent of a " + Str$(dDegrees) +
       " degree angle is " +
       Str$( Tan(dRadians)) )
```

5.5.10 Rnd Function

Description Returns a random number in a user-defined value-range.

Declaration

```
Rnd( dNumber AS Double  ) AS Double
Rnd( iNumber AS Integer ) AS Integer
```

Remarks The argument `dNumber` can be any valid numeric expression.

The `Rnd` function returns a pseudo random value in the range 0 to `dNumber`. The `SRnd` function can be used to seed the pseudo random number generator before calling `Rnd`.

> **Note** The same random-number sequence is generated each time the program runs. To have the program generate a different random-number sequence each time it is run, use the `SRnd` function to initialise the random-number generator before `Rnd` is called.

See Also `SRnd`

Example The example uses the `Rnd` function to generate 20 random values in the range from 0 to 10. Each time this program runs, the user can initialise the random-number generator by using `SRnd` to give a new seed value.

```
Sub Rnd_Example()
DIM iStart   AS Integer
DIM iCnt     AS Integer
DIM DateTime AS Date_Time_Type

CSV_GetDateTime( DateTime )
iStart = DateTime.Time.Second
iStart = SRnd( iStart )      'seed random number
                             '  generator

  FOR iCnt = 1 to 20
    Write( Str$(Rnd(10)) )   'generate 20
                             '  random values
  NEXT
END Rnd_Example
```

5.5.11 SRnd Function

Description Initialises the random-number generator.

Declaration

```
SRnd( dNumber AS Double  ) AS Double
SRnd( iNumber AS Integer ) AS Integer
```

Remarks The argument number can be any valid numeric expression, both `Integer` and `Double` works. `iNumber` (or `dNumber`) is used to initialise the pseudo random-number generator by giving it a new seed value.

If `SRnd` is not used, the `Rnd` function returns the same sequence of random numbers every time the program runs. To have the sequence of random numbers change each time the program is run, place the `SRnd` function at the beginning of the program.

The `SRnd`-function returns the value of its argument unchanged.

See Also `Rnd`

Example See `Rnd` function.

5.6 GEODESY MATHEMATICS

5.6.1 Summarising Lists of GM Types and Procedures

5.6.1.5 Types

type name	description
`GM_4Transform_Param_Type`	Transformation parameters.
`GM_Circle_Type`	Definition of a circle.
`GM_Excenter_Elems_Type`	Elements of the eccentric observation.
`GM_Line_Type`	Definition of a line.
`GM_Mean_StdDev_Type`	Average, middle error of average, and middle error of any observation.
`GM_Measurements_Type`	Structure used for measurement (polar coordinates).
`GM_Point_Type`	Definition of a point.
`GM_QXX_Matrix_Type`	Coefficients of the cofactor matrix of the unknown.
`GM_Triangle_Accuracy_Type`	Accuracy of angle and side of the triangle.
`GM_Triangle_Values_Type`	Sides and angles of a triangle.

5.6.1.6 Procedures

procedure name	description
`GM_AdjustAngleFromZeroToTwoPi`	Normalise angle to [0, 2*Pi].
`GM_AngleFromThreePoints`	Calculate enclosed angle from three points.
`GM_CalcAreaOfCoord`	Calculation of area result from measurement.
`GM_CalcAreaOfMeas`	Calculation of area result from measurement.
`GM_CalcAziZenAndDist`	Convert a point given in Cartesian coordinates to polar coordinates.

`GM_CalcCenterAndRadius`	Calculation of centre coordinate and radius result from 3 points.
`GM_CalcClothCoord`	Calculation of coordinate on the unitary clothoids (A=1).
`GM_CalcAziAndDist`	Calculation of azimuth and distance result from coordinate.
`GM_CalcCoord`	Calculation of coordinate result from azimuth and distance.
`GM_CalcDistPointCircle`	Calculation of the distance point to circle and the base point of plumb line.
`GM_CalcDistPointCloth`	Calculation of the distance point - clothoide and the base point of plumb line.
`GM_CalcDistPointLine`	Calculation of the distance point - line and the base point of plumb line.
`GM_CalcHiddenPointObservation`	Calculated measurement to the hidden point.
`GM_CalcIntersectionCircleCircle`	Calculation of intersection-point circle - circle.
`GM_CalcIntersectionLineCircle`	Calculation of intersection-point line - circle.
`GM_CalcIntersectionLineLine`	Calculation of intersection-point line - line.
`GM_CalcMean`	Calculation of the average result from several observations.
`GM_CalcMean_Add`	Calculation of the average result from several observations.
`GM_CalcMeanOfHz`	Calculation of the average from several Hz-directions.
`GM_CalcMedianOfHz`	Calculation of Hz-directions and the average as median.
`GM_CalcOrientationOfHz`	Calculation of the circle-section orientation.
`GM_CalcPointInCircle`	Calculation of a point on a circle.
`GM_CalcPointInLine`	Calculation of a point on a line.

`GM_CalcTriangle`	Calculation of the missing values of a triangle.
`GM_CalcVAndSlope`	Calculation of zenith- and slope-distance from given points (Cartesian coordinates).
`GM_ConvertAngle`	Conversion of angle from one system into the other.
`GM_ConvertDecSexa`	Conversion of value from the decimal into the sexagesimal system.
`GM_ConvertDist`	Conversion of distances from one system into the other.
`GM_ConvertExcentricHzV`	Re-centration of hz- and v-direction.
`GM_ConvertExcentricHzVDist`	Re-centration of hz- and v-direction and distance.
`GM_ConvertPressure`	Conversion of pressure from one system into the other.
`GM_ConvertSexaDec`	Conversion of value from the sexagesimal into the decimal system.
`GM_ConvertTemp`	Conversion of temperature from one system into the other.
`GM_ConvertVDirection`	Conversion of v-directions from one system into the other.
`GM_CopyPoint`	Copy the contents of a point.
`GM_InitQXXMatrix`	Initialise the QXX-Matrix for a point structure.
`GM_LineAzi`	Calculate azimuth of a line.
`GM_MathOrSurveyorsAngleConv`	Adjusts a math angle in radians to a surveyor's angle in radians or vice versa.
`GM_SamePoint`	Test if two points are equal.
`GM_TransformPoints`	Transformation of point.
`GM_Traverse3D`	Convert a point in polar coordinates to Cartesian coordinates.

5.6.2 GeoMath Structures

GM_Mean_StdDev - Exactness

Description With this structure, average, middle error of average, and middle error of any observation are defined.

`TYPE GM_Mean_StdDev_Type`		
`dMeanValue`	`AS Double`	average [m]
`dStdvOfMean`	`AS Double`	middle Error of average [m]
`dStdvOfAnyValue`	`AS Double`	middle Error of any observation [m]
`END GM_Mean_StdDev_Type`		

GM_Excentr_Elems - Eccentric Elements

Description Elements of the eccentric observation.

`TYPE GM_Excenter_Elems_Type`		
`dHzCent`	`AS Double`	horizontal angle to centre [rad]
`dExDist`	`AS Double`	horizontal distance to centre [m]
`dDHeight`	`AS Double`	height difference excenter-centre
`END GM_Excenter_Elems_Type`		

GM_4Transform_Param - Transformation parameters

Description In this structure the transformation parameters are defined.

`TYPE GM_4Transform_Param_Type`		
`dPhi`	`AS Double`	rotation angle
`dScal`	`AS Double`	measure

dX0	AS Double	translation in X-direction
dY0	AS Double	translation in Y-direction

```
END GM_4Transform_Param_Type
```

GM_Measurements - Measurement

Description Structure used for measurement (polar coordinates).

```
TYPE GM_Measurements_Type
```

dHz	AS Double	horizontal reading [rad]
dV	AS Double	vertical reading [rad]
dSlopeDist	AS Double	slope distance [m]

```
END GM_Measurements_Type
```

GM_QXX_Matrix - Co-Factor Matrix of the Unknown

Description With this structure the coefficients of the cofactor matrix of the unknown are defined .

```
TYPE GM_QXX_Matrix_Type
```

dM0	AS Double	middle weight unit error
dA11	AS Double	dA11 to dA33 are the
dA12	AS Double	coefficient of the co factor matrix of
dA13	AS Double	the unknown
dA22	AS Double	
dA23	AS Double	
dA33	AS Double	

```
END GM_ QXX_Matrix_Type
```

GM_Point - Definition of a point

Description With this structure the point is defined.

```
TYPE GM_Point_Type
```

`dE`	`AS Double`	e-coordinate [m]
`dN`	`AS Double`	n-coordinate [m]
`dHeight`	`AS Double`	height [m]
`bHeightValid`	`AS Logical`	indicates whether the height is valid
`Koeff`	`AS GM_QXX_Matrix_Type`	coefficent of the co factor matrix of the unknown

```
END GM_Point_Type
```

GM_Line - Definition of a line

Description With this structure a line is defined.

```
TYPE GM_Line_Type
```

`iType`	`AS Integer`	defines the line type
	Valid values:	**Meaning:**
	`GM_POINT_AND_POINT`	Line defined with two points
	`GM_POINT_AND_AZI`	Line defined with point and azimut
`FirstPt`	`AS GM_Point_Type`	first point on the line
`SecondPt`	`AS GM_Point_Type`	second point on the line
`dAzi`	`AS Double`	azimuth [rad]
`dParShift`	`AS Double`	parallel displacement

```
END GM_Line_Type
```

GM_Circle - Definition of a circle

Description With this structure a circle is defined.

`TYPE GM_Circle_Type`		
`Center`	`AS GM_Point_Type`	centre of the circle
`dRadius`	`AS Double`	radius
`END GM_Circle_Type`		

GM_Triangle_Values - Sides and angles of a triangle

Description With this structure the sides and angles of a triangle are defined.

`TYPE GM_Triangle_Values_Type`		
`dSide1`	`AS Double`	1st triangle side [m]
`dSide2`	`AS Double`	2nd triangle side [m]
`dSide3`	`AS Double`	3rd triangle side [m]
`dAngle1`	`AS Double`	angle opposite side 1 [rad]
`dAngle2`	`AS Double`	angle opposite side 2 [rad]
`dAngle3`	`AS Double`	angle opposite side 3 [rad]
`END GM_Triangle_Values_Type`		

GM_Triangle_ Accuracy - Accuracy of angle and side of the triangle

Description With this structure the exactness of the sides and angles are defined.

`TYPE GM_Triangle_Accuracy_Type`		
`dMeS1`	`AS Double`	mean error of the 1st triangle side [m]
`dMeS2`	`AS Double`	mean error of the 2nd triangle side [m]
`dMeS3`	`AS Double`	mean error of the 3rd triangle side [m]
`dMeA1`	`AS Double`	mean error of the angle opposite side 1 [rad]
`dMeA2`	`AS Double`	mean error of the angle opposite

		side 2 [rad]
dMeA3	AS Double	mean error of the angle opposite side 3 [rad]

```
END GM_Triangle_Accuracy_Type
```

5.6.3 GM_CalcAreaOfCoord

Description Calculation of area result from measurement.

Declaration

```
GM_CalcAreaOfCoord_Start(
         StartPt AS GM_Point_Type )

GM_CalcAreaOfCoord_Add(
         CurrPt            AS GM_Point_Type,
         byVal dRadius     AS Double,
               dArea       AS Double,
               iReturnCode AS Integer )
```

Remarks With the first function the calculation of the area of an arbitrary polygon can be started by defining the start-point (`StartPt`, `cartesian` coordinates). The second function allows to extend the polygon by adding new points. When `CurrPt` equates to the start-point, the area of the now closed polygon will be calculated.

Note	The computation is done the plane, i.e. the height is ignored.

Note	For the used formula see Appendix, Geodesy Math. Formulas.

Parameters

StartPt	in	start point of the polygon in Cartesian coordinates
CurrPt	in	current point to be added to the polygon in cart. coordinates

`dRadius`	in	if `dRadius>0`, the connection between the last point added and the current point (current edge) is assumed to be an arc. The area for the arc segment will be calculated as follows: $F = \frac{1}{2} \times \mathrm{dRadius}^2 \times (d - \sin(d))$, where *d* is the angle change of the arc.
`dArea`	out	superficies of the closed polygon [m²]
`iReturnCode`	out	return code

value	meaning
`GM_NO_SOLUTION`	current and start-point are not yet identical, point has been added to polygon

Return Codes

`GM_RADIUS_NOT_POSSIBLE` invalid value for `dRadius`; this is the case if

1) `dRadius` $\neq$ `0.0` **and**

2) $\texttt{Abs}(\texttt{dRadius}) < \frac{\text{length of current edge}}{2}$.

Example Calculate the area defined by 3 given edges.

```
DIM iRetCode AS Integer
DIM CurrPt   AS GM_Point_Type
DIM dRadius  AS Double
DIM dArea    AS Double

'init CurrPt and dRadius with the first point
Init_GM_Point_Type( CurrPt )
CurrPt.dE = 1.0
CurrPt.dN = 1.0
GM_CalcAreaOfCoord_Start( CurrPt )

'add the second point
CurrPt.dE = 3.0
CurrPt.dN = 1.0
GM_CalcAreaOfCoord_Add( CurrPt, dRadius,
                        dArea, iRetCode )

'add the third point
CurrPt.dE = 2.0
CurrPt.dN = 2.0
GM_CalcAreaOfCoord_Add( CurrPt, dRadius,
                        dArea, iRetCode )

'close the polygon: back to the first point
CurrPt.dE = 1.0
CurrPt.dN = 1.0
GM_CalcAreaOfCoord_Add( CurrPt, dRadius,
                        dArea, iRetCode )
```

5.6.4 GM_CalcAreaOfMeas

Description Calculation of area result from measurement.

Declaration

```
GM_CalcAreaOfMeas_Start( StartPt AS
GM_Measurements_Type )

GM_CalcAreaOfMeas_Add(
          CurrPt  AS GM_Measurements_Type,
    byVal dRadius     AS Double,
          dArea       AS Double,
          iReturnCode AS Integer )
```

Remarks With the first function the calculation of the area of an arbitrary polygon can be started by defining the start-point (`startPt`, polar coordinates). The second function allows to extend the polygon by adding new points. When `currPt` equates the start-point, the area of the now closed polygon will be calculated.

Note	The computation is done the plane, i.e. the horizontal distance is computed and the height is ignored. For the used formula see Appendix, Geodesy Math. Formulas.

Parameters

`StartPt`	`in`	start - point of the polygon in polar coordinates
`CurrPt`	`in`	current point to be added to the polygon in polar coordinates
`dRadius`	`in`	if `dRadius>0`, the connection between the last point added and the current point (current edge) is assumed to be an arc. The area for the arc segment will be calculated as follows: $F = \frac{1}{2} \times dRadius^2 \times (d - \sin(d))$, where *d* is the angle change of the arc.
`dArea`	`out`	Superficies of the closed polygon [m^2]

iReturnCode	out	Return-code; possible values: RC_OK successful calculation of area GM_NO_SOLUTION current and start-point are not yet identical, point has been added to polygon

Return Codes

RC_OK	successful calculation of area
GM_RADIUS_NOT_POSSIBLE	invalid value for dRadius; this is the case if

1) dRadius ≠ 0.0 **and**

2) $\text{Abs}(\text{dRadius}) < \frac{\text{length of current edge}}{2}$.

Example Calculate the area from 3 given edges.

```
DIM iRetCode AS Integer
DIM CurrPt   AS GM_Measurements_Type
DIM dRadius  AS Double
DIM dArea    AS Double

'init CurrPt and dRadius with the first point
Init_GM_Point_Type( CurrPt )
CurrPt.dHz        =  0.0
CurrPt.dV         =  1.5707963
CurrPt.dSlopeDist = 10.0
GM_CalcAreaOfMeas_Start( CurrPt )

'add the second point
CurrPt.dHz        =  1.5707863
CurrPt.dV         =  1.5707963
CurrPt.dSlopeDist =  5.0
GM_CalcAreaOfMeas_Add( CurrPt, dRadius,
                       dArea, iRetCode )
```

```
'add the thrid point
CurrPt.dHz        =  1.5707863
CurrPt.dV         =  1.2341223
CurrPt.dSlopeDist = 16.8775
GM_CalcAreaOfMeas_Add( CurrPt, dRadius,
                       dArea, iRetCode )

'close the polygon: back to the first point
CurrPt.dHz        =  0.0
CurrPt.dV         =  1.5707963
CurrPt.dSlopeDist = 10.0
GM_CalcAreaOfMeas_Add( CurrPt )
```

5.6.5 GM_CalcAziAndDist

Description Calculation of azimuth and distance result from coordinates.

Declaration

```
GM_CalcAziAndDist(
                StationPt AS GM_Point_Type,
                TargetPt  AS GM_Point_Type,
                dAzi      AS Double,
                dDist     AS Double,
                dStdvAzi  AS Double,
                dStdvDist AS Double )
```

Remarks This function is calculating azimuth and distance result from coordinates.

> **Note** Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

StationPt	in	coordinates and exactness of the station-point
TargetPt	in	coordinates and exactness of the target-point
dAzi	out	calculated azimuth [rad]
dDist	out	calculated distance [m]
dStdvAzi	out	set to 0 (reserved for future use)
dStdvDist	out	set to 0 (reserved for future use)

Return Codes

RC_OK	successful calculation of azimuth and distance
GM_IDENTICAL_POINTS	Station- and target-point are identical, calculation not possible. The recovered values are not defined.

Example Calculate the distance of a target from a station according to given StationPt and TargetPt.

```
DIM StationPt AS GM_Point_Type
DIM TargetPt  AS GM_Point_Type
DIM dAzi      AS Double
DIM dDist     AS Double
DIM dStdvAzi  AS Double
DIM dStdvDist AS Double

'initialize StationPt and TargetPt
StationPt.dN      = 3.0
StationPt.dE      = 0.0
StationPt.dHeight = 0.0
TargetPt.dN       = 0.0
TargetPt.dE       = 5.0
TargetPt.dHeight  = 0.0
'in GM_QXX_MATRIX set all values to 0.0 (for
'  StationPt and TargetPt)

GM_CalcAziAndDist( StationPt, TargetPt,
                   dAzi, dDist,
                   dStdvAzi, dStdvDist)
```

5.6.6 GM_CalcCenterAndRadius

Description Calculation of centre coordinate and radius result from 3 points.

Declaration

```
GM_CalcCenterAndRadius(
                 Pt0      AS GM_Point_Type,
                 Pt1      AS GM_Point_Type,
                 Pt2      AS GM_Point_Type,
                 dRadius  AS Double,
                 Center   AS GM_Point_Type,
                 dMRadius AS Double )
```

Remarks This function is calculating the coordinate of the centre and the radius result from 3 given points.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`Pt0`	`in`	contains the coordinate and the exactness of the 1. point
`Pt1`	`in`	contains the coordinate and the exactness of the 2. point
`Pt2`	`in`	contains the coordinate and the exactness of the 3. point
`dRadius`	`out`	calculated radius [m]
`Center`	`out`	calculated coordinates and exactness of the centre
`dMRadius`	`out`	middle error of the radius [m]

Return Codes

`GM_PTS_IN_LINE`	The 3 points are located on one line, the calculation not possible. All output values are undefined.

Example Calculate the centre from the 3 given points.

```
DIM Pt0      AS GM_Point_Type
DIM Pt1      AS GM_Point_Type
DIM Pt2      AS GM_Point_Type
DIM dRadius  AS Double
DIM dMRadius AS Double
DIM Center   AS GM_Point_Type

GM_CalcCenterAndRadius( Pt0, Pt1, Pt2, dRadius,
                        Center, dMRadius )
```

5.6.7 GM_CalcClothCoord

Description Calculation of coordinate on the unitary clothoid (A=1).

Declaration

```
GM_CalcClothCoord( byVal dTau AS Double,
                         dX   AS Double,
                         dY   AS Double )
```

Remarks This function is calculating the coordinate, dependent from the tangent angle, of one point on the unitary clothoid.

Note Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

dTau	in	tangent angle [rad]
dX	out	x-coordinate of the Clothoid point
dY	out	y-coordinate of the Clothoid point

Return Codes

RC_OK	always OK

Example Calculate the centre from the 3 given points.

```
DIM dX AS Double
DIM dY AS Double

GM_CalcClothCoord( 3.1415, dX, dY )
```

5.6.8 GM_CalcCoord

Description Calculation of coordinate result from azimuth and distance.

Declaration

```
GM_CalcCoord( StationPt   AS GM_Point_Type,
       byVal dAzi        AS Double,
       byVal dHorizDist  AS Double,
             TargetPt    AS GM_Point_Type )
```

Remarks This function is calculating the coordinate result from azimuth and distance.

Note Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`StationPt`	`in`	coordinates and exactness of the station point
`dAzi`	`in`	azimuth [rad]
`dHorizDist`	`in`	horizontal distance[m]
`TargetPt`	`out`	coordinates and exactness of the target point

Return Codes

`RC_OK`	always OK

Example Calculate the distance of a target from a station according to given azimuth and horizontal distance.

```
DIM StationPt AS GM_Point_Type
DIM TargetPt  AS GM_Point_Type

'initialize StationPt

GM_CalcCoord( StationPt, 0.5, 1000.0, TargetPt )
```

5.6.9 GM_CalcDistPointCircle

Description Calculation of the distance point to circle and the base point of plumb line.

Declaration

```
GM_CalcDistPointCircle(
                Point     AS GM_Point_Type,
                Circle    AS GM_Circle_Type,
                dDist     AS Double,
                FootPoint AS GM_Point_Type )
```

Remarks This function is calculating the distance of one point to a circle and his base-point of the foot of a perpendicular observation.

> **Note** Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`Point`	`in`	coordinates and exactness of the point to be plumbed
`Circle`	`in`	circle
`dDist`	`out`	distance point - circle [m]
`FootPoint`	`out`	coordinate of the base point of plumb line

Return Codes

`RC_OK`	always OK

Example Calculate the distance of a point to a circle.

```
DIM Pt     AS GM_Point_Type
DIM Circle AS GM_Circle_Type
DIM dDist  AS Double
DIM BasePt AS GM_Point_Type

'initialize Pt and circle with any values

GM_CalcDistPointCircle( Pt, Circle,
                        dDist, BasePt )
```

5.6.10 GM_CalcDistPointCloth

Description Calculation of the distance point - Clothoid and the base point of plumb line.

Declaration

```
GM_CalcDistPointCloth(
                BA          AS GM_Point_Type,
                BE          AS GM_Point_Type,
                Point       AS GM_Point_Type,
         byVal  dA          AS Double,
         byVal  dL          AS Double,
                dDist       AS Double,
                dDistAlongSpiral AS Double,
                FootPoint   AS GM_Point_Type )
```

Remarks This function is calculating the distance of one point to the clothoid and his base point of plumb line in the area of $0 < \tau < \pi / 2$. Prerequisite that, the Clothoid is placed in the country-coordinate -system.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`BA`	`in`	beginning of the arc in the country coordinate system
`BE`	`in`	end of the arc in the country coordinate system
`Point`	`in`	point to be plumbed out in the country coordinate system
`dA`	`in`	clothoid - parameter
`dL`	`in`	arc length [m]
`dDist`	`out`	distance point - Clothoid [m]
`dDistAlongSpiral`	`out`	distance along arc
`FootPoint`	`out`	coordinate of the base point of foot of a perpendicular observation

Return Codes

`GM_OUT_OF_RANGE`	The foot of a perpendicular observation is placed outside the area $0 < \tau < \pi / 2$, not perpendicular.

Example Calculate the distance of a point to a clothoid.

```
DIM BA     AS GM_Point_Type
DIM BE     AS GM_Point_Type
DIM Point  AS GM_Point_Type
DIM dL     AS Double
DIM dA     AS Double
DIM dDist  AS Double
DIM dDist2 AS Double
DIM BasePt AS GM_Point_Type

'initialize BA, BE, Point, dA, dL adequatley

GM_CalcDistCloth( BA, BE, Point, dA, dL,
                  dDist, dDist2, BasePt )
```

5.6.11 GM_CalcDistPointLine

Description Calculation of the distance point - line and the base point of foot of a perpendicular observation.

Declaration

```
GM_CalcDistPointLine(
            Line      AS GM_Line_Type,
            Point     AS GM_Point_Type,
            dDistX    AS Double,
            dDistY    AS Double,
            FootPoint AS GM_Point_Type )
```

Remarks This function is calculating the distance of one point to the line and his base point of the foot of a perpendicular observation. One effective definition of line is also possible result from one parallel (see predefined type `GM_Line_Type`).

Note Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`Line`	`in`	line
`Point`	`in`	point to be plumbed out
`dDistX`	`out`	distance point - line [m]
`dDistY`	`out`	distance point in the direction of the line [m]
`FootPoint`	`out`	coordinate of the base point of plumb line

Return Codes

`RC_OK`	successful calculation
`GM_IDENTICAL_PTS`	Start - and endpoint of the line are identical. Calculation is not possible. The recovered values are not defined.

Example Calculate the distance of a point to a line.

```
DIM Line   AS GM_Line_Type
DIM Point  AS GM_Point_Type
DIM dDistX AS Double
DIM dDistY AS Double
DIM BasePt AS GM_Point_Type

'initialize Line and Point adequatley

GM_CalcDistPointLine( Line, Point, dDistX,
                      dDistY, BasePt )
```

5.6.12 GM_CalcHiddenPointObservation

Description Calculated measurement to the hidden point.

Declaration

```
GM_CalcHiddenPointObservation(
          Point1    AS GM_Measurements_Type,
          Point2    AS GM_Measurements_Type,
   byVal dDistP1P2 AS Double,
   byVal dDistP1HP AS Double,
          HiddenPt  AS GM_Measurements_Type )
```

Remarks This function is calculating the measurement to the hidden point, result from the measurements onto both reflectors of the hidden point staff.

Note Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`Point1`	`in`	contains the measurement of the reflector 1 of hidden point staff
`Point2`	`in`	contains the measurement of the reflector 2 of hidden point staff
`dDistP1P2`	`in`	Distance of both reflectors [m].
`dDistP1HP`	`in`	Distance of reflectors 1 and the hidden point's [m].
`HiddenPt`	`out`	calculated measurement to the hidden point

Return Codes

`GM_IDENTICAL_PTS`	Both measurement onto the same point. Calculation is not possible. The recovered values are not defined.
`GM_PLAUSIBILITY_ERR`	The distance to the reflectors does not correspond to the measurement. The recovered values are not defined .

Example Calculate the hidden point.

```
DIM Point1 AS GM_Point_Type
DIM Point2 AS GM_Point_Type
DIM dDistP1P2 AS Double
DIM dDistP1Hd AS Double
DIM HiddenPt AS GM_Point_Type

'initialize Point1, Point2,
'dDistP1P2, dDistP1Hd adequatley

GM_CalcHiddenPointObservation( Point1, Point2,
                               dDistP1P2,
                               dDistP1Hd,
                               HiddenPt )
```

5.6.13 GM_CalcIntersectionCircleCircle

Description Calculation of intersection-point circle - circle.

Declaration

```
GM_CalcIntersectionCircleCircle(
             FirstCircle  AS GM_Circle_Type,
             SecondCircle AS GM_Circle_Type,
             FirstInters  AS GM_Point_Type,
             SecondInters AS GM_Point_Type,
             iReturnCode  AS Integer )
```

Remarks This function is calculating the intersection point(s) between two circles.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`FirstCircle`	`in`	Definition of the 1. circle
`SecondCircle`	`in`	Definition of the 2. circle
`FirstInters`	`out`	Coordinate. and exactness of the 1. intersect. point
`SecondInters`	`out`	Coordinate. and exactness of the 2. intersect. point
`iReturnCode`	`out`	indicates the number of solutions

`GM_NO_ SOLUTION`	no intersection point
`GM_ONE_ SOLUTION`	exactly one solution. The values for `Second-Inters` are nor defined.
`GM_TWO_ SOLUTIONS`	two intersection points

Return Codes

`RC_OK`	successful calculation

Example Calculate the intersection points between the circles.

```
DIM Circle1   AS GM_Circle_Type
DIM Circle2   AS GM_Circle_Type
DIM Interspt1 AS GM_Point_Type
DIM Interspt2 AS GM_Point_Type
DIM iRetCode  AS Integer

'initialize circle1 and circle2 adequatley

GM_CalcIntersectionCircleCircle( Circle1,
                                 Circle2,
                                 Interspt1,
                                 Interspt2,
                                 iRetCode )
```

5.6.14 GM_CalcIntersectionLineCircle

Description Calculation of intersection-point line - circle.

Declaration

```
GM_CalcIntersectionLineCircle(
            Line         AS GM_Line_Type,
            Circle       AS GM_Circle_Type,
            FirstInters  AS GM_Point_Type,
            SecondInters AS GM_Point_Type,
            iReturnCode  AS Integer )
```

Remarks This function is calculating the intersection-point(s) between one line and one circle. The line could show a transverse displacement and can be defined as a result from 2 points, or as result from one point and azimuth (see predefined type `GM_Line`).

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`Line`	`in`	Definition of the line.
`Circle`	`in`	Definition of the circle.
`FirstInters`	`out`	Coordinate and exactness of the 1. intersect. point.
`SecondInters`	`out`	Coordinate and exactness of the 2. intersect. point.
`iReturnCode`	`out`	indicates the number of solutions

`GM_NO_SOLUTION`	no intersection point
`GM_ONE_SOLUTION`	exactly one solution; the values for `Second-Inters` are nor defined
`GM_TWO_SOLUTIONS`	two intersection points

Return Codes

GM_IDENTICAL_PTS	Start- and endpoint of the line are identical. Calculation is not possible.

Example Calculate the intersection points between the line and the circle.

```
DIM Line      AS GM_Line_Type
DIM Circle    AS GM_Circle_Type
DIM Interspt1 AS GM_Point_Type
DIM Interspt2 AS GM_Point_Type
DIM iRetCode  AS Integer

'initialize Line and Circle adequatley

GM_CalcIntersectionLineCircle( Line, Circle,
                               Interspt1,
                               Interspt2,
                               iRetCode )
```

5.6.15 GM_CalcIntersectionLineLine

Description Calculation of intersection-point line - line.

Declaration

```
GM_CalcIntersectionLineLine(
             FirstLine    AS GM_Line_Type,
             SecondLine   AS GM_Line_Type,
             Intersection AS GM_Point_Type,
             iReturnCode  AS Integer )
```

Remarks This function is calculating the intersection-point between two Lines. The lines could show a transverse displacement and can be defined as a result from 2 points, or as result from one point and azimuth (see predefined type `GM_Line`).

> **Note** Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`FirstLine`	`in`	Definition of the 1. line.
`SecondLine`	`in`	Definition of the 2. line.
`Intersection`	`out`	Coordinate and exactness of the intersect. point.
`iReturnCode`	`out`	indicates the number of solutions

`GM_NO_SOLUTION`	no intersection point, i.e. the lines are parallel
`GM_ANGLE_SMALLER_15GON`	Warning: the intersect. Angle of the line is smaller than 15 gon. The intersect. point was still calculated.

Return Codes

`GM_IDENTICAL_PTS`	Start- and endpoint of a line are identical. Calculation is not possible.

Example Calculate the intersection points between the 2 lines.

```
DIM Line1    AS GM_Line_Type
DIM Line2    AS GM_Line_Type
DIM IntersPt AS GM_Point_Type
DIM iRetCode AS Integer

' initialize Line1 and Line2 adequatley

GM_CalcIntersectionLineLine( Line1, Line2,
                             IntersPt,
                             iRetCode )
```

5.6.16 GM_CalcMean

Description Calculation of the average result from several observations.

Declaration

```
GM_CalcMean_Add(
        byVal dObservation AS Double,
        byVal dWeight      AS Double,
        byVal lStartNew    AS Logical )

GM_CalcMean( Mean AS GM_Mean_StdDev_Type )
```

Remarks The first function creates an internal data list and adds the values (`dObservation`, `dWeight`) to it. The second is calculating the average, the middle error of the average, the middle error of the observations stored in the data list.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`dObservation`	`in`	observation to be averaged
`dWeight`	`in`	weight for averaging
`lStartNew`	`in`	`TRUE`: the given values (`dObservation`, `dWeight`) are the first in a new series (initialisation). The old series (belonging to this function) will be lost. `FALSE`: add the values to an existing data series.
`Mean`	`out`	calculated results from the current data series

Return Codes

RC_OK	successful creation, adding, and calculation
GM_OUT_OF_RANGE	This may occur when calling `GM_CalcMean_Add( ..., ..., FALSE )`. Two reasons: 1. no data series exists, 2. too many data items.
RC_IV_RESULT	When calling `GM_CalcMean` with no successful previous call of `GM_CalcMean_Add`.
GM_TOO_FEW_ OBSERVATIONS	Too few observations to be able to calculate the average. The recovered values are not defined.
GM_PLAUSIBILITY_ ERR	The sum of the weights is 0.

Example Calculate the weighted average and standard deviation.

```
DIM Mean AS GM_Mean_StdDev_Type

GM_CalcMean_Add( 1.0, 0.5, TRUE  )
GM_CalcMean_Add( 2.0, 1.0, FALSE )
GM_CalcMean_Add( 3.0, 1.5, FALSE )
GM_CalcMean( Mean )
```

5.6.17 GM_CalcMeanOfHz

Description Calculation of the average from several Hz-directions.

Declaration

```
GM_CalcMeanOfHz_Add(
            byVal dHzDirection AS Double,
            byVal lStartNew AS Logical )

GM_CalcMeanOfHz(
            Mean AS GM_Mean_StdDev_Type )
```

Remarks The first function creates an internal data list and adds Hz-directions to it. The second is calculating the average, the middle error of the average, the middle error of any direction evaluating the added Hz-directions in the list.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`dHzDirection`	`in`	Hz - direction
`lStartNew`	`in`	`TRUE`: the given value (`dHzDirection`) is the first in a new series (initialisation). The old series (belonging to this function) will be lost. `FALSE`: add the values to an existing data series.
`Mean`	`out`	calculated results from the current data series.

Return Codes

RC_OK	successful creation, adding, and evaluation
RC_IV_RESULT	When calling GM_CalcMeanOfHz with no successful previous call of GM_CalcMeanOfHz_Add.
GM_OUT_OF_RANGE	This may occur when calling GM_CalcMeanOfHz_Add(..., ..., FALSE) Two reasons: 1. no data series exists, 2. too many data items.
GM_TOO_FEW_ OBSERVATIONS	Too few observations to be able to calculate the average. The recovered values are not defined.

Example Calculate the weighted average etc.

```
DIM Mean AS GM_Mean_StdDev_Type

GM_CalcMeanOfHz_Add( 1.0, TRUE  )
GM_CalcMeanOfHz_Add( 2.0, FALSE )
GM_CalcMeanOfHz_Add( 3.0, FALSE )
GM_CalcMean( Mean )
```

5.6.18 GM_CalcMedianOfHz

Description Calculation of Hz-directions and the average as median.

Declaration

```
GM_CalcMedianOfHz_Add(
            byVal dHzDirection AS Double,
            byVal lStartNew    AS Logical )

GM_CalcMedianOfHz( dMedian AS Double )
```

Remarks The first function creates an internal data list and adds Hz-directions to it. The second is calculating the average as median evaluating the added Hz-directions in the list.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`dHzDirection`	`in`	Hz - direction
`lStartNew`	`in`	`TRUE`: the given value (`dHzDirection`) is the first in a new series (initialisation). The old series (belonging to this function) will be lost. `FALSE`: add the values to an existing data series.
`DMedian`	`out`	Median [rad]

Return Codes

`RC_OK`	successful creation, adding, and evaluation
`RC_IV_RESULT`	When calling `GM_CalcMedianOfHz` with no successful previous call of `GM_CalcMedianOfHz_Add`.
`GM_OUT_OF_RANGE`	This may occur when calling `GM_CalcMedianOfHz_Add( ..., ..., FALSE )` Two reasons: 1. no data series exists, 2. too many data items.
`GM_TOO_FEW_ OBSERVATIONS`	Too few observations to be able to calculate the average. The recovered values are not defined.

Example Calculate the median.

```
DIM dMedian AS Double
GM_CalcMedianOfHz_Add( 1.0, TRUE  )
GM_CalcMedianOfHz_Add( 2.0, FALSE )
GM_CalcMedianOfHz_Add( 3.0, FALSE )
GM_CalcMedian( dMedian )
```

5.6.19 GM_CalcOrientationOfHz

Description Calculation of the circle-section orientation of graduated circle.

Declaration

```
GM_CalcOrientationOfHz_Add(
            Station   AS GM_Point_Type,
            Target    AS GM_Point_Type,
    byVal   dHz       AS Double,
    byVal   lStartNew AS Logical )

GM_CalcOrientationOfHz(
    Ori         AS GM_Mean_StdDev_Type,
    dOriMedian  AS Double )
```

Remarks The first function creates an internal data list and adds the data to it. The second is calculating the orientation of graduated circle evaluating the added data in the list.

Note Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`Station`	in	Coordinate of the station-point.
`Target`	in	measured point
`dHz`	in	observed Hz-direction
`lStartNew`	in	`TRUE`: the given value (`dHzDirection`) is the first in a new series (initialisation). The old series (belonging to this function) will be lost. `FALSE`: add the values to an existing data series.
`Ori`	out	unknown -orientation -variable and the exactness
`dOriMedian`	out	as median middle unknown - orientation - variable

Return Codes

`RC_OK`	successful creation, adding, and evaluation
`RC_IV_RESULT`	When calling `GM_CalcOrientationOfHz` with no successful previous call of `GM_CalcOrientationHz_Add`.
`GM_OUT_OF_RANGE`	This may occur when calling `GM_CalcOrientationOfHz_Add( .., .., FALSE )`. Two reasons: 1. no data series exists, 2. too many data items.
`GM_TOO_FEW_ OBSERVATIONS`	Too few observations to be able to calculate the average. The recovered values are not defined.

Example Calculate the average etc.

```
DIM Station    AS GM_Point_Type
DIM Target     AS GM_Point_Type
DIM Ori        AS GM_Mean_StdDev_Type
DIM dOriMedian AS Double

'initialize Station and Target

GM_CalcOrientationOfHz_Add( Station, Target,
                            1.571, TRUE  )
GM_CalcOrientationOfHz_Add( Station, Target,
                            3.109, FALSE )
GM_CalcOrientationOfHz_Add( Station, Target,
                            2.395, FALSE )
GM_CalcOrientationOfHz( Ori, dOriMedian )
```

5.6.20 GM_CalcPointInLine

Description Calculation of a point on a line.

Declaration

```
GM_CalcPointInLine(
      Line  AS GM_Line_Type,
      byVal dDist AS Double,
            Point AS GM_Point_Type )
```

Remarks This function is calculating the point with the distance `dDist` from a given point on a line (the first point of the line definition - see predefined structure `GM_Line_Type`) on the line.

Note Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`Line`	`in`	Definition of the line.
`dDist`	`in`	Distance of the point on the line to be calculated, from the 1. point of the line [m].
`Point`	`out`	Calculated point on the line.

Return Codes

`GM_IDENTICAL_PTS`	Start- and endpoint of a line are identical. Calculation is not possible.

Example Calculate the point in the line.

```
DIM Line  AS GM_Line_Type
DIM Point AS GM_Point_Type

'initialize line

GM_CalcPointInLine( Line, 1.0, Point )
```

5.6.21 GM_CalcPointInCircle

Description Calculation of a point on a circle.

Declaration

```
GM_CalcPointInCircle(
              StartOfArc   AS GM_Point_Type,
              EndOfArc     AS GM_Point_Type,
     byVal    dRadius      AS Double,
     byVal    dLengthOfArc AS Double,
              Point        AS GM_Point_Type )
```

Remarks This function is calculating the point with the distance `dDist` from a given point on a circle (the first point of the circle definition - see predefined structure `GM_Circle_Type`) on the circle.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`StartOfArc`	`in`	beginning of the arc
`EndOfArc`	`in`	end of the arc
`dRadius`	`in`	radius
`dLengthOfArc`	`in`	arc length clockwise relative to `StartOfArc` are positive
`Point`	`out`	Calculated point on the arc.

Return Codes

`GM_IDENTICAL_PTS`	`Startpoint` and `endpoint` of the arc are identical. Calculation is not possible.

Example Calculate the point in the circle.

```
DIM Arc1  AS GM_Point_Type
DIM Arc2  AS GM_Point_Type
DIM Point AS GM_Point_Type

'initialize Arc1 and Arc2
GM_CalcPointInLine( Arc1, Arc2, 1.0, Pi, Point )
```

5.6.22 GM_CalcTriangle

Description Calculation of the missing values of a triangle.

Declaration

```
GM_CalcTriangle(
  byVal iProblemKind AS Integer,
     FirstSol  AS GM_Triangle_Values_Type,
     MeanError AS GM_Triangle_Accuracy_Type,
     SecondSol AS GM_Triangle_Values_Type,
     iRetCode  AS Integer )
```

Remarks With this function (depending on which triangle is chosen) the missing sides and angles are calculated. If there is a second solution, it also will be calculated and the recovered code will be returned. Subsequently following the calculation of the exactness.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`iProblemKind`	`in`	Shows the function which triangle-type has to be used; possible values:
		`GM_SIDE_ANGLE_SIDE` Case: Side-Angle-Side
		`GM_SIDE_SIDE_SIDE`
		`GM_SIDE_SIDE_ANGLE`
		`GM_ANGLE_SIDE_SIDE`
		`GM_ANGLE_ANGLE_SIDE`
		`GM_SIDE_ANGLE_ANGLE`
		`GM_ANGLE_SIDE_ANGLE`

`FirstSol`	`in-out`	The given sides and angles have to be recorded in this structure.
`MeanError`	`in-out`	The exactness of the corresponding sides respective angles have to be recorded in this structure.
`SecondSol`	`out`	The calculated sides respective angles of the 2. solution (if existing) are recorded in this structure.

iRetCode	out	Return - Code; possible values:	
		GM_NO_ SOLUTION	no solution found
		GM_ONE_ SOLUTION	with the delivered values there is exactly one triangle solution
		GM_TWO_ SOLUTIONS	with the delivered values there are triangle solutions

Return Codes

GM_INVALID_ TRIANGLE_TYPE	Invalid triangle-type. There was no calculation. The recovered values are not defined.

Example

Calculate the distance of a target from a station according to given StationPt and TargetPt.

```
DIM FirstSol  AS GM_Triangle_Values_Type
DIM SecondSol AS GM_Triangle_Values_Type
DIM MeanError AS GM_Triangle_Accuracy_Type
DIM iRetCode  AS Integer

'initialize
FirstSol.dSide1  = 3.0
FirstSol.dSide3  = 5.0
FirstSol.dAngle2 = Atn( 4.0/3.0 )

GM_CalcTriangle( GM_SIDE_ANGLE_SIDE, FirstSol,
                 MeanError, SecondSol, iRetCode)
'iRetCode will be GM_ONE_SOLUTION for
'  GM_SIDE_ANGLE_SIDE problems
```

5.6.23 GM_CalcVAndSlope

Description Calculation of zenith- and slope-distance from given points (Cartesian coordinates).

Declaration

```
GM_CalcVAndSlope(
             StationPt       AS GM_Point_Type,
             TargetPt        AS GM_Point_Type,
      byVal dInstrHeight    AS Double,
      byVal dRefHeight      AS Double,
             dVZenit         AS Double,
             dSlopeDist      AS Double,
             dStdvVZenit     AS Double,
             dStdvSlopeDist  AS Double )
```

Remarks Calculation of zenith- and slope-distance from given points - cart. coordinates.

> **Note** Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`StationPt`	`in`	coordinates and exactness of the station point
`TargetPt`	`in`	coordinates and exactness of the target point
`dInstrHeight`	`in`	instrument height [m]
`dRefHeight`	`in`	reflector height [m]
`dVZenit`	`out`	calculated V-direction (zenith - distance) [rad]
`dSlopeDist`	`out`	calculated slope distance [m]
`dStdvVZenit`	`out`	middle error of the V-direction [rad]
`dStdvSlopeDist`	`out`	middle error of the slope-distance [m]

Return Codes

`GM_IDENTICAL_PTS`	`StationPt` and `TargetPt` are identical. Calculation is not possible.

Example Calculate the values.

```
DIM StationPt      AS GM_Point_Type
DIM TargetPt       AS GM_Point_Type
DIM dVZenit        AS Double
DIM dSlopeDist     AS Double
DIM dStdvVZenit    AS Double
DIM dStdvSlopeDist AS Double

'initialize StationPt, TargetPt

GM_CalcVAndSlope( StationPt, TargetPt,
                  1.75, 1.0, dVZenit,
                  dSlopeDist, dStdvVZenit,
                  dStdvSlopeDist )
```

5.6.24 GM_ConvertAngle

Description Conversion of angle from one system into the other.

Declaration

```
GM_ConvertAngle(
    byVal iOldSys      AS Integer,
    byVal dAngleOldSys AS Angle,
    byVal iNewSys      AS Integer,
          dAngleNewSys AS Angle )
```

Remarks This function is converting angle-value from one standard system into the other.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

iOldSys	in	standard system of the given angle	
		GM_DEGREE_SEXA	sexagesimal degrees
		GM_DEGREE_DEZ	decimal degrees
		GM_GRAD	grads (gons)
		GM_RADIANS	radians
		GM_MIL	mils
dAngleOldSys	in	angle to convert	
iNewSys	in	standard system of the wanted	

		angle
dAngleNewSys	out	converted angle

Return Codes

GM_INVALID_ ANGLE_SYSTEM	One of the angle-systems was invalid. There was no conversion. The recovered value is not defined.

Example Convert dAngleOldSys from [g] to [rad].

The following variables have to be defined:

```
DIM dAngleOldSys AS Angle
DIM dAngleNewSys AS Angle
DIM iOldsys      AS Integer
DIM iNewsys      AS Integer

'initialize values
iOldsys      = GM_GRAD    'the old angle is
                          '   given in grad
dAngleOldSys = 200.0      'its value is 200.0
                          '   gon
iNewSys      = GM_RADIANS 'the new angle should
                          '   be in radians

GM_ConvertAngle( iOldsys, dAngleOldSys,
                 iNewsys, dAngleNewSys )
```

5.6.25 GM_ConvertDecSexa

Description Conversion of value from the decimal into the sexagesimal system.

Declaration

```
GM_ConvertDecSexa(
              byVal dValueDec  AS Double,
                    dValueSexa AS Double )
```

Remarks This function is converting the value from the decimal into the sexagesimal system.

Note Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`dValueDec`	`in`	decimal value
`dValueSexa`	`out`	sexagesimal value

Return Codes

`RC_OK`	always OK

Example Convert the angle.

```
DIM dAngleSexa AS Double

GM_ConvertDecSexa( dAngleSexa )
```

5.6.26 GM_ConvertDist

Description Conversion of distances from one system into the other.

Declaration

```
GM_ConvertDist(
     byVal iOldSys     AS Integer,
     byVal dDistOldSys AS Double,
     byVal iNewSys     AS Integer,
           dDistNewSys AS Double )
```

Remarks This function is converting distance-values from one standard system into the other.

> **Note** Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`iOldSys`	standard system of the given distance	
	`GM_METER`	meter
	`GM_US_FOOT`	American feet
	`GM_SURVEY_FOOT`	surveyor feet
	`GM_INTER_FOOT`	international feet
`dDistOldSys`	distance to convert	
`iNewSys`	standard system of the wanted distance	
`dDistNewSys`	converted distance	

Return Codes

`GM_INVALID_DIST_SYSTEM`	One of the distance standard systems was invalid. There was no conversion. The recovered value was not defined.

Example Convert `dDistOldSys` from [m] to [us-feet].

```
DIM dDistOldSys AS Double
DIM dDistNewSys AS Double
DIM iOldsys     AS Integer
DIM iNewsys     AS Integer

'initialize values
iOldsys     = GM_METER
dDistOldSys = 1.8
iNewsys     = GM_US_FOOT

GM_ConvertDist( iOldsys, dDistOldSys,
                iNewsys, dDistNewSys )
```

5.6.27 GM_ConvertExcentricHzV

Description Re-centration of hz- and v-direction.

Declaration

```
GM_ConvertExcentricHzV(
    ExCentMeas  AS GM_Measurements_Type,
    ExCentElems AS GM_Excenter_Elems_Type,
    Center      AS GM_Point_Type,
    Target      AS GM_Point_Type,
    CentMeas    AS GM_Measurements_Type )
```

Remarks With this function, the measured values (which are measured to the excenter) could be re-centred to the `Centre`. The difference to the function `GM_ConvertExcentricHzVDist` is that only the directions hz and v are measured and recorded to the structure `GM_Measurements_Type`.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`ExCentMeas`	`in`	eccentric observation
`ExCentElems`	`in`	height difference between the centre and the excenter [m] and horizontal distance between the centre and the excenter [m]
`Center`		coordinate of the centre
`Target`		coordinate of the target
`CentMeas`		onto the centre re-centred measurement-element

Return Codes

`GM_IDENTICAL_PTS`	`Center` and `Target` are identical. Calculation is not possible.

Example Calculate the point in the circle.

```
DIM StationPt    AS GM_Point_Type
DIM TargetPt     AS GM_Point_Type
DIM ExcElems     AS GM_Excenter_Elems_Type
DIM ExcenterMeas AS GM_Measurements_Type
DIM CenterMeas   AS GM_Measurements_Type

'initialize StationPt, TargetPt,
'  ExcElems, ExcenterMeas

GM_ConvertExcentricHzV( StationPt, TargetPt,
                        ExcElems, ExcenterMeas,
                        CenterMeas )
```

5.6.28 GM_ConvertExcentricHzVDist

Description Re-centration of hz- and v-direction and distance.

Declaration

```
GM_ConvertExcentricHzVDist(
     ExCentMeas  AS GM_Measurements_Type,
     ExCentElems AS GM_Excenter_Elems_Type,
     CentMeas    AS GM_Measurements_Type )
```

Remarks With this function, the measured values (which are measured to the excenter) could be re-centred to the centre. The difference to the function `GM_ConvertExcentricHzV` is, that in addition to the directions hz and v, the slope distance to the target point is measured and recorded to the structure `GM_Measurements_Type`.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`ExCentMeas`	`in`	eccentric observation
`ExCentElems`	`in`	height difference between the centre and the excenter [m] and horizontal distance between the centre and the excenter [m]
`CentMeas`	`out`	onto the centre re-centred measurement-element

Return Codes

`RC_OK`	always OK

Example Calculate the point in the circle.

```
DIM ExcElems     AS GM_Excenter_Elems_Type
DIM ExcenterMeas AS GM_Measurements_Type
DIM CenterMeas   AS GM_Measurements_Type

'initialize ExcElems, ExcenterMeas

GM_ConvertExcentricHzVDist( ExcElems,
                            ExcenterMeas,
                            CenterMeas)
```

5.6.29 GM_ConvertPressure

Description Conversion of pressure from one system into the other.

Declaration

```
GM_ConvertPressure(
    byVal iOldSys     AS Integer,
    byVal dPresOldSys AS Double,
    byVal iNewSys     AS Integer,
    dPresNewSys AS Double )
```

Remarks This function is converting pressure-values from one standard system into the other.

> **Note** Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

iOldSys	in	standard system of the given pressure	
		GM_MM_HG	mercury column [mm]
		GM_M_BAR	millibar
		GM_ATMOS	atmosphere
dPresOldSys	in	pressure to convert	
iNewSys	in	standard system of the wanted pressure	
dPresNewSys	out	converted pressure	

Return Codes

GM_INVALID_ PRES_SYSTEM	One of the pressure standard systems was invalid. There was no conversion. The

recovered value was not defined.

Example Convert `dPresOldSys` from atmosphere to millibar.

```
DIM dPresOldSys AS Double
DIM dPresNewSys AS Double
DIM iOldsys     AS Integer
DIM iNewsys     AS Integer

'initialize values
iOldsys     = GM_ATMOS
dPresOldSys = 1.0
iNewsys     = GM_M_BAR

GM_ConvertPressure( iOldsys, dPresOldSys,
                    iNewsys, dPresNewSys )
```

5.6.30 GM_ConvertTemp

Description Conversion of temperature from one system into the other.

Declaration

```
GM_ConvertTemp(
      byVal iOldSys     AS Integer,
      byVal dTempOldSys AS Double
      byVal iNewSys     AS Integer,
      dTempNewSys AS Double)
```

Remarks This function is converting temperature-values from one standard system into the other.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

iOldSys	in	standard system of the given temperature	
		GM_KELVIN	Kelvin
		GM_CELSIUS	Celsius
		GM_FAHRENHEIT	Fahrenheit
dTempOldSys	in	temperature to convert	
iNewSys	in	standard system of the wanted temperature	
dTempNewSys	out	converted temperature	

Return Codes

GM_INVALID_ TEMP_SYSTEM	One of the temperature standard systems was invalid. There was no conversion. The recovered value was not defined.

Example Convert `dTempOldSys` from [Celsius] to [Fahrenheit].

```
DIM dTempOldSys AS Double
DIM dTempNewSys AS Double
DIM iOldsys     AS Integer
DIM iNewsys     AS Integer

'initialize values
iOldsys     = GM_CELSIUS
dTempOldSys = 1.8
iNewsys     = GM_FAHRENHEIT

GM_ConvertTemp( iOldsys, dTempOldSys,
                iNewsys, dTempNewSys )
```

5.6.31 GM_ConvertVDirection

Description Conversion of v-directions from one system into the other.

Declaration

```
GM_ConvertVDirection(
            byVal OldSys   AS Integer,
            byVal dVOldSys AS Double,
            byVal NewSys   AS Integer,
                  dVNewSys AS Double )
```

Remarks This function is converting v-distance-values from one standard system into the other.

> **Note** Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

iOldSys	in	standard system of the given v-direction	
		GM_ZENITH	zenith direction [rad]
		GM_NADIR	nadir direction[radians]
		GM_V_ANGLE_RAD	height angle [rad]
		GM_V_ANGLE_PERCENT	height angle [%]
dVOldSys	in	v-distance to convert	
iNewSys	in	standard system of the wanted v-distance	
dVNewSys	out	converted v-distance	

Return Codes

GM_INVALID_V_SYSTEM	One of the standard systems was invalid.
	There was no conversion. The recovered value was not defined

Example Convert `dVOldSys`.

```
DIM dVOldSys AS Double
DIM dVNewSys AS Double
DIM iOldsys  AS Integer
DIM iNewsys  AS Integer

'initialize values
iOldsys  = GM_ZENITH
dVOldSys = Pi
iNewsys  = GM_V_ANGLE_RAD

GM_ConvertVDirection( iOldsys, dVOldSys,
                      iNewsys, dVNewSys )
```

5.6.32 GM_ConvertSexaDec

Description Conversion of value from the sexagesimal into the decimal system.

Declaration

```
GM_ConvertSexaDec(
             byVal  dValueSexa AS Double,
                    dValueDec  AS Double )
```

Remarks This function is converting the value from the sexagesimal into the decimal system.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`dValueSexa`	`in`	sexagesimal value
`dValueDec`	`out`	decimal value

Return Codes

`RC_OK`	always OK

Example Convert the angle. The following variables have to be defined:

```
DIM dAngleDec AS Double

GM_ConvertSexaDec( 99.9, dAngleDec )
```

5.6.33 GM_TransformPoints

Description Transformation of point.

Declaration

```
GM_TransformPoints(
            OldPt AS GM_Point_Type,
            Param AS GM_4Transform_Param_Type,
            NewPt AS GM_Point_Type )
```

Remarks This function transforms a point from one coordinate system into an other after the transformation parameters are calculated. In addition the coordinate systems have to be in the same sense.

Note	Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

OldPt	in	point to be transformed
Param	in	transformation parameters
NewPt	out	transformed point

Return Codes

RC_OK	always OK

Example Calculate the point in the circle.

```
DIM OldPt AS GM_Point_Type
DIM NewPt AS GM_Point_Type
DIM Param AS GM_4Transform_Param_Type

'initialize OldPt, NewPt, Param

GM_TransformPoints( OldPt, Param, NewPt )
```

5.6.34 GM_SamePoint

Description Test if two points are equal.

Declaration

```
GM_SamePoint( Point1 AS GM_Point_Type,
              Point2 AS GM_Point_Type,
              lSame  AS Logical )
```

Remarks The function checks, if the two given points are the same (coordinate difference < `GM_THRESHOLD`).

Note	Height is ignored in the comparison.

Parameters

`Point1`	`in`	1. point to be tested
`Point2`	`in`	2. point
`lSame`	`out`	`TRUE`: difference of each coordinate < `GM_THRESHOLD`

Return Codes

`RC_OK`	always OK

Example Test if the 2 points are the same.

```
DIM Pt1   AS GM_Point_Type
DIM Pt2   AS GM_Point_Type
DIM lSame AS Logical

'initialize Pt1, Pt2

GM_TransformPoints( Pt1, Pt2, lSame )
```

5.6.35 GM_CopyPoint

Description Copy the contents of a point.

Declaration

```
GM_CopyPoint( Pt1 AS GM_Point_Type,
              Pt2 AS GM_Point_Type )
```

Remarks Copy the contents of `Pt1` to `Pt2`.

Parameters

`Pt1`	`in`	point to be copied
`Pt2`	`out`	taken copy

Return Codes

`RC_OK`	always OK

Example Copy point.

```
DIM Pt1 AS GM_Point_Type
DIM Pt2 AS GM_Point_Type

'initialize Pt1, Pt2

GM_CopyPoint( Pt1, Pt2 )
```

5.6.36 GM_AngleFromThreePoints

Description Calculate enclosed angle from three points.

Declaration

```
GM_AngleFromThreePoints(
             StartPoint AS GM_Point_Type,
             Vertex     AS GM_Point_Type,
             EndPoint   AS GM_Point_Type,
             dAngle     AS Double )
```

Remarks This function calculates the angle enclosed by the 3 given points (counter clockwise).

Note	The height is ignored.

Parameters

`StartPoint`	`in`	1. point for angle definition
`Vertex`	`in`	2. point (middle)
`EndPoint`	`in`	3. point
`dAngle`	`out`	calculated enclosed angle

Return Codes

`GM_IDENTICAL_PTS`	at least 2 points are identical (`GM_SamePoint`), calculation not possible

Example Calculate the point in the circle.

```
DIM StartPt AS GM_Point_Type
DIM Vertex  AS GM_Point_Type
DIM EndPt   AS GM_Point_Type
DIM dAngle  AS Double

'initialize StartPt, Vertex, EndPt

GM_AngleFromThreePoints( StartPt, Vertex,
                         EndPt, dAngle )
```

5.6.37 GM_AdjustAngleFromZeroToTwoPi

Description Normalise angle to [0, 2×Pi].

Declaration

```
GM_AdjustAngleFromZeroToTwoPi(
                                dAngle AS
Double )
```

Remarks This function adjusts the angle to be 0 ≤ `pdAngle` < 2×Pi.

Parameters

`dAngle`	`in out`	angle to be transformed

Return Codes

`RC_OK`	always OK

Example Convert angle.

```
DIM dAngle AS Double

'initialize dAngle
dAngle = 4*Pi

GM_AdjustAngleFromZeroToTwoPi( dAngle )
```

5.6.38 GM_LineAzi

Description Calculate azimuth of a line.

Declaration

```
GM_LineAzi( Line     AS GM_Line_Type,
            dAzimuth AS Double )
```

Remarks This function calculates the azimuth of the line from `Line.FirstPt`.

Parameters

Line	in	a line
dAzimuth	out	the azimuth of the line from Line.FirstPt

Return Codes

GM_IDENTICAL_PTS	The points in the line are identical. Calculation not possible.

Example Calculate the azimuth of the line.

```
DIM Line AS GM_Line_Type
DIM dAzi AS Double

'initialize Line

GM_LineAzi( Line, dAzi )
```

5.6.39 GM_MathOrSurveyorsAngleConv

Description Adjusts a math angle in radians to a surveyors angle in radians or vice versa.

Declaration

```
GM_MathOrSurveyorsAngleConv(
                     dAngle AS Double )
```

Remarks Converts the angle from surveyors convention (azimuth) to a math direction (x/y axis) or vice versa.

Parameters

dAngle	in out	angle to be transformed

Return Codes

`RC_OK`	always OK

Example Calculate the point in the circle.

```
DIM dAngle AS Double
dAngle = Pi
GM_MathOrSurveyorsAngleConv( dAngle )
```

5.6.40 GM_Traverse3D

Description Convert a point in polar coordinates to Cartesian coordinates.

Declaration

```
GM_Traverse3D(
              StartPt AS GM_Point_Type,
              Polar   AS GM_Measurements_Type,
              NewPt   AS GM_Point_Type )
```

Remarks This function converts a point given in polar coordinates relative to `StartPt` to Cartesian coordinates (`NewPt`).

> **Note** Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`StartPt`	`in`	relative origin for `Polar`
`Polar`	`in`	point in polar coordinates
`NewPt`	`out`	transformed point in Cartesian coordinates

Return Codes

`RC_OK`	always OK

Example Convert a point in polar to Cartesian coordinates.

```
DIM StartPt AS GM_Point_Type
DIM NewPt   AS GM_Point_Type
DIM Polar   AS GM_Measurements_Type

'initialize StartPt, Polar

GM_Traverse3D( StartPt, Polar, NewPt )
```

5.6.41 GM_InitQXXMatrix

Description Initialise the QXX-Matrix for a point structure.

Declaration `GM_InitQXXMatrix( Point AS GM_Point_Type )`

Remarks This function sets all values in the QXX-matrix of a point to zero.

Parameters

`Point`	`in out`	point of which the QXX-matrix is to be initialised

Return Codes

`RC_OK`	always OK

Example Initialise QXX-matrix of a point.

```
DIM Point AS GM_Point_Type

GM_InitQXXMatrix( Point )
```

5.6.42 GM_CalcAziZenAndDist

Description Convert a point given in Cartesian coordinates to polar coordinates.

Declaration

```
GM_CalcAziZenAndDist(
              Point  AS GM_Point_Type,
              Point2 AS GM_Point_Type,
              Polar  AS GM_Measurements_Type )
```

Remarks This function converts a point given in Cartesian coordinates relative to `Pt1` to polar coordinates (`Polar`).

Note Used formula: see Appendix, Geodesy Math. Formulas.

Parameters

`Point1`	`in`	relative origin for `Point2`
`Point2`	`in`	point in Cartesian coordinates
`Polar`	`out`	transformed point in polar coordinates

Return Codes

`RC_OK`	always OK

Example Convert a point in Cartesian to polar coordinates.

```
DIM Point1 AS GM_Point_Type
DIM Point2 AS GM_Point_Type
DIM Polar  AS GM_Measurements_Type

'initialize Point1, Point2

GM_CalcAziZenAndDist( Point1, Point2, Polar )
```

6. SYSTEM FUNCTIONS

6.1 MMI FUNCTIONS

6.1.1 Summarising Lists of MMI Types and Procedures

6.1.1.1 Types

Type name	description
`ListArray`	List field Data structure
`sLine`	Display line

6.1.1.2 Procedures

procedure name	description
`MMI_AddButton`	Add a Button to a dialog.
`MMI_AddGBMenuButton`	Adds a button to a menu
`MMI_BeepAlarm`	Create an alert beep.
`MMI_BeepLong`	Create an alert beep.
`MMI_BeepNormal`	Create an alert beep.
`MMI_CheckButton`	Checks if a button was pressed.
`MMI_CreateGBMenu`	Creates a menu
`MMI_CreateGBMenuItem`	Creates an item to an existing menu
`MMI_CreateGBMenuItemStr`	Creates an item with a variable string
`MMI_CreateGBMenuStr`	Creates a menu with variable strings
`MMI_CreateGraphDialog`	Create and show a graphics dialog.
`MMI_CreateMenuItem`	Creates a menu item on the Theodolite menu.
`MMI_CreateTextDialog`	Create and show a text dialog.
`MMI_DeleteButton`	Delete a button from a dialog.
`MMI_DeleteDialog`	Deletes a dialog.
`MMI_DeleteGBMenu`	Deletes a menu
`MMI_DrawBusyField`	Shows or hides the Busy-Icon
`MMI_DrawCircle`	Draw a circle / ellipse.

procedure name	**description**
MMI_DrawLine	Draw a line.
MMI_DrawRect	Draw a rectangle.
MMI_DrawText	Draw / delete text.
MMI_FormatVal	Convert a value to a string.
MMI_GetAngleRelation	Request the current angle relationships.
MMI_GetAngleUnit	Return the currently displayed unit of angle.
MMI_GetButton	Get the button identifier of the pressed button.
MMI_GetCoordOrder	Retrieve the co-ordinate order.
MMI_GetDateFormat	Retrieves the date display format.
MMI_GetDistUnit	Return the currently displayed unit of distance.
MMI_GetLangName	Gets the name to a language number.
MMI_GetLanguage	Query the current language.
MMI_GetPressUnit	Return the currently displayed unit of pressure.
MMI_GetTempUnit	Return the currently displayed unit of temperature.
MMI_GetTimeFormat	This function retrieves the format used to display the time.
MMI_GetVAngleMode	Returns the V-Angle mode
MMI_GetVarBeepStatus	Read the switch status for a variable signal beep.
MMI_InputInt	Get an integer input value in a text dialog.
MMI_InputList	Shows a list field in a text dialog.
MMI_InputStr	Get a string input in a text dialog.
MMI_InputVal	Get a numerical input value in a text dialog.
MMI_PrintInt	Print an integer value on a text dialog.
MMI_PrintStr	Print a string on a text dialog.
MMI_PrintTok	Print a token on a text dialog.
MMI_PrintVal	Print a value on a text dialog.
MMI_SelectGBMenuItem	Select a menu item
MMI_SetAngleRelation	Set the angle relationship.
MMI_SetAngleUnit	Set the displayed unit of angle.
MMI_SetCoordOrder	Set the co-ordinate order.

procedure name	**description**
`MMI_SetDateFormat`	Set the date display format.
`MMI_SetDistUnit`	Set the displayed unit of distance.
`MMI_SetLanguage`	Set the display language.
`MMI_SetPressUnit`	Set the displayed unit of pressure.
`MMI_SetTempUnit`	Set the displayed unit of temperature.
`MMI_SetTimeFormat`	Set the time display format.
`MMI_SetVAngleMode`	Set the V-Angle mode.
`MMI_StartVarBeep`	Start beep sequences with configurable interrupts.
`MMI_SwitchAFKey`	Switch aF… key
`MMI_SwitchIconsBeep`	Switches measurement icons and special beeps
`MMI_SwitchVarBeep`	Switch a varying beep.
`MMI_WriteMsg`	Output to a message window. Parameter is a token.
`MMI_WriteMsgStr`	Output to a message window. Parameter is a string.

6.1.2 MMI Data Types

6.1.2.1 ListArray – List field data structure

Description This array is used for list fields and consists of `LIST_ARRAY_MAX_ELEMENT` (200) elements of the type `STRING30`.

Note	Each variable of this data type reserves 6400 Bytes.

6.1.2.2 sLine – Display line

Description This type is used to define a string with 29 characters, which is necessary to print variable strings on the display. The length depends on the actual display width, which is 29 for TPS1100 instruments.

6.1.3 MMI_CreateMenuItem

Description Creates a system menu item on the Theodolite menu to establish the invocation of a GeoBASIC application.

Declaration

```
MMI_CreateMenuItem(
            BYVAL sAppName  AS String,
            BYVAL sFuncName AS String,
            BYVAL iMenuNum  AS Integer,
            BYVAL sMenuText AS _Token )
```

Remarks The `CreateMenuItem` creates a menu item in a system menu with the text `MenuText` on the chosen entry point `MenuNum` in the menu-system. By clicking the new menu item on the Theodolite, the subroutine with the name `FuncName` in the Program `AppName` will be executed. The number of applications which can be loaded at a time are limited to 25. The maximum number of entry points over all applications (C and GeoBASIC applications) is 50. All GLOBAL declared subroutines count as entry points. Be aware of the fact that the interpreter and a possible Coding function also count for the number of application. The same is true for any C-application which has been loaded onto the TPS.

Note	The subroutine denoted in sFuncName must be declared as `GLOBAL`. The intended use for this procedure is during the installation phase only!

Parameters

`sAppName`	`in`	The name of the program where the function or subroutine is defined.
`sFuncName`	`in`	The name of the global function or subroutine to be called.
`iMenuNum`	`in`	Defines in which menu the menu-entry is generated. There are three possible menus where a menu item can be added. For multiple menu items the menus can be combined with ‘+’-operator.

	valid menus	**meaning**
	MMI_MENU_PROGRAMS	Add to menu „Main menu“
	MMI_MENU_PROGMENU	Add to „PROG“ - Key menu
	MMI_MENU_AUTOEXEC	Add to menu „Autoexec“
sMenuText in	The text of the menu-entry which should be displayed on the Theodolite.	

Return-Codes

RC_OK	Successful termination.

Note	Since this procedure will be called during installation phase you do not have the possibility to do any error handling. Only the loader will report an error which may be caused by an erroneous call.

Example The example uses the MMI_CreateMenuItem routine to create a menu entry named "START THE PROGRAM" under the main menu. The function "Main" in the GeoBASIC program "ExampleProgram" will be called when this menu item is selected.

```
MMI_CreateMenuItem( "ExampleProgram", "Main",
                    MMI_MENU_PROGRAMS,
                    "START THE PROGRAM" )
```

6.1.4 MMI_CreateGBMenu

Description Creates a menu.

Declaration

```
MMI_CreateGBMenu(
    BYVAL sMenuName     AS _Token,
          iMenuId       AS Integer )
```

Remarks This routine creates an empty menu and the caption sMenuName. The function MMI_CreateGBMenuItem adds items to a menu.

Note	Before terminating a GeoBASIC program, all menus must be deleted. The GeoBASIC menus system has the following limitations: The maximal number of menus for a GeoBASIC program is 5. The maximal number of items / menu is 49. The maximal number of items over all menus plus menus is 254.

Parameters

`sMenuName`	`in`	The caption of the menu.
`iMenuId`	`out`	Returned menu identifier. It is the handle for using this menu.

Return-Codes

`RC_OK`	Successful termination.
`MMI_NOMORE_ MENUS`	No more menus available

See Also `MMI_CreateGBMenuItem`, `MMI_DeleteGBMenu`, `MMI_SelectGBMenuItem`, `MMI_AddGBMenuButton`

Example The example creates a menu with a button. For a complete example see sample program `MENU.GBS`

```
CONST MHELP = "Help for measurement type...."

DIM iMenu      AS Integer ' menu identifier
DIM iSelection AS Integer ' selected item
DIM iButton    AS Integer ' used button

'Create main menu
MMI_CreateGBMenu("MEASUREMENT TYPE", iMenu)
```

```
'Create menu items - all items use
'  the same help text
MMI_CreateGBMenuItem(iMenu,
  "Polygon", MHELP)
MMI_CreateGBMenuItem(iMenu,
  "Border point", MHELP)
MMI_CreateGBMenuItem(iMenu,
  "Situation point", MHELP)

'Create the button supported in this menu
MMI_AddGBMenuButton(iMenu, MMI_F5_KEY, "EXIT ")

' show and execute menu
MMI_SelectGBMenuItem(iMenu, "TEST",
  iSelection, iButton)
SELECT CASE iSelection
    CASE 1 ' Polygon
    '  ...
    CASE ELSE
       MMI_BeepAlarm()
    END SELECT
MMI_DeleteGBMenu(iMenu)
```

6.1.5 MMI_CreateGBMenuItem

Description Creates an item in an existing menu.

Declaration

```
MMI_CreateGBMenuItem(
             BYVAL iMenuId       AS Integer,
             BYVAL sMenuItemName AS _Token,
             BYVAL sHelpText     AS _Token )
```

Remarks This function adds one menu item to an existing menu `iMenuId`. This item will be displayed as the last item.

Parameters

`iMenuId`	`in`	Menu identifier
`sMenuItemName`	`in`	Displayed text
`sHelpText`	`in`	Help text; only visible if the help functionality of theodolite is enabled

Return-Codes

RC_OK	Successful termination.
BAS_MENU_ ID_INVALID	Bad iMenuId
BAS_MENU_ TABLE_FULL	No more free menu items

See Also MMI_CreateGBMenu, MMI_DeleteGBMenu, MMI_SelectGBMenuItem, MMI_AddGBMenuButton

Example see MMI_CreateGBMenu

6.1.6 MMI_CreateGBMenuStr

Description Creates a menu with variable strings as menu name and menu items.

Declaration

```
MMI_CreateGBMenuStr(
    BYVAL sMenuName     AS sLine,
          iMenuId       AS Integer )
```

Remarks This routine creates an empty menu and the caption sMenuName. sMenuName need not be constant, it can be generated during the execution of the program. The function MMI_CreateGBMenuItemStr adds items to this kind of menu.

> **Note** Before terminating a GeoBASIC program, all menus must be deleted.
>
> The GeoBASIC menus system has the following limitations:
>
> The maximal number of menus for a GeoBASIC program is 5.
> The maximal number of items / menu is 49.
> The maximal number of items over all menus plus menus is 254.

Parameters

sMenuName	in	The caption of the menu.

`iMenuId`	`out`	Returned menu identifier. It is the handle for using this menu.

Return-Codes

`RC_OK`	Successful termination.
`MMI_NOMORE_ MENUS`	No more menus available

See Also `MMI_CreateGBMenuItemStr, MMI_DeleteGBMenu, MMI_SelectGBMenuItem, MMI_AddGBMenuButton`

Example The example creates a menu with a button. The menu name is a composition with a constant string and the instrument name. The menu item names are extended with the current language name.

```
CONST MHELP = "Help for measurement type...."

DIM iMenu            AS Integer ' menu identifier
DIM iSelection       AS Integer ' selected item
DIM iButton          AS Integer ' used button
DIM sMenuName        AS sLine   ' menu name
DIM sMenuItemName1   AS sLine   ' menu item 1 name
DIM sMenuItemName2   AS sLine   ' menu item 2 name
DIM iLangNr          AS Integer ' language number
DIM sLangName        AS String20' language name
DIM sInstrumentName  AS String30' instrument name

' generate menu name
CSV_GetInstrumentName(sInstrumentName)
sMenuName = "Programs on " + sInstrumentName
' Create menu
MMI_CreateGBMenuStr(sMenuName, iMenu)
' generate menu item names
MMI_GetLanguage(iLangNr, sLangName)
sMenuItemName1 = "Polygon in " + sLangName
sMenuItemName2 = "Border point in " + sLangName
' Create menu items - all items use
' the same help text
MMI_CreateGBMenuItemStr(iMenu,
 sMenuItemName1, MHELP)
MMI_CreateGBMenuItemStr(iMenu,
 sMenuItemName2, MHELP)
```

```
'Create the button supported in this menu
MMI_AddGBMenuButton(iMenu, MMI_F5_KEY, "EXIT ")

' show and execute menu
MMI_SelectGBMenuItem(iMenu, "TEST",
  iSelection, iButton)
SELECT CASE iSelection
    CASE 1 ' Polygon
    '   ...
    CASE ELSE
       MMI_BeepAlarm()
    END SELECT
MMI_DeleteGBMenu(iMenu)
```

6.1.7 MMI_CreateGBMenuItemStr

Description Creates an item with a variable string in an existing menu.

Declaration

```
MMI_CreateGBMenuItemStr(
             BYVAL iMenuId       AS Integer,
             BYVAL sMenuItemName AS sLine,
             BYVAL sHelpText     AS _Token )
```

Remarks This routine adds one menu item to an existing menu `iMenuId`. This item will be displayed as the last item. The menu must be created with `MMI_CreateGBMenuStr`. `sMenuItemName` need not be constant, it can be generated during the execution of the program.

Parameters

`iMenuId`	`in`	Menu identifier
`sMenuItemName`	`in`	Displayed text
`sHelpText`	`in`	Help text; only visible if the help functionality of the theodolite is enabled

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ID_INVALID`	Bad `iMenuId`

`BAS_MENU_TABLE_FULL`	No more free menu items

See Also `MMI_CreateGBMenuStr, MMI_DeleteGBMenu, MMI_SelectGBMenuItem, MMI_AddGBMenuButton`

Example see `MMI_CreateGBMenuStr`

6.1.8 MMI_DeleteGBMenu

Description Deletes a menu.

Declaration

```
MMI_DeleteGBMenu( BYVAL iMenuId AS Integer )
```

Remarks This function deletes the menu `iMenuId`.

Parameters

`iMenuId`	`in`	Menu identifier

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ID_INVALID`	Bad `iMenuId`

See Also `MMI_CreateGBMenu, MMI_CreateGBMenuItem, MMI_SelectGBMenuItem, MMI_AddGBMenuButton`

Example see `MMI_CreateGBMenu`

6.1.9 MMI_SelectGBMenuItem

Description Select a menu item.

Declaration

```
MMI_SelectGBMenuItem(
            BYVAL iMenuId       AS Integer,
            BYVAL sCaptionLeft  AS _Token,
                  iSelItem      AS Integer,
                  iButtonId     AS Integer )
```

Remarks This function shows and executes a menu `iMenuId` and returns the selected item `iSelItem` or pressed button `iButtonId`.

Parameters

`iMenuId`	`in`	Menu identifier
`sCaptionLeft`	`in`	The maximal five-character long part of the title bar displayed left of the menu title, with a separation symbol.
`iSelItem`	`in/out`	Selected item
`iButtonId`	`out`	Pressed button

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ ID_INVALID`	Bad `iMenuId`

See Also `MMI_CreateGBMenu`, `MMI_CreateGBMenuItem`, `MMI_DeleteGBMenu`, `MMI_AddGBMenuButton`

Example see `MMI_CreateGBMenu`

6.1.10 MMI_AddGBMenuButton

Description Adds a button to a menu.

Declaration

```
MMI_AddGBMenuButton(
            BYVAL iMenuId   AS Integer,
            BYVAL iButtonId AS Integer,
            BYVAL sCaption  AS _Token )
```

Remarks This function adds a button with the identifier `iButtonId` to the menu `iMenuId` and shows the caption `sCaption`.

Parameters

iMenuId	in	Menu identifier
iButtonId	in	Identifier of the button to be added. Valid buttons are MMI_F1_KEY.. MMI_F6_KEY and MMI_SHF2_KEY.. MMI_SHF6_KEY.
sCaption	in	Text placed onto the button (max. 5 characters)

Return-Codes

RC_OK	Successful termination.
BAS_MENU_ ID_INVALID	Bad iMenuId

See Also MMI_CreateGBMenu, MMI_CreateGBMenuItem, MMI_DeleteGBMenu, MMI_SelectGBMenuItem

Example see MMI_CreateGBMenu

6.1.11 MMI_CreateTextDialog

Description Create and show a text dialog.

Declaration

```
MMI_CreateTextDialog(
    BYVAL iLines        AS Integer,
    BYVAL sCaptionLeft  AS _Token,
    BYVAL sCaptionRight AS _Token,
    BYVAL sHelptext     AS _Token )
```

Remarks The routine creates and shows a dialog with iLines lines, the left part of the title bar sCaptionLeft, the caption sCaptionRight and the help text sHelpText. Only one text dialog can exist at the same time. If MMI_CreateTextDialog is called while already a text dialog or a measurement dialog exists, the existing dialog (together with all attached buttons) is deleted and the new dialog is created.

Note	Only a text dialog or a measurement dialog is valid at a time. They cannot be defined at the same time. A graphic dialog overrides a text or measurement dialog but does not delete the definition of it.

On the dialog field strings, numerical values and list fields can be displayed or edited using the routines `MMI_PrintStr`, `MMI_PrintVal`, `MMI_PrintInt`, `MMI_InputStr`, `MMI_InputVal`, `MMI_InputInt` and `MMI_InputList`.

Parameters

`iLines`	`in`	The number of lines of the dialog. There are up to 12 lines possible. If the dialog has more than 6 lines, a scrollbar on the right side appear and it is possible to scroll up and down with the cursor keys.
`sCaptionLeft`	`in`	The maximal five-character long part of the title bar displayed left of the `CaptionRight`, with a separation symbol.
`sCaptionRight`	`in`	The caption of the dialog.
`sHelpText`	`in`	This text is shown, when the help button `SHIFT-F1` is pressed and the help functionality of the theodolite is enabled.

Return-Codes

`RC_OK`	Successful termination.

See Also `MMI_DeleteDialog`, `MMI_CreateGraphDialog`, `GSI_CreateMDlg`, `MMI_PrintVal`, `MMI_PrintStr`, `MMI_PrintTok`, `MMI_PrintInt`, `MMI_InputVal`, `MMI_InputStr`, `MMI_InputInt`, `MMI_InputList`

Example The example uses the `MMI_CreateTextDialog` routine to create and display a text dialog.

```
Define a help text containing the
'  inverse written word "Help"
CONST Helptext = MMI_INVERSE_ON +
                 "Help" + MMI_INVERSE_OFF +
                 " Test"

MMI_CreateTextDialog(5, "TEXT", "DIALOG
                     CAPTION", Helptext)
```

6.1.12 MMI_CreateGraphDialog

Description Create and show a graphics dialog.

Declaration

```
MMI_CreateGraphDialog(
      BYVAL sCaptionLeft  AS _Token,
      BYVAL sCaptionRight AS _Token,
      BYVAL sHelptext     AS _Token )
```

Remarks The routine creates and shows a graphics dialog filled with the left part of the title bar `sCaptionLeft`, the caption `sCaptionRight` and the help text `sHelpText` for later use of MMI graphics functions. The size of the field is the whole dialog display area = 232 x 48 pixels. Only one graphics dialog can exist at the same time. If `CreateGraphDialog` is called while already a graphics dialog exists, the existing dialog (together with all attached buttons) is deleted and the new dialog is created.

Note	Only a text dialog or a measurement dialog is valid at a time. They cannot be defined at the same time. A graphic dialog overrides a text or measurement dialog but does not delete the definition of it.

Parameters

`sCaptionLeft`	in	The maximal five-character long part of the title bar displayed left of the `sCaptionRight`, with a separation symbol
`sCaptionRight`	in	The caption of the dialog.
`sHelpText`	in	This text is shown, when the help button Shift-F1 is pressed and the help functionality of the theodolite is enabled.

Return-Codes

`RC_OK`	Successful termination.

See Also `MMI_DeleteDialog`, `MMI_CreateTextDialog`, `GSI_CreateMDlg`, MMI Graphic Functions

Example The example uses the `MMI_CreateGraphDialog` routine to create and display a graphic dialog field.

```
MMI_CreateGraphDialog( "GRAPH",
                       "DIALOG CAPTION",
                       "This is a help text")
```

6.1.13 MMI_DeleteDialog

Description Deletes a dialog.

Declaration `MMI_DeleteDialog()`

Remarks The routine deletes the currently active dialog. It makes no distinction between graphic, measure and text dialog. By deleting the dialog all user defined buttons added with `MMI_AddButton` are deleted as well.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_CreateTextDialog`, `MMI_CreateGraphDialog`, GSI_CreateMDlg

Example The example uses the `MMI_DeleteDialog` routine to delete a text, measure or graphic dialog.

```
MMI_DeleteDialog()
```

6.1.14 MMI_CheckButton

Description Checks if a button was pressed.

Declaration `MMI_CheckButton( lKeyPressed AS Logical )`

Remarks The routine `MMI_CheckButton` checks the keyboard buffer for pressed buttons. If a button was pressed, the routine returns `KeyPressed = TRUE`, otherwise `KeyPressed = FALSE` is returned.

Note	The routine `MMI_CheckButton` does not wait until a button was pressed. It only checks the keyboard buffer.

Parameters

lKeyPressed	In	`lKeyPressed = TRUE` is returned, if a valid button was pressed. Otherwise the value of `lKeyPressed` is `FALSE`.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also `MMI_AddButton`
`MMI_GetButton`

Example The example uses the `MMI_CheckButton` routine to wait until a (valid) key was pressed.

```
DIM lKeyPressed AS Logical

DO
  MMI_CheckButton( lKeyPressed )
LOOP UNTIL lKeyPressed

'do something ..
```

6.1.15 MMI_GetButton

Description Get the button identifier of the pressed button.

Declaration

```
MMI_GetButton( iButtonId AS Integer,
               BYVAL lAllKeys  AS Logical )
```

Remarks Waits until a valid key is pressed and returns the button Identifier `iButtonId` of the pressed button.
If `lAllKeys = FALSE`, the keys `ESC`, `ENTER`, `ON/OFF` or any assigned button (added with `MMI_AddButton`) terminates this function and the `iButtonId` of the pressed button is returned. If `lAllKeys = TRUE,` additional keys i.e. the cursor keys terminates this routine too. For details see table below.

Note	This function relates to the currently active dialog.

Parameters

`iButtonId`	`Out`	The identifier of the pressed button. For values of `iButtonId` see the table below.
`lAllKeys`	`In`	Determines which keys exit the routine. If `lAllKeys = TRUE` any valid pressed key exit the routine, otherwise only normal ones.

Button pressed	iButtonId returned	
	lAllKeys = TRUE	lAllKeys = FALSE
assigned (using MMI_AddButton) "F1".."F6", "SHIFT-F2".. "SHIFT-F6"	MMI_F1_KEY.. MMI_F6_KEY, MMI_SHF2_KEY.. MMI_SHF6_KEY	MMI_F1_KEY.. MMI_F6_KEY, MMI_SHF2_KEY.. MMI_SHF6_KEY
unassigned "F1".."F6", "SHIFT-F2".. "SHIFT-F6"	MMI_UNASS_KEY	no return
assigned "CODE"	MMI_CODE_KEY	MMI_CODE_KEY
unassigned "CODE"	MMI_UNASS_KEY	no return
"ENTER" within dialog, focus on a field	MMI_UNASS_KEY	no return
"ENTER" within dialog, no focus	MMI_UNASS_KEY	no return
"ENTER" after editing	MMI_EDIT_ ENTER_KEY	MMI_EDIT_ ENTER_KEY
"ESC" within dialog	MMI_ESC_KEY	MMI_ESC_KEY
"ESC" after editing	MMI_EDIT_ ESC_KEY	no return
"SHIFT"	MMI_UNASS_KEY	no return
"0".."9", focus on spin/list-field	MMI_UNASS_KEY	no return
"0..9", no focus	MMI_NUM0_KEY.. MMI_NUM9_KEY	no return
"CE"	MMI_UNASS_KEY	no return
cursor keys	MMI_UP_KEY, MMI_DOWN_KEY, MMI_RIGHT_KEY, MMI_LEFT_KEY	no return

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_AddButton, MMI_CheckButton

Example The example uses the MMI_GetButton routine to react to a pressed button. To make a function key valid for MMI_GetButton it must be added to the dialog (with MMI_AddButton).

```
DIM iActionButton  AS Integer
DIM iPressedButton AS Integer

iActionButton = MMI_F2_KEY

MMI_GetButton ( iPressedButton, TRUE )
IF iPressedButton = iActionButton THEN
  'any actions
END IF
```

6.1.16 MMI_AddButton

Description Add a button to a dialog.

Declaration

```
MMI_AddButton( BYVAL iButtonId AS Integer,
               BYVAL sCaption  AS _Token )
```

Remarks The routine MMI_AddButton adds the button with the Identifier iButtonId to the actual dialog and places the text sCaption onto the button. These added buttons are valid for the routines MMI_CheckButton and MMI_GetButton and the input routines (MMI_InputStr, MMI_InputVal, MMI_InputInt and MMI_InputList) which means the according button identifier can be returned from this routines.

Note	Either a text dialog <u>or</u> a measurement dialog can be defined at a time. Additionally a graphics dialog can override one of these above. Then the functionality applies to the graphics dialog.

The added buttons can be deleted with the routine MMI_DeleteButton while the dialog exists. Closing the dialog with MMI_DeleteDialog deletes all buttons attached to this dialog.

Parameters

iButtonId	in	Identifier of the button to be added. See for the values that can be used for the iButtonId under the routine description MMI_GetButton. Only MMI_F1_Key..MMI_F5_KEY, MMI_SHF2_KEY..MMI_SHF6_KEY and MMI_CODE_KEY are available for the AddButton routine.
sCaption	in	The text placed onto the button, left alignment (max. 5 characters).

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.
MMI_BUTTON_ID_EXISTS	This button has been defined already.

See Also MMI_GetButton, MMI_CheckButton, MMI_DeleteButton

Example The example uses the MMI_AddButton routine to add the F2-KEY with the caption "EXIT" to the dialog.

```
MMI_AddButton( MMI_F2_KEY, "EXIT" )
```

6.1.17 MMI_DeleteButton

Description Delete a button from a dialog.

Declaration `MMI_DeleteButton( iButtonId AS Integer )`

Remarks The routine MMI_DeleteButton deletes the button with the Identifier iButtonId from the actual dialog. Only a button that was added with MMI_AddButton can be deleted. Closing the dialog with MMI_DeleteDialog deletes all buttons attached to this dialog.

Parameters

iButtonId	in	Identifier of the button to be deleted. See for the values that can be used for `iButtonId` under the routine description `MMI_GetButton`.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.
MMI_ILLEGAL_BUTTON_ID	This button has not been defined by `MMI_AddButton`.

See Also `MMI_AddButton`

Example The example uses the `MMI_DeleteButton` routine to delete the `F2-KEY` from the dialog.

```
MMI_DeleteButton( MMI_F2_KEY )
```

6.1.18 MMI_PrintStr

Description Print a string on a text dialog.

Declaration

```
MMI_PrintStr( BYVAL iColumn AS Integer,
              BYVAL iLine   AS Integer,
              BYVAL sText   AS String30,
              BYVAL lValid  AS Logical )
```

Remarks The text string `sText` is placed on position `iColumn` and `iLine` on the text dialog. If `lValid` is not `TRUE`, then the symbols for invalid values are displayed. Too long text strings are truncated, illegal co-ordinates are adjusted.

> **Note** A text dialog must already exist. Only display length number of character will be displayed, hence 29.

Parameters

iColumn	in	The horizontal position (0..28)

`iLine`	in	The vertical position (0..number of lines defined with `MMI_CreateTextDialog`)
`sText`	in	The text string to display
`lValid`	in	Determines if the value should be shown as valid. If `lValid = TRUE` the value `sText` is displayed, otherwise the symbols for invalid values are displayed.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_InputStr`

Example The example uses the `MMI_PrintStr` routine to print the text string „Hello World“ in the first line on row 2 of the actual text dialog.

```
MMI_PrintStr( 2, 0, "Hello World", TRUE )
```

6.1.19 MMI_PrintTok

Description Print a string on a text dialog.

Declaration

```
MMI_PrintTok(  BYVAL iColumn AS Integer,
               BYVAL iLine   AS Integer,
               BYVAL sText   AS _Token )
```

Remarks The text token `sText` is placed on position `iColumn` and `iLine` on the text dialog. Too long text strings are truncated, illegal co-ordinates are adjusted. This routine may be used instead of `MMI_PrintStr` to support internationalisation of multiple language applications.

Note A text dialog must already exist.

Parameters

`iColumn`	in	The horizontal position (0..28)
`iLine`	in	The vertical position (0..number of lines defined with `MMI_CreateTextDialog`)

`sText`	`in`	The text string to display

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.
`TXT_UNDEF_TOKEN`	The given token could not be found in the database. Most probably an old version is loaded either on TPS or simulator.
`RC_IVPARAM`	No text token database is loaded with the currently set language.

See Also `MMI_PrintStr`

Example The example uses the `MMI_PrintTok` routine to print the text string „Hello World" in the first line on row 2 of the actual text dialog.

```
MMI_PrintTok( 2, 0, "Hello World" )
```

6.1.20 MMI_PrintVal

Description Print a value on a text dialog.

Declaration

```
MMI_PrintVal( BYVAL iColumn   AS Integer,
              BYVAL iLine     AS Integer,
              BYVAL iLen      AS Integer,
              BYVAL iDecimals AS Integer,
              BYVAL dVal      AS Double,
              BYVAL lValid    AS Logical,
              BYVAL iMode     AS Integer )
```

Remarks This routine can be used to display double values (or values with equal type, e.g. dimension). If `lValid = TRUE` the value `dVal` is placed on position `iColumn` and `iLine` on the text dialog, otherwise the symbols for invalid values `"-----"` are displayed. Too long value strings are truncated, illegal co-ordinates are adjusted. If `iMode = MMI_DIM_ON`, a dimension field is automatically displayed when the type of `dVal` has units.

If the `dVal` can not be displayed in `iLen` characters, then `"xxx"` will be displayed instead.

Note	A text dialog must already exist.

Parameters

`iColumn`	in	The horizontal position (0..28).
`iLine`	in	The vertical position (0..number of lines defined with `CreateTextDialog).`
`iLen`	in	The length of the value consisting of a sign, the characters before and after the comma and the comma itself. The dimension field is not included.
`iDecimals`	in	The number of decimals. If `iDecimals = -1` then the number of decimals set by the system is taken.
`dVal`	in	The value to display. Use this routine to display double (and equal to double) values with the correct units. For integer values a separate routine (`MMI_PrintInt`) exists.
`lValid`	in	Determines if the value should be shown as valid. If `lValid = TRUE` the value `dVal` is displayed, otherwise the symbols for invalid values are displayed.
`iMode`	in	Determines the display of the dimension. If `Mode = MMI_DIM_ON` a dimension field is automatically displayed when the type `dVal` has units. Otherwise use `MMI_DEFAULT_MODE`.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_PrintInt , MMI_InputVal`

Example The example uses the `MMI_PrintVal` routine to print the value of `TestVal` as distance (with corresponding dimension) in the first line on row 2 of the currently open text dialog.

```
DIM TestVal AS Distance
TestVal = 287.47

MMI_PrintVal( 2, 0, 10, 2, TestVal, TRUE,
              MMI_DIM_ON )
```

6.1.21 MMI_PrintInt

Description Print an integer value on a text dialog.

Declaration

```
MMI_PrintInt( BYVAL iColumn AS Integer,
              BYVAL iLine   AS Integer,
              BYVAL iLen    AS Integer,
              BYVAL iVal    AS Integer,
              BYVAL lValid  AS Logical )
```

Remarks This routine can be used to display integer values. Too long value strings are truncated, illegal co-ordinates are adjusted. If `lValid = TRUE` the value `iVal` is placed on position `iColumn` and `iLine` on the text dialog, otherwise the symbols for invalid values are displayed.
If the `iVal` can not be displayed in `iLen` characters, then `"xxx"` will be displayed instead.

Note	A text dialog must already exist.

Parameters

`iColumn`	`in`	The horizontal position (0..28).
`iLine`	`in`	The vertical position (0..number of lines defined with `MMI_CreateTextDialog)`.
`iLen`	`in`	The length of the value plus the sign.
`iVal`	`in`	The value to display. Use this routine to display integer values. For double values a separate routine (`MMI_PrintVal`) exists.
`lValid`	`in`	Determines if the value should be shown as valid. If `lValid = TRUE` the value `iVal` is displayed, otherwise the symbols for invalid values are displayed.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_PrintVal
MMI_InputInt

Example The example uses the MMI_PrintInt routine to print the value of TestVal in the first line on row 2 of the currently open text dialog.

```
DIM TestVal AS Integer
TestVal = 1000

MMI_PrintInt( 2, 0, 5, TestVal, TRUE )
```

6.1.22 MMI_InputStr

Description Get a string input in a text dialog.

Declaration

```
MMI_InputStr( BYVAL iColumn   AS Integer,
              BYVAL iLine     AS Integer,
              BYVAL iLen      AS Integer,
              BYVAL iMode     AS Integer,
                    sText     AS String30,
                    lValid    AS Logical,
                    iButtonId AS Integer )
```

Remarks If lValid = TRUE the text string sText is placed on position iColumn and iLine on the text dialog, otherwise the symbols for invalid values are displayed.
Illegal co-ordinates are adjusted. If the length of the string exceeds the given length iLen the string is truncated at position iLen. After the edit process the string is returned and the text is placed right aligned on the display. If the length iLen <= 0 or no part of the field is in the dialog area the Text is not edited and the routine exits.

The string can be edited by pressing αEDIT or a numerical key. If iMode = MMI_DEFAULT_MODE the keys ESC, ENTER,

ON/OFF or any user defined button (added with MMI_AddButton) terminates the edit process and the iButtonId of the pressed button is returned. If iMode = MMI_SPECIALKEYS_ON additional keys i.e. the cursor keys terminates MMI_InputStr too. For details see MMI_GetButton.

Note	A text dialog must already exist.

Parameters

iColumn	in	The horizontal position (0..28).
iLine	in	The vertical position (0..number of lines defined with MMI_CreateTextDialog).
iLen	in	The length of the input field.
iMode	in	Defines the editing mode. MMI_DEFAULT_MODE defines normal editing MMI_SPECIALKEYS_ON allows editing with full cursor control
sText	inout	The text string to edit.
lValid	inout	Determines if the value should be shown as valid. If lValid=TRUE the string sText is displayed, otherwise the symbols for invalid values are displayed.
iButtonId	out	The identifier of the pressed valid button to exit the edit process.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_PrintStr

Example The example uses the `MMI_InputStr` routine to get the text string `sInputString` in the first line on row 2 of the actual text dialog.

```
DIM sInputString AS String30
DIM iButton      AS Integer
DIM lValid       AS Logical

sInputString = "The input text"
lValid = TRUE
MMI_InputStr( 2, 0, 20, MMI_DEFAULT_MODE,
             sInputString, lValid,iButton )
```

6.1.23 MMI_InputVal

Description Get a numerical input for double values in a text dialog.

Declaration

```
MMI_InputVal( BYVAL iColumn   AS Integer,
              BYVAL iLine     AS Integer,
              BYVAL iLen      AS Integer,
              BYVAL iDecimals AS Integer,
              BYVAL dMin      AS Double,
              BYVAL dMax      AS Double,
              BYVAL iMode     AS Integer,
                    dVal      AS Double,
                    lValid    AS Logical,
                    iButtonId AS Integer )
```

Remarks If `lValid = TRUE` then the value `dVal` is placed on position `iColumn` and `iLine` on the text dialog, otherwise the symbols for invalid values are displayed. Illegal co-ordinates are adjusted. If `iMode = MMI_DIM_ON`, a dimension field is automatically displayed when the type of `dVal` has units. If the length `iLen <= 0` or no part of the field is in the dialog area the value is not edited and the routine exits.

The value within the bounds `dMin` and `dMax` can be edited by pressing `EDIT` or the numerical block keys. If `iMode = MMI_DEFAULT_MODE` the keys `ESC`, `ENTER`, `ON/OFF` or any user defined button (added with `MMI_AddButton`) terminates

the edit process and the `iButtonId` of the pressed button is returned. If `iMode = MMI_SPECIALKEYS_ON` additional keys i.e. the cursor keys terminates `MMI_InputVal` too. For details see `MMI_GetButton.`

Note	A text dialog must already exist.

Parameters

`iColumn`	`in`	The horizontal position (0..28).
`iLine`	`in`	The vertical position (0..number of lines defined with `MMI_CreateTextDialog).`
`iLen`	`in`	The length of the value inclusive decimals, sign and the comma, exclusive the dimension field
`iDecimals`	`in`	The number of decimals. If `iDecimals = -1` the number of decimals set by the system is taken.
`dMin` `dMax`	`in`	The lower and upper bounds.
`iMode`	`in`	Defines the editing mode. `MMI_DEFAULT_MODE` defines normal editing `MMI_SPECIALKEYS_ON` allows editing with full cursor control `MMI_DIM_ON` shows a dimension field if `dVal` has units. Modes can be added, i.e. `MMI_SPECIALKEYS_ON + MMI_DIM_ON`
`dVal`	`inout`	The value to edit. Use this routine to edit double (and equal to double) values. For integer values a separate routine (`MMI_InputInt`) exists.

`lValid`	`inout`	Determines if the value should be shown as valid. If `lValid=TRUE` the value `dVal` is displayed, otherwise the symbols for invalid values are displayed.
`iButtonId`	`out`	The identifier of the pressed valid button to exit the edit process.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_InputInt`
`MMI_PrintVal`

Example See example file „`cursor.gbs`“ too.

The example uses the `MMI_InputVal` routine to get the distance of `TestVal` with default decimal places. Input field is placed in the second line on row 2 of the actual text dialog. The entered values must lie in the range 0..1000.

```
CONST MODE = MMI_DEFAULT_MODE 'define editmode

DIM TestVal  AS Distance
DIM iButton  AS Integer
DIM lValid   AS Logical

lValid = FALSE

MMI_InputVal( 2, 1, 8, -1, 0, 1000, MODE,
              TestVal, lValid, iButton )
```

6.1.24 MMI_InputInt

Description Get an integer input value in a text dialog.

Declaration

```
MMI_InputInt( BYVAL iColumn   AS Integer,
              BYVAL iLine     AS Integer,
              BYVAL iLen      AS Integer,
              BYVAL iMin      AS Integer,
              BYVAL iMax      AS Integer,
              BYVAL iMode     AS Integer,
                    iVal      AS Integer
                    lValid    AS Logical,
                    iButtonId AS Integer )
```

Remarks If `lValid = TRUE` then the integer value `iVal` is placed on position `iColumn` and `iLine` on the text dialog. Illegal co-ordinates are adjusted. If the length `iLen ≤ 0` or no part of the field is in the dialog area the value is not edited and the routine exits.

The integer value within the bounds `iMin` and `iMax` can be edited by pressing `EDIT` or the numerical block keys. If `iMode = MMI_DEFAULT_MODE` the keys `ESC`, `ENTER`, `ON/OFF` or any user defined button (added with `MMI_AddButton`) terminates the edit process and the `iButtonId` of the pressed button is returned. If `iMode = MMI_SPECIALKEYS_ON` additional keys i.e. the cursor keys terminates `MMI_InputInt` too.

Note	A text dialog must already exist.

Parameters

`iColumn`	`in`	The horizontal position (0..28).
`iLine`	`in`	The vertical position (0..number of lines defined with `MMI_CreateTextDialog`).
`iLen`	`in`	The length of the value plus the sign.
`iMin` `iMax`	`in`	The lower and upper bounds.

iMode	in	Defines the editing mode. MMI_DEFAULT_MODE defines normal editing MMI_SPECIALKEYS_ON allows editing with full cursor control
iVal	inout	The value to display. Use this routine to edit integer values. For double values a separate routine (MMI_InputVal) exists.
lValid	inout	Determines if the value should be shown as valid. If lValid=TRUE the value iVal is displayed, otherwise the symbols for invalid values are displayed.
iButtonId	out	The identifier of the pressed valid button to exit the edit process.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_PrintInt, MMI_InputVal

Example See example file „cursor.gbs“ too.

The example uses the MMI_InputInt routine to get the value of iTestVal in the second line on row 2 of the actual text dialog. The entered values must lie in the range 0..1000.

```
CONST MODE = MMI_DEFAULT_MODE 'define editmode

DIM iTestVal AS Integer
DIM iButton  AS Integer
DIM lValid   AS Logical

lValid = FALSE
MMI_InputInt( 2,1,5,0,1000,
              MODE,iTestVal,lValid,iButton )
```

6.1.25 MMI_InputList

Description Shows a list field in a text dialog.

Declaration

```
MMI_InputList( BYVAL iColumn   AS Integer,
               BYVAL iLine     AS Integer,
               BYVAL iLen      AS Integer,
               BYVAL iElements AS Integer,
               BYVAL iMode     AS Integer,
                     List      AS ListArray,
                     iIndex    AS Integer,
                     lValid    AS Logical,
                     iButtonId AS Integer )
```

Remarks If `lValid = TRUE` then a list field is placed on position `iColumn` and `iLine` on the text dialog. Too long list elements are truncated, illegal co-ordinates are adjusted. The `ListArray` is an array of `String30` with `LIST_ARRAY_MAX_ELEMENT` Elements. Only the first `iElements` are displayed. The value of `iIndex` defines which element is shown first.

The list can be edited by pressing `F6` (`LIST`). With the cursor keys `UP` and `DOWN` a field element can be selected. If the list elements are numbered (begins with a number), then the elements can be selected directly by pressing numerical buttons. If `iMode = MMI_DEFAULT_MODE` the keys `ESC`, `ENTER`, `ON/OFF` or any user defined button (added with `MMI_AddButton`) terminates the edit process and the `iButtonId` of the pressed button is returned. If `iMode = MMI_SPECIALKEYS_ON` additional keys i.e. the cursor keys terminates `MMI_InputList` too.

Note	A text dialog must already exist.

Parameters

`iColumn`	in	The horizontal position (0..28).
`iLine`	in	The vertical position (0..number of lines defined with `MMI_CreateTextDialog`).
`iLen`	in	The displayed length of the list elements.

`iElements`	in	The number of list elements. The maximum number is limited to `LIST_ARRAY_MAX_ELEMENT`.
`iMode`	in	Defines the editing mode. `MMI_DEFAULT_MODE` defines normal editing `MMI_SPECIALKEYS_ON` allows editing with full cursor control
`List`	in	The array of the list elements.
`iIndex`	inout	Index (number of the line) of the first shown and selected field respectively. Possible value for `iIndex` are in the range of 1 up to `Elements`.
`lValid`	inout	Determines if the value should be shown as valid. If `lValid=TRUE` the a value is displayed, otherwise the symbols for invalid values are displayed.
`iButtonId`	out	The identifier of the pressed valid button to exit the list process.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

Example See example file „`cursor.gbs`“ too.

The example uses the `MMI_InputList` routine to get the value of the selected list element (the selected line) of a list field displayed in the second line on row 2 of the actual text dialog. The first displayed line is the line with the number Index.

```
CONST MODE = MMI_DEFAULT_MODE 'define editmode

DIM iLen      AS Integer
DIM iElements AS Integer
DIM List      AS ListArray
DIM iIndex    AS Integer
DIM iButton   AS Integer
DIM lValid    AS Logical

'initialize the variables
iLen      = 10   'displayed length of the list
iElements =  7   'number of available fields
iIndex    =  3   'number of the first shown list
element
lValid    = TRUE

List(1) = "1 Line No.: 1"
List(2) = "2 Line No.: 2"
List(3) = "3 Line No.: 3"
List(4) = "4 Line No.: 4"
List(5) = "5 Line No.: 5"
List(6) = "6 Line No.: 6"
List(7) = "7 Line No.: 7"

InputList( 5, 1, iLen, iElements, MODE,
           List, iIndex, lValid, iButton )
```

6.1.26 MMI_FormatVal

Description Convert a value to a string and use TPS system formatting rules.

Declaration

```
MMI_FormatVal( BYVAL iType      AS Integer,
               BYVAL iLen       AS Integer,
               BYVAL iDecimals  AS Integer,
               BYVAL dVal       AS Double,
               BYVAL lValid     AS Logical,
               BYVAL iMode      AS Integer,
                     sValStr    AS String30 )
```

Remarks If `lValid = TRUE` then this routine converts a double value (or values with equal type, e.g. dimension) to a text string, otherwise the symbols for invalid values are returned. The returned string

`sValStr` contains the value string in the same kind as it would be displayed on the Theodolite: the value is placed right aligned with the number `iDecimals` of decimals. If `iMode = MMI_DIM_ON`, a dimension field is appended to the output string when the type `iType` allows it.
If the `dVal` can not be displayed in `iLen` characters, then `"xxx"` will be returned instead.

This routine is useful, if numeric values should be written on files (see chapter file handling for further information).

Parameters

`iType` `in` The type of the numerical field. The type defines if a dimension field is available. Following values for the type can be used:

Type	**Meaning**
MMI_FFORMAT_DOUBLE	double
MMI_FFORMAT_DISTANCE	distance
MMI_FFORMAT_SUBDISTANCE	sub-distance [mm]
MMI_FFORMAT_ANGLE	angle
MMI_FFORMAT_VANGLE	vertical angle
MMI_FFORMAT_HZANGLE	horizontal angle
MMI_FFORMAT_TEMPERATURE	temperature
MMI_FFORMAT_TIME	time 12h/24h-format
MMI_FFORMAT_DATE	date
MMI_FFORMAT_DATE_TIME	date/time

`iLen` `in` The length of the value consisting of a sign, the characters before and after the comma and the comma itself. The dimension field is not included.

`iDecimals` `in` The number of decimals. If `iDecimals = -1` the number of decimals set by the system is taken.

dVal	in	The value to convert. Use this routine to convert double (and equal to double) values.
iMode	in	If iMode = MMI_DIM_ON a dimension string is automatically added to sValStr when the type dVal has units. Otherwise use MMI_DEFAULT_MODE.
sValStr	out	sValStr contains the string representation of the value dVal.

Return-Codes

RC_OK	Successful termination.
RC_IVRESULT	The result is not valid due to an illegal input value.

See Also sFormatVal

Example The example uses the MMI_FormatVal routine to convert the value dTestVal as distance (with corresponding dimension).

```
DIM dTestVal AS Distance
DIM sVString AS String30

dTestVal = 287.47

MMI_FormatVal( MMI_FFORMAT_DISTANCE, 10, -1,
               dTestVal, TRUE,
               MMI_DIM_ON, sVString )
```

6.1.27 MMI_WriteMsg

Description Output to a message window.

Declaration

```
MMI_WriteMsg( BYVAL sText    AS _Token,
              BYVAL sCaption AS _Token,
              BYVAL iMsgType AS Integer,
                    iRetKey  AS Integer )
```

Remarks The function opens a message window on the display, which shows the text specified by sText. Lines that are too long to fit into the window are split automatically.

`sText` may contain a carriage return (character code 10) which breaks a line explicitly. The predefined constants `MMI_INVERSE_ON` and `MMI_INVERSE_OFF` can be used for inverse text.
Text lines, that exceed the size of the window, are not displayed. A title text, which will be printed on the first line of the message box, can be set with `sCaption`, which may not be longer than one line and contain neither font attributes nor type information.

Parameters

`sText`	in	Text-token to be displayed on the window (on the Theodolite).
`sCaption`	in	Text-token that will be displayed as title of the window.

`iMsgType`	in	Defines the type of the message window to be displayed, with the corresponding text on the buttons; possible types:
		`MMI_MB_OK`
		`MMI_MB_ABORT`
		`MMI_MB_OK_ABORT`
		`MMI_MB_ABORT_RETRY_CONT`
		`MMI_MB_YES_NO_ABORT`
		`MMI_MB_YES_NO`
		`MMI_MB_RETRY_ABORT`
		`MMI_MB_ABORT_CONT`
		`MMI_MB_ABORT_RETRY_IGNORE`
		`MMI_MB_ABORT_IGNORE`

`iRetKey`	out	Returns the button pressed, i. e. `iRetKey`:
		`MMI_MB_RET_OK`
		`MMI_MB_RET_ABORT`
		`MMI_MB_RET_RETRY`
		`MMI_MB_RET_CONT`
		`MMI_MB_RET_YES`
		`MMI_MB_RET_NO`
		`MMI_MB_RET_IGNORE`

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

Example The example uses the MMI_WriteMsg routine to display a message box with the title text “Warning“ and the text “timed out“ and shows the buttons “Retry“, “Abort“ returning the button-id in iRetKey.

```
MMI_WriteMsg( "Warning", "timeout",
                MMI_MB_RETRY_ABORT, iMBRetKey )
```

6.1.28 MMI_WriteMsgStr

Description Output to a message window.

Declaration

```
MMI_WriteMsgStr( BYVAL sText     AS String255,
                 BYVAL sCaption AS _Token,
                 BYVAL iMsgType AS Integer,
                       iRetKey  AS Integer )
```

Remarks The function opens a message window on the display, which shows the text specified by sText. Lines, which are too long to fit into the window, are split automatically. sText may contain a carriage return (character code 10) which breaks a line explicitly.
The predefined constants MMI_INVERSE_ON and MMI_INVERSE_OFF can be used for inverse text.
Text lines, that exceed the size of the window, are not displayed.
A title text, which will be printed on the first line of the message box, can be set with sCaption, which may not be longer than one line and contain neither font attributes nor type information.

Note	This routine is different to MMI_WriteMsg in such a way that sText may be computed. But, of course, sText will not be entered into the text token data base.

Parameters

sText	in	Text string to be displayed in a message box.

`sCaption`	`in`	Text-token that will be displayed as title of the window.

`iMsgType`	`in`	Defines the type of the message window to be displayed, with the corresponding text on the buttons; possible types:
		`MMI_MB_OK`
		`MMI_MB_ABORT`
		`MMI_MB_OK_ABORT`
		`MMI_MB_ABORT_RETRY_CONT`
		`MMI_MB_YES_NO_ABORT`
		`MMI_MB_YES_NO`
		`MMI_MB_RETRY_ABORT`
		`MMI_MB_ABORT_CONT`
		`MMI_MB_ABORT_RETRY_IGNORE`
		`MMI_MB_ABORT_IGNORE`

`iRetKey`	`out`	Returns the button pressed, i. e. `iRetKey`:
		`MMI_MB_RET_OK`
		`MMI_MB_RET_ABORT`
		`MMI_MB_RET_RETRY`
		`MMI_MB_RET_CONT`
		`MMI_MB_RET_YES`
		`MMI_MB_RET_NO`
		`MMI_MB_RET_IGNORE`

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_WriteMsg`

Example The example uses the `MMI_WriteMsgStr` routine to display a message box with the title text "`Warning`" and the text:

```
MessageStr
time out in 10 seconds
```

and shows the buttons "`Retry`", "`Abort`" returning the button-id in `iRetKey`.

```
CONST  iTimeOut  AS Integer = 10
DIM    sMessage  As String255
DIM    iMBRetKey AS Integer

sMessage = "MessageStr\d010time out in " +
            Str$(iTimeOut) + "seconds"
MMI_WriteMsgStr( "Warning", sMessage,
                 MMI_MB_RETRY_ABORT,iMBRetKey )
```

6.1.29 MMI_DrawLine

Description Draw a line.

Declaration

```
MMI_DrawLine( BYVAL iX1  AS Integer,
              BYVAL iY1  AS Integer,
              BYVAL iX2  AS Integer,
              BYVAL iY2  AS Integer,
              BYVAL iPen AS Integer )
```

Remarks The function draws a line within the graphic field using the line-style `iPen`.

Note	A graphics dialog has to be set up before.

Parameters

`iX1`	`in`	x-co-ordinate of the beginning of the line [pixel]
`iY1`	`in`	y-co-ordinate of the beginning of the line [pixel]
`iX2`	`in`	x-co-ordinate of the end of the line [pixel]
`iY2`	`in`	y-co-ordinate of the end of the line [pixel]

`iPen`	`in`	Line-style; possible values:
		`MMI_PEN_WHITE`
		`MMI_PEN_BLACK`
		`MMI_PEN_DASHED`

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No graphics dialog exists for this operation.

See Also `MMI_CreateGraphDialog`, `MMI_DrawRect`, `MMI_DrawCircle`, `MMI_DrawText`

Example The example uses the `MMI_DrawLine` routine to draw a line with the specified attributes.

```
MMI_DrawLine( 10, 10, 100, 50, MMI_PEN_BLACK )
```

6.1.30 MMI_DrawRect

Description Draw a rectangle.

Declaration

```
MMI_DrawRect( BYVAL iX1    AS Integer,
              BYVAL iY1    AS Integer,
              BYVAL iX2    AS Integer,
              BYVAL iY2    AS Integer,
              BYVAL iBrush AS Integer,
              BYVAL iPen   AS Integer )
```

Remarks This function draws a rectangle in the graphic field using the fill-style `iBrush` and the line-style `iPen`.

Note	A graphics dialog has to be set up before.

Parameters

`iX1`	`in`	x-co-ordinate at the upper left-hand corner of the rectangle [pixel]
`iY1`	`in`	y-co-ordinate at the upper left-hand corner of the rectangle [pixel]
`iX2`	`in`	x-co-ordinate at the bottom right-hand corner of the rectangle [pixel]
`iY2`	`in`	y-co-ordinate at the bottom right-hand corner of the rectangle [pixel]

`iBrush`	`in`	Fill-style for the rectangle; possible values:
		`MMI_BRUSH_WHITE`
		`MMI_BRUSH_BLACK`
		`MMI_NO_BRUSH`

`iPen`	`in`	Line-style:
		`MMI_PEN_WHITE`
		`MMI_PEN_BLACK`
		`MMI_PEN_DASHED`

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No graphics dialog exists for this operation.

See Also `MMI_CreateGraphDialog`, `MMI_DrawLine`, `MMI_DrawCircle`, `MMI_DrawText`

Example The example uses the `MMI_DrawRect` routine to draw a rectangle with the specified attributes.

```
MMI_DrawRect( 10, 10, 100, 50, MMI_NO_BRUSH,
MMI_PEN_BLACK )
```

6.1.31 MMI_DrawCircle

Description Draw a circle / ellipse.

Declaration

```
MMI_DrawCircle( BYVAL iX      AS Integer,
                BYVAL iY      AS Integer,
                BYVAL iRx     AS Integer,
                BYVAL iRy     AS Integer,
                BYVAL iBrush  AS Integer,
                BYVAL iPen    AS Integer )
```

Remarks This function draws a circle in the graphic field, using the radius `iRx`, the fill-style `iBrush`, and the line-style `iPen`, as long as `iRx` = `iRy`. Otherwise, an ellipse is drawn, where `iRx` and `iRy` are the lengths of the perpendicular radii.

Note	A graphics dialog has to be set up before.

Parameters

`iX`	`in`	x-co-ordinate at the centre of the circle/ellipse [pixel]
`iY`	`in`	y-co-ordinate at the centre of the circle/ellipse [pixel]
`iRx`	`in`	Radius of the circle, horizontal radius [pixel]
`iRy`	`in`	Radius of the circle, vertical radius [pixel]

`iBrush`	`in`	Fill-style for the rectangle; possible values:
		`MMI_BRUSH_WHITE`
		`MMI_BRUSH_BLACK`
		`MMI_NO_BRUSH`

`iPen`	`in`	Line-style; possible values:
		`MMI_PEN_WHITE`
		`MMI_PEN_BLACK`
		`MMI_PEN_DASHED`

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No graphics dialog exists for this operation.

See Also MMI_CreateGraphDialog, MMI_DrawLine, MMI_DrawRect, MMI_DrawText

Example Draw a circle with a radius of 10.

```
MMI_DrawCircle( 80, 25, 10, 10,
                MMI_BRUSH_BLACK,
                MMI_PEN_BLACK )
```

6.1.32 MMI_DrawText

Description Draw / delete text.

Declaration

```
MMI_DrawText( BYVAL iX    AS Integer,
              BYVAL iY    AS Integer,
              BYVAL sText AS String20,
              BYVAL iAttr AS Integer,
              BYVAL iPen AS Integer )
```

Remarks This function either draws (iPen = MMI_PEN_BLACK) or deletes (iPen = MMI_PEN_WHITE) a text string in graphic field. The co-ordinates (iX, iY) correspond to the upper left-hand corner of the first character. The character size is 6 x 8 pixel.

Note	A graphics dialog has to be set up before.

Parameters

iX	in	x-co-ordinate at the upper left-hand corner of the first character [pixel]	
iY	in	y-co-ordinate at the upper left-hand corner of the first character [pixel]	
sText	in	Pointer to the text string	
iAttr	in	Text attribute	
		MMI_TXT_NORMAL	normal text
		MMI_TXT_INVERSE	inverted text

`iPen`	`in`	`MMI_PEN_BLACK`	draw text
		`MMI_PEN_WHITE`	delete text

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No graphics dialog exists for this operation.

See Also `MMI_CreateGraphDialog, MMI_DrawLine, MMI_DrawRect, MMI_DrawCircle`

Example Print a text at position 10, 10.

```
DIM sOutput AS String20
sOutput = "distance"
MMI_DrawText( 10, 10, sOutput, MMI_TXT_NORMAL,
MMI_PEN_BLACK )
```

6.1.33 MMI_DrawBusyField

Description Shows or hides the Busy-Icon.

Declaration
```
MMI_DrawBusyField(
            BYVAL lVisible as Logical )
```

Remarks This function controls the Busy-Icon (Hourglass).

Parameters

`lVisible`	`in`	TRUE: Icon is visible

Return-Codes

`RC_OK`	Successful termination.

Example The example shows and hides the Busy-Icon

```
MMI_DrawBusyField(TRUE)  ' show icon

' time consuming function....

MMI_DrawBusyField(FALSE) ' hide icon
```

6.1.34 MMI_BeepAlarm, MMI_BeepNormal, MMI_BeepLong

Description Create an alert beep.

Declaration
```
MMI_BeepAlarm()
MMI_BeepNormal()
MMI_BeepLong()
```

Remarks The functions create one or a sequence of alert beeps with configurable volume, if the boxes are turned on.

Any previously set continuous signal beep will be finished.

Return-Codes

RC_OK	Successful termination.

See Also MMI_StartVarBeep
MMI_SwitchVarBeep
MMI_GetVarBeepStatus

Example The example uses the MMI_BeepNormal to sound a signal beep.

```
MMI_BeepNormal()
```

6.1.35 MMI_StartVarBeep

Description Start beep sequences with configurable interrupts.

Declaration `MMI_StartVarBeep( BYVAL iRate AS Integer )`

Remarks The function creates sequences of beeps with configurable interrupts.

If previously a continuous signal beep has been set, the new rate will be established.

Parameters

`iRate`	`in`	frequency in [%]; 0 is very slow, 100 is very fast

Return-Codes

`RC_OK`	Successful termination.

See Also `MMI_BeepAlarm`, `MMI_BeepNormal`, `MMI_BeepLong`, `MMI_SwitchVarBeep`, `MMI_GetVarBeepStatus`

Example The example uses the `MMI_StartVarBeep` to create a very fast sequence of signal beeps.

```
MMI_StartVarBeep( 100 )
```

6.1.36 MMI_SwitchVarBeep

Description Switch a varying beep.

Declaration `MMI_SwitchVarBeep( BYVAL lOn AS Logical )`

Remarks The function allows the general switching (on/off) of a signal beep. A continuous signal beep will be switched off immediately.

Parameters

`lOn` `in` switches the beep on or off

lOn	**meaning**
`FALSE`	the beep is switched off generally
`TRUE`	beep is on; the functions `MMI_BeepNormal` etc. will only work if the beep is switched on.

Return-Codes

`RC_OK`	Successful termination.

See Also `MMI_BeepNormal`, `MMI_BeepLong`, `MMI_BeepAlarm`, `MMI_StartVarBeep`, `MMI_GetVarBeepStatus`

Example The example uses the `MMI_SwitchVarBeep` to switch off the beep.

```
MMI_SwitchVarBeep( TRUE )
```

6.1.37 MMI_GetVarBeepStatus

Description Read the switch status for a variable signal beep.

Declaration `MMI_GetVarBeepStatus( lOn AS Logical )`

Remarks The function retrieves the state of the general signal beep switch.

Parameters

`lOn` `out` state of the switch

lOn	**meaning**
FALSE	off
TRUE	on

Return-Codes

RC_OK	Successful termination.

See Also `MMI_BeepNormal`, `MMI_BeepLong`, `MMI_BeepAlarm`, `MMI_StartVarBeep`, `MMI_SwitchVarBeep`

Example The example uses the `MMI_GetVarBeepStatus` to revert the beep status (i.e. switch on when it is off and vice versa).

```
DIM lOn AS Logical

MMI_GetVarBeepStatus(lOn)
MMI_SwitchVarBeep( NOT lOn )
```

6.1.38 MMI_SwitchAFKey

Description Switch the `aF…` key on or off.

Declaration `MMI_SwitchAFKEY( BYVAL lOn AS Logical )`

Remarks The function allows the switching (on/off) off the `aF…` key. Normally it is enabled, but during tracking distances it is disabled.

Parameters

`lOn` `in` switches the beep on or off

lOn	**meaning**
FALSE	Key is switched off generally
TRUE	Key is active

Return-Codes

RC_OK	Successful termination.

See Also `BAP_MeasRec`, `BAP_MeasDistAng`

Example The example uses the `MMI_SwitchAFKey` to disable the `aF…` key.

```
MMI_SwitchAFKey( FALSE )
```

6.1.39 MMI_SwitchIconsBeep

Description Switches measurement icons and special beeps on or off.

Declaration `MMI_SwitchIconsBeep( BYVAL lOn AS Logical )`

Remarks The function allows the switching (on/off) of the measurement icons and special beeps (sector and lost lock).

Parameters

`lOn` `in` switches the icons and beep on or off

lOn	**meaning**
FALSE	no measurement icons and no special beep
TRUE	the measurement icons will be updated and the beeps are enabled. This is the normal state during a measurement dialog with continuos measurements.

Return-Codes

RC_OK	Successful termination.

See Also `BAP_MeasRec`
`BAP_MeasDistAng`

Example The example uses the `MMI_SwitchIconsBeep` to disable the icons and beeps.

```
MMI_SwitchIconsBeep( FALSE )
```

6.1.40 MMI_SetAngleRelation

Description Set the angle relationship.

Declaration

```
MMI_SetAngleRelation(
            BYVAL iVertRel AS Integer,
            BYVAL iHorzRel AS Integer)
```

Remarks This function sets the relationship of the vertical and horizontal angles. Fields already displayed are not updated.

Parameters

iVertRel	in	Relationship of the vertical angle; valid values: MMI_VANGLE_IN_PERCENT MMI_VANGLE_REL_HORIZON MMI_VANGLE_REL_ZENIT
iHorzRel	in	Relationship of the horizontal angle; valid values: MMI_HANGLE_CLOCKWISE MMI_HANGLE_ANTICLOCKWISE MMI_HANGLE_CLOCKWISE_SOUTH MMI_HANGLE_BEARING

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetAngleRelation

Example Set the angle relations (with internal default values).

```
MMI_SetAngleRelation(
      MMI_VANGLE_IN_PERCENT,
      MMI_HANGLE_CLOCKWISE)
```

6.1.41 MMI_GetAngleRelation

Description Request the current angle relationships.

Declaration
```
MMI_GetAngleRelation(iVertRel AS Integer,
                     iHorzRel AS Integer)
```

Remarks This function returns the current vertical- and horizontal- angle relationships.

Parameters

`iVertRel`	`out`	Relationship of the vertical angle
`iHorzRel`	`out`	Relationship of the horizontal angle

Return Codes

`none`

See Also `MMI_SetAngleRelation`

Example Get the angle relations.
```
DIM iVertRel AS Integer
DIM iHorzRel AS Integer

MMI_GetAngleRelation( iVertRel, iHorzRel )
```

6.1.42 MMI_SetVAngleMode

Description Set the V-Angle mode.

Declaration
```
MMI_SetVAngleMode(BYVAL lAngleFree AS
Logical)
```

Remarks This function sets the vertical angle mode. Normally (`lAngleFree=FALSE`), the vertical angle is fix if there is a valid distance available. If `lAngleFree=TRUE`, the vertical angle will be updated including all corresponding values (slope distance, vertical distance, coordinates etc)

Parameters

`lAngleFree`	`in`	TRUE: V-Angle is free (running)

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_GetVAngleMode`

Example See example file „`meas.gbs`“.

6.1.43 MMI_GetVAngleMode

Description Returns the V-Angle mode.

Declaration `MMI_GetVAngleMode(lAngleFree AS Logical)`

Remarks This function returns the vertical angle mode.

Parameters

`lAngleFree`	`in`	TRUE: V-Angle is free (running)

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_SetVAngleMode`

Example See example file „`meas.gbs`“.

6.1.44 MMI_SetAngleUnit

Description Set the displayed unit of angle.

Declaration

```
MMI_SetAngleUnit(BYVAL iUnit   AS Integer,
                 BYVAL iDigits AS Integer)
```

Remarks This function sets the displayed unit of angle. Existing display fields are not updated. If `iDigits` is greater than the maximal number it will be reset to it without notifying the user. A negative value of `iDigits` is not allowed.

Note	The maximal number of decimal digits depends on the Theodolite class.

Parameters

iUnit	in	Specified unit of angle; possible values:

value	meaning
MMI_ANGLE_GON	400 Gon
MMI_ANGLE_DEC	360 Decimal
MMI_ANGLE_SEXADEC	360 Sexadecimal
MMI_ANGLE_MIL	6400 Mil
MMI_ANGLE_PERCENT	$-300 \le x \le 300$; only for vertical angles

iDigits	in	Number of decimal places. The maximum number of decimal places (iDigits) for each unit is set to the following values:

angle unit	places
MMI_ANGLE_GON	0-4
MMI_ANGLE_DEC	0-4
MMI_ANGLE_SEXADEC	0-4
MMI_ANGLE_MIL	0-3
MMI_ANGLE_PERCENT	don't care

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetAngleUnit

Example Set the angle unit.

```
MMI_SetAngleUnit( MMI_ANGLE_GON, 3 )
```

6.1.45 MMI_GetAngleUnit

Description Return the currently displayed unit of angle.

Declaration

```
MMI_GetAngleUnit(iUnit   AS Integer,
                 iDigits AS Integer)
```

Remarks This function returns the current unit of angle.

Parameters

iUnit	out	Specified unit of angle
iDigits	out	Number of decimal places.

Return Codes

RC_OK	Successful termination.

See Also MMI_SetAngleUnit

Example Get the angle unit.

```
DIM iUnit AS Integer
DIM iDigits AS Integer

MMI_GetAngleUnit( iUnit, iDigits )
```

6.1.46 MMI_SetDistUnit

Description Set the displayed unit of distance.

Declaration

```
MMI_SetDistUnit(BYVAL iUnit   AS Integer,
                BYVAL iDigits AS Integer)
```

Remarks This function sets the display unit for distance. Fields already displayed are not updated. If `iDigits` is greater than the maximal number it will be reset to it without notifying the user. A negative value of `iDigits` is not allowed.

Note	The maximal number of decimal digits depends on the Theodolite class

Parameters

iUnit	in	Specified unit of distance; possible values:

value	**meaning**
MMI_DIST_METER	Meter
MMI_DIST_FOOT	normal foot
MMI_DIST_FOOT_INCH	normal foot / inch / 1/8inch
MMI_DIST_US_FOOT	US-foot
MMI_DIST_US_FOOT_INCH	US-foot / inch / 1/8inch
MMI_DIST_MM	Millimetre
MMI_DIST_INCH	inches

iDigits	in	Number of decimal places. The maximum number of decimal places (iDigits) for each unit is set to the following values:

angle unit	**places**
MMI_DIST_METER	0-4
MMI_DIST_FOOT	0-4
MMI_DIST_FOOT_INCH	0-1
MMI_DIST_US_FOOT	0-4
MMI_DIST_US_FOOT_INCH	0-1
MMI_DIST_MM	0
MMI_DIST_INCH	0-3

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetDistUnit

Example Set the distance unit.

```
MMI_SetDistUnit( MMI_DIST_METER, 4 )
```

6.1.47 MMI_GetDistUnit

Description Return the currently displayed unit of distance.

Declaration
```
MMI_GetDistUnit(    iUnit   AS Integer,
                    iDigits AS Integer)
```

Remarks This function returns the current unit of distance.

Parameters

iUnit	out	Specified unit of distance
iDigits	out	Number of decimal places.

Return Codes

RC_OK	Successful termination.

See Also MMI_SetDistUnit

Example Get the distance unit.

```
DIM iUnit AS Integer
DIM iDigits AS Integer

MMI_GetDistUnit( iUnit, iDigits )
```

6.1.48 MMI_SetPressUnit

Description Set the displayed unit of pressure.

Declaration
```
MMI_SetPressUnit(BYVAL iUnit   AS Integer,
                 BYVAL iDigits AS Integer)
```

Remarks This function sets the display unit for pressure. Fields already displayed are not updated. If `iDigits` is greater than 1 it will be reset to it without notifying the user. A negative value of `iDigits` is not allowed.

Parameters

iUnit	in	Specified unit of pressure; possible values:	
		value	**meaning**
		MMI_PRESS_MBAR	MilliBar
		MMI_PRESS_MMHG	Millimetre mercury
		MMI_PRESS_INCHHG	Inch mercury
		MMI_PRESS_HPA	Hekto-Pascal
		MMI_PRESS_PSI	PSI
iDigits	in	Number of decimal places. The maximum number of decimal places (iDigits) for each unit is set to the following values:	
		angle unit	**places**
		MMI_PRESS_MBAR	0-1
		MMI_PRESS_MMHG	0-1
		MMI_PRESS_INCHHG	0-1
		MMI_PRESS_HPA	0-1
		MMI_PRESS_PSI	0-1

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetPressUnit

Example Set the pressure unit.

```
MMI_SetPressUnit( MMI_PRESS_MBAR, 1 )
```

6.1.49 MMI_GetPressUnit

Description Return the currently displayed unit of pressure.

Declaration
```
MMI_GetPressUnit(iUnit   AS Integer,
                 iDigits AS Integer)
```

Remarks This function returns the current unit of pressure.

Parameters

iUnit	out	Specified unit of pressure
iDigits	out	Number of decimal places.

Return Codes

RC_OK	Successful termination.

See Also MMI_SetPressUnit

Example Get the pressure unit.

```
DIM iUnit AS Integer
DIM iDigits AS Integer

MMI_GetPressUnit( iUnit, iDigits )
```

6.1.50 MMI_SetTempUnit

Description Set the displayed unit of temperature.

Declaration
```
MMI_SetTempUnit(BYVAL iUnit   AS Integer,
                BYVAL iDigits AS Integer)
```

Remarks This function sets the display unit for temperature. Fields already displayed are not updated. If `iDigits` is greater than 1 it will be reset to it without notifying the user. A negative value of `iDigits` is not allowed.

Parameters

`iUnit`	`in`	Specified unit of temperature; possible values:
		value / **meaning**
		`MMI_TEMP_C` Celsius
		`MMI_TEMP_F` Fahrenheit
`iDigits`	`in`	Number of decimal places. The maximum number of decimal places (`iDigits`) for each unit is set to the following values:
		angle unit / **places**
		`MMI_TEMP_C` 0-1
		`MMI_TEMP_F` 0-1

Return Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	The function has been called with an invalid parameter

See Also `MMI_GetTempUnit`

Example Set the temperature unit.

```
MMI_SetTempUnit( MMI_TEMP_C, 1 )
```

6.1.51 MMI_GetTempUnit

Description Return the currently displayed unit of temperature.

Declaration

```
MMI_GetTempUnit(iUnit   AS Integer,
                iDigits AS Integer)
```

Remarks This function returns the current unit of temperature.

Parameters

`iUnit`	`out`	Specified unit of temperature
`iDigits`	`out`	Number of decimal places.

Return Codes

RC_OK	Successful termination.

See Also MMI_SetTempUnit

Example Get the temperature unit.

```
DIM iUnit   AS Integer
DIM iDigits AS Integer

MMI_GetTempUnit( iUnit, iDigits )
```

6.1.52 MMI_SetDateFormat

Description Set the date display format.

Declaration `MMI_SetDateFormat(BYVAL iFormat AS Integer)`

Remarks This function sets the format in which the date is to be displayed. Existing fields remain unchanged.

Parameters

iFormat in — Specified date format; possible values:

value	meaning
MMI_DATE_EU	European: DD.MM.YY
MMI_DATE_US	US: MM/DD/YY
MMI_DATE_JP	Japanese: YY/MM/DD

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetDateFormat

Example Set the date format (internal default value).

```
MMI_SetDateFormat( MMI_DATE_EU )
```

6.1.53 MMI_GetDateFormat

Description Retrieves the date display format.

Declaration `MMI_GetDateFormat(iFormat AS Integer)`

Remarks This function retrieves the format used to display the date.

Parameters

`iFormat`	`out`	Specified date format

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_SetDateFormat`

Example Get the date format.

```
DIM iFormat AS Integer

MMI_GetDateFormat( iFormat )
```

6.1.54 MMI_SetTimeFormat

Description Set the time display format.

Declaration `MMI_SetTimeFormat(BYVAL iFormat AS Integer)`

Remarks This function sets the format in which the time is to be displayed. Existing fields remain unchanged.

Parameters

`iFormat` `in` Specified time format; possible values:

value	**meaning**
`MMI_TIME_12H`	12 hour display
`MMI_TIME_24H`	24 hour display

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetTimeFormat

Example Set the time format (internal default value).

```
MMI_SetTimeFormat( MMI_TIME_12H )
```

6.1.55 MMI_GetTimeFormat

Description Retrieves the time display format.

Declaration `MMI_GetTimeFormat(iFormat AS Integer)`

Remarks This function retrieves the format used to display the time.

Parameters

iFormat	out	Specified time format

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_SetTimeFormat

Example Get the time format.

```
DIM iFormat AS Integer

MMI_GetTimeFormat( iFormat )
```

6.1.56 MMI_SetCoordOrder

Description Set the co-ordinate order.

Declaration `MMI_SetCoordOrder(BYVAL iOrder AS Integer)`

Remarks This function sets the order of co-ordinates. The fields already displayed are not changed.

Parameters

iOrder	in	Specifies the co-ordinate order; possible values:

value	meaning
MMI_COORD_N_E	Order North East
MMI_COORD_E_N	Order East North

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetCoordOrder

Example Set the co-ordinate order (internal default value).

```
MMI_SetCoordOrder( MMI_COORD_N_E )
```

6.1.57 MMI_GetCoordOrder

Description Retrieve the co-ordinate order.

Declaration `MMI_GetCoordOrder(iOrder AS Integer)`

Remarks This function retrieves the order in which co-ordinates are displayed.

Parameters

iOrder	out	Specified co-ordinate order

Return Codes

RC_OK	Successful termination.

See Also `MMI_SetCoordOrder`

Example Get the co-ordinate order.

```
DIM iOrder AS Integer
MMI_GetCoordOrder( iOrder )
```

6.1.58 MMI_SetLanguage

Description Set the display language.

Declaration

```
MMI_SetLanguage(
      BYVAL iLanguageNr AS Integer )
```

Remarks This function sets the current language. All displayed text are immediately shown in the new language.

Parameters

iLanguageNr	in	Specifies the language number; possible values:

Value	Meaning
MMI_REF_LANGUAGE	Reference language (English) = 1
2.. MMI_MAX_LANGUAGE	Language numbers

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter.
TXT_UNDEF_LANG	The given language is not defined.

See Also MMI_GetLanguage

Example Set the language for the display (internal default value).

```
MMI_SetLanguage( MMI_REF_LANGUAGE )
```

6.1.59 MMI_GetLanguage

Description Query the current language.

Declaration

```
MMI_GetLanguage( iLangNr AS Integer,
                 sLangName AS String20)
```

Remarks This function returns the current language and the associated character symbols.

Parameters

iLangNr	out	Language number
sLangName	out	Language description

Return Codes

RC_OK	Successful termination.

See Also MMI_SetLanguage

Example Get the current language.

```
DIM iLangNr   AS Integer
DIM sLangName AS String20

MMI_GetLanguage( iLangNr, sLangName )
```

6.1.60 MMI_GetLangName

Description Gets the name to a language number.

Declaration

```
MMI_GetLangName(
                byVal iLangNr    AS Integer,
                      sLangName  AS String20)
```

Remarks This routine delivers the name associated with the number `iLangNr`.

Parameters

iLangNr	in	Language number
sLangName	out	Language description

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	iLangNr is invalid

See Also MMI_SetLanguage
MMI_GetLanguage

Example Get the name of a language.

```
DIM sLangName AS String20

MMI_GetLangName( 2, sLangName )
```

6.2 BASIC APPLICATIONS BAP

6.2.1 Summarizing Lists of BAP Types and Procedures

6.2.1.1 Procedures

procedure name	description
`BAP_SetAccessoriesDlg`	Sets the used accessories
`BAP_FineAdjust`	Automatic target positioning
`BAP_GetMeasPrg`	Get the current distance measure program.
`BAP_MeasDistAngle`	Measures distance and angles.
`BAP_MeasRec`	Measures and record distance and angles.
`BAP_PosTelescope`	Positioning of the Telescope.
`BAP_SearchPrism`	Searches the prism.
`BAP_SetHz`	Sets the horizontal angle to 0 or another given value.
`BAP_SetManDist`	Set the distance manually.
`BAP_SetMeasPrg`	Set the distance measure program.
`BAP_SetPpm`	Sets the ppm for distance measurements.
`BAP_SetPrism`	Sets the current prism type and constant.

6.2.2 BAP_SetAccessoriesDlg

Description Sets the used accessories.

Declaration `BAP_SetAccessoriesDlg()`

Remarks This function displays the accessories dialog.

Parameters

-

Return-Codes

RC_OK	Successful termination.

Example The example displays the accessories dialog

```
BAP_SetAccessoriesDlg()
```

6.2.3 BAP_MeasDistAngle

Description Measures distance and angles.

Declaration

```
BAP_MeasDistAngle( iDistMode    AS Integer,
                   dHz          AS Angle,
                   dV           AS Angle,
                   dDist        AS Distance,
            BYVAL  lDisplayOn   AS Logical,
            BYVAL  sCaptionLeft AS _Token )
```

Remarks Measures distance and angles and updates the data pool after correct measurements. It controls the special beep (Sector or Lost Lock) and switches measurement icons and disables the `aF...` key during tracking.

Parameters

`iDistMode` Distance measuring modes:

Mode as Input	**Meaning**
BAP_NO_MEAS	No new measurement, get last one
BAP_NO_DIST	No distance measurement, get only angles
BAP_DEF_DIST	Measure distance and angles using default measurement program
BAP_TRK_DIST	Measure distance and angles using the tracking measurement program
BAP_RTRK_DIST	Measure distance and angles using the fast tracking measurement program
BAP_STOP_TRK	Stop tracking, no measurement. No valid results returned.
BAP_CLEAR_DIST	Clear distance (Theodolite data-pool), no measurement. No valid results returned.
BAP_RED_TRK_DIST	Measure distance and angles using the tracking with red laser measurement program

Mode returned	**Meaning**
BAP_DEF_DIST	Depends on distance measurement. Can be changed during distance measurement.
BAP_TRK_DIST	Depends on distance measurement. Can be changed during distance measurement.
BAP_RTRK_DIST	Depends on distance measurement. Can be changed during distance measurement.
All other modes	Returns BAP_DEF_DIST.

`dHz, dV` out Angles [rad] , depends on

		`iDistMode`
`dDist`	`out`	Distance [m], depends on `iDistMode`
`sCaptionLeft`	`in`	Left caption for the distance measurement display.
`lDisplayOn`	`in`	`TRUE`: shows the distance measurement display during distance measurement.

Return Codes

`RC_OK`	Measurement executed successfully
`AUT_RC_ANGLE_ERROR`	Angle measurement error
`AUT_RC_BAD_ENVIRONMENT`	Bad Environment conditions
`AUT_RC_CALACC`	ATR-calibration failed
`AUT_RC_DETECTOR_ERROR`	Error in target acquisition
`AUT_RC_DETENT_ERROR`	Positioning not possible due to mounted EDM
`AUT_RC_DEV_ERROR`	Deviation measurement error
`AUT_RC_INCACC`	Position not exactly reached
`AUT_RC_MOTOR_ERROR`	Motorization error
`AUT_RC_MULTIPLE_TARGETS`	Multiple targets detected
`AUT_RC_NO_TARGET`	No target detected
`AUT_RC_TIMEOUT`	Position not reached
`BAP_CHANGE_ALL_TO_DIST`	No prism has been found during distance measurement with ATR, command changed from "`All`" to "`Dist`"
`TMC_ACCURACY_GUARANTEE`	Info, accuracy cannot be guaranteed
`TMC_ANGLE_ACCURACY_GUARANTEE`	Info, only angle measurement valid, accuracy cannot be guaranteed

TMC_ANGLE_ERROR	Error, no valid angle measurement
TMC_ANGLE_NO_ FULL_ CORRECTION	Warning, only angle measurement valid, accuracy cannot be guaranteed
TMC_ANGLE_OK	Warning, only angle measurement valid
TMC_BUSY	Error, TMC submodule already in use by another subsystem, command not processed
TMC_DIST_ERROR	An error occurred during distance measurement.
TMC_DIST_PPM	Error, wrong setting of PPM or MM on EDM
TMC_NO_FULL_ CORRECTION	Warning, measurement without full correction
TMC_SIGNAL_ERROR	Error, no signal on EDM (only in signal mode)
RC_ABORT	Error, measurement aborted
RC_IVPARAM	Error, invalid DistMode

See Also BAP_MeasRec

Example See example file „meas.gbs“.

The example uses the BAP_MeasDistAngle routine to measure a distance and angles.

```
DIM iDistMode   AS Integer
DIM dHz         AS Angle
DIM dV          AS Angle
DIM dDist       AS Distance

iDistMode = BAP_DEF_DIST
BAP_MeasDistAngle(iDistMode, dHz, dV, dDist,
TRUE, "TEST")
```

6.2.4 BAP_MeasRec

Description Measures distance and angles records.

Declaration

```
BAP_MeasRec(        iDistMode     AS Integer,
             BYVAL lDisplayOn    AS Logical,
             BYVAL sCaptionLeft  AS _Token )
```

Remarks Measures distance and angles and updates the Theodolite data pool after correct measurements and records values according the predefined record mask. After recording, a running point number will be incremented.

It controls the special beep (Sector or Lost Lock), switches Measurement icons and disables `aF...` Key during tracking.

Parameters

`iDistMode` Distance measuring modes:

Mode as Input	Meaning
BAP_NO_MEAS	No new measurement before recording
BAP_NO_DIST	No distance measurement before recording (only new angles)
BAP_DEF_DIST	Use default distance measurement program and record values
BAP_TRK_DIST	Use the tracking measurement program and record values
BAP_RTRK_DIST	Use the fast tracking measurement program and record values
BAP_STOP_TRK	Stop tracking, no measurement and no recording
BAP_CLEAR_DIST	Clear distance (Theodolite data pool), no measurement and no recording.
BAP_RED_TRK_ DIST	Use the tracking with red laser measurement program and record values

Mode returned	Meaning
BAP_DEF_DIST	Depends on distance measurement. Can be changed during distance measurement.
BAP_TRK_DIST	Depends on distance measurement. Can be changed during distance measurement.
BAP_RTRK_DIST	Depends on distance measurement. Can be changed during distance measurement.
All other modes	Returns BAP_DEF_DIST.

sCaptionLeft	in	Left caption for the distance measurement display.
lDisplayOn	in	TRUE: shows the distance measurement display during distance measurement.

Return Codes

RC_OK	Successful termination.
WIR_NO_MEDIUM	No storage medium is available.
AUT_RC_ANGLE_ERROR	Angle measurement error
AUT_RC_BAD_ENVIRONMENT	Bad Environment conditions
AUT_RC_CALACC	ATR-calibration failed
AUT_RC_DETECTOR_ERROR	Error in target acquisition
AUT_RC_DETENT_ERROR	Positioning not possible due to mounted EDM
AUT_RC_DEV_ERROR	Deviation measurement error
AUT_RC_INCACC	Position not exactly reached
AUT_RC_MOTOR_ERROR	Motorization error
AUT_RC_MULTIPLE_TARGETS	Multiple targets detected

AUT_RC_NO_TARGET	No target detected
AUT_RC_TIMEOUT	Position not reached
BAP_CHANGE_ALL_ TO_DIST	No prism has been found during distance measurement with ATR, command changed from "All" to "Dist"
TMC_ACCURACY_ GUARANTEE	Info, accuracy cannot be guaranteed
TMC_ANGLE_ ACCURACY_ GUARANTEE	Info, only angle measurement valid, accuracy cannot be guaranteed
TMC_ANGLE_ERROR	Error, no valid angle measurement
TMC_ANGLE_NO_ FULL_ CORRECTION	Warning, only angle measurement valid, accuracy cannot be guaranteed
TMC_ANGLE_OK	Warning, only angle measurement valid
TMC_BUSY	Error, TMC sub-module already in use by another subsystem, command not processed
TMC_DIST_ERROR	An error occurred during distance measurement.
TMC_DIST_PPM	Error, wrong setting of PPM or MM on EDM
TMC_NO_FULL_ CORRECTION	Warning, measurement without full correction
TMC_SIGNAL_ERROR	Error, no signal on EDM (only in signal mode)
RC_ABORT	Error, measurement aborted
RC_IVPARAM	Error, invalid DistMode

See Also BAP_MeasDistAngle, GSI_SetRecMask

Example See example file „`meas.gbs`".

The example uses the `BAP_MeasMeasRec` routine to record actual distance and angles (no new measurement.

```
DIM iDistMode   AS Integer

iDistMode = BAP_NO_MEAS ' no measurement
BAP_MeasRec(iDistMode, FALSE, "")
```

6.2.5 BAP_FineAdjust

Description Automatic target positioning.

Declaration

```
BAP_FineAdjust(
          BYVAL dSearchHz AS Angle,
          BYVAL dSearchV  AS Angle )
```

Remarks This procedure performs a positioning of the Theodolite axis onto a destination target. If the target is not within the sensor measure region a target search will be executed. The target search range is limited by the parameter `dSearchV` in V- direction and by parameter `dSearchHz` in Hz - direction. If no target is found, the instrument turns back to the initial start position. The ATR mode must be enabled for this functionality, see `CSV_SetATRStatus` and `CSV_GetATRStatus`.

Parameters

`dSearchHz`	in	Search range Hz
`dSearchV`	in	Search range V

Return Codes

`RC_OK`	Successful termination.
`AUT_RC_TIMEOUT`	Timeout while positioning of one or both axes. The position fault lies above 100[cc].
`AUT_RC_MOTOR_ERROR`	Instrument has no 'motorization'.
`RC_FATAL`	Fatal error.
`RC_ABORT`	Function aborted.
`AUT_RC_NO_TARGET`	No target found.

`AUT_RC_MULTIPLE_TARGETS`	Multiple targets found.
`AUT_RC_BAD_ENVIRONMENT`	Inadequate environment conditions.
`AUT_RC_DEV_ERROR`	During the determination of the angle deviation error detected, repeat fine positioning
`AUT_RC_NOT_ENABLED`	ATR mode not enabled, enable ATR mode
`AUT_RC_DETECTOR_ERROR`	ATR error, at repeated occur call service

See Also `CSV_SetATRStatus, CSV_GetATRStatus`

Example The example see sample `TRACKING.GBS.`

6.2.6 BAP_SearchPrism

Description Searches the prism.

Declaration

```
BAP_SearchPrism(
          BYVAL lShowMessages As Logical )
```

Remarks This procedure searches the prism. The searching area depends on the defined searching area and on the setting of the additional working area.
This routine works only in ATR instruments and needs at least Firmware-Release 2.00

Parameters

`lShowMessages`	`in`	TRUE: show error-messages if there are problems to find the prism

Return Codes

`RC_OK`	Successful termination.
`AUT_RC_TIMEOUT`	Timeout while positioning of one or both axes. The position fault lies above 100[cc].

AUT_RC_MOTOR_ ERROR	Instrument has no ‘motorization’.
RC_FATAL	Fatal error.
RC_ABORT	Function aborted.
AUT_RC_NO_TARGET	No target found.
AUT_RC_MULTIPLE_ TARGETS	Multiple targets found.
AUT_RC_BAD_ ENVIRONMENT	Inadequate environment conditions.
AUT_RC_DEV_ERROR	During the determination of the angle deviation error detected, repeat fine positioning
AUT_RC_NOT_ ENABLED	ATR mode not enabled, enable ATR mode

See Also CSV_SetATRStatus, CSV_GetATRStatus

6.2.7 BAP_SetManDist

Description Set the distance manually.

Declaration

```
BAP_SetManDist(
         BYVAL sCaptionLeft AS _Token,
         BYVAL dDistance AS Double,
               iButtonId AS Integer )
```

Remarks The BAP_SetManDist routine starts a dialog with the caption sCaption where the user can enter a horizontal distance. The distance will be stored into the Theodolite data pool.

TPS_Sim	Has no effect. iButtonId will be set to MMI_UNASS_KEY.

Parameters

sCaptionLeft	in	left caption string of the dialog
dDistance	in	initial value for the distance. A negative value will be displayed as "----"

iButtonId	out	identifier of the pressed valid button to exit the dialog

Return Codes

RC_OK	Successful termination.
TMC_ACCURACY_ GUARANTEE	Info, accuracy cannot be guaranteed
TMC_ANGLE_ERROR	Error, no valid angle measurement
TMC_ANGLE_OK	Warning, only angle measurement valid
TMC_BUSY	Error, TMC sub-module already in use by another subsystem, command not processed
TMC_NO_FULL_ CORRECTION	Warning, measurement without full correction
RC_IVPARAM	Error, invalid DistMode

See Also TMC_IfDistTapeMeasured, TMC_SetHandDist, TMC_GetPolar, TMC_GetCoordinate

Example The example uses the BAP_SetManDist routine to enter a distance.

```
DIM iButton   AS Integer
DIM dInitDist AS Distance

dInitDist = 15.0   'initial value

BAP_SetManDist( "BASIC", dInitDist, iButton )
```

6.2.8 BAP_SetPpm

Description Sets the PPM for distance measurements.

Declaration BAP_SetPpm()

Remarks The BAP_SetPpm routine opens a dialog which the user can complete in order to calculate the PPM (parts per million) correction to be used to reduce the distance measured by the EDM.

TPS_Sim	Has no effect.

Return Codes

`RC_OK`	Successful termination.
`RC_SET_INCOMPL`	Parameter set-up for subsystem incomplete.

See Also `BAP_SetManDist, BAP_SetPrism`

Example The example uses the `BAP_SetPpm` routine to open the PPM dialog.

```
BAP_SetPpm()
```

6.2.9 BAP_SetPrism

Description Sets the current prism type and constant.

Declaration `BAP_SetPrism()`

Remarks The `BAP_SetPrism` routine opens a dialog which the user can complete in order to choose one of five prism types/constants. Two types are LEICA defaults, whereas the other three can be named and the constant values given/changed by the user. The prism constants are always given and displayed in millimetres, regardless of the distance units in use at the time.

Return Codes

`RC_OK`	Successful termination.

See Also `BAP_SetManDist, BAP_SetPpm`

Example The example uses the `BAP_SetPrism routine` to open the Prism dialog.

```
BAP_SetPrism()
```

6.2.10 BAP_SetMeasPrg

Description Set the distance measure program.

Declaration `BAP_SetMeasPrg( BYVAL iMeasPrg AS Integer )`

Remarks The `BAP_SetMeasPrg` routine sets the program for the distance measurement.

Parameters

`iMeasPrg`	`in`	Distance measure program

Valid measure programs	**Meaning**
`BAP_SINGLE_REF_STANDARD`	Single measurement, with reflector, standard speed
`BAP_SINGLE_REF_FAST`	Single measurement, with reflector, fast
`BAP_SINGLE_REF_VISIBLE`	Single measurement, with reflector and red laser
`BAP_SINGLE_RLESS_VISIBLE`	Single measurement, reflectorless, with red laser
`BAP_CONT_REF_STANDARD`	Continuous measurement, with reflector, standard speed
`BAP_CONT_REF_FAST`	Continuous measurement, with reflector, fast
`BAP_CONT_RLESS_VISIBLE`	Continuous measurement, reflectorless, with red laser
`BAP_AVG_REF_STANDARD`	Average measurement, with reflector, standard speed
`BAP_AVG_REF_VISIBLE`	Average measurement, with reflector and red laser
`BAP_AVG_RLESS_VISIBLE`	Average measurement, reflectorless, with red laser

See Also `BAP_GetMeasPrg`

Example The example uses the BAP_SetMeasPrg routine to set the distance measurement program on single measurement without reflector.

```
BAP_SetMeasPrg(BAP_SINGLE_RLESS_VISIBLE)
```

6.2.11 BAP_GetMeasPrg

Description Get the current distance measure program.

Declaration `BAP_GetMeasPrg( iMeasPrg AS Integer )`

Remarks The BAP_GetMeasPrg routine fetches the current program for the distance measurement.

Parameters

iMeasPrg	out	Distance measure program

Valid measure programs	Meaning
BAP_SINGLE_REF_ STANDARD	Single measurement, with reflector, standard speed
BAP_SINGLE_REF_ FAST	Single measurement, with reflector, fast
BAP_SINGLE_REF_ VISIBLE	Single measurement, with reflector and red laser
BAP_SINGLE_RLESS_ VISIBLE	Single measurement, reflectorless, with red laser
BAP_CONT_REF_ STANDARD	Continuous measurement, with reflector, standard speed
BAP_CONT_REF_FAST	Continuous measurement, with reflector, fast
BAP_CONT_RLESS_ VISIBLE	Continuous measurement, reflectorless, with red laser
BAP_AVG_REF_ STANDARD	Average measurement, with reflector, standard speed
BAP_AVG_REF_ VISIBLE	Average measurement, with reflector and red laser
BAP_AVG_RLESS_ VISIBLE	Average measurement, reflectorless, with red laser

See Also `BAP_SetMeasPrg`

Example The example uses the `BAP_GetMeasPrg` routine to fetch the current distance measurement program.

```
DIM iMeasPrg AS Integer

BAP_GetMeasPrg(iMeasPrg)
```

6.2.12 BAP_PosTelescope

Description Positioning of the Telescope.

Declaration

```
BAP_PosTelescope(
            BYVAL eMode        AS Integer,
            BYVAL eDspMode     AS Integer,
            BYVAL dHz          AS Double,
            BYVAL dV           AS Double,
            BYVAL dHzTolerance AS Double,
            BYVAL dVTolerance  AS Double)
```

Remarks This procedure positions the telescope according to the specified mode and angles.

TPS_Sim	Has no effect.

Parameters

`eMode`	Positioning mode.	
	`BAP_POSIT`	positioning on Hz and V angle
	`BAP_POSIT_HZ`	positioning on Hz angle
	`BAP_POSIT_V`	positioning on V angle
	`BAP_CHANGE_FACE`	change face

`eDspMode`	Controls the context and layout of the display during manual positioning. This parameter has no effect on motorised Theodolites. `BAP_POS_NOMSG` — No message will be displayed `BAP_POS_MSG` — Only a message will be displayed `BAP_POS_DLG` — Positioning will be guided with a dialog if it is a non motorised Theodolite
`dHz, dV`	Target position
`dHzTolerance, dVTolerance`	In case of manual positioning, the tolerances define the upper and lower boundaries of the target position. For successful termination of the positioning, the final target position must be within these boundaries. If the tolerance is lower then the default accuracy of the Theodolite, the tolerance will be the default accuracy. There is no effect on the motorised Theodolites. The tolerances (and speed) of the positioning will be defined separately.

Return Codes

`RC_OK`	Positioning successful
`RC_ABORT`	Abnormal termination (No positioning possible, ESC-Key)

See Also `CSV_MakePositioning`
`CSV_ChangeFace`

Example Position the telescope.

```
BAP_PosTelescope(BAP_CHANGE_FACE, BAP_POS_DLG,
     0, 0, .5, .5 )
```

6.2.13 BAP_SetHz

Description Sets the horizontal angle to 0 or another given value.

Declaration `BAP_SetHz( BYVAL sCaptionLeft AS _Token )`

Remarks This procedure offers a dialogue which the user can complete in order to influence the angular offset provided by the TMC subsystem for the horizontal angle encoder. A button is provided for setting the angle to zero, directly, or the user may prefer to input another given value. Furthermore, the angle beep (at the quarter circle positions from 0°) can be turned on and off.

> **Note** If the instrument is in Lock mode, then the instrument tries to lock first before it sets the angle to 0.

Parameters

`sCaptionLeft`	Left caption text for dialog

See Also

Return Codes

`RC_OK`	Horizontal angular offset correct.

Example Set the horizontal angle.

```
BAP_SetHz("BASIC" )
```

6.3 MEASUREMENT FUNCTIONS TMC

This section contains the lower level measurement procedures.

6.3.1 Summarizing Lists of TMC Types and Procedures

6.3.1.1 Types

type name	description
TMC_ANG_SWITCH_Type	Angle measurement switches
TMC_Angle_Type	Data structure for measuring angles.
TMC_Coordinate_Type	Data structure for the co-ordinates (tracking and fixed co-ordinates).
TMC_DIST_SWITCHES_ Type	Distance measurement switches
TMC_Distance_Type	Data structure for the distance measurement.
TMC_HZ_V_Ang_Type	Horizontal and vertical angle.
TMC_Incline_Type	Data structure for the inclination measurement.
TMC_OFFSET_DIST_ Type	Target offset
TMC_PPM_CORR_Type	Corrections for distance measurement: PPM values
TMC_GEOM_PROJECTION _Type	Corrections for distance measurement: to define PPM values of projection
TMC_GEOM_REDUCTION_ Type	Corrections for distance measurement: to define PPM values of reduction to the reference
TMC_ATMOS_ TEMPERATURE_Type	Corrections for distance measurement: to define PPM values of atmosphere
TMC_REFRACTION_Type	Refraction correction for distance measurement
TMC_STATION_Type	Station co-ordinates

6.3.1.2 Procedures

procedure name	**description**
`TMC_DoMeasure`	Start a measure program.
`TMC_Get/ SetAngleFaceDef`	Gets and sets the current face definition.
`TMC_Get/ SetRefractiveCorr`	Gets and sets the refractive correction for measuring the distance.
`TMC_Get/ SetRefractiveMethod`	Gets and sets the method of refractive correction for measuring the distance.
`TMC_Get/SetDistPpm`	Gets and sets the PPM values for distance measurement corrections.
`TMC_Get/ SetGeomProjection`	Gets and sets the projection part of distance measurement corrections.
`TMC_Get/SetGeomReduction`	Gets and sets the reduction to the reference part of distance measurement corrections
`TMC_Get/SetAtmCorr`	Gets and sets the atmosphere part of distance measurement corrections
`TMC_Get/SetHeight`	Gets and sets the current height of the reflector.
`TMC_Get/SetHzOffset`	Gets and sets the current horizontal offset.
`TMC_Get/SetStation`	Gets and sets station co-ordinates.
`TMC_GetAngle`	Measure angles.
`TMC_GetAngle_Winc`	Measure angles with inclination control
`TMC_GetAngSwitch`	Returns the angle measurement correction switches
`TMC_GetCoordinate`	Calculate and read co-ordinates.
`TMC_GetDistSwitch`	Returns the distance measurement correction switches
`TMC_GetFace1`	Get face information of current telescope position
`TMC_GetInclineStatus`	Returns the inclination compensator status.
`TMC_GetInclineSwitch`	Returns the compensator switch
`TMC_GetOffsetDist`	Returns the distance measurement offset
`TMC_GetPolar`	Calculate and read polar co-ordinates.

procedure name	description
`TMC_GetSimpleMea`	Gets the results of distance and angle measurement
`TMC_IfDistTapeMeasured`	Gets information about manual measurement.
`TMC_IfOffsetDistMeasured`	Returns the EDM measurement mode
`TMC_QuickDist`	Measure slope distance and angles
`TMC_SetAngSwitch`	Defines the angle measurement correction switches
`TMC_SetDistSwitch`	Defines the distance measurement correction switches
`TMC_SetHandDist`	Sets distance manually.
`TMC_SetInclineSwitch`	Defines the compensator switch
`TMC_SetOffsetDist`	Defines the distance measurement offset

6.3.2 TMC Data Structures

6.3.2.1 TMC_INCLINE - Data structure for the inclination measurement

```
TYPE TMC_Incline_Type
  dCrossIncline        AS Double      cross inclination
  dLengthIncline       AS Double      alongside inclination
  dAccuracyIncline     AS Double      accuracy of measuring
  InclineTime          AS Integer     time of measuring
END TMC_Incline_Type
```

6.3.2.2 TMC_ANGLE - Data structure for measuring angles

`TYPE TMC_Angle_Type`		
`dHz`	`AS Double`	horizontal angle
`dV`	`AS Double`	vertical angle
`dAngleAccuracy`	`AS Double`	accuracy of angle
`iAngleTime`	`AS Integer`	time of measurement
`Incline`	`AS TMC_Incline_Type`	inclination belonging to the measurement
`iFace`	`AS Integer`	information about position of the telescope
`END TMC_Angle_Type`		

6.3.2.3 TMC_DISTANCE - Data structure for the distance measurement

`TYPE TMC_Distance_Type`		
`Angle`	`AS TMC_Angle_Type`	set of angles belonging to distance
`dSlopeDist`	`AS Double`	slope distance
`dSlopeDistAccuracy`	`AS Double`	accuracy of distance
`dHorizDist`	`AS Double`	horizontal distance
`dHeightDiff`	`AS Double`	difference in altitude
`AngleCont`	`AS TMC_Angle_Type`	set of angles, measured continuously
`dSlopeDistCont`	`AS Double`	slope distance, measured continuously
`dHeightDiffCont`	`AS Double`	distance in altitude, measured continuously
`END TMC_Distance_Type`		

6.3.2.4 TMC_COORDINATE - Data structure for the coordinates

(tracking and fixed co-ordinates)

```
TYPE TMC_Coordinate_Type
  dE                    AS Double     east co-ordinate
  dN                    AS Double     north co-ordinate
  dH                    AS Double     height co-ordinate
  iCoordTime            AS Integer    time of measurement
  dE_Cont               AS Double     east coordinate, measured
                                      continuously
  dN_Cont               AS Double     north co-ordinate, measured
                                      continuously
  dH_Cont               AS Double     height co-ordinate,
                                      measured continuously
  iCoordContTime        AS Integer    time of continuous
                                      measurement
END TMC_Coordinate_Type
```

6.3.2.5 TMC_HZ_V_ANG - Horizontal and vertical angle

```
TYPE TMC_HZ_V_Ang_Type
  dHz                   AS Double     horizontal angle
  dV                    AS Double     vertical angle
END TMC_HZ_V_Ang_Type
```

6.3.2.6 TMC_PPM_CORR - Corrections for distance measurement (PPM values)

```
TYPE TMC_PPM_CORR_Type
  dPpmI                 AS Double     individual ppm
  dPpmA                 AS Double     atmospheric ppm
  dPpmR                 AS Double     height relative ppm
  dPpmP                 AS Double     projection contortion ppm
END TMC_PPM_CORR_Type
```

6.3.2.7 TMC_GEOM_PROJECTION - to define PPM values of projection

```
TYPE TMC_GEOM_PROJECTION_Type
  dProjectionSpace      AS Double     distance to the reference
  dProjectionScale      AS Double     factor of projection
  dEarthRadius          AS Double     earth radius
```

```
END TMC_GEOM_PROJECTION_Type
```

6.3.2.8 TMC_GEOM_REDUCTION - to define PPM values of reduction to the reference

```
TYPE TMC_GEOM_REDUCTION_Type
  dHeightReference    AS Double      reference height
  dEarthRadius        AS Double      earth radius
END TMC_GEOM_REDUCTION_Type
```

6.3.2.9 TMC_ATM_TEMPERATURE - to define PPM values of atmosphere

```
TYPE TMC_ATM_TEMPERATURE_Type
  dLambda             AS Double      laser wave length
  dPressure           AS Double      atmospheric pressure
  dDryTemperature     AS Double      dry temperature
  dWetTemperature     AS Double      wet temperature
END TMC_ATM_TEMPERATURE_Type
```

6.3.2.10 TMC_STATION - Station coordinates

```
TYPE TMC_STATION_Type
  dE0                 AS Double      easting co-ordinate
  dN0                 AS Double      northing co-ordinate
  dH0                 AS Double      height co-ordinate
  dHi                 AS Double      instrument height
END TMC_STATION_Type
```

6.3.2.11 TMC_REFRACTION- Refraction correction for distance measurement

```
TYPE TMC_REFRACTION_Type
  bOnOff              AS Logical     TRUE if refraction is valid
  dEarthRadius        AS Double      earth radius
  dRefractiveScale    AS Double      refraction coefficient
END TMC_REFRACTION_Type
```

6.3.2.12 TMC_DIST_SWITCH_Type– Distance measurement switches

```
TYPE TMC_DIST_SWITCHES_Type
```

```
  lAxisDifferCorr   AS Logical  ' EDM to optical axis correction
  lProjectScaleCorr AS Logical  ' Projection scale correction
  lHgtReductionCorr AS Logical  ' Height reduction correction
END TMC_DIST_SWITCHES_Type
```

6.3.2.13 TMC_ANGLE_SWITCH_Type – Angle measurement switches

```
TYPE TMC_ANG_SWITCH_Type
  lInclineCorr     AS Logical ' Inclination correction
  lStandAxisCorr   AS Logical ' Standing axis correction
  lCollimationCorr AS Logical ' Collimation error correction
  lTiltAxisCorr    AS Logical ' Tilting axis correction
END TMC_ANG_SWITCH_Type
```

6.3.2.14 TMC_OFFSET_DIST_Type – Target offset

```
TYPE TMC_OFFSET_DIST_Type
 dLengthVal  AS Distance     ' Target - Offset Length
 dCrossVal   AS Distance     ' Target - Offset Cross
 dHeightVal  AS Distance     ' Target - Offset Height
END TMC_OFFSET_DIST_Type
```

6.3.3 TMC_DoMeasure

Description Start a measure program.

Declaration `TMC_DoMeasure( BYVAL iCommand AS Integer )`

Remarks With this function a measure program is started. The commands start a distance measurement and / or a test mode. In addition an angle- and an inclination-measure are done (not at measurement).

The tracking measure program performs e.g. as follows: Start the measure program with TMC_`DoMeasure(TMC_TRK_DIST)`.

The electronic distance measuring device (EDM) begins to run. Now the co-ordinates can be read, e.g. with `TMC_GetCoordinate()`. Tracking can be stopped with `TMC_DoMeasure(TMC_STOP)`. With `TMC_DoMeasure(TMC_CLEAR)` the function will be stopped and the distance cleared.

Note	After calling a measure program, the last valid distance results will be cleared (as after `TMC_STOP`).

Parameters

`iCommand` `in` start a measure program; possible values:

`TMC_STOP`	switch off EDM and finish program
`TMC_DEF_DIST`	do default distance measure
`TMC_TRK_DIST`	do tracking distance measure
`TMC_RTRK_DIST`	do fast tracking distance measure
`TMC_CLEAR`	clear distance and switch off EDM
`TMC_SIGNAL`	start signal measurement (test mode)
`TMC_RED_TRK_DIST`	do tracking distance measure with red laser

See Also `TMC_GetPolar`
`TMC_GetCoordinate`

Return Codes

`RC_OK`	measure program started
`RC_IVPARAM`	The function has been called with an invalid parameter
`TMC_BUSY`	Measurement system is busy

Example Start a distance measure, do something, stop it and clear results.

The following variable has to be defined:

```
TMC_DoMeasure (TMC_DEF_DIST) ' ... do a measure
TMC_DoMeasure (TMC_CLEAR)
```

6.3.4 TMC_GetPolar

Description Calculate and read polar co-ordinates.

Declaration

```
TMC_GetPolar(
     BYVAL iWaitTime   AS Integer,
           Polar       AS TMC_Distance_Type,
           iReturnCode AS Integer )
```

Remarks The function corrects and takes in calculation a measured distance. Angle and possibly inclination are being calculated. The result is a point in polar co-ordinates.

Simple and multiple measures (distance tracking, altitude tracking) are supported. The horizontal and the inclined distance with the difference in altitude are read. The delay (`iWaitTime`) just works on the distance measure, not on the measure of the angle. As long as no new measure program is started, the results can be read. Additional to the normal return codes `iReturnCode` delivers also informational return codes which will not interrupt program execution.

Note	The measure program must have been started (see `TMC_DoMeasure`).

Parameters

`iWaitTime`	`in`	delay time [ms] until a result is available `=0` returns results with an already measured distance. `>0` waits maximal the time `iWaitTime` for a result. If `iWaitTime` is chosen big enough (e. g. 60000, which is surely longer than the time-out period of the device), the system will wait for a result or until an error occurs `<0` Performs an automatic target acquisition (if possible) and then tries to measuring in a until a valid result or an irrecoverable error occurs. The value itself of `iWaitTime` is ignored.
`Polar`	`out`	point in polar co-ordinates
`iReturnCode`	`out`	see Additional Codes below

See Also `TMC_GetCoordinates`

Additional Codes in `iReturnCode`

`RC_OK`	measurement and values are OK
`TMC_ACCURACY_ GUARANTEE`	Accuracy is not guaranteed, because the results are consist of measuring data which accuracy could not be verified by the system. Co-ordinates are available.
`TMC_NO_FULL_ CORRECTION`	The results are not corrected by all active sensors. Co-ordinates are available.
`TMC_ANGLE_OK`	Angle values okay, but no valid distance. Co-ordinates are not available.

TMC_ANGLE_ ACCURACY_ GUARANTEE	No distance data available but angle data are valid. The return code is equivalent to the TMC_ACCURACY_GUARANTEE and relates to the angle data. Co-ordinates are not available.
TMC_ANGLE_NO_ FULL_ CORRECTION	No distance data available but angle data are valid. The return code is equivalent to the TMC_NO_FULL_CORRECTION and relates to the angle data. Co-ordinates are not available. Perform a distance measurement first before you call this function.
TMC_DIST_ERROR	No measuring, because of missing target point, co-ordinates are not available. Aim target point and try it again
TMC_DIST_PPM	No distance measurement respectively no distance data because of wrong EDM settings. The co-ordinates are not available. Set EDM –ppm and -mm to 0.

Return Codes

RC_OK	measurement and values are OK
TMC_ANGLE_ERROR	Problems with angle res. incline sensor. A valid angle could not be measured. At repeated occur call service.
TMC_BUSY	TMC resource is locked respectively TMC task is busy. Repeat measurement.
RC_ABORT	Measurement through customer aborted.

Example Start a distance measure, perform measure.

```
DIM iRetCode  AS Integer
DIM iWaitTime AS Integer
DIM Polar     AS TMC_Distance_Type
DIM lError    AS Logical
DIM lDone     AS Logical


'start distance measurement
ON ERROR RESUME    ' to get valid angles
TMC_DoMeasure( TMC_DEF_DIST )

iWaitTime = -1
lDone  = FALSE
lError = FALSE


DO                 'display measured values
  TMC_GetPolar( iWaitTime, Polar, iRetCode )
  SELECT CASE iRetCode
    CASE RC_OK
        'display all data
        'e.g. set lDone here
    CASE else
        'handle error
        lError = TRUE
  END SELECT
LOOP UNTIL lError OR lDone

'stop distance measurement
TMC_DoMeasure( TMC_CLEAR )
```

6.3.5 TMC_GetCoordinate

Description Calculate and read co-ordinates.

Declaration

```
TMC_GetCoordinate(
   BYVAL iWaitTime   AS Integer,
         Coordinate  AS TMC_COORDINATE_Type,
         iReturnCode AS Integer )
```

Remarks The function calculates and out put co-ordinates. Angle and possibly inclination are being measured. The co-ordinates are being corrected. The result is a point in Cartesian co-ordinates. The system calculates co-ordinates and tracking co-ordinates.

Simple and multiple measurements (distance-, altitude- and co-ordinate- tracking) are supported. The delay (`iWaitTime`) just works on the distance measure, not on the measuring of the angle.

As far as no new measure program is started, the results can be read. Additional to the normal return codes `iReturnCode` delivers also informational return codes which will not interrupt program execution.

Note	The measure program must have been started (see `TMC_DoMeasure`).

Parameters

`iWaitTime`	`in`	delay time [ms] until a result is available =0 returns already measured values >0 waits the maximal time `iWaitTime` for a result
`Coordinate`	`out`	point in Cartesian co-ordinates (output)
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_GetPolar`

Additional Codes in `iReturnCode`

`RC_OK`	measurement and values are OK
`TMC_ACCURACY_`	Accuracy is not guaranteed, because the

GUARANTEE	result are consist of measuring data which accuracy could not be verified by the system. Co-ordinates are available.
TMC_NO_FULL_ CORRECTION	The results are not corrected by all active sensors. Co-ordinates are available.
TMC_ANGLE_OK	Angle values okay, but no valid distance. Co-ordinates are not available.
TMC_ANGLE_ ACCURACY_ GUARANTEE	No distance data available but angle data are valid. The return code is equivalent to the TMC_ACCURACY_GUARANTEE and relates to the angle data. Co-ordinates are not available.
TMC_ANGLE_NO_ FULL_ CORRECTION	No distance data available but angle data are valid. The return code is equivalent to the TMC_NO_FULL_CORRECTION and relates to the angle data. Co-ordinates are not available. Perform a distance measurement first before you call this function.
TMC_DIST_ERROR	No measuring, because of missing target point, co-ordinates are not available. Aim target point and try it again
TMC_DIST_PPM	No distance measurement respectively no distance data because of wrong EDM settings. The co-ordinates are not available. Set EDM –ppm and -mm to 0.

Return Codes

RC_OK	measurement and values are OK
TMC_ANGLE_ERROR	Problems with angle res. incline sensor. A valid angle could not be measured. At repeated occur call service.
TMC_BUSY	TMC resource is locked respectively TMC task is busy.

	Repeat measurement.
RC_ABORT	Measurement through customer aborted.

Example Start a distance measure, perform measurement.

```
DIM iretCode  AS Integer
DIM iWaitTime AS Integer
DIM Coord     AS TMC_COORDINATE_Type
DIM lError    AS Logical
DIM lDone     AS Logical

ON ERROR RESUME NEXT  ' to get valid angle data
TMC_DoMeasure( TMC_DEF_DIST )
lDone  = FALSE
lError = FALSE

DO                    ' display measured values
  TMC_GetCoordinate( 5, Coord, iRetCode )
  SELECT CASE iRetCode
    CASE RC_OK
        'display all data
        'e.g. set lDone
    CASE ANGLE_OK
        ' display coordinate
    CASE ELSE
        'handle error
        lError = TRUE
  END SELECT
LOOP UNTIL lError OR lDone
TMC_DoMeasure( TMC_CLEAR )
```

6.3.6 TMC_GetAngle

Description Measure angles.

Declaration

```
TMC_GetAngle( Angles      AS TMC_ANGLE_Type,
              iReturnCode AS Integer )
```

Remarks The function measures the horizontal and vertical angle and the possibly belonging inclination, if the inclination compensation is on. If the compensation is off and no valid inclination is present, there may be a delay if the inclination can't be measured immediately. The correction values for the inclination can be calculated with several methods.

As long as no new measure program is started, the results can be read. Additional to the normal return codes `iReturnCode` delivers also informational return codes which will not interrupt program execution.

Parameters

`Angles`	`out`	result of measuring the angle
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_DoMeasure`

Additional Codes in `iReturnCode`

`RC_OK`	Execution successful.
`TMC_NO_FULL_CORRECTION`	The results are not corrected by all active sensors. Angle data are available. This message is to be considers as warning.
`TMC_ACCURACY_GUARANTEE`	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system. Angle data are available. You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.

Return Codes

`RC_OK`	angle OK

`TMC_ANGLE_ERROR`	Problems with angle res. incline sensor. A valid angle could not be measured. Angle data are not available. At repeated occur call service.
`TMC_BUSY`	TMC resource is locked respectively TMC task is busy. Angle data are not available. Repeat measurement.
`RC_ABORT`	Measurement through customer aborted.

Example Read the currently valid angle.

```
DIM Angles AS TMC_ANGLE_Type
DIM RetCode AS Integer

TMC_GetAngle( Angles, RetCode )
```

6.3.7 TMC_GetAngle_WInc

Description Measure angles with inclination control.

Declaration

```
TMC_GetAngle_WInc(
               iIncProg    AS Integer,
               Angle       AS TMC_ANGLE,
               iReturnCode AS Integer )
```

Remarks The function measures the horizontal and vertical angle and in dependence of the configuration, the inclination.

As far as no new measure program is started, the results can be read. Additional to the normal return codes `iReturnCode` delivers also informational return codes, which will not interrupt program execution.

Parameters

`iIncProg`	`in`	The manner of incline compensation. Following settings are possible:

Incline Program	**Meaning**
`TMC_MEA_INC`	get inclination (apriori sigma)
`TMC_`	get inclination with

		`AUTO_INC`	automatism (sensor/plane)
		`TMC_PLANE_INC`	get inclination always with plane
`Angle`	`out`	result of measuring the angle	
`iReturnCode`	`out`	return code, see Additional Codes	

See Also `TMC_DoMeasure, TMC_GetAngle`

Additional Codes in `iReturnCode`

`RC_OK`	Execution successful.
`TMC_NO_FULL_CORRECTION`	The results are not corrected by all active sensors. Angle data are available. This message is to be considers as warning.
`TMC_ACCURACY_GUARANTEE`	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system. Angle data are available. You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.

Return Codes

`RC_OK`	angle OK
`TMC_ANGLE_ERROR`	Problems with angle res. incline sensor. A valid angle could not be measured. Angle data are not available. At repeated occur call service.
`TMC_BUSY`	TMC resource is locked respectively TMC task is busy. Angle data are not available. Repeat measurement.
`RC_ABORT`	Measurement through customer aborted.

Example Read the currently valid angle.

```
DIM Angles   AS TMC_Angle
DIM iRetCode AS Integer

TMC_GetAngle_WInc(TMC_AUTO_INC, Angles,iRetCode)
```

6.3.8 TMC_QuickDist

Description Measure slope distance and angles.

Declaration

```
TMC_QuickDist(
            Angle       AS TMC_HZ_V_ANG_type,
            Dist        AS Distance,
            iReturnCode AS Integer )
```

Remarks The function measures the horizontal and vertical angle and in dependence of the configuration, the inclination.

The function waits until a new distance is measured and then it returns the angle and the slope-distance, but no co-ordinates. Is no distance available, then it returns the angle values (hz, v) and the corresponding return-code.

At the call of this function, a distance measurement will be started with the rapid-tracking measuring program. If the EDM is active with the standard tracking measuring program already, the measuring program will not be changed to rapid tracking. Generally if the EDM is not active, then the rapid tracking measuring program will be started, otherwise the used measuring program will not be changed.

In order to abort the current measuring program use the function `TMC_DoMeasure`.

This function is very good suitable for target tracking, where high data transfers are required.

Note:	Due to performance reasons the used inclination will be calculated (only if incline is activated). if the basic data for the incline calculation is exact, at least two forced incline measurements should be performed in between. The forced incline measurement is only necessary if the incline of the instrument because of measuring assembly has been changed. Use the function `TMC_GetAngle_WInc(TMC_MEA_INC, Angle)` for the forced incline measurement. (For the forced incline measurement, the instrument must be in stable state for more than 3sec.).

Parameters

`Angle`	`out`	measured Hz- and V-angle
`Distance`	`out`	measured slope-distance
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_DoMeasure, TMC_GetAngle`

Additional Codes in `iReturnCode`

`RC_OK`	Execution successful.
`TMC_NO_FULL_CORRECTION`	The results are not corrected by all active sensors. Angle data are available. This message is to be considers as warning.
`TMC_ACCURACY_GUARANTEE`	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system. Angle data are available. You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.
`TMC_ANGLE_ERROR`	Problems with angle res. incline sensor. A valid angle could not be measured. Angle data are not available. At repeated occur call service.
`TMC_ANGLE_OK`	Angle measuring data are valid, but no distance data available. (Possible reasons are:

	–time out period to short –target out of view) This message is to be considers as warning.
`TMC_ANGLE_NO_ FULL_CORRECTION`	Angle measuring data are valid, but not corrected by all active sensors. The distance data are not available. (Possible reasons are: -see return code `TMC_ANGLE_OK`) This message is to be considers as warning.
`TMC_ANGLE_ ACCURACY_ GUARANTEE`	Angle measuring data are valid, but the accuracy is not guarantee, because the result (angle) consisting of measuring data, which accuracy could not be verified by the system. The distance data are not available. (Possible reasons are: -see return code `TMC_ANGLE_OK`) This message is to be considers as info.
`TMC_DIST_ERROR`	Because of missing target point no distance data available, but the angle data are valid respectively available. Aim target point and try it again.
`TMC_DIST_PPM`	No distance measurement respectively no distance data because of wrong EDM settings. The angle data are valid. Set EDM –ppm and –mm to 0.

Return Codes

`RC_OK`	angle OK
`TMC_ANGLE_ERROR`	Problems with angle res. incline sensor. At repeated occur call service.
`TMC_BUSY`	TMC resource is locked respectively TMC task is busy. Angle data are not available. Repeat measurement.
`RC_ABORT`	Measurement through customer aborted.

Example Fast tracking with `QuickDist`. See example program `TRACKING` for more details.

```
DIM iRetCode AS Integer
DIM HzV      AS TMC_HZ_V_ANG_Type
DIM dDist    AS Distance

TMC_DoMeasure( TMC_CLEAR ) ' clear distances



' measurement loop
DO
    ' get measurement values
    TMC_QuickDist( HzV, dDist, iRetCode )
    IF iRetCode = RC_OK OR
       iRetCode = TMC_NO_FULL_CORRECTION OR
       iRetCode = TMC_ACCURACY_GUARANTEE THEN
        ' Angles and distance are valid
        ' ...
      ELSE
        ' only Angles are valid
        ' ...
        END IF
LOOP UNTIL ....

' terminate
TMC_DoMeasure( TMC_CLEAR ) ' stop measurement
```

6.3.9 TMC_GetSimpleMea

Description Gets the results of distance and angle measurement.

Declaration

```
TMC_GetSimpleMea(
      Angles        AS TMC_HZ_V_ANG_Type,
      dSlopeDist    AS Double,
      iReturnCode   AS Integer )
```

Remarks This function returns the angles and distance measurement data. The distance measurement will be set invalid afterwards. It is important to note that this command does not issue a new distance measurement.

If a distance measurement is valid the function ignores `WaitTime` and returns the results.

If no valid distance measurement is available and the distance measurement unit is not activated (by `TMC_DoMeasure` before the `TMC_GetSimpleMea` call) the `WaitTime` is also ignored and the angle measurement result is returned.

Information about distance measurement is returned in the return- code.

Parameters

`Angles`	`out`	result of measuring: the angles
`dSlopeDist`	`out`	slope distance [m]
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_DoMeasure`

Additional Codes in `iReturnCode`

`RC_OK`	Angle OK
`TMC_NO_FULL_CORRECTION`	The results are not corrected by all active sensors. Angle and distance data are available. This message is to be considers as warning.
`TMC_ACCURACY_GUARANTEE`	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system. Angle and distance data are available. You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.

`TMC_ANGLE_OK`	Angle values okay, but no valid distance. Perform a distance measurement.
`TMC_ANGLE_NO_ FULL_ CORRECTION`	No distance data available but angle data are valid. The return code is equivalent to the `TMC_NO_FULL_CORRECTION` and relates to the angle data. Perform a distance measurement first before you call this function.
`TMC_ANGLE_ACCURACY _GUARANTEE`	No distance data available but angle data are valid. The return code is equivalent to the `TMC_ACCURACY_GUARANTEE` and relates to the angle data.
`TMC_DIST_ERROR`	No measuring, because of missing target point, angle data are available but distance data are not available. Aims target point and try it again.
`TMC_DIST_PPM`	No distance measurement respectively no distance data because of wrong EDM settings. Angle data are available but distance data are not available. Set EDM –ppm and -mm to 0.

Return Codes

`RC_OK`	Angle OK
`TMC_ANGLE_ERROR`	Problems with angle res. incline sensor. A valid angle could not be measured. Distance and angle data are not available. At repeated occur call service.
`TMC_BUSY`	TMC resource is locked respectively TMC task is busy. Distance and angle data are not available. Repeat measurement.
`RC_ABORT`	Measurement aborted.

Example This example measures the slope distance and angles.

```
DIM Angle   AS Double
DIM dSlope  AS Double
DIM RetCode AS Integer

TMC_GetSimpleMea( Angle, dSlope, RetCode )
```

6.3.10 TMC_Get/SetAngleFaceDef

Description Gets and sets the current face definition.

Declaration

```
TMC_GetAngleFaceDef( eFaceDef  AS Integer )

TMC_SetAngleFaceDef(
              byVal eFaceDef  AS Integer )
```

Remarks

TPS_Sim	Has no effect.

Note	No distance may exist for setting the face definition. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

`eFaceDef`	`out/in`	`TMC_FACE_NORMAL` or `TMC_FACE_TURN`

See Also -

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results) or a distance exists

Example The example reads the current definition and sets the opposite one.

```
DIM face  AS TMC_FACE_DEF

TMC_GetAngelFaceDef(face)
IF (face = TMC_FACE_NORMAL) THEN
  TMC_SetAngelFaceDef(TMC_FACE_TURN)
ELSE
  TMC_SetAngelFaceDef(TMC_FACE_NORMAL)
END IF
```

6.3.11 TMC_Get/SetHzOffset

Description Gets and sets the current horizontal offset.

Declaration `TMC_GetHzOffset( dHzOffset AS Double )`

`TMC_SetHzOffset( byVal dHzOffset AS Double )`

Remarks

Note	No distance may exist for setting the Hz-offset. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

`dHzOffset`	`out/in`	Horizontal offset in radiant.

See Also -

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results) or a distance exists

Example The example reads the current offsets and sets it to an increased value.

```
DIM off  AS Double

TMC_GetHzOffset ( off )
TMC_SetHzOffset ( off + 1.0 )
```

6.3.12 TMC_Get/SetDistPpm

Description Gets and sets the PPM values for distance measurement corrections.

Declaration

```
TMC_GetDistPpm( PpmCorr  AS
TMC_PPM_CORR_Type)
```

```
TMC_SetDistPpm( PpmCorr  AS
TMC_PPM_CORR_Type)
```

Parameters

`PpmCorr`	`out/in`	PPM values for distance measurement corrections.

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	TMC is in use and can not be changed.

Example -

6.3.13 TMC_Get/SetGeomProjection

Description Gets and sets the projection part of distance measurement corrections.

Declaration

```
TMC_GetGeomProjection ( GeomProj  AS
TMC_GEOM_PROJECTION_Type)
```

```
TMC_SetGeomProjection ( GeomProj  AS
TMC_GEOM_PROJECTION_Type)
```

Parameters

`GeomProj`	`out/in`	Projection (distance to the reference, factor of projection, earth radius).

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	TMC is in use and can not be changed.

Example -

6.3.14 TMC_Get/SetGeomReduction

Description Gets and sets the reduction to the reference part of distance measurement corrections.

Declaration

```
TMC_GetGeomReduction ( GeomRed  AS
TMC_GEOM_REDUCTION_Type)
```

```
TMC_SetGeomReduction ( GeomRed  AS
TMC_GEOM_REDUCTION_Type)
```

Parameters

GeomRed	`out/in`	Reduction to the reference (reference height, earth radius)

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	TMC is in use and can not be changed.

Example -

6.3.15 TMC_Get/SetAtmCorr

Description Gets and sets the atmosphere part of distance measurement corrections.

Declaration

```
TMC_GetAtmCorr ( AtmCorr  AS
TMC_ATM_TEMPERATURE_Type)

TMC_SetAtmCorr ( AtmCorr  AS
TMC_ATM_TEMPERATURE_Type)
```

Parameters

AtmCorr	out/in	Atmosphere

Return Codes

RC_OK	Completed successfully.
TMC_BUSY	TMC is in use and can not be changed.

Example -

6.3.16 TMC_Get/SetHeight

Description Gets and sets the current height of the reflector.

Declaration

```
TMC_GetHeight (        Height  AS Double )
TMC_SetHeight ( byVal Height  AS Double )
```

Parameters

Height	out/in	Height of reflector in Meters.

Return Codes

RC_OK	Completed successfully.
TMC_BUSY	measurement system is busy (no valid results)

Example The example sets the reflectors height to the value of 1.0 m.

```
TMC_SetHeight ( 1.0 )
```

6.3.17 TMC_Get/SetRefractiveCorr

Description Gets and sets the refractive correction for measuring the distance.

Declaration

```
TMC_GetRefractiveCorr (
    Refraction AS TMC_REFRACTION_Type)

TMC_SetRefractiveCorr (
    Refraction AS TMC_REFRACTION_Type)
```

Parameters

`Refraction`	`out/in`	Refraction correction value(s).

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results)

Example -

6.3.18 TMC_Get/SetRefractiveMethod

Description Gets and sets the method of refractive correction for measuring the distance.

Declaration

```
TMC_GetRefractiveMethod (
          Method  AS Integer )

TMC_SetRefractiveMethod (
    byVal Method  AS Integer )
```

Parameters

`Method`	`out/in`	Method of refraction calculation: 1: method 1 2: method 2 else: undefined

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results)

6.3.19 TMC_Get/SetStation

Description Gets and sets station co-ordinates.

Declaration

```
TMC_GetStation (
         Station  AS TMC_STATION_Type )

TMC_SetStation (
         Station  AS TMC_STATION_Type )
```

Remarks

Note	No distance may exist for setting a new station. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

`Station`	`out/in`	Station co-ordinates.

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results) or a distance exists.

Example -

6.3.20 TMC_IfDistTapeMeasured

Description Gets information about manual measurement.

Declaration

```
TMC_IfDistTapeMeasured (
           bTapeMeasured  AS Logical )
```

Parameters

`bTapeMeasured`	`out`	TRUE: if measurement has been done by hand. FALSE: if measurement has been done with EDM or if invalid.

Return Codes

`RC_OK`	Completed successfully.

Example -

6.3.21 TMC_SetHandDist

Description Sets distance manually.

Declaration

```
TMC_SetHandDist(
        byVal dSlopeDistance  AS Double,
        byVal dHgtOffset      AS Double )
```

Parameters

`dSlopeDistance`	`in`	slope distance [m]
`dHgtOffset`	`in`	Height to measured point. [m]

See Also -

Return Codes

`RC_OK`	Execution successful.
`TMC_NO_FULL_ CORRECTION`	The results are not corrected by all active sensors. This message is to be considers as warning.
`TMC_ACCURACY_ GUARANTEE`	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.
`TMC_ANGLE_ERROR`	Problems with angle res. incline sensor. A valid angle could not be measured. At repeated occur call service.

`TMC_BUSY`	TMC resource is locked respectively TMC task is busy. Repeat measurement.
`RC_ABORT`	Measurement through customer aborted.
`RC_IVPARAM`	Invalid parameter

Example -

6.3.22 TMC_SetDistSwitch

Description Defines the distance measurement correction switches.

Declaration
```
TMC_SetDistSwitch(
       Switches AS TMC_DIST_SWITCH_Type )
```

Remarks This procedure sets the distance measurement correction switches.

Parameters

`Switches`	`in`	Distance switches

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_GetDistSwitch`

6.3.23 TMC_GetDistSwitch

Description Returns the distance measurement correction switches.

Declaration
```
TMC_GetDistSwitch(
       Switches AS TMC_DIST_SWITCH_Type )
```

Remarks This procedure returns the distance measurement correction switches.

Parameters

`Switches`	`out`	Distance switches

Return-Codes

RC_OK	Successful termination.

See Also TMC_SetDistSwitch

6.3.24 TMC_SetOffsetDist

Description Defines the distance measurement offset.

Declaration

```
TMC_SetOffsetDist(
        Offsets AS TMC_OFFSET_DIST_Type )
```

Remarks This procedure defines the offset to the prism pole. The `dLengthVal` defines the offset away from the prism pole, positive means in the line from instrument to prism. `dCrossVal` means right from the prism pole and `dHeightVal` means higher than prism pole.

Remarks

Note	No distance may exist for offset setting.. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

Offsets	in	Target point offset

Return-Codes

RC_OK	Successful termination.
TMC_BUSY	measurement system is busy (no valid results) or a distance exists.

See Also TMC_GetOffsetDist, BAP_Offset, TMC_IfOffsetDistMeasured

6.3.25 TMC_GetOffsetDist

Description Returns the distance measurement offset.

Declaration

```
TMC_GetOffsetDist(
        Offsets AS TMC_OFFSET_DIST_Type )
```

Remarks This procedure returns the actual offset to the prism pole. The `dLengthVal` defines the offset away from the prism pole, positive means in the line from instrument to prism. `dCrossVal` means right from the prism pole and `dHeightVal` means higher than prism pole.

Parameters

`Offsets`	`out`	Target point offset

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_SetOffsetDist`, `BAP_Offset`, `TMC_IfOffsetDistMeasured`

6.3.26 TMC_IfOffsetDistMeasured

Description Returns the EDM measurement mode.

Declaration

```
TMC_IfOffsetDistMeasured(
                lOffset AS Logical )
```

Remarks This function returns TRUE if an offset is defined.

Parameters

`lOffset`	`out`	Offset is valid

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_SetOffsetDist`, `TMC_GetOffsetDist`, `BAP_Offset`

6.3.27 TMC_GetFace1

Description Get face information of current telescope position.

Declaration `TMC_GetFace1( lFace1 AS Logical )`

Remarks This function returns the face information of the current telescope position. The face information is only valid, if the instrument is in an active measurement state (that means a measurement function was called before the `TMC_GetFace1` call). Note that the instrument automatically turns into an inactive measurement state after a predefined timeout.

Parameters

`lFace1`	`out`	`TRUE`: Face I `FALSE`: Face II

Return-Codes

`RC_OK`	Successful termination.

6.3.28 TMC_SetAngSwitch

Description Defines the angle measurement correction switches.

Declaration

```
TMC_SetAngSwitch(
       Switches AS TMC_ANG_SWITCH_Type )
```

Remarks This procedure sets the angle measurement correction switches.

> **Note** No distance may exist for setting the angle switches. Call `TMC_DoMeasure( TMC_CLEAR )` before this function.

Parameters

`Switches`	`in`	angular switches

Return-Codes

`RC_OK`	Successful termination.
`TMC_BUSY`	A distance exists

See Also `TMC_GetAngSwitch`

Example Change switches

```
DIM AngSwitches AS TMC_ANG_SWITCH_Type

TMC_DoMeasure( TMC_CLEAR ) ' clear distances
TMC_GetAngSwitch( AngSwitches )
AngSwitches.lInclineCorr = TRUE
AngSwitches.lCollimationCorr = FALSE
TMC_SetAngSwitch( AngSwitches )
```

6.3.29 TMC_GetAngSwitch

Description Returns the angle measurement correction switches.

Declaration

```
TMC_GetAngSwitch(
        Switches AS TMC_ANG_SWITCH_Type )
```

Remarks This procedure returns the actual angle measurement correction switches.

Parameters

`Switches`	`in`	Angular switches

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_SetAngSwitch`

6.3.30 TMC_SetInclineSwitch

Description Defines the compensator switch.

Declaration `TMC_SetAngSwitches( lOn AS Logical )`

Remarks This procedure enables or disables the dual axis compensator correction.

> **Note** No distance may exist for a switch setting.. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

`lOn`	`in`	Switch

Return-Codes

RC_OK	Successful termination.
TMC_BUSY	A distance exists

See Also TMC_GetInclineSwitch

6.3.31 TMC_GetInclineSwitch

Description Returns the compensator switch.

Declaration `TMC_GetInclineSwitches( lOn AS Logical )`

Remarks This procedure returns the dual axis compensator correction state.

Parameters

lOn	out	Switch

Return-Codes

RC_OK	Successful termination.

See Also TMC_SetInclineSwitch

6.3.32 TMC_GetInclineStatus

Description Returns the inclination compensator status.

Declaration `TMC_GetInclineStatus( iStatus AS Integer )`

Remarks This procedure returns status of the inclination sensor.

Parameters

iStatus	out	TMC_INC_OFF	Incline-sensor is switched off
		TMC_INC_OK	Inclination is ok, recording is allowed
		TMC_INC_TILT	Incline-sensor is out of working area
		TMC_INC_OLD	Incline-values are not yet updated

TMC_INC_FAIL	Inclination - measurement fails

Return-Codes

RC_OK	Successful termination.

See Also TMC_SetInclineSwitch

Example See example file „meas.gbs“.

6.4 FUNCTIONS FOR GSI

6.4.1 Summarizing Lists of GSI Types and Procedures

6.4.1.1 Types

type name	description
Wi_List	Array of GSI_WiDlg_Entry_Type.
GSI_Point_Coord_Type	Point co-ordinate data.
GSI_Rec_Id_List	Record mask array of integers (indicating WI–identifications)
GSI_WiDlg_Entry_Type	Dialog entry information.

6.4.1.2 Procedures

procedure name	description
GSI_Coding	Starts the active coding function of the TPS system.
GSI_CheckTracking	Returns if distance tracking is running.
GSI_CreateMDlg	Creates and shows the user definable measurement dialog.
GSI_DefineMDlg	Defines the entries of the user definable measurement dialog.
GSI_DefineRecMaskDlg	Defines the recording mask dialog.
GSI_ExecuteAutoDist	Executes an automatic distance measurement.
GSI_ExecQCoding	Executes the Quick-Coding.
GSI_GetDataPath	Get the name of the file with the import data.
GSI_GetIndivNr	Fetches the individual point number.
GSI_GetLineSysMDlg	Gets the definition of a line in the system measurement dialog.
GSI_GetMDlgNr	Returns the number of the system measurement dialog.
GSI_GetQCodeAvailable	This routine returns the status for Quick-

procedure name	description
	Coding.
GSI_GetRecMask	Get the definition and the format of a recording mask.
GSI_GetRecMaskNr	Returns the used recording mask.
GSI_GetRecOrder	Returns the recording order for Quick-Coding.
GSI_GetRecPath	Returns the recording path
GSI_GetRunningNr	Fetches the running point number and the increment.
GSI_GetWiEntryText	Get text-data from the Theodolite data pool.
GSI_GetWiEntry	Get data from the Theodolite data pool.
GSI_ImportCoordDlg	Show the co-ordinate import dialog.
GSI_IncPNumber	Automatically point number increment.
GSI_IsRunningNr	Queries if running number is being used.
GSI_ManCoordDlg	Show the manual co-ordinate input dialog.
GSI_Measure	Entry point for measure and registration dialog (measure and registration).
GSI_QuickSet	Show the Quickset dialog
GSI_RecordRecMask	Recording the given `Wi` mask.
GSI_SelectCode	This routine shows the codelist-coding dialog.
GSI_SetDataPath	Set the file with the import data.
GSI_SetIndivNr	Sets the individual point number.
GSI_SetIvPtNrStatus	Switches the individual point number mode on/off.
GSI_SetLineMDlg	Sets one line in the user definable measurement dialog to system parameter.
GSI_SetLineMDlgPar	Sets a line in the user definable measurement dialog to an application parameter.
GSI_SetLineMDlgText	Puts a textline into the user definable measurement dialog.
GSI_SetLineSysMDlg	Sets a line in the system measurement dialog.
GSI_SetMDlgNr	Sets the number of the system measurement

procedure name	description
	dialog.
GSI_SetQCodeMode	Sets the Quick-Coding mode.
GSI_SetRecMask	Set the definition and the format of a recording mask.
GSI_SetRecMaskNr	Set the used recording mask.
GSI_SetRecOrder	Sets the recording order for Quick-Coding.
GSI_SetRecPath	Defines the recording path
GSI_SetRunningNr	Sets the running point number and increment.
GSI_SetWiEntry	Set data to the Theodolite data pool.
GSI_UpdateMDlg	Updates the user definable measurement dialog.
GSI_UpdateMeasurment	Update the measurement data.

6.4.2 Constants for WI values

Definitions for WI values:

Name	Data Type	Meaning
GSI_ID_PTNR	String	Point number
GSI_ID_FNR	Double	Serial number
GSI_ID_TYPE	String	Device type
GSI_ID_TIME_1	String	First time art
GSI_ID_TIME_2	String	Second time art
GSI_ID_HZ	Double	Horizontal angle
GSI_ID_V	Double	Vertical angle
GSI_ID_NHZ	Double	Nominal horizontal angle
GSI_ID_DHZ	Double	Difference horizontal angle
GSI_ID_NV	Double	Nominal vertical angle
GSI_ID_DV	Double	Difference vertical angle

Name	Data Type	Meaning
GSI_ID_SLOPE	Double	Slope distance
GSI_ID_HOR	Double	Horizontal distance
GSI_ID_HGT	Double	Height difference
GSI_ID_NHOR	Double	Nominal horizontal distance
GSI_ID_DHOR	Double	Difference horizontal distance
GSI_ID_NHGT	Double	Nominal height difference
GSI_ID_DHGT	Double	Difference height difference
GSI_ID_NSLOPE	Double	Nominal slope distance
GSI_ID_DSLOPE	Double	Difference slope distance
GSI_ID_CODE	String	Code information
GSI_ID_CODE_1	String	Information 1
GSI_ID_CODE_2	String	Information 2
GSI_ID_CODE_3	String	Information 3
GSI_ID_CODE_4	String	Information 4
GSI_ID_CODE_5	String	Information 5
GSI_ID_CODE_6	String	Information 6
GSI_ID_CODE_7	String	Information 7
GSI_ID_CODE_8	String	Information 8
GSI_ID_PPMM	String	mm and ppm
GSI_ID_SIGMA	String	Distance count and deviation
GSI_ID_MM	Double	mm
GSI_ID_PPM	Double	ppm
GSI_ID_REM_1	String	Remark 1
GSI_ID_REM_2	String	Remark 2
GSI_ID_REM_3	String	Remark 3
GSI_ID_REM_4	String	Remark 4
GSI_ID_REM_5	String	Remark 5
GSI_ID_REM_6	String	Remark 6
GSI_ID_REM_7	String	Remark 7
GSI_ID_REM_8	String	Remark 8
GSI_ID_REM_9	String	Remark 9

Name	Data Type	Meaning
GSI_ID_E	Double	East co-ordinate
GSI_ID_N	Double	North co-ordinate
GSI_ID_H	Double	Height
GSI_ID_E0	Double	East station co-ordinate
GSI_ID_N0	Double	North station co-ordinate
GSI_ID_H0	Double	Station height
GSI_ID_HR	Double	Reflector height
GSI_ID_HI	Double	Instrument height
GSI_ID_INDIV	String	Individual point number
GSI_ID_PTLA	String	Number of the last recorded point
GSI_ID_STEP	Double	Increment of the running point number
GSI_ID_SPTNR	String	Station point number
GSI_ID_SHZ	Double	Hz angle with no sign change
GSI_ID_CD_DSC	String	Code description
GSI_ID_PTCD_DSC	String	Point code description
GSI_ID_PV_CD	String	Preview code
GSI_ID_PV_PTCD	String	Preview point code
GSI_ID_ACT_PTID	String	Actual point ID
GSI_ID_BACKID	String	Backside ID
GSI_ID_APPDATA0	String/Double	Application data 0
GSI_ID_APPDATA1	String/Double	Application data 1
GSI_ID_APPDATA2	String/Double	Application data 2
GSI_ID_APPDATA3	String/Double	Application data 3
GSI_ID_APPDATA4	String/Double	Application data 4
GSI_ID_APPDATA5	String/Double	Application data 5
GSI_ID_APPDATA6	String/Double	Application data 6
GSI_ID_APPDATA7	String/Double	Application data 7
GSI_ID_APPDATA8	String/Double	Application data 8
GSI_ID_APPDATA9	String/Double	Application data 9
GSI_ID_APPDATA10	String/Double	Application data 10
GSI_ID_APPDATA11	String/Double	Application data 11

Name	Data Type	Meaning
GSI_ID_FS_SCALE	Double	Free station scale
GSI_ID_EMPTY		Blank line
GSI_ID_NONE		End mark
GSI_ID_UNKNOWN		Unknown WI

6.4.3 Constants for Measurement Dialog Definition

Definition of (user definable) application parameters for measurement dialogs, either Double or String. See also GSI_SetLineMDlgPar and GSI_SetLineMDlgText.

Name	Meaning
GSI_PAR_AppData0	Application parameter 0
GSI_PAR_AppData1	Application parameter 1
GSI_PAR_AppData2	Application parameter 2
GSI_PAR_AppData3	Application parameter 3
GSI_PAR_AppData4	Application parameter 4
GSI_PAR_AppData5	Application parameter 5
GSI_PAR_AppData6	Application parameter 6
GSI_PAR_AppData7	Application parameter 7
GSI_PAR_AppData8	Application parameter 8
GSI_PAR_AppData9	Application parameter 9

Name	Meaning
GSI_PAR_AppData10	Application parameter 10
GSI_PAR_AppData11	Application parameter 11

Definition of system (defined) parameters for measurement dialogs. See also GSI_SetLineSysMDlg and GSI_SetLineMDlg.

Name	Meaning
GSI_PAR_AddConst	Prism constant
GSI_PAR_Attrib1	Point Code Attribute 1
GSI_PAR_Attrib2	Point Code Attribute 2
GSI_PAR_Attrib3	Point Code Attribute 3
GSI_PAR_Attrib4	Point Code Attribute 4
GSI_PAR_Attrib5	Point Code Attribute 5
GSI_PAR_Attrib6	Point Code Attribute 6
GSI_PAR_Attrib7	Point Code Attribute 7
GSI_PAR_Attrib8	Point Code Attribute 8
GSI_PAR_AvgMeasNo	Maximal number of distance measurements of the average mode
GSI_PAR_BacksideId	Last used Backside
GSI_PAR_Code	Last used Code
GSI_PAR_CodeDescr	Last used free Code Description
GSI_PAR_CodeList	Codelist management (select, create etc)
GSI_PAR_CodeListSelect	Codelist selection (of an existing codelist)
GSI_PAR_DataJobSelect	Data job selection (of an existing job)
GSI_PAR_Date	Current date of the instrument. The displayed format depends on the setting of the parameter "Date form."
GSI_PAR_DisplayMask	Select display mask for standard measuring dialog. Max. 3 displaymasks can be defined for this dialog. The displaymasks can also be changed with the system function "Next Displaymask".
GSI_PAR_DataJob	Data job management (select, create etc)
GSI_PAR_TargetEast	Target point Easting

Name	Meaning
GSI_PAR_DistMeasProg	EDM measurement program selection. Attention: The available measurement programs depends on the selected target type and on the instrument type
GSI_PAR_TargetElev	Target point Elevation
GSI_PAR_ElevDiff	Elevation difference
GSI_PAR_HalfLineSpace	This item can be used to display a half line space in order to separate or group lines on instrument screen.
GSI_PAR_DistHoriz	Horizontal distance
GSI_PAR_AngleHz	Hz-Angle
GSI_PAR_PointIdIncr	defines the increment step. It is used to increment the Target Point Id after recording a target point.
GSI_PAR_IndivPointId	Individual point identifier
GSI_PAR_Info1	Shows the Free Code Info 1
GSI_PAR_Info2	Shows the Free Code Info 2
GSI_PAR_Info3	Shows the Free Code Info 3
GSI_PAR_Info4	Shows the Free Code Info 4
GSI_PAR_Info5	Shows the Free Code Info 5
GSI_PAR_Info6	Shows the Free Code Info 6
GSI_PAR_Info7	Shows the Free Code Info 7
GSI_PAR_Info8	Shows the Free Code Info 8
GSI_PAR_InstrHeight	Instrument Height (hi)
GSI_PAR_LastPointId	Last recorded target point identifier
GSI_PAR_MeasJobSelect	Measurement Job selection (of an existing Job or RS232 for online recording)
GSI_PAR_MeasJob	Measurement Job management (select, create, etc.)
GSI_PAR_NS	Number of measurements and standard deviation
GSI_PAR_TargetNorth	Target point Northing
GSI_PAR_OffsetCross	Cross Offset

Name	Meaning
GSI_PAR_OffsetElev	Offset Elevation
GSI_PAR_OffsetLength	Offset Length
GSI_PAR_OffsetMode	Defines the resetting of the offset
GSI_PAR_PointCode	Actual Feature Code
GSI_PAR_PointId	Actual Target point identifier, running or individual. The Value and the display text changes if an individual number is set.
GSI_PAR_PpmAtm	ppm atmospheric
GSI_PAR_PpmGeom	ppm geometric
GSI_PAR_PpmTotal	Total ppm
GSI_PAR_PpmMm	Total ppm and prism constant
GSI_PAR_PrevCode	Shows the second last used Code
GSI_PAR_PrevPointCode	Last used Feature Code
GSI_PAR_PointCodeDescr	Shows the Point Code Description of the actual Feature Code
GSI_PAR_RecMask	Selected Recording mask for target point measurements
GSI_PAR_ReflHeight	Reflector height (hr)
GSI_PAR_ReflName	Used reflector type
GSI_PAR_ReflSelection	reflector type selection. If there are user defined prism, then they will be added to this list. The User Refl1..User Refl3 are only valid, if these user definable prisms are defined.
GSI_PAR_RunningPointId	Running target point identifier
GSI_PAR_DistSlope	Slope distance
GSI_PAR_StationId	Identifies the Station
GSI_PAR_StationEast	Station Easting
GSI_PAR_StationElev	Station Elevation
GSI_PAR_StationNorth	Station Northing
GSI_PAR_TargetType	Definition of the target type (Reflector / reflectorless)
GSI_PAR_Time	Current time of the instrument. The displayed format depends on the setting of the

Name	Meaning
	parameter "Time form."
`GSI_PAR_AngleV`	V-Angle
`GSI_PAR_VangleFormat`	Vertical angle display format:Zenith angle = 0gon for zenith, angles are positive, Elev. angle = 0gon for horizontal, (+) above horizont and (-) below horizont. Elev.angle% = 0% for horizont, 100% for 50gon. V-angle is displayed (+) above and (-) below horizont but as percentage of the gradient.
`GSI_PAR_NONE`	Designates a line that is unused.

6.4.4 Relationship of GSI_ID's to GSI_PAR's

In general we can distinguish between two data value pools who are able to store values in it. Some of theses values are shared between the two pools.

GSI_ID_-Ids describe the values which can be stored and requested in the (WI) data value pool. GSI_PAR_-Ids describe the values which can be used for displaying in a measurement dialog. Their sets of id's are not associated directly in all cases. Moreover their sets of Id's can be distinguished in their meaning.

Association in this context means that both pools, the data value pool and the data display pool, share their values directly. Nonassociated values are unique to either the data value pool or the data display pool.

Many of the GSI_IDs are record-able. Two types of record-able Ids can be distinguished:

a) Measurement block (“Meas”) (has to start with a GSI_ID_PTNR)

b) Code block (“Code”) (has to start with a GSI_ID_CODE)

They may not be mixed.

Record-able	GSI_ID_-Ids	GSI_PAR_-Ids
	`GSI_ID_NHZ`	
	`GSI_ID_DHZ`	
	`GSI_ID_NV`	

	GSI_ID_DV	
	GSI_ID_NHOR	
	GSI_ID_DHOR	
	GSI_ID_NHGT	
	GSI_ID_DHGT	
	GSI_ID_NSLOPE	
	GSI_ID_DSLOPE	
	GSI_ID_INDIV	GSI_PAR_IndivPointId
	GSI_ID_PTLA	GSI_PAR_LastPointId
	GSI_ID_STEP	GSI_PAR_PointIdIncr
	GSI_ID_SPTNR	GSI_PAR_StationId
	GSI_ID_SHZ	
	GSI_ID_CD_DSC	GSI_PAR_CodeDescr
	GSI_ID_PTCD_DSC	GSI_PAR_PointCodeDescr
	GSI_ID_PV_CD	GSI_PAR_PrevCode
	GSI_ID_PV_PTCD	GSI_PAR_PrevPointCode
	GSI_ID_ACT_PTID	GSI_PAR_PointId
	GSI_ID_BACKID	GSI_PAR_BackSideId
Meas	GSI_ID_PTNR	GSI_PAR_RunningPointId
Meas	GSI_ID_FNR	GSI_PAR_SerialNr (undefined)
Meas	GSI_ID_TYPE	GSI_PAR_InstrType (undefined)
Meas	GSI_ID_TIME_1	See GSI_PAR_Date
Meas	GSI_ID_TIME_2	See GSI_PAR_Time
Meas	GSI_ID_HZ	GSI_PAR_AngleHz
Meas	GSI_ID_V	GSI_PAR_AngleV
Meas	GSI_ID_SLOPE	GSI_PAR_DistSlope
Meas	GSI_ID_HOR	GSI_PAR_DistHoriz
Meas	GSI_ID_HGT	GSI_PAR_ElevDiff
Meas	GSI_ID_PPMM	GSI_PAR_PpmMm
Meas	GSI_ID_SIGMA	GSI_PAR_NS

Meas	GSI_ID_MM	GSI_PAR_AddConst
Meas	GSI_ID_PPM	GSI_PAR_PpmTotal
Meas	GSI_ID_REM_1	GSI_PAR_Info1
Meas	GSI_ID_REM_2	GSI_PAR_Info2
Meas	GSI_ID_REM_3	GSI_PAR_Info3
Meas	GSI_ID_REM_4	GSI_PAR_Info4
Meas	GSI_ID_REM_5	GSI_PAR_Info5
Meas	GSI_ID_REM_6	GSI_PAR_Info6
Meas	GSI_ID_REM_7	GSI_PAR_Info7
Meas	GSI_ID_REM_8	GSI_PAR_Info8
Meas	GSI_ID_REM_9	GSI_PAR_Info9
Meas	GSI_ID_E	GSI_PAR_TargetEast
Meas	GSI_ID_N	GSI_PAR_TargetNorth
Meas	GSI_ID_H	GSI_PAR_TargetElev
Meas	GSI_ID_E0	GSI_PAR_StationEast
Meas	GSI_ID_N0	GSI_PAR_StationNorth
Meas	GSI_ID_H0	GSI_PAR_StationElev
Meas	GSI_ID_HR	GSI_PAR_ReflHeight
Meas	GSI_ID_HI	GSI_PAR_InstrHeight
Code	GSI_ID_CODE	GSI_PAR_Attrib1
Code	GSI_ID_CODE_1	GSI_PAR_Attrib2
Code	GSI_ID_CODE_2	GSI_PAR_Attrib3
Code	GSI_ID_CODE_3	GSI_PAR_Attrib4
Code	GSI_ID_CODE_4	GSI_PAR_Attrib5
Code	GSI_ID_CODE_5	GSI_PAR_Attrib6
Code	GSI_ID_CODE_6	GSI_PAR_Attrib7
Code	GSI_ID_CODE_7	GSI_PAR_Attrib8
Code	GSI_ID_CODE_8	GSI_PAR_Attrib9

`GSI_ID_APPDATA0` are for the purpose of exchanging data between applications and between application and MDlg. They cannot be recorded. Both can be of the form `GSI_ASCII` or `GSI_DOUBLE`.

	GSI_ID_APPDATA0	GSI_PAR_APPDATA0
	GSI_ID_APPDATA1	GSI_PAR_APPDATA1
	GSI_ID_APPDATA2	GSI_PAR_APPDATA2
	GSI_ID_APPDATA3	GSI_PAR_APPDATA3
	GSI_ID_APPDATA4	GSI_PAR_APPDATA4
	GSI_ID_APPDATA5	GSI_PAR_APPDATA5
	GSI_ID_APPDATA6	GSI_PAR_APPDATA6
	GSI_ID_APPDATA7	GSI_PAR_APPDATA7
	GSI_ID_APPDATA8	GSI_PAR_APPDATA8
	GSI_ID_APPDATA9	GSI_PAR_APPDATA9
	GSI_ID_APPDATA10	GSI_PAR_APPDATA10
	GSI_ID_APPDATA11	GSI_PAR_APPDATA11

Special Ids

	GSI_ID_NONE	
	GSI_ID_EMPTY	
	GSI_ID_UNKNOWN	
		GSI_PAR_NONE

The set of GSI_PAR-ids is not complete in this table. There exist several more Ids, which can be used for displaying.

6.4.5 Data Structures for GSI Functions

GSI_WiDlg_Entry_Type: Dialog entry information

Description This data structure is used to store information about the entries (data fields) of the WI dialog.

```
TYPE GSI_WiDlg_Entry_Type
  iId          AS Integer
```

The identifier of the dialog entry. For possible value see WI constants.

`iDataType`	`AS Integer`	The type of the date stored in `dValue` or `sValue`. For possible value see table below.

`iDataType`	**Meaning**
`GSI_ASCII`	ASCII data (stored in `sValue`)
`GSI_ASCII_SIGN`	signed ASCII data (stored in `sValue`)
`GSI_DOUBLE`	double data (stored in `dValue`)

`lValid`	`AS Logical`	`TRUE` if the value is valid.
`dValue`	`AS Double`	Data if value is of type `Double`.
`sValue`	`AS String18`	Data if value is of type `String`.

```
END GSI_WiDlg_Entry_Type
```

Wi_List: An array of GSI_WiDlg_Entry_Type

Description This array consists of `GSI_MAX_REC_WI` elements of the type `GSI_WiDlg_Entry_Type`.

GSI_Rec_Id_List: An array of integers (indicating WI–identifications)

Description This array consists of `GSI_MAX_REC_WI` elements of the type `Integer`. It is used to define the recorded values (recmask).

GSI_Point_Coord_Type: Point co-ordinate data

Description This data structure is used to store a point name and its co-ordinates.

```
TYPE GSI_Point_Coord_Type
```

`sPtNr`	`AS String18`	point number
`dEast`	`AS Double`	east co-ordinate
`dNorth`	`AS Double`	north co-ordinate
`dHeight`	`AS Double`	height co-ordinate
`lPtNrValid`	`AS Logical`	`TRUE` if point number is valid
`lEValid`	`AS Logical`	`TRUE` if east co-ordinate is valid
`lNValid`	`AS Logical`	`TRUE` if north co-ordinate is valid

`lHValid`	`AS Logical`	`TRUE` if height co-ordinate is valid

```
END GSI_Point_Coord_Type
```

6.4.6 GSI_GetRunningNr

Description Fetches the running point number and the increment.

Declaration
```
GSI_GetRunningNr( sPntId   AS String20,
                  sPntIncr AS String20 )
```

Remarks Fetches the running point number and increment for it.

Parameters

`sPntId`	`out`	the running point number
`sPntIncr`	`out`	the increment for the running point number

See Also `GSI_SetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr, GSI_IsRunningNr`

Return-Codes

`RC_OK`	successful

Example

```
DIM sPntId  AS String20
DIM sPntInc AS String20

GSI_GetRunningNr( sPntId, sPntInc )
```

6.4.7 GSI_SetRunningNr

Description Sets the running point number and increment.

Declaration
```
GSI_SetRunningNr(
            BYVAL sPntId   AS String20,
            BYVAL sPntIncr AS String20 )
```

Remarks Sets the running point number and the increment for it. The running point number mode is switched on.

Parameters

sPntId	in	The user running point number.
sPntIncr	in	The increment for the user point running number.

See Also GSI_GetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr, GSI_IsRunningNr

Return-Codes

RC_OK	successful

Example
```
DIM sPntId  AS String20
DIM sPntInc AS String20

GSI_SetRunningNr( sPntId, sPntInc )
```

6.4.8 GSI_ GetIndivNr

Description Fetches the individual point number.

Declaration `GSI_GetIndivNr( sPntId AS String20 )`

Remarks Fetches the individual point number.

Parameters

sPntId	out	The user-defined individual point number.

See Also GSI_GetRunningNr, GSI_SetRunningNr, GSI_SetIndivNr, GSI_IsRunningNr

Return-Codes

`RC_OK`	successful

Example

```
DIM sPntId AS String20

GSI_GetIndivNr( sPntId )
```

6.4.9 GSI_SetIndivNr

Description Sets the individual point number.

Declaration `GSI_SetIndivNr( BYVAL sPntId AS String20 )`

Remarks Sets the individual point number. After this call, the running point number mode is switched to the individual point number. This mode will be active until replaced by a running number or until the next save.

Parameters

`sPntId`	`in`	The user-defined individual point number.

See Also `GSI_GetRunningNr, GSI_SetRunningNr, GSI_GetIndivNr, GSI_IsRunningNr`

Return-Codes

`RC_OK`	successful

Example

```
DIM sPntId AS String20

GSI_SetIndivNr( sPntId )
```

6.4.10 GSI_IsRunningNr

Description Queries if running number is being used.

Declaration `GSI_IsRunningNr( lRunningOn AS Logical )`

Remarks If the running number is active the parameter will forced to `TRUE` otherwise to `FALSE`.

Parameters

`lRunningOn`	`out`	information about the running point number

See Also `GSI_GetRunningNr, GSI_SetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr`

Return-Codes

`RC_OK`	successful

Example

```
DIM lRunningOn AS Logical

GSI_IsRunningNr( lRunningOn )
```

6.4.11 GSI_SetIvPtNrStatus

Description Switches the individual point number mode on/off.

Declaration

```
GSI_SetIvPtNrStatus(
                BYVAL lSwitch AS Logical )
```

Remarks Switch the individual point number on or off. When point number is shown in the display the number will change.

Parameters

`lSwitch`	`in`	switch for the individual point-number (`TRUE` = `on`, `FALSE` = `off`)

See Also `GSI_GetRunningNr, GSI_SetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr, GSI_IsRunningNr`

Return-Codes

`RC_OK`	successful

Example

```
GSI_SetIvPtNrStatus( FALSE )
```

6.4.12 GSI_IncPNumber

Description Automatically point number increment.

Declaration `GSI_IncPNumber()`

Remarks This function increments the running alphanumeric point number.

Parameters none

See Also `GSI_GetRunningNr, GSI_SetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr`

Return Codes

`RC_IVRESULT`	Point number is not incremented, possible reasons could be: wrong alphanumerically chars in point number alphanumerically chars in step overflow on a alphanumerically char step is longer as the point number

Example

```
GSI_IncPNumber()
```

6.4.13 GSI_Coding

Description Starts the active coding function of the TPS system.

Declaration `GSI_Coding( BYVAL Caption AS _Token)`

Remarks This routine starts the active coding function of the TPS system. Since there exist three possible locations, the TPS system follows a default ordering rule to invoke one of the programs. First it checks if there is an appropriate set up GeoBASIC coding program. If yes it will be executed, otherwise it examines the codelist management if a codelist is selected. If yes then the codelist will be opened, otherwise the standard coding will be activated.

Parameters

`Caption`	`in`	The left caption string of the dialog.

Return-Codes

RC_OK	successful
LDR_ RECURSIV_ERR	GeoBASIC is already running

Example The example uses the GSI_Coding routine to open a dialog for coding.

```
GSI_Coding( "CODE" )
```

6.4.14 GSI_SelectCode

Description This routine shows the codelist-coding dialog

Declaration

```
GSI_SelectCode( BYVAL Caption AS _Token)
```

Remarks This routine starts the codelist-coding function of the TPS system. It will be executed only if a valid codelist is selected.

Parameters

Caption	in	The left caption string of the dialog.

Return-Codes

RC_OK	successful
RC_ABORT	Coding was aborted by pressing of the ESC-button
RC_ABORT_APPL	Coding was aborted by pressing of the QUIT-button
COD_RC_LIST_ NOT_VALID	No valid codelist selected

Example See example file „meas.gbs“.

6.4.15 GSI_GetQCodeAvailable

Description This routine returns the status for Quick-Coding.

Declaration

```
GSI_GetQCodeAvailable(lAvailable As Logical,
                      lEnabled   As Logical)
```

Remarks This routine returns if a valid codelist is selected and if Quick-Coding is enabled or not.

Parameters

lAvailable	out	TRUE: a valid codelist is selected.
lEnabled	out	TRUE: Quick-Coding is activated

See Also GSI_SetQCodeMode, GSI_ExecQCoding

Return-Codes

RC_OK	successful

Example See example file „meas_od.gbs“.

6.4.16 GSI_SetQCodeMode

Description Sets the Quick-Coding mode.

Declaration `GSI_SetQCodeMode(BYVAL lEnabled As Logical)`

Remarks This routine enables or disables the Quick-Coding. It can be only activated if a valid codelist is selected (see GSI_GetQCodeAvailable)

Parameters

lEnabled	in	TRUE: enable Quick-Coding

See Also GSI_GetQCodeAvailable, GSI_ExecQCoding

Return-Codes

RC_OK	successful

Example See example file „meas.gbs“.

6.4.17 GSI_ExecQCoding

Description Executes the Quick-Coding.

Declaration

```
GSI_ExecQCoding(
      BYVAL lRecEnable AS Logical
            iButtonId  AS Integer,
            lNewCode   AS Logical)
```

Remarks

This routine executes the Quick-Coding. If Quick-Coding is enabled, it checks the button `iButtonId` and searches the corresponding code. If the selected code needs mandatory attributes, it shows the coding dialog. As successful coding is indicated by `lNewCode=TRUE`. The results are stored in the Theodolite data pool (see `GSI_GetWiEntry`)

If `lRecEnable=TRUE`, this routine executes the ALL-button functionality too, it measures a distance and records the results. The recording order (measurement block – code block or vice versa) depends on the system setting (see `GSI_GetRecOrder`).

If `lRecEnable=FALSE`, this routine forces no new distance measurement and there is no recording.

Parameters

`lRecEnable`	`in`	TRUE: Quick-Coding including distance measurement. It records a code- and a measurement-block in the correct order. FALSE: Quick-Coding without measurement and without recording
`iButtonId`	`inout`	`In`: Pressed button. `Out`: If a Quick-Coding was possible, `iButtonId` is changed to `MMI_NO_KEY`, otherwise it is unchanged
`lNewCode`	`out`	`TRUE`: Quick-Coding was successful

See Also

`GSI_GetQCodeAvailable, GSI_SetQCodeMode, GSI_SetRecOrder`

Return-Codes

`RC_OK`	successful

Example

See example files „`meas.gbs`“ and „`meas_od.gbs`“..

6.4.18 GSI_SetRecOrder

Description Sets the recording order for Quick-Coding.

Declaration `GSI_SetRecOrder(BYVAL lCodeFirst As Logical)`

Remarks This routine defines the recording order for Quick-Coding.

`If lCodeFirst=TRUE`, then the code-block will be recorded before the measurement block.

Parameters

`lCodeFirst`	`in`	TRUE: code-block before measurement block

See Also `GSI_GetRecOrder, GSI_ExecQCoding`

Return-Codes

`RC_OK`	successful

Example See example file „`meas_od.gbs`“.

6.4.19 GSI_GetRecOrder

Description Returns the recording order for Quick-Coding.

Declaration `GSI_GetRecOrder(lCodeFirst As Logical)`

Remarks This routine returns the recording order for Quick-Coding.

`If lCodeFirst=TRUE`, then the code-block will be recorded before the measurement block.

Parameters

`lCodeFirst`	`out`	TRUE: code-block before measurement block

See Also `GSI_SetRecOrder, GSI_ExecQCoding`

Return-Codes

`RC_OK`	successful

Example See example file „`meas_od.gbs`“.

6.4.20 GSI_QuickSet

Description Shows the Quickset dialog.

Declaration `GSI_QuickSet(BYVAL sCaptionLeft AS _Token)`

Remarks This procedure shows Quickset for station setting.

Parameters

`sCaptionLeft`	`in`	Left caption for the Quickset dialog

Return-Codes

`RC_OK`	Successful termination.

Example Show the dialog:

```
GSI_QuickSet ( "BASIC" )
```

6.4.21 GSI_SetRecPath

Description Defines the recording path for the measurements.

Declaration

```
GSI_SetRecPath(
          BYVAL iPathInfo AS Integer,
          BYVAL sFileName AS FileName,
          BYVAL sFilePath AS FilePath )
```

Remarks This procedure defines where the measurements will be recorded. If `iPathInfo` is set to `GSI_INTERFACE`, then the measurements will be sent to the RS232 line and the other parameters are not be interpreted. If `iPathInfo` is set to `GSI_EXTERNAL`, then `sFileName` defines the filename i.e. "`MeasJob.GSI`" and `sFilePath` defines the file-path, i.e. "`A:\\GSI`".

Parameters

`iPathInfo`	`in`	Defines where the data are recorded
`sFileName`	`in`	Valid Filename (8+3 format)
`sFilePath`	`in`	file-path

Return-Codes

RC_OK	Successful termination.

See Also GSI_GetRecPath

Example This example shows the actual recording path and set it to the RS232 line:

```
DIM sFile      As FileName
DIM sPath      As FilePath
DIM iPathInfo  As Integer

GSI_GetRecPath(iPathInfo, sFile, sPath)
IF iPathInfo = GSI_EXTERNAL THEN
    MMI_PrintStr(0, 1,
          "RecFile-CARD: "+sFile, TRUE)
    MMI_PrintStr(0, 2,
          "   Path: " + sPath, TRUE)
  ELSE
    MMI_PrintStr(0, 1,
          "RecPath - serial line", TRUE)
END IF
GSI_SetRecPath( GSI_INTERFACE, sFile, sPath)
```

6.4.22 GSI_GetRecPath

Description Returns the recording path for the measurements.

Declaration

```
GSI_GetRecPath(
      iPathInfo AS Integer,
      sFileName AS FileName,
      sFilePath AS FilePath )
```

Remarks This procedure returns where the measurements will be recorded. If `iPathInfo` = `GSI_INTERFACE`, then the measurements will be sent to the RS232 line and the other parameters are not valid. If `iPathInfo` = `GSI_EXTERNAL`, then `sFileName` defines the filename i.e. "`MeasJob.GSI`" and `sFilePath` defines the file-path, i.e. "`A:\\GSI`".

Parameters

`iPathInfo`	`out`	Device info
`sFileName`	`out`	Filename (8+3 format)
`sFilePath`	`out`	File-path

Return-Codes

`RC_OK`	Successful termination.

See Also `GSI_SetRecPath`

Example see `GSI_SetRecPath`

6.4.23 GSI_SetDataPath

Description Set the file with the import data.

Declaration

```
GSI_SetDataPath(
         BYVAL iPathInfo AS Integer,
         BYVAL sFileName AS FileName,
         BYVAL sFilePath AS FilePath )
```

Remarks This procedure sets the file from which data will be imported. Only `GSI_EXTERNAL` is valid for the iPathInfo. `sFileName` defines the filename i.e. "`DataJob.GSI`" and `sFilePath` defines the file-path, i.e. "`A:\\GSI`".

Parameters

`iPathInfo`	`in`	Device info (Only `GSI_EXTERNAL` is valid)
`sFileName`	`in`	Valid Filename (8+3 format)
`sFilePath`	`in`	File-path

Return-Codes

`RC_OK`	Successful termination.

See Also `GSI_GetDataPath`

Example The example defines the file “A:\GSI\DataJob.GSI” as new import file.

```
GSI_SetDataPath(GSI_EXTERNAL, “DataJob.GSI”,
“A:\\GSI”)
```

6.4.24 GSI_GetDataPath

Description Get the name of the file with the import data.

Declaration

```
GSI_GetDataPath(
      iPathInfo AS Integer,
      sFileName AS FileName,
      sFilePath AS FilePath )
```

Remarks This procedure fetches the name and the path of the file from which data will be imported. If `iPathInfo` = `GSI_EXTERNAL`, then `sFileName` defines the filename i.e. "`DataJob.GSI`" and `sFilePath` defines the file-path, i.e. "`A:\\GSI`".

Parameters

iPathInfo	out	Device info
sFileName	out	Filename (8+3 format)
sFilePath	out	File-path

Return-Codes

RC_OK	Successful termination.

See Also `GSI_SetDataPath`

Example The example fetches the name and the path of the standard import data file:

```
DIM iPathInfo  AS Integer
DIM sFileName  AS FileName
DIM sFilePath  AS FilePath
GSI_GetDataPath(iPathInfo, sFileName, sFilePath)
```

6.4.25 GSI_GetWiEntryText

Description Get coding text-data from the Theodolite data pool.

Declaration
```
GSI_GetWiEntryText(
       WiIdentification  AS Integer,
       WiEntryText AS String30 )
```

Remarks This routine is used to fetch coding descriptions from the Theodolite data pool, i.e. the code-description itself or the description text of the attributes. If no codelist is selected, then the standard prompts will be returned. Texts for the following wi's can be fetched: GSI_ID_PTCD_DSC, GSI_ID_REM_1, GSI_ID_REM_2, GSI_ID_REM_3, GSI_ID_REM_4, GSI_ID_REM_5, GSI_ID_REM_6, GSI_ID_REM_7, GSI_ID_REM_8, GSI_ID_REM_9, GSI_ID_CD_DSC, GSI_ID_CODE, GSI_ID_CODE_1, GSI_ID_CODE_2, GSI_ID_CODE_3, GSI_ID_CODE_4, GSI_ID_CODE_5, GSI_ID_CODE_6, GSI_ID_CODE_7, GSI_ID_CODE_8.

Parameters

WiIdentification	in	The identification of the WI.
WiEntryText	out	Entry-Text.

See Also -

Example This example gets the description-text and the value of the first coding attribute and send it out over the serial line.

```
GSI_GetWiEntryText( GSI_ID_CODE_1, sWiEntryText )
GSI_GetWiEntry( GSI_ID_CODE_1, WiEntry   )
send("Info1: " + sWiEntryText
+":"+WiEntry.sValue)
```

6.4.26 GSI_GetWiEntry

Description Get data from the Theodolite data pool.

Declaration
```
GSI_GetWiEntry(
       WiIdentification  AS Integer,
       WiEntry AS GSI_WiDlg_Entry_Type )
```

Remarks This routine is used to fetch data from the Theodolite data pool. All existing wi's can be fetched (see the description of the WI constants for possible values).

Parameters

`WiIdentification`	`in`	The identification of the WI.
`WiEntry`	`out`	The WI entry data. See the description of `GSI_WiDlg_Entry_Type` for further information.

See Also `GSI_SetWiEntry`

Example See example `GSI_SetWiEntry`.

6.4.27 GSI_SetWiEntry

Description Put data to the Theodolite data pool.

Declaration

```
GSI_SetWiEntry(
        WiIdentification  AS Integer,
        WiEntry AS GSI_WiDlg_Entry_Type )
```

Remarks This routine is used to put data to the Theodolite data pool. See the description of the WI constants.

Parameters

`WiIdentification`	`in`	The identification of the WI.
`WiEntry`	`in`	The WI entry data. See the description of `GSI_WiDlg_Entry_Type` for further information.

See Also `GSI_GetWiEntry`

Example GSI_SetWiEntry does not set WI.iId according to the first parameter, instead it will just use the value stored in WI.iId. If that value is unequal to the first parameter value, then it comes to a conflict. Use a GSI_GetWiEntry() first, to be sure that all values of the GSI_WiDlg_Entry_Type are initialized correctly. See also the example for the definition of a measurement dialog.
Save way:

```
GSI_GetWiEntry ( GSI_ID_HR, Wi )
Wi.lValid = TRUE
Wi.dValue = 2.12
GSI_SetWiEntry ( GSI_ID_HR, Wi )
```

6.4.28 GSI_GetRecMask

Description Get the definition and the format of a recording mask.

Declaration

```
GSI_GetRecMask(
     BYVAL iMaskNr AS Integer,
           sMaskName     AS String18,
           RecWiMask     AS GSI_Rec_Id_List,
           iRecFormat    AS Integer,
           lEditMask     AS Logical )
```

Remarks This routine fetches the definition and the format of the recording mask with the number `iMaskNr`. Valid formats are `GSI_RECFORMAT_GSI` and `GSI_RECFORMAT_GSI16.` A recording mask can be set with `GSI_SetRecMask`. If `lEditMask` is TRUE the elements of the recording mask can be changed in `GSI_DefineRecMaskDlg`. All unused elements of the recording list are set to `GSI_ID_NONE`. All values from 0 to 5 are valid for the mask number. Mask number 0 is predefined for the station recording mask.

Note	Only the first 16 characters of `sMaskName` are valid.

Parameters

`iMaskNr`	`in`	Number of the recording mask. `GSI_ACTUAL_RECMASK` can be used to retrieve settings of the actual mask
`sMaskName`	`out`	Name of the recording mask
`RecWiMask`	`out`	The definition of the recording mask. The elements of the array are the identification numbers of the `WI's`. See the description of the WI constants.
`iRec Format`	`out`	Recording format (`GSI_RECFORMAT_GSI` , `GSI_RECFORMAT_GSI16`)
`lEditMask`	`out`	Mask editable flag

See Also `GSI_SetRecMask, GSI_DefineRecMaskDlg`

Example The example uses the `GSI_GetRecMask` routine to fetch the definition and the format of the recording mask number 2.

```
DIM sMaskName   AS String18
DIM RecWiMask   AS GSI_Rec_Id_List
DIM iRecFormat  AS Integer
DIM lEditMask   AS Logical

GSI_GetRecMask( 2, sMaskName, RecWiMask,
                iRecFormat, lEditMask)
```

6.4.29 GSI_SetRecMask

Description Set the definition and the format of a recording mask.

Declaration

```
GSI_SetRecMask(
     BYVAL iMaskNr AS Integer,
     BYVAL sMaskName     AS String18,
     BYVAL RecWiMask     AS GSI_Rec_Id_List,
     BYVAL iRecFormat    AS Integer,
     BYVAL lEditMask     AS Logical)
```

Remarks This routine sets the definition and the format of the recording mask with the number `iMaskNr`. Valid formats are `GSI_RECFORMAT_GSI` and `GSI_RECFORMAT_GSI16.` If `lEditMask` is TRUE the elements of the recording mask can be changed in `GSI_DefineRecMaskDlg.` All unused elements should be set to `GSI_ID_NONE`. All values from 0 to 5 are valid for the mask number. Mask number 0 is predefined for the station recording mask.

Note	1) `WiEntries` must be unique, hence may not appear doubly. 2) Only `GSI_MAX_REC_WI` number of entries may be defined. 3) Only the first 16 characters of `sMaskName` are valid.

Parameters

`iMaskNr`	`in`	Number of the recording mask. `GSI_ACTUAL_RECMASK` can be used to set the values of the currently active

		mask.
`sMaskName`	in	Name of the recording mask.
`RecWiMask`	in	The definition of the recording mask. The elements of the array are the identification numbers of the `WI's`. See the description of the WI constants.
`iRec Format`	in	Recording format (`GSI_RECFORMAT_GSI`, `GSI_RECFORMAT_GSI16`)
`lEditMask`	in	Mask editable flag

See Also `GSI_GetRecMask`, `GSI_DefineRecMaskDlg`

Example The example sets the 4th element of the currently active recording mask on GSI_ID_HZ.

```
DIM sMaskName   AS String18
DIM RecWiMask   AS GSI_Rec_Id_List
DIM iRecFormat  AS Integer
DIM lEditMask   AS Logical

GSI_GetRecMask(GSI_ACTUAL_RECMASK, sMaskName,
               RecWiMask, iRecFormat, lEditMask)
RecWiMask(4) = GSI_ID_HZ
GSI_SetRecMask(GSI_ACTUAL_RECMASK, sMaskName,
               RecWiMask, iRecFormat, lEditMask)
```

6.4.30 GSI_SetRecMaskNr

Description Set the used recording mask.

Declaration `GSI_SetRecMaskNr(BYVAL iMaskNr AS Integer)`

Parameters

`iMaskNr`	in	Number of the recording mask. Number must be in the range `1.. GSI_MAX_REC_MASKS.`

See Also `GSI_GetRecMaskNr`

Example The example sets the next recording mask.

```
DIM i   AS Integer

GSI_GetRecMaskNr( i )
i = i + 1 ' take next mask
i = ((i - 1) MOD GSI_MAX_REC_MASKS) + 1
GSI_SetRecMaskNr( i )
```

6.4.31 GSI_GetRecMaskNr

Description Returns the used recording mask.

Declaration `GSI_GetRecMaskNr(iMaskNr AS Integer)`

Parameters

iMaskNr	out	Number of the recording mask.

See Also `GSI_SetRecMaskNr`

6.4.32 GSI_DefineRecMaskDlg

Description Defines the recording mask dialog.

Declaration `GSI_DefineRecMaskDlg()`

Remarks Defines the contents of the recording mask. Using a dialog with list-fields, the user can select the items for the user registration mask. This routine is an interactive equivalent to the routines `GSI_GetRecMask and GSI_SetRecMask.`

See Also `GSI_GetRecMask, GSI_SetRecMask,`

Example

```
GSI_DefineRecMaskDlg ()
```

6.4.33 GSI_ManCoordDlg

Description Show the manual co-ordinate input dialog.

Declaration

```
GSI_ManCoordDlg(
      BYVAL sCaption       AS _Token,
      BYVAL iPointType     AS Integer,
        Point   AS GSI_Point_Coord_Type,
      BYVAL iFlags         AS Integer,
      BYVAL sHelpText      AS _Token )
```

Remarks

This routine shows the manual co-ordinates input dialog and allows editing, coding and recording. The type of co-ordinates (station or target) can be selected using `iPointType`. Recording to the current data-file (defined in `GSI_ImportCoordDlg`) with `REC` or leaving this function with `CONT` is only possible if the point number is valid, and at least E- and N-co-ordinates are valid. If GSI_HEIGHT_MUST is included in `iFlags` the Height / Elevation-co-ordinate must be valid too. Leaving using `ESC` or `QUIT` (`Shift-F6`) is always possible. Recording and coding sets the according values in the Theodolite data-pool too.

Parameters

`sCaption` in The maximal five-character long left part of the title bar.

`iPointType` in station or target point. For the values for `PointType` see table below

Point Type	**Meaning**
`GSI_STATION`	station point number
`GSI_INDIV_TG`	individual target number
`GSI_RUN_TG`	running target
`GSI_BACKSIGHT`	backside number (analog target, only changed prompts)

		GSI_POINT_CODE	PointId / CodeId (analog target, only changed prompts)
Point	in	only point number, co-ordinates will be set to 0	
Point	out	point number and -co-ordinates. For further information see the description of GSI_Point_Coord_Type	
iFlags	in	defines functionality	
		Valid Flags	**Meaning**
		GSI_ALLOW_REC	allows recording and coding
		GSI_HEIGHT_MUST	height must be entered
		GSI_NE_OPTIONAL	only height must be entered, north & east are optional
		GSI_MULTI_REC	Allows entering and recording of more than one data-set, without leaving this routine
		GSI_NO_FILE_CHANGE	File changing is disabled
		Flags can be combined with '+'-operator (iFlags = iFlag1 + iFlag2)	
sHelpText	in	This text is shown, when the help button SHIFT-F1 is pressed and the help functionality of the theodolite is enabled.	

See Also GSI_ImportCoordDlg

Example

```
DIM Point AS GSI_Point_Coord_Type

GSI_ManCoordDlg ( "TEST", GSI_STATION, Point,
                  GSI_HEIGHT_MUST+GSI_ALLOW_REC,
                  "This is the Helptext" )
```

6.4.34 GSI_ImportCoordDlg

Description Show the co-ordinate import dialog.

Declaration

```
GSI_ImportCoordDlg(
    BYVAL sCaption        AS _Token,
    BYVAL iPointType      AS Integer,
    Point    AS GSI_Point_Coord_Type,
    BYVAL iFlags          AS Integer,
    BYVAL iImportFile     AS Integer,
    BYVAL sImportHelp     AS _Token,
    BYVAL sInputHelp      AS _Token,
    BYVAL sF2Button       AS _Token,
    BYVAL sF4Button       AS _Token)
```

Remarks This routine contains three dialogues, the search-, the view- and the manual-input dialog. The type of co-ordinates (station or target) can be selected using `iPointType`. The search dialog allows selecting the data- or the measure file and editing a point-number. Depending on the pressed button, the manual co-ordinate input function (only if `GSI_ALLOW_MAN` is included in `iFlags`, see `GSI_ManCoordDlg`) or the view-co-ordinates dialog will be called.

The start of searching is always at the top of the file. With the two search keys, the user can step from one valid point to the next in both directions.

Rules for a valid point:

- point number found
- E- and N-coordinates (target or station) exists and are valid
- if `GSI_HEIGHT_MUST` is included in `iFlags`, a valid

height / elevation-coordinate must exist to within the file too.

If no valid point exists or no more valid points are in the desired search direction, a warning message will be displayed.

Parameters

`sCaption`	`in`	The maximal five-character long left part of the title bar.
`iPointType`	`in`	station or target point. For the values for `PointType` see table below

Point Type	Meaning
`GSI_STATION`	station point number
`GSI_INDIV_TG`	individual target number
`GSI_RUN_TG`	running target
`GSI_BACKSIGHT`	backside number (analog target, only changed prompts)
`GSI_POINT_CODE`	PointId / CodeId (analog target, only changed prompts)

`Point`	`in`	Only point number, the co-ordinates will be set to 0.
`Point`	`out`	point number and -co-ordinates. For further information see the description of `GSI_Point_Coord_Type`.
`iFlags`	`in`	defines functionality

Valid Flags	Meaning
`GSI_ALLOW_REC`	allows recording and coding
`GSI_MULTI_REC`	Allows multiple manual coord. entering

		`GSI_ALLOW_MAN`	allows manual coord. entering
		`GSI_HEIGHT_MUST`	height must be entered
		`GSI_DIRECT_SEARCH`	direct searching without dialog
		`GSI_NO_VIEW`	no coord view if found
		`GSI_NE_OPTIONAL`	only height must be entered, north & east are optional
		`GSI_SEARCH_FROM_END`	Starts searching from end of file
		`GSI_NO_FILE_CHANGE`	Changing of file is disabled
		`GSI_GET_NEXT`	Return the next valid data-set, ignore `sPtNr`
		Flags can be combined with '+'-operator (`iFlags` = iFlag1 + iFlag2)	
`iImportFile`	`in`	defines the source file for importing	
		Valid Import File	**Meaning**
		`GSI_FILE_MEAS`	MEAS file
		`GSI_FILE_DATA`	DATA file
		`GSI_FILE_LAST`	last used file
`sImportHelp`	`in`	Help text for import dialog. Only visible if the help functionality of the theodolite is enabled.	
`sInputHelp`	`in`	Help text for manual input dialog. Only visible if the help functionality of the theodolite is enabled.	
`sF2Button`	`in`	Text for activating F2 button.	
`sF4Button`	`in`	Text for activating F4 button	

See Also `GSI_ManCoordDlg`

Example

```
DIM Point AS GSI_Point_Coord_Type
GSI_ImportCoordDlg( "IMP", GSI_INDIV_TG,
        Point, GSI_ALLOW_REC + GSI_ALLOW_MAN,
        GSI_FILE_DATA, "Import Help Text",
        "Input Help Text", "F2", "F4" )
```

6.4.35 GSI_SetLineSysMDlg

Description Sets a line in the system measurement dialog.

Declaration

```
GSI_SetLineSysMDlg(
             BYVAL iDlgNr      AS Integer
             BYVAL iLineNr     AS Integer
             BYVAL iSysParamId AS Integer )
```

Remarks This routine sets one line in the system measurement dialog. To fetch information about a line, `GSI_GetLineSysMDlg` can be used. Unused lines should be set to `GSI_PAR_NONE`.

> **Note** 1) Parameters are identified by `GSI_PAR_*` values and not by `GSI_ID_*` values.
> 2) A line in the system measurement dialog can only be set to a system parameter not to an application parameter.

Parameters

`iDlgNr`	`in`	The number of the system measurement dialog where the line should be set. Possible values are:

Value	Meaning
`GSI_SYS_MDLG_1`	Dialog 1
`GSI_SYS_MDLG_2`	Dialog 2
`GSI_SYS_MDLG_3`	Dialog 3

`iLineNr`	`in`	The number of the line to set. Valid numbers: `1.. GSI_MAX_DLG_LINES`
`iSysParamId`	`in`	Identification of the system parameter. Refer to the chapter

"Constants for Measurement Dialog Definition"

See Also `GSI_GetLineSysMDlg`
`GSI_DefineMDlg`

Example See sample program "`meas.gbs`".
This example uses `GSI_SetLineSysMDlg` to configure the first two lines of the first system measurement dialog.

```
GSI_SetLineSysMDlg( GSI_SYS_MDLG_1, 1,
                    GSI_PAR_Date )
GSI_SetLineSysMDlg( GSI_SYS_MDLG_1, 2,
                    GSI_PAR_Time )
```

6.4.36 GSI_GetLineSysMDlg

Description Gets the definition of a line in the system measurement dialog.

Declaration

```
GSI_GetLineSysMDlg(
            BYVAL iDlgNr      AS Integer
            BYVAL iLineNr     AS Integer
                  iSysParamId AS Integer )
```

Remarks This routine fetches the information about the setting of one line in the system measurement dialog. To set a line in the system measurement dialog the routine `GSI_SetLineMDlg` can be used.

Parameters

`iDlgNr`	in	The number of the system measurement dialog where the line should be fetched. Possible values are:
		Value / **Meaning**
		`GSI_SYS_MDLG_1` Dialog 1
		`GSI_SYS_MDLG_2` Dialog 2
		`GSI_SYS_MDLG_3` Dialog 3
`iLineNr`	in	The number of the line to fetch.
`iSysParamId`	out	Identification of the system parameter. Refer to the chapter "Constants for Measurement Dialog Definition"

See Also `GSI_SetLineSysMDlg`
`GSI_DefineMDlg`

Example See sample program "`meas.gbs`".
This example uses `GSI_GetLineSysMDlg` to get information about the configuration of the first system measurement dialog's first two lines.

```
DIM iParLine1 AS Integer
DIM iParLine2 AS Integer

GSI_GetLineSysMDlg( GSI_SYS_MDLG_1, 1, iParLine1)
GSI_GetLineSysMDlg( GSI_SYS_MDLG_1, 2, iParLine2)
```

6.4.37 GSI_SetMDlgNr

Description Sets the number of the system measurement dialog.

Declaration `GSI_SetMDlgNr( BYVAL iMDlgNr AS Integer)`

Remarks Sets the number of the system measurement dialog. The content of these dialogs can by changed by using of `DefineMDlg`.

Parameters

`iMDlgNr`	in	Number of the measurement dialog. Valid values: `0..GSI_MAX_MDLG_MASKS-1`

See Also `GSI_GetMDlgNr`

Example See sample program "`meas_od.gbs`".
This example sets the next dialog mask

```
GSI_GetMDlgNr( i )
i = (i + 1) MOD GSI_MAX_MDLG_MASKS
GSI_SetMDlgNr( i )
```

6.4.38 GSI_GetMDlgNr

Description Returns the number of the system measurement dialog.

Declaration `GSI_GetMDlgNr(iMDlgNr AS Integer)`

Remarks Returns the number of the system measurement dialog.

Parameters

`iMDlgNr`	out	Number of the actual measurement dialog

See Also `GSI_SetMDlgNr`

6.4.39 GSI_CreateMDlg

Description Create and show the user definable measurement dialog.

Declaration

```
GSI_CreateMDlg(
            BYVAL iFixLines     AS Integer
            BYVAL sCaptionLeft  AS _Token
            BYVAL sCaptionRight AS _Token
            BYVAL sHelpText     AS _Token )
```

Remarks This routine creates and shows the user definable measurement dialog with `iFixLines` fix lines, the left part of the title bar `sCaptionLeft`, the caption `sCaptionRight`, and the help text `sHelpText`.

Only one measurement dialog can exist at the same time. If `GSI_CreateMDlg` is called and there already exists a measurement dialog, the existing dialog (together with all attached buttons) is deleted and the new dialog is created.

Note	If a graphics dialog or a text dialog exist together with a measurement dialog, all button routines (`MMI_AddButton`, `MMI_GetButton`, `MMI_DeleteButton`) are related to the measurement dialog.

The shown parameters used in the dialog are defined in the user display mask (see `GSI_DefineMDlg`).

Parameters

`iFixLines`	`in`	The number of fix lines. (These lines are not scrolled.)
`sCaptionLeft`	`in`	The part of the title bar displayed on the left border (up to five characters wide)
`sCaptionRight`	`in`	The caption of the dialog.
`sHelpText`	`in`	This text is shown, when the help button `SHIFT-F1` is pressed and the help functionality of the theodolite is enabled.

See Also `GSI_UpdateMDlg`
`GSI_UpdateMeasurement`

Example See example file „`meas.gbs`“ too.

This example uses the measure dialog routines `GSI_CreateMDlg`, `GSI_UpdateMDlg` and `GSI_UpdateMeasurment` to execute a measure process.

```
DIM ValidForRec   AS Logical
DIM RetCodeForMsg AS Integer
DIM WaitTime      AS Integer
DIM iButton       AS Integer

WaitTime = 10 'ms

'user definition of measurement dialog
'can be placed here
```

```
GSI_CreateMDlg( 1, "WIR", "Measure Dialog",
                   "This is the Helptext")
DO
  GSI_UpdateMeasurment( TMC_MEA_INC,
                        WaitTime, ValidForRec,
                        RetCodeForMsg, FALSE )
  GSI_UpdateMDlg (iButton)
LOOP UNTIL iButton = MMI_ESC_KEY

GSI_DeleteDialog()
```

6.4.40 GSI_SetLineMDlg

Description Sets one line in the user definable measurement dialog to system parameter.

Declaration

```
GSI_SetLineMDlg(
             BYVAL iLineNr     AS Integer
             BYVAL iSysParamId AS Integer )
```

Remarks This routine sets the configuration of a line in the user definable measurement dialog to a system parameter. This measurement dialog is initialized automatically with the actual settings of the first system measurement dialog. Modifications of the user definable dialog have no effects on the system measurement dialog and will be lost after termination of the program. An unused line should be set to `GSI_PAR_NONE`. To add a user definable application parameter to the dialog use `GSI_SetLineMDlgPar`. To add a line of text (e.g. separator line) to the dialog use `GSI_SetLineMDlgText`.

Parameters

`iLineNr`	in	The number of the line to set. Valid numbers: `1.. GSI_MAX_DLG_LINES`
`iSysParamId`	in	Identification of the system parameter. Refer to the chapter “Constants for Measurement Dialog Definition”

See Also `GSI_SetLineMDlgPar`
`GSI_SetLineMDlgText`
`GSI_CreateMDlg`

Example This example uses `GSI_SetLineMDlg` to configure the user definable measurement dialog.

```
GSI_SetLineMDlg( 1, GSI_PAR_ReflHeight )
GSI_SetLineMDlg( 2, GSI_PAR_Info1 )
GSI_SetLineMDlg( 3, GSI_PAR_Info2 )
…
GSI_SetLineMDlg( 10, GSI_PAR_NONE )
GSI_SetLineMDlg( 11, GSI_PAR_NONE )
GSI_SetLineMDlg( 12, GSI_PAR_NONE )
```

6.4.41 GSI_SetLineMDlgText

Description Puts a text line into the user definable measurement dialog.

Declaration

```
GSI_SetLineMDlgText(
             BYVAL iLineNr  AS Integer,
             BYVAL iParamId AS Integer,
             BYVAL sText    AS _Token )
```

Remarks This routine inserts a pure text line into the user definable measurement dialog. To add an user definable application parameter to the dialog use `GSI_SetLineMDlgPar`. To add a system parameter to the dialog use `GSI_SetLineMDlg`.

Parameters

`iLineNr`	`in`	The number of the line to set. Valid numbers: `1.. GSI_MAX_DLG_LINES`
`iParamId`	`in`	Id of the system parameter.
`sText`	`in`	Contents of the line.

See Also `GSI_SetLineMDlg`
`GSI_SetLineMDlgPar`
`GSI_CreateMDlg`

Example This example uses GSI_SetLineMDlg and GSI_SetLineMDlgText to configure the user definable measurement dialog.

```
GSI_SetLineMDlg( 1, GSI_PAR_Date )
GSI_SetLineMDlg( 2, GSI_PAR_Time )
GSI_SetLineMDlgText( 3, GSI_PAR_APPDATA0,
                     "----------------" )
GSI_SetLineMDlg( 4, GSI_PAR_Info1 )
GSI_SetLineMDlg( 5, GSI_PAR_Info2 )
```

6.4.42 GSI_SetLineMDlgPar

Description Sets one line in the user definable measurement dialog to an application parameter.

Declaration

```
GSI_SetLineMDlgPar(
            BYVAL iLineNr      AS Integer
            BYVAL iApplParamId AS Integer
            BYVAL sLabel       AS _Token
            BYVAL lEditAble    AS Logical
            BYVAL iFormat      AS Integer )
```

Remarks This routine sets the configuration of a line in the user definable measurement dialog to an application parameter. The style of the application parameter is also defined in this routine. Any floating point format and strings are valid formats. The starting values of every application parameter is not predefined and hence has to be set explicitly. To initialize an application parameter the routine GSI_SetWiEntry can be used. To add a line of text to the dialog use GSI_SetLineMDlgText. To add a system parameter to the dialog use GSI_SetLineMDlg.

Parameters

iLineNr	in	The number of the line to set. Valid numbers: 1.. GSI_MAX_DLG_LINES
iApplParamId	in	Id of the application parameter.
sLabel	in	Description of parameter on display.

lEditAble	in	Edit ability of the value in the measurement dialog.
iFormat	in	Format descriptor of the application parameter. The format defines if a dimension field is available. Following values can be used:

Value	**Meaning**
MMI_FFORMAT_STRING	string
MMI_FFORMAT_DOUBLE	double
MMI_FFORMAT_DISTANCE	distance
MMI_FFORMAT_SUBDISTANCE	sub-distance [mm]
MMI_FFORMAT_ANGLE	angle
MMI_FFORMAT_VANGLE	vertical angle
MMI_FFORMAT_HZANGLE	horizontal angle
MMI_FFORMAT_TEMPERATURE	temperature

See Also GSI_SetLineMDlg
GSI_SetLineMDlgText
GSI_CreateMDlg

Example See also sample file “meas.gbs”.
This example uses GSI_SetLineMDlgPar and GSI_SetWiEntry to configure the user definable measurement dialog.

```
DIM WI AS GSI_WIDLG_ENTRY_TYPE

WI.lValid    = FALSE
WI.iDataType = GSI_ASCII
GSI_SetWiEntry(GSI_ID_APPDATA0, WI)
GSI_SetLineMDlgPar(1, GSI_PAR_AppData0,
                   "Stat. Name:", TRUE,
                   MMI_FFORMAT_STRING)
WI.lValid    = TRUE
WI.iDataType = GSI_DOUBLE
WI.dValue    = 2.2
GSI_SetWiEntry(GSI_ID_APPDATA3, WI)
GSI_SetLineMDlgPar(8, GSI_PAR_AppData3,
                   "Distance : ", TRUE,
                   MMI_FFORMAT_DISTANCE)
```

6.4.43 GSI_UpdateMDlg

Description Updates the user definable measurement dialog.

Declaration `GSI_UpdateMDlg( iButton As Integer)`

Remarks This procedure updates the user definable measurement dialog with the actual values from the Theodolite data pool and returns pressed buttons.

Parameters

`iButton`	`out`	Contains pressed button identifier. For details see `MMI_GetButton` (`lAllKeys = TRUE`).

See Also `GSI_CreateMDlg`
`GSI_UpdateMeasurement`

Example See example `GSI_CreateMDlg` and example file „`meas.gbs`“.

6.4.44 GSI_DefineMDlg

Description Defines the entries of the user definable measurement dialog.

Declaration `GSI_DefineMDlg( BYVAL sCaption AS _Token)`

Remarks Interactively defines the contents of the user definable measurement dialog. Using a dialog with list fields, the user can select the items for the measurement dialog. This routine is an interactive equivalent to the routines `GSI_SetLineSysMDlg` and `GSI_GetLineSysMDlg`.

Parameters

`sCaption`	`in`	The left caption of the title bar. (Up to 5 characters wide.)

See Also `GSI_GetDlgMask`
`GSI_SetDlgMask`

Example

```
GSI_DefineMDlg( "DEF" )
```

6.4.45 GSI_UpdateMeasurment

Description Update the measurement data.

Declaration

```
GSI_UpdateMeasurment(
            iInclinePrg     AS Integer,
            iWaitTime       AS Integer,
            lValidForRec    AS Logical,
            iRetCodeForMsg  AS Integer,
            lChkIncRangeNow AS Logical )
```

Remarks This function updates the measurement values in the Theodolite data pool. The data are the incline program, angles, distances, time, reflector height.

Parameters

`iInclinePrg`	`in`	The manner of incline compensation. Following settings are possible: **Incline Program** / **Meaning** `TMC_MEA_INC` — get inclination `TMC_AUTO_INC` — get inclination with automatism `TMC_PLANE_INC` — get inclination always with plane
`iWaitTime`	`in`	The wait time for a result (in ms). This time is used for synchronising the TMC task.
`lValidForRec`	`out`	Indicates validity of the registration
`iRetCodeForMsg`	`out`	Return code of the measurement
`lChkIncRangeNow`	`in`	`TRUE`: check incline range immediate

See Also `GSI_CreateMDlg`
`GSI_UpdateMDlg`
`GSI_DeleteDialog`

Example See example `GSI_CreateMDlg` and example file „`meas.gbs`“.

6.4.46 GSI_Measure

Description Measure and registration dialog.

Declaration `GSI_Measure ( )`

Remarks This procedure opens the measure and registration dialog.

Parameters

`none`

Return Codes

RC_OK	Success

Example Do a measure and registration dialog.

```
GSI_Measure ( )
```

6.4.47 GSI_ExecuteAutoDist

Description Executes an automatic distance measurement.

Declaration `GSI_ExecuteAutoDist ( )`

Remarks This procedure starts a distance measurement on condition that “Auto Dist” is enabled and one of the distance measurement-program buttons (`FNC`-menu) was pressed.

Parameters

none

Return Codes

RC_OK	Success

Example See example file „`meas.gbs`“ or „`meas_od.gbs`“.

6.4.48 GSI_CheckTracking

Description Returns if distance tracking is running.

Declaration `GSI_CheckTracking(lTracking As Logical)`

Remarks This returns if a distance tracking is running.

An automatic start of distance tracking can be started on several conditions, i.e. by Quick-Coding, `GSI_ExecuteAutoDist` or by pressing buttons in the `FNC`-menu.

Tracking can be terminated by the instrument itself due several reasons, i.e. for laser security reasons (US-configuration)

Parameters

`lTracking`	In	`TRUE`: a distance tracking is running

Return Codes

`RC_OK`	Successful

Example See example file „`meas.gbs`“ or „`meas_od.gbs`“.

6.4.49 GSI_RecordRecMask

Description Recording the given wi mask.

Declaration

```
GSI_RecordRecMask (
                RecList AS GSI_REC_ID_LIST,
          BYVAL eProgFunction AS Logical,
          BYVAL bCheckStdMask AS Logical,
          BYVAL bIncAndSetRunPt AS Logical)
```

Remarks This procedure records the given wi list. The target can be the memory card or the interface. The parameter for the interface depends on the GSI communication settings. Errors will shown on the display, when recording list will be stored in the memory card. Otherwise the error messages will be given on the interface.

Parameters

`RecList`	in	recording list
`eProgFunction`	in	program flag in the wi's (`TRUE` = ON, `FALSE` = OFF)
`bCheckStdMask`	in	testing the standard recording mask
`bIncAndSetRunPt`	in	increment the point number

Return Codes

`RC_OK`	Success
`RC_IVRESULT`	registration failure

See Also

Example Record `RecList`.

```
DIM RecList AS GSI_REC_ID_LIST

' initialize RecList with adequate values
GSI_RecordRecMask ( RecList, TRUE, TRUE, TRUE )
```

6.5 CENTRAL SERVICE FUNCTIONS CSV

6.5.1 Summarizing Lists of CSV Types and Procedures

6.5.1.1 Types

type name	description
`TPS_Fam_Type`	Information about the current hardware.
`Date_Time_Type`	Date and time information.
`Date_Type`	Date information.
`Time_Type`	Time information.

6.5.1.2 Procedures

procedure name	description
`CSV_ChangeFace`	Do an absolute positioning to the opposite.
`CSV_CheckAltUserTask`	Returns if an alternative user-task was running.
`CSV_Delay`	Delay routine
`CSV_GetATRStatus`	Gets the current ATR state.
`CSV_GetDateTime`	Get the date and the time of the system.
`CSV_GetElapseSysTime`	Returns the difference between a reference time and the system time.
`CSV_GetGBIVersion`	Returns the release number of the GeoBASIC interpreter
`CSV_GetInstrumentFamily`	Get information about the system.
`CSV_GetInstrumentName`	Get the LEICA specific instrument name.
`CSV_GetInstrumentNo`	Get the instrument number.
`CSV_GetLaserPlummet`	Returns the laser plummet state
`CSV_GetLockStatus`	Gets the current state of the locking facility.
`CSV_GetLRStatus`	Returns the status of the system.

procedure name	**description**
CSV_GetPrismType	Returns the used prism
CSV_GetSWVersion	Get the version of the system software.
CSV_GetSysTime	Returns the system time.
CSV_GetTargetType	Get the target type for distance measurements.
CSV_GetTemperature	Returns the internal temperature of the instrument.
CSV_Laserpointer	Switch on / off the laser pointer.
CSV_LibCall	Call a GeoBASIC routine from another program.
CSV_LibCallAvailable	Check if GeoBASIC routine from another program is available.
CSV_LockIn	Starts locking (ATR)
CSV_LockOut	Stops locking (ATR)
CSV_MakePositioning	Do an absolute positioning.
CSV_ResetAltUserTask	Resets the “alternative user-task was running” flag.
CSV_SetATRStatus	Sets the current state of Automatic Target Recognition.
CSV_SetLaserPlummet	Switches the laser plummet
CSV_SetLightGuide	Switch on / off the light guide.
CSV_SetLockStatus	Sets the current state of the locking facility.
CSV_SetPrismType	Sets the used prism
CSV_SetTargetType	Set the target type for distance measurements.
CSV_SysCall	Call a system function.
CSV_SysCallAvailable	Check if system function is available.

6.5.2 Data Structures for the Central Service Functions

6.5.2.1 Date_Time_Type: Date and Time

Description These data structures are used to store date and time information.

```
TYPE Date_Type
  iYear          AS Integer     year as a 4 digit number
  iMonth         AS Integer     month as a 2 digit number
  iDay           AS Integer     day as a 2 digit number
END Date_Type

TYPE Time_Type
  iHour          AS Integer     hour as a 2 digit number (24 hours
                                format)
  iMinute        AS Integer     minutes as a 2 digit number
  iSecond        AS Integer     seconds as a 2 digit number
END Time_Type


Date_Time_Type
  Date           AS Date_Type   date (as defined above)
  Time           AS Time_Type   time (as defined above)
END Date_Time_Type
```

6.5.2.2 TPS_Fam_Type: Information about the system

Description This data structure is used to store information about the hardware. Further information about the hardware can be obtained by your local Leica representative.

```
TYPE TPS_Fam_Type
  iClass              AS Integer
```

The class of the system. Values:

Id	Meaning
TPS1101	TPS1100 accuracy 1”
TPS1102	TPS1100 accuracy 2”
TPS1103	TPS1100 accuracy 3”
TPS1105	TPS1100 accuracy 5”

lEDMBuiltIn	AS Logical	EDM built-in
lEDMTypeII	AS Logical	EDM built-in, type II
lEDMTypeIII	AS Logical	EDM built-in, type III
lEDMReflectorless	AS Logical	Red Laser
lMotorized	AS Logical	Motorised
lATR	AS Logical	Automatic Target Recognition (ATR)
lEGL	AS Logical	EGL Guide Light
lLaserPlummet	AS Logical	Laser Plummet
lAutoCollimation	AS Logical	Auto-collimation lamp
lSimulator	AS Logical	Hardware is simulator on Windows-PC

```
END TPS_Fam_Type
```

6.5.3 CSV_GetDateTime

Description Get the date and the time of the system.

Declaration
```
CSV_GetDateTime(
      DateAndTime AS Date_Time_Type )
```

Remarks The `CSV_GetDateTime` routine reads the date and the time from the system's real-time clock (RTC) and returns the values in the structure `Date_Time_Type`. In the case of TPS_Sim the system clock will be read.

Parameters

`DateAndTime`	`out`	The structure for the date and the time.

Return Codes

`RC_UNDEFINED`	The date and time is not set (not yet/not any longer).

Example The example uses the `CSV_GetDateTime` routine to get the date and the time of the system and displays the values.

```
DIM DT AS Date_Time_Type

ON ERROR RESUME
CSV_GetDateTime( DT )

IF ERR = RC_OK THEN
  MMI_PrintInt(  0, 0, 5, DT.Date.iYear, TRUE  )
  MMI_PrintInt(  6, 0, 3, DT.Date.iMonth, TRUE )
  MMI_PrintInt( 10, 0, 3, DT.Date.iDay, TRUE   )
  MMI_PrintInt(  0, 1, 3, DT.Time.iHour, TRUE  )
  MMI_PrintInt(  4, 1, 3, DT.Time.iMinute, TRUE)
  MMI_PrintInt(  8, 1, 3, DT.Time.iSecond, TRUE)

ELSEIF ERR = RC_UNDEFINED THEN
  MMI_PrintStr(  0, 0,
                "Date and time not set.", TRUE )
ELSE
  MMI_PrintStr(  0, 0,
                "Unexpected error code.", TRUE )
END IF
```

6.5.4 CSV_GetTemperature

Description Returns the internal temperature of the instrument.

Declaration `CSV_GetTemperature( IntTemp AS Temperature )`

Remarks This routine returns the internal temperature.

Parameters

`IntTemp`	`out`	Internal temperature

6.5.5 CSV_GetInstrumentName

Description Get the LEICA specific instrument name.

Declaration `CSV_GetInstrumentName( sName AS String30 )`

Remarks The `CSV_GetInstrumentName` routine returns the name of the system in the string `sName`.

Parameters

`sName`	`out`	The LEICA specific instrument name.

Return Codes

`none`

See Also `CSV_GetInstrumentNo`, `CSV_GetInstrumentFamily`

Example The example uses the `CSV_GetInstrumentName` routine to get the instrument name and displays it.

```
DIM sName AS String30

CSV_GetInstrumentName ( sName )
MMI_PrintStr ( 0, 0, sName, TRUE )
```

6.5.6 CSV_GetInstrumentNo

Description Get the instrument number.

Declaration `CSV_GetInstrumentNo( iSerialNo AS Integer )`

Remarks The `CSV_GetInstrumentNo` routine returns the serial number of the system.

TPS_Sim	Always delivers 0.

Parameters

`iSerialNo`	`out`	The serial number of the system.

Return Codes

`none`

See Also `CSV_GetInstrumentName`, `CSV_GetInstrumentFamily`

Example The example uses the `CSV_GetInstrumentNo` routine to get the instrument number and displays it.

```
DIM iSerialNo AS Integer

CSV_GetInstrumentNo( iSerialNo )
MMI_PrintInt( 0, 1, 20, iSerialNo, TRUE )
```

6.5.7 CSV_GetInstrumentFamily

Description Get information about the system.

Declaration

```
CSV_GetInstrumentFamily(
          Family AS TPS_Fam_Type )
```

Remarks The `CSV_GetInstrumentFamily` routine returns the class and the instrument type of the system (see description of the data structure `TPS_Fam` for return values).

TPS_Sim	Always sets `Familiy.lSimulator` to `TRUE`.

Parameters

Family	out	Contains the class and instrument type data. See description of the data structure TPS_Fam for return values.

See Also CSV_GetInstrumentName, CSV_GetInstrumentNo

Example The example uses the CSV_GetInstrumentFamily routine to get information about the instrument and displays it.

```
DIM Family AS TPS_Fam_Type

CSV_GetInstrumentFamily( Family )
MMI_PrintInt( 0, 1, 10, Family.iClass, TRUE )
IF (Family.lSimulator) THEN
  MMI_PrintString( 0, 2, 10, "ON TPS_SIM", TRUE)
END IF
```

6.5.8 CSV_GetSWVersion

Description Get the version of the system software.

Declaration

```
CSV_GetSWVersion( iRelease AS Integer,
                  iVersion AS Integer )
```

Remarks The CSV_GetSWVersion routine returns the Release number and the number of the system software version. These numbers can be interpreted together as software identification (Release.Version, e.g. 1.05).

TPS_Sim	Delivers the version of the simulator.

Parameters

iRelease	out	value of the Release number can be in the range from 0 to 99
iVersion	out	value of the version number can be in the range from 0 to 99

See Also

Example The example uses the `CSV_GetSWVersion` routine to get the system software version and displays it.

```
DIM iRelease AS Integer
DIM iVersion AS Integer

CSV_GetSWVersion( iRelease, iVersion )
MMI_PrintVal( 0, 0, 6, 2,
              iRelease + iVersion / 100, TRUE )
```

6.5.9 CSV_GetGBIVersion

Description Returns the release number of the GeoBASIC interpreter.

Declaration

```
CSV_GetGBIVersion(
           iRelease    as Integer,
           iVersion    as Integer,
           iSubVersion as Integer )
```

Remarks This function returns the release version of the running GeoBASIC interpreter.

Parameters

iRelease	out	Release number
iVersion	Out	Version Number
iSubVersion	out	Subversion number

Return-Codes

RC_OK	Successful termination.

Example This example shows the currently used GeoBASIC interpreter release number.

```
DIM iRel       As Integer
DIM iVer       As Integer
DIM iSubVer    As Integer

MMI_CreateTextDialog(
     6, "-CSV-", "Test CSV", "no help available")
CSV_GetGBIVersion (iRel, iVer, iSubVer)
MMI_PrintStr(0, 0,
     "GBI: "+Str$(iRel) + "." +
     Str$(iVer) +" ."+Str$(iSubVer), TRUE)
MMI_DeleteDialog()
```

6.5.10 CSV_GetElapseSysTime

Description Returns the difference between a reference time and the system time.

Declaration

```
CSV_GetElapseSysTime( iRefTime AS Integer,
                      iElapse  AS Integer )
```

TPS_Sim	Use PC time base. Time resolution is one second.

Remarks The routine `CSV_GetElapseSysTime` returns the difference of between a given reference time `iRefTime` and the systems time. Whenever the system starts up, the system time is reset.

Parameters

`iRefTime`	`in`	The reference time.
`iElapse`	`out`	The difference between `iRefTime` and the system time. The difference is returned in [ms].

See Also `CSV_GetSysTime`, `CSV_GetDateTime`

Example The example uses the routine `CSV_GetElapseSysTime` to get a time difference.

```
DIM iElapse  AS Integer
DIM iRefTime AS Integer

CSV_GetSysTime(iRefTime)'returns reference time
' do something. . .
CSV_GetElapseSysTime( iRefTime, iElapse )
MMI_PrintInt ( 0, 0, 20, iElapse, TRUE )
```

6.5.11 CSV_GetSysTime

Description Returns the system time.

Declaration `CSV_GetSysTime( iTime AS Integer )`

Remarks The routine returns the systems time. Whenever the system starts up, the system time is reset.

TPS_Sim	Delivers the system up time of the PC.

Parameters

`iTime`	`out`	The system time in ms.

See Also `CSV_GetElapseSysTime`, `CSV_GetDateTime`

Example See `CSV_GetElapsedTime`.

6.5.12 CSV_GetLRStatus

Description Returns the status of the system.

Declaration `CSV_GetLRStatus( iLRStatus AS Integer )`

Remarks The routine `CSV_GetLRStatus` returns the mode of the system. The system can either be in local or in Remote mode. For Release 1.0 this function always delivers local mode as an answer.

Note	This function is reserved for future purposes and has no special usage in the current implementation.
TPS_Sim	Always delivers `LOCAL_MODE`.

Parameters

`iLRStatus` The mode of the system. Possible values for the `iLRStatus` are:

Mode	Value	Comment
LOCAL_MODE	0	local mode
REMOTE_MODE	1	Remote mode

Example The example uses the routine `CSV_GetLRStatus` to get the mode of the system.

```
DIM iLRStatus AS Integer

CSV_GetLRStatus( iLRStatus )
MMI_PrintInt( 0, 0, 10, iLRStatus, TRUE )
```

6.5.13 CSV_SetGuideLight

Description Set the guide light intensity.

Declaration `CSV_SetGuideLight( BYVAL iLight AS Integer )`

Remarks Sets the guide light intensity.

Parameters

`iLight` in Guide light intensity

Value	Meaning
CSV_EGL_OFF	Switching off
CSV_EGL_LOW	Low intensity
CSV_EGL_MID	Middle intensity
CSV_EGL_HIGH	High intensity

Return Codes

RC_SYSBUSY	EDM is busy. Guide light cannot be switched.
RC_NOT_IMPL	Guide light Hardware is not available

Example Switch off the Light guide.

```
CSV_SetGuideLight( CSV_EGL_OFF )
```

6.5.14 CSV_Laserpointer

Description Switch on / off the laser pointer.

Declaration `CSV_Laserpointer( BYVAL lLaser AS Logical )`

Remarks Switches on / off the laser pointer.

Parameters

`lLaser`	`in`	Switch on / off the Laser pointer (`TRUE` = on, `FALSE` = off)

Return Codes

`RC_SYSBUSY`	EDM is busy. Laser pointer cannot be switched.
`RC_NOT_IMPL`	Laser pointer Hardware is not available.

Example Switch off the laser pointer.

```
CSV_Laserpointer( FALSE )
```

6.5.15 CSV_MakePositioning

Description Do an absolute positioning.

Declaration

```
CSV_MakePositioning(BYVAL dHz AS Double,
                    BYVAL dV  AS Double)
```

Remarks Absolute positioning of the Theodolite axes to the desired angles with the currently active tolerance for positioning. If any control function is active at the point of call, it will be cancelled and the positioning will be performed. After the positioning the controller will be automatically activated for manual input for the moving device. When starting the positioning the calling application has to take care that a valid inclination plane is available for an angle measure, as it can normally not be redone during positioning.
The positioning is done with the planes valid at the beginning of

it. During the process no inclination will be measured. The used positioning method can cause inexact results, especially for steep V > ~25 GON

Parameters

`dHz`	in	Corrected Hz-angle [Radiant]
`dV`	in	Corrected V-angle [Radiant]

Return Codes

`RC_IVPARAM`	No valid positioning angle.
`CSV_DETENT_ERROR`	target angle is out of the limits or a collision is occurred.
`CSV_TIMEOUT`	time out at positioning of one or both axes
`CSV_MOTOR_ERROR`	error in subsystem
`CSV_ANGLE_ERROR`	error at measuring the angle
`RC_FATAL`	fatal error
`RC_ABORT`	system abort

See Also `BAP_PosTelescope`

Example Perform an absolute positioning.

```
CSV_MakePositioning( 0, 2*atn(1) ) ' (0, Pi/2)
```

6.5.16 CSV_ChangeFace

Description Do an absolute positioning to the opposite.

Declaration `CSV_ChangeFace( )`

Remarks Perform positioning into the position opposite to the current. If any control function is active at the point of call, it will be cancelled and the positioning will be performed. After the positioning the controller will be automatically activated for manual input for the moving device. When starting the positioning the calling application has to take care that a valid inclination plane is available for an angle measure, as it can normally not be redone during positioning.

The positioning is done with the planes valid at the beginning of it. During the process no inclination will be measured. The used positioning method can cause inexact results, especially for steep V > ~25 GON

Parameters

none

Return Codes

RC_IVPARAM	No valid positioning angle.
CSV_DETENT_ERROR	target angle is out of the limits or a collision is occurred.
CSV_TIMEOUT	time out at positioning of one or both axes
CSV_MOTOR_ERROR	error in subsystem
CSV_ANGLE_ERROR	error at measuring the angle
RC_FATAL	fatal error
RC_ABORT	system abort

See Also BAP_PosTelescope

Example Perform a change of face.

```
CSV_ChangeFace()
```

6.5.17 CSV_SetLockStatus

Description Sets the current state of the locking facility.

Declaration `CSV_SetLockStatus(BYVAL lOn AS Logical )`

Remarks It switches the locking facility on or off.

Parameters

lOn	in	Switches on / off the locking facility (TRUE = on, FALSE = off)

Return Codes

RC_FATAL	fatal error
RC_NOT_IMPL	if ATR hardware is not available
RC_ABORT	system abort

See Also CSV_SetLockStatus,
CSV_LockIn,
CSV_LockOut

Example Perform an absolute positioning.

```
CSV_SetLockStatus( TRUE ) ' switches locking on
```

6.5.18 CSV_GetLockStatus

Description Gets the current state of the locking facility.

Declaration `CSV_GetLockStatus( lOn AS Logical )`

Remarks It queries the TPS system if the locking facility is on or off.

Parameters

lOn	out	**meaning**	
		FALSE	Locking is switched off.
		TRUE	Locking is switched on.

Return Codes

RC_FATAL	fatal error
RC_NOT_IMPL	if ATR hardware is not available
RC_ABORT	system abort

See Also CSV_GetLockStatus,
CSV_LockIn,
CSV_LockOut

Example Perform an absolute positioning.

```
DIM l AS Logical
CSV_SetLockStatus( l ) ' queries locking
```

6.5.19 CSV_LockIn

Description Starts the locking facility.

Declaration `CSV_LockIn( )`

Remarks If ATR is switched on then locking to the target will be done. If no target available, then manual positioning will be started.

Parameters

`none`

Return Codes

AUT_RC_NOT_ENABLED	Theodolite without ATR or lock status not set
AUT_RC_MOTOR_ERROR	Error at motor control.
AUT_RC_DETECTOR_ERROR	Error at ATR
AUT_RC_NO_TARGET	No target at the detection range
AUT_RC_BAD_ENVIRONMENT	Bad environment at the detection range (bad light…)
RC_NOT_IMPL	if ATR hardware is not available

See Also `CSV_GetLockStatus`, `CSV_SetLockStatus`, `CSV_LockOut`

Example This example starts locking.

```
CSV_LockIn( )
```

6.5.20 CSV_LockOut

Description Stops a running locking function.

Declaration `CSV_LockOut( )`

Parameters

none

Return Codes

RC_OK	no error
RC_NOT_IMPL	if ATR hardware is not available

See Also CSV_GetLockStatus,CSV_SetLockStatus, CSV_LockIn

Example This example stops locking.

```
CSV_LockOut( )
```

6.5.21 CSV_SetATRStatus

Description Sets the current state of Automatic Target Recognition.

Declaration `CSV_SetATRStatus(BYVAL lOn AS Logical )`

Remarks It switches the ATR facility on or off.

Parameters

lOn	in	Switches on / off the ATR facility (TRUE = on, FALSE = off)

Return Codes

RC_FATAL	fatal error
RC_ABORT	system abort
RC_NOT_IMPL	if ATR hardware is not available

Example Perform an absolute positioning.

```
CSV_SetATRStatus( TRUE ) ' switches ATR on
```

6.5.22 CSV_GetATRStatus

Description Gets the current ATR state.

Declaration `CSV_GetATRStatus(lOnl AS Logical )`

Remarks It queries the TPS system if the ATR facility is on or off.

Parameters

`lOn`	`out`	**meaning**	
		`FALSE`	ATR is switched off.
		`TRUE`	ATR is switched on.

Return Codes

`RC_FATAL`	fatal error
`RC_ABORT`	system abort
`RC_NOT_IMPL`	if ATR hardware is not available

Example Get current ATR status.

```
DIM l AS Logical

CSV_SetATRStatus( l )
```

6.5.23 CSV_Delay

Description This routine delays the execution of a program.

Declaration `CSV_Delay( BYVAL iDelay AS Integer )`

Remarks This routine delay using the operating system, that means that other Theodolite tasks can run during the delay (It is not a busy waiting).

Note	Avoid busy waiting using `FOR` - or `WHILE` loops.

TPS_Sim	Delay resolution is one second. `iDelay` < 500 means no delay

Parameters

`iDelay`	`in`	Time to delay [ms]

Example This example „waits“ 2 seconds until it goes on.

```
CSV_Delay( 2000 )
```

6.5.24 CSV_SetTargetType

Description Set the target type for distance measurements.

Declaration

```
CSV_SetTargetType(
              BYVAL iTargetType as Integer )
```

Remarks This routine sets the target type for distance measurements. The target type defines if the next distance measurement happens with prism or without prism.

Parameters

`iTargetType`	`in`	Target type

Valid target types	Meaning
`CSV_WITH_REFLECTOR`	With reflector
`CSV_WITHOUT_REFLECTOR`	Without reflector

Return-Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	Instrument don’t support this target type

See `CSV_ GetTargetType, BAP_SetMeasPrg, BAP_GetMeasPrg`

Example The example sets a target type without prism.

```
CSV_SetTargetType(CSV_WITHOUT_REFLECTOR)
```

6.5.25 CSV_GetTargetType

Description Get the target type for distance measurements.

Declaration `CSV_GetTargetType( iTargetType as Integer )`

Remarks This routine fetches the target type for distance measurements. The target type defines if the next distance measurement happens with prism or without prism.

Parameters

iTarget Type	out	Target type

Valid target types	Meaning
CSV_WITH_ REFLECTOR	With reflector
CSV_WITHOUT _REFLECTOR	Without reflector

Return-Codes

RC_OK	Successful termination.

See `CSV_ SetTargetType, BAP_SetMeasPrg, BAP_GetMeasPrg`

Example The example fetches the target type.

```
DIM iTargetType AS Integer

CSV_GetTargetType(iTargetType)
```

6.5.26 CSV_SetPrismType

Description Sets the used prism.

Declaration `CSV_SetPrismType( BYVAL iPrism as Integer)`

Remarks This routine sets the used prism `iPrism` (`BAP_PRISM_ROUND`, `BAP_PRISM_TAPE`, `BAP_PRISM_MINI`, `BAP_PRISM_360`, `BAP_PRISM_USER1`, `BAP_PRISM_USER2` or `BAP_PRISM_USER3`). If `iPrism` is one of the user defined prisms and this prism is actually not defined then this routine will return `RC_IVRESULT`.

Parameters

iPrism	in	Used prism

Return-Codes

RC_OK	Successful termination.
RC_IVRESULT	Prism not defined.

See `CSV_GetPrismType`

Example The example sets the 360 degrees prism.

```
CSV_SetPrismType(BAP_PRISM_360)
```

6.5.27 CSV_GetPrismType

Description Returns the used prism.

Declaration `CSV_GetPrismType(iPrism as Integer)`

Remarks This routine returns the used prism `iPrism`.

Parameters

iPrism	out	Used prism

Return-Codes

RC_OK	Successful termination.

See `CSV_SetPrismType`

Example The example returns the used prism.

```
DIM iPrism AS Integer

CSV_SetPrismType( iPrism )
```

6.5.28 CSV_SetLaserPlummet

Description Switches the laser plummet.

Declaration `CSV_SetLaserPlummet( BYVAL lOn as Logical )`

Remarks This function switches the optional laser plummet. The plummet will be switched off automatically after 3 minutes.

Parameters

`lOn`	`in`	`TRUE`: switch plummet on

Return-Codes

`RC_OK`	Successful termination.

See `CSV_GetLaserPlumet, CSV_GetInstrumentFamily`

6.5.29 CSV_GetLaserPlummet

Description Returns the laser plummet state.

Declaration `CSV_GetLaserPlummet( lOn as Logical )`

Remarks This function returns the state of the optional laser plummet.

Parameters

`lOn`	`out`	`TRUE`: plummet is switched on

Return-Codes

`RC_OK`	Successful termination.

See CSV_SetLaserPlumet, CSV_GetInstrumentFamily

6.5.30 CSV_CheckAltUserTask

Description Returns if an alternative user-task was running.

Declaration `CSV_CheckAltUserTask(lWasRunning AS Logical)`

Remarks This routine returns if an alternative user-task was running. One of these tasks can be started by pressing one of the buttons `FNC`, `Shift-FNC`, `PROG`, `Shift-PROG`, `Light` and `Level`.

Functions, executed by an alternative user task, can change several system settings. The `CSV_CheckAltUserTask` routine notifies the running GeoBASIC application that it was interrupted by another program. With this information, the GeoBASIC program is able to respond to these changes.

After processing this information, the subroutine `CSV_ResetAltUserTask` must be called.

Parameters

lWasRunning	out	TRUE: a task was running

Return-Codes

RC_OK	Successful termination.

See CSV_ResetAltUserTask

Example The example checks if an alternative task was running.

```
CSV_CheckAltUserTask( l )
IF l THEN
    send("AltUserTask: was running")
  ELSE
    send("AltUserTask: was NOT running")
    END IF
CSV_ResetAltUserTask( )
```

6.5.31 CSV_ResetAltUserTask

Description Resets the “alternative user-task was running” flag.

Declaration `CSV_ResetAltUserTask( )`

Remarks This routine restarts the alternative user-task tracking.

Parameters

`none`

Return-Codes

`RC_OK`	Successful termination.

See `CSV_CheckAltUserTask`

6.5.32 CSV_SysCall

Description Call a system function.

Declaration `CSV_SysCall( BYVAL CId AS CIdType)`

Remarks This routine works in two different forms depending on the parameter `CId`. If `CId` is a system function `CSV_SysCall` calls the function directly. In the other form the `CId` is a system event. In this case `CSV_SysCall` calls the system function (or dialog, menu, macro, application) which is defined in the current configuration to handle this event. See description of the system functions and system events in the appendix H.

Parameters

`CId`	`in`	System function or system event

Return-Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	No function defined to handle the event
`RC_NOT_IMPL`	System function not available

See `CSV_SysCallAvailable`

Example The example calls the system function electronic level.

```
CSV_SysCall(CSV_SFNC_Libelle)
```

6.5.33 CSV_SysCallAvailable

Description Check if system function is available.

Declaration

```
CSV_SysCallAvailable(
                    BYVAL CId AS CIdType,
                    lAvailable AS Logical )
```

Remarks This routine checks, if it is possible to call the function `CId` if `CId` is a system function or if there is a function defined and available to handle the event `CId` if `CId` is an system event. See the description of system functions and system events in appendix H.

Parameters

`CId`	in	System function or system event.
`lAvailable`	out	`TRUE`: System function is available or function (dialog, menu, macro, application) to handle the event is defined and available.

Return-Codes

`RC_OK`	Successful termination.

See `CSV_SysCall`

Example The example checks if the red laser is available.

```
DIM lAvailable AS Logical

CSV_SysCallAvailable(CSV_SFNC_ToggleRedLaser,
                     lAvailable)
```

6.5.34 CSV_LibCall

Description Call a GeoBASIC or C application routine of another program.

Declaration

```
CSV_LibCall( BYVAL PrgName  AS String255,
             BYVAL FuncName AS String255,
             BYVAL CptShort AS _Token )
```

Remarks This routine is used to call a GeoBASIC routine which is defined in another program. Please refer also to Appendix

Parameters

PrgName	in	Program name
FuncName	in	Function name
CptShort	In	Short caption for dialogs

Return-Codes

RC_OK	Successful termination.

See `CSV_LibCallAvailable`

Example See `IAC.GBS` and `IAC2.GBS` for an example.

6.5.35 CSV_LibCallAvailable

Description Check if the GeoBASIC routine from another program is available.

Declaration

```
CSV_LibCallAvailable(
             BYVAL PrgName  AS String255,
             BYVAL FuncName AS String255,
             lAvailable     AS Logical )
```

Remarks This routine checks if a GeoBASIC routine which is defined in another program is available. Usually this means that it checks if the other program is loaded and the specified entry point exists.

Parameters

`PrgName`	`in`	Program name
`FuncName`	`in`	Function name
`lAvailable`	`out`	Routine is available

Return-Codes

`RC_OK`	Successful termination.

See `CSV_LibCall`

Example See `IAC.GBS` and `IAC2.GBS` for an example.

Appendix A — GeoBasic Syntax

```
ArrayDeclaration      ::=   "TYPE" "DIM" Name SubscriptList
                            "AS" DataType "END"
DataType         ::=  ( DataTypeName | "STRING" "*" Length )
SubscriptList    ::=  "(" UpperBound { "," UpperBound } ")"
UpperBound       ::=  IntegerConstant
Length           ::=  IntegerConstant

TypeDeclaration       ::=   "TYPE" Name
                         { ElementName "AS" DataTypeName }
                      "END"  [ Name ]

ConstantDeclaration ::=     "CONST" Name [ "AS" DataType ] "="
                            Expression

VariableDeclaration   ::=   "DIM" Name [ SubscriptList ]
                            "AS" DataType
DataType         ::=  ( DataTypeName | "STRING" "*" Length )
SubscriptList    ::=  "(" UpperBound { "," UpperBound } ")"
UpperBound       ::=  IntegerConstant
Length           ::=  IntegerConstant

Variable         ::=  VariableName { Selector }
Selector         ::=  ( ArraySelector | FieldSelector )
ArraySelector    ::=  "(" SubscriptExpression { ","
                            SubscriptExpression } ")"
FieldSelector    ::=  "." ElementName
SubscriptExpression ::=     IntegerExpression

Expression       ::=  LogicalTerm { "OR" LogicalTerm }
LogicalTerm      ::=  LogicalFactor { "AND" LogicalFactor }
LogicalFactor    ::=  { "NOT" } LogicalPrimary
LogicalPrimary   ::=  SimpleExpression
                            [ RelationOperator SimpleExpression ]
RelationOperator      ::=   ( "=" | "<>" | ">" | "<" | ">=" | "<=" )
SimpleExpression      ::=   [ AddOperator ] Term
                            { AddOperator Term }
AddOperator      ::=  ( "+" | "-" )
Term             ::=  Factor { MultOperator Factor }
MultOperator     ::=  ( "*" | "/" | "\" | "MOD" )
Factor           ::=  Primary [ "^" Factor ]
Primary          ::=  ( Variable | Constant | FunctionCall
```

6. SYSTEM FUNCTIONS

6. SYSTEM FUNCTIONS

6.1 MMI FUNCTIONS

6.1.1 Summarising Lists of MMI Types and Procedures

6.1.1.1 Types

Type name	**description**
`ListArray`	List field Data structure
`sLine`	Display line

6.1.1.2 Procedures

procedure name	**description**
`MMI_AddButton`	Add a Button to a dialog.
`MMI_AddGBMenuButton`	Adds a button to a menu
`MMI_BeepAlarm`	Create an alert beep.
`MMI_BeepLong`	Create an alert beep.
`MMI_BeepNormal`	Create an alert beep.
`MMI_CheckButton`	Checks if a button was pressed.
`MMI_CreateGBMenu`	Creates a menu
`MMI_CreateGBMenuItem`	Creates an item to an existing menu
`MMI_CreateGBMenuItemStr`	Creates an item with a variable string
`MMI_CreateGBMenuStr`	Creates a menu with variable strings
`MMI_CreateGraphDialog`	Create and show a graphics dialog.
`MMI_CreateMenuItem`	Creates a menu item on the Theodolite menu.
`MMI_CreateTextDialog`	Create and show a text dialog.
`MMI_DeleteButton`	Delete a button from a dialog.
`MMI_DeleteDialog`	Deletes a dialog.
`MMI_DeleteGBMenu`	Deletes a menu
`MMI_DrawBusyField`	Shows or hides the Busy-Icon
`MMI_DrawCircle`	Draw a circle / ellipse.

procedure name	**description**
`MMI_DrawLine`	Draw a line.
`MMI_DrawRect`	Draw a rectangle.
`MMI_DrawText`	Draw / delete text.
`MMI_FormatVal`	Convert a value to a string.
`MMI_GetAngleRelation`	Request the current angle relationships.
`MMI_GetAngleUnit`	Return the currently displayed unit of angle.
`MMI_GetButton`	Get the button identifier of the pressed button.
`MMI_GetCoordOrder`	Retrieve the co-ordinate order.
`MMI_GetDateFormat`	Retrieves the date display format.
`MMI_GetDistUnit`	Return the currently displayed unit of distance.
`MMI_GetLangName`	Gets the name to a language number.
`MMI_GetLanguage`	Query the current language.
`MMI_GetPressUnit`	Return the currently displayed unit of pressure.
`MMI_GetTempUnit`	Return the currently displayed unit of temperature.
`MMI_GetTimeFormat`	This function retrieves the format used to display the time.
`MMI_GetVAngleMode`	Returns the V-Angle mode
`MMI_GetVarBeepStatus`	Read the switch status for a variable signal beep.
`MMI_InputInt`	Get an integer input value in a text dialog.
`MMI_InputList`	Shows a list field in a text dialog.
`MMI_InputStr`	Get a string input in a text dialog.
`MMI_InputVal`	Get a numerical input value in a text dialog.
`MMI_PrintInt`	Print an integer value on a text dialog.
`MMI_PrintStr`	Print a string on a text dialog.
`MMI_PrintTok`	Print a token on a text dialog.
`MMI_PrintVal`	Print a value on a text dialog.
`MMI_SelectGBMenuItem`	Select a menu item
`MMI_SetAngleRelation`	Set the angle relationship.
`MMI_SetAngleUnit`	Set the displayed unit of angle.
`MMI_SetCoordOrder`	Set the co-ordinate order.

procedure name	**description**
`MMI_SetDateFormat`	Set the date display format.
`MMI_SetDistUnit`	Set the displayed unit of distance.
`MMI_SetLanguage`	Set the display language.
`MMI_SetPressUnit`	Set the displayed unit of pressure.
`MMI_SetTempUnit`	Set the displayed unit of temperature.
`MMI_SetTimeFormat`	Set the time display format.
`MMI_SetVAngleMode`	Set the V-Angle mode.
`MMI_StartVarBeep`	Start beep sequences with configurable interrupts.
`MMI_SwitchAFKey`	Switch aF… key
`MMI_SwitchIconsBeep`	Switches measurement icons and special beeps
`MMI_SwitchVarBeep`	Switch a varying beep.
`MMI_WriteMsg`	Output to a message window. Parameter is a token.
`MMI_WriteMsgStr`	Output to a message window. Parameter is a string.

6.1.2 MMI Data Types

6.1.2.1 ListArray – List field data structure

Description This array is used for list fields and consists of `LIST_ARRAY_MAX_ELEMENT` (200) elements of the type `STRING30`.

Note	Each variable of this data type reserves 6400 Bytes.

6.1.2.2 sLine – Display line

Description This type is used to define a string with 29 characters, which is necessary to print variable strings on the display. The length depends on the actual display width, which is 29 for TPS1100 instruments.

6.1.3 MMI_CreateMenuItem

Description Creates a system menu item on the Theodolite menu to establish the invocation of a GeoBASIC application.

Declaration

```
MMI_CreateMenuItem(
                BYVAL sAppName  AS String,
                BYVAL sFuncName AS String,
                BYVAL iMenuNum  AS Integer,
                BYVAL sMenuText AS _Token )
```

Remarks The `CreateMenuItem` creates a menu item in a system menu with the text `MenuText` on the chosen entry point `MenuNum` in the menu-system. By clicking the new menu item on the Theodolite, the subroutine with the name `FuncName` in the Program `AppName` will be executed. The number of applications which can be loaded at a time are limited to 25. The maximum number of entry points over all applications (C and GeoBASIC applications) is 50. All GLOBAL declared subroutines count as entry points. Be aware of the fact that the interpreter and a possible Coding function also count for the number of application. The same is true for any C-application which has been loaded onto the TPS.

Note	The subroutine denoted in sFuncName must be declared as `GLOBAL`. The intended use for this procedure is during the installation phase only!

Parameters

`sAppName`	`in`	The name of the program where the function or subroutine is defined.
`sFuncName`	`in`	The name of the global function or subroutine to be called.
`iMenuNum`	`in`	Defines in which menu the menu-entry is generated. There are three possible menus where a menu item can be added. For multiple menu items the menus can be combined with ‘+’-operator.

		valid menus	meaning
		MMI_MENU_PROGRAMS	Add to menu „Main menu“
		MMI_MENU_PROGMENU	Add to „PROG“ - Key menu
		MMI_MENU_AUTOEXEC	Add to menu „Autoexec“
sMenuText	in	The text of the menu-entry which should be displayed on the Theodolite.	

Return-Codes

RC_OK	Successful termination.

Note	Since this procedure will be called during installation phase you do not have the possibility to do any error handling. Only the loader will report an error which may be caused by an erroneous call.

Example The example uses the MMI_CreateMenuItem routine to create a menu entry named "START THE PROGRAM" under the main menu. The function "Main" in the GeoBASIC program "ExampleProgram" will be called when this menu item is selected.

```
MMI_CreateMenuItem( "ExampleProgram", "Main",
                    MMI_MENU_PROGRAMS,
                    "START THE PROGRAM" )
```

6.1.4 MMI_CreateGBMenu

Description Creates a menu.

Declaration

```
MMI_CreateGBMenu(
    BYVAL sMenuName     AS _Token,
          iMenuId       AS Integer )
```

Remarks This routine creates an empty menu and the caption sMenuName. The function MMI_CreateGBMenuItem adds items to a menu.

Note	Before terminating a GeoBASIC program, all menus must be deleted. The GeoBASIC menus system has the following limitations: The maximal number of menus for a GeoBASIC program is 5. The maximal number of items / menu is 49. The maximal number of items over all menus plus menus is 254.

Parameters

`sMenuName`	`in`	The caption of the menu.
`iMenuId`	`out`	Returned menu identifier. It is the handle for using this menu.

Return-Codes

`RC_OK`	Successful termination.
`MMI_NOMORE_MENUS`	No more menus available

See Also `MMI_CreateGBMenuItem`, `MMI_DeleteGBMenu`, `MMI_SelectGBMenuItem`, `MMI_AddGBMenuButton`

Example The example creates a menu with a button. For a complete example see sample program `MENU.GBS`

```
CONST MHELP = "Help for measurement type...."

DIM iMenu      AS Integer ' menu identifier
DIM iSelection AS Integer ' selected item
DIM iButton    AS Integer ' used button

'Create main menu
MMI_CreateGBMenu("MEASUREMENT TYPE", iMenu)
```

```
'Create menu items - all items use
'  the same help text
MMI_CreateGBMenuItem(iMenu,
  "Polygon", MHELP)
MMI_CreateGBMenuItem(iMenu,
  "Border point", MHELP)
MMI_CreateGBMenuItem(iMenu,
  "Situation point", MHELP)

'Create the button supported in this menu
MMI_AddGBMenuButton(iMenu, MMI_F5_KEY, "EXIT ")

' show and execute menu
MMI_SelectGBMenuItem(iMenu, "TEST",
  iSelection, iButton)
SELECT CASE iSelection
    CASE 1 ' Polygon
    '  ...
    CASE ELSE
       MMI_BeepAlarm()
    END SELECT
MMI_DeleteGBMenu(iMenu)
```

6.1.5 MMI_CreateGBMenuItem

Description Creates an item in an existing menu.

Declaration

```
MMI_CreateGBMenuItem(
              BYVAL iMenuId       AS Integer,
              BYVAL sMenuItemName AS _Token,
              BYVAL sHelpText     AS _Token )
```

Remarks This function adds one menu item to an existing menu `iMenuId`. This item will be displayed as the last item.

Parameters

`iMenuId`	`in`	Menu identifier
`sMenuItemName`	`in`	Displayed text
`sHelpText`	`in`	Help text; only visible if the help functionality of theodolite is enabled

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ID_INVALID`	Bad `iMenuId`
`BAS_MENU_TABLE_FULL`	No more free menu items

See Also `MMI_CreateGBMenu`, `MMI_DeleteGBMenu`, `MMI_SelectGBMenuItem`, `MMI_AddGBMenuButton`

Example see `MMI_CreateGBMenu`

6.1.6 MMI_CreateGBMenuStr

Description Creates a menu with variable strings as menu name and menu items.

Declaration

```
MMI_CreateGBMenuStr(
    BYVAL sMenuName      AS sLine,
          iMenuId        AS Integer )
```

Remarks This routine creates an empty menu and the caption `sMenuName`. `sMenuName` need not be constant, it can be generated during the execution of the program. The function `MMI_CreateGBMenuItemStr` adds items to this kind of menu.

> **Note** Before terminating a GeoBASIC program, all menus must be deleted.
>
> The GeoBASIC menus system has the following limitations:
>
> The maximal number of menus for a GeoBASIC program is 5.
> The maximal number of items / menu is 49.
> The maximal number of items over all menus plus menus is 254.

Parameters

`sMenuName`	`in`	The caption of the menu.

`iMenuId`	`out`	Returned menu identifier. It is the handle for using this menu.

Return-Codes

`RC_OK`	Successful termination.
`MMI_NOMORE_ MENUS`	No more menus available

See Also `MMI_CreateGBMenuItemStr, MMI_DeleteGBMenu, MMI_SelectGBMenuItem, MMI_AddGBMenuButton`

Example The example creates a menu with a button. The menu name is a composition with a constant string and the instrument name. The menu item names are extended with the current language name.

```
CONST MHELP = "Help for measurement type...."

DIM iMenu            AS Integer ' menu identifier
DIM iSelection       AS Integer ' selected item
DIM iButton          AS Integer ' used button
DIM sMenuName        AS sLine   ' menu name
DIM sMenuItemName1   AS sLine   ' menu item 1 name
DIM sMenuItemName2   AS sLine   ' menu item 2 name
DIM iLangNr          AS Integer ' language number
DIM sLangName        AS String20' language name
DIM sInstrumentName AS String30' instrument name

' generate menu name
CSV_GetInstrumentName(sInstrumentName)
sMenuName = "Programs on " + sInstrumentName
' Create menu
MMI_CreateGBMenuStr(sMenuName, iMenu)
' generate menu item names
MMI_GetLanguage(iLangNr, sLangName)
sMenuItemName1 = "Polygon in " + sLangName
sMenuItemName2 = "Border point in " + sLangName
' Create menu items - all items use
' the same help text
MMI_CreateGBMenuItemStr(iMenu,
 sMenuItemName1, MHELP)
MMI_CreateGBMenuItemStr(iMenu,
 sMenuItemName2, MHELP)
```

```
'Create the button supported in this menu
MMI_AddGBMenuButton(iMenu, MMI_F5_KEY, "EXIT ")

' show and execute menu
MMI_SelectGBMenuItem(iMenu, "TEST",
  iSelection, iButton)
SELECT CASE iSelection
    CASE 1 ' Polygon
    '  ...
    CASE ELSE
       MMI_BeepAlarm()
    END SELECT
MMI_DeleteGBMenu(iMenu)
```

6.1.7 MMI_CreateGBMenuItemStr

Description Creates an item with a variable string in an existing menu.

Declaration

```
MMI_CreateGBMenuItemStr(
             BYVAL iMenuId       AS Integer,
             BYVAL sMenuItemName AS sLine,
             BYVAL sHelpText     AS _Token )
```

Remarks This routine adds one menu item to an existing menu `iMenuId`. This item will be displayed as the last item. The menu must be created with `MMI_CreateGBMenuStr`. `sMenuItemName` need not be constant, it can be generated during the execution of the program.

Parameters

`iMenuId`	in	Menu identifier
`sMenuItemName`	in	Displayed text
`sHelpText`	in	Help text; only visible if the help functionality of the theodolite is enabled

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ID_INVALID`	Bad `iMenuId`

`BAS_MENU_ TABLE_FULL`	No more free menu items

See Also `MMI_CreateGBMenuStr, MMI_DeleteGBMenu, MMI_SelectGBMenuItem, MMI_AddGBMenuButton`

Example see `MMI_CreateGBMenuStr`

6.1.8 MMI_DeleteGBMenu

Description Deletes a menu.

Declaration `MMI_DeleteGBMenu( BYVAL iMenuId AS Integer )`

Remarks This function deletes the menu `iMenuId`.

Parameters

`iMenuId`	`in`	Menu identifier

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ ID_INVALID`	Bad `iMenuId`

See Also `MMI_CreateGBMenu, MMI_CreateGBMenuItem, MMI_SelectGBMenuItem, MMI_AddGBMenuButton`

Example see `MMI_CreateGBMenu`

6.1.9 MMI_SelectGBMenuItem

Description Select a menu item.

Declaration

```
MMI_SelectGBMenuItem(
            BYVAL iMenuId      AS Integer,
            BYVAL sCaptionLeft AS _Token,
                  iSelItem     AS Integer,
                  iButtonId    AS Integer )
```

Remarks This function shows and executes a menu `iMenuId` and returns the selected item `iSelItem` or pressed button `iButtonId`.

Parameters

`iMenuId`	`in`	Menu identifier
`sCaptionLeft`	`in`	The maximal five-character long part of the title bar displayed left of the menu title, with a separation symbol.
`iSelItem`	`in/out`	Selected item
`iButtonId`	`out`	Pressed button

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ ID_INVALID`	Bad `iMenuId`

See Also `MMI_CreateGBMenu`, `MMI_CreateGBMenuItem`, `MMI_DeleteGBMenu`, `MMI_AddGBMenuButton`

Example see `MMI_CreateGBMenu`

6.1.10 MMI_AddGBMenuButton

Description Adds a button to a menu.

Declaration

```
MMI_AddGBMenuButton(
            BYVAL iMenuId   AS Integer,
            BYVAL iButtonId AS Integer,
            BYVAL sCaption  AS _Token )
```

Remarks This function adds a button with the identifier `iButtonId` to the menu `iMenuId` and shows the caption `sCaption`.

Parameters

`iMenuId`	`in`	Menu identifier
`iButtonId`	`in`	Identifier of the button to be added. Valid buttons are `MMI_F1_KEY.. MMI_F6_KEY` and `MMI_SHF2_KEY.. MMI_SHF6_KEY`.
`sCaption`	`in`	Text placed onto the button (max. 5 characters)

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ ID_INVALID`	Bad `iMenuId`

See Also `MMI_CreateGBMenu, MMI_CreateGBMenuItem, MMI_DeleteGBMenu, MMI_SelectGBMenuItem`

Example see `MMI_CreateGBMenu`

6.1.11 MMI_CreateTextDialog

Description Create and show a text dialog.

Declaration

```
MMI_CreateTextDialog(
    BYVAL iLines        AS Integer,
    BYVAL sCaptionLeft  AS _Token,
    BYVAL sCaptionRight AS _Token,
    BYVAL sHelptext     AS _Token )
```

Remarks The routine creates and shows a dialog with `iLines` lines, the left part of the title bar `sCaptionLeft`, the caption `sCaptionRight` and the help text `sHelpText`. Only one text dialog can exist at the same time. If `MMI_CreateTextDialog` is called while already a text dialog or a measurement dialog exists, the existing dialog (together with all attached buttons) is deleted and the new dialog is created.

Note	Only a text dialog or a measurement dialog is valid at a time. They cannot be defined at the same time. A graphic dialog overrides a text or measurement dialog but does not delete the definition of it.

On the dialog field strings, numerical values and list fields can be displayed or edited using the routines `MMI_PrintStr`, `MMI_PrintVal`, `MMI_PrintInt`, `MMI_InputStr`, `MMI_InputVal`, `MMI_InputInt` and `MMI_InputList`.

Parameters

`iLines`	in	The number of lines of the dialog. There are up to 12 lines possible. If the dialog has more than 6 lines, a scrollbar on the right side appear and it is possible to scroll up and down with the cursor keys.
`sCaptionLeft`	in	The maximal five-character long part of the title bar displayed left of the `CaptionRight`, with a separation symbol.
`sCaptionRight`	in	The caption of the dialog.
`sHelpText`	in	This text is shown, when the help button `SHIFT-F1` is pressed and the help functionality of the theodolite is enabled.

Return-Codes

`RC_OK`	Successful termination.

See Also `MMI_DeleteDialog`, `MMI_CreateGraphDialog`, `GSI_CreateMDlg`, `MMI_PrintVal`, `MMI_PrintStr`, `MMI_PrintTok`, `MMI_PrintInt`, `MMI_InputVal`, `MMI_InputStr`, `MMI_InputInt`, `MMI_InputList`

Example The example uses the `MMI_CreateTextDialog` routine to create and display a text dialog.

```
Define a help text containing the
'  inverse written word "Help"
CONST Helptext = MMI_INVERSE_ON +
                 "Help" + MMI_INVERSE_OFF +
                 " Test"

MMI_CreateTextDialog(5, "TEXT", "DIALOG
                     CAPTION", Helptext)
```

6.1.12 MMI_CreateGraphDialog

Description Create and show a graphics dialog.

Declaration

```
MMI_CreateGraphDialog(
      BYVAL sCaptionLeft  AS _Token,
      BYVAL sCaptionRight AS _Token,
      BYVAL sHelptext     AS _Token )
```

Remarks The routine creates and shows a graphics dialog filled with the left part of the title bar `sCaptionLeft`, the caption `sCaptionRight` and the help text `sHelpText` for later use of MMI graphics functions. The size of the field is the whole dialog display area = 232 x 48 pixels. Only one graphics dialog can exist at the same time. If `CreateGraphDialog` is called while already a graphics dialog exists, the existing dialog (together with all attached buttons) is deleted and the new dialog is created.

Note	Only a text dialog <u>or</u> a measurement dialog is valid at a time. They cannot be defined at the same time. A graphic dialog overrides a text or measurement dialog but does not delete the definition of it.

Parameters

sCaptionLeft	in	The maximal five-character long part of the title bar displayed left of the sCaptionRight, with a separation symbol
sCaptionRight	in	The caption of the dialog.
sHelpText	in	This text is shown, when the help button Shift-F1 is pressed and the help functionality of the theodolite is enabled.

Return-Codes

RC_OK	Successful termination.

See Also MMI_DeleteDialog, MMI_CreateTextDialog, GSI_CreateMDlg, MMI Graphic Functions

Example The example uses the MMI_CreateGraphDialog routine to create and display a graphic dialog field.

```
MMI_CreateGraphDialog( "GRAPH",
                       "DIALOG CAPTION",
                       "This is a help text")
```

6.1.13 MMI_DeleteDialog

Description Deletes a dialog.

Declaration MMI_DeleteDialog()

Remarks The routine deletes the currently active dialog. It makes no distinction between graphic, measure and text dialog. By deleting the dialog all user defined buttons added with MMI_AddButton are deleted as well.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_CreateTextDialog, MMI_CreateGraphDialog, GSI_CreateMDlg

Example The example uses the `MMI_DeleteDialog` routine to delete a text, measure or graphic dialog.

```
MMI_DeleteDialog()
```

6.1.14 MMI_CheckButton

Description Checks if a button was pressed.

Declaration `MMI_CheckButton( lKeyPressed AS Logical )`

Remarks The routine `MMI_CheckButton` checks the keyboard buffer for pressed buttons. If a button was pressed, the routine returns `KeyPressed = TRUE`, otherwise `KeyPressed = FALSE` is returned.

Note	The routine `MMI_CheckButton` does not wait until a button was pressed. It only checks the keyboard buffer.

Parameters

`lKeyPressed`	`In`	`lKeyPressed = TRUE` is returned, if a valid button was pressed. Otherwise the value of `lKeyPressed` is `FALSE`.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_AddButton`
`MMI_GetButton`

Example The example uses the `MMI_CheckButton` routine to wait until a (valid) key was pressed.

```
DIM lKeyPressed AS Logical

DO
  MMI_CheckButton( lKeyPressed )
LOOP UNTIL lKeyPressed

'do something ..
```

6.1.15 MMI_GetButton

Description Get the button identifier of the pressed button.

Declaration

```
MMI_GetButton( iButtonId AS Integer,
               BYVAL lAllKeys  AS Logical )
```

Remarks Waits until a valid key is pressed and returns the button Identifier `iButtonId` of the pressed button.
If `lAllKeys = FALSE`, the keys `ESC`, `ENTER`, `ON/OFF` or any assigned button (added with `MMI_AddButton`) terminates this function and the `iButtonId` of the pressed button is returned. If `lAllKeys = TRUE,` additional keys i.e. the cursor keys terminates this routine too. For details see table below.

Note	This function relates to the currently active dialog.

Parameters

`iButtonId`	`Out`	The identifier of the pressed button. For values of `iButtonId` see the table below.
`lAllKeys`	`In`	Determines which keys exit the routine. If `lAllKeys = TRUE` any valid pressed key exit the routine, otherwise only normal ones.

Button pressed	iButtonId returned	
	lAllKeys = TRUE	lAllKeys = FALSE
assigned (using MMI_AddButton) "F1".."F6", "SHIFT-F2".. "SHIFT-F6"	MMI_F1_KEY.. MMI_F6_KEY, MMI_SHF2_KEY.. MMI_SHF6_KEY	MMI_F1_KEY.. MMI_F6_KEY, MMI_SHF2_KEY.. MMI_SHF6_KEY
unassigned "F1".."F6", "SHIFT-F2".. "SHIFT-F6"	MMI_UNASS_KEY	no return
assigned "CODE"	MMI_CODE_KEY	MMI_CODE_KEY
unassigned "CODE"	MMI_UNASS_KEY	no return
"ENTER" within dialog, focus on a field	MMI_UNASS_KEY	no return
"ENTER" within dialog, no focus	MMI_UNASS_KEY	no return
"ENTER" after editing	MMI_EDIT_ ENTER_KEY	MMI_EDIT_ ENTER_KEY
"ESC" within dialog	MMI_ESC_KEY	MMI_ESC_KEY
"ESC" after editing	MMI_EDIT_ ESC_KEY	no return
"SHIFT"	MMI_UNASS_KEY	no return
"0".."9", focus on spin/list-field	MMI_UNASS_KEY	no return
"0..9", no focus	MMI_NUM0_KEY.. MMI_NUM9_KEY	no return
"CE"	MMI_UNASS_KEY	no return
cursor keys	MMI_UP_KEY, MMI_DOWN_KEY, MMI_RIGHT_KEY, MMI_LEFT_KEY	no return

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_AddButton, MMI_CheckButton

Example The example uses the `MMI_GetButton` routine to react to a pressed button. To make a function key valid for `MMI_GetButton` it must be added to the dialog (with `MMI_AddButton`).

```
DIM iActionButton  AS Integer
DIM iPressedButton AS Integer

iActionButton = MMI_F2_KEY

MMI_GetButton ( iPressedButton, TRUE )
IF iPressedButton = iActionButton THEN
  'any actions
END IF
```

6.1.16 MMI_AddButton

Description Add a button to a dialog.

Declaration

```
MMI_AddButton( BYVAL iButtonId AS Integer,
               BYVAL sCaption  AS _Token )
```

Remarks The routine `MMI_AddButton` adds the button with the Identifier `iButtonId` to the actual dialog and places the text `sCaption` onto the button. These added buttons are valid for the routines `MMI_CheckButton` and `MMI_GetButton` and the input routines (`MMI_InputStr, MMI_InputVal, MMI_InputInt` and `MMI_InputList`) which means the according button identifier can be returned from this routines.

Note	Either a text dialog <u>or</u> a measurement dialog can be defined at a time. Additionally a graphics dialog can override one of these above. Then the functionality applies to the graphics dialog.

The added buttons can be deleted with the routine `MMI_DeleteButton` while the dialog exists. Closing the dialog with `MMI_DeleteDialog` deletes all buttons attached to this dialog.

Parameters

`iButtonId`	`in`	Identifier of the button to be added. See for the values that can be used for the `iButtonId` under the routine description `MMI_GetButton`. Only `MMI_F1_Key..MMI_F5_KEY`, `MMI_SHF2_KEY..MMI_SHF6_KEY` and `MMI_CODE_KEY` are available for the `AddButton` routine.
`sCaption`	`in`	The text placed onto the button, left alignment (max. 5 characters).

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.
`MMI_BUTTON_ID_EXISTS`	This button has been defined already.

See Also `MMI_GetButton, MMI_CheckButton, MMI_DeleteButton`

Example The example uses the `MMI_AddButton` routine to add the `F2-KEY` with the caption "EXIT" to the dialog.

```
MMI_AddButton( MMI_F2_KEY, "EXIT" )
```

6.1.17 MMI_DeleteButton

Description Delete a button from a dialog.

Declaration `MMI_DeleteButton( iButtonId AS Integer )`

Remarks The routine `MMI_DeleteButton` deletes the button with the Identifier `iButtonId` from the actual dialog. Only a button that was added with `MMI_AddButton` can be deleted. Closing the dialog with `MMI_DeleteDialog` deletes all buttons attached to this dialog.

Parameters

`iButtonId`	`in`	Identifier of the button to be deleted. See for the values that can be used for `iButtonId` under the routine description `MMI_GetButton`.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.
`MMI_ILLEGAL_BUTTON_ID`	This button has not been defined by `MMI_AddButton`.

See Also `MMI_AddButton`

Example The example uses the `MMI_DeleteButton` routine to delete the `F2-KEY` from the dialog.

```
MMI_DeleteButton( MMI_F2_KEY )
```

6.1.18 MMI_PrintStr

Description Print a string on a text dialog.

Declaration

```
MMI_PrintStr( BYVAL iColumn AS Integer,
              BYVAL iLine   AS Integer,
              BYVAL sText   AS String30,
              BYVAL lValid  AS Logical )
```

Remarks The text string `sText` is placed on position `iColumn` and `iLine` on the text dialog. If `lValid` is not `TRUE`, then the symbols for invalid values are displayed. Too long text strings are truncated, illegal co-ordinates are adjusted.

> **Note** A text dialog must already exist. Only display length number of character will be displayed, hence 29.

Parameters

`iColumn`	`in`	The horizontal position (0..28)

`iLine`	in	The vertical position (0..number of lines defined with `MMI_CreateTextDialog`)
`sText`	in	The text string to display
`lValid`	in	Determines if the value should be shown as valid. If `lValid = TRUE` the value `sText` is displayed, otherwise the symbols for invalid values are displayed.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_InputStr`

Example The example uses the `MMI_PrintStr` routine to print the text string „Hello World“ in the first line on row 2 of the actual text dialog.

```
MMI_PrintStr( 2, 0, "Hello World", TRUE )
```

6.1.19 MMI_PrintTok

Description Print a string on a text dialog.

Declaration

```
MMI_PrintTok(  BYVAL iColumn AS Integer,
               BYVAL iLine   AS Integer,
               BYVAL sText   AS _Token )
```

Remarks The text token `sText` is placed on position `iColumn` and `iLine` on the text dialog. Too long text strings are truncated, illegal co-ordinates are adjusted. This routine may be used instead of `MMI_PrintStr` to support internationalisation of multiple language applications.

Note	A text dialog must already exist.

Parameters

`iColumn`	in	The horizontal position (0..28)
`iLine`	in	The vertical position (0..number of lines defined with `MMI_CreateTextDialog`)

`sText`	`in`	The text string to display

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.
`TXT_UNDEF_TOKEN`	The given token could not be found in the database. Most probably an old version is loaded either on TPS or simulator.
`RC_IVPARAM`	No text token database is loaded with the currently set language.

See Also `MMI_PrintStr`

Example The example uses the `MMI_PrintTok` routine to print the text string „Hello World“ in the first line on row 2 of the actual text dialog.

```
MMI_PrintTok( 2, 0, "Hello World" )
```

6.1.20 MMI_PrintVal

Description Print a value on a text dialog.

Declaration

```
MMI_PrintVal( BYVAL iColumn   AS Integer,
              BYVAL iLine     AS Integer,
              BYVAL iLen      AS Integer,
              BYVAL iDecimals AS Integer,
              BYVAL dVal      AS Double,
              BYVAL lValid    AS Logical,
              BYVAL iMode     AS Integer )
```

Remarks This routine can be used to display double values (or values with equal type, e.g. dimension). If `lValid = TRUE` the value `dVal` is placed on position `iColumn` and `iLine` on the text dialog, otherwise the symbols for invalid values `"-----"` are displayed. Too long value strings are truncated, illegal co-ordinates are adjusted. If `iMode = MMI_DIM_ON`, a dimension field is automatically displayed when the type of `dVal` has units.

If the dVal can not be displayed in iLen characters, then "xxx" will be displayed instead.

Note	A text dialog must already exist.

Parameters

iColumn	in	The horizontal position (0..28).
iLine	in	The vertical position (0..number of lines defined with CreateTextDialog).
iLen	in	The length of the value consisting of a sign, the characters before and after the comma and the comma itself. The dimension field is not included.
iDecimals	in	The number of decimals. If iDecimals = -1 then the number of decimals set by the system is taken.
dVal	in	The value to display. Use this routine to display double (and equal to double) values with the correct units. For integer values a separate routine (MMI_PrintInt) exists.
lValid	in	Determines if the value should be shown as valid. If lValid = TRUE the value dVal is displayed, otherwise the symbols for invalid values are displayed.
iMode	in	Determines the display of the dimension. If Mode = MMI_DIM_ON a dimension field is automatically displayed when the type dVal has units. Otherwise use MMI_DEFAULT_MODE.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_PrintInt , MMI_InputVal

Example The example uses the MMI_PrintVal routine to print the value of TestVal as distance (with corresponding dimension) in the first line on row 2 of the currently open text dialog.

```
DIM TestVal AS Distance
TestVal = 287.47

MMI_PrintVal( 2, 0, 10, 2, TestVal, TRUE,
              MMI_DIM_ON )
```

6.1.21 MMI_PrintInt

Description Print an integer value on a text dialog.

Declaration

```
MMI_PrintInt( BYVAL iColumn AS Integer,
              BYVAL iLine   AS Integer,
              BYVAL iLen    AS Integer,
              BYVAL iVal    AS Integer,
              BYVAL lValid  AS Logical )
```

Remarks This routine can be used to display integer values. Too long value strings are truncated, illegal co-ordinates are adjusted. If `lValid = TRUE` the value `iVal` is placed on position `iColumn` and `iLine` on the text dialog, otherwise the symbols for invalid values are displayed.
If the `iVal` can not be displayed in `iLen` characters, then `"xxx"` will be displayed instead.

Note	A text dialog must already exist.

Parameters

`iColumn`	`in`	The horizontal position (0..28).
`iLine`	`in`	The vertical position (0..number of lines defined with `MMI_CreateTextDialog`).
`iLen`	`in`	The length of the value plus the sign.
`iVal`	`in`	The value to display. Use this routine to display integer values. For double values a separate routine (`MMI_PrintVal`) exists.
`lValid`	`in`	Determines if the value should be shown as valid. If `lValid = TRUE` the value `iVal` is displayed, otherwise the symbols for invalid values are displayed.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_PrintVal`
`MMI_InputInt`

Example The example uses the `MMI_PrintInt` routine to print the value of `TestVal` in the first line on row 2 of the currently open text dialog.

```
DIM TestVal AS Integer
TestVal = 1000

MMI_PrintInt( 2, 0, 5, TestVal, TRUE )
```

6.1.22 MMI_InputStr

Description Get a string input in a text dialog.

Declaration

```
MMI_InputStr( BYVAL iColumn   AS Integer,
              BYVAL iLine     AS Integer,
              BYVAL iLen      AS Integer,
              BYVAL iMode     AS Integer,
                    sText     AS String30,
                    lValid    AS Logical,
                    iButtonId AS Integer )
```

Remarks If `lValid = TRUE` the text string `sText` is placed on position `iColumn` and `iLine` on the text dialog, otherwise the symbols for invalid values are displayed.
Illegal co-ordinates are adjusted. If the length of the string exceeds the given length `iLen` the string is truncated at position `iLen`. After the edit process the string is returned and the text is placed right aligned on the display. If the length `iLen <= 0` or no part of the field is in the dialog area the Text is not edited and the routine exits.

The string can be edited by pressing α`EDIT` or a numerical key. If `iMode = MMI_DEFAULT_MODE` the keys `ESC`, `ENTER`,

ON/OFF or any user defined button (added with MMI_AddButton) terminates the edit process and the iButtonId of the pressed button is returned. If iMode = MMI_SPECIALKEYS_ON additional keys i.e. the cursor keys terminates MMI_InputStr too. For details see MMI_GetButton.

Note	A text dialog must already exist.

Parameters

iColumn	in	The horizontal position (0..28).
iLine	in	The vertical position (0..number of lines defined with MMI_CreateTextDialog).
iLen	in	The length of the input field.
iMode	in	Defines the editing mode. MMI_DEFAULT_MODE defines normal editing MMI_SPECIALKEYS_ON allows editing with full cursor control
sText	inout	The text string to edit.
lValid	inout	Determines if the value should be shown as valid. If lValid=TRUE the string sText is displayed, otherwise the symbols for invalid values are displayed.
iButtonId	out	The identifier of the pressed valid button to exit the edit process.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_PrintStr

Example The example uses the `MMI_InputStr` routine to get the text string `sInputString` in the first line on row 2 of the actual text dialog.

```
DIM sInputString AS String30
DIM iButton      AS Integer
DIM lValid       AS Logical

sInputString = "The input text"
lValid = TRUE
MMI_InputStr( 2, 0, 20, MMI_DEFAULT_MODE,
              sInputString, lValid,iButton )
```

6.1.23 MMI_InputVal

Description Get a numerical input for double values in a text dialog.

Declaration

```
MMI_InputVal( BYVAL iColumn   AS Integer,
              BYVAL iLine     AS Integer,
              BYVAL iLen      AS Integer,
              BYVAL iDecimals AS Integer,
              BYVAL dMin      AS Double,
              BYVAL dMax      AS Double,
              BYVAL iMode     AS Integer,
                    dVal      AS Double,
                    lValid    AS Logical,
                    iButtonId AS Integer )
```

Remarks If `lValid = TRUE` then the value `dVal` is placed on position `iColumn` and `iLine` on the text dialog, otherwise the symbols for invalid values are displayed. Illegal co-ordinates are adjusted. If `iMode = MMI_DIM_ON`, a dimension field is automatically displayed when the type of `dVal` has units. If the length `iLen <= 0` or no part of the field is in the dialog area the value is not edited and the routine exits.

The value within the bounds `dMin` and `dMax` can be edited by pressing `EDIT` or the numerical block keys. If `iMode = MMI_DEFAULT_MODE` the keys `ESC`, `ENTER`, `ON/OFF` or any user defined button (added with `MMI_AddButton`) terminates

the edit process and the `iButtonId` of the pressed button is returned. If `iMode = MMI_SPECIALKEYS_ON` additional keys i.e. the cursor keys terminates `MMI_InputVal` too. For details see `MMI_GetButton`.

Note	A text dialog must already exist.

Parameters

`iColumn`	`in`	The horizontal position (0..28).
`iLine`	`in`	The vertical position (0..number of lines defined with `MMI_CreateTextDialog`).
`iLen`	`in`	The length of the value inclusive decimals, sign and the comma, exclusive the dimension field
`iDecimals`	`in`	The number of decimals. If `iDecimals = -1` the number of decimals set by the system is taken.
`dMin` `dMax`	`in`	The lower and upper bounds.
`iMode`	`in`	Defines the editing mode. `MMI_DEFAULT_MODE` defines normal editing `MMI_SPECIALKEYS_ON` allows editing with full cursor control `MMI_DIM_ON` shows a dimension field if `dVal` has units. Modes can be added, i.e. `MMI_SPECIALKEYS_ON + MMI_DIM_ON`
`dVal`	`inout`	The value to edit. Use this routine to edit double (and equal to double) values. For integer values a separate routine (`MMI_InputInt`) exists.

lValid	inout	Determines if the value should be shown as valid. If lValid=TRUE the value dVal is displayed, otherwise the symbols for invalid values are displayed.
iButtonId	out	The identifier of the pressed valid button to exit the edit process.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_InputInt
MMI_PrintVal

Example See example file „cursor.gbs“ too.

The example uses the MMI_InputVal routine to get the distance of TestVal with default decimal places. Input field is placed in the second line on row 2 of the actual text dialog. The entered values must lie in the range 0..1000.

```
CONST MODE = MMI_DEFAULT_MODE 'define editmode

DIM TestVal  AS Distance
DIM iButton  AS Integer
DIM lValid   AS Logical

lValid = FALSE

MMI_InputVal( 2, 1, 8, -1, 0, 1000, MODE,
              TestVal, lValid, iButton )
```

6.1.24 MMI_InputInt

Description Get an integer input value in a text dialog.

Declaration

```
MMI_InputInt( BYVAL iColumn   AS Integer,
              BYVAL iLine     AS Integer,
              BYVAL iLen      AS Integer,
              BYVAL iMin      AS Integer,
              BYVAL iMax      AS Integer,
              BYVAL iMode     AS Integer,
                    iVal      AS Integer
                    lValid    AS Logical,
                    iButtonId AS Integer )
```

Remarks If `lValid = TRUE` then the integer value `iVal` is placed on position `iColumn` and `iLine` on the text dialog. Illegal co-ordinates are adjusted. If the length `iLen ≤ 0` or no part of the field is in the dialog area the value is not edited and the routine exits.

The integer value within the bounds `iMin` and `iMax` can be edited by pressing `EDIT` or the numerical block keys. If `iMode = MMI_DEFAULT_MODE` the keys `ESC`, `ENTER`, `ON/OFF` or any user defined button (added with `MMI_AddButton`) terminates the edit process and the `iButtonId` of the pressed button is returned. If `iMode = MMI_SPECIALKEYS_ON` additional keys i.e. the cursor keys terminates `MMI_InputInt` too.

Note	A text dialog must already exist.

Parameters

`iColumn`	in	The horizontal position (0..28).
`iLine`	in	The vertical position (0..number of lines defined with `MMI_CreateTextDialog`).
`iLen`	in	The length of the value plus the sign.
`iMin` `iMax`	in	The lower and upper bounds.

iMode	in	Defines the editing mode. MMI_DEFAULT_MODE defines normal editing MMI_SPECIALKEYS_ON allows editing with full cursor control
iVal	inout	The value to display. Use this routine to edit integer values. For double values a separate routine (MMI_InputVal) exists.
lValid	inout	Determines if the value should be shown as valid. If lValid=TRUE the value iVal is displayed, otherwise the symbols for invalid values are displayed.
iButtonId	out	The identifier of the pressed valid button to exit the edit process.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_PrintInt, MMI_InputVal

Example See example file „cursor.gbs“ too.

The example uses the MMI_InputInt routine to get the value of iTestVal in the second line on row 2 of the actual text dialog. The entered values must lie in the range 0..1000.

```
CONST MODE = MMI_DEFAULT_MODE 'define editmode

DIM iTestVal AS Integer
DIM iButton  AS Integer
DIM lValid   AS Logical

lValid = FALSE
MMI_InputInt( 2,1,5,0,1000,
              MODE,iTestVal,lValid,iButton )
```

6.1.25 MMI_InputList

Description Shows a list field in a text dialog.

Declaration

```
MMI_InputList( BYVAL iColumn   AS Integer,
               BYVAL iLine     AS Integer,
               BYVAL iLen      AS Integer,
               BYVAL iElements AS Integer,
               BYVAL iMode     AS Integer,
                     List      AS ListArray,
                     iIndex    AS Integer,
                     lValid    AS Logical,
                     iButtonId AS Integer )
```

Remarks If `lValid = TRUE` then a list field is placed on position `iColumn` and `iLine` on the text dialog. Too long list elements are truncated, illegal co-ordinates are adjusted. The `ListArray` is an array of `String30` with `LIST_ARRAY_MAX_ELEMENT` Elements. Only the first `iElements` are displayed. The value of `iIndex` defines which element is shown first.

The list can be edited by pressing `F6` (`LIST`). With the cursor keys `UP` and `DOWN` a field element can be selected. If the list elements are numbered (begins with a number), then the elements can be selected directly by pressing numerical buttons. If `iMode = MMI_DEFAULT_MODE` the keys `ESC`, `ENTER`, `ON/OFF` or any user defined button (added with `MMI_AddButton`) terminates the edit process and the `iButtonId` of the pressed button is returned. If `iMode = MMI_SPECIALKEYS_ON` additional keys i.e. the cursor keys terminates `MMI_InputList` too.

Note	A text dialog must already exist.

Parameters

`iColumn`	`in`	The horizontal position (0..28).
`iLine`	`in`	The vertical position (0..number of lines defined with `MMI_CreateTextDialog).`
`iLen`	`in`	The displayed length of the list elements.

iElements	in	The number of list elements. The maximum number is limited to LIST_ARRAY_MAX_ELEMENT.
iMode	in	Defines the editing mode. MMI_DEFAULT_MODE defines normal editing MMI_SPECIALKEYS_ON allows editing with full cursor control
List	in	The array of the list elements.
iIndex	inout	Index (number of the line) of the first shown and selected field respectively. Possible value for iIndex are in the range of 1 up to Elements.
lValid	inout	Determines if the value should be shown as valid. If lValid=TRUE the a value is displayed, otherwise the symbols for invalid values are displayed.
iButtonId	out	The identifier of the pressed valid button to exit the list process.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

Example See example file „cursor.gbs“ too.

The example uses the MMI_InputList routine to get the value of the selected list element (the selected line) of a list field displayed in the second line on row 2 of the actual text dialog. The first displayed line is the line with the number Index.

```
CONST MODE = MMI_DEFAULT_MODE 'define editmode

DIM iLen      AS Integer
DIM iElements AS Integer
DIM List      AS ListArray
DIM iIndex    AS Integer
DIM iButton   AS Integer
DIM lValid    AS Logical

'initialize the variables
iLen      = 10   'displayed length of the list
iElements =  7   'number of available fields
iIndex    =  3   'number of the first shown list
element
lValid    = TRUE

List(1) = "1 Line No.: 1"
List(2) = "2 Line No.: 2"
List(3) = "3 Line No.: 3"
List(4) = "4 Line No.: 4"
List(5) = "5 Line No.: 5"
List(6) = "6 Line No.: 6"
List(7) = "7 Line No.: 7"

InputList( 5, 1, iLen, iElements, MODE,
           List, iIndex, lValid, iButton )
```

6.1.26 MMI_FormatVal

Description Convert a value to a string and use TPS system formatting rules.

Declaration

```
MMI_FormatVal( BYVAL iType      AS Integer,
               BYVAL iLen       AS Integer,
               BYVAL iDecimals  AS Integer,
               BYVAL dVal       AS Double,
               BYVAL lValid     AS Logical,
               BYVAL iMode      AS Integer,
                     sValStr    AS String30 )
```

Remarks If `lValid = TRUE` then this routine converts a double value (or values with equal type, e.g. dimension) to a text string, otherwise the symbols for invalid values are returned. The returned string

`sValStr` contains the value string in the same kind as it would be displayed on the Theodolite: the value is placed right aligned with the number `iDecimals` of decimals. If `iMode = MMI_DIM_ON`, a dimension field is appended to the output string when the type `iType` allows it.
If the `dVal` can not be displayed in `iLen` characters, then `"xxx"` will be returned instead.

This routine is useful, if numeric values should be written on files (see chapter file handling for further information).

Parameters

`iType`	`in`	The type of the numerical field. The type defines if a dimension field is available. Following values for the type can be used:

Type	**Meaning**
`MMI_FFORMAT_DOUBLE`	double
`MMI_FFORMAT_DISTANCE`	distance
`MMI_FFORMAT_SUBDISTANCE`	sub-distance [mm]
`MMI_FFORMAT_ANGLE`	angle
`MMI_FFORMAT_VANGLE`	vertical angle
`MMI_FFORMAT_HZANGLE`	horizontal angle
`MMI_FFORMAT_TEMPERATURE`	temperature
`MMI_FFORMAT_TIME`	time 12h/24h-format
`MMI_FFORMAT_DATE`	date
`MMI_FFORMAT_DATE_TIME`	date/time

`iLen`	`in`	The length of the value consisting of a sign, the characters before and after the comma and the comma itself. The dimension field is not included.
`iDecimals`	`in`	The number of decimals. If `iDecimals = -1` the number of decimals set by the system is taken.

`dVal`	in	The value to convert. Use this routine to convert double (and equal to double) values.
`iMode`	in	If `iMode = MMI_DIM_ON` a dimension string is automatically added to `sValStr` when the type `dVal` has units. Otherwise use `MMI_DEFAULT_MODE`.
`sValStr`	out	`sValStr` contains the string representation of the value `dVal`.

Return-Codes

`RC_OK`	Successful termination.
`RC_IVRESULT`	The result is not valid due to an illegal input value.

See Also `sFormatVal`

Example The example uses the `MMI_FormatVal` routine to convert the value `dTestVal` as distance (with corresponding dimension).

```
DIM dTestVal AS Distance
DIM sVString AS String30

dTestVal = 287.47

MMI_FormatVal( MMI_FFORMAT_DISTANCE, 10, -1,
               dTestVal, TRUE,
               MMI_DIM_ON, sVString )
```

6.1.27 MMI_WriteMsg

Description Output to a message window.

Declaration

```
MMI_WriteMsg( BYVAL sText    AS _Token,
              BYVAL sCaption AS _Token,
              BYVAL iMsgType AS Integer,
                    iRetKey  AS Integer )
```

Remarks The function opens a message window on the display, which shows the text specified by `sText`. Lines that are too long to fit into the window are split automatically.

`sText` may contain a carriage return (character code 10) which breaks a line explicitly. The predefined constants `MMI_INVERSE_ON` and `MMI_INVERSE_OFF` can be used for inverse text.
Text lines, that exceed the size of the window, are not displayed. A title text, which will be printed on the first line of the message box, can be set with `sCaption`, which may not be longer than one line and contain neither font attributes nor type information.

Parameters

`sText`	`in`	Text-token to be displayed on the window (on the Theodolite).
`sCaption`	`in`	Text-token that will be displayed as title of the window.

`iMsgType`	`in`	Defines the type of the message window to be displayed, with the corresponding text on the buttons; possible types:
		`MMI_MB_OK`
		`MMI_MB_ABORT`
		`MMI_MB_OK_ABORT`
		`MMI_MB_ABORT_RETRY_CONT`
		`MMI_MB_YES_NO_ABORT`
		`MMI_MB_YES_NO`
		`MMI_MB_RETRY_ABORT`
		`MMI_MB_ABORT_CONT`
		`MMI_MB_ABORT_RETRY_IGNORE`
		`MMI_MB_ABORT_IGNORE`

`iRetKey`	`out`	Returns the button pressed, i. e. `iRetKey`:
		`MMI_MB_RET_OK`
		`MMI_MB_RET_ABORT`
		`MMI_MB_RET_RETRY`
		`MMI_MB_RET_CONT`
		`MMI_MB_RET_YES`
		`MMI_MB_RET_NO`
		`MMI_MB_RET_IGNORE`

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

Example The example uses the MMI_WriteMsg routine to display a message box with the title text “Warning“ and the text “timed out“ and shows the buttons “Retry“, “Abort“ returning the button-id in iRetKey.

```
MMI_WriteMsg( "Warning", "timeout",
                MMI_MB_RETRY_ABORT, iMBRetKey )
```

6.1.28 MMI_WriteMsgStr

Description Output to a message window.

Declaration

```
MMI_WriteMsgStr( BYVAL sText    AS String255,
                 BYVAL sCaption AS _Token,
                 BYVAL iMsgType AS Integer,
                       iRetKey  AS Integer )
```

Remarks The function opens a message window on the display, which shows the text specified by sText. Lines, which are too long to fit into the window, are split automatically. sText may contain a carriage return (character code 10) which breaks a line explicitly.
The predefined constants MMI_INVERSE_ON and MMI_INVERSE_OFF can be used for inverse text.
Text lines, that exceed the size of the window, are not displayed.
A title text, which will be printed on the first line of the message box, can be set with sCaption, which may not be longer than one line and contain neither font attributes nor type information.

Note	This routine is different to MMI_WriteMsg in such a way that sText may be computed. But, of course, sText will not be entered into the text token data base.

Parameters

sText	in	Text string to be displayed in a message box.

`sCaption`	`in`	Text-token that will be displayed as title of the window.

`iMsgType`	`in`	Defines the type of the message window to be displayed, with the corresponding text on the buttons; possible types:
		`MMI_MB_OK`
		`MMI_MB_ABORT`
		`MMI_MB_OK_ABORT`
		`MMI_MB_ABORT_RETRY_CONT`
		`MMI_MB_YES_NO_ABORT`
		`MMI_MB_YES_NO`
		`MMI_MB_RETRY_ABORT`
		`MMI_MB_ABORT_CONT`
		`MMI_MB_ABORT_RETRY_IGNORE`
		`MMI_MB_ABORT_IGNORE`

`iRetKey`	`out`	Returns the button pressed, i. e. `iRetKey`:
		`MMI_MB_RET_OK`
		`MMI_MB_RET_ABORT`
		`MMI_MB_RET_RETRY`
		`MMI_MB_RET_CONT`
		`MMI_MB_RET_YES`
		`MMI_MB_RET_NO`
		`MMI_MB_RET_IGNORE`

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_WriteMsg`

Example The example uses the `MMI_WriteMsgStr` routine to display a message box with the title text “`Warning`“ and the text:

```
MessageStr
time out in 10 seconds
```

and shows the buttons “`Retry`“, “`Abort`“ returning the button-id in `iRetKey`.

```
CONST  iTimeOut  AS Integer = 10
DIM    sMessage  As String255
DIM    iMBRetKey AS Integer

sMessage = "MessageStr\d010time out in " +
             Str$(iTimeOut) + "seconds"
MMI_WriteMsgStr( "Warning", sMessage,
                  MMI_MB_RETRY_ABORT,iMBRetKey )
```

6.1.29 MMI_DrawLine

Description Draw a line.

Declaration

```
MMI_DrawLine( BYVAL iX1  AS Integer,
              BYVAL iY1  AS Integer,
              BYVAL iX2  AS Integer,
              BYVAL iY2  AS Integer,
              BYVAL iPen AS Integer )
```

Remarks The function draws a line within the graphic field using the line-style `iPen`.

> **Note** A graphics dialog has to be set up before.

Parameters

iX1	in	x-co-ordinate of the beginning of the line [pixel]
iY1	in	y-co-ordinate of the beginning of the line [pixel]
iX2	in	x-co-ordinate of the end of the line [pixel]
iY2	in	y-co-ordinate of the end of the line [pixel]

`iPen`	`in`	Line-style; possible values:
		`MMI_PEN_WHITE`
		`MMI_PEN_BLACK`
		`MMI_PEN_DASHED`

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No graphics dialog exists for this operation.

See Also `MMI_CreateGraphDialog`, `MMI_DrawRect`, `MMI_DrawCircle`, `MMI_DrawText`

Example The example uses the `MMI_DrawLine` routine to draw a line with the specified attributes.

```
MMI_DrawLine( 10, 10, 100, 50, MMI_PEN_BLACK )
```

6.1.30 MMI_DrawRect

Description Draw a rectangle.

Declaration

```
MMI_DrawRect( BYVAL iX1    AS Integer,
              BYVAL iY1    AS Integer,
              BYVAL iX2    AS Integer,
              BYVAL iY2    AS Integer,
              BYVAL iBrush AS Integer,
              BYVAL iPen   AS Integer )
```

Remarks This function draws a rectangle in the graphic field using the fill-style `iBrush` and the line-style `iPen`.

Note	A graphics dialog has to be set up before.

Parameters

`iX1`	`in`	x-co-ordinate at the upper left-hand corner of the rectangle [pixel]
`iY1`	`in`	y-co-ordinate at the upper left-hand corner of the rectangle [pixel]
`iX2`	`in`	x-co-ordinate at the bottom right-hand corner of the rectangle [pixel]
`iY2`	`in`	y-co-ordinate at the bottom right-hand corner of the rectangle [pixel]

`iBrush`	`in`	Fill-style for the rectangle; possible values:
		`MMI_BRUSH_WHITE`
		`MMI_BRUSH_BLACK`
		`MMI_NO_BRUSH`

`iPen`	`in`	Line-style:
		`MMI_PEN_WHITE`
		`MMI_PEN_BLACK`
		`MMI_PEN_DASHED`

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No graphics dialog exists for this operation.

See Also `MMI_CreateGraphDialog, MMI_DrawLine, MMI_DrawCircle, MMI_DrawText`

Example The example uses the `MMI_DrawRect` routine to draw a rectangle with the specified attributes.

```
MMI_DrawRect( 10, 10, 100, 50, MMI_NO_BRUSH,
MMI_PEN_BLACK )
```

6.1.31 MMI_DrawCircle

Description Draw a circle / ellipse.

Declaration

```
MMI_DrawCircle( BYVAL iX     AS Integer,
                BYVAL iY     AS Integer,
                BYVAL iRx    AS Integer,
                BYVAL iRy    AS Integer,
                BYVAL iBrush AS Integer,
                BYVAL iPen   AS Integer )
```

Remarks This function draws a circle in the graphic field, using the radius `iRx`, the fill-style `iBrush`, and the line-style `iPen`, as long as `iRx` = `iRy`. Otherwise, an ellipse is drawn, where `iRx` and `iRy` are the lengths of the perpendicular radii.

Note	A graphics dialog has to be set up before.

Parameters

`iX`	`in`	x-co-ordinate at the centre of the circle/ellipse [pixel]
`iY`	`in`	y-co-ordinate at the centre of the circle/ellipse [pixel]
`iRx`	`in`	Radius of the circle, horizontal radius [pixel]
`iRy`	`in`	Radius of the circle, vertical radius [pixel]

`iBrush`	`in`	Fill-style for the rectangle; possible values:
		`MMI_BRUSH_WHITE`
		`MMI_BRUSH_BLACK`
		`MMI_NO_BRUSH`

`iPen`	`in`	Line-style; possible values:
		`MMI_PEN_WHITE`
		`MMI_PEN_BLACK`
		`MMI_PEN_DASHED`

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No graphics dialog exists for this operation.

See Also MMI_CreateGraphDialog, MMI_DrawLine, MMI_DrawRect, MMI_DrawText

Example Draw a circle with a radius of 10.

```
MMI_DrawCircle( 80, 25, 10, 10,
                MMI_BRUSH_BLACK,
                MMI_PEN_BLACK )
```

6.1.32 MMI_DrawText

Description Draw / delete text.

Declaration

```
MMI_DrawText( BYVAL iX    AS Integer,
              BYVAL iY    AS Integer,
              BYVAL sText AS String20,
              BYVAL iAttr AS Integer,
              BYVAL iPen AS Integer )
```

Remarks This function either draws (iPen = MMI_PEN_BLACK) or deletes (iPen = MMI_PEN_WHITE) a text string in graphic field. The co-ordinates (iX, iY) correspond to the upper left-hand corner of the first character. The character size is 6 x 8 pixel.

Note	A graphics dialog has to be set up before.

Parameters

iX	in	x-co-ordinate at the upper left-hand corner of the first character [pixel]	
iY	in	y-co-ordinate at the upper left-hand corner of the first character [pixel]	
sText	in	Pointer to the text string	
iAttr	in	Text attribute	
		MMI_TXT_NORMAL	normal text
		MMI_TXT_INVERSE	inverted text

iPen	in	MMI_PEN_BLACK	draw text
		MMI_PEN_WHITE	delete text

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No graphics dialog exists for this operation.

See Also MMI_CreateGraphDialog, MMI_DrawLine, MMI_DrawRect, MMI_DrawCircle

Example Print a text at position 10, 10.

```
DIM sOutput AS String20
sOutput = "distance"
MMI_DrawText( 10, 10, sOutput, MMI_TXT_NORMAL,
MMI_PEN_BLACK )
```

6.1.33 MMI_DrawBusyField

Description Shows or hides the Busy-Icon.

Declaration

```
MMI_DrawBusyField(
             BYVAL lVisible as Logical )
```

Remarks This function controls the Busy-Icon (Hourglass).

Parameters

lVisible	in	TRUE: Icon is visible

Return-Codes

RC_OK	Successful termination.

Example The example shows and hides the Busy-Icon

```
MMI_DrawBusyField(TRUE)  ' show icon

' time consuming function....

MMI_DrawBusyField(FALSE) ' hide icon
```

6.1.34 MMI_BeepAlarm, MMI_BeepNormal, MMI_BeepLong

Description Create an alert beep.

Declaration
```
MMI_BeepAlarm()
MMI_BeepNormal()
MMI_BeepLong()
```

Remarks The functions create one or a sequence of alert beeps with configurable volume, if the boxes are turned on.

Any previously set continuous signal beep will be finished.

Return-Codes

RC_OK	Successful termination.

See Also
MMI_StartVarBeep
MMI_SwitchVarBeep
MMI_GetVarBeepStatus

Example The example uses the `MMI_BeepNormal` to sound a signal beep.

```
MMI_BeepNormal()
```

6.1.35 MMI_StartVarBeep

Description Start beep sequences with configurable interrupts.

Declaration `MMI_StartVarBeep( BYVAL iRate AS Integer )`

Remarks The function creates sequences of beeps with configurable interrupts.

If previously a continuous signal beep has been set, the new rate will be established.

Parameters

`iRate`	`in`	frequency in [%]; 0 is very slow, 100 is very fast

Return-Codes

`RC_OK`	Successful termination.

See Also `MMI_BeepAlarm`, `MMI_BeepNormal`, `MMI_BeepLong`, `MMI_SwitchVarBeep`, `MMI_GetVarBeepStatus`

Example The example uses the `MMI_StartVarBeep` to create a very fast sequence of signal beeps.

```
MMI_StartVarBeep( 100 )
```

6.1.36 MMI_SwitchVarBeep

Description Switch a varying beep.

Declaration `MMI_SwitchVarBeep( BYVAL lOn AS Logical )`

Remarks The function allows the general switching (on/off) of a signal beep. A continuous signal beep will be switched off immediately.

Parameters

`lOn`	`in`	switches the beep on or off

lOn	**meaning**
`FALSE`	the beep is switched off generally
`TRUE`	beep is on; the functions `MMI_BeepNormal` etc. will only work if the beep is switched on.

Return-Codes

`RC_OK`	Successful termination.

See Also MMI_BeepNormal,
MMI_BeepLong,
MMI_BeepAlarm,
MMI_StartVarBeep,
MMI_GetVarBeepStatus

Example The example uses the MMI_SwitchVarBeep to switch off the beep.

```
MMI_SwitchVarBeep( TRUE )
```

6.1.37 MMI_GetVarBeepStatus

Description Read the switch status for a variable signal beep.

Declaration `MMI_GetVarBeepStatus( lOn AS Logical )`

Remarks The function retrieves the state of the general signal beep switch.

Parameters

lOn out state of the switch

lOn	**meaning**
FALSE	off
TRUE	on

Return-Codes

RC_OK	Successful termination.

See Also MMI_BeepNormal,
MMI_BeepLong,
MMI_BeepAlarm,
MMI_StartVarBeep,
MMI_SwitchVarBeep

Example The example uses the `MMI_GetVarBeepStatus` to revert the beep status (i.e. switch on when it is off and vice versa).

```
DIM lOn AS Logical

MMI_GetVarBeepStatus(lOn)
MMI_SwitchVarBeep( NOT lOn )
```

6.1.38 MMI_SwitchAFKey

Description Switch the `aF…` key on or off.

Declaration `MMI_SwitchAFKEY( BYVAL lOn AS Logical )`

Remarks The function allows the switching (on/off) off the `aF…` key. Normally it is enabled, but during tracking distances it is disabled.

Parameters

`lOn` `in` switches the beep on or off

lOn	**meaning**
FALSE	Key is switched off generally
TRUE	Key is active

Return-Codes

RC_OK	Successful termination.

See Also `BAP_MeasRec`, `BAP_MeasDistAng`

Example The example uses the `MMI_SwitchAFKey` to disable the `aF…` key.

```
MMI_SwitchAFKey( FALSE )
```

6.1.39 MMI_SwitchIconsBeep

Description Switches measurement icons and special beeps on or off.

Declaration `MMI_SwitchIconsBeep( BYVAL lOn AS Logical )`

Remarks The function allows the switching (on/off) of the measurement icons and special beeps (sector and lost lock).

Parameters

`lOn` `in` switches the icons and beep on or off

lOn	**meaning**
FALSE	no measurement icons and no special beep
TRUE	the measurement icons will be updated and the beeps are enabled. This is the normal state during a measurement dialog with continuos measurements.

Return-Codes

RC_OK	Successful termination.

See Also `BAP_MeasRec`
`BAP_MeasDistAng`

Example The example uses the `MMI_SwitchIconsBeep` to disable the icons and beeps.

```
MMI_SwitchIconsBeep( FALSE )
```

6.1.40 MMI_SetAngleRelation

Description Set the angle relationship.

Declaration

```
MMI_SetAngleRelation(
            BYVAL iVertRel AS Integer,
            BYVAL iHorzRel AS Integer)
```

Remarks This function sets the relationship of the vertical and horizontal angles. Fields already displayed are not updated.

Parameters

`iVertRel`	in	Relationship of the vertical angle; valid values:
		`MMI_VANGLE_IN_PERCENT`
		`MMI_VANGLE_REL_HORIZON`
		`MMI_VANGLE_REL_ZENIT`

`iHorzRel`	in	Relationship of the horizontal angle; valid values:
		`MMI_HANGLE_CLOCKWISE`
		`MMI_HANGLE_ANTICLOCKWISE`
		`MMI_HANGLE_CLOCKWISE_SOUTH`
		`MMI_HANGLE_BEARING`

Return Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	The function has been called with an invalid parameter

See Also `MMI_GetAngleRelation`

Example Set the angle relations (with internal default values).

```
MMI_SetAngleRelation(
      MMI_VANGLE_IN_PERCENT,
      MMI_HANGLE_CLOCKWISE)
```

6.1.41 MMI_GetAngleRelation

Description Request the current angle relationships.

Declaration
```
MMI_GetAngleRelation(iVertRel AS Integer,
                     iHorzRel AS Integer)
```

Remarks This function returns the current vertical- and horizontal- angle relationships.

Parameters

`iVertRel`	`out`	Relationship of the vertical angle
`iHorzRel`	`out`	Relationship of the horizontal angle

Return Codes

`none`

See Also `MMI_SetAngleRelation`

Example Get the angle relations.

```
DIM iVertRel AS Integer
DIM iHorzRel AS Integer

MMI_GetAngleRelation( iVertRel, iHorzRel )
```

6.1.42 MMI_SetVAngleMode

Description Set the V-Angle mode.

Declaration
```
MMI_SetVAngleMode(BYVAL lAngleFree AS
Logical)
```

Remarks This function sets the vertical angle mode. Normally (`lAngleFree=FALSE`), the vertical angle is fix if there is a valid distance available. If `lAngleFree=TRUE`, the vertical angle will be updated including all corresponding values (slope distance, vertical distance, coordinates etc)

Parameters

`lAngleFree`	`in`	TRUE: V-Angle is free (running)

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_GetVAngleMode`

Example See example file „`meas.gbs`“.

6.1.43 MMI_GetVAngleMode

Description Returns the V-Angle mode.

Declaration `MMI_GetVAngleMode(lAngleFree AS Logical)`

Remarks This function returns the vertical angle mode.

Parameters

`lAngleFree`	`in`	TRUE: V-Angle is free (running)

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_SetVAngleMode`

Example See example file „`meas.gbs`“.

6.1.44 MMI_SetAngleUnit

Description Set the displayed unit of angle.

Declaration

```
MMI_SetAngleUnit(BYVAL iUnit   AS Integer,
                 BYVAL iDigits AS Integer)
```

Remarks This function sets the displayed unit of angle. Existing display fields are not updated. If `iDigits` is greater than the maximal number it will be reset to it without notifying the user. A negative value of `iDigits` is not allowed.

Note	The maximal number of decimal digits depends on the Theodolite class.

Parameters

`iUnit` in Specified unit of angle; possible values:

value	meaning
MMI_ANGLE_GON	400 Gon
MMI_ANGLE_DEC	360 Decimal
MMI_ANGLE_SEXADEC	360 Sexadecimal
MMI_ANGLE_MIL	6400 Mil
MMI_ANGLE_PERCENT	$-300 \leq x \leq 300$; only for vertical angles

`iDigits` in Number of decimal places. The maximum number of decimal places (`iDigits`) for each unit is set to the following values:

angle unit	places
MMI_ANGLE_GON	0-4
MMI_ANGLE_DEC	0-4
MMI_ANGLE_SEXADEC	0-4
MMI_ANGLE_MIL	0-3
MMI_ANGLE_PERCENT	don’t care

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also `MMI_GetAngleUnit`

Example Set the angle unit.

```
MMI_SetAngleUnit( MMI_ANGLE_GON, 3 )
```

6.1.45 MMI_GetAngleUnit

Description Return the currently displayed unit of angle.

Declaration
```
MMI_GetAngleUnit(iUnit   AS Integer,
                 iDigits AS Integer)
```

Remarks This function returns the current unit of angle.

Parameters

`iUnit`	`out`	Specified unit of angle
`iDigits`	`out`	Number of decimal places.

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_SetAngleUnit`

Example Get the angle unit.

```
DIM iUnit AS Integer
DIM iDigits AS Integer

MMI_GetAngleUnit( iUnit, iDigits )
```

6.1.46 MMI_SetDistUnit

Description Set the displayed unit of distance.

Declaration
```
MMI_SetDistUnit(BYVAL iUnit   AS Integer,
                BYVAL iDigits AS Integer)
```

Remarks This function sets the display unit for distance. Fields already displayed are not updated. If `iDigits` is greater than the maximal number it will be reset to it without notifying the user. A negative value of `iDigits` is not allowed.

Note	The maximal number of decimal digits depends on the Theodolite class

Parameters

`iUnit`	in	Specified unit of distance; possible values:

value	**meaning**
MMI_DIST_METER	Meter
MMI_DIST_FOOT	normal foot
MMI_DIST_FOOT_INCH	normal foot / inch / 1/8inch
MMI_DIST_US_FOOT	US-foot
MMI_DIST_US_FOOT_INCH	US-foot / inch / 1/8inch
MMI_DIST_MM	Millimetre
MMI_DIST_INCH	inches

`iDigits`	in	Number of decimal places. The maximum number of decimal places (`iDigits`) for each unit is set to the following values:

angle unit	**places**
MMI_DIST_METER	0-4
MMI_DIST_FOOT	0-4
MMI_DIST_FOOT_INCH	0-1
MMI_DIST_US_FOOT	0-4
MMI_DIST_US_FOOT_INCH	0-1
MMI_DIST_MM	0
MMI_DIST_INCH	0-3

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also `MMI_GetDistUnit`

Example Set the distance unit.

```
MMI_SetDistUnit( MMI_DIST_METER, 4 )
```

6.1.47 MMI_GetDistUnit

Description Return the currently displayed unit of distance.

Declaration
```
MMI_GetDistUnit(    iUnit   AS Integer,
                    iDigits AS Integer)
```

Remarks This function returns the current unit of distance.

Parameters

iUnit	out	Specified unit of distance
iDigits	out	Number of decimal places.

Return Codes

RC_OK	Successful termination.

See Also MMI_SetDistUnit

Example Get the distance unit.

```
DIM iUnit AS Integer
DIM iDigits AS Integer

MMI_GetDistUnit( iUnit, iDigits )
```

6.1.48 MMI_SetPressUnit

Description Set the displayed unit of pressure.

Declaration
```
MMI_SetPressUnit(BYVAL iUnit   AS Integer,
                 BYVAL iDigits AS Integer)
```

Remarks This function sets the display unit for pressure. Fields already displayed are not updated. If `iDigits` is greater than 1 it will be reset to it without notifying the user. A negative value of `iDigits` is not allowed.

Parameters

iUnit	in	Specified unit of pressure; possible values:

value	meaning
MMI_PRESS_MBAR	MilliBar
MMI_PRESS_MMHG	Millimetre mercury
MMI_PRESS_INCHHG	Inch mercury
MMI_PRESS_HPA	Hekto-Pascal
MMI_PRESS_PSI	PSI

iDigits	in	Number of decimal places. The maximum number of decimal places (iDigits) for each unit is set to the following values:

angle unit	places
MMI_PRESS_MBAR	0-1
MMI_PRESS_MMHG	0-1
MMI_PRESS_INCHHG	0-1
MMI_PRESS_HPA	0-1
MMI_PRESS_PSI	0-1

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetPressUnit

Example Set the pressure unit.

```
MMI_SetPressUnit( MMI_PRESS_MBAR, 1 )
```

6.1.49 MMI_GetPressUnit

Description Return the currently displayed unit of pressure.

Declaration
```
MMI_GetPressUnit(iUnit   AS Integer,
                 iDigits AS Integer)
```

Remarks This function returns the current unit of pressure.

Parameters

iUnit	out	Specified unit of pressure
iDigits	out	Number of decimal places.

Return Codes

RC_OK	Successful termination.

See Also MMI_SetPressUnit

Example Get the pressure unit.
```
DIM iUnit AS Integer
DIM iDigits AS Integer

MMI_GetPressUnit( iUnit, iDigits )
```

6.1.50 MMI_SetTempUnit

Description Set the displayed unit of temperature.

Declaration
```
MMI_SetTempUnit(BYVAL iUnit   AS Integer,
                BYVAL iDigits AS Integer)
```

Remarks This function sets the display unit for temperature. Fields already displayed are not updated. If `iDigits` is greater than 1 it will be reset to it without notifying the user. A negative value of `iDigits` is not allowed.

Parameters

iUnit	in	Specified unit of temperature; possible values:

value	meaning
MMI_TEMP_C	Celsius
MMI_TEMP_F	Fahrenheit

iDigits	in	Number of decimal places. The maximum number of decimal places (iDigits) for each unit is set to the following values:

angle unit	places
MMI_TEMP_C	0-1
MMI_TEMP_F	0-1

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetTempUnit

Example Set the temperature unit.

```
MMI_SetTempUnit( MMI_TEMP_C, 1 )
```

6.1.51 MMI_GetTempUnit

Description Return the currently displayed unit of temperature.

Declaration

```
MMI_GetTempUnit(iUnit   AS Integer,
                iDigits AS Integer)
```

Remarks This function returns the current unit of temperature.

Parameters

iUnit	out	Specified unit of temperature
iDigits	out	Number of decimal places.

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_SetTempUnit`

Example Get the temperature unit.

```
DIM iUnit   AS Integer
DIM iDigits AS Integer

MMI_GetTempUnit( iUnit, iDigits )
```

6.1.52 MMI_SetDateFormat

Description Set the date display format.

Declaration `MMI_SetDateFormat(BYVAL iFormat AS Integer)`

Remarks This function sets the format in which the date is to be displayed. Existing fields remain unchanged.

Parameters

`iFormat` in Specified date format; possible values:

value	meaning
`MMI_DATE_EU`	European: DD.MM.YY
`MMI_DATE_US`	US: MM/DD/YY
`MMI_DATE_JP`	Japanese: YY/MM/DD

Return Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	The function has been called with an invalid parameter

See Also `MMI_GetDateFormat`

Example Set the date format (internal default value).

```
MMI_SetDateFormat( MMI_DATE_EU )
```

6.1.53 MMI_GetDateFormat

Description Retrieves the date display format.

Declaration `MMI_GetDateFormat(iFormat AS Integer)`

Remarks This function retrieves the format used to display the date.

Parameters

`iFormat`	`out`	Specified date format

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_SetDateFormat`

Example Get the date format.

```
DIM iFormat AS Integer

MMI_GetDateFormat( iFormat )
```

6.1.54 MMI_SetTimeFormat

Description Set the time display format.

Declaration `MMI_SetTimeFormat(BYVAL iFormat AS Integer)`

Remarks This function sets the format in which the time is to be displayed. Existing fields remain unchanged.

Parameters

`iFormat` `in` Specified time format; possible values:

value	**meaning**
`MMI_TIME_12H`	12 hour display
`MMI_TIME_24H`	24 hour display

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetTimeFormat

Example Set the time format (internal default value).

```
MMI_SetTimeFormat( MMI_TIME_12H )
```

6.1.55 MMI_GetTimeFormat

Description Retrieves the time display format.

Declaration `MMI_GetTimeFormat(iFormat AS Integer)`

Remarks This function retrieves the format used to display the time.

Parameters

iFormat	out	Specified time format

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_SetTimeFormat

Example Get the time format.

```
DIM iFormat AS Integer

MMI_GetTimeFormat( iFormat )
```

6.1.56 MMI_SetCoordOrder

Description Set the co-ordinate order.

Declaration `MMI_SetCoordOrder(BYVAL iOrder AS Integer)`

Remarks This function sets the order of co-ordinates. The fields already displayed are not changed.

Parameters

`iOrder`	`in`	Specifies the co-ordinate order; possible values:

value	meaning
`MMI_COORD_N_E`	Order North East
`MMI_COORD_E_N`	Order East North

Return Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	The function has been called with an invalid parameter

See Also `MMI_GetCoordOrder`

Example Set the co-ordinate order (internal default value).

```
MMI_SetCoordOrder( MMI_COORD_N_E )
```

6.1.57 MMI_GetCoordOrder

Description Retrieve the co-ordinate order.

Declaration `MMI_GetCoordOrder(iOrder AS Integer)`

Remarks This function retrieves the order in which co-ordinates are displayed.

Parameters

`iOrder`	`out`	Specified co-ordinate order

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_SetCoordOrder`

Example Get the co-ordinate order.

```
DIM iOrder AS Integer
MMI_GetCoordOrder( iOrder )
```

6.1.58 MMI_SetLanguage

Description Set the display language.

Declaration

```
MMI_SetLanguage(
      BYVAL iLanguageNr AS Integer )
```

Remarks This function sets the current language. All displayed text are immediately shown in the new language.

Parameters

`iLanguageNr` `in` Specifies the language number; possible values:

Value	Meaning
`MMI_REF_LANGUAGE`	Reference language (English) = 1
`2.. MMI_MAX_LANGUAGE`	Language numbers

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter.
TXT_UNDEF_LANG	The given language is not defined.

See Also MMI_GetLanguage

Example Set the language for the display (internal default value).

```
MMI_SetLanguage( MMI_REF_LANGUAGE )
```

6.1.59 MMI_GetLanguage

Description Query the current language.

Declaration

```
MMI_GetLanguage( iLangNr AS Integer,
                 sLangName AS String20)
```

Remarks This function returns the current language and the associated character symbols.

Parameters

iLangNr	out	Language number
sLangName	out	Language description

Return Codes

RC_OK	Successful termination.

See Also MMI_SetLanguage

Example Get the current language.

```
DIM iLangNr   AS Integer
DIM sLangName AS String20

MMI_GetLanguage( iLangNr, sLangName )
```

6.1.60 MMI_GetLangName

Description Gets the name to a language number.

Declaration

```
MMI_GetLangName(
                byVal iLangNr    AS Integer,
                      sLangName  AS String20)
```

Remarks This routine delivers the name associated with the number `iLangNr`.

Parameters

iLangNr	in	Language number
sLangName	out	Language description

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	iLangNr is invalid

See Also MMI_SetLanguage
MMI_GetLanguage

Example Get the name of a language.

```
DIM sLangName AS String20

MMI_GetLangName( 2, sLangName )
```

6.2 BASIC APPLICATIONS BAP

6.2.1 Summarizing Lists of BAP Types and Procedures

6.2.1.1 Procedures

procedure name	description
`BAP_SetAccessoriesDlg`	Sets the used accessories
`BAP_FineAdjust`	Automatic target positioning
`BAP_GetMeasPrg`	Get the current distance measure program.
`BAP_MeasDistAngle`	Measures distance and angles.
`BAP_MeasRec`	Measures and record distance and angles.
`BAP_PosTelescope`	Positioning of the Telescope.
`BAP_SearchPrism`	Searches the prism.
`BAP_SetHz`	Sets the horizontal angle to 0 or another given value.
`BAP_SetManDist`	Set the distance manually.
`BAP_SetMeasPrg`	Set the distance measure program.
`BAP_SetPpm`	Sets the ppm for distance measurements.
`BAP_SetPrism`	Sets the current prism type and constant.

6.2.2 BAP_SetAccessoriesDlg

Description Sets the used accessories.

Declaration `BAP_SetAccessoriesDlg()`

Remarks This function displays the accessories dialog.

Parameters

-

Return-Codes

RC_OK	Successful termination.

Example The example displays the accessories dialog

```
BAP_SetAccessoriesDlg()
```

6.2.3 BAP_MeasDistAngle

Description Measures distance and angles.

Declaration

```
BAP_MeasDistAngle( iDistMode    AS Integer,
                   dHz          AS Angle,
                   dV           AS Angle,
                   dDist        AS Distance,
            BYVAL  lDisplayOn   AS Logical,
            BYVAL  sCaptionLeft AS _Token )
```

Remarks Measures distance and angles and updates the data pool after correct measurements. It controls the special beep (Sector or Lost Lock) and switches measurement icons and disables the `aF...` key during tracking.

Parameters

`iDistMode` Distance measuring modes:

Mode as Input	Meaning
`BAP_NO_MEAS`	No new measurement, get last one
`BAP_NO_DIST`	No distance measurement, get only angles
`BAP_DEF_DIST`	Measure distance and angles using default measurement program
`BAP_TRK_DIST`	Measure distance and angles using the tracking measurement program
`BAP_RTRK_DIST`	Measure distance and angles using the fast tracking measurement program
`BAP_STOP_TRK`	Stop tracking, no measurement. No valid results returned.
`BAP_CLEAR_DIST`	Clear distance (Theodolite data-pool), no measurement. No valid results returned.
`BAP_RED_TRK_ DIST`	Measure distance and angles using the tracking with red laser measurement program
Mode returned	**Meaning**
`BAP_DEF_DIST`	Depends on distance measurement. Can be changed during distance measurement.
`BAP_TRK_DIST`	Depends on distance measurement. Can be changed during distance measurement.
`BAP_RTRK_DIST`	Depends on distance measurement. Can be changed during distance measurement.
`All other modes`	Returns `BAP_DEF_DIST`.

`dHz, dV` `out` Angles [rad] , depends on

		`iDistMode`
`dDist`	out	Distance [m], depends on `iDistMode`
`sCaptionLeft`	in	Left caption for the distance measurement display.
`lDisplayOn`	in	`TRUE`: shows the distance measurement display during distance measurement.

Return Codes

`RC_OK`	Measurement executed successfully
`AUT_RC_ANGLE_ERROR`	Angle measurement error
`AUT_RC_BAD_ENVIRONMENT`	Bad Environment conditions
`AUT_RC_CALACC`	ATR-calibration failed
`AUT_RC_DETECTOR_ERROR`	Error in target acquisition
`AUT_RC_DETENT_ERROR`	Positioning not possible due to mounted EDM
`AUT_RC_DEV_ERROR`	Deviation measurement error
`AUT_RC_INCACC`	Position not exactly reached
`AUT_RC_MOTOR_ERROR`	Motorization error
`AUT_RC_MULTIPLE_TARGETS`	Multiple targets detected
`AUT_RC_NO_TARGET`	No target detected
`AUT_RC_TIMEOUT`	Position not reached
`BAP_CHANGE_ALL_TO_DIST`	No prism has been found during distance measurement with ATR, command changed from "`All`" to "`Dist`"
`TMC_ACCURACY_GUARANTEE`	Info, accuracy cannot be guaranteed
`TMC_ANGLE_ACCURACY_GUARANTEE`	Info, only angle measurement valid, accuracy cannot be guaranteed

TMC_ANGLE_ERROR	Error, no valid angle measurement
TMC_ANGLE_NO_ FULL_ CORRECTION	Warning, only angle measurement valid, accuracy cannot be guaranteed
TMC_ANGLE_OK	Warning, only angle measurement valid
TMC_BUSY	Error, TMC submodule already in use by another subsystem, command not processed
TMC_DIST_ERROR	An error occurred during distance measurement.
TMC_DIST_PPM	Error, wrong setting of PPM or MM on EDM
TMC_NO_FULL_ CORRECTION	Warning, measurement without full correction
TMC_SIGNAL_ERROR	Error, no signal on EDM (only in signal mode)
RC_ABORT	Error, measurement aborted
RC_IVPARAM	Error, invalid DistMode

See Also BAP_MeasRec

Example See example file „meas.gbs“.

The example uses the BAP_MeasDistAngle routine to measure a distance and angles.

```
DIM iDistMode   AS Integer
DIM dHz         AS Angle
DIM dV          AS Angle
DIM dDist       AS Distance

iDistMode = BAP_DEF_DIST
BAP_MeasDistAngle(iDistMode, dHz, dV, dDist,
TRUE, "TEST")
```

6.2.4 BAP_MeasRec

Description Measures distance and angles records.

Declaration

```
BAP_MeasRec(        iDistMode      AS Integer,
             BYVAL  lDisplayOn     AS Logical,
             BYVAL  sCaptionLeft   AS _Token )
```

Remarks Measures distance and angles and updates the Theodolite data pool after correct measurements and records values according the predefined record mask. After recording, a running point number will be incremented.

It controls the special beep (Sector or Lost Lock), switches Measurement icons and disables `aF...` Key during tracking.

Parameters

`iDistMode` Distance measuring modes:

Mode as Input	**Meaning**
BAP_NO_MEAS	No new measurement before recording
BAP_NO_DIST	No distance measurement before recording (only new angles)
BAP_DEF_DIST	Use default distance measurement program and record values
BAP_TRK_DIST	Use the tracking measurement program and record values
BAP_RTRK_DIST	Use the fast tracking measurement program and record values
BAP_STOP_TRK	Stop tracking, no measurement and no recording
BAP_CLEAR_DIST	Clear distance (Theodolite data pool), no measurement and no recording.
BAP_RED_TRK_ DIST	Use the tracking with red laser measurement program and record values

Mode returned	Meaning
BAP_DEF_DIST	Depends on distance measurement. Can be changed during distance measurement.
BAP_TRK_DIST	Depends on distance measurement. Can be changed during distance measurement.
BAP_RTRK_DIST	Depends on distance measurement. Can be changed during distance measurement.
All other modes	Returns BAP_DEF_DIST.

sCaptionLeft	in	Left caption for the distance measurement display.
lDisplayOn	in	TRUE: shows the distance measurement display during distance measurement.

Return Codes

RC_OK	Successful termination.
WIR_NO_MEDIUM	No storage medium is available.
AUT_RC_ANGLE_ERROR	Angle measurement error
AUT_RC_BAD_ENVIRONMENT	Bad Environment conditions
AUT_RC_CALACC	ATR-calibration failed
AUT_RC_DETECTOR_ERROR	Error in target acquisition
AUT_RC_DETENT_ERROR	Positioning not possible due to mounted EDM
AUT_RC_DEV_ERROR	Deviation measurement error
AUT_RC_INCACC	Position not exactly reached
AUT_RC_MOTOR_ERROR	Motorization error
AUT_RC_MULTIPLE_TARGETS	Multiple targets detected

AUT_RC_NO_TARGET	No target detected
AUT_RC_TIMEOUT	Position not reached
BAP_CHANGE_ALL_ TO_DIST	No prism has been found during distance measurement with ATR, command changed from "All" to "Dist"
TMC_ACCURACY_ GUARANTEE	Info, accuracy cannot be guaranteed
TMC_ANGLE_ ACCURACY_ GUARANTEE	Info, only angle measurement valid, accuracy cannot be guaranteed
TMC_ANGLE_ERROR	Error, no valid angle measurement
TMC_ANGLE_NO_ FULL_ CORRECTION	Warning, only angle measurement valid, accuracy cannot be guaranteed
TMC_ANGLE_OK	Warning, only angle measurement valid
TMC_BUSY	Error, TMC sub-module already in use by another subsystem, command not processed
TMC_DIST_ERROR	An error occurred during distance measurement.
TMC_DIST_PPM	Error, wrong setting of PPM or MM on EDM
TMC_NO_FULL_ CORRECTION	Warning, measurement without full correction
TMC_SIGNAL_ERROR	Error, no signal on EDM (only in signal mode)
RC_ABORT	Error, measurement aborted
RC_IVPARAM	Error, invalid DistMode

See Also BAP_MeasDistAngle, GSI_SetRecMask

Example See example file „meas.gbs“.

The example uses the BAP_MeasMeasRec routine to record actual distance and angles (no new measurement.

```
DIM iDistMode   AS Integer

iDistMode = BAP_NO_MEAS ' no measurement
BAP_MeasRec(iDistMode, FALSE, "")
```

6.2.5 BAP_FineAdjust

Description Automatic target positioning.

Declaration

```
BAP_FineAdjust(
          BYVAL dSearchHz AS Angle,
          BYVAL dSearchV  AS Angle )
```

Remarks This procedure performs a positioning of the Theodolite axis onto a destination target. If the target is not within the sensor measure region a target search will be executed. The target search range is limited by the parameter dSearchV in V- direction and by parameter dSearchHz in Hz - direction. If no target is found, the instrument turns back to the initial start position. The ATR mode must be enabled for this functionality, see CSV_SetATRStatus and CSV_GetATRStatus.

Parameters

dSearchHz	in	Search range Hz
dSearchV	in	Search range V

Return Codes

RC_OK	Successful termination.
AUT_RC_TIMEOUT	Timeout while positioning of one or both axes. The position fault lies above 100[cc].
AUT_RC_MOTOR_ ERROR	Instrument has no ‘motorization’.
RC_FATAL	Fatal error.
RC_ABORT	Function aborted.
AUT_RC_NO_TARGET	No target found.

`AUT_RC_MULTIPLE_TARGETS`	Multiple targets found.
`AUT_RC_BAD_ENVIRONMENT`	Inadequate environment conditions.
`AUT_RC_DEV_ERROR`	During the determination of the angle deviation error detected, repeat fine positioning
`AUT_RC_NOT_ENABLED`	ATR mode not enabled, enable ATR mode
`AUT_RC_DETECTOR_ERROR`	ATR error, at repeated occur call service

See Also `CSV_SetATRStatus, CSV_GetATRStatus`

Example The example see sample `TRACKING.GBS.`

6.2.6 BAP_SearchPrism

Description Searches the prism.

Declaration

```
BAP_SearchPrism(
          BYVAL lShowMessages As Logical )
```

Remarks This procedure searches the prism. The searching area depends on the defined searching area and on the setting of the additional working area.
This routine works only in ATR instruments and needs at least Firmware-Release 2.00

Parameters

`lShowMessages`	`in`	TRUE: show error-messages if there are problems to find the prism

Return Codes

`RC_OK`	Successful termination.
`AUT_RC_TIMEOUT`	Timeout while positioning of one or both axes. The position fault lies above 100[cc].

`AUT_RC_MOTOR_ ERROR`	Instrument has no ‘motorization’.
`RC_FATAL`	Fatal error.
`RC_ABORT`	Function aborted.
`AUT_RC_NO_TARGET`	No target found.
`AUT_RC_MULTIPLE_ TARGETS`	Multiple targets found.
`AUT_RC_BAD_ ENVIRONMENT`	Inadequate environment conditions.
`AUT_RC_DEV_ERROR`	During the determination of the angle deviation error detected, repeat fine positioning
`AUT_RC_NOT_ ENABLED`	ATR mode not enabled, enable ATR mode

See Also `CSV_SetATRStatus, CSV_GetATRStatus`

6.2.7 BAP_SetManDist

Description Set the distance manually.

Declaration

```
BAP_SetManDist(
          BYVAL sCaptionLeft AS _Token,
          BYVAL dDistance AS Double,
                iButtonId AS Integer )
```

Remarks The `BAP_SetManDist` routine starts a dialog with the caption `sCaption` where the user can enter a horizontal distance. The distance will be stored into the Theodolite data pool.

Parameters

`sCaptionLeft`	`in`	left caption string of the dialog
`dDistance`	`in`	initial value for the distance. A negative value will be displayed as `"----"`
`iButtonId`	`out`	identifier of the pressed valid button to exit the dialog

Return Codes

`RC_OK`	Successful termination.
`TMC_ACCURACY_ GUARANTEE`	Info, accuracy cannot be guaranteed
`TMC_ANGLE_ERROR`	Error, no valid angle measurement
`TMC_ANGLE_OK`	Warning, only angle measurement valid
`TMC_BUSY`	Error, TMC sub-module already in use by another subsystem, command not processed
`TMC_NO_FULL_ CORRECTION`	Warning, measurement without full correction
`RC_IVPARAM`	Error, invalid `DistMode`

See Also `TMC_IfDistTapeMeasured, TMC_SetHandDist, TMC_GetPolar, TMC_GetCoordinate`

Example The example uses the `BAP_SetManDist` routine to enter a distance.

```
DIM iButton   AS Integer
DIM dInitDist AS Distance

dInitDist = 15.0   'initial value

BAP_SetManDist( "BASIC", dInitDist, iButton )
```

6.2.8 BAP_SetPpm

Description Sets the PPM for distance measurements.

Declaration `BAP_SetPpm()`

Remarks The `BAP_SetPpm` routine opens a dialog which the user can complete in order to calculate the PPM (parts per million) correction to be used to reduce the distance measured by the EDM.

Return Codes

`RC_OK`	Successful termination.

`RC_SET_INCOMPL`	Parameter set-up for subsystem incomplete.

See Also `BAP_SetManDist, BAP_SetPrism`

Example The example uses the `BAP_SetPpm` routine to open the PPM dialog.

```
BAP_SetPpm()
```

6.2.9 BAP_SetPrism

Description Sets the current prism type and constant.

Declaration `BAP_SetPrism()`

Remarks The `BAP_SetPrism` routine opens a dialog which the user can complete in order to choose one of five prism types/constants. Two types are LEICA defaults, whereas the other three can be named and the constant values given/changed by the user. The prism constants are always given and displayed in millimetres, regardless of the distance units in use at the time.

Return Codes

`RC_OK`	Successful termination.

See Also `BAP_SetManDist, BAP_SetPpm`

Example The example uses the `BAP_SetPrism routine` to open the Prism dialog.

```
BAP_SetPrism()
```

6.2.10 BAP_SetMeasPrg

Description Set the distance measure program.

Declaration `BAP_SetMeasPrg( BYVAL iMeasPrg AS Integer )`

Remarks The `BAP_SetMeasPrg` routine sets the program for the distance measurement.

Parameters

`iMeasPrg`	`in`	Distance measure program

Valid measure programs	Meaning
`BAP_SINGLE_REF_STANDARD`	Single measurement, with reflector, standard speed
`BAP_SINGLE_REF_FAST`	Single measurement, with reflector, fast
`BAP_SINGLE_REF_VISIBLE`	Single measurement, with reflector and red laser
`BAP_SINGLE_RLESS_VISIBLE`	Single measurement, reflectorless, with red laser
`BAP_CONT_REF_STANDARD`	Continuous measurement, with reflector, standard speed
`BAP_CONT_REF_FAST`	Continuous measurement, with reflector, fast
`BAP_CONT_RLESS_VISIBLE`	Continuous measurement, reflectorless, with red laser
`BAP_AVG_REF_STANDARD`	Average measurement, with reflector, standard speed
`BAP_AVG_REF_VISIBLE`	Average measurement, with reflector and red laser
`BAP_AVG_RLESS_VISIBLE`	Average measurement, reflectorless, with red laser

See Also `BAP_GetMeasPrg`

Example The example uses the `BAP_SetMeasPrg` routine to set the distance measurement program on single measurement without reflector.

```
BAP_SetMeasPrg(BAP_SINGLE_RLESS_VISIBLE)
```

6.2.11 BAP_GetMeasPrg

Description Get the current distance measure program.

Declaration `BAP_GetMeasPrg( iMeasPrg AS Integer )`

Remarks The `BAP_GetMeasPrg` routine fetches the current program for the distance measurement.

Parameters

`iMeasPrg`	`out`	Distance measure program

Valid measure programs	**Meaning**
`BAP_SINGLE_REF_STANDARD`	Single measurement, with reflector, standard speed
`BAP_SINGLE_REF_FAST`	Single measurement, with reflector, fast
`BAP_SINGLE_REF_VISIBLE`	Single measurement, with reflector and red laser
`BAP_SINGLE_RLESS_VISIBLE`	Single measurement, reflectorless, with red laser
`BAP_CONT_REF_STANDARD`	Continuous measurement, with reflector, standard speed
`BAP_CONT_REF_FAST`	Continuous measurement, with reflector, fast
`BAP_CONT_RLESS_VISIBLE`	Continuous measurement, reflectorless, with red laser
`BAP_AVG_REF_STANDARD`	Average measurement, with reflector, standard speed
`BAP_AVG_REF_VISIBLE`	Average measurement, with reflector and red laser
`BAP_AVG_RLESS_VISIBLE`	Average measurement, reflectorless, with red laser

See Also `BAP_SetMeasPrg`

Example The example uses the `BAP_GetMeasPrg` routine to fetch the current distance measurement program.

```
DIM iMeasPrg AS Integer

BAP_GetMeasPrg(iMeasPrg)
```

6.2.12 BAP_PosTelescope

Description Positioning of the Telescope.

Declaration

```
BAP_PosTelescope(
            BYVAL eMode        AS Integer,
            BYVAL eDspMode     AS Integer,
            BYVAL dHz          AS Double,
            BYVAL dV           AS Double,
            BYVAL dHzTolerance AS Double,
            BYVAL dVTolerance  AS Double)
```

Remarks This procedure positions the telescope according to the specified mode and angles.

Parameters

`eMode`	Positioning mode.	
	`BAP_POSIT`	positioning on Hz and V angle
	`BAP_POSIT_HZ`	positioning on Hz angle
	`BAP_POSIT_V`	positioning on V angle
	`BAP_CHANGE_FACE`	change face

`eDspMode`	Controls the context and layout of the display during manual positioning. This parameter has no effect on motorised Theodolites. `BAP_POS_NOMSG` No message will be displayed `BAP_POS_MSG` Only a message will be displayed `BAP_POS_DLG` Positioning will be guided with a dialog if it is a non motorised Theodolite
`dHz, dV`	Target position
`dHzTolerance, dVTolerance`	In case of manual positioning, the tolerances define the upper and lower boundaries of the target position. For successful termination of the positioning, the final target position must be within these boundaries. If the tolerance is lower then the default accuracy of the Theodolite, the tolerance will be the default accuracy.

Return Codes

`RC_OK`	Positioning successful
`RC_ABORT`	Abnormal termination (No positioning possible, ESC-Key)

See Also `CSV_MakePositioning`
`CSV_ChangeFace`

Example Position the telescope.

```
BAP_PosTelescope(BAP_CHANGE_FACE, BAP_POS_DLG,
     0, 0, .5, .5 )
```

6.2.13 BAP_SetHz

Description Sets the horizontal angle to 0 or another given value.

Declaration `BAP_SetHz( BYVAL sCaptionLeft AS _Token )`

Remarks This procedure offers a dialogue which the user can complete in order to influence the angular offset provided by the TMC subsystem for the horizontal angle encoder. A button is provided for setting the angle to zero, directly, or the user may prefer to input another given value. Furthermore, the angle beep (at the quarter circle positions from 0°) can be turned on and off.

Note	If the instrument is in Lock mode, then the instrument tries to lock first before it sets the angle to 0.

Parameters

`sCaptionLeft`	Left caption text for dialog

See Also

Return Codes

`RC_OK`	Horizontal angular offset correct.

Example Set the horizontal angle.

```
BAP_SetHz("BASIC" )
```

6.3 MEASUREMENT FUNCTIONS TMC

This section contains the lower level measurement procedures.

6.3.1 Summarizing Lists of TMC Types and Procedures

6.3.1.1 Types

type name	description
TMC_ANG_SWITCH_Type	Angle measurement switches
TMC_Angle_Type	Data structure for measuring angles.
TMC_Coordinate_Type	Data structure for the co-ordinates (tracking and fixed co-ordinates).
TMC_DIST_SWITCHES_Type	Distance measurement switches
TMC_Distance_Type	Data structure for the distance measurement.
TMC_HZ_V_Ang_Type	Horizontal and vertical angle.
TMC_Incline_Type	Data structure for the inclination measurement.
TMC_OFFSET_DIST_Type	Target offset
TMC_PPM_CORR_Type	Correction for distance measurement
TMC_REFRACTION_Type	Refraction correction for distance measurement
TMC_STATION_Type	Station co-ordinates

6.3.1.2 Procedures

procedure name	description
TMC_DoMeasure	Start a measure program.
TMC_Get/SetAngleFaceDef	Gets and sets the current face definition.

procedure name	description
`TMC_Get/ SetRefractiveCorr`	Gets and sets the refractive correction for measuring the distance.
`TMC_Get/ SetRefractiveMethod`	Gets and sets the method of refractive correction for measuring the distance.
`TMC_Get/SetDistPpm`	Gets and sets the correction values for distance measurements.
`TMC_Get/SetHeight`	Gets and sets the current height of the reflector.
`TMC_Get/SetHzOffset`	Gets and sets the current horizontal offset.
`TMC_Get/SetStation`	Gets and sets station co-ordinates.
`TMC_GetAngle`	Measure angles.
`TMC_GetAngle_Winc`	Measure angles with inclination control
`TMC_GetAngSwitch`	Returns the angle measurement correction switches
`TMC_GetCoordinate`	Calculate and read co-ordinates.
`TMC_GetDistSwitch`	Returns the distance measurement correction switches
`TMC_GetFace1`	Get face information of current telescope position
`TMC_GetInclineStatus`	Returns the inclination compensator status.
`TMC_GetInclineSwitch`	Returns the compensator switch
`TMC_GetOffsetDist`	Returns the distance measurement offset
`TMC_GetPolar`	Calculate and read polar co-ordinates.
`TMC_GetSimpleMea`	Gets the results of distance and angle measurement
`TMC_IfDistTapeMeasured`	Gets information about manual measurement.
`TMC_IfOffsetDistMeasured`	Returns the EDM measurement mode
`TMC_QuickDist`	Measure slope distance and angles
`TMC_SetAngSwitch`	Defines the angle measurement correction switches
`TMC_SetDistSwitch`	Defines the distance measurement correction switches
`TMC_SetHandDist`	Sets distance manually.

procedure name	**description**
`TMC_SetInclineSwitch`	Defines the compensator switch
`TMC_SetOffsetDist`	Defines the distance measurement offset

6.3.2 TMC Data Structures

6.3.2.1 TMC_INCLINE - Data structure for the inclination measurement

```
TYPE TMC_Incline_Type
  dCrossIncline        AS Double     cross inclination
  dLengthIncline       AS Double     alongside inclination
  dAccuracyIncline     AS Double     accuracy of measuring
  InclineTime          AS Integer    time of measuring
END TMC_Incline_Type
```

6.3.2.2 TMC_ANGLE - Data structure for measuring angles

```
TYPE TMC_Angle_Type
  dHz              AS Double       horizontal angle
  dV               AS Double       vertical angle
  dAngleAccuracy   AS Double       accuracy of angle
  iAngleTime       AS Integer      time of measurement
  Incline          AS TMC_         inclination belonging to the
                     Incline_Type  measurement
  iFace            AS Integer      information about position
                                   of the telescope
END TMC_Angle_Type
```

6.3.2.3 TMC_DISTANCE - Data structure for the distance measurement

`TYPE TMC_Distance_Type`		
`Angle`	`AS TMC_Angle_Type`	set of angles belonging to distance
`dSlopeDist`	`AS Double`	slope distance
`dSlopeDistAccuracy`	`AS Double`	accuracy of distance
`dHorizDist`	`AS Double`	horizontal distance
`dHeightDiff`	`AS Double`	difference in altitude
`AngleCont`	`AS TMC_Angle_Type`	set of angles, measured continuously
`dSlopeDistCont`	`AS Double`	slope distance, measured continuously
`dHeightDiffCont`	`AS Double`	distance in altitude, measured continuously
`END TMC_Distance_Type`		

6.3.2.4 TMC_COORDINATE - Data structure for the coordinates

(tracking and fixed co-ordinates)

`TYPE TMC_Coordinate_Type`		
`dE`	`AS Double`	east co-ordinate
`dN`	`AS Double`	north co-ordinate
`dH`	`AS Double`	height co-ordinate
`iCoordTime`	`AS Integer`	time of measurement
`dE_Cont`	`AS Double`	east coordinate, measured continuously
`dN_Cont`	`AS Double`	north co-ordinate, measured continuously
`dH_Cont`	`AS Double`	height co-ordinate, measured continuously
`iCoordContTime`	`AS Integer`	time of continuous measurement
`END TMC_Coordinate_Type`		

6.3.2.5 TMC_HZ_V_ANG - Horizontal and vertical angle

`TYPE TMC_HZ_V_Ang_Type`		
`dHz`	`AS Double`	horizontal angle
`dV`	`AS Double`	vertical angle
`END TMC_HZ_V_Ang_Type`		

6.3.2.6 TMC_PPM_CORR - Correction for distance measurement

```
TYPE TMC_PPM_CORR_Type
  dPpmI                AS Double     individual
  dPpmA                AS Double     atmospheric
  dPpmR                AS Double     height relative
  dPpmP                AS Double     projection contortion
END TMC_PPM_CORR_Type
```

6.3.2.7 TMC_STATION - Station coordinates

```
TYPE TMC_STATION_Type
  dE0                  AS Double     easting co-ordinate
  dN0                  AS Double     northing co-ordinate
  dH0                  AS Double     height co-ordinate
  dHi                  AS Double     instrument height
END TMC_STATION_Type
```

6.3.2.8 TMC_REFRACTION- Refraction correction for distance measurement

```
TYPE TMC_REFRACTION_Type
  bOnOff               AS Logical    TRUE if refraction is valid
  dEarthRadius         AS Double     earth radius
  dRefractiveScale     AS Double     refraction coefficient
END TMC_REFRACTION_Type
```

6.3.2.9 TMC_DIST_SWITCH_Type– Distance measurement switches

```
TYPE TMC_DIST_SWITCHES_Type
  lAxisDifferCorr   AS Logical  'EDM to optical axis correction
  lProjectScaleCorr AS Logical  'Projection scale correction
  lHgtReductionCorr AS Logical  'Height reduction correction
END TMC_DIST_SWITCHES_Type
```

6.3.2.10 TMC_ANGLE_SWITCH_Type – Angle measurement switches

```
TYPE TMC_ANG_SWITCH_Type
  lInclineCorr      AS Logical ' Inclination correction
  lStandAxisCorr    AS Logical ' Standing axis correction
  lCollimationCorr AS Logical ' Collimation error correction
  lTiltAxisCorr     AS Logical ' Tilting axis correction
END TMC_ANG_SWITCH_Type
```

6.3.2.11 TMC_OFFSET_DIST_Type – Target offset

```
TYPE TMC_OFFSET_DIST_Type
 dLengthVal  AS Distance     ' Target - Offset Length
 dCrossVal   AS Distance     ' Target - Offset Cross
 dHeightVal  AS Distance     ' Target - Offset Height
END TMC_OFFSET_DIST_Type
```

6.3.3 TMC_DoMeasure

Description Start a measure program.

Declaration `TMC_DoMeasure( BYVAL iCommand AS Integer )`

Remarks With this function a measure program is started. The commands start a distance measurement and / or a test mode. In addition an angle- and an inclination-measure are done (not at measurement).

The tracking measure program performs e.g. as follows: Start the measure program with `TMC_DoMeasure(TMC_TRK_DIST)`. The electronic distance measuring device (EDM) begins to run. Now the co-ordinates can be read, e.g. with `TMC_GetCoordinate()`. Tracking can be stopped with `TMC_DoMeasure(TMC_STOP)`. With `TMC_DoMeasure(TMC_CLEAR)` the function will be stopped and the distance cleared.

Note	After calling a measure program, the last valid distance results will be cleared (as after `TMC_STOP`).

Parameters

`iCommand` `in` start a measure program; possible values:

`TMC_STOP`	switch off EDM and finish program
`TMC_DEF_DIST`	do default distance measure
`TMC_TRK_DIST`	do tracking distance measure
`TMC_RTRK_DIST`	do fast tracking distance measure
`TMC_CLEAR`	clear distance and switch off EDM
`TMC_SIGNAL`	start signal measurement (test mode)
`TMC_RED_TRK_DIST`	do tracking distance measure with red laser

See Also `TMC_GetPolar`
`TMC_GetCoordinate`

Return Codes

`RC_OK`	measure program started
`RC_IVPARAM`	The function has been called with an invalid parameter
`TMC_BUSY`	Measurement system is busy

Example Start a distance measure, do something, stop it and clear results.

The following variable has to be defined:

```
TMC_DoMeasure (TMC_DEF_DIST) ' ... do a measure
TMC_DoMeasure (TMC_CLEAR)
```

6.3.4 TMC_GetPolar

Description Calculate and read polar co-ordinates.

Declaration

```
TMC_GetPolar(
     BYVAL iWaitTime   AS Integer,
           Polar       AS TMC_Distance_Type,
           iReturnCode AS Integer )
```

Remarks The function corrects and takes in calculation a measured distance. Angle and possibly inclination are being calculated. The result is a point in polar co-ordinates.

Simple and multiple measures (distance tracking, altitude tracking) are supported. The horizontal and the inclined distance with the difference in altitude are read. The delay (`iWaitTime`) just works on the distance measure, not on the measure of the angle. As long as no new measure program is started, the results can be read. Additional to the normal return codes `iReturnCode` delivers also informational return codes which will not interrupt program execution.

Note	The measure program must have been started (see `TMC_DoMeasure`).

Parameters

`iWaitTime`	`in`	delay time [ms] until a result is available
		`=0` returns results with an already measured distance.

		>0	waits maximal the time `iWaitTime` for a result. If `iWaitTime` is chosen big enough (e. g. 60000, which is surely longer than the time-out period of the device), the system will wait for a result or until an error occurs
		<0	Performs an automatic target acquisition (if possible) and then tries to measuring in a until a valid result or an irrecoverable error occurs. The value itself of `iWaitTime` is ignored.
`Polar`	`out`	point in polar co-ordinates	
`iReturnCode`	`out`	see Additional Codes below	

See Also `TMC_GetCoordinates`

Additional Codes in `iReturnCode`

`RC_OK`	measurement and values are OK
`TMC_ACCURACY_GUARANTEE`	Accuracy is not guaranteed, because the results are consist of measuring data which accuracy could not be verified by the system. Co-ordinates are available.
`TMC_NO_FULL_CORRECTION`	The results are not corrected by all active sensors. Co-ordinates are available.
`TMC_ANGLE_OK`	Angle values okay, but no valid distance. Co-ordinates are not available.
`TMC_ANGLE_ACCURACY_GUARANTEE`	No distance data available but angle data are valid. The return code is equivalent to the `TMC_ACCURACY_GUARANTEE` and relates to the angle data. Co-ordinates are not available.

`TMC_ANGLE_NO_ FULL_ CORRECTION`	No distance data available but angle data are valid. The return code is equivalent to the `TMC_NO_FULL_CORRECTION` and relates to the angle data. Co-ordinates are not available. Perform a distance measurement first before you call this function.
`TMC_DIST_ERROR`	No measuring, because of missing target point, co-ordinates are not available. Aim target point and try it again
`TMC_DIST_PPM`	No distance measurement respectively no distance data because of wrong EDM settings. The co-ordinates are not available. Set EDM –ppm and -mm to 0.

Return Codes

`RC_OK`	measurement and values are OK
`TMC_ANGLE_ERROR`	Problems with angle res. incline sensor. A valid angle could not be measured. At repeated occur call service.
`TMC_BUSY`	TMC resource is locked respectively TMC task is busy. Repeat measurement.
`RC_ABORT`	Measurement through customer aborted.

Example Start a distance measure, perform measure.

```
DIM iRetCode  AS Integer
DIM iWaitTime AS Integer
DIM Polar     AS TMC_Distance_Type
DIM lError    AS Logical
DIM lDone     AS Logical
```

```
'start distance measurement
ON ERROR RESUME    ' to get valid angles
TMC_DoMeasure( TMC_DEF_DIST )

iWaitTime = -1
lDone  = FALSE
lError = FALSE


DO                 'display measured values
  TMC_GetPolar( iWaitTime, Polar, iRetCode )
  SELECT CASE iRetCode
    CASE RC_OK
        'display all data
        'e.g. set lDone here
    CASE else
        'handle error
        lError = TRUE
  END SELECT
LOOP UNTIL lError OR lDone

'stop distance measurement
TMC_DoMeasure( TMC_CLEAR )
```

6.3.5 TMC_GetCoordinate

Description Calculate and read co-ordinates.

Declaration

```
TMC_GetCoordinate(
   BYVAL iWaitTime   AS Integer,
         Coordinate  AS TMC_COORDINATE_Type,
         iReturnCode AS Integer )
```

Remarks The function calculates and out put co-ordinates. Angle and possibly inclination are being measured. The co-ordinates are being corrected. The result is a point in Cartesian co-ordinates. The system calculates co-ordinates and tracking co-ordinates.

Simple and multiple measurements (distance-, altitude- and co-ordinate- tracking) are supported. The delay (`iWaitTime`) just works on the distance measure, not on the measuring of the angle.

As far as no new measure program is started, the results can be read. Additional to the normal return codes `iReturnCode` delivers also informational return codes which will not interrupt program execution.

Note	The measure program must have been started (see `TMC_DoMeasure`).

Parameters

`iWaitTime`	`in`	delay time [ms] until a result is available =0 returns already measured values >0 waits the maximal time `iWaitTime` for a result
`Coordinate`	`out`	point in Cartesian co-ordinates (output)
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_GetPolar`

Additional Codes in `iReturnCode`

`RC_OK`	measurement and values are OK
`TMC_ACCURACY_GUARANTEE`	Accuracy is not guaranteed, because the result are consist of measuring data which accuracy could not be verified by the system. Co-ordinates are available.
`TMC_NO_FULL_CORRECTION`	The results are not corrected by all active sensors. Co-ordinates are available.
`TMC_ANGLE_OK`	Angle values okay, but no valid distance. Co-ordinates are not available.
`TMC_ANGLE_ACCURACY_GUARANTEE`	No distance data available but angle data are valid. The return code is equivalent to the `TMC_ACCURACY_GUARANTEE` and relates to the angle data. Co-ordinates are not available.

`TMC_ANGLE_NO_FULL_CORRECTION`	No distance data available but angle data are valid. The return code is equivalent to the `TMC_NO_FULL_CORRECTION` and relates to the angle data. Co-ordinates are not available. Perform a distance measurement first before you call this function.
`TMC_DIST_ERROR`	No measuring, because of missing target point, co-ordinates are not available. Aim target point and try it again
`TMC_DIST_PPM`	No distance measurement respectively no distance data because of wrong EDM settings. The co-ordinates are not available. Set EDM –ppm and -mm to 0.

Return Codes

`RC_OK`	measurement and values are OK
`TMC_ANGLE_ERROR`	Problems with angle res. incline sensor. A valid angle could not be measured. At repeated occur call service.
`TMC_BUSY`	TMC resource is locked respectively TMC task is busy. Repeat measurement.
`RC_ABORT`	Measurement through customer aborted.

Example Start a distance measure, perform measurement.

```
DIM iretCode  AS Integer
DIM iWaitTime AS Integer
DIM Coord     AS TMC_COORDINATE_Type
DIM lError    AS Logical
DIM lDone     AS Logical

ON ERROR RESUME NEXT  ' to get valid angle data
TMC_DoMeasure( TMC_DEF_DIST )
lDone  = FALSE
lError = FALSE
```

```
DO                      ' display measured values
  TMC_GetCoordinate( 5, Coord, iRetCode )
  SELECT CASE iRetCode
    CASE RC_OK
        'display all data
        'e.g. set lDone
    CASE ANGLE_OK
        ' display coordinate
    CASE ELSE
        'handle error
        lError = TRUE
  END SELECT
LOOP UNTIL lError OR lDone
TMC_DoMeasure( TMC_CLEAR )
```

6.3.6 TMC_GetAngle

Description Measure angles.

Declaration

```
TMC_GetAngle( Angles      AS TMC_ANGLE_Type,
              iReturnCode AS Integer )
```

Remarks The function measures the horizontal and vertical angle and the possibly belonging inclination, if the inclination compensation is on. If the compensation is off and no valid inclination is present, there may be a delay if the inclination can't be measured immediately. The correction values for the inclination can be calculated with several methods.

As long as no new measure program is started, the results can be read. Additional to the normal return codes `iReturnCode` delivers also informational return codes which will not interrupt program execution.

Parameters

`Angles`	`out`	result of measuring the angle
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_DoMeasure`

Additional Codes in `iReturnCode`

`RC_OK`	Execution successful.
`TMC_NO_FULL_CORRECTION`	The results are not corrected by all active sensors. Angle data are available. This message is to be considers as warning.
`TMC_ACCURACY_GUARANTEE`	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system. Angle data are available. You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.

Return Codes

`RC_OK`	angle OK
`TMC_ANGLE_ERROR`	Problems with angle res. incline sensor. A valid angle could not be measured. Angle data are not available. At repeated occur call service.
`TMC_BUSY`	TMC resource is locked respectively TMC task is busy. Angle data are not available. Repeat measurement.
`RC_ABORT`	Measurement through customer aborted.

Example Read the currently valid angle.

```
DIM Angles AS TMC_ANGLE_Type
DIM RetCode AS Integer

TMC_GetAngle( Angles, RetCode )
```

6.3.7 TMC_GetAngle_WInc

Description Measure angles with inclination control.

Declaration

```
TMC_GetAngle_WInc(
              iIncProg    AS Integer,
              Angle       AS TMC_ANGLE,
              iReturnCode AS Integer )
```

Remarks The function measures the horizontal and vertical angle and in dependence of the configuration, the inclination.

As far as no new measure program is started, the results can be read. Additional to the normal return codes `iReturnCode` delivers also informational return codes, which will not interrupt program execution.

Parameters

`iIncProg`	`in`	The manner of incline compensation. Following settings are possible: **Incline Program** / **Meaning** `TMC_MEA_INC`: get inclination (apriori sigma) `TMC_AUTO_INC`: get inclination with automatism (sensor/plane) `TMC_PLANE_INC`: get inclination always with plane
`Angle`	`out`	result of measuring the angle
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_DoMeasure, TMC_GetAngle`

Additional Codes in `iReturnCode`

`RC_OK`	Execution successful.
`TMC_NO_FULL_CORRECTION`	The results are not corrected by all active sensors. Angle data are available. This message is to be considers as warning.

`TMC_ACCURACY_ GUARANTEE`	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system. Angle data are available. You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.

Return Codes

`RC_OK`	angle OK
`TMC_ANGLE_ERROR`	Problems with angle res. incline sensor. A valid angle could not be measured. Angle data are not available. At repeated occur call service.
`TMC_BUSY`	TMC resource is locked respectively TMC task is busy. Angle data are not available. Repeat measurement.
`RC_ABORT`	Measurement through customer aborted.

Example Read the currently valid angle.

```
DIM Angles   AS TMC_Angle
DIM iRetCode AS Integer

TMC_GetAngle_WInc(TMC_AUTO_INC, Angles,iRetCode)
```

6.3.8 TMC_QuickDist

Description Measure slope distance and angles.

Declaration

```
TMC_QuickDist(
            Angle       AS TMC_HZ_V_ANG_type,
            Dist        AS Distance,
            iReturnCode AS Integer )
```

Remarks The function measures the horizontal and vertical angle and in dependence of the configuration, the inclination.

The function waits until a new distance is measured and then it returns the angle and the slope-distance, but no co-ordinates. Is no distance available, then it returns the angle values (hz, v) and the corresponding return-code.

At the call of this function, a distance measurement will be started with the rapid-tracking measuring program. If the EDM is active with the standard tracking measuring program already, the measuring program will not be changed to rapid tracking. Generally if the EDM is not active, then the rapid tracking measuring program will be started, otherwise the used measuring program will not be changed.

In order to abort the current measuring program use the function `TMC_DoMeasure`.

This function is very good suitable for target tracking, where high data transfers are required.

Note:	Due to performance reasons the used inclination will be calculated (only if incline is activated). if the basic data for the incline calculation is exact, at least two forced incline measurements should be performed in between. The forced incline measurement is only necessary if the incline of the instrument because of measuring assembly has been changed. Use the function `TMC_GetAngle_WInc(TMC_MEA_INC, Angle)` for the forced incline measurement. (For the forced incline measurement, the instrument must be in stable state for more than 3sec.).

Parameters

`Angle`	`out`	measured Hz- and V-angle
`Distance`	`out`	measured slope-distance
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_DoMeasure, TMC_GetAngle`

Additional Codes in `iReturnCode`

`RC_OK`	Execution successful.
`TMC_NO_FULL_CORRECTION`	The results are not corrected by all active sensors. Angle data are available. This message is to be considers as warning.
`TMC_ACCURACY_GUARANTEE`	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system. Angle data are available. You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.
`TMC_ANGLE_ERROR`	Problems with angle res. incline sensor. A valid angle could not be measured. Angle data are not available. At repeated occur call service.
`TMC_ANGLE_OK`	Angle measuring data are valid, but no distance data available. (Possible reasons are: –time out period to short –target out of view) This message is to be considers as warning.
`TMC_ANGLE_NO_FULL_CORRECTION`	Angle measuring data are valid, but not corrected by all active sensors. The distance data are not available. (Possible reasons are: -see return code `TMC_ANGLE_OK`) This message is to be considers as warning.

`TMC_ANGLE_ACCURACY_GUARANTEE`	Angle measuring data are valid, but the accuracy is not guarantee, because the result (angle) consisting of measuring data, which accuracy could not be verified by the system. The distance data are not available. (Possible reasons are: -see return code `TMC_ANGLE_OK`) This message is to be considers as info.
`TMC_DIST_ERROR`	Because of missing target point no distance data available, but the angle data are valid respectively available. Aim target point and try it again.
`TMC_DIST_PPM`	No distance measurement respectively no distance data because of wrong EDM settings. The angle data are valid. Set EDM –ppm and –mm to 0.

Return Codes

`RC_OK`	angle OK
`TMC_ANGLE_ERROR`	Problems with angle res. incline sensor. At repeated occur call service.
`TMC_BUSY`	TMC resource is locked respectively TMC task is busy. Angle data are not available. Repeat measurement.
`RC_ABORT`	Measurement through customer aborted.

Example Fast tracking with `QuickDist`. See example program `TRACKING` for more details.

```
DIM iRetCode AS Integer
DIM HzV      AS TMC_HZ_V_ANG_Type
DIM dDist    AS Distance

TMC_DoMeasure( TMC_CLEAR ) ' clear distances
```

```
' measurement loop
DO
    ' get measurement values
    TMC_QuickDist( HzV, dDist, iRetCode )
    IF iRetCode = RC_OK OR
       iRetCode = TMC_NO_FULL_CORRECTION OR
       iRetCode = TMC_ACCURACY_GUARANTEE THEN
        ' Angles and distance are valid
        ' ...
      ELSE
        ' only Angles are valid
        ' ...
        END IF
LOOP UNTIL ....

' terminate
TMC_DoMeasure( TMC_CLEAR ) ' stop measurement
```

6.3.9 TMC_GetSimpleMea

Description Gets the results of distance and angle measurement.

Declaration

```
TMC_GetSimpleMea(
     Angles       AS TMC_HZ_V_ANG_Type,
     dSlopeDist   AS Double,
     iReturnCode  AS Integer )
```

Remarks This function returns the angles and distance measurement data. The distance measurement will be set invalid afterwards. It is important to note that this command does not issue a new distance measurement.

If a distance measurement is valid the function ignores `WaitTime` and returns the results.

If no valid distance measurement is available and the distance measurement unit is not activated (by `TMC_DoMeasure` before the `TMC_GetSimpleMea` call) the `WaitTime` is also ignored and the angle measurement result is returned.

Information about distance measurement is returned in the return- code.

Parameters

`Angles`	`out`	result of measuring: the angles
`dSlopeDist`	`out`	slope distance [m]
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_DoMeasure`

Additional Codes in `iReturnCode`

`RC_OK`	Angle OK
`TMC_NO_FULL_ CORRECTION`	The results are not corrected by all active sensors. Angle and distance data are available. This message is to be considers as warning.
`TMC_ACCURACY_ GUARANTEE`	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system. Angle and distance data are available. You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.
`TMC_ANGLE_OK`	Angle values okay, but no valid distance. Perform a distance measurement.
`TMC_ANGLE_NO_ FULL_ CORRECTION`	No distance data available but angle data are valid. The return code is equivalent to the `TMC_NO_FULL_CORRECTION` and relates to the angle data. Perform a distance measurement first before you call this function.

TMC_ANGLE_ACCURACY _GUARANTEE	No distance data available but angle data are valid. The return code is equivalent to the TMC_ACCURACY_GUARANTEE and relates to the angle data.
TMC_DIST_ERROR	No measuring, because of missing target point, angle data are available but distance data are not available. Aims target point and try it again.
TMC_DIST_PPM	No distance measurement respectively no distance data because of wrong EDM settings. Angle data are available but distance data are not available. Set EDM –ppm and -mm to 0.

Return Codes

RC_OK	Angle OK
TMC_ANGLE_ERROR	Problems with angle res. incline sensor. A valid angle could not be measured. Distance and angle data are not available. At repeated occur call service.
TMC_BUSY	TMC resource is locked respectively TMC task is busy. Distance and angle data are not available. Repeat measurement.
RC_ABORT	Measurement aborted.

Example This example measures the slope distance and angles.

```
DIM Angle   AS Double
DIM dSlope  AS Double
DIM RetCode AS Integer

TMC_GetSimpleMea( Angle, dSlope, RetCode )
```

6.3.10 TMC_Get/SetAngleFaceDef

Description Gets and sets the current face definition.

Declaration

```
TMC_GetAngleFaceDef( eFaceDef  AS Integer )

TMC_SetAngleFaceDef(
            byVal eFaceDef  AS Integer )
```

Remarks

Note	No distance may exist for setting the face definition. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

eFaceDef	out/in	TMC_FACE_NORMAL or TMC_FACE_TURN

See Also -

Return Codes

RC_OK	Completed successfully.
TMC_BUSY	measurement system is busy (no valid results) or a distance exists

Example The example reads the current definition and sets the opposite one.

```
DIM face  AS TMC_FACE_DEF

TMC_GetAngelFaceDef(face)
IF (face = TMC_FACE_NORMAL) THEN
  TMC_SetAngelFaceDef(TMC_FACE_TURN)
ELSE
  TMC_SetAngelFaceDef(TMC_FACE_NORMAL)
END IF
```

6.3.11 TMC_Get/SetHzOffset

Description Gets and sets the current horizontal offset.

Declaration `TMC_GetHzOffset( dHzOffset AS Double )`

`TMC_SetHzOffset( byVal dHzOffset AS Double )`

Remarks

Note	No distance may exist for setting the Hz-offset. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

`dHzOffset`	`out/in`	Horizontal offset in radiant.

See Also -

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results) or a distance exists

Example The example reads the current offsets and sets it to an increased value.

```
DIM off  AS Double

TMC_GetHzOffset ( off )
TMC_SetHzOffset ( off + 1.0 )
```

6.3.12 TMC_Get/SetDistPpm

Description Gets and sets the correction values for distance measurements.

Declaration
```
TMC_GetDistPpm( PpmCorr  AS
TMC_PPM_CORR_Type)

TMC_SetDistPpm( PpmCorr  AS
TMC_PPM_CORR_Type)
```

Parameters

`PpmCorr`	`out/in`	Correction value for distance measurement.

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	TMC is in use and can not be changed.

Example -

6.3.13 TMC_Get/SetHeight

Description Gets and sets the current height of the reflector.

Declaration
```
TMC_GetHeight (        Height  AS Double )

TMC_SetHeight ( byVal Height  AS Double )
```

Parameters

`Height`	`out/in`	Height of reflector in Meters.

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results)

Example The example sets the reflectors height to the value of 1.0 m.

```
TMC_SetHeight ( 1.0 )
```

6.3.14 TMC_Get/SetRefractiveCorr

Description Gets and sets the refractive correction for measuring the distance.

Declaration

```
TMC_GetRefractiveCorr (
    Refraction AS TMC_REFRACTION_Type)

TMC_SetRefractiveCorr (
    Refraction AS TMC_REFRACTION_Type)
```

Parameters

Refraction	out/in	Refraction correction value(s).

Return Codes

RC_OK	Completed successfully.
TMC_BUSY	measurement system is busy (no valid results)

Example -

6.3.15 TMC_Get/SetRefractiveMethod

Description Gets and sets the method of refractive correction for measuring the distance.

Declaration

```
TMC_GetRefractiveMethod (
          Method  AS Integer )

TMC_SetRefractiveMethod (
    byVal Method  AS Integer )
```

Parameters

Method	out/in	Method of refraction calculation: 1: method 1 2: method 2 else: undefined

Return Codes

RC_OK	Completed successfully.
TMC_BUSY	measurement system is busy (no valid results)

6.3.16 TMC_Get/SetStation

Description Gets and sets station co-ordinates.

Declaration

```
TMC_GetStation (
          Station  AS TMC_STATION_Type )

TMC_SetStation (
          Station  AS TMC_STATION_Type )
```

Remarks

> **Note** No distance may exist for setting a new station. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

Station	out/in	Station co-ordinates.

Return Codes

RC_OK	Completed successfully.
TMC_BUSY	measurement system is busy (no valid results) or a distance exists.

Example -

6.3.17 TMC_IfDistTapeMeasured

Description Gets information about manual measurement.

Declaration

```
TMC_IfDistTapeMeasured (
            bTapeMeasured  AS Logical )
```

Parameters

bTapeMeasured	out	TRUE: if measurement has been done by hand. FALSE: if measurement has been done with EDM or if invalid.

Return Codes

RC_OK	Completed successfully.

Example -

6.3.18 TMC_SetHandDist

Description Sets distance manually.

Declaration

```
TMC_SetHandDist(
        byVal dSlopeDistance  AS Double,
        byVal dHgtOffset      AS Double )
```

Parameters

dSlopeDistance	in	slope distance [m]
dHgtOffset	in	Height to measured point. [m]

See Also -

Return Codes

RC_OK	Execution successful.
TMC_NO_FULL_CORRECTION	The results are not corrected by all active sensors. This message is to be considers as warning.
TMC_ACCURACY_GUARANTEE	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.
TMC_ANGLE_ERROR	Problems with angle res. incline sensor. A valid angle could not be measured. At repeated occur call service.

`TMC_BUSY`	TMC resource is locked respectively TMC task is busy. Repeat measurement.
`RC_ABORT`	Measurement through customer aborted.
`RC_IVPARAM`	Invalid parameter

Example -

6.3.19 TMC_SetDistSwitch

Description Defines the distance measurement correction switches.

Declaration
```
TMC_SetDistSwitch(
        Switches AS TMC_DIST_SWITCH_Type )
```

Remarks This procedure sets the distance measurement correction switches.

Parameters

`Switches`	`in`	Distance switches

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_GetDistSwitch`

6.3.20 TMC_GetDistSwitch

Description Returns the distance measurement correction switches.

Declaration
```
TMC_GetDistSwitch(
        Switches AS TMC_DIST_SWITCH_Type )
```

Remarks This procedure returns the distance measurement correction switches.

Parameters

`Switches`	`out`	Distance switches

Return-Codes

RC_OK	Successful termination.

See Also TMC_SetDistSwitch

6.3.21 TMC_SetOffsetDist

Description Defines the distance measurement offset.

Declaration

```
TMC_SetOffsetDist(
        Offsets AS TMC_OFFSET_DIST_Type )
```

Remarks This procedure defines the offset to the prism pole. The dLengthVal defines the offset away from the prism pole, positive means in the line from instrument to prism. dCrossVal means right from the prism pole and dHeightVal means higher than prism pole.

Remarks

Note	No distance may exist for offset setting.. Call TMC_DoMeasure(TMC_CLEAR) before this function.

Parameters

Offsets	in	Target point offset

Return-Codes

RC_OK	Successful termination.
TMC_BUSY	measurement system is busy (no valid results) or a distance exists.

See Also TMC_GetOffsetDist, BAP_Offset, TMC_IfOffsetDistMeasured

6.3.22 TMC_GetOffsetDist

Description Returns the distance measurement offset.

Declaration
```
TMC_GetOffsetDist(
        Offsets AS TMC_OFFSET_DIST_Type )
```

Remarks This procedure returns the actual offset to the prism pole. The `dLengthVal` defines the offset away from the prism pole, positive means in the line from instrument to prism. `dCrossVal` means right from the prism pole and `dHeightVal` means higher than prism pole.

Parameters

`Offsets`	`out`	Target point offset

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_SetOffsetDist`, `BAP_Offset`, `TMC_IfOffsetDistMeasured`

6.3.23 TMC_IfOffsetDistMeasured

Description Returns the EDM measurement mode.

Declaration
```
TMC_IfOffsetDistMeasured(
                   lOffset AS Logical )
```

Remarks This function returns TRUE if an offset is defined.

Parameters

`lOffset`	`out`	Offset is valid

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_SetOffsetDist`, `TMC_GetOffsetDist`, `BAP_Offset`

6.3.24 TMC_GetFace1

Description Get face information of current telescope position.

Declaration `TMC_GetFace1( lFace1 AS Logical )`

Remarks This function returns the face information of the current telescope position. The face information is only valid, if the instrument is in an active measurement state (that means a measurement function was called before the `TMC_GetFace1` call). Note that the instrument automatically turns into an inactive measurement state after a predefined timeout.

Parameters

`lFace1`	`out`	`TRUE`: Face I
		`FALSE`: Face II

Return-Codes

`RC_OK`	Successful termination.

6.3.25 TMC_SetAngSwitch

Description Defines the angle measurement correction switches.

Declaration

```
TMC_SetAngSwitch(
       Switches AS TMC_ANG_SWITCH_Type )
```

Remarks This procedure sets the angle measurement correction switches.

> **Note** No distance may exist for setting the angle switches. Call `TMC_DoMeasure( TMC_CLEAR )` before this function.

Parameters

`Switches`	`in`	angular switches

Return-Codes

`RC_OK`	Successful termination.
`TMC_BUSY`	A distance exists

See Also `TMC_GetAngSwitch`

Example Change switches

```
DIM AngSwitches AS TMC_ANG_SWITCH_Type

TMC_DoMeasure( TMC_CLEAR ) ' clear distances
TMC_GetAngSwitch( AngSwitches )
AngSwitches.lInclineCorr = TRUE
AngSwitches.lCollimationCorr = FALSE
TMC_SetAngSwitch( AngSwitches )
```

6.3.26 TMC_GetAngSwitch

Description Returns the angle measurement correction switches.

Declaration

```
TMC_GetAngSwitch(
        Switches AS TMC_ANG_SWITCH_Type )
```

Remarks This procedure returns the actual angle measurement correction switches.

Parameters

`Switches`	`in`	Angular switches

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_SetAngSwitch`

6.3.27 TMC_SetInclineSwitch

Description Defines the compensator switch.

Declaration `TMC_SetAngSwitches( lOn AS Logical )`

Remarks This procedure enables or disables the dual axis compensator correction.

> **Note** No distance may exist for a switch setting.. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

`lOn`	`in`	Switch

Return-Codes

`RC_OK`	Successful termination.
`TMC_BUSY`	A distance exists

See Also `TMC_GetInclineSwitch`

6.3.28 TMC_GetInclineSwitch

Description Returns the compensator switch.

Declaration `TMC_GetInclineSwitches( lOn AS Logical )`

Remarks This procedure returns the dual axis compensator correction state.

Parameters

`lOn`	`out`	Switch

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_SetInclineSwitch`

6.3.29 TMC_GetInclineStatus

Description Returns the inclination compensator status.

Declaration `TMC_GetInclineStatus( iStatus AS Integer )`

Remarks This procedure returns status of the inclination sensor.

Parameters

`iStatus`	`out`	`TMC_INC_OFF`	Incline-sensor is switched off
		`TMC_INC_OK`	Inclination is ok, recording is allowed
		`TMC_INC_TILT`	Incline-sensor is out of working area
		`TMC_INC_OLD`	Incline-values are not yet updated

TMC_INC_FAIL	Inclination - measurement fails

Return-Codes

RC_OK	Successful termination.

See Also TMC_SetInclineSwitch

Example See example file „meas.gbs“.

6.4 FUNCTIONS FOR GSI

6.4.1 Summarizing Lists of GSI Types and Procedures

6.4.1.1 Types

type name	description
Wi_List	Array of GSI_WiDlg_Entry_Type.
GSI_Point_Coord_Type	Point co-ordinate data.
GSI_Rec_Id_List	Record mask array of integers (indicating WI–identifications)
GSI_WiDlg_Entry_Type	Dialog entry information.

6.4.1.2 Procedures

procedure name	description
GSI_Coding	Starts the active coding function of the TPS system.
GSI_CheckTracking	Returns if distance tracking is running.
GSI_CreateMDlg	Creates and shows the user definable measurement dialog.
GSI_DefineMDlg	Defines the entries of the user definable measurement dialog.
GSI_DefineRecMaskDlg	Defines the recording mask dialog.
GSI_ExecuteAutoDist	Executes an automatic distance measurement.
GSI_ExecQCoding	Executes the Quick-Coding.
GSI_GetDataPath	Get the name of the file with the import data.
GSI_GetIndivNr	Fetches the individual point number.
GSI_GetLineSysMDlg	Gets the definition of a line in the system measurement dialog.
GSI_GetMDlgNr	Returns the number of the system measurement dialog.
GSI_GetQCodeAvailable	This routine returns the status for Quick-

procedure name	description
	Coding.
GSI_GetRecMask	Get the definition and the format of a recording mask.
GSI_GetRecMaskNr	Returns the used recording mask.
GSI_GetRecOrder	Returns the recording order for Quick-Coding.
GSI_GetRecPath	Returns the recording path
GSI_GetRunningNr	Fetches the running point number and the increment.
GSI_GetWiEntry	Get data from the Theodolite data pool.
GSI_ImportCoordDlg	Show the co-ordinate import dialog.
GSI_IncPNumber	Automatically point number increment.
GSI_IsRunningNr	Queries if running number is being used.
GSI_ManCoordDlg	Show the manual co-ordinate input dialog.
GSI_Measure	Entry point for measure and registration dialog (measure and registration).
GSI_QuickSet	Show the Quickset dialog
GSI_RecordRecMask	Recording the given `wi` mask.
GSI_SelectCode	This routine shows the codelist-coding dialog.
GSI_SetDataPath	Set the file with the import data.
GSI_SetIndivNr	Sets the individual point number.
GSI_SetIvPtNrStatus	Switches the individual point number mode on/off.
GSI_SetLineMDlg	Sets one line in the user definable measurement dialog to system parameter.
GSI_SetLineMDlgPar	Sets a line in the user definable measurement dialog to an application parameter.
GSI_SetLineMDlgText	Puts a textline into the user definable measurement dialog.
GSI_SetLineSysMDlg	Sets a line in the system measurement dialog.
GSI_SetMDlgNr	Sets the number of the system measurement dialog.

procedure name	description
GSI_SetQCodeMode	Sets the Quick-Coding mode.
GSI_SetRecMask	Set the definition and the format of a recording mask.
GSI_SetRecMaskNr	Set the used recording mask.
GSI_SetRecOrder	Sets the recording order for Quick-Coding.
GSI_SetRecPath	Defines the recording path
GSI_SetRunningNr	Sets the running point number and increment.
GSI_SetWiEntry	Set data to the Theodolite data pool.
GSI_UpdateMDlg	Updates the user definable measurement dialog.
GSI_UpdateMeasurment	Update the measurement data.

6.4.2 Constants for WI values

Definitions for WI values:

Name	Data Type	Meaning
GSI_ID_PTNR	String	Point number
GSI_ID_FNR	Double	Serial number
GSI_ID_TYPE	String	Device type
GSI_ID_TIME_1	String	First time art
GSI_ID_TIME_2	String	Second time art
GSI_ID_HZ	Double	Horizontal angle
GSI_ID_V	Double	Vertical angle
GSI_ID_NHZ	Double	Nominal horizontal angle
GSI_ID_DHZ	Double	Difference horizontal angle
GSI_ID_NV	Double	Nominal vertical angle
GSI_ID_DV	Double	Difference vertical angle
GSI_ID_SLOPE	Double	Slope distance

Name	Data Type	Meaning
GSI_ID_HOR	Double	Horizontal distance
GSI_ID_HGT	Double	Height difference
GSI_ID_NHOR	Double	Nominal horizontal distance
GSI_ID_DHOR	Double	Difference horizontal distance
GSI_ID_NHGT	Double	Nominal height difference
GSI_ID_DHGT	Double	Difference height difference
GSI_ID_NSLOPE	Double	Nominal slope distance
GSI_ID_DSLOPE	Double	Difference slope distance
GSI_ID_CODE	String	Code information
GSI_ID_CODE_1	String	Information 1
GSI_ID_CODE_2	String	Information 2
GSI_ID_CODE_3	String	Information 3
GSI_ID_CODE_4	String	Information 4
GSI_ID_CODE_5	String	Information 5
GSI_ID_CODE_6	String	Information 6
GSI_ID_CODE_7	String	Information 7
GSI_ID_CODE_8	String	Information 8
GSI_ID_PPMM	String	mm and ppm
GSI_ID_SIGMA	String	Distance count and deviation
GSI_ID_MM	Double	mm
GSI_ID_PPM	Double	ppm
GSI_ID_REM_1	String	Remark 1
GSI_ID_REM_2	String	Remark 2
GSI_ID_REM_3	String	Remark 3
GSI_ID_REM_4	String	Remark 4
GSI_ID_REM_5	String	Remark 5
GSI_ID_REM_6	String	Remark 6
GSI_ID_REM_7	String	Remark 7
GSI_ID_REM_8	String	Remark 8
GSI_ID_REM_9	String	Remark 9
GSI_ID_E	Double	East co-ordinate

Name	Data Type	Meaning
GSI_ID_N	Double	North co-ordinate
GSI_ID_H	Double	Height
GSI_ID_E0	Double	East station co-ordinate
GSI_ID_N0	Double	North station co-ordinate
GSI_ID_H0	Double	Station height
GSI_ID_HR	Double	Reflector height
GSI_ID_HI	Double	Instrument height
GSI_ID_INDIV	String	Individual point number
GSI_ID_PTLA	String	Number of the last recorded point
GSI_ID_STEP	Double	Increment of the running point number
GSI_ID_SPTNR	String	Station point number
GSI_ID_SHZ	Double	Hz angle with no sign change
GSI_ID_CD_DSC	String	Code description
GSI_ID_PTCD_DSC	String	Point code description
GSI_ID_PV_CD	String	Preview code
GSI_ID_PV_PTCD	String	Preview point code
GSI_ID_ACT_PTID	String	Actual point ID
GSI_ID_BACKID	String	Backside ID
GSI_ID_APPDATA0	String/Double	Application data 0
GSI_ID_APPDATA1	String/Double	Application data 1
GSI_ID_APPDATA2	String/Double	Application data 2
GSI_ID_APPDATA3	String/Double	Application data 3
GSI_ID_APPDATA4	String/Double	Application data 4
GSI_ID_APPDATA5	String/Double	Application data 5
GSI_ID_APPDATA6	String/Double	Application data 6
GSI_ID_APPDATA7	String/Double	Application data 7
GSI_ID_APPDATA8	String/Double	Application data 8
GSI_ID_APPDATA9	String/Double	Application data 9
GSI_ID_APPDATA10	String/Double	Application data 10
GSI_ID_APPDATA11	String/Double	Application data 11
GSI_ID_FS_SCALE	Double	Free station scale

Name	Data Type	Meaning
GSI_ID_EMPTY		Blank line
GSI_ID_NONE		End mark
GSI_ID_UNKNOWN		Unknown WI

6.4.3 Constants for Measurement Dialog Definition

Definition of (user definable) application parameters for measurement dialogs, either Double or String. See also `GSI_SetLineMDlgPar` and `GSI_SetLineMDlgText`.

Name	Meaning
GSI_PAR_AppData0	Application parameter 0
GSI_PAR_AppData1	Application parameter 1
GSI_PAR_AppData2	Application parameter 2
GSI_PAR_AppData3	Application parameter 3
GSI_PAR_AppData4	Application parameter 4
GSI_PAR_AppData5	Application parameter 5
GSI_PAR_AppData6	Application parameter 6
GSI_PAR_AppData7	Application parameter 7
GSI_PAR_AppData8	Application parameter 8
GSI_PAR_AppData9	Application parameter 9
GSI_PAR_AppData10	Application parameter 10

Name	Meaning
GSI_PAR_AppData11	Application parameter 11

Definition of system (defined) parameters for measurement dialogs. See also GSI_SetLineSysMDlg and GSI_SetLineMDlg.

Name	Meaning
GSI_PAR_AddConst	Prism constant
GSI_PAR_Attrib1	Point Code Attribute 1
GSI_PAR_Attrib2	Point Code Attribute 2
GSI_PAR_Attrib3	Point Code Attribute 3
GSI_PAR_Attrib4	Point Code Attribute 4
GSI_PAR_Attrib5	Point Code Attribute 5
GSI_PAR_Attrib6	Point Code Attribute 6
GSI_PAR_Attrib7	Point Code Attribute 7
GSI_PAR_Attrib8	Point Code Attribute 8
GSI_PAR_AvgMeasNo	Maximal number of distance measurements of the average mode
GSI_PAR_BacksideId	Last used Backside
GSI_PAR_Code	Last used Code
GSI_PAR_CodeDescr	Last used free Code Description
GSI_PAR_CodeList	Codelist management (select, create etc)
GSI_PAR_CodeListSelect	Codelist selection (of an existing codelist)
GSI_PAR_DataJobSelect	Data job selection (of an existing job)
GSI_PAR_Date	Current date of the instrument. The displayed format depends on the setting of the parameter "Date form."
GSI_PAR_DisplayMask	Select display mask for standard measuring dialog. Max. 3 displaymasks can be defined for this dialog. The displaymasks can also be changed with the system function "Next Displaymask".
GSI_PAR_DataJob	Data job management (select, create etc)
GSI_PAR_TargetEast	Target point Easting
GSI_PAR_DistMeasProg	EDM measurement program selection.

Name	Meaning
	Attention: The available measurement programs depends on the selected target type and on the instrument type
GSI_PAR_TargetElev	Target point Elevation
GSI_PAR_ElevDiff	Elevation difference
GSI_PAR_HalfLineSpace	This item can be used to display a half line space in order to separate or group lines on instrument screen.
GSI_PAR_DistHoriz	Horizontal distance
GSI_PAR_AngleHz	Hz-Angle
GSI_PAR_PointIdIncr	defines the increment step. It is used to increment the Target Point Id after recording a target point.
GSI_PAR_IndivPointId	Individual point identifier
GSI_PAR_Info1	Shows the Free Code Info 1
GSI_PAR_Info2	Shows the Free Code Info 2
GSI_PAR_Info3	Shows the Free Code Info 3
GSI_PAR_Info4	Shows the Free Code Info 4
GSI_PAR_Info5	Shows the Free Code Info 5
GSI_PAR_Info6	Shows the Free Code Info 6
GSI_PAR_Info7	Shows the Free Code Info 7
GSI_PAR_Info8	Shows the Free Code Info 8
GSI_PAR_InstrHeight	Instrument Height (hi)
GSI_PAR_LastPointId	Last recorded target point identifier
GSI_PAR_MeasJobSelect	Measurement Job selection (of an existing Job or RS232 for online recording)
GSI_PAR_MeasJob	Measurement Job management (select, create, etc.)
GSI_PAR_NS	Number of measurements and standard deviation
GSI_PAR_TargetNorth	Target point Northing
GSI_PAR_OffsetCross	Cross Offset
GSI_PAR_OffsetElev	Offset Elevation

Name	Meaning
GSI_PAR_OffsetLength	Offset Length
GSI_PAR_OffsetMode	Defines the resetting of the offset
GSI_PAR_PointCode	Actual Feature Code
GSI_PAR_PointId	Actual Target point identifier, running or individual. The Value and the display text changes if an individual number is set.
GSI_PAR_PpmAtm	ppm atmospheric
GSI_PAR_PpmGeom	ppm geometric
GSI_PAR_PpmTotal	Total ppm
GSI_PAR_PpmMm	Total ppm and prism constant
GSI_PAR_PrevCode	Shows the second last used Code
GSI_PAR_PrevPointCode	Last used Feature Code
GSI_PAR_PointCodeDescr	Shows the Point Code Description of the actual Feature Code
GSI_PAR_RecMask	Selected Recording mask for target point measurements
GSI_PAR_ReflHeight	Reflector height (hr)
GSI_PAR_ReflName	Used reflector type
GSI_PAR_ReflSelection	reflector type selection. If there are user defined prism, then they will be added to this list. The User Refl1..User Refl3 are only valid, if these user definable prisms are defined.
GSI_PAR_RunningPointId	Running target point identifier
GSI_PAR_DistSlope	Slope distance
GSI_PAR_StationId	Identifies the Station
GSI_PAR_StationEast	Station Easting
GSI_PAR_StationElev	Station Elevation
GSI_PAR_StationNorth	Station Northing
GSI_PAR_TargetType	Definition of the target type (Reflector / reflectorless)
GSI_PAR_Time	Current time of the instrument. The displayed format depends on the setting of the parameter "Time form."

Name	Meaning
GSI_PAR_AngleV	V-Angle
GSI_PAR_VangleFormat	Vertical angle display format:Zenith angle = 0gon for zenith, angles are positive, Elev. angle = 0gon for horizontal, (+) above horizont and (-) below horizont. Elev.angle% = 0% for horizont, 100% for 50gon. V-angle is displayed (+) above and (-) below horizont but as percentage of the gradient.
GSI_PAR_NONE	Designates a line that is unused.

6.4.4 Relationship of GSI_ID’s to GSI_PAR’s

In general we can distinguish between two data value pools who are able to store values in it. Some of theses values are shared between the two pools.

GSI_ID_-Ids describe the values which can be stored and requested in the (WI) data value pool. GSI_PAR_-Ids describe the values which can be used for displaying in a measurement dialog. Their sets of id's are not associated directly in all cases. Moreover their sets of Id's can be distinguished in their meaning.

Association in this context means that both pools, the data value pool and the data display pool, share their values directly. Nonassociated values are unique to either the data value pool or the data display pool.

Many of the GSI_IDs are record-able. Two types of record-able Ids can be distinguished:

a) Measurement block (“Meas”) (has to start with a GSI_ID_PTNR)

b) Code block (“Code”) (has to start with a GSI_ID_CODE)

They may not be mixed.

Record-able	GSI_ID_-Ids	GSI_PAR_-Ids
	GSI_ID_NHZ	
	GSI_ID_DHZ	
	GSI_ID_NV	

	GSI_ID_DV	
	GSI_ID_NHOR	
	GSI_ID_DHOR	
	GSI_ID_NHGT	
	GSI_ID_DHGT	
	GSI_ID_NSLOPE	
	GSI_ID_DSLOPE	
	GSI_ID_INDIV	GSI_PAR_IndivPointId
	GSI_ID_PTLA	GSI_PAR_LastPointId
	GSI_ID_STEP	GSI_PAR_PointIdIncr
	GSI_ID_SPTNR	GSI_PAR_StationId
	GSI_ID_SHZ	
	GSI_ID_CD_DSC	GSI_PAR_CodeDescr
	GSI_ID_PTCD_DSC	GSI_PAR_PointCodeDescr
	GSI_ID_PV_CD	GSI_PAR_PrevCode
	GSI_ID_PV_PTCD	GSI_PAR_PrevPointCode
	GSI_ID_ACT_PTID	GSI_PAR_PointId
	GSI_ID_BACKID	GSI_PAR_BackSideId
Meas	GSI_ID_PTNR	GSI_PAR_RunningPointId
Meas	GSI_ID_FNR	GSI_PAR_SerialNr (undefined)
Meas	GSI_ID_TYPE	GSI_PAR_InstrType (undefined)
Meas	GSI_ID_TIME_1	See GSI_PAR_Date
Meas	GSI_ID_TIME_2	See GSI_PAR_Time
Meas	GSI_ID_HZ	GSI_PAR_AngleHz
Meas	GSI_ID_V	GSI_PAR_AngleV
Meas	GSI_ID_SLOPE	GSI_PAR_DistSlope
Meas	GSI_ID_HOR	GSI_PAR_DistHoriz
Meas	GSI_ID_HGT	GSI_PAR_ElevDiff
Meas	GSI_ID_PPMM	GSI_PAR_PpmMm
Meas	GSI_ID_SIGMA	GSI_PAR_NS

Meas	GSI_ID_MM	GSI_PAR_AddConst
Meas	GSI_ID_PPM	GSI_PAR_PpmTotal
Meas	GSI_ID_REM_1	GSI_PAR_Info1
Meas	GSI_ID_REM_2	GSI_PAR_Info2
Meas	GSI_ID_REM_3	GSI_PAR_Info3
Meas	GSI_ID_REM_4	GSI_PAR_Info4
Meas	GSI_ID_REM_5	GSI_PAR_Info5
Meas	GSI_ID_REM_6	GSI_PAR_Info6
Meas	GSI_ID_REM_7	GSI_PAR_Info7
Meas	GSI_ID_REM_8	GSI_PAR_Info8
Meas	GSI_ID_REM_9	GSI_PAR_Info9
Meas	GSI_ID_E	GSI_PAR_TargetEast
Meas	GSI_ID_N	GSI_PAR_TargetNorth
Meas	GSI_ID_H	GSI_PAR_TargetElev
Meas	GSI_ID_E0	GSI_PAR_StationEast
Meas	GSI_ID_N0	GSI_PAR_StationNorth
Meas	GSI_ID_H0	GSI_PAR_StationElev
Meas	GSI_ID_HR	GSI_PAR_ReflHeight
Meas	GSI_ID_HI	GSI_PAR_InstrHeight
Code	GSI_ID_CODE	GSI_PAR_Attrib1
Code	GSI_ID_CODE_1	GSI_PAR_Attrib2
Code	GSI_ID_CODE_2	GSI_PAR_Attrib3
Code	GSI_ID_CODE_3	GSI_PAR_Attrib4
Code	GSI_ID_CODE_4	GSI_PAR_Attrib5
Code	GSI_ID_CODE_5	GSI_PAR_Attrib6
Code	GSI_ID_CODE_6	GSI_PAR_Attrib7
Code	GSI_ID_CODE_7	GSI_PAR_Attrib8
Code	GSI_ID_CODE_8	GSI_PAR_Attrib9

`GSI_ID_APPDATA0` are for the purpose of exchanging data between applications and between application and MDlg. They cannot be recorded. Both can be of the form `GSI_ASCII` or `GSI_DOUBLE`.

	GSI_ID_APPDATA0	GSI_PAR_APPDATA0
	GSI_ID_APPDATA1	GSI_PAR_APPDATA1
	GSI_ID_APPDATA2	GSI_PAR_APPDATA2
	GSI_ID_APPDATA3	GSI_PAR_APPDATA3
	GSI_ID_APPDATA4	GSI_PAR_APPDATA4
	GSI_ID_APPDATA5	GSI_PAR_APPDATA5
	GSI_ID_APPDATA6	GSI_PAR_APPDATA6
	GSI_ID_APPDATA7	GSI_PAR_APPDATA7
	GSI_ID_APPDATA8	GSI_PAR_APPDATA8
	GSI_ID_APPDATA9	GSI_PAR_APPDATA9
	GSI_ID_APPDATA10	GSI_PAR_APPDATA10
	GSI_ID_APPDATA11	GSI_PAR_APPDATA11

Special Ids

	GSI_ID_NONE	
	GSI_ID_EMPTY	
	GSI_ID_UNKNOWN	
		GSI_PAR_NONE

The set of GSI_PAR-ids is not complete in this table. There exist several more Ids, which can be used for displaying.

6.4.5 Data Structures for GSI Functions

`GSI_WiDlg_Entry_Type`: Dialog entry information

Description This data structure is used to store information about the entries (data fields) of the WI dialog.

```
TYPE GSI_WiDlg_Entry_Type
  iId          AS Integer
```

The identifier of the dialog entry. For possible value see WI constants.

`iDataType`	`AS Integer`	The type of the date stored in `dValue` or `sValue`. For possible value see table below.
	`AS iDataType`	**Meaning**
	`GSI_ASCII`	ASCII data (stored in `sValue`)
	`GSI_ASCII_SIGN`	signed ASCII data (stored in `sValue`)
	`GSI_DOUBLE`	double data (stored in `dValue`)
`lValid`	`AS Logical`	`TRUE` if the value is valid.
`dValue`	`AS Double`	Data if value is of type `Double`.
`sValue`	`AS String10`	Data if value is of type `String`.

`END GSI_WiDlg_Entry_Type`

Wi_List: **An array of GSI_WiDlg_Entry_Type**

Description This array consists of `GSI_MAX_REC_WI` elements of the type `GSI_WiDlg_Entry_Type.`

GSI_Rec_Id_List: **An array of integers (indicating WI–identifications)**

Description This array consists of `GSI_MAX_REC_WI` elements of the type `Integer. It is used to define the recorded values (recmask).`

GSI_Point_Coord_Type: **Point co-ordinate data**

Description This data structure is used to store a point name and its co-ordinates.

`TYPE GSI_Point_Coord_Type`

`sPtNr`	`AS String10`	point number
`dEast`	`AS Double`	east co-ordinate
`dNorth`	`AS Double`	north co-ordinate
`dHeight`	`AS Double`	height co-ordinate
`lPtNrValid`	`AS Logical`	`TRUE` if point number is valid
`lEValid`	`AS Logical`	`TRUE` if east co-ordinate is valid
`lNValid`	`AS Logical`	`TRUE` if north co-ordinate is valid

`lHValid`	`AS Logical`	`TRUE` if height co-ordinate is valid

`END GSI_Point_Coord_Type`

6.4.6 GSI_GetRunningNr

Description Fetches the running point number and the increment.

Declaration
```
GSI_GetRunningNr( sPntId   AS String20,
                  sPntIncr AS String20 )
```

Remarks Fetches the running point number and increment for it.

Parameters

`sPntId`	`out`	the running point number
`sPntIncr`	`out`	the increment for the running point number

See Also `GSI_SetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr, GSI_IsRunningNr`

Return-Codes

`RC_OK`	successful

Example
```
DIM sPntId  AS String20
DIM sPntInc AS String20

GSI_GetRunningNr( sPntId, sPntInc )
```

6.4.7 GSI_SetRunningNr

Description Sets the running point number and increment.

Declaration
```
GSI_SetRunningNr(
                BYVAL sPntId   AS String20,
                BYVAL sPntIncr AS String20 )
```

Remarks Sets the running point number and the increment for it. The running point number mode is switched on.

Parameters

sPntId	in	The user running point number.
sPntIncr	in	The increment for the user point running number.

See Also GSI_GetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr, GSI_IsRunningNr

Return-Codes

RC_OK	successful

Example

```
DIM sPntId  AS String20
DIM sPntInc AS String20

GSI_SetRunningNr( sPntId, sPntInc )
```

6.4.8 GSI_ GetIndivNr

Description Fetches the individual point number.

Declaration `GSI_GetIndivNr( sPntId AS String20 )`

Remarks Fetches the individual point number.

Parameters

sPntId	out	The user-defined individual point number.

See Also GSI_GetRunningNr, GSI_SetRunningNr, GSI_SetIndivNr, GSI_IsRunningNr

Return-Codes

`RC_OK`	successful

Example

```
DIM sPntId AS String20

GSI_GetIndivNr( sPntId )
```

6.4.9 GSI_SetIndivNr

Description Sets the individual point number.

Declaration `GSI_SetIndivNr( BYVAL sPntId AS String20 )`

Remarks Sets the individual point number. After this call, the running point number mode is switched to the individual point number. This mode will be active until replaced by a running number or until the next save.

Parameters

`sPntId`	`in`	The user-defined individual point number.

See Also `GSI_GetRunningNr, GSI_SetRunningNr, GSI_GetIndivNr, GSI_IsRunningNr`

Return-Codes

`RC_OK`	successful

Example

```
DIM sPntId AS String20

GSI_SetIndivNr( sPntId )
```

6.4.10 GSI_IsRunningNr

Description Queries if running number is being used.

Declaration `GSI_IsRunningNr( lRunningOn AS Logical )`

Remarks If the running number is active the parameter will forced to `TRUE` otherwise to `FALSE`.

Parameters

`lRunningOn`	`out`	information about the running point number

See Also `GSI_GetRunningNr, GSI_SetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr`

Return-Codes

`RC_OK`	successful

Example

```
DIM lRunningOn AS Logical

GSI_IsRunningNr( lRunningOn )
```

6.4.11 GSI_SetIvPtNrStatus

Description Switches the individual point number mode on/off.

Declaration

```
GSI_SetIvPtNrStatus(
                 BYVAL lSwitch AS Logical )
```

Remarks Switch the individual point number on or off. When point number is shown in the display the number will change.

Parameters

`lSwitch`	`in`	switch for the individual point-number (`TRUE` = `on`, `FALSE` = `off`)

See Also `GSI_GetRunningNr, GSI_SetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr, GSI_IsRunningNr`

Return-Codes

`RC_OK`	successful

Example

```
GSI_SetIvPtNrStatus( FALSE )
```

6.4.12 GSI_IncPNumber

Description Automatically point number increment.

Declaration `GSI_IncPNumber()`

Remarks This function increments the running alphanumeric point number.

Parameters none

See Also `GSI_GetRunningNr, GSI_SetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr`

Return Codes

`RC_IVRESULT`	Point number is not incremented, possible reasons could be: wrong alphanumerically chars in point number alphanumerically chars in step overflow on a alphanumerically char step is longer as the point number

Example

```
GSI_IncPNumber()
```

6.4.13 GSI_Coding

Description Starts the active coding function of the TPS system.

Declaration `GSI_Coding( BYVAL Caption AS _Token)`

Remarks This routine starts the active coding function of the TPS system. Since there exist three possible locations, the TPS system follows a default ordering rule to invoke one of the programs. First it checks if there is an appropriate set up GeoBASIC coding program. If yes it will be executed, otherwise it examines the codelist management if a codelist is selected. If yes then the codelist will be opened, otherwise the standard coding will be activated.

Parameters

`Caption`	`in`	The left caption string of the dialog.

Return-Codes

RC_OK	successful
LDR_ RECURSIV_ERR	GeoBASIC is already running

Example The example uses the `GSI_Coding` routine to open a dialog for coding.

```
GSI_Coding( "CODE" )
```

6.4.14 GSI_SelectCode

Description This routine shows the codelist-coding dialog

Declaration `GSI_SelectCode( BYVAL Caption AS _Token)`

Remarks This routine starts the codelist-coding function of the TPS system. It will be executed only if a valid codelist is selected.

Parameters

Caption	in	The left caption string of the dialog.

Return-Codes

RC_OK	successful
RC_ABORT	Coding was aborted by pressing of the ESC-button
RC_ABORT_APPL	Coding was aborted by pressing of the QUIT-button
COD_RC_LIST_ NOT_VALID	No valid codelist selected

Example See example file „`meas.gbs`“.

6.4.15 GSI_GetQCodeAvailable

Description This routine returns the status for Quick-Coding.

Declaration

```
GSI_GetQCodeAvailable(lAvailable As Logical,
                      lEnabled   As Logical)
```

Remarks This routine returns if a valid codelist is selected and if Quick-Coding is enabled or not.

Parameters

`lAvailable`	`out`	TRUE: a valid codelist is selected.
`lEnabled`	`out`	TRUE: Quick-Coding is activated

See Also `GSI_SetQCodeMode, GSI_ExecQCoding`

Return-Codes

`RC_OK`	successful

Example See example file „`meas_od.gbs`“.

6.4.16 GSI_SetQCodeMode

Description Sets the Quick-Coding mode.

Declaration `GSI_SetQCodeMode(BYVAL lEnabled As Logical)`

Remarks This routine enables or disables the Quick-Coding. It can be only activated if a valid codelist is selected (see `GSI_GetQCodeAvailable`)

Parameters

`lEnabled`	`in`	TRUE: enable Quick-Coding

See Also `GSI_GetQCodeAvailable, GSI_ExecQCoding`

Return-Codes

`RC_OK`	successful

Example See example file „`meas.gbs`“.

6.4.17 GSI_ExecQCoding

Description Executes the Quick-Coding.

Declaration

```
GSI_ExecQCoding(
      BYVAL lRecEnable AS Logical
            iButtonId  AS Integer,
            lNewCode   AS Logical)
```

Remarks

This routine executes the Quick-Coding. If Quick-Coding is enabled, it checks the button `iButtonId` and searches the corresponding code. If the selected code needs mandatory attributes, it shows the coding dialog. As successful coding is indicated by `lNewCode=TRUE`. The results are stored in the Theodolite data pool (see `GSI_GetWiEntry`)

If `lRecEnable=TRUE`, this routine executes the ALL-button functionality too, it measures a distance and records the results. The recording order (measurement block – code block or vice versa) depends on the system setting (see `GSI_GetRecOrder`).

If `lRecEnable=FALSE`, this routine forces no new distance measurement and there is no recording.

Parameters

`lRecEnable`	in	TRUE: Quick-Coding including distance measurement. It records a code- and a measurement-block in the correct order. FALSE: Quick-Coding without measurement and without recording
`iButtonId`	inout	`In`: Pressed button. `Out`: If a Quick-Coding was possible, `iButtonId` is changed to `MMI_NO_KEY`, otherwise it is unchanged
`lNewCode`	out	`TRUE`: Quick-Coding was successful

See Also `GSI_GetQCodeAvailable, GSI_SetQCodeMode, GSI_SetRecOrder`

Return-Codes

`RC_OK`	successful

Example See example files „`meas.gbs`“ and „`meas_od.gbs`“..

6.4.18 GSI_SetRecOrder

Description Sets the recording order for Quick-Coding.

Declaration `GSI_SetRecOrder(BYVAL lCodeFirst As Logical)`

Remarks This routine defines the recording order for Quick-Coding.

`If lCodeFirst=TRUE`, then the code-block will be recorded before the measurement block.

Parameters

`lCodeFirst`	`in`	TRUE: code-block before measurement block

See Also `GSI_GetRecOrder, GSI_ExecQCoding`

Return-Codes

`RC_OK`	successful

Example See example file „`meas_od.gbs`“.

6.4.19 GSI_GetRecOrder

Description Returns the recording order for Quick-Coding.

Declaration `GSI_GetRecOrder(lCodeFirst As Logical)`

Remarks This routine returns the recording order for Quick-Coding.

`If lCodeFirst=TRUE`, then the code-block will be recorded before the measurement block.

Parameters

`lCodeFirst`	`out`	TRUE: code-block before measurement block

See Also `GSI_SetRecOrder, GSI_ExecQCoding`

Return-Codes

`RC_OK`	successful

Example See example file „`meas_od.gbs`“.

6.4.20 GSI_QuickSet

Description Shows the Quickset dialog.

Declaration `GSI_QuickSet(BYVAL sCaptionLeft AS _Token)`

Remarks This procedure shows Quickset for station setting.

Parameters

`sCaptionLeft`	`in`	Left caption for the Quickset dialog

Return-Codes

`RC_OK`	Successful termination.

Example Show the dialog:

```
GSI_QuickSet ( "BASIC" )
```

6.4.21 GSI_SetRecPath

Description Defines the recording path for the measurements.

Declaration

```
GSI_SetRecPath(
          BYVAL iPathInfo AS Integer,
          BYVAL sFileName AS FileName,
          BYVAL sFilePath AS FilePath )
```

Remarks This procedure defines where the measurements will be recorded. If `iPathInfo` is set to `GSI_INTERFACE`, then the measurements will be sent to the RS232 line and the other parameters are not be interpreted. If `iPathInfo` is set to `GSI_EXTERNAL`, then `sFileName` defines the filename i.e. "`MeasJob.GSI`" and `sFilePath` defines the file-path, i.e. "`A:\\GSI`".

Parameters

`iPathInfo`	`in`	Defines where the data are recorded
`sFileName`	`in`	Valid Filename (8+3 format)
`sFilePath`	`in`	file-path

Return-Codes

RC_OK	Successful termination.

See Also GSI_GetRecPath

Example This example shows the actual recording path and set it to the RS232 line:

```
DIM sFile      As FileName
DIM sPath      As FilePath
DIM iPathInfo  As Integer

GSI_GetRecPath(iPathInfo, sFile, sPath)
IF iPathInfo = GSI_EXTERNAL THEN
    MMI_PrintStr(0, 1,
          "RecFile-CARD: "+sFile, TRUE)
    MMI_PrintStr(0, 2,
          "   Path: " + sPath, TRUE)
  ELSE
    MMI_PrintStr(0, 1,
          "RecPath - serial line", TRUE)
END IF
GSI_SetRecPath( GSI_INTERFACE, sFile, sPath)
```

6.4.22 GSI_GetRecPath

Description Returns the recording path for the measurements.

Declaration

```
GSI_GetRecPath(
       iPathInfo AS Integer,
       sFileName AS FileName,
       sFilePath AS FilePath )
```

Remarks This procedure returns where the measurements will be recorded. If `iPathInfo` = `GSI_INTERFACE`, then the measurements will be sent to the RS232 line and the other parameters are not valid. If `iPathInfo` = `GSI_EXTERNAL`, then `sFileName` defines the filename i.e. "`MeasJob.GSI`" and `sFilePath` defines the file-path, i.e. "`A:\\GSI`".

Parameters

`iPathInfo`	`out`	Device info
`sFileName`	`out`	Filename (8+3 format)
`sFilePath`	`out`	File-path

Return-Codes

`RC_OK`	Successful termination.

See Also `GSI_SetRecPath`

Example see `GSI_SetRecPath`

6.4.23 GSI_SetDataPath

Description Set the file with the import data.

Declaration

```
GSI_SetDataPath(
          BYVAL iPathInfo AS Integer,
          BYVAL sFileName AS FileName,
          BYVAL sFilePath AS FilePath )
```

Remarks This procedure sets the file from which data will be imported. Only `GSI_EXTERNAL` is valid for the iPathInfo. `sFileName` defines the filename i.e. "`DataJob.GSI`" and `sFilePath` defines the file-path, i.e. "`A:\\GSI`".

Parameters

`iPathInfo`	`in`	Device info (Only `GSI_EXTERNAL` is valid)
`sFileName`	`in`	Valid Filename (8+3 format)
`sFilePath`	`in`	File-path

Return-Codes

`RC_OK`	Successful termination.

See Also `GSI_GetDataPath`

Example The example defines the file “A:\GSI\DataJob.GSI” as new import file.

```
GSI_SetDataPath(GSI_EXTERNAL, “DataJob.GSI”,
“A:\\GSI”)
```

6.4.24 GSI_GetDataPath

Description Get the name of the file with the import data.

Declaration

```
GSI_GetDataPath(
      iPathInfo AS Integer,
      sFileName AS FileName,
      sFilePath AS FilePath )
```

Remarks This procedure fetches the name and the path of the file from which data will be imported. If `iPathInfo` = `GSI_EXTERNAL`, then `sFileName` defines the filename i.e. "`DataJob.GSI`" and `sFilePath` defines the file-path, i.e. "`A:\\GSI`".

Parameters

`iPathInfo`	`out`	Device info
`sFileName`	`out`	Filename (8+3 format)
`sFilePath`	`out`	File-path

Return-Codes

`RC_OK`	Successful termination.

See Also `GSI_SetDataPath`

Example The example fetches the name and the path of the standard import data file:

```
DIM iPathInfo  AS Integer
DIM sFileName  AS FileName
DIM sFilePath  AS FilePath
GSI_GetDataPath(iPathInfo, sFileName, sFilePath)
```

6.4.25 GSI_GetWiEntry

Description Get data from the Theodolite data pool.

Declaration

```
GSI_GetWiEntry(
        WiIdentification  AS Integer,
        WiEntry AS GSI_WiDlg_Entry_Type )
```

Remarks This routine is used to fetch data from the Theodolite data pool. All existing wi's can be fetched (see the description of the WI constants for possible values).

Parameters

`WiIdentification`	in	The identification of the WI.
`WiEntry`	out	The WI entry data. See the description of `GSI_WiDlg_Entry_Type` for further information.

See Also `GSI_SetWiEntry`

Example See example `GSI_SetWiEntry`.

6.4.26 GSI_SetWiEntry

Description Put data to the Theodolite data pool.

Declaration

```
GSI_SetWiEntry(
        WiIdentification  AS Integer,
        WiEntry AS GSI_WiDlg_Entry_Type )
```

Remarks This routine is used to put data to the Theodolite data pool. See the description of the WI constants.

Parameters

`WiIdentification`	in	The identification of the WI.
`WiEntry`	in	The WI entry data. See the description of `GSI_WiDlg_Entry_Type` for further information.

See Also `GSI_GetWiEntry`

Example GSI_SetWiEntry does not set WI.iId according to the first parameter, instead it will just use the value stored in WI.iId. If that value is unequal to the first parameter value, then it comes to a conflict. Use a GSI_GetWiEntry() first, to be sure that all values

of the GSI_WiDlg_Entry_Type are initialized correctly. See also the example for the definition of a measurement dialog.
Save way:

```
GSI_GetWiEntry ( GSI_ID_HR, Wi )
Wi.lValid = TRUE
Wi.dValue = 2.12
GSI_SetWiEntry ( GSI_ID_HR, Wi )
```

6.4.27 GSI_GetRecMask

Description Get the definition and the format of a recording mask.

Declaration

```
GSI_GetRecMask(
     BYVAL iMaskNr AS Integer,
           sMaskName     AS String18,
           RecWiMask     AS GSI_Rec_Id_List,
           iRecFormat    AS Integer,
           lEditMask     AS Logical )
```

Remarks This routine fetches the definition and the format of the recording mask with the number `iMaskNr`. Valid formats are `GSI_RECFORMAT_GSI` and `GSI_RECFORMAT_GSI16.` A recording mask can be set with `GSI_SetRecMask`. If `lEditMask` is TRUE the elements of the recording mask can be changed in `GSI_DefineRecMaskDlg`. All unused elements of the recording list are set to `GSI_ID_NONE`. All values from 0 to 5 are valid for the mask number. Mask number 0 is predefined for the station recording mask.

Note	Only the first 16 characters of `sMaskName` are valid.

Parameters

iMaskNr	in	Number of the recording mask. `GSI_ACTUAL_RECMASK` can be used to retrieve settings of the actual mask
sMaskName	out	Name of the recording mask
RecWiMask	out	The definition of the recording mask. The elements of the array are the identification numbers of the `WI's`. See the description

		of the WI constants.
iRec Format	out	Recording format (GSI_RECFORMAT_GSI , GSI_RECFORMAT_GSI16)
lEditMask	out	Mask editable flag

See Also GSI_SetRecMask, GSI_DefineRecMaskDlg

Example The example uses the GSI_GetRecMask routine to fetch the definition and the format of the recording mask number 2.

```
DIM sMaskName   AS String18
DIM RecWiMask   AS GSI_Rec_Id_List
DIM iRecFormat  AS Integer
DIM lEditMask   AS Logical

GSI_GetRecMask( 2, sMaskName, RecWiMask,
                iRecFormat, lEditMask)
```

6.4.28 GSI_SetRecMask

Description Set the definition and the format of a recording mask.

Declaration

```
GSI_SetRecMask(
     BYVAL iMaskNr AS Integer,
     BYVAL sMaskName     AS String18,
     BYVAL RecWiMask     AS GSI_Rec_Id_List,
     BYVAL iRecFormat    AS Integer,
     BYVAL lEditMask     AS Logical)
```

Remarks This routine sets the definition and the format of the recording mask with the number iMaskNr. Valid formats are GSI_RECFORMAT_GSI and GSI_RECFORMAT_GSI16. If lEditMask is TRUE the elements of the recording mask can be changed in GSI_DefineRecMaskDlg. All unused elements should be set to GSI_ID_NONE. All values from 0 to 5 are valid for the mask number. Mask number 0 is predefined for the station recording mask.

Note	1) `WiEntries` must be unique, hence may not appear doubly. 2) Only `GSI_MAX_REC_WI` number of entries may be defined. 3) Only the first 16 characters of `sMaskName` are valid.

Parameters

`iMaskNr`	`in`	Number of the recording mask. `GSI_ACTUAL_RECMASK` can be used to set the values of the currently active mask.
`sMaskName`	`in`	Name of the recording mask.
`RecWiMask`	`in`	The definition of the recording mask. The elements of the array are the identification numbers of the `WI’s`. See the description of the WI constants.
`iRec Format`	`in`	Recording format (`GSI_RECFORMAT_GSI` , `GSI_RECFORMAT_GSI16`)
`lEditMask`	`in`	Mask editable flag

See Also `GSI_GetRecMask`, `GSI_DefineRecMaskDlg`

Example The example sets the 4th element of the currently active recording mask on GSI_ID_HZ.

```
DIM sMaskName   AS String18
DIM RecWiMask   AS GSI_Rec_Id_List
DIM iRecFormat  AS Integer
DIM lEditMask   AS Logical

GSI_GetRecMask(GSI_ACTUAL_RECMASK, sMaskName,
               RecWiMask, iRecFormat, lEditMask)
RecWiMask(4) = GSI_ID_HZ
GSI_SetRecMask(GSI_ACTUAL_RECMASK, sMaskName,
               RecWiMask, iRecFormat, lEditMask)
```

6.4.29 GSI_SetRecMaskNr

Description Set the used recording mask.

Declaration `GSI_SetRecMaskNr(BYVAL iMaskNr AS Integer)`

Parameters

`iMaskNr`	`in`	Number of the recording mask. Number must be in the range `1.. GSI_MAX_REC_MASKS.`

See Also `GSI_GetRecMaskNr`

Example The example sets the next recording mask.

```
DIM i   AS Integer

GSI_GetRecMaskNr( i )
i = i + 1 ‘ take next mask
i = ((i - 1) MOD GSI_MAX_REC_MASKS) + 1
GSI_SetRecMaskNr( i )
```

6.4.30 GSI_GetRecMaskNr

Description Returns the used recording mask.

Declaration `GSI_GetRecMaskNr(iMaskNr AS Integer)`

Parameters

iMaskNr	out	Number of the recording mask.

See Also `GSI_SetRecMaskNr`

6.4.31 GSI_DefineRecMaskDlg

Description Defines the recording mask dialog.

Declaration `GSI_DefineRecMaskDlg()`

Remarks Defines the contents of the recording mask. Using a dialog with list-fields, the user can select the items for the user registration mask. This routine is an interactive equivalent to the routines `GSI_GetRecMask and GSI_SetRecMask.`

See Also `GSI_GetRecMask, GSI_SetRecMask,`

Example

```
GSI_DefineRecMaskDlg ()
```

6.4.32 GSI_ManCoordDlg

Description Show the manual co-ordinate input dialog.

Declaration

```
GSI_ManCoordDlg(
      BYVAL sCaption        AS _Token,
      BYVAL iPointType      AS Integer,
        Point   AS GSI_Point_Coord_Type,
      BYVAL iFlags          AS Integer,
      BYVAL sHelpText       AS _Token )
```

Remarks

This routine shows the manual co-ordinates input dialog and allows editing, coding and recording. The type of co-ordinates (station or target) can be selected using `iPointType`. Recording to the current data-file (defined in `GSI_ImportCoordDlg`) with `REC` or leaving this function with `CONT` is only possible if the point number is valid, and at least E- and N-co-ordinates are valid. If GSI_HEIGHT_MUST is included in `iFlags` the Height / Elevation-co-ordinate must be valid too. Leaving using `ESC` or `QUIT` (`Shift-F6`) is always possible. Recording and coding sets the according values in the Theodolite data-pool too.

Parameters

`sCaption`	in	The maximal five-character long left part of the title bar.
`iPointType`	in	station or target point. For the values for `PointType` see table below

Point Type	**Meaning**
`GSI_STATION`	station point number
`GSI_INDIV_TG`	individual target number
`GSI_RUN_TG`	running target
`GSI_BACKSIGHT`	backside number (analog target, only changed prompts)

		GSI_POINT_ CODE	PointId / CodeId (analog target, only changed prompts)
Point	in	only point number, co-ordinates will be set to 0	
Point	out	point number and -co-ordinates. For further information see the description of GSI_Point_Coord_Type	
iFlags	in	defines functionality	
		Valid Flags	**Meaning**
		GSI_ALLOW_ REC	allows recording and coding
		GSI_HEIGHT_ MUST	height must be entered
		GSI_NE_ OPTIONAL	only height must be entered, north & east are optional
		GSI_MULTI_ REC	Allows entering and recording of more than one data-set, without leaving this routine
		GSI_NO_FILE_ CHANGE	File changing is disabled
		Flags can be combined with '+'-operator (iFlags = iFlag1 + iFlag2)	
sHelpText	in	This text is shown, when the help button SHIFT-F1 is pressed and the help functionality of the theodolite is enabled.	

See Also GSI_ImportCoordDlg

Example

```
DIM Point AS GSI_Point_Coord_Type

GSI_ManCoordDlg ( "TEST", GSI_STATION, Point,
                  GSI_HEIGHT_MUST+GSI_ALLOW_REC,
                  "This is the Helptext" )
```

6.4.33 GSI_ImportCoordDlg

Description Show the co-ordinate import dialog.

Declaration

```
GSI_ImportCoordDlg(
    BYVAL sCaption        AS _Token,
    BYVAL iPointType      AS Integer,
    Point    AS GSI_Point_Coord_Type,
    BYVAL iFlags          AS Integer,
    BYVAL iImportFile     AS Integer,
    BYVAL sImportHelp     AS _Token,
    BYVAL sInputHelp      AS _Token,
    BYVAL sF2Button       AS _Token,
    BYVAL sF4Button       AS _Token)
```

Remarks This routine contains three dialogues, the search-, the view- and the manual-input dialog. The type of co-ordinates (station or target) can be selected using `iPointType`. The search dialog allows selecting the data- or the measure file and editing a point-number. Depending on the pressed button, the manual co-ordinate input function (only if `GSI_ALLOW_MAN` is included in `iFlags`, see `GSI_ManCoordDlg`) or the view-co-ordinates dialog will be called.

The start of searching is always at the top of the file. With the two search keys, the user can step from one valid point to the next in both directions.

Rules for a valid point:

- point number found
- E- and N-coordinates (target or station) exists and are valid
- if `GSI_HEIGHT_MUST` is included in `iFlags`, a valid

height / elevation-coordinate must exist to within the file too.

If no valid point exists or no more valid points are in the desired search direction, a warning message will be displayed.

Parameters

`sCaption`	`in`	The maximal five-character long left part of the title bar.
`iPointType`	`in`	station or target point. For the values for `PointType` see table below

Point Type	**Meaning**
`GSI_STATION`	station point number
`GSI_INDIV_TG`	individual target number
`GSI_RUN_TG`	running target
`GSI_BACKSIGHT`	backside number (analog target, only changed prompts)
`GSI_POINT_CODE`	PointId / CodeId (analog target, only changed prompts)

`Point`	`in`	Only point number, the co-ordinates will be set to 0.
`Point`	`out`	point number and -co-ordinates. For further information see the description of `GSI_Point_Coord_Type`.
`iFlags`	`in`	defines functionality

Valid Flags	**Meaning**
`GSI_ALLOW_REC`	allows recording and coding
`GSI_MULTI_REC`	Allows multiple manual coord. entering

		GSI_ALLOW_ MAN	allows manual coord. entering
		GSI_HEIGHT_ MUST	height must be entered
		GSI_DIRECT_ SEARCH	direct searching without dialog
		GSI_NO_VIEW	no coord view if found
		GSI_NE_ OPTIONAL	only height must be entered, north & east are optional
		GSI_SEARCH_ FROM_END	Starts searching from end of file
		GSI_NO_FILE_ CHANGE	Changing of file is disabled
		GSI_GET_NEXT	Return the next valid data-set, ignore `sPtNr`
		Flags can be combined with '+'-operator (`iFlags` = iFlag1 + iFlag2)	
`iImportFile`	`in`	defines the source file for importing	
		Valid Import File	**Meaning**
		GSI_FILE_MEAS	MEAS file
		GSI_FILE_DATA	DATA file
		GSI_FILE_LAST	last used file
`sImportHelp`	`in`	Help text for import dialog. Only visible if the help functionality of the theodolite is enabled.	
`sInputHelp`	`in`	Help text for manual input dialog. Only visible if the help functionality of the theodolite is enabled.	
`sF2Button`	`in`	Text for activating F2 button.	
`sF4Button`	`in`	Text for activating F4 button	

See Also `GSI_ManCoordDlg`

Example

```
DIM Point AS GSI_Point_Coord_Type
GSI_ImportCoordDlg( "IMP", GSI_INDIV_TG,
        Point, GSI_ALLOW_REC + GSI_ALLOW_MAN,
        GSI_FILE_DATA, "Import Help Text",
        "Input Help Text", "F2", "F4" )
```

6.4.34 GSI_SetLineSysMDlg

Description Sets a line in the system measurement dialog.

Declaration

```
GSI_SetLineSysMDlg(
              BYVAL iDlgNr      AS Integer
              BYVAL iLineNr     AS Integer
              BYVAL iSysParamId AS Integer )
```

Remarks This routine sets one line in the system measurement dialog. To fetch information about a line, GSI_GetLineSysMDlg can be used. Unused lines should be set to GSI_PAR_NONE.

> **Note** 1) Parameters are identified by GSI_PAR_* values and not by GSI_ID_* values.
> 2) A line in the system measurement dialog can only be set to a system parameter not to an application parameter.

Parameters

iDlgNr — in — The number of the system measurement dialog where the line should be set. Possible values are:

Value	Meaning
GSI_SYS_MDLG_1	Dialog 1
GSI_SYS_MDLG_2	Dialog 2
GSI_SYS_MDLG_3	Dialog 3

iLineNr — in — The number of the line to set.

Valid numbers:
1.. GSI_MAX_DLG_LINES

iSysParamId — in — Identification of the system parameter. Refer to the chapter

"Constants for Measurement Dialog Definition"

See Also `GSI_GetLineSysMDlg`
`GSI_DefineMDlg`

Example See sample program "`meas.gbs`".
This example uses `GSI_SetLineSysMDlg` to configure the first two lines of the first system measurement dialog.

```
GSI_SetLineSysMDlg( GSI_SYS_MDLG_1, 1,
                    GSI_PAR_Date )
GSI_SetLineSysMDlg( GSI_SYS_MDLG_1, 2,
                    GSI_PAR_Time )
```

6.4.35 GSI_GetLineSysMDlg

Description Gets the definition of a line in the system measurement dialog.

Declaration

```
GSI_GetLineSysMDlg(
            BYVAL iDlgNr      AS Integer
            BYVAL iLineNr     AS Integer
                  iSysParamId AS Integer )
```

Remarks This routine fetches the information about the setting of one line in the system measurement dialog. To set a line in the system measurement dialog the routine `GSI_SetLineMDlg` can be used.

Parameters

iDlgNr	in	The number of the system measurement dialog where the line should be fetched. Possible values are:
		Value / **Meaning**
		GSI_SYS_MDLG_1 — Dialog 1
		GSI_SYS_MDLG_2 — Dialog 2
		GSI_SYS_MDLG_3 — Dialog 3
iLineNr	in	The number of the line to fetch.
iSysParamId	out	Identification of the system parameter. Refer to the chapter “Constants for Measurement Dialog Definition”

See Also GSI_SetLineSysMDlg
GSI_DefineMDlg

Example See sample program “meas.gbs”.
This example uses GSI_GetLineSysMDlg to get information about the configuration of the first system measurement dialog’s first two lines.

```
DIM iParLine1 AS Integer
DIM iParLine2 AS Integer

GSI_GetLineSysMDlg( GSI_SYS_MDLG_1, 1, iParLine1)
GSI_GetLineSysMDlg( GSI_SYS_MDLG_1, 2, iParLine2)
```

6.4.36 GSI_SetMDlgNr

Description Sets the number of the system measurement dialog.

Declaration `GSI_SetMDlgNr( BYVAL iMDlgNr AS Integer)`

Remarks Sets the number of the system measurement dialog. The content of these dialogs can by changed by using of DefineMDlg.

Parameters

`iMDlgNr`	in	Number of the measurement dialog. Valid values: `0..GSI_MAX_MDLG_MASKS-1`

See Also `GSI_GetMDlgNr`

Example See sample program “`meas_od.gbs`”.
This example sets the next dialog mask

```
GSI_GetMDlgNr( i )
i = (i + 1) MOD GSI_MAX_MDLG_MASKS
GSI_SetMDlgNr( i )
```

6.4.37 GSI_GetMDlgNr

Description Returns the number of the system measurement dialog.

Declaration `GSI_GetMDlgNr(iMDlgNr AS Integer)`

Remarks Returns the number of the system measurement dialog.

Parameters

`iMDlgNr`	out	Number of the actual measurement dialog

See Also `GSI_SetMDlgNr`

6.4.38 GSI_CreateMDlg

Description Create and show the user definable measurement dialog.

Declaration

```
GSI_CreateMDlg(
            BYVAL iFixLines     AS Integer
            BYVAL sCaptionLeft  AS _Token
            BYVAL sCaptionRight AS _Token
            BYVAL sHelpText     AS _Token )
```

Remarks This routine creates and shows the user definable measurement dialog with `iFixLines` fix lines, the left part of the title bar `sCaptionLeft`, the caption `sCaptionRight`, and the help text `sHelpText`.

Only one measurement dialog can exist at the same time. If `GSI_CreateMDlg` is called and there already exists a measurement dialog, the existing dialog (together with all attached buttons) is deleted and the new dialog is created.

Note	If a graphics dialog or a text dialog exist together with a measurement dialog, all button routines (`MMI_AddButton`, `MMI_GetButton`, `MMI_DeleteButton`) are related to the measurement dialog.

The shown parameters used in the dialog are defined in the user display mask (see `GSI_DefineMDlg`).

Parameters

`iFixLines`	`in`	The number of fix lines. (These lines are not scrolled.)
`sCaptionLeft`	`in`	The part of the title bar displayed on the left border (up to five characters wide)
`sCaptionRight`	`in`	The caption of the dialog.
`sHelpText`	`in`	This text is shown, when the help button `SHIFT-F1` is pressed and the help functionality of the theodolite is enabled.

See Also `GSI_UpdateMDlg`
`GSI_UpdateMeasurement`

Example See example file „`meas.gbs`“ too.

This example uses the measure dialog routines `GSI_CreateMDlg`, `GSI_UpdateMDlg` and `GSI_UpdateMeasurment` to execute a measure process.

```
DIM ValidForRec   AS Logical
DIM RetCodeForMsg AS Integer
DIM WaitTime      AS Integer
DIM iButton       AS Integer

WaitTime = 10 'ms

'user definition of measurement dialog
'can be placed here
```

```
GSI_CreateMDlg( 1, "WIR", "Measure Dialog",
                   "This is the Helptext")
DO
  GSI_UpdateMeasurment( TMC_MEA_INC,
                        WaitTime, ValidForRec,
                        RetCodeForMsg, FALSE )
  GSI_UpdateMDlg (iButton)
LOOP UNTIL iButton = MMI_ESC_KEY

GSI_DeleteDialog()
```

6.4.39 GSI_SetLineMDlg

Description Sets one line in the user definable measurement dialog to system parameter.

Declaration

```
GSI_SetLineMDlg(
             BYVAL iLineNr     AS Integer
             BYVAL iSysParamId AS Integer )
```

Remarks This routine sets the configuration of a line in the user definable measurement dialog to a system parameter. This measurement dialog is initialized automatically with the actual settings of the first system measurement dialog. Modifications of the user definable dialog have no effects on the system measurement dialog and will be lost after termination of the program. An unused line should be set to `GSI_PAR_NONE`. To add a user definable application parameter to the dialog use `GSI_SetLineMDlgPar`. To add a line of text (e.g. separator line) to the dialog use `GSI_SetLineMDlgText`.

Parameters

`iLineNr`	in	The number of the line to set. Valid numbers: `1.. GSI_MAX_DLG_LINES`
`iSysParamId`	in	Identification of the system parameter. Refer to the chapter “Constants for Measurement Dialog Definition”

See Also `GSI_SetLineMDlgPar`
`GSI_SetLineMDlgText`
`GSI_CreateMDlg`

Example This example uses `GSI_SetLineMDlg` to configure the user definable measurement dialog.

```
GSI_SetLineMDlg( 1, GSI_PAR_ReflHeight )
GSI_SetLineMDlg( 2, GSI_PAR_Info1 )
GSI_SetLineMDlg( 3, GSI_PAR_Info2 )
…
GSI_SetLineMDlg( 10, GSI_PAR_NONE )
GSI_SetLineMDlg( 11, GSI_PAR_NONE )
GSI_SetLineMDlg( 12, GSI_PAR_NONE )
```

6.4.40 GSI_SetLineMDlgText

Description Puts a text line into the user definable measurement dialog.

Declaration

```
GSI_SetLineMDlgText(
             BYVAL iLineNr  AS Integer,
             BYVAL iParamId AS Integer,
             BYVAL sText    AS _Token )
```

Remarks This routine inserts a pure text line into the user definable measurement dialog. To add an user definable application parameter to the dialog use `GSI_SetLineMDlgPar`. To add a system parameter to the dialog use `GSI_SetLineMDlg`.

Parameters

`iLineNr`	`in`	The number of the line to set. Valid numbers: `1.. GSI_MAX_DLG_LINES`
`iParamId`	`in`	Id of the system parameter.
`sText`	`in`	Contents of the line.

See Also `GSI_SetLineMDlg`
`GSI_SetLineMDlgPar`
`GSI_CreateMDlg`

Example This example uses `GSI_SetLineMDlg` and `GSI_SetLineMDlgText` to configure the user definable measurement dialog.

```
GSI_SetLineMDlg( 1, GSI_PAR_Date )
GSI_SetLineMDlg( 2, GSI_PAR_Time )
GSI_SetLineMDlgText( 3, GSI_PAR_APPDATA0,
                     "----------------" )
GSI_SetLineMDlg( 4, GSI_PAR_Info1 )
GSI_SetLineMDlg( 5, GSI_PAR_Info2 )
```

6.4.41 GSI_SetLineMDlgPar

Description Sets one line in the user definable measurement dialog to an application parameter.

Declaration

```
GSI_SetLineMDlgPar(
             BYVAL iLineNr       AS Integer
             BYVAL iApplParamId  AS Integer
             BYVAL sLabel        AS _Token
             BYVAL lEditAble     AS Logical
             BYVAL iFormat       AS Integer )
```

Remarks This routine sets the configuration of a line in the user definable measurement dialog to an application parameter. The style of the application parameter is also defined in this routine. Any floating point format and strings are valid formats. The starting values of every application parameter is not predefined and hence has to be set explicitly. To initialize an application parameter the routine `GSI_SetWiEntry` can be used. To add a line of text to the dialog use `GSI_SetLineMDlgText`. To add a system parameter to the dialog use `GSI_SetLineMDlg`.

Parameters

`iLineNr`	`in`	The number of the line to set. Valid numbers: `1.. GSI_MAX_DLG_LINES`
`iApplParamId`	`in`	Id of the application parameter.
`sLabel`	`in`	Description of parameter on display.

`lEditAble`	`in`	Edit ability of the value in the measurement dialog.
`iFormat`	`in`	Format descriptor of the application parameter. The format defines if a dimension field is available. Following values can be used:

Value	Meaning
`MMI_FFORMAT_STRING`	string
`MMI_FFORMAT_DOUBLE`	double
`MMI_FFORMAT_DISTANCE`	distance
`MMI_FFORMAT_SUBDISTANCE`	sub-distance [mm]
`MMI_FFORMAT_ANGLE`	angle
`MMI_FFORMAT_VANGLE`	vertical angle
`MMI_FFORMAT_HZANGLE`	horizontal angle
`MMI_FFORMAT_TEMPERATURE`	temperature

See Also `GSI_SetLineMDlg`
`GSI_SetLineMDlgText`
`GSI_CreateMDlg`

Example See also sample file “`meas.gbs`”.
This example uses `GSI_SetLineMDlgPar` and `GSI_SetWiEntry` to configure the user definable measurement dialog.

```
DIM WI AS GSI_WIDLG_ENTRY_TYPE

WI.lValid    = FALSE
WI.iDataType = GSI_ASCII
GSI_SetWiEntry(GSI_ID_APPDATA0, WI)
GSI_SetLineMDlgPar(1, GSI_PAR_AppData0,
                   "Stat. Name:", TRUE,
                   MMI_FFORMAT_STRING)
WI.lValid    = TRUE
WI.iDataType = GSI_DOUBLE
WI.dValue    = 2.2
GSI_SetWiEntry(GSI_ID_APPDATA3, WI)
GSI_SetLineMDlgPar(8, GSI_PAR_AppData3,
                   "Distance : ", TRUE,
                   MMI_FFORMAT_DISTANCE)
```

6.4.42 GSI_UpdateMDlg

Description Updates the user definable measurement dialog.

Declaration `GSI_UpdateMDlg( iButton As Integer)`

Remarks This procedure updates the user definable measurement dialog with the actual values from the Theodolite data pool and returns pressed buttons.

Parameters

`iButton`	`out`	Contains pressed button identifier. For details see `MMI_GetButton` (`lAllKeys = TRUE`).

See Also `GSI_CreateMDlg`
`GSI_UpdateMeasurement`

Example See example `GSI_CreateMDlg` and example file „`meas.gbs`“.

6.4.43 GSI_DefineMDlg

Description Defines the entries of the user definable measurement dialog.

Declaration `GSI_DefineMDlg( BYVAL sCaption AS _Token)`

Remarks Interactively defines the contents of the user definable measurement dialog. Using a dialog with list fields, the user can select the items for the measurement dialog. This routine is an interactive equivalent to the routines `GSI_SetLineSysMDlg` and `GSI_GetLineSysMDlg`.

Parameters

`sCaption`	`in`	The left caption of the title bar. (Up to 5 characters wide.)

See Also `GSI_GetDlgMask`
`GSI_SetDlgMask`

Example

```
GSI_DefineMDlg( "DEF" )
```

6.4.44 GSI_UpdateMeasurment

Description Update the measurement data.

Declaration

```
GSI_UpdateMeasurment(
            iInclinePrg     AS Integer,
            iWaitTime       AS Integer,
            lValidForRec    AS Logical,
            iRetCodeForMsg  AS Integer,
            lChkIncRangeNow AS Logical )
```

Remarks This function updates the measurement values in the Theodolite data pool. The data are the incline program, angles, distances, time, reflector height.

Parameters

`iInclinePrg`	`in`	The manner of incline compensation. Following settings are possible: **Incline Program** / **Meaning** `TMC_MEA_INC` — get inclination `TMC_AUTO_INC` — get inclination with automatism `TMC_PLANE_INC` — get inclination always with plane
`iWaitTime`	`in`	The wait time for a result (in ms). This time is used for synchronising the TMC task.
`lValidForRec`	`out`	Indicates validity of the registration
`iRetCodeForMsg`	`out`	Return code of the measurement
`lChkIncRangeNow`	`in`	`TRUE`: check incline range immediate

See Also `GSI_CreateMDlg`
`GSI_UpdateMDlg`
`GSI_DeleteDialog`

Example See example `GSI_CreateMDlg` and example file „`meas.gbs`“.

6.4.45 GSI_Measure

Description Measure and registration dialog.

Declaration `GSI_Measure ( )`

Remarks This procedure opens the measure and registration dialog.

Parameters

`none`

Return Codes

RC_OK	Success

Example Do a measure and registration dialog.

```
GSI_Measure ( )
```

6.4.46 GSI_ExecuteAutoDist

Description Executes an automatic distance measurement.

Declaration `GSI_ExecuteAutoDist ( )`

Remarks This procedure starts a distance measurement on condition that “Auto Dist” is enabled and one of the distance measurement-program buttons (`FNC`-menu) was pressed.

Parameters

none

Return Codes

RC_OK	Success

Example See example file „`meas.gbs`“ or „`meas_od.gbs`“.

6.4.47 GSI_CheckTracking

Description Returns if distance tracking is running.

Declaration `GSI_CheckTracking(lTracking As Logical)`

Remarks This returns if a distance tracking is running.

An automatic start of distance tracking can be started on several conditions, i.e. by Quick-Coding, `GSI_ExecuteAutoDist` or by pressing buttons in the `FNC`-menu.

Tracking can be terminated by the instrument itself due several reasons, i.e. for laser security reasons (US-configuration)

Parameters

`lTracking`	`In`	`TRUE`: a distance tracking is running

Return Codes

`RC_OK`	Successful

Example See example file „`meas.gbs`“ or „`meas_od.gbs`“.

6.4.48 GSI_RecordRecMask

Description Recording the given wi mask.

Declaration

```
GSI_RecordRecMask (
                RecList AS GSI_REC_ID_LIST,
          BYVAL eProgFunction AS Logical,
          BYVAL bCheckStdMask AS Logical,
          BYVAL bIncAndSetRunPt AS Logical)
```

Remarks This procedure records the given wi list. The target can be the memory card or the interface. The parameter for the interface depends on the GSI communication settings. Errors will shown on the display, when recording list will be stored in the memory card. Otherwise the error messages will be given on the interface.

Parameters

`RecList`	`in`	recording list
`eProgFunction`	`in`	program flag in the wi's (`TRUE` = ON, `FALSE` = OFF)
`bCheckStdMask`	`in`	testing the standard recording mask
`bIncAndSetRunPt`	`in`	increment the point number

Return Codes

`RC_OK`	Success
`RC_IVRESULT`	registration failure

See Also

Example Record `RecList`.

```
DIM RecList AS GSI_REC_ID_LIST

' initialize RecList with adequate values
GSI_RecordRecMask ( RecList, TRUE, TRUE, TRUE )
```

6.5 CENTRAL SERVICE FUNCTIONS CSV

6.5.1 Summarizing Lists of CSV Types and Procedures

6.5.1.1 Types

type name	description
`TPS_Fam_Type`	Information about the current hardware.
`Date_Time_Type`	Date and time information.
`Date_Type`	Date information.
`Time_Type`	Time information.

6.5.1.2 Procedures

procedure name	description
`CSV_ChangeFace`	Do an absolute positioning to the opposite.
`CSV_CheckAltUserTask`	Returns if an alternative user-task was running.
`CSV_Delay`	Delay routine
`CSV_GetATRStatus`	Gets the current ATR state.
`CSV_GetDateTime`	Get the date and the time of the system.
`CSV_GetElapseSysTime`	Returns the difference between a reference time and the system time.
`CSV_GetGBIVersion`	Returns the release number of the GeoBASIC interpreter
`CSV_GetInstrumentFamily`	Get information about the system.
`CSV_GetInstrumentName`	Get the LEICA specific instrument name.
`CSV_GetInstrumentNo`	Get the instrument number.
`CSV_GetLaserPlummet`	Returns the laser plummet state
`CSV_GetLockStatus`	Gets the current state of the locking facility.
`CSV_GetLRStatus`	Returns the status of the system.

procedure name	description
CSV_GetPrismType	Returns the used prism
CSV_GetSWVersion	Get the version of the system software.
CSV_GetSysTime	Returns the system time.
CSV_GetTargetType	Get the target type for distance measurements.
CSV_GetTemperature	Returns the internal temperature of the instrument.
CSV_Laserpointer	Switch on / off the laser pointer.
CSV_LibCall	Call a GeoBASIC routine from another program.
CSV_LibCallAvailable	Check if GeoBASIC routine from another program is available.
CSV_LockIn	Starts locking (ATR)
CSV_LockOut	Stops locking (ATR)
CSV_MakePositioning	Do an absolute positioning.
CSV_ResetAltUserTask	Resets the “alternative user-task was running” flag.
CSV_SetATRStatus	Sets the current state of Automatic Target Recognition.
CSV_SetLaserPlummet	Switches the laser plummet
CSV_SetLightGuide	Switch on / off the light guide.
CSV_SetLockStatus	Sets the current state of the locking facility.
CSV_SetPrismType	Sets the used prism
CSV_SetTargetType	Set the target type for distance measurements.
CSV_SysCall	Call a system function.
CSV_SysCallAvailable	Check if system function is available.

6.5.2 Data Structures for the Central Service Functions

6.5.2.1 Date_Time_Type: Date and Time

Description These data structures are used to store date and time information.

```
TYPE Date_Type
  iYear          AS Integer      year as a 4 digit number
  iMonth         AS Integer      month as a 2 digit number
  iDay           AS Integer      day as a 2 digit number
END Date_Type

TYPE Time_Type
  iHour          AS Integer      hour as a 2 digit number (24 hours
                                 format)
  iMinute        AS Integer      minutes as a 2 digit number
  iSecond        AS Integer      seconds as a 2 digit number
END Time_Type


Date_Time_Type
  Date           AS Date_Type    date (as defined above)
  Time           AS Time_Type    time (as defined above)
END_Time_Type
```

6.5.2.2 TPS_Fam_Type: Information about the system

Description This data structure is used to store information about the hardware. Further information about the hardware can be obtained by your local Leica representative.

```
TYPE TPS_Fam_Type
  iClass              AS Integer
```

The class of the system. Values:

Id	Meaning
TPS1101	TPS1100 accuracy 1”
TPS1102	TPS1100 accuracy 2”
TPS1103	TPS1100 accuracy 3”
TPS1105	TPS1100 accuracy 5”

lEDMBuiltIn	AS Logical	EDM built-in
lEDMTypeII	AS Logical	EDM built-in, type II
lEDMTypeIII	AS Logical	EDM built-in, type III
lEDMReflectorless	AS Logical	Red Laser
lMotorized	AS Logical	Motorised
lATR	AS Logical	Automatic Target Recognition (ATR)
lEGL	AS Logical	EGL Guide Light
lLaserPlummet	AS Logical	Laser Plummet
lAutoCollimation	AS Logical	Auto-collimation lamp
lSimulator	AS Logical	Hardware is simulator on Windows-PC

```
END TPS_Fam_Type
```

6.5.3 CSV_GetDateTime

Description Get the date and the time of the system.

Declaration

```
CSV_GetDateTime(
      DateAndTime AS Date_Time_Type )
```

Remarks The `CSV_GetDateTime` routine reads the date and the time from the system's real-time clock (RTC) and returns the values in the structure `Date_Time_Type`. In the case of TPS_Sim the system clock will be read.

Parameters

`DateAndTime`	`out`	The structure for the date and the time.

Return Codes

`RC_UNDEFINED`	The date and time is not set (not yet/not any longer).

Example The example uses the `CSV_GetDateTime` routine to get the date and the time of the system and displays the values.

```
DIM DT AS Date_Time_Type

ON ERROR RESUME
CSV_GetDateTime( DT )

IF ERR = RC_OK THEN
  MMI_PrintInt(  0, 0, 5, DT.Date.iYear, TRUE  )
  MMI_PrintInt(  6, 0, 3, DT.Date.iMonth, TRUE )
  MMI_PrintInt( 10, 0, 3, DT.Date.iDay, TRUE   )
  MMI_PrintInt(  0, 1, 3, DT.Time.iHour, TRUE  )
  MMI_PrintInt(  4, 1, 3, DT.Time.iMinute, TRUE)
  MMI_PrintInt(  8, 1, 3, DT.Time.iSecond, TRUE)

ELSEIF ERR = RC_UNDEFINED THEN
  MMI_PrintStr(  0, 0,
                "Date and time not set.", TRUE )
ELSE
  MMI_PrintStr(  0, 0,
                "Unexpected error code.", TRUE )
END IF
```

6.5.4 CSV_GetTemperature

Description Returns the internal temperature of the instrument.

Declaration `CSV_GetTemperature( IntTemp AS Temperature )`

Remarks This routine returns the internal temperature.

Parameters

`IntTemp`	`out`	Internal temperature

6.5.5 CSV_GetInstrumentName

Description Get the LEICA specific instrument name.

Declaration `CSV_GetInstrumentName( sName AS String30 )`

Remarks The `CSV_GetInstrumentName` routine returns the name of the system in the string `sName`.

Parameters

`sName`	`out`	The LEICA specific instrument name.

Return Codes

`none`

See Also `CSV_GetInstrumentNo`, `CSV_GetInstrumentFamily`

Example The example uses the `CSV_GetInstrumentName` routine to get the instrument name and displays it.

```
DIM sName AS String30

CSV_GetInstrumentName ( sName )
MMI_PrintStr ( 0, 0, sName, TRUE )
```

6.5.6 CSV_GetInstrumentNo

Description Get the instrument number.

Declaration `CSV_GetInstrumentNo( iSerialNo AS Integer )`

Remarks The `CSV_GetInstrumentNo` routine returns the serial number of the system.

Parameters

`iSerialNo`	`out`	The serial number of the system.

Return Codes

`none`

See Also `CSV_GetInstrumentName`, `CSV_GetInstrumentFamily`

Example The example uses the `CSV_GetInstrumentNo` routine to get the instrument number and displays it.

```
DIM iSerialNo AS Integer

CSV_GetInstrumentNo( iSerialNo )
MMI_PrintInt( 0, 1, 20, iSerialNo, TRUE )
```

6.5.7 CSV_GetInstrumentFamily

Description Get information about the system.

Declaration

```
CSV_GetInstrumentFamily(
          Family AS TPS_Fam_Type )
```

Remarks The `CSV_GetInstrumentFamily` routine returns the class and the instrument type of the system (see description of the data structure `TPS_Fam` for return values).

TPS_Sim	Always sets `Familiy.lSimulator` to `TRUE`.

Parameters

`Family`	`out`	Contains the class and instrument type data. See description of the data structure `TPS_Fam` for return values.

See Also `CSV_GetInstrumentName`, `CSV_GetInstrumentNo`

Example The example uses the `CSV_GetInstrumentFamily` routine to get information about the instrument and displays it.

```
DIM Family AS TPS_Fam_Type

CSV_GetInstrumentFamily( Family )
MMI_PrintInt( 0, 1, 10, Family.iClass, TRUE )
IF (Family.lSimulator) THEN
  MMI_PrintString( 0, 2, 10, "ON TPS_SIM", TRUE)
END IF
```

6.5.8 CSV_GetSWVersion

Description Get the version of the system software.

Declaration

```
CSV_GetSWVersion( iRelease AS Integer,
                  iVersion AS Integer )
```

Remarks The `CSV_GetSWVersion` routine returns the Release number and the number of the system software version. These numbers can be interpreted together as software identification (`Release.Version`, e.g. 1.05).

TPS_Sim	Delivers the version of the simulator.

Parameters

`iRelease`	`out`	value of the Release number can be in the range from 0 to 99
`iVersion`	`out`	value of the version number can be in the range from 0 to 99

See Also

Example The example uses the `CSV_GetSWVersion` routine to get the system software version and displays it.

```
DIM iRelease AS Integer
DIM iVersion AS Integer

CSV_GetSWVersion( iRelease, iVersion )
MMI_PrintVal( 0, 0, 6, 2,
              iRelease + iVersion / 100, TRUE )
```

6.5.9 CSV_GetGBIVersion

Description Returns the release number of the GeoBASIC interpreter.

Declaration

```
CSV_GetGBIVersion(
           iRelease    as Integer,
           iVersion    as Integer,
           iSubVersion as Integer )
```

Remarks This function returns the release version of the running GeoBASIC interpreter.

Parameters

iRelease	out	Release number
iVersion	Out	Version Number
iSubVersion	out	Subversion number

Return-Codes

RC_OK	Successful termination.

Example This example shows the currently used GeoBASIC interpreter release number.

```
DIM iRel       As Integer
DIM iVer       As Integer
DIM iSubVer    As Integer

MMI_CreateTextDialog(
     6, "-CSV-", "Test CSV", "no help available")
CSV_GetGBIVersion (iRel, iVer, iSubVer)
MMI_PrintStr(0, 0,
     "GBI: "+Str$(iRel) + "." +
     Str$(iVer) +" ."+Str$(iSubVer), TRUE)
MMI_DeleteDialog()
```

6.5.10 CSV_GetElapseSysTime

Description Returns the difference between a reference time and the system time.

Declaration

```
CSV_GetElapseSysTime( iRefTime AS Integer,
                      iElapse  AS Integer )
```

TPS_Sim	Use PC time base. Time resolution is one second.

Remarks The routine `CSV_GetElapseSysTime` returns the difference of between a given reference time `iRefTime` and the systems time. Whenever the system starts up, the system time is reset.

Parameters

`iRefTime`	`in`	The reference time.
`iElapse`	`out`	The difference between `iRefTime` and the system time. The difference is returned in [ms].

See Also `CSV_GetSysTime`, `CSV_GetDateTime`

Example The example uses the routine CSV_GetElapseSysTime to get a time difference.

```
DIM iElapse  AS Integer
DIM iRefTime AS Integer

CSV_GetSysTime(iRefTime)'returns reference time
' do something. . .
CSV_GetElapseSysTime( iRefTime, iElapse )
MMI_PrintInt ( 0, 0, 20, iElapse, TRUE )
```

6.5.11 CSV_GetSysTime

Description Returns the system time.

Declaration `CSV_GetSysTime( iTime AS Integer )`

Remarks The routine returns the systems time. Whenever the system starts up, the system time is reset.

TPS_Sim	Delivers the system up time of the PC.

Parameters

iTime	out	The system time in ms.

See Also CSV_GetElapseSysTime, CSV_GetDateTime

Example See CSV_GetElapsedTime.

6.5.12 CSV_GetLRStatus

Description Returns the status of the system.

Declaration `CSV_GetLRStatus( iLRStatus AS Integer )`

Remarks The routine CSV_GetLRStatus returns the mode of the system. The system can either be in local or in Remote mode. For Release 1.0 this function always delivers local mode as an answer.

Note	This function is reserved for future purposes and has no special usage in the current implementation.
TPS_Sim	Always delivers `LOCAL_MODE`.

Parameters

`iLRStatus` The mode of the system. Possible values for the `iLRStatus` are:

Mode	Value	Comment
`LOCAL_MODE`	`0`	local mode
`REMOTE_MODE`	`1`	Remote mode

Example The example uses the routine `CSV_GetLRStatus` to get the mode of the system.

```
DIM iLRStatus AS Integer

CSV_GetLRStatus( iLRStatus )
MMI_PrintInt( 0, 0, 10, iLRStatus, TRUE )
```

6.5.13 CSV_SetGuideLight

Description Set the guide light intensity.

Declaration `CSV_SetGuideLight( BYVAL iLight AS Integer )`

Remarks Sets the guide light intensity.

Parameters

`iLight` `in` Guide light intensity

Value	Meaning
`CSV_EGL_OFF`	Switching off
`CSV_EGL_LOW`	Low intensity
`CSV_EGL_MID`	Middle intensity
`CSV_EGL_HIGH`	High intensity

Return Codes

`RC_SYSBUSY`	EDM is busy. Guide light cannot be switched.
`RC_NOT_IMPL`	Guide light Hardware is not available

Example Switch off the Light guide.

```
CSV_SetGuideLight( CSV_EGL_OFF )
```

6.5.14 CSV_Laserpointer

Description Switch on / off the laser pointer.

Declaration

```
CSV_Laserpointer( BYVAL lLaser AS Logical )
```

Remarks Switches on / off the laser pointer.

Parameters

`lLaser`	`in`	Switch on / off the Laser pointer (`TRUE` = on, `FALSE` = off)

Return Codes

`RC_SYSBUSY`	EDM is busy. Laser pointer cannot be switched.
`RC_NOT_IMPL`	Laser pointer Hardware is not available.

Example Switch off the laser pointer.

```
CSV_Laserpointer( FALSE )
```

6.5.15 CSV_MakePositioning

Description Do an absolute positioning.

Declaration

```
CSV_MakePositioning(BYVAL dHz AS Double,
                    BYVAL dV  AS Double)
```

Remarks Absolute positioning of the Theodolite axes to the desired angles with the currently active tolerance for positioning. If any control function is active at the point of call, it will be cancelled and the positioning will be performed. After the positioning the controller will be automatically activated for manual input for the moving device. When starting the positioning the calling application has to take care that a valid inclination plane is available for an angle measure, as it can normally not be redone during positioning.
The positioning is done with the planes valid at the beginning of

it. During the process no inclination will be measured. The used positioning method can cause inexact results, especially for steep V > ~25 GON

Parameters

`dHz`	in	Corrected Hz-angle [Radiant]
`dV`	in	Corrected V-angle [Radiant]

Return Codes

`RC_IVPARAM`	No valid positioning angle.
`CSV_DETENT_ERROR`	target angle is out of the limits or a collision is occurred.
`CSV_TIMEOUT`	time out at positioning of one or both axes
`CSV_MOTOR_ERROR`	error in subsystem
`CSV_ANGLE_ERROR`	error at measuring the angle
`RC_FATAL`	fatal error
`RC_ABORT`	system abort

See Also `BAP_PosTelescope`

Example Perform an absolute positioning.

```
CSV_MakePositioning( 0, 2*atn(1) ) ' (0, Pi/2)
```

6.5.16 CSV_ChangeFace

Description Do an absolute positioning to the opposite.

Declaration `CSV_ChangeFace( )`

Remarks Perform positioning into the position opposite to the current. If any control function is active at the point of call, it will be cancelled and the positioning will be performed. After the positioning the controller will be automatically activated for manual input for the moving device. When starting the positioning the calling application has to take care that a valid inclination plane is available for an angle measure, as it can normally not be redone during positioning.

The positioning is done with the planes valid at the beginning of it. During the process no inclination will be measured. The used positioning method can cause inexact results, especially for steep V > ~25 GON

Parameters

`none`

Return Codes

RC_IVPARAM	No valid positioning angle.
CSV_DETENT_ERROR	target angle is out of the limits or a collision is occurred.
CSV_TIMEOUT	time out at positioning of one or both axes
CSV_MOTOR_ERROR	error in subsystem
CSV_ANGLE_ERROR	error at measuring the angle
RC_FATAL	fatal error
RC_ABORT	system abort

See Also BAP_PosTelescope

Example Perform a change of face.

```
CSV_ChangeFace()
```

6.5.17 CSV_SetLockStatus

Description Sets the current state of the locking facility.

Declaration `CSV_SetLockStatus(BYVAL lOn AS Logical )`

Remarks It switches the locking facility on or off.

Parameters

lOn	in	Switches on / off the locking facility (TRUE = on, FALSE = off)

Return Codes

`RC_FATAL`	fatal error
`RC_NOT_IMPL`	if ATR hardware is not available
`RC_ABORT`	system abort

See Also `CSV_SetLockStatus`, `CSV_LockIn`, `CSV_LockOut`

Example Perform an absolute positioning.

```
CSV_SetLockStatus( TRUE ) ' switches locking on
```

6.5.18 CSV_GetLockStatus

Description Gets the current state of the locking facility.

Declaration `CSV_GetLockStatus( lOn AS Logical )`

Remarks It queries the TPS system if the locking facility is on or off.

Parameters

`lOn`	`out`	**meaning**	
		`FALSE`	Locking is switched off.
		`TRUE`	Locking is switched on.

Return Codes

`RC_FATAL`	fatal error
`RC_NOT_IMPL`	if ATR hardware is not available
`RC_ABORT`	system abort

See Also `CSV_GetLockStatus`, `CSV_LockIn`, `CSV_LockOut`

Example Perform an absolute positioning.

```
DIM l AS Logical
CSV_SetLockStatus( l ) ' queries locking
```

6.5.19 CSV_LockIn

Description Starts the locking facility.

Declaration `CSV_LockIn( )`

Remarks If ATR is switched on then locking to the target will be done. If no target available, then manual positioning will be started.

Parameters

`none`

Return Codes

AUT_RC_NOT_ENABLED	Theodolite without ATR or lock status not set
AUT_RC_MOTOR_ERROR	Error at motor control.
AUT_RC_DETECTOR_ERROR	Error at ATR
AUT_RC_NO_TARGET	No target at the detection range
AUT_RC_BAD_ENVIRONMENT	Bad environment at the detection range (bad light…)
RC_NOT_IMPL	if ATR hardware is not available

See Also `CSV_GetLockStatus`, `CSV_SetLockStatus`, `CSV_LockOut`

Example This example starts locking.

```
CSV_LockIn( )
```

6.5.20 CSV_LockOut

Description Stops a running locking function.

Declaration `CSV_LockOut( )`

Parameters

`none`

Return Codes

RC_OK	no error
RC_NOT_IMPL	if ATR hardware is not available

See Also `CSV_GetLockStatus,CSV_SetLockStatus, CSV_LockIn`

Example This example stops locking.

```
CSV_LockOut( )
```

6.5.21 CSV_SetATRStatus

Description Sets the current state of Automatic Target Recognition.

Declaration `CSV_SetATRStatus(BYVAL lOn AS Logical )`

Remarks It switches the ATR facility on or off.

Parameters

lOn	in	Switches on / off the ATR facility (TRUE = on, FALSE = off)

Return Codes

RC_FATAL	fatal error
RC_ABORT	system abort
RC_NOT_IMPL	if ATR hardware is not available

Example Perform an absolute positioning.

```
CSV_SetATRStatus( TRUE ) ' switches ATR on
```

6.5.22 CSV_GetATRStatus

Description Gets the current ATR state.

Declaration `CSV_GetATRStatus(lOnl AS Logical )`

Remarks It queries the TPS system if the ATR facility is on or off.

Parameters

`lOn`	`out`	**meaning**	
		`FALSE`	ATR is switched off.
		`TRUE`	ATR is switched on.

Return Codes

`RC_FATAL`	fatal error
`RC_ABORT`	system abort
`RC_NOT_IMPL`	if ATR hardware is not available

Example Get current ATR status.

```
DIM l AS Logical

CSV_SetATRStatus( l )
```

6.5.23 CSV_Delay

Description This routine delays the execution of a program.

Declaration `CSV_Delay( BYVAL iDelay AS Integer )`

Remarks This routine delay using the operating system, that means that other Theodolite tasks can run during the delay (It is not a busy waiting).

Note	Avoid busy waiting using `FOR` - or `WHILE` loops.

TPS_Sim	Delay resolution is one second. `iDelay` < 500 means no delay

Parameters

iDelay	in	Time to delay [ms]

Example This example „waits“ 2 seconds until it goes on.

```
CSV_Delay( 2000 )
```

6.5.24 CSV_SetTargetType

Description Set the target type for distance measurements.

Declaration

```
CSV_SetTargetType(
                  BYVAL iTargetType as Integer )
```

Remarks This routine sets the target type for distance measurements. The target type defines if the next distance measurement happens with prism or without prism.

Parameters

iTarget Type	in	Target type

Valid target types	Meaning
CSV_WITH_REFLECTOR	With reflector
CSV_WITHOUT_REFLECTOR	Without reflector

Return-Codes

RC_OK	Successful termination.
RC_IVPARAM	Instrument don’t support this target type

See `CSV_ GetTargetType, BAP_SetMeasPrg, BAP_GetMeasPrg`

Example The example sets a target type without prism.

```
CSV_SetTargetType(CSV_WITHOUT_REFLECTOR)
```

6.5.25 CSV_GetTargetType

Description Get the target type for distance measurements.

Declaration `CSV_GetTargetType( iTargetType as Integer )`

Remarks This routine fetches the target type for distance measurements. The target type defines if the next distance measurement happens with prism or without prism.

Parameters

iTargetType	out	Target type

Valid target types	Meaning
CSV_WITH_REFLECTOR	With reflector
CSV_WITHOUT_REFLECTOR	Without reflector

Return-Codes

RC_OK	Successful termination.

See `CSV_ SetTargetType, BAP_SetMeasPrg, BAP_GetMeasPrg`

Example The example fetches the target type.

```
DIM iTargetType AS Integer

CSV_GetTargetType(iTargetType)
```

6.5.26 CSV_SetPrismType

Description Sets the used prism.

Declaration `CSV_SetPrismType( BYVAL iPrism as Integer)`

Remarks This routine sets the used prism `iPrism` (`BAP_PRISM_ROUND, BAP_PRISM_TAPE, BAP_PRISM_MINI, BAP_PRISM_360, BAP_PRISM_USER1, BAP_PRISM_USER2` or `BAP_PRISM_USER3`). If `iPrism` is one of the user defined prisms and this prism is actually not defined then this routine will return `RC_IVRESULT`.

Parameters

`iPrism`	`in`	Used prism

Return-Codes

`RC_OK`	Successful termination.
`RC_IVRESULT`	Prism not defined.

See `CSV_GetPrismType`

Example The example sets the 360 degrees prism.

```
CSV_SetPrismType(BAP_PRISM_360)
```

6.5.27 CSV_GetPrismType

Description Returns the used prism.

Declaration `CSV_GetPrismType(iPrism as Integer)`

Remarks This routine returns the used prism `iPrism`.

Parameters

`iPrism`	`out`	Used prism

Return-Codes

`RC_OK`	Successful termination.

See `CSV_SetPrismType`

Example The example returns the used prism.

```
DIM iPrism AS Integer

CSV_SetPrismType( iPrism )
```

6.5.28 CSV_SetLaserPlummet

Description Switches the laser plummet.

Declaration `CSV_SetLaserPlummet( BYVAL lOn as Logical )`

Remarks This function switches the optional laser plummet. The plummet will be switched off automatically after 3 minutes.

Parameters

`lOn`	`in`	`TRUE`: switch plummet on

Return-Codes

`RC_OK`	Successful termination.

See `CSV_GetLaserPlumet, CSV_GetInstrumentFamily`

6.5.29 CSV_GetLaserPlummet

Description Returns the laser plummet state.

Declaration `CSV_GetLaserPlummet( lOn as Logical )`

Remarks This function returns the state of the optional laser plummet.

Parameters

`lOn`	`out`	`TRUE`: plummet is switched on

Return-Codes

`RC_OK`	Successful termination.

See `CSV_SetLaserPlumet, CSV_GetInstrumentFamily`

6.5.30 CSV_CheckAltUserTask

Description Returns if an alternative user-task was running.

Declaration `CSV_CheckAltUserTask(lWasRunning AS Logical)`

Remarks This routine returns if an alternative user-task was running. One of these tasks can be started by pressing one of the buttons `FNC`, `Shift-FNC`, `PROG`, `Shift-PROG`, `Light` and `Level`.

Functions, executed by an alternative user task, can change several system settings. The `CSV_CheckAltUserTask` routine notifies the running GeoBASIC application that it was interrupted by another program. With this information, the GeoBASIC program is able to respond to these changes.

After processing this information, the subroutine `CSV_ResetAltUserTask` must be called.

Parameters

`lWasRunning`	`out`	`TRUE`: a task was running

Return-Codes

`RC_OK`	Successful termination.

See `CSV_ResetAltUserTask`

Example The example checks if an alternative task was running.

```
CSV_CheckAltUserTask( l )
IF l THEN
    send("AltUserTask: was running")
  ELSE
    send("AltUserTask: was NOT running")
    END IF
CSV_ResetAltUserTask( )
```

6.5.31 CSV_ResetAltUserTask

Description Resets the “alternative user-task was running” flag.

Declaration	`CSV_ResetAltUserTask( )`
Remarks	This routine restarts the alternative user-task tracking.

Parameters

`none`

Return-Codes

`RC_OK`	Successful termination.

See `CSV_CheckAltUserTask`

6.5.32 CSV_SysCall

Description Call a system function.

Declaration `CSV_SysCall( BYVAL CId AS CIdType)`

Remarks This routine works in two different forms depending on the parameter `CId`. If `CId` is a system function `CSV_SysCall` calls the function directly. In the other form the `CId` is a system event. In this case `CSV_SysCall` calls the system function (or dialog, menu, macro, application) which is defined in the current configuration to handle this event. See description of the system functions and system events in the appendix H.

Parameters

`CId`	`in`	System function or system event

Return-Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	No function defined to handle the event
`RC_NOT_IMPL`	System function not available

See `CSV_SysCallAvailable`

Example The example calls the system function electronic level.

```
CSV_SysCall(CSV_SFNC_Libelle)
```

6.5.33 CSV_SysCallAvailable

Description Check if system function is available.

Declaration

```
CSV_SysCallAvailable(
                   BYVAL CId AS CIdType,
                   lAvailable AS Logical )
```

Remarks This routine checks, if it is possible to call the function `CId` if `CId` is a system function or if there is a function defined and available to handle the event `CId` if `CId` is an system event. See the description of system functions and system events in appendix H.

Parameters

`CId`	in	System function or system event.
`lAvailable`	out	`TRUE`: System function is available or function (dialog, menu, macro, application) to handle the event is defined and available.

Return-Codes

`RC_OK`	Successful termination.

See CSV_SysCall

Example The example checks if the red laser is available.

```
DIM lAvailable AS Logical

CSV_SysCallAvailable(CSV_SFNC_ToggleRedLaser,
                     lAvailable)
```

6.5.34 CSV_LibCall

Description Call a GeoBASIC or C application routine of another program.

Declaration
```
CSV_LibCall( BYVAL PrgName  AS String255,
             BYVAL FuncName AS String255,
             BYVAL CptShort AS _Token )
```

Remarks This routine is used to call a GeoBASIC routine which is defined in another program. Please refer also to Appendix

Parameters

PrgName	in	Program name
FuncName	in	Function name
CptShort	In	Short caption for dialogs

Return-Codes

RC_OK	Successful termination.

See CSV_LibCallAvailable

Example See IAC.GBS and IAC2.GBS for an example.

6.5.35 CSV_LibCallAvailable

Description Check if the GeoBASIC routine from another program is available.

Declaration
```
CSV_LibCallAvailable(
             BYVAL PrgName  AS String255,
             BYVAL FuncName AS String255,
             lAvailable     AS Logical )
```

Remarks This routine checks if a GeoBASIC routine which is defined in another program is available. Usually this means that it checks if the other program is loaded and the specified entry point exists.

Parameters

`PrgName`	`in`	Program name
`FuncName`	`in`	Function name
`lAvailable`	`out`	Routine is available

Return-Codes

`RC_OK`	Successful termination.

See `CSV_LibCall`

Example See `IAC.GBS` and `IAC2.GBS` for an example.

6.1 MMI FUNCTIONS

6.1.1 Summarising Lists of MMI Types and Procedures

6.1.1.1 Types

Type name	description
ListArray	List field Data structure
sLine	Display line

6.1.1.2 Procedures

procedure name	description
MMI_AddButton	Add a Button to a dialog.
MMI_AddGBMenuButton	Adds a button to a menu
MMI_BeepAlarm	Create an alert beep.
MMI_BeepLong	Create an alert beep.
MMI_BeepNormal	Create an alert beep.
MMI_CheckButton	Checks if a button was pressed.
MMI_CreateGBMenu	Creates a menu
MMI_CreateGBMenuItem	Creates an item to an existing menu
MMI_CreateGBMenuItemStr	Creates an item with a variable string
MMI_CreateGBMenuStr	Creates a menu with variable strings
MMI_CreateGraphDialog	Create and show a graphics dialog.
MMI_CreateMenuItem	Creates a menu item on the Theodolite menu.
MMI_CreateTextDialog	Create and show a text dialog.
MMI_DeleteButton	Delete a button from a dialog.
MMI_DeleteDialog	Deletes a dialog.
MMI_DeleteGBMenu	Deletes a menu
MMI_DrawBusyField	Shows or hides the Busy-Icon
MMI_DrawCircle	Draw a circle / ellipse.

procedure name	description
MMI_DrawLine	Draw a line.
MMI_DrawRect	Draw a rectangle.
MMI_DrawText	Draw / delete text.
MMI_FormatVal	Convert a value to a string.
MMI_GetAngleRelation	Request the current angle relationships.
MMI_GetAngleUnit	Return the currently displayed unit of angle.
MMI_GetButton	Get the button identifier of the pressed button.
MMI_GetCoordOrder	Retrieve the co-ordinate order.
MMI_GetDateFormat	Retrieves the date display format.
MMI_GetDistUnit	Return the currently displayed unit of distance.
MMI_GetLangName	Gets the name to a language number.
MMI_GetLanguage	Query the current language.
MMI_GetPressUnit	Return the currently displayed unit of pressure.
MMI_GetTempUnit	Return the currently displayed unit of temperature.
MMI_GetTimeFormat	This function retrieves the format used to display the time.
MMI_GetVAngleMode	Returns the V-Angle mode
MMI_GetVarBeepStatus	Read the switch status for a variable signal beep.
MMI_InputInt	Get an integer input value in a text dialog.
MMI_InputList	Shows a list field in a text dialog.
MMI_InputStr	Get a string input in a text dialog.
MMI_InputVal	Get a numerical input value in a text dialog.
MMI_PrintInt	Print an integer value on a text dialog.
MMI_PrintStr	Print a string on a text dialog.
MMI_PrintTok	Print a token on a text dialog.
MMI_PrintVal	Print a value on a text dialog.
MMI_SelectGBMenuItem	Select a menu item
MMI_SetAngleRelation	Set the angle relationship.
MMI_SetAngleUnit	Set the displayed unit of angle.
MMI_SetCoordOrder	Set the co-ordinate order.

procedure name	description
MMI_SetDateFormat	Set the date display format.
MMI_SetDistUnit	Set the displayed unit of distance.
MMI_SetLanguage	Set the display language.
MMI_SetPressUnit	Set the displayed unit of pressure.
MMI_SetTempUnit	Set the displayed unit of temperature.
MMI_SetTimeFormat	Set the time display format.
MMI_SetVAngleMode	Set the V-Angle mode.
MMI_StartVarBeep	Start beep sequences with configurable interrupts.
MMI_SwitchAFKey	Switch aF… key
MMI_SwitchIconsBeep	Switches measurement icons and special beeps
MMI_SwitchVarBeep	Switch a varying beep.
MMI_WriteMsg	Output to a message window. Parameter is a token.
MMI_WriteMsgStr	Output to a message window. Parameter is a string.

6.1.2 MMI Data Types

6.1.2.1 ListArray – List field data structure

Description This array is used for list fields and consists of `LIST_ARRAY_MAX_ELEMENT` (200) elements of the type `STRING30`.

Note	Each variable of this data type reserves 6400 Bytes.

6.1.2.2 sLine – Display line

Description This type is used to define a string with 29 characters, which is necessary to print variable strings on the display. The length depends on the actual display width, which is 29 for TPS1100 instruments.

6.1.3 MMI_CreateMenuItem

Description Creates a system menu item on the Theodolite menu to establish the invocation of a GeoBASIC application.

Declaration

```
MMI_CreateMenuItem(
            BYVAL sAppName  AS String,
            BYVAL sFuncName AS String,
            BYVAL iMenuNum  AS Integer,
            BYVAL sMenuText AS _Token )
```

Remarks The `CreateMenuItem` creates a menu item in a system menu with the text `MenuText` on the chosen entry point `MenuNum` in the menu-system. By clicking the new menu item on the Theodolite, the subroutine with the name `FuncName` in the Program `AppName` will be executed. The number of applications which can be loaded at a time are limited to 25. The maximum number of entry points over all applications (C and GeoBASIC applications) is 50. All GLOBAL declared subroutines count as entry points. Be aware of the fact that the interpreter and a possible Coding function also count for the number of application. The same is true for any C-application which has been loaded onto the TPS.

Note	The subroutine denoted in sFuncName must be declared as `GLOBAL`. The intended use for this procedure is during the installation phase only!

Parameters

`sAppName`	`in`	The name of the program where the function or subroutine is defined.
`sFuncName`	`in`	The name of the global function or subroutine to be called.
`iMenuNum`	`in`	Defines in which menu the menu-entry is generated. There are three possible menus where a menu item can be added. For multiple menu items the menus can be combined with ‘+’-operator.

		valid menus	meaning
		MMI_MENU_PROGRAMS	Add to menu „Main menu“
		MMI_MENU_PROGMENU	Add to „PROG“ - Key menu
		MMI_MENU_AUTOEXEC	Add to menu „Autoexec“
sMenuText	in	The text of the menu-entry which should be displayed on the Theodolite.	

Return-Codes

RC_OK	Successful termination.

> **Note** Since this procedure will be called during installation phase you do not have the possibility to do any error handling. Only the loader will report an error which may be caused by an erroneous call.

Example The example uses the MMI_CreateMenuItem routine to create a menu entry named "START THE PROGRAM" under the main menu. The function "Main" in the GeoBASIC program "ExampleProgram" will be called when this menu item is selected.

```
MMI_CreateMenuItem( "ExampleProgram", "Main",
                    MMI_MENU_PROGRAMS,
                    "START THE PROGRAM" )
```

6.1.4 MMI_CreateGBMenu

Description Creates a menu.

Declaration

```
MMI_CreateGBMenu(
    BYVAL sMenuName     AS _Token,
          iMenuId       AS Integer )
```

Remarks This routine creates an empty menu and the caption sMenuName. The function MMI_CreateGBMenuItem adds items to a menu.

Note	Before terminating a GeoBASIC program, all menus must be deleted. The GeoBASIC menus system has the following limitations: The maximal number of menus for a GeoBASIC program is 5. The maximal number of items / menu is 49. The maximal number of items over all menus plus menus is 254.

Parameters

`sMenuName`	`in`	The caption of the menu.
`iMenuId`	`out`	Returned menu identifier. It is the handle for using this menu.

Return-Codes

`RC_OK`	Successful termination.
`MMI_NOMORE_MENUS`	No more menus available

See Also `MMI_CreateGBMenuItem`, `MMI_DeleteGBMenu`, `MMI_SelectGBMenuItem`, `MMI_AddGBMenuButton`

Example The example creates a menu with a button. For a complete example see sample program `MENU.GBS`

```
CONST MHELP = "Help for measurement type...."

DIM iMenu      AS Integer ' menu identifier
DIM iSelection AS Integer ' selected item
DIM iButton    AS Integer ' used button

'Create main menu
MMI_CreateGBMenu("MEASUREMENT TYPE", iMenu)
```

```
'Create menu items - all items use
'  the same help text
MMI_CreateGBMenuItem(iMenu,
  "Polygon", MHELP)
MMI_CreateGBMenuItem(iMenu,
  "Border point", MHELP)
MMI_CreateGBMenuItem(iMenu,
  "Situation point", MHELP)

'Create the button supported in this menu
MMI_AddGBMenuButton(iMenu, MMI_F5_KEY, "EXIT ")

' show and execute menu
MMI_SelectGBMenuItem(iMenu, "TEST",
  iSelection, iButton)
SELECT CASE iSelection
    CASE 1 ' Polygon
    '  ...
    CASE ELSE
       MMI_BeepAlarm()
    END SELECT
MMI_DeleteGBMenu(iMenu)
```

6.1.5 MMI_CreateGBMenuItem

Description Creates an item in an existing menu.

Declaration

```
MMI_CreateGBMenuItem(
             BYVAL iMenuId       AS Integer,
             BYVAL sMenuItemName AS _Token,
             BYVAL sHelpText     AS _Token )
```

Remarks This function adds one menu item to an existing menu `iMenuId`. This item will be displayed as the last item.

Parameters

`iMenuId`	`in`	Menu identifier
`sMenuItemName`	`in`	Displayed text
`sHelpText`	`in`	Help text; only visible if the help functionality of theodolite is enabled

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ID_INVALID`	Bad `iMenuId`
`BAS_MENU_TABLE_FULL`	No more free menu items

See Also `MMI_CreateGBMenu`, `MMI_DeleteGBMenu`, `MMI_SelectGBMenuItem`, `MMI_AddGBMenuButton`

Example see `MMI_CreateGBMenu`

6.1.6 MMI_CreateGBMenuStr

Description Creates a menu with variable strings as menu name and menu items.

Declaration

```
MMI_CreateGBMenuStr(
    BYVAL sMenuName     AS sLine,
          iMenuId       AS Integer )
```

Remarks This routine creates an empty menu and the caption `sMenuName`. `sMenuName` need not be constant, it can be generated during the execution of the program. The function `MMI_CreateGBMenuItemStr` adds items to this kind of menu.

> **Note** Before terminating a GeoBASIC program, all menus must be deleted.
>
> The GeoBASIC menus system has the following limitations:
>
> The maximal number of menus for a GeoBASIC program is 5.
> The maximal number of items / menu is 49.
> The maximal number of items over all menus plus menus is 254.

Parameters

`sMenuName`	`in`	The caption of the menu.

`iMenuId`	`out`	Returned menu identifier. It is the handle for using this menu.

Return-Codes

`RC_OK`	Successful termination.
`MMI_NOMORE_ MENUS`	No more menus available

See Also `MMI_CreateGBMenuItemStr, MMI_DeleteGBMenu, MMI_SelectGBMenuItem, MMI_AddGBMenuButton`

Example The example creates a menu with a button. The menu name is a composition with a constant string and the instrument name. The menu item names are extended with the current language name.

```
CONST MHELP = "Help for measurement type...."

DIM iMenu            AS Integer ' menu identifier
DIM iSelection       AS Integer ' selected item
DIM iButton          AS Integer ' used button
DIM sMenuName        AS sLine   ' menu name
DIM sMenuItemName1   AS sLine   ' menu item 1 name
DIM sMenuItemName2   AS sLine   ' menu item 2 name
DIM iLangNr          AS Integer ' language number
DIM sLangName        AS String20' language name
DIM sInstrumentName AS String30' instrument name

' generate menu name
CSV_GetInstrumentName(sInstrumentName)
sMenuName = "Programs on " + sInstrumentName
' Create menu
MMI_CreateGBMenuStr(sMenuName, iMenu)
' generate menu item names
MMI_GetLanguage(iLangNr, sLangName)
sMenuItemName1 = "Polygon in " + sLangName
sMenuItemName2 = "Border point in " + sLangName
' Create menu items - all items use
' the same help text
MMI_CreateGBMenuItemStr(iMenu,
 sMenuItemName1, MHELP)
MMI_CreateGBMenuItemStr(iMenu,
 sMenuItemName2, MHELP)
```

```
'Create the button supported in this menu
MMI_AddGBMenuButton(iMenu, MMI_F5_KEY, "EXIT ")

' show and execute menu
MMI_SelectGBMenuItem(iMenu, "TEST",
  iSelection, iButton)
SELECT CASE iSelection
    CASE 1 ' Polygon
    '  ...
    CASE ELSE
       MMI_BeepAlarm()
    END SELECT
MMI_DeleteGBMenu(iMenu)
```

6.1.7 MMI_CreateGBMenuItemStr

Description Creates an item with a variable string in an existing menu.

Declaration

```
MMI_CreateGBMenuItemStr(
             BYVAL iMenuId       AS Integer,
             BYVAL sMenuItemName AS sLine,
             BYVAL sHelpText     AS _Token )
```

Remarks This routine adds one menu item to an existing menu `iMenuId`. This item will be displayed as the last item. The menu must be created with `MMI_CreateGBMenuStr`. `sMenuItemName` need not be constant, it can be generated during the execution of the program.

Parameters

`iMenuId`	`in`	Menu identifier
`sMenuItemName`	`in`	Displayed text
`sHelpText`	`in`	Help text; only visible if the help functionality of the theodolite is enabled

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ID_INVALID`	Bad `iMenuId`

`BAS_MENU_TABLE_FULL`	No more free menu items

See Also `MMI_CreateGBMenuStr, MMI_DeleteGBMenu, MMI_SelectGBMenuItem, MMI_AddGBMenuButton`

Example see `MMI_CreateGBMenuStr`

6.1.8 MMI_DeleteGBMenu

Description Deletes a menu.

Declaration

```
MMI_DeleteGBMenu( BYVAL iMenuId AS Integer )
```

Remarks This function deletes the menu `iMenuId`.

Parameters

`iMenuId`	`in`	Menu identifier

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ID_INVALID`	Bad `iMenuId`

See Also `MMI_CreateGBMenu, MMI_CreateGBMenuItem, MMI_SelectGBMenuItem, MMI_AddGBMenuButton`

Example see `MMI_CreateGBMenu`

6.1.9 MMI_SelectGBMenuItem

Description Select a menu item.

Declaration

```
MMI_SelectGBMenuItem(
            BYVAL iMenuId      AS Integer,
            BYVAL sCaptionLeft AS _Token,
                  iSelItem     AS Integer,
                  iButtonId    AS Integer )
```

Remarks This function shows and executes a menu `iMenuId` and returns the selected item `iSelItem` or pressed button `iButtonId`.

Parameters

`iMenuId`	`in`	Menu identifier
`sCaptionLeft`	`in`	The maximal five-character long part of the title bar displayed left of the menu title, with a separation symbol.
`iSelItem`	`in/out`	Selected item
`iButtonId`	`out`	Pressed button

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ ID_INVALID`	Bad `iMenuId`

See Also `MMI_CreateGBMenu, MMI_CreateGBMenuItem, MMI_DeleteGBMenu, MMI_AddGBMenuButton`

Example see `MMI_CreateGBMenu`

6.1.10 MMI_AddGBMenuButton

Description Adds a button to a menu.

Declaration

```
MMI_AddGBMenuButton(
            BYVAL iMenuId   AS Integer,
            BYVAL iButtonId AS Integer,
            BYVAL sCaption  AS _Token )
```

Remarks This function adds a button with the identifier `iButtonId` to the menu `iMenuId` and shows the caption `sCaption`.

Parameters

`iMenuId`	`in`	Menu identifier
`iButtonId`	`in`	Identifier of the button to be added. Valid buttons are `MMI_F1_KEY..` `MMI_F6_KEY` and `MMI_SHF2_KEY..` `MMI_SHF6_KEY`.
`sCaption`	`in`	Text placed onto the button (max. 5 characters)

Return-Codes

`RC_OK`	Successful termination.
`BAS_MENU_ ID_INVALID`	Bad `iMenuId`

See Also `MMI_CreateGBMenu`, `MMI_CreateGBMenuItem`, `MMI_DeleteGBMenu`, `MMI_SelectGBMenuItem`

Example see `MMI_CreateGBMenu`

6.1.11 MMI_CreateTextDialog

Description Create and show a text dialog.

Declaration

```
MMI_CreateTextDialog(
    BYVAL iLines        AS Integer,
    BYVAL sCaptionLeft  AS _Token,
    BYVAL sCaptionRight AS _Token,
    BYVAL sHelptext     AS _Token )
```

Remarks The routine creates and shows a dialog with `iLines` lines, the left part of the title bar `sCaptionLeft`, the caption `sCaptionRight` and the help text `sHelpText`. Only one text dialog can exist at the same time. If `MMI_CreateTextDialog` is called while already a text dialog or a measurement dialog exists, the existing dialog (together with all attached buttons) is deleted and the new dialog is created.

Note	Only a text dialog <u>or</u> a measurement dialog is valid at a time. They cannot be defined at the same time. A graphic dialog overrides a text or measurement dialog but does not delete the definition of it.

On the dialog field strings, numerical values and list fields can be displayed or edited using the routines `MMI_PrintStr`, `MMI_PrintVal`, `MMI_PrintInt`, `MMI_InputStr`, `MMI_InputVal`, `MMI_InputInt` and `MMI_InputList`.

Parameters

`iLines`	in	The number of lines of the dialog. There are up to 12 lines possible. If the dialog has more than 6 lines, a scrollbar on the right side appear and it is possible to scroll up and down with the cursor keys.
`sCaptionLeft`	in	The maximal five-character long part of the title bar displayed left of the `CaptionRight`, with a separation symbol.
`sCaptionRight`	in	The caption of the dialog.
`sHelpText`	in	This text is shown, when the help button `SHIFT-F1` is pressed and the help functionality of the theodolite is enabled.

Return-Codes

`RC_OK`	Successful termination.

See Also `MMI_DeleteDialog`, `MMI_CreateGraphDialog`, `GSI_CreateMDlg`, `MMI_PrintVal`, `MMI_PrintStr`, `MMI_PrintTok`, `MMI_PrintInt`, `MMI_InputVal`, `MMI_InputStr`, `MMI_InputInt`, `MMI_InputList`

Example The example uses the `MMI_CreateTextDialog` routine to create and display a text dialog.

```
Define a help text containing the
'  inverse written word "Help"
CONST Helptext = MMI_INVERSE_ON +
                 "Help" + MMI_INVERSE_OFF +
                 " Test"

MMI_CreateTextDialog(5, "TEXT", "DIALOG
                     CAPTION", Helptext)
```

6.1.12 MMI_CreateGraphDialog

Description Create and show a graphics dialog.

Declaration

```
MMI_CreateGraphDialog(
      BYVAL sCaptionLeft  AS _Token,
      BYVAL sCaptionRight AS _Token,
      BYVAL sHelptext     AS _Token )
```

Remarks The routine creates and shows a graphics dialog filled with the left part of the title bar `sCaptionLeft`, the caption `sCaptionRight` and the help text `sHelpText` for later use of MMI graphics functions. The size of the field is the whole dialog display area = 232 x 48 pixels. Only one graphics dialog can exist at the same time. If `CreateGraphDialog` is called while already a graphics dialog exists, the existing dialog (together with all attached buttons) is deleted and the new dialog is created.

Note	Only a text dialog or a measurement dialog is valid at a time. They cannot be defined at the same time. A graphic dialog overrides a text or measurement dialog but does not delete the definition of it.

Parameters

`sCaptionLeft`	in	The maximal five-character long part of the title bar displayed left of the `sCaptionRight`, with a separation symbol
`sCaptionRight`	in	The caption of the dialog.
`sHelpText`	in	This text is shown, when the help button Shift-F1 is pressed and the help functionality of the theodolite is enabled.

Return-Codes

`RC_OK`	Successful termination.

See Also `MMI_DeleteDialog`, `MMI_CreateTextDialog`, `GSI_CreateMDlg`, MMI Graphic Functions

Example The example uses the `MMI_CreateGraphDialog` routine to create and display a graphic dialog field.

```
MMI_CreateGraphDialog( "GRAPH",
                       "DIALOG CAPTION",
                       "This is a help text")
```

6.1.13 MMI_DeleteDialog

Description Deletes a dialog.

Declaration `MMI_DeleteDialog()`

Remarks The routine deletes the currently active dialog. It makes no distinction between graphic, measure and text dialog. By deleting the dialog all user defined buttons added with `MMI_AddButton` are deleted as well.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_CreateTextDialog`, `MMI_CreateGraphDialog`, GSI_CreateMDlg

Example The example uses the `MMI_DeleteDialog` routine to delete a text, measure or graphic dialog.

```
MMI_DeleteDialog()
```

6.1.14 MMI_CheckButton

Description Checks if a button was pressed.

Declaration `MMI_CheckButton( lKeyPressed AS Logical )`

Remarks The routine `MMI_CheckButton` checks the keyboard buffer for pressed buttons. If a button was pressed, the routine returns `KeyPressed = TRUE`, otherwise `KeyPressed = FALSE` is returned.

Note	The routine `MMI_CheckButton` does not wait until a button was pressed. It only checks the keyboard buffer.

Parameters

`lKeyPressed`	`In`	`lKeyPressed = TRUE` is returned, if a valid button was pressed. Otherwise the value of `lKeyPressed` is `FALSE`.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_AddButton`
`MMI_GetButton`

Example The example uses the `MMI_CheckButton` routine to wait until a (valid) key was pressed.

```
DIM lKeyPressed AS Logical

DO
  MMI_CheckButton( lKeyPressed )
LOOP UNTIL lKeyPressed

'do something ..
```

6.1.15 MMI_GetButton

Description Get the button identifier of the pressed button.

Declaration

```
MMI_GetButton( iButtonId AS Integer,
               BYVAL lAllKeys  AS Logical )
```

Remarks Waits until a valid key is pressed and returns the button Identifier `iButtonId` of the pressed button.
If `lAllKeys = FALSE`, the keys `ESC`, `ENTER`, `ON/OFF` or any assigned button (added with `MMI_AddButton`) terminates this function and the `iButtonId` of the pressed button is returned. If `lAllKeys = TRUE`, additional keys i.e. the cursor keys terminates this routine too. For details see table below.

Note	This function relates to the currently active dialog.

Parameters

`iButtonId`	`Out`	The identifier of the pressed button. For values of `iButtonId` see the table below.
`lAllKeys`	`In`	Determines which keys exit the routine. If `lAllKeys = TRUE` any valid pressed key exit the routine, otherwise only normal ones.

Button pressed	iButtonId returned	
	lAllKeys = TRUE	lAllKeys = FALSE
assigned (using MMI_AddButton) "F1".."F6", "SHIFT-F2".. "SHIFT-F6"	MMI_F1_KEY.. MMI_F6_KEY, MMI_SHF2_KEY.. MMI_SHF6_KEY	MMI_F1_KEY.. MMI_F6_KEY, MMI_SHF2_KEY.. MMI_SHF6_KEY
unassigned "F1".."F6", "SHIFT-F2".. "SHIFT-F6"	MMI_UNASS_KEY	no return
assigned "CODE"	MMI_CODE_KEY	MMI_CODE_KEY
unassigned "CODE"	MMI_UNASS_KEY	no return
"ENTER" within dialog, focus on a field	MMI_UNASS_KEY	no return
"ENTER" within dialog, no focus	MMI_UNASS_KEY	no return
"ENTER" after editing	MMI_EDIT_ ENTER_KEY	MMI_EDIT_ ENTER_KEY
"ESC" within dialog	MMI_ESC_KEY	MMI_ESC_KEY
"ESC" after editing	MMI_EDIT_ ESC_KEY	no return
"SHIFT"	MMI_UNASS_KEY	no return
"0".."9", focus on spin/list-field	MMI_UNASS_KEY	no return
"0..9", no focus	MMI_NUM0_KEY.. MMI_NUM9_KEY	no return
"CE"	MMI_UNASS_KEY	no return
cursor keys	MMI_UP_KEY, MMI_DOWN_KEY, MMI_RIGHT_KEY, MMI_LEFT_KEY	no return

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_AddButton, MMI_CheckButton

Example The example uses the `MMI_GetButton` routine to react to a pressed button. To make a function key valid for `MMI_GetButton` it must be added to the dialog (with `MMI_AddButton`).

```
DIM iActionButton  AS Integer
DIM iPressedButton AS Integer

iActionButton = MMI_F2_KEY

MMI_GetButton ( iPressedButton, TRUE )
IF iPressedButton = iActionButton THEN
  'any actions
END IF
```

6.1.16 MMI_AddButton

Description Add a button to a dialog.

Declaration

```
MMI_AddButton( BYVAL iButtonId AS Integer,
               BYVAL sCaption  AS _Token )
```

Remarks The routine `MMI_AddButton` adds the button with the Identifier `iButtonId` to the actual dialog and places the text `sCaption` onto the button. These added buttons are valid for the routines `MMI_CheckButton` and `MMI_GetButton` and the input routines (`MMI_InputStr, MMI_InputVal, MMI_InputInt` and `MMI_InputList`) which means the according button identifier can be returned from this routines.

Note	Either a text dialog or a measurement dialog can be defined at a time. Additionally a graphics dialog can override one of these above. Then the functionality applies to the graphics dialog.

The added buttons can be deleted with the routine `MMI_DeleteButton` while the dialog exists. Closing the dialog with `MMI_DeleteDialog` deletes all buttons attached to this dialog.

Parameters

`iButtonId`	in	Identifier of the button to be added. See for the values that can be used for the `iButtonId` under the routine description `MMI_GetButton`. Only `MMI_F1_Key..MMI_F5_KEY`, `MMI_SHF2_KEY..MMI_SHF6_KEY` and `MMI_CODE_KEY` are available for the `AddButton` routine.
`sCaption`	in	The text placed onto the button, left alignment (max. 5 characters).

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.
`MMI_BUTTON_ID_EXISTS`	This button has been defined already.

See Also `MMI_GetButton, MMI_CheckButton, MMI_DeleteButton`

Example The example uses the `MMI_AddButton` routine to add the `F2-KEY` with the caption "EXIT" to the dialog.

```
MMI_AddButton( MMI_F2_KEY, "EXIT" )
```

6.1.17 MMI_DeleteButton

Description Delete a button from a dialog.

Declaration `MMI_DeleteButton( iButtonId AS Integer )`

Remarks The routine `MMI_DeleteButton` deletes the button with the Identifier `iButtonId` from the actual dialog. Only a button that was added with `MMI_AddButton` can be deleted. Closing the dialog with `MMI_DeleteDialog` deletes all buttons attached to this dialog.

Parameters

`iButtonId`	`in`	Identifier of the button to be deleted. See for the values that can be used for `iButtonId` under the routine description `MMI_GetButton`.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.
`MMI_ILLEGAL_BUTTON_ID`	This button has not been defined by `MMI_AddButton`.

See Also `MMI_AddButton`

Example The example uses the `MMI_DeleteButton` routine to delete the `F2-KEY` from the dialog.

```
MMI_DeleteButton( MMI_F2_KEY )
```

6.1.18 MMI_PrintStr

Description Print a string on a text dialog.

Declaration

```
MMI_PrintStr( BYVAL iColumn AS Integer,
              BYVAL iLine   AS Integer,
              BYVAL sText   AS String30,
              BYVAL lValid  AS Logical )
```

Remarks The text string `sText` is placed on position `iColumn` and `iLine` on the text dialog. If `lValid` is not `TRUE`, then the symbols for invalid values are displayed. Too long text strings are truncated, illegal co-ordinates are adjusted.

Note	A text dialog must already exist. Only display length number of character will be displayed, hence 29.

Parameters

`iColumn`	`in`	The horizontal position (0..28)

iLine	in	The vertical position (0..number of lines defined with MMI_CreateTextDialog)
sText	in	The text string to display
lValid	in	Determines if the value should be shown as valid. If lValid = TRUE the value sText is displayed, otherwise the symbols for invalid values are displayed.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_InputStr

Example The example uses the MMI_PrintStr routine to print the text string „Hello World“ in the first line on row 2 of the actual text dialog.

```
MMI_PrintStr( 2, 0, "Hello World", TRUE )
```

6.1.19 MMI_PrintTok

Description Print a string on a text dialog.

Declaration

```
MMI_PrintTok(   BYVAL iColumn AS Integer,
                BYVAL iLine   AS Integer,
                BYVAL sText   AS _Token )
```

Remarks The text token sText is placed on position iColumn and iLine on the text dialog. Too long text strings are truncated, illegal co-ordinates are adjusted. This routine may be used instead of MMI_PrintStr to support internationalisation of multiple language applications.

Note	A text dialog must already exist.

Parameters

iColumn	in	The horizontal position (0..28)
iLine	in	The vertical position (0..number of lines defined with MMI_CreateTextDialog)

`sText`	`in`	The text string to display

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.
`TXT_UNDEF_TOKEN`	The given token could not be found in the database. Most probably an old version is loaded either on TPS or simulator.
`RC_IVPARAM`	No text token database is loaded with the currently set language.

See Also `MMI_PrintStr`

Example The example uses the `MMI_PrintTok` routine to print the text string „Hello World" in the first line on row 2 of the actual text dialog.

```
MMI_PrintTok( 2, 0, "Hello World" )
```

6.1.20 MMI_PrintVal

Description Print a value on a text dialog.

Declaration

```
MMI_PrintVal( BYVAL iColumn   AS Integer,
              BYVAL iLine     AS Integer,
              BYVAL iLen      AS Integer,
              BYVAL iDecimals AS Integer,
              BYVAL dVal      AS Double,
              BYVAL lValid    AS Logical,
              BYVAL iMode     AS Integer )
```

Remarks This routine can be used to display double values (or values with equal type, e.g. dimension). If `lValid = TRUE` the value `dVal` is placed on position `iColumn` and `iLine` on the text dialog, otherwise the symbols for invalid values `"-----"` are displayed. Too long value strings are truncated, illegal co-ordinates are adjusted. If `iMode = MMI_DIM_ON`, a dimension field is automatically displayed when the type of `dVal` has units.

If the `dVal` can not be displayed in `iLen` characters, then `"xxx"` will be displayed instead.

Note	A text dialog must already exist.

Parameters

`iColumn`	in	The horizontal position (0..28).
`iLine`	in	The vertical position (0..number of lines defined with `CreateTextDialog).`
`iLen`	in	The length of the value consisting of a sign, the characters before and after the comma and the comma itself. The dimension field is not included.
`iDecimals`	in	The number of decimals. If `iDecimals = -1` then the number of decimals set by the system is taken.
`dVal`	in	The value to display. Use this routine to display double (and equal to double) values with the correct units. For integer values a separate routine (`MMI_PrintInt`) exists.
`lValid`	in	Determines if the value should be shown as valid. If `lValid = TRUE` the value `dVal` is displayed, otherwise the symbols for invalid values are displayed.
`iMode`	in	Determines the display of the dimension. If `Mode = MMI_DIM_ON` a dimension field is automatically displayed when the type `dVal` has units. Otherwise use `MMI_DEFAULT_MODE`.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_PrintInt , MMI_InputVal`

Example The example uses the `MMI_PrintVal` routine to print the value of `TestVal` as distance (with corresponding dimension) in the first line on row 2 of the currently open text dialog.

```
DIM TestVal AS Distance
TestVal = 287.47

MMI_PrintVal( 2, 0, 10, 2, TestVal, TRUE,
              MMI_DIM_ON )
```

6.1.21 MMI_PrintInt

Description Print an integer value on a text dialog.

Declaration

```
MMI_PrintInt( BYVAL iColumn AS Integer,
              BYVAL iLine   AS Integer,
              BYVAL iLen    AS Integer,
              BYVAL iVal    AS Integer,
              BYVAL lValid  AS Logical )
```

Remarks This routine can be used to display integer values. Too long value strings are truncated, illegal co-ordinates are adjusted. If `lValid = TRUE` the value `iVal` is placed on position `iColumn` and `iLine` on the text dialog, otherwise the symbols for invalid values are displayed.
If the `iVal` can not be displayed in `iLen` characters, then `"xxx"` will be displayed instead.

Note	A text dialog must already exist.

Parameters

`iColumn`	`in`	The horizontal position (0..28).
`iLine`	`in`	The vertical position (0..number of lines defined with `MMI_CreateTextDialog`).
`iLen`	`in`	The length of the value plus the sign.
`iVal`	`in`	The value to display. Use this routine to display integer values. For double values a separate routine (`MMI_PrintVal`) exists.
`lValid`	`in`	Determines if the value should be shown as valid. If `lValid = TRUE` the value `iVal` is displayed, otherwise the symbols for invalid values are displayed.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_PrintVal
MMI_InputInt

Example The example uses the MMI_PrintInt routine to print the value of TestVal in the first line on row 2 of the currently open text dialog.

```
DIM TestVal AS Integer
TestVal = 1000

MMI_PrintInt( 2, 0, 5, TestVal, TRUE )
```

6.1.22 MMI_InputStr

Description Get a string input in a text dialog.

Declaration

```
MMI_InputStr( BYVAL iColumn   AS Integer,
              BYVAL iLine     AS Integer,
              BYVAL iLen      AS Integer,
              BYVAL iMode     AS Integer,
                    sText     AS String30,
                    lValid    AS Logical,
                    iButtonId AS Integer )
```

Remarks If lValid = TRUE the text string sText is placed on position iColumn and iLine on the text dialog, otherwise the symbols for invalid values are displayed.
Illegal co-ordinates are adjusted. If the length of the string exceeds the given length iLen the string is truncated at position iLen.
After the edit process the string is returned and the text is placed right aligned on the display. If the length iLen <= 0 or no part of the field is in the dialog area the Text is not edited and the routine exits.

The string can be edited by pressing αEDIT or a numerical key. If iMode = MMI_DEFAULT_MODE the keys ESC, ENTER,

ON/OFF or any user defined button (added with MMI_AddButton) terminates the edit process and the iButtonId of the pressed button is returned. If iMode = MMI_SPECIALKEYS_ON additional keys i.e. the cursor keys terminates MMI_InputStr too. For details see MMI_GetButton.

Note	A text dialog must already exist.

Parameters

iColumn	in	The horizontal position (0..28).
iLine	in	The vertical position (0..number of lines defined with MMI_CreateTextDialog).
iLen	in	The length of the input field.
iMode	in	Defines the editing mode. MMI_DEFAULT_MODE defines normal editing MMI_SPECIALKEYS_ON allows editing with full cursor control
sText	inout	The text string to edit.
lValid	inout	Determines if the value should be shown as valid. If lValid=TRUE the string sText is displayed, otherwise the symbols for invalid values are displayed.
iButtonId	out	The identifier of the pressed valid button to exit the edit process.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_PrintStr

Example The example uses the `MMI_InputStr` routine to get the text string `sInputString` in the first line on row 2 of the actual text dialog.

```
DIM sInputString AS String30
DIM iButton      AS Integer
DIM lValid       AS Logical

sInputString = "The input text"
lValid = TRUE
MMI_InputStr( 2, 0, 20, MMI_DEFAULT_MODE,
              sInputString, lValid,iButton )
```

6.1.23 MMI_InputVal

Description Get a numerical input for double values in a text dialog.

Declaration

```
MMI_InputVal( BYVAL iColumn   AS Integer,
              BYVAL iLine     AS Integer,
              BYVAL iLen      AS Integer,
              BYVAL iDecimals AS Integer,
              BYVAL dMin      AS Double,
              BYVAL dMax      AS Double,
              BYVAL iMode     AS Integer,
                    dVal      AS Double,
                    lValid    AS Logical,
                    iButtonId AS Integer )
```

Remarks If `lValid = TRUE` then the value `dVal` is placed on position `iColumn` and `iLine` on the text dialog, otherwise the symbols for invalid values are displayed. Illegal co-ordinates are adjusted. If `iMode = MMI_DIM_ON`, a dimension field is automatically displayed when the type of `dVal` has units. If the length `iLen <= 0` or no part of the field is in the dialog area the value is not edited and the routine exits.

The value within the bounds `dMin` and `dMax` can be edited by pressing `EDIT` or the numerical block keys. If `iMode = MMI_DEFAULT_MODE` the keys `ESC`, `ENTER`, `ON/OFF` or any user defined button (added with `MMI_AddButton`) terminates

the edit process and the `iButtonId` of the pressed button is returned. If `iMode = MMI_SPECIALKEYS_ON` additional keys i.e. the cursor keys terminates `MMI_InputVal` too. For details see `MMI_GetButton`.

Note	A text dialog must already exist.

Parameters

`iColumn`	`in`	The horizontal position (0..28).
`iLine`	`in`	The vertical position (0..number of lines defined with `MMI_CreateTextDialog)`.
`iLen`	`in`	The length of the value inclusive decimals, sign and the comma, exclusive the dimension field
`iDecimals`	`in`	The number of decimals. If `iDecimals = -1` the number of decimals set by the system is taken.
`dMin` `dMax`	`in`	The lower and upper bounds.
`iMode`	`in`	Defines the editing mode. `MMI_DEFAULT_MODE` defines normal editing `MMI_SPECIALKEYS_ON` allows editing with full cursor control `MMI_DIM_ON` shows a dimension field if `dVal` has units. Modes can be added, i.e. `MMI_SPECIALKEYS_ON + MMI_DIM_ON`
`dVal`	`inout`	The value to edit. Use this routine to edit double (and equal to double) values. For integer values a separate routine (`MMI_InputInt`) exists.

`lValid`	`inout`	Determines if the value should be shown as valid. If `lValid=TRUE` the value `dVal` is displayed, otherwise the symbols for invalid values are displayed.
`iButtonId`	`out`	The identifier of the pressed valid button to exit the edit process.

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_InputInt`
`MMI_PrintVal`

Example See example file „`cursor.gbs`“ too.

The example uses the `MMI_InputVal` routine to get the distance of `TestVal` with default decimal places. Input field is placed in the second line on row 2 of the actual text dialog. The entered values must lie in the range 0..1000.

```
CONST MODE = MMI_DEFAULT_MODE 'define editmode

DIM TestVal  AS Distance
DIM iButton  AS Integer
DIM lValid   AS Logical

lValid = FALSE

MMI_InputVal( 2, 1, 8, -1, 0, 1000, MODE,
              TestVal, lValid, iButton )
```

6.1.24 MMI_InputInt

Description Get an integer input value in a text dialog.

Declaration

```
MMI_InputInt( BYVAL iColumn   AS Integer,
              BYVAL iLine     AS Integer,
              BYVAL iLen      AS Integer,
              BYVAL iMin      AS Integer,
              BYVAL iMax      AS Integer,
              BYVAL iMode     AS Integer,
                    iVal      AS Integer
                    lValid    AS Logical,
                    iButtonId AS Integer )
```

Remarks If `lValid = TRUE` then the integer value `iVal` is placed on position `iColumn` and `iLine` on the text dialog. Illegal co-ordinates are adjusted. If the length `iLen ≤ 0` or no part of the field is in the dialog area the value is not edited and the routine exits.

The integer value within the bounds `iMin` and `iMax` can be edited by pressing `EDIT` or the numerical block keys. If `iMode = MMI_DEFAULT_MODE` the keys `ESC`, `ENTER`, `ON/OFF` or any user defined button (added with `MMI_AddButton`) terminates the edit process and the `iButtonId` of the pressed button is returned. If `iMode = MMI_SPECIALKEYS_ON` additional keys i.e. the cursor keys terminates `MMI_InputInt` too.

Note	A text dialog must already exist.

Parameters

`iColumn`	in	The horizontal position (0..28).
`iLine`	in	The vertical position (0..number of lines defined with `MMI_CreateTextDialog`).
`iLen`	in	The length of the value plus the sign.
`iMin` `iMax`	in	The lower and upper bounds.

iMode	in	Defines the editing mode. MMI_DEFAULT_MODE defines normal editing MMI_SPECIALKEYS_ON allows editing with full cursor control
iVal	inout	The value to display. Use this routine to edit integer values. For double values a separate routine (MMI_InputVal) exists.
lValid	inout	Determines if the value should be shown as valid. If lValid=TRUE the value iVal is displayed, otherwise the symbols for invalid values are displayed.
iButtonId	out	The identifier of the pressed valid button to exit the edit process.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

See Also MMI_PrintInt, MMI_InputVal

Example See example file „cursor.gbs“ too.

The example uses the MMI_InputInt routine to get the value of iTestVal in the second line on row 2 of the actual text dialog. The entered values must lie in the range 0..1000.

```
CONST MODE = MMI_DEFAULT_MODE 'define editmode

DIM iTestVal AS Integer
DIM iButton  AS Integer
DIM lValid   AS Logical

lValid = FALSE
MMI_InputInt( 2,1,5,0,1000,
              MODE,iTestVal,lValid,iButton )
```

6.1.25 MMI_InputList

Description Shows a list field in a text dialog.

Declaration

```
MMI_InputList( BYVAL iColumn   AS Integer,
               BYVAL iLine     AS Integer,
               BYVAL iLen      AS Integer,
               BYVAL iElements AS Integer,
               BYVAL iMode     AS Integer,
                     List      AS ListArray,
                     iIndex    AS Integer,
                     lValid    AS Logical,
                     iButtonId AS Integer )
```

Remarks If `lValid = TRUE` then a list field is placed on position `iColumn` and `iLine` on the text dialog. Too long list elements are truncated, illegal co-ordinates are adjusted. The `ListArray` is an array of `String30` with `LIST_ARRAY_MAX_ELEMENT` Elements. Only the first `iElements` are displayed. The value of `iIndex` defines which element is shown first.

The list can be edited by pressing `F6` (`LIST`). With the cursor keys `UP` and `DOWN` a field element can be selected. If the list elements are numbered (begins with a number), then the elements can be selected directly by pressing numerical buttons. If `iMode = MMI_DEFAULT_MODE` the keys `ESC`, `ENTER`, `ON/OFF` or any user defined button (added with `MMI_AddButton`) terminates the edit process and the `iButtonId` of the pressed button is returned. If `iMode = MMI_SPECIALKEYS_ON` additional keys i.e. the cursor keys terminates `MMI_InputList` too.

Note	A text dialog must already exist.

Parameters

`iColumn`	`in`	The horizontal position (0..28).
`iLine`	`in`	The vertical position (0..number of lines defined with `MMI_CreateTextDialog).`
`iLen`	`in`	The displayed length of the list elements.

iElements	in	The number of list elements. The maximum number is limited to LIST_ARRAY_MAX_ELEMENT.
iMode	in	Defines the editing mode. MMI_DEFAULT_MODE defines normal editing MMI_SPECIALKEYS_ON allows editing with full cursor control
List	in	The array of the list elements.
iIndex	inout	Index (number of the line) of the first shown and selected field respectively. Possible value for iIndex are in the range of 1 up to Elements.
lValid	inout	Determines if the value should be shown as valid. If lValid=TRUE the a value is displayed, otherwise the symbols for invalid values are displayed.
iButtonId	out	The identifier of the pressed valid button to exit the list process.

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

Example See example file „cursor.gbs“ too.

The example uses the MMI_InputList routine to get the value of the selected list element (the selected line) of a list field displayed in the second line on row 2 of the actual text dialog. The first displayed line is the line with the number Index.

```
CONST MODE = MMI_DEFAULT_MODE 'define editmode

DIM iLen      AS Integer
DIM iElements AS Integer
DIM List      AS ListArray
DIM iIndex    AS Integer
DIM iButton   AS Integer
DIM lValid    AS Logical

'initialize the variables
iLen      = 10   'displayed length of the list
iElements =  7   'number of available fields
iIndex    =  3   'number of the first shown list
element
lValid    = TRUE

List(1) = "1 Line No.: 1"
List(2) = "2 Line No.: 2"
List(3) = "3 Line No.: 3"
List(4) = "4 Line No.: 4"
List(5) = "5 Line No.: 5"
List(6) = "6 Line No.: 6"
List(7) = "7 Line No.: 7"

InputList( 5, 1, iLen, iElements, MODE,
           List, iIndex, lValid, iButton )
```

6.1.26 MMI_FormatVal

Description Convert a value to a string and use TPS system formatting rules.

Declaration

```
MMI_FormatVal( BYVAL iType      AS Integer,
               BYVAL iLen       AS Integer,
               BYVAL iDecimals  AS Integer,
               BYVAL dVal       AS Double,
               BYVAL lValid     AS Logical,
               BYVAL iMode      AS Integer,
                     sValStr    AS String30 )
```

Remarks If `lValid = TRUE` then this routine converts a double value (or values with equal type, e.g. dimension) to a text string, otherwise the symbols for invalid values are returned. The returned string

`sValStr` contains the value string in the same kind as it would be displayed on the Theodolite: the value is placed right aligned with the number `iDecimals` of decimals. If `iMode = MMI_DIM_ON`, a dimension field is appended to the output string when the type `iType` allows it.
If the `dVal` can not be displayed in `iLen` characters, then `"xxx"` will be returned instead.

This routine is useful, if numeric values should be written on files (see chapter file handling for further information).

Parameters

`iType` `in` The type of the numerical field. The type defines if a dimension field is available. Following values for the type can be used:

Type	**Meaning**
MMI_FFORMAT_DOUBLE	double
MMI_FFORMAT_DISTANCE	distance
MMI_FFORMAT_ SUBDISTANCE	sub-distance [mm]
MMI_FFORMAT_ANGLE	angle
MMI_FFORMAT_VANGLE	vertical angle
MMI_FFORMAT_HZANGLE	horizontal angle
MMI_FFORMAT_ TEMPERATURE	temperature
MMI_FFORMAT_TIME	time 12h/24h-format
MMI_FFORMAT_DATE	date
MMI_FFORMAT_ DATE_TIME	date/time

`iLen` `in` The length of the value consisting of a sign, the characters before and after the comma and the comma itself. The dimension field is not included.

`iDecimals` `in` The number of decimals. If `iDecimals = -1` the number of decimals set by the system is taken.

`dVal`	in	The value to convert. Use this routine to convert double (and equal to double) values.
`iMode`	in	If `iMode = MMI_DIM_ON` a dimension string is automatically added to `sValStr` when the type `dVal` has units. Otherwise use `MMI_DEFAULT_MODE`.
`sValStr`	out	`sValStr` contains the string representation of the value `dVal`.

Return-Codes

`RC_OK`	Successful termination.
`RC_IVRESULT`	The result is not valid due to an illegal input value.

See Also `sFormatVal`

Example The example uses the `MMI_FormatVal` routine to convert the value `dTestVal` as distance (with corresponding dimension).

```
DIM dTestVal AS Distance
DIM sVString AS String30

dTestVal = 287.47

MMI_FormatVal( MMI_FFORMAT_DISTANCE, 10, -1,
               dTestVal, TRUE,
               MMI_DIM_ON, sVString )
```

6.1.27 MMI_WriteMsg

Description Output to a message window.

Declaration

```
MMI_WriteMsg( BYVAL sText    AS _Token,
              BYVAL sCaption AS _Token,
              BYVAL iMsgType AS Integer,
                    iRetKey  AS Integer )
```

Remarks The function opens a message window on the display, which shows the text specified by `sText`. Lines that are too long to fit into the window are split automatically.

`sText` may contain a carriage return (character code 10) which breaks a line explicitly. The predefined constants `MMI_INVERSE_ON` and `MMI_INVERSE_OFF` can be used for inverse text.
Text lines, that exceed the size of the window, are not displayed. A title text, which will be printed on the first line of the message box, can be set with `sCaption`, which may not be longer than one line and contain neither font attributes nor type information.

Parameters

`sText`	`in`	Text-token to be displayed on the window (on the Theodolite).
`sCaption`	`in`	Text-token that will be displayed as title of the window.

`iMsgType`	`in`	Defines the type of the message window to be displayed, with the corresponding text on the buttons; possible types:
		`MMI_MB_OK`
		`MMI_MB_ABORT`
		`MMI_MB_OK_ABORT`
		`MMI_MB_ABORT_RETRY_CONT`
		`MMI_MB_YES_NO_ABORT`
		`MMI_MB_YES_NO`
		`MMI_MB_RETRY_ABORT`
		`MMI_MB_ABORT_CONT`
		`MMI_MB_ABORT_RETRY_IGNORE`
		`MMI_MB_ABORT_IGNORE`

`iRetKey`	`out`	Returns the button pressed, i. e. `iRetKey`:
		`MMI_MB_RET_OK`
		`MMI_MB_RET_ABORT`
		`MMI_MB_RET_RETRY`
		`MMI_MB_RET_CONT`
		`MMI_MB_RET_YES`
		`MMI_MB_RET_NO`
		`MMI_MB_RET_IGNORE`

Return-Codes

RC_OK	Successful termination.
BAS_NO_DLG_EXIST	No dialog exists for this operation.

Example The example uses the MMI_WriteMsg routine to display a message box with the title text "Warning" and the text "timed out" and shows the buttons "Retry", "Abort" returning the button-id in iRetKey.

```
MMI_WriteMsg( "Warning", "timeout",
                MMI_MB_RETRY_ABORT, iMBRetKey )
```

6.1.28 MMI_WriteMsgStr

Description Output to a message window.

Declaration

```
MMI_WriteMsgStr( BYVAL sText    AS String255,
                 BYVAL sCaption AS _Token,
                 BYVAL iMsgType AS Integer,
                       iRetKey  AS Integer )
```

Remarks The function opens a message window on the display, which shows the text specified by sText. Lines, which are too long to fit into the window, are split automatically. sText may contain a carriage return (character code 10) which breaks a line explicitly. The predefined constants MMI_INVERSE_ON and MMI_INVERSE_OFF can be used for inverse text.
Text lines, that exceed the size of the window, are not displayed.
A title text, which will be printed on the first line of the message box, can be set with sCaption, which may not be longer than one line and contain neither font attributes nor type information.

Note	This routine is different to MMI_WriteMsg in such a way that sText may be computed. But, of course, sText will not be entered into the text token data base.

Parameters

sText	in	Text string to be displayed in a message box.

`sCaption`	in	Text-token that will be displayed as title of the window.

`iMsgType`	in	Defines the type of the message window to be displayed, with the corresponding text on the buttons; possible types:
		`MMI_MB_OK`
		`MMI_MB_ABORT`
		`MMI_MB_OK_ABORT`
		`MMI_MB_ABORT_RETRY_CONT`
		`MMI_MB_YES_NO_ABORT`
		`MMI_MB_YES_NO`
		`MMI_MB_RETRY_ABORT`
		`MMI_MB_ABORT_CONT`
		`MMI_MB_ABORT_RETRY_IGNORE`
		`MMI_MB_ABORT_IGNORE`

`iRetKey`	out	Returns the button pressed, i. e. `iRetKey`:
		`MMI_MB_RET_OK`
		`MMI_MB_RET_ABORT`
		`MMI_MB_RET_RETRY`
		`MMI_MB_RET_CONT`
		`MMI_MB_RET_YES`
		`MMI_MB_RET_NO`
		`MMI_MB_RET_IGNORE`

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No dialog exists for this operation.

See Also `MMI_WriteMsg`

Example The example uses the `MMI_WriteMsgStr` routine to display a message box with the title text “`Warning`“ and the text:

```
MessageStr
time out in 10 seconds
```

and shows the buttons “`Retry`“, “`Abort`“ returning the button-id in `iRetKey`.

```
CONST  iTimeOut  AS Integer = 10
DIM    sMessage  As String255
DIM    iMBRetKey AS Integer

sMessage = "MessageStr\d010time out in " +
             Str$(iTimeOut) + "seconds"
MMI_WriteMsgStr( "Warning", sMessage,
                  MMI_MB_RETRY_ABORT,iMBRetKey )
```

6.1.29 MMI_DrawLine

Description Draw a line.

Declaration

```
MMI_DrawLine( BYVAL iX1  AS Integer,
              BYVAL iY1  AS Integer,
              BYVAL iX2  AS Integer,
              BYVAL iY2  AS Integer,
              BYVAL iPen AS Integer )
```

Remarks The function draws a line within the graphic field using the line-style `iPen`.

Note	A graphics dialog has to be set up before.

Parameters

iX1	in	x-co-ordinate of the beginning of the line [pixel]
iY1	in	y-co-ordinate of the beginning of the line [pixel]
iX2	in	x-co-ordinate of the end of the line [pixel]
iY2	in	y-co-ordinate of the end of the line [pixel]

`iPen`	in	Line-style; possible values:
		`MMI_PEN_WHITE`
		`MMI_PEN_BLACK`
		`MMI_PEN_DASHED`

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No graphics dialog exists for this operation.

See Also `MMI_CreateGraphDialog`, `MMI_DrawRect`, `MMI_DrawCircle`, `MMI_DrawText`

Example The example uses the `MMI_DrawLine` routine to draw a line with the specified attributes.

```
MMI_DrawLine( 10, 10, 100, 50, MMI_PEN_BLACK )
```

6.1.30 MMI_DrawRect

Description Draw a rectangle.

Declaration

```
MMI_DrawRect( BYVAL iX1    AS Integer,
              BYVAL iY1    AS Integer,
              BYVAL iX2    AS Integer,
              BYVAL iY2    AS Integer,
              BYVAL iBrush AS Integer,
              BYVAL iPen   AS Integer )
```

Remarks This function draws a rectangle in the graphic field using the fill-style `iBrush` and the line-style `iPen`.

Note	A graphics dialog has to be set up before.

Parameters

`iX1`	`in`	x-co-ordinate at the upper left-hand corner of the rectangle [pixel]
`iY1`	`in`	y-co-ordinate at the upper left-hand corner of the rectangle [pixel]
`iX2`	`in`	x-co-ordinate at the bottom right-hand corner of the rectangle [pixel]
`iY2`	`in`	y-co-ordinate at the bottom right-hand corner of the rectangle [pixel]

`iBrush`	`in`	Fill-style for the rectangle; possible values:
		`MMI_BRUSH_WHITE`
		`MMI_BRUSH_BLACK`
		`MMI_NO_BRUSH`

`iPen`	`in`	Line-style:
		`MMI_PEN_WHITE`
		`MMI_PEN_BLACK`
		`MMI_PEN_DASHED`

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No graphics dialog exists for this operation.

See Also `MMI_CreateGraphDialog`, `MMI_DrawLine`, `MMI_DrawCircle`, `MMI_DrawText`

Example The example uses the `MMI_DrawRect` routine to draw a rectangle with the specified attributes.

```
MMI_DrawRect( 10, 10, 100, 50, MMI_NO_BRUSH,
MMI_PEN_BLACK )
```

6.1.31 MMI_DrawCircle

Description Draw a circle / ellipse.

Declaration

```
MMI_DrawCircle( BYVAL iX     AS Integer,
                BYVAL iY     AS Integer,
                BYVAL iRx    AS Integer,
                BYVAL iRy    AS Integer,
                BYVAL iBrush AS Integer,
                BYVAL iPen   AS Integer )
```

Remarks This function draws a circle in the graphic field, using the radius `iRx`, the fill-style `iBrush`, and the line-style `iPen`, as long as `iRx` = `iRy`. Otherwise, an ellipse is drawn, where `iRx` and `iRy` are the lengths of the perpendicular radii.

Note	A graphics dialog has to be set up before.

Parameters

`iX`	`in`	x-co-ordinate at the centre of the circle/ellipse [pixel]
`iY`	`in`	y-co-ordinate at the centre of the circle/ellipse [pixel]
`iRx`	`in`	Radius of the circle, horizontal radius [pixel]
`iRy`	`in`	Radius of the circle, vertical radius [pixel]

`iBrush`	`in`	Fill-style for the rectangle; possible values:
		`MMI_BRUSH_WHITE`
		`MMI_BRUSH_BLACK`
		`MMI_NO_BRUSH`

`iPen`	`in`	Line-style; possible values:
		`MMI_PEN_WHITE`
		`MMI_PEN_BLACK`
		`MMI_PEN_DASHED`

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No graphics dialog exists for this operation.

See Also `MMI_CreateGraphDialog`, `MMI_DrawLine`, `MMI_DrawRect`, `MMI_DrawText`

Example Draw a circle with a radius of 10.

```
MMI_DrawCircle( 80, 25, 10, 10,
                MMI_BRUSH_BLACK,
                MMI_PEN_BLACK )
```

6.1.32 MMI_DrawText

Description Draw / delete text.

Declaration

```
MMI_DrawText( BYVAL iX    AS Integer,
              BYVAL iY    AS Integer,
              BYVAL sText AS String20,
              BYVAL iAttr AS Integer,
              BYVAL iPen AS Integer )
```

Remarks This function either draws (`iPen` = `MMI_PEN_BLACK`) or deletes (`iPen` = `MMI_PEN_WHITE`) a text string in graphic field. The co-ordinates (`iX`, `iY`) correspond to the upper left-hand corner of the first character. The character size is 6 x 8 pixel.

Note A graphics dialog has to be set up before.

Parameters

`iX`	in	x-co-ordinate at the upper left-hand corner of the first character [pixel]	
`iY`	in	y-co-ordinate at the upper left-hand corner of the first character [pixel]	
`sText`	in	Pointer to the text string	
`iAttr`	in	Text attribute	
		`MMI_TXT_NORMAL`	normal text
		`MMI_TXT_INVERSE`	inverted text

`iPen`	in	`MMI_PEN_BLACK`	draw text
		`MMI_PEN_WHITE`	delete text

Return-Codes

`RC_OK`	Successful termination.
`BAS_NO_DLG_EXIST`	No graphics dialog exists for this operation.

See Also `MMI_CreateGraphDialog, MMI_DrawLine, MMI_DrawRect, MMI_DrawCircle`

Example Print a text at position 10, 10.

```
DIM sOutput AS String20
sOutput = "distance"
MMI_DrawText( 10, 10, sOutput, MMI_TXT_NORMAL,
MMI_PEN_BLACK )
```

6.1.33 MMI_DrawBusyField

Description Shows or hides the Busy-Icon.

Declaration
```
MMI_DrawBusyField(
            BYVAL lVisible as Logical )
```

Remarks This function controls the Busy-Icon (Hourglass).

Parameters

`lVisible`	in	TRUE: Icon is visible

Return-Codes

`RC_OK`	Successful termination.

Example The example shows and hides the Busy-Icon

```
MMI_DrawBusyField(TRUE)  ' show icon

' time consuming function....

MMI_DrawBusyField(FALSE) ' hide icon
```

6.1.34 MMI_BeepAlarm, MMI_BeepNormal, MMI_BeepLong

Description Create an alert beep.

Declaration
```
MMI_BeepAlarm()
MMI_BeepNormal()
MMI_BeepLong()
```

Remarks The functions create one or a sequence of alert beeps with configurable volume, if the boxes are turned on.

Any previously set continuous signal beep will be finished.

Return-Codes

RC_OK	Successful termination.

See Also
MMI_StartVarBeep
MMI_SwitchVarBeep
MMI_GetVarBeepStatus

Example The example uses the `MMI_BeepNormal` to sound a signal beep.

```
MMI_BeepNormal()
```

6.1.35 MMI_StartVarBeep

Description Start beep sequences with configurable interrupts.

Declaration `MMI_StartVarBeep( BYVAL iRate AS Integer )`

Remarks The function creates sequences of beeps with configurable interrupts.

If previously a continuous signal beep has been set, the new rate will be established.

Parameters

`iRate`	`in`	frequency in [%]; 0 is very slow, 100 is very fast

Return-Codes

`RC_OK`	Successful termination.

See Also `MMI_BeepAlarm`, `MMI_BeepNormal`, `MMI_BeepLong`, `MMI_SwitchVarBeep`, `MMI_GetVarBeepStatus`

Example The example uses the `MMI_StartVarBeep` to create a very fast sequence of signal beeps.

```
MMI_StartVarBeep( 100 )
```

6.1.36 MMI_SwitchVarBeep

Description Switch a varying beep.

Declaration `MMI_SwitchVarBeep( BYVAL lOn AS Logical )`

Remarks The function allows the general switching (on/off) of a signal beep. A continuous signal beep will be switched off immediately.

Parameters

`lOn` `in` switches the beep on or off

lOn	**meaning**
`FALSE`	the beep is switched off generally
`TRUE`	beep is on; the functions `MMI_BeepNormal` etc. will only work if the beep is switched on.

Return-Codes

`RC_OK`	Successful termination.

See Also `MMI_BeepNormal`, `MMI_BeepLong`, `MMI_BeepAlarm`, `MMI_StartVarBeep`, `MMI_GetVarBeepStatus`

Example The example uses the `MMI_SwitchVarBeep` to switch off the beep.

```
MMI_SwitchVarBeep( TRUE )
```

6.1.37 MMI_GetVarBeepStatus

Description Read the switch status for a variable signal beep.

Declaration `MMI_GetVarBeepStatus( lOn AS Logical )`

Remarks The function retrieves the state of the general signal beep switch.

Parameters

lOn	out	state of the switch

lOn	**meaning**
FALSE	off
TRUE	on

Return-Codes

RC_OK	Successful termination.

See Also `MMI_BeepNormal`, `MMI_BeepLong`, `MMI_BeepAlarm`, `MMI_StartVarBeep`, `MMI_SwitchVarBeep`

Example The example uses the `MMI_GetVarBeepStatus` to revert the beep status (i.e. switch on when it is off and vice versa).

```
DIM lOn AS Logical

MMI_GetVarBeepStatus(lOn)
MMI_SwitchVarBeep( NOT lOn )
```

6.1.38 MMI_SwitchAFKey

Description Switch the `aF…` key on or off.

Declaration `MMI_SwitchAFKEY( BYVAL lOn AS Logical )`

Remarks The function allows the switching (on/off) off the `aF…` key. Normally it is enabled, but during tracking distances it is disabled.

Parameters

`lOn` `in` switches the beep on or off

lOn	**meaning**
FALSE	Key is switched off generally
TRUE	Key is active

Return-Codes

RC_OK	Successful termination.

See Also `BAP_MeasRec`, `BAP_MeasDistAng`

Example The example uses the `MMI_SwitchAFKey` to disable the `aF…` key.

```
MMI_SwitchAFKey( FALSE )
```

6.1.39 MMI_SwitchIconsBeep

Description Switches measurement icons and special beeps on or off.

Declaration `MMI_SwitchIconsBeep( BYVAL lOn AS Logical )`

Remarks The function allows the switching (on/off) of the measurement icons and special beeps (sector and lost lock).

Parameters

`lOn` in switches the icons and beep on or off

lOn	**meaning**
FALSE	no measurement icons and no special beep
TRUE	the measurement icons will be updated and the beeps are enabled. This is the normal state during a measurement dialog with continuos measurements.

Return-Codes

`RC_OK` Successful termination.

See Also `BAP_MeasRec`
`BAP_MeasDistAng`

Example The example uses the `MMI_SwitchIconsBeep` to disable the icons and beeps.

```
MMI_SwitchIconsBeep( FALSE )
```

6.1.40 MMI_SetAngleRelation

Description Set the angle relationship.

Declaration

```
MMI_SetAngleRelation(
            BYVAL iVertRel AS Integer,
            BYVAL iHorzRel AS Integer)
```

Remarks This function sets the relationship of the vertical and horizontal angles. Fields already displayed are not updated.

Parameters

`iVertRel`	in	Relationship of the vertical angle; valid values:
		`MMI_VANGLE_IN_PERCENT`
		`MMI_VANGLE_REL_HORIZON`
		`MMI_VANGLE_REL_ZENIT`

`iHorzRel`	in	Relationship of the horizontal angle; valid values:
		`MMI_HANGLE_CLOCKWISE`
		`MMI_HANGLE_ANTICLOCKWISE`
		`MMI_HANGLE_CLOCKWISE_SOUTH`
		`MMI_HANGLE_BEARING`

Return Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	The function has been called with an invalid parameter

See Also `MMI_GetAngleRelation`

Example Set the angle relations (with internal default values).

```
MMI_SetAngleRelation(
      MMI_VANGLE_IN_PERCENT,
      MMI_HANGLE_CLOCKWISE)
```

6.1.41 MMI_GetAngleRelation

Description Request the current angle relationships.

Declaration
```
MMI_GetAngleRelation(iVertRel AS Integer,
                     iHorzRel AS Integer)
```

Remarks This function returns the current vertical- and horizontal- angle relationships.

Parameters

`iVertRel`	`out`	Relationship of the vertical angle
`iHorzRel`	`out`	Relationship of the horizontal angle

Return Codes

`none`

See Also `MMI_SetAngleRelation`

Example Get the angle relations.

```
DIM iVertRel AS Integer
DIM iHorzRel AS Integer

MMI_GetAngleRelation( iVertRel, iHorzRel )
```

6.1.42 MMI_SetVAngleMode

Description Set the V-Angle mode.

Declaration
```
MMI_SetVAngleMode(BYVAL lAngleFree AS
Logical)
```

Remarks This function sets the vertical angle mode. Normally (`lAngleFree=FALSE`), the vertical angle is fix if there is a valid distance available. If `lAngleFree=TRUE`, the vertical angle will be updated including all corresponding values (slope distance, vertical distance, coordinates etc)

Parameters

`lAngleFree`	`in`	TRUE: V-Angle is free (running)

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_GetVAngleMode`

Example See example file „`meas.gbs`“.

6.1.43 MMI_GetVAngleMode

Description Returns the V-Angle mode.

Declaration `MMI_GetVAngleMode(lAngleFree AS Logical)`

Remarks This function returns the vertical angle mode.

Parameters

`lAngleFree`	`in`	TRUE: V-Angle is free (running)

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_SetVAngleMode`

Example See example file „`meas.gbs`“.

6.1.44 MMI_SetAngleUnit

Description Set the displayed unit of angle.

Declaration

```
MMI_SetAngleUnit(BYVAL iUnit   AS Integer,
                 BYVAL iDigits AS Integer)
```

Remarks This function sets the displayed unit of angle. Existing display fields are not updated. If `iDigits` is greater than the maximal number it will be reset to it without notifying the user. A negative value of `iDigits` is not allowed.

Note	The maximal number of decimal digits depends on the Theodolite class.

Parameters

iUnit	in	Specified unit of angle; possible values:

value	meaning
MMI_ANGLE_GON	400 Gon
MMI_ANGLE_DEC	360 Decimal
MMI_ANGLE_SEXADEC	360 Sexadecimal
MMI_ANGLE_MIL	6400 Mil
MMI_ANGLE_PERCENT	-300 ≤ x ≤ 300; only for vertical angles

iDigits	in	Number of decimal places. The maximum number of decimal places (iDigits) for each unit is set to the following values:

angle unit	places
MMI_ANGLE_GON	0-4
MMI_ANGLE_DEC	0-4
MMI_ANGLE_SEXADEC	0-4
MMI_ANGLE_MIL	0-3
MMI_ANGLE_PERCENT	don't care

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetAngleUnit

Example Set the angle unit.

```
MMI_SetAngleUnit( MMI_ANGLE_GON, 3 )
```

6.1.45 MMI_GetAngleUnit

Description Return the currently displayed unit of angle.

Declaration
```
MMI_GetAngleUnit(iUnit   AS Integer,
                 iDigits AS Integer)
```

Remarks This function returns the current unit of angle.

Parameters

iUnit	out	Specified unit of angle
iDigits	out	Number of decimal places.

Return Codes

RC_OK	Successful termination.

See Also MMI_SetAngleUnit

Example Get the angle unit.
```
DIM iUnit AS Integer
DIM iDigits AS Integer

MMI_GetAngleUnit( iUnit, iDigits )
```

6.1.46 MMI_SetDistUnit

Description Set the displayed unit of distance.

Declaration
```
MMI_SetDistUnit(BYVAL iUnit   AS Integer,
                BYVAL iDigits AS Integer)
```

Remarks This function sets the display unit for distance. Fields already displayed are not updated. If `iDigits` is greater than the maximal number it will be reset to it without notifying the user. A negative value of `iDigits` is not allowed.

Note	The maximal number of decimal digits depends on the Theodolite class

Parameters

iUnit	in	Specified unit of distance; possible values:

value	meaning
MMI_DIST_METER	Meter
MMI_DIST_FOOT	normal foot
MMI_DIST_FOOT_INCH	normal foot / inch / 1/8inch
MMI_DIST_US_FOOT	US-foot
MMI_DIST_US_FOOT_INCH	US-foot / inch / 1/8inch
MMI_DIST_MM	Millimetre
MMI_DIST_INCH	inches

iDigits	in	Number of decimal places. The maximum number of decimal places (iDigits) for each unit is set to the following values:

angle unit	places
MMI_DIST_METER	0-4
MMI_DIST_FOOT	0-4
MMI_DIST_FOOT_INCH	0-1
MMI_DIST_US_FOOT	0-4
MMI_DIST_US_FOOT_INCH	0-1
MMI_DIST_MM	0
MMI_DIST_INCH	0-3

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetDistUnit

Example Set the distance unit.

```
MMI_SetDistUnit( MMI_DIST_METER, 4 )
```

6.1.47 MMI_GetDistUnit

Description Return the currently displayed unit of distance.

Declaration
```
MMI_GetDistUnit(    iUnit   AS Integer,
                    iDigits AS Integer)
```

Remarks This function returns the current unit of distance.

Parameters

iUnit	out	Specified unit of distance
iDigits	out	Number of decimal places.

Return Codes

RC_OK	Successful termination.

See Also MMI_SetDistUnit

Example Get the distance unit.

```
DIM iUnit AS Integer
DIM iDigits AS Integer

MMI_GetDistUnit( iUnit, iDigits )
```

6.1.48 MMI_SetPressUnit

Description Set the displayed unit of pressure.

Declaration
```
MMI_SetPressUnit(BYVAL iUnit   AS Integer,
                 BYVAL iDigits AS Integer)
```

Remarks This function sets the display unit for pressure. Fields already displayed are not updated. If `iDigits` is greater than 1 it will be reset to it without notifying the user. A negative value of `iDigits` is not allowed.

Parameters

iUnit	in	Specified unit of pressure; possible values:	
		value	**meaning**
		MMI_PRESS_MBAR	MilliBar
		MMI_PRESS_MMHG	Millimetre mercury
		MMI_PRESS_INCHHG	Inch mercury
		MMI_PRESS_HPA	Hekto-Pascal
		MMI_PRESS_PSI	PSI
iDigits	in	Number of decimal places. The maximum number of decimal places (iDigits) for each unit is set to the following values:	
		angle unit	**places**
		MMI_PRESS_MBAR	0-1
		MMI_PRESS_MMHG	0-1
		MMI_PRESS_INCHHG	0-1
		MMI_PRESS_HPA	0-1
		MMI_PRESS_PSI	0-1

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetPressUnit

Example Set the pressure unit.

```
MMI_SetPressUnit( MMI_PRESS_MBAR, 1 )
```

6.1.49 MMI_GetPressUnit

Description Return the currently displayed unit of pressure.

Declaration
```
MMI_GetPressUnit(iUnit   AS Integer,
                 iDigits AS Integer)
```

Remarks This function returns the current unit of pressure.

Parameters

iUnit	out	Specified unit of pressure
iDigits	out	Number of decimal places.

Return Codes

RC_OK	Successful termination.

See Also MMI_SetPressUnit

Example Get the pressure unit.
```
DIM iUnit AS Integer
DIM iDigits AS Integer

MMI_GetPressUnit( iUnit, iDigits )
```

6.1.50 MMI_SetTempUnit

Description Set the displayed unit of temperature.

Declaration
```
MMI_SetTempUnit(BYVAL iUnit   AS Integer,
                BYVAL iDigits AS Integer)
```

Remarks This function sets the display unit for temperature. Fields already displayed are not updated. If iDigits is greater than 1 it will be reset to it without notifying the user. A negative value of iDigits is not allowed.

Parameters

iUnit	in	Specified unit of temperature; possible values:

value	meaning
MMI_TEMP_C	Celsius
MMI_TEMP_F	Fahrenheit

iDigits	in	Number of decimal places. The maximum number of decimal places (iDigits) for each unit is set to the following values:

angle unit	places
MMI_TEMP_C	0-1
MMI_TEMP_F	0-1

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetTempUnit

Example Set the temperature unit.

```
MMI_SetTempUnit( MMI_TEMP_C, 1 )
```

6.1.51 MMI_GetTempUnit

Description Return the currently displayed unit of temperature.

Declaration

```
MMI_GetTempUnit(iUnit   AS Integer,
                iDigits AS Integer)
```

Remarks This function returns the current unit of temperature.

Parameters

iUnit	out	Specified unit of temperature
iDigits	out	Number of decimal places.

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_SetTempUnit`

Example Get the temperature unit.

```
DIM iUnit   AS Integer
DIM iDigits AS Integer

MMI_GetTempUnit( iUnit, iDigits )
```

6.1.52 MMI_SetDateFormat

Description Set the date display format.

Declaration `MMI_SetDateFormat(BYVAL iFormat AS Integer)`

Remarks This function sets the format in which the date is to be displayed. Existing fields remain unchanged.

Parameters

`iFormat` in Specified date format; possible values:

value	meaning
`MMI_DATE_EU`	European: DD.MM.YY
`MMI_DATE_US`	US: MM/DD/YY
`MMI_DATE_JP`	Japanese: YY/MM/DD

Return Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	The function has been called with an invalid parameter

See Also `MMI_GetDateFormat`

Example Set the date format (internal default value).

```
MMI_SetDateFormat( MMI_DATE_EU )
```

6.1.53 MMI_GetDateFormat

Description Retrieves the date display format.

Declaration `MMI_GetDateFormat(iFormat AS Integer)`

Remarks This function retrieves the format used to display the date.

Parameters

`iFormat`	`out`	Specified date format

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_SetDateFormat`

Example Get the date format.

```
DIM iFormat AS Integer

MMI_GetDateFormat( iFormat )
```

6.1.54 MMI_SetTimeFormat

Description Set the time display format.

Declaration `MMI_SetTimeFormat(BYVAL iFormat AS Integer)`

Remarks This function sets the format in which the time is to be displayed. Existing fields remain unchanged.

Parameters

`iFormat` `in` Specified time format; possible values:

value	**meaning**
`MMI_TIME_12H`	12 hour display
`MMI_TIME_24H`	24 hour display

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_GetTimeFormat

Example Set the time format (internal default value).

```
MMI_SetTimeFormat( MMI_TIME_12H )
```

6.1.55 MMI_GetTimeFormat

Description Retrieves the time display format.

Declaration `MMI_GetTimeFormat(iFormat AS Integer)`

Remarks This function retrieves the format used to display the time.

Parameters

iFormat	out	Specified time format

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter

See Also MMI_SetTimeFormat

Example Get the time format.

```
DIM iFormat AS Integer

MMI_GetTimeFormat( iFormat )
```

6.1.56 MMI_SetCoordOrder

Description Set the co-ordinate order.

Declaration `MMI_SetCoordOrder(BYVAL iOrder AS Integer)`

Remarks This function sets the order of co-ordinates. The fields already displayed are not changed.

Parameters

`iOrder`	`in`	Specifies the co-ordinate order; possible values:

value	**meaning**
`MMI_COORD_N_E`	Order North East
`MMI_COORD_E_N`	Order East North

Return Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	The function has been called with an invalid parameter

See Also `MMI_GetCoordOrder`

Example Set the co-ordinate order (internal default value).

```
MMI_SetCoordOrder( MMI_COORD_N_E )
```

6.1.57 MMI_GetCoordOrder

Description Retrieve the co-ordinate order.

Declaration `MMI_GetCoordOrder(iOrder AS Integer)`

Remarks This function retrieves the order in which co-ordinates are displayed.

Parameters

`iOrder`	`out`	Specified co-ordinate order

Return Codes

`RC_OK`	Successful termination.

See Also `MMI_SetCoordOrder`

Example Get the co-ordinate order.

```
DIM iOrder AS Integer
MMI_GetCoordOrder( iOrder )
```

6.1.58 MMI_SetLanguage

Description Set the display language.

Declaration

```
MMI_SetLanguage(
      BYVAL iLanguageNr AS Integer )
```

Remarks This function sets the current language. All displayed text are immediately shown in the new language.

Parameters

`iLanguageNr` `in` Specifies the language number; possible values:

Value	Meaning
`MMI_REF_LANGUAGE`	Reference language (English) = 1
`2.. MMI_MAX_LANGUAGE`	Language numbers

Return Codes

RC_OK	Successful termination.
RC_IVPARAM	The function has been called with an invalid parameter.
TXT_UNDEF_LANG	The given language is not defined.

See Also MMI_GetLanguage

Example Set the language for the display (internal default value).

```
MMI_SetLanguage( MMI_REF_LANGUAGE )
```

6.1.59 MMI_GetLanguage

Description Query the current language.

Declaration

```
MMI_GetLanguage( iLangNr AS Integer,
                 sLangName AS String20)
```

Remarks This function returns the current language and the associated character symbols.

Parameters

iLangNr	out	Language number
sLangName	out	Language description

Return Codes

RC_OK	Successful termination.

See Also MMI_SetLanguage

Example Get the current language.

```
DIM iLangNr   AS Integer
DIM sLangName AS String20

MMI_GetLanguage( iLangNr, sLangName )
```

6.1.60 MMI_GetLangName

Description Gets the name to a language number.

Declaration
```
MMI_GetLangName(
                byVal iLangNr    AS Integer,
                      sLangName  AS String20)
```

Remarks This routine delivers the name associated with the number `iLangNr`.

Parameters

`iLangNr`	`in`	Language number
`sLangName`	`out`	Language description

Return Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	`iLangNr` is invalid

See Also `MMI_SetLanguage`
`MMI_GetLanguage`

Example Get the name of a language.
```
DIM sLangName AS String20

MMI_GetLangName( 2, sLangName )
```

6.2 BASIC APPLICATIONS BAP

6.2.1 Summarizing Lists of BAP Types and Procedures

6.2.1.1 Procedures

procedure name	**description**
`BAP_SetAccessoriesDlg`	Sets the used accessories
`BAP_FineAdjust`	Automatic target positioning
`BAP_GetMeasPrg`	Get the current distance measure program.
`BAP_MeasDistAngle`	Measures distance and angles.
`BAP_MeasRec`	Measures and record distance and angles.
`BAP_PosTelescope`	Positioning of the Telescope.
`BAP_SearchPrism`	Searches the prism.
`BAP_SetHz`	Sets the horizontal angle to 0 or another given value.
`BAP_SetManDist`	Set the distance manually.
`BAP_SetMeasPrg`	Set the distance measure program.
`BAP_SetPpm`	Sets the ppm for distance measurements.
`BAP_SetPrism`	Sets the current prism type and constant.

6.2.2 BAP_SetAccessoriesDlg

Description Sets the used accessories.

Declaration `BAP_SetAccessoriesDlg()`

Remarks This function displays the accessories dialog.

Parameters

-

Return-Codes

`RC_OK`	Successful termination.

Example The example displays the accessories dialog

```
BAP_SetAccessoriesDlg()
```

6.2.3 BAP_MeasDistAngle

Description Measures distance and angles.

Declaration

```
BAP_MeasDistAngle( iDistMode    AS Integer,
                   dHz          AS Angle,
                   dV           AS Angle,
                   dDist        AS Distance,
            BYVAL lDisplayOn   AS Logical,
            BYVAL sCaptionLeft AS _Token )
```

Remarks Measures distance and angles and updates the data pool after correct measurements. It controls the special beep (Sector or Lost Lock) and switches measurement icons and disables the `aF...` key during tracking.

Parameters

`iDistMode` Distance measuring modes:

Mode as Input	**Meaning**
`BAP_NO_MEAS`	No new measurement, get last one
`BAP_NO_DIST`	No distance measurement, get only angles
`BAP_DEF_DIST`	Measure distance and angles using default measurement program
`BAP_TRK_DIST`	Measure distance and angles using the tracking measurement program
`BAP_RTRK_DIST`	Measure distance and angles using the fast tracking measurement program
`BAP_STOP_TRK`	Stop tracking, no measurement. No valid results returned.
`BAP_CLEAR_DIST`	Clear distance (Theodolite data-pool), no measurement. No valid results returned.
`BAP_RED_TRK_DIST`	Measure distance and angles using the tracking with red laser measurement program
Mode returned	**Meaning**
`BAP_DEF_DIST`	Depends on distance measurement. Can be changed during distance measurement.
`BAP_TRK_DIST`	Depends on distance measurement. Can be changed during distance measurement.
`BAP_RTRK_DIST`	Depends on distance measurement. Can be changed during distance measurement.
`All other modes`	Returns `BAP_DEF_DIST`.

`dHz, dV` `out` Angles [rad] , depends on

		`iDistMode`
`dDist`	`out`	Distance [m], depends on `iDistMode`
`sCaptionLeft`	`in`	Left caption for the distance measurement display.
`lDisplayOn`	`in`	`TRUE`: shows the distance measurement display during distance measurement.

Return Codes

`RC_OK`	Measurement executed successfully
`AUT_RC_ANGLE_ERROR`	Angle measurement error
`AUT_RC_BAD_ENVIRONMENT`	Bad Environment conditions
`AUT_RC_CALACC`	ATR-calibration failed
`AUT_RC_DETECTOR_ERROR`	Error in target acquisition
`AUT_RC_DETENT_ERROR`	Positioning not possible due to mounted EDM
`AUT_RC_DEV_ERROR`	Deviation measurement error
`AUT_RC_INCACC`	Position not exactly reached
`AUT_RC_MOTOR_ERROR`	Motorization error
`AUT_RC_MULTIPLE_TARGETS`	Multiple targets detected
`AUT_RC_NO_TARGET`	No target detected
`AUT_RC_TIMEOUT`	Position not reached
`BAP_CHANGE_ALL_TO_DIST`	No prism has been found during distance measurement with ATR, command changed from "`All`" to "`Dist`"
`TMC_ACCURACY_GUARANTEE`	Info, accuracy cannot be guaranteed
`TMC_ANGLE_ACCURACY_GUARANTEE`	Info, only angle measurement valid, accuracy cannot be guaranteed

TMC_ANGLE_ERROR	Error, no valid angle measurement
TMC_ANGLE_NO_ FULL_ CORRECTION	Warning, only angle measurement valid, accuracy cannot be guaranteed
TMC_ANGLE_OK	Warning, only angle measurement valid
TMC_BUSY	Error, TMC submodule already in use by another subsystem, command not processed
TMC_DIST_ERROR	An error occurred during distance measurement.
TMC_DIST_PPM	Error, wrong setting of PPM or MM on EDM
TMC_NO_FULL_ CORRECTION	Warning, measurement without full correction
TMC_SIGNAL_ERROR	Error, no signal on EDM (only in signal mode)
RC_ABORT	Error, measurement aborted
RC_IVPARAM	Error, invalid DistMode

See Also BAP_MeasRec

Example See example file „meas.gbs“.

The example uses the BAP_MeasDistAngle routine to measure a distance and angles.

```
DIM iDistMode   AS Integer
DIM dHz         AS Angle
DIM dV          AS Angle
DIM dDist       AS Distance

iDistMode = BAP_DEF_DIST
BAP_MeasDistAngle(iDistMode, dHz, dV, dDist,
TRUE, "TEST")
```

6.2.4 BAP_MeasRec

Description Measures distance and angles records.

Declaration

```
BAP_MeasRec(        iDistMode    AS Integer,
             BYVAL lDisplayOn   AS Logical,
             BYVAL sCaptionLeft AS _Token )
```

Remarks Measures distance and angles and updates the Theodolite data pool after correct measurements and records values according the predefined record mask. After recording, a running point number will be incremented.

It controls the special beep (Sector or Lost Lock), switches Measurement icons and disables `aF...` Key during tracking.

Parameters

`iDistMode` Distance measuring modes:

Mode as Input	**Meaning**
`BAP_NO_MEAS`	No new measurement before recording
`BAP_NO_DIST`	No distance measurement before recording (only new angles)
`BAP_DEF_DIST`	Use default distance measurement program and record values
`BAP_TRK_DIST`	Use the tracking measurement program and record values
`BAP_RTRK_DIST`	Use the fast tracking measurement program and record values
`BAP_STOP_TRK`	Stop tracking, no measurement and no recording
`BAP_CLEAR_DIST`	Clear distance (Theodolite data pool), no measurement and no recording.
`BAP_RED_TRK_DIST`	Use the tracking with red laser measurement program and record values

Mode returned	Meaning
BAP_DEF_DIST	Depends on distance measurement. Can be changed during distance measurement.
BAP_TRK_DIST	Depends on distance measurement. Can be changed during distance measurement.
BAP_RTRK_DIST	Depends on distance measurement. Can be changed during distance measurement.
All other modes	Returns BAP_DEF_DIST.

sCaptionLeft	in	Left caption for the distance measurement display.
lDisplayOn	in	TRUE: shows the distance measurement display during distance measurement.

Return Codes

RC_OK	Successful termination.
WIR_NO_MEDIUM	No storage medium is available.
AUT_RC_ANGLE_ ERROR	Angle measurement error
AUT_RC_BAD_ ENVIRONMENT	Bad Environment conditions
AUT_RC_CALACC	ATR-calibration failed
AUT_RC_ DETECTOR_ERROR	Error in target acquisition
AUT_RC_DETENT_ ERROR	Positioning not possible due to mounted EDM
AUT_RC_DEV_ ERROR	Deviation measurement error
AUT_RC_INCACC	Position not exactly reached
AUT_RC_MOTOR_ ERROR	Motorization error
AUT_RC_MULTIPLE_ TARGETS	Multiple targets detected

AUT_RC_NO_TARGET	No target detected
AUT_RC_TIMEOUT	Position not reached
BAP_CHANGE_ALL_ TO_DIST	No prism has been found during distance measurement with ATR, command changed from "All" to "Dist"
TMC_ACCURACY_ GUARANTEE	Info, accuracy cannot be guaranteed
TMC_ANGLE_ ACCURACY_ GUARANTEE	Info, only angle measurement valid, accuracy cannot be guaranteed
TMC_ANGLE_ERROR	Error, no valid angle measurement
TMC_ANGLE_NO_ FULL_ CORRECTION	Warning, only angle measurement valid, accuracy cannot be guaranteed
TMC_ANGLE_OK	Warning, only angle measurement valid
TMC_BUSY	Error, TMC sub-module already in use by another subsystem, command not processed
TMC_DIST_ERROR	An error occurred during distance measurement.
TMC_DIST_PPM	Error, wrong setting of PPM or MM on EDM
TMC_NO_FULL_ CORRECTION	Warning, measurement without full correction
TMC_SIGNAL_ERROR	Error, no signal on EDM (only in signal mode)
RC_ABORT	Error, measurement aborted
RC_IVPARAM	Error, invalid DistMode

See Also BAP_MeasDistAngle, GSI_SetRecMask

Example See example file „`meas.gbs`“.

The example uses the `BAP_MeasMeasRec` routine to record actual distance and angles (no new measurement.

```
DIM iDistMode   AS Integer

iDistMode = BAP_NO_MEAS ' no measurement
BAP_MeasRec(iDistMode, FALSE, "")
```

6.2.5 BAP_FineAdjust

Description Automatic target positioning.

Declaration

```
BAP_FineAdjust(
          BYVAL dSearchHz AS Angle,
          BYVAL dSearchV  AS Angle )
```

Remarks This procedure performs a positioning of the Theodolite axis onto a destination target. If the target is not within the sensor measure region a target search will be executed. The target search range is limited by the parameter `dSearchV` in V- direction and by parameter `dSearchHz` in Hz - direction. If no target is found, the instrument turns back to the initial start position. The ATR mode must be enabled for this functionality, see `CSV_SetATRStatus` and `CSV_GetATRStatus`.

Parameters

`dSearchHz`	`in`	Search range Hz
`dSearchV`	`in`	Search range V

Return Codes

`RC_OK`	Successful termination.
`AUT_RC_TIMEOUT`	Timeout while positioning of one or both axes. The position fault lies above 100[cc].
`AUT_RC_MOTOR_ ERROR`	Instrument has no ‘motorization’.
`RC_FATAL`	Fatal error.
`RC_ABORT`	Function aborted.
`AUT_RC_NO_TARGET`	No target found.

`AUT_RC_MULTIPLE_TARGETS`	Multiple targets found.
`AUT_RC_BAD_ENVIRONMENT`	Inadequate environment conditions.
`AUT_RC_DEV_ERROR`	During the determination of the angle deviation error detected, repeat fine positioning
`AUT_RC_NOT_ENABLED`	ATR mode not enabled, enable ATR mode
`AUT_RC_DETECTOR_ERROR`	ATR error, at repeated occur call service

See Also `CSV_SetATRStatus, CSV_GetATRStatus`

Example The example see sample `TRACKING.GBS.`

6.2.6 BAP_SearchPrism

Description Searches the prism.

Declaration

```
BAP_SearchPrism(
          BYVAL lShowMessages As Logical )
```

Remarks This procedure searches the prism. The searching area depends on the defined searching area and on the setting of the additional working area.
This routine works only in ATR instruments and needs at least Firmware-Release 2.00

Parameters

`lShowMessages`	`in`	TRUE: show error-messages if there are problems to find the prism

Return Codes

`RC_OK`	Successful termination.
`AUT_RC_TIMEOUT`	Timeout while positioning of one or both axes. The position fault lies above 100[cc].

`AUT_RC_MOTOR_ ERROR`	Instrument has no 'motorization'.
`RC_FATAL`	Fatal error.
`RC_ABORT`	Function aborted.
`AUT_RC_NO_TARGET`	No target found.
`AUT_RC_MULTIPLE_ TARGETS`	Multiple targets found.
`AUT_RC_BAD_ ENVIRONMENT`	Inadequate environment conditions.
`AUT_RC_DEV_ERROR`	During the determination of the angle deviation error detected, repeat fine positioning
`AUT_RC_NOT_ ENABLED`	ATR mode not enabled, enable ATR mode

See Also `CSV_SetATRStatus, CSV_GetATRStatus`

6.2.7 BAP_SetManDist

Description Set the distance manually.

Declaration

```
BAP_SetManDist(
          BYVAL sCaptionLeft AS _Token,
          BYVAL dDistance AS Double,
                iButtonId AS Integer )
```

Remarks The `BAP_SetManDist` routine starts a dialog with the caption `sCaption` where the user can enter a horizontal distance. The distance will be stored into the Theodolite data pool.

Parameters

`sCaptionLeft`	`in`	left caption string of the dialog
`dDistance`	`in`	initial value for the distance. A negative value will be displayed as `"----"`
`iButtonId`	`out`	identifier of the pressed valid button to exit the dialog

Return Codes

RC_OK	Successful termination.
TMC_ACCURACY_ GUARANTEE	Info, accuracy cannot be guaranteed
TMC_ANGLE_ERROR	Error, no valid angle measurement
TMC_ANGLE_OK	Warning, only angle measurement valid
TMC_BUSY	Error, TMC sub-module already in use by another subsystem, command not processed
TMC_NO_FULL_ CORRECTION	Warning, measurement without full correction
RC_IVPARAM	Error, invalid DistMode

See Also TMC_IfDistTapeMeasured, TMC_SetHandDist, TMC_GetPolar, TMC_GetCoordinate

Example The example uses the BAP_SetManDist routine to enter a distance.

```
DIM iButton   AS Integer
DIM dInitDist AS Distance

dInitDist = 15.0   'initial value

BAP_SetManDist( "BASIC", dInitDist, iButton )
```

6.2.8 BAP_SetPpm

Description Sets the PPM for distance measurements.

Declaration BAP_SetPpm()

Remarks The BAP_SetPpm routine opens a dialog which the user can complete in order to calculate the PPM (parts per million) correction to be used to reduce the distance measured by the EDM.

Return Codes

RC_OK	Successful termination.

`RC_SET_INCOMPL`	Parameter set-up for subsystem incomplete.

See Also `BAP_SetManDist, BAP_SetPrism`

Example The example uses the `BAP_SetPpm` routine to open the PPM dialog.

```
BAP_SetPpm()
```

6.2.9 BAP_SetPrism

Description Sets the current prism type and constant.

Declaration `BAP_SetPrism()`

Remarks The `BAP_SetPrism` routine opens a dialog which the user can complete in order to choose one of five prism types/constants. Two types are LEICA defaults, whereas the other three can be named and the constant values given/changed by the user. The prism constants are always given and displayed in millimetres, regardless of the distance units in use at the time.

Return Codes

`RC_OK`	Successful termination.

See Also `BAP_SetManDist, BAP_SetPpm`

Example The example uses the `BAP_SetPrism routine` to open the Prism dialog.

```
BAP_SetPrism()
```

6.2.10 BAP_SetMeasPrg

Description Set the distance measure program.

Declaration `BAP_SetMeasPrg( BYVAL iMeasPrg AS Integer )`

Remarks The `BAP_SetMeasPrg` routine sets the program for the distance measurement.

Parameters

`iMeasPrg`	`in`	Distance measure program

Valid measure programs	**Meaning**
`BAP_SINGLE_REF_STANDARD`	Single measurement, with reflector, standard speed
`BAP_SINGLE_REF_FAST`	Single measurement, with reflector, fast
`BAP_SINGLE_REF_VISIBLE`	Single measurement, with reflector and red laser
`BAP_SINGLE_RLESS_VISIBLE`	Single measurement, reflectorless, with red laser
`BAP_CONT_REF_STANDARD`	Continuous measurement, with reflector, standard speed
`BAP_CONT_REF_FAST`	Continuous measurement, with reflector, fast
`BAP_CONT_RLESS_VISIBLE`	Continuous measurement, reflectorless, with red laser
`BAP_AVG_REF_STANDARD`	Average measurement, with reflector, standard speed
`BAP_AVG_REF_VISIBLE`	Average measurement, with reflector and red laser
`BAP_AVG_RLESS_VISIBLE`	Average measurement, reflectorless, with red laser

See Also `BAP_GetMeasPrg`

Example The example uses the `BAP_SetMeasPrg` routine to set the distance measurement program on single measurement without reflector.

```
BAP_SetMeasPrg(BAP_SINGLE_RLESS_VISIBLE)
```

6.2.11 BAP_GetMeasPrg

Description Get the current distance measure program.

Declaration `BAP_GetMeasPrg( iMeasPrg AS Integer )`

Remarks The `BAP_GetMeasPrg` routine fetches the current program for the distance measurement.

Parameters

`iMeasPrg`	`out`	Distance measure program

Valid measure programs	**Meaning**
`BAP_SINGLE_REF_STANDARD`	Single measurement, with reflector, standard speed
`BAP_SINGLE_REF_FAST`	Single measurement, with reflector, fast
`BAP_SINGLE_REF_VISIBLE`	Single measurement, with reflector and red laser
`BAP_SINGLE_RLESS_VISIBLE`	Single measurement, reflectorless, with red laser
`BAP_CONT_REF_STANDARD`	Continuous measurement, with reflector, standard speed
`BAP_CONT_REF_FAST`	Continuous measurement, with reflector, fast
`BAP_CONT_RLESS_VISIBLE`	Continuous measurement, reflectorless, with red laser
`BAP_AVG_REF_STANDARD`	Average measurement, with reflector, standard speed
`BAP_AVG_REF_VISIBLE`	Average measurement, with reflector and red laser
`BAP_AVG_RLESS_VISIBLE`	Average measurement, reflectorless, with red laser

See Also `BAP_SetMeasPrg`

Example The example uses the `BAP_GetMeasPrg` routine to fetch the current distance measurement program.

```
DIM iMeasPrg AS Integer

BAP_GetMeasPrg(iMeasPrg)
```

6.2.12 BAP_PosTelescope

Description Positioning of the Telescope.

Declaration

```
BAP_PosTelescope(
            BYVAL eMode        AS Integer,
            BYVAL eDspMode     AS Integer,
            BYVAL dHz          AS Double,
            BYVAL dV           AS Double,
            BYVAL dHzTolerance AS Double,
            BYVAL dVTolerance  AS Double)
```

Remarks This procedure positions the telescope according to the specified mode and angles.

Parameters

`eMode` Positioning mode.

`BAP_POSIT`	positioning on Hz and V angle
`BAP_POSIT_HZ`	positioning on Hz angle
`BAP_POSIT_V`	positioning on V angle
`BAP_CHANGE_FACE`	change face

`eDspMode`	Controls the context and layout of the display during manual positioning. This parameter has no effect on motorised Theodolites. `BAP_POS_NOMSG` No message will be displayed `BAP_POS_MSG` Only a message will be displayed `BAP_POS_DLG` Positioning will be guided with a dialog if it is a non motorised Theodolite
`dHz, dV`	Target position
`dHzTolerance, dVTolerance`	In case of manual positioning, the tolerances define the upper and lower boundaries of the target position. For successful termination of the positioning, the final target position must be within these boundaries. If the tolerance is lower then the default accuracy of the Theodolite, the tolerance will be the default accuracy.

Return Codes

`RC_OK`	Positioning successful
`RC_ABORT`	Abnormal termination (No positioning possible, ESC-Key)

See Also `CSV_MakePositioning`
`CSV_ChangeFace`

Example Position the telescope.

```
BAP_PosTelescope(BAP_CHANGE_FACE, BAP_POS_DLG,
     0, 0, .5, .5 )
```

6.2.13 BAP_SetHz

Description Sets the horizontal angle to 0 or another given value.

Declaration `BAP_SetHz( BYVAL sCaptionLeft AS _Token )`

Remarks This procedure offers a dialogue which the user can complete in order to influence the angular offset provided by the TMC subsystem for the horizontal angle encoder. A button is provided for setting the angle to zero, directly, or the user may prefer to input another given value. Furthermore, the angle beep (at the quarter circle positions from 0°) can be turned on and off.

Note	If the instrument is in Lock mode, then the instrument tries to lock first before it sets the angle to 0.

Parameters

`sCaptionLeft`	Left caption text for dialog

See Also

Return Codes

`RC_OK`	Horizontal angular offset correct.

Example Set the horizontal angle.

```
BAP_SetHz("BASIC" )
```

6.3 MEASUREMENT FUNCTIONS TMC

This section contains the lower level measurement procedures.

6.3.1 Summarizing Lists of TMC Types and Procedures

6.3.1.1 Types

type name	description
TMC_ANG_SWITCH_Type	Angle measurement switches
TMC_Angle_Type	Data structure for measuring angles.
TMC_Coordinate_Type	Data structure for the co-ordinates (tracking and fixed co-ordinates).
TMC_DIST_SWITCHES_Type	Distance measurement switches
TMC_Distance_Type	Data structure for the distance measurement.
TMC_HZ_V_Ang_Type	Horizontal and vertical angle.
TMC_Incline_Type	Data structure for the inclination measurement.
TMC_OFFSET_DIST_Type	Target offset
TMC_PPM_CORR_Type	Correction for distance measurement
TMC_REFRACTION_Type	Refraction correction for distance measurement
TMC_STATION_Type	Station co-ordinates

6.3.1.2 Procedures

procedure name	description
TMC_DoMeasure	Start a measure program.
TMC_Get/SetAngleFaceDef	Gets and sets the current face definition.

procedure name	description
TMC_Get/ SetRefractiveCorr	Gets and sets the refractive correction for measuring the distance.
TMC_Get/ SetRefractiveMethod	Gets and sets the method of refractive correction for measuring the distance.
TMC_Get/SetDistPpm	Gets and sets the correction values for distance measurements.
TMC_Get/SetHeight	Gets and sets the current height of the reflector.
TMC_Get/SetHzOffset	Gets and sets the current horizontal offset.
TMC_Get/SetStation	Gets and sets station co-ordinates.
TMC_GetAngle	Measure angles.
TMC_GetAngle_Winc	Measure angles with inclination control
TMC_GetAngSwitch	Returns the angle measurement correction switches
TMC_GetCoordinate	Calculate and read co-ordinates.
TMC_GetDistSwitch	Returns the distance measurement correction switches
TMC_GetFace1	Get face information of current telescope position
TMC_GetInclineStatus	Returns the inclination compensator status.
TMC_GetInclineSwitch	Returns the compensator switch
TMC_GetOffsetDist	Returns the distance measurement offset
TMC_GetPolar	Calculate and read polar co-ordinates.
TMC_GetSimpleMea	Gets the results of distance and angle measurement
TMC_IfDistTapeMeasured	Gets information about manual measurement.
TMC_IfOffsetDistMeasured	Returns the EDM measurement mode
TMC_QuickDist	Measure slope distance and angles
TMC_SetAngSwitch	Defines the angle measurement correction switches
TMC_SetDistSwitch	Defines the distance measurement correction switches
TMC_SetHandDist	Sets distance manually.

procedure name	**description**
TMC_SetInclineSwitch	Defines the compensator switch
TMC_SetOffsetDist	Defines the distance measurement offset

6.3.2 TMC Data Structures

6.3.2.1 TMC_INCLINE - Data structure for the inclination measurement

```
TYPE TMC_Incline_Type
  dCrossIncline        AS Double      cross inclination
  dLengthIncline       AS Double      alongside inclination
  dAccuracyIncline     AS Double      accuracy of measuring
  InclineTime          AS Integer     time of measuring
END TMC_Incline_Type
```

6.3.2.2 TMC_ANGLE - Data structure for measuring angles

```
TYPE TMC_Angle_Type
  dHz               AS Double        horizontal angle
  dV                AS Double        vertical angle
  dAngleAccuracy    AS Double        accuracy of angle
  iAngleTime        AS Integer       time of measurement
  Incline           AS TMC_          inclination belonging to the
                      Incline_Type   measurement
  iFace             AS Integer       information about position
                                     of the telescope
END TMC_Angle_Type
```

6.3.2.3 TMC_DISTANCE - Data structure for the distance measurement

TYPE TMC_Distance_Type

Angle	AS TMC_Angle_Type	set of angles belonging to distance
dSlopeDist	AS Double	slope distance
dSlopeDistAccuracy	AS Double	accuracy of distance
dHorizDist	AS Double	horizontal distance
dHeightDiff	AS Double	difference in altitude
AngleCont	AS TMC_Angle_Type	set of angles, measured continuously
dSlopeDistCont	AS Double	slope distance, measured continuously
dHeightDiffCont	AS Double	distance in altitude, measured continuously

END TMC_Distance_Type

6.3.2.4 TMC_COORDINATE - Data structure for the coordinates

(tracking and fixed co-ordinates)

TYPE TMC_Coordinate_Type

dE	AS Double	east co-ordinate
dN	AS Double	north co-ordinate
dH	AS Double	height co-ordinate
iCoordTime	AS Integer	time of measurement
dE_Cont	AS Double	east coordinate, measured continuously
dN_Cont	AS Double	north co-ordinate, measured continuously
dH_Cont	AS Double	height co-ordinate, measured continuously
iCoordContTime	AS Integer	time of continuous measurement

END TMC_Coordinate_Type

6.3.2.5 TMC_HZ_V_ANG - Horizontal and vertical angle

TYPE TMC_HZ_V_Ang_Type

dHz	AS Double	horizontal angle
dV	AS Double	vertical angle

END TMC_HZ_V_Ang_Type

6.3.2.6 TMC_PPM_CORR - Correction for distance measurement

```
TYPE TMC_PPM_CORR_Type
  dPpmI                AS Double      individual
  dPpmA                AS Double      atmospheric
  dPpmR                AS Double      height relative
  dPpmP                AS Double      projection contortion
END TMC_PPM_CORR_Type
```

6.3.2.7 TMC_STATION - Station coordinates

```
TYPE TMC_STATION_Type
  dE0                  AS Double      easting co-ordinate
  dN0                  AS Double      northing co-ordinate
  dH0                  AS Double      height co-ordinate
  dHi                  AS Double      instrument height
END TMC_STATION_Type
```

6.3.2.8 TMC_REFRACTION- Refraction correction for distance measurement

```
TYPE TMC_REFRACTION_Type
  bOnOff               AS Logical     TRUE if refraction is valid
  dEarthRadius         AS Double      earth radius
  dRefractiveScale     AS Double      refraction coefficient
END TMC_REFRACTION_Type
```

6.3.2.9 TMC_DIST_SWITCH_Type– Distance measurement switches

```
TYPE TMC_DIST_SWITCHES_Type
  lAxisDifferCorr    AS Logical  'EDM to optical axis correction
  lProjectScaleCorr  AS Logical  'Projection scale correction
  lHgtReductionCorr  AS Logical  'Height reduction correction
END TMC_DIST_SWITCHES_Type
```

6.3.2.10 TMC_ANGLE_SWITCH_Type – Angle measurement switches

```
TYPE TMC_ANG_SWITCH_Type
  lInclineCorr      AS Logical ' Inclination correction
  lStandAxisCorr    AS Logical ' Standing axis correction
  lCollimationCorr  AS Logical ' Collimation error correction
  lTiltAxisCorr     AS Logical ' Tilting axis correction
END TMC_ANG_SWITCH_Type
```

6.3.2.11 TMC_OFFSET_DIST_Type – Target offset

```
TYPE TMC_OFFSET_DIST_Type
 dLengthVal  AS Distance     'Target - Offset Length
 dCrossVal   AS Distance     'Target - Offset Cross
 dHeightVal  AS Distance     'Target - Offset Height
END TMC_OFFSET_DIST_Type
```

6.3.3 TMC_DoMeasure

Description Start a measure program.

Declaration `TMC_DoMeasure( BYVAL iCommand AS Integer )`

Remarks With this function a measure program is started. The commands start a distance measurement and / or a test mode. In addition an angle- and an inclination-measure are done (not at measurement).

The tracking measure program performs e.g. as follows: Start the measure program with TMC_`DoMeasure(TMC_TRK_DIST)`. The electronic distance measuring device (EDM) begins to run. Now the co-ordinates can be read, e.g. with TMC_`GetCoordinate()`. Tracking can be stopped with TMC_`DoMeasure(TMC_STOP)`. With `TMC_DoMeasure(TMC_CLEAR)` the function will be stopped and the distance cleared.

Note	After calling a measure program, the last valid distance results will be cleared (as after `TMC_STOP`).

Parameters

`iCommand` `in` start a measure program; possible values:

`TMC_STOP`	switch off EDM and finish program
`TMC_DEF_DIST`	do default distance measure
`TMC_TRK_DIST`	do tracking distance measure
`TMC_RTRK_DIST`	do fast tracking distance measure
`TMC_CLEAR`	clear distance and switch off EDM
`TMC_SIGNAL`	start signal measurement (test mode)
`TMC_RED_TRK_DIST`	do tracking distance measure with red laser

See Also `TMC_GetPolar`
`TMC_GetCoordinate`

Return Codes

`RC_OK`	measure program started
`RC_IVPARAM`	The function has been called with an invalid parameter
`TMC_BUSY`	Measurement system is busy

Example Start a distance measure, do something, stop it and clear results.

The following variable has to be defined:

```
TMC_DoMeasure (TMC_DEF_DIST) ' ... do a measure
TMC_DoMeasure (TMC_CLEAR)
```

6.3.4 TMC_GetPolar

Description Calculate and read polar co-ordinates.

Declaration

```
TMC_GetPolar(
     BYVAL iWaitTime   AS Integer,
           Polar       AS TMC_Distance_Type,
           iReturnCode AS Integer )
```

Remarks The function corrects and takes in calculation a measured distance. Angle and possibly inclination are being calculated. The result is a point in polar co-ordinates.

Simple and multiple measures (distance tracking, altitude tracking) are supported. The horizontal and the inclined distance with the difference in altitude are read. The delay (`iWaitTime`) just works on the distance measure, not on the measure of the angle. As long as no new measure program is started, the results can be read. Additional to the normal return codes `iReturnCode` delivers also informational return codes which will not interrupt program execution.

Note	The measure program must have been started (see `TMC_DoMeasure`).

Parameters

`iWaitTime`	`in`	delay time [ms] until a result is available `=0` returns results with an already measured distance.

	>0	waits maximal the time `iWaitTime` for a result. If `iWaitTime` is chosen big enough (e. g. 60000, which is surely longer than the time-out period of the device), the system will wait for a result or until an error occurs
	<0	Performs an automatic target acquisition (if possible) and then tries to measuring in a until a valid result or an irrecoverable error occurs. The value itself of `iWaitTime` is ignored.

`Polar`	`out`	point in polar co-ordinates
`iReturnCode`	`out`	see Additional Codes below

See Also `TMC_GetCoordinates`

Additional Codes in `iReturnCode`

`RC_OK`	measurement and values are OK
`TMC_ACCURACY_GUARANTEE`	Accuracy is not guaranteed, because the results are consist of measuring data which accuracy could not be verified by the system. Co-ordinates are available.
`TMC_NO_FULL_CORRECTION`	The results are not corrected by all active sensors. Co-ordinates are available.
`TMC_ANGLE_OK`	Angle values okay, but no valid distance. Co-ordinates are not available.
`TMC_ANGLE_ACCURACY_GUARANTEE`	No distance data available but angle data are valid. The return code is equivalent to the `TMC_ACCURACY_GUARANTEE` and relates to the angle data. Co-ordinates are not available.

TMC_ANGLE_NO_ FULL_ CORRECTION	No distance data available but angle data are valid. The return code is equivalent to the TMC_NO_FULL_CORRECTION and relates to the angle data. Co-ordinates are not available.
	Perform a distance measurement first before you call this function.
TMC_DIST_ERROR	No measuring, because of missing target point, co-ordinates are not available.
	Aim target point and try it again
TMC_DIST_PPM	No distance measurement respectively no distance data because of wrong EDM settings. The co-ordinates are not available. Set EDM –ppm and -mm to 0.

Return Codes

RC_OK	measurement and values are OK
TMC_ANGLE_ERROR	Problems with angle res. incline sensor. A valid angle could not be measured.
	At repeated occur call service.
TMC_BUSY	TMC resource is locked respectively TMC task is busy.
	Repeat measurement.
RC_ABORT	Measurement through customer aborted.

Example Start a distance measure, perform measure.

```
DIM iRetCode  AS Integer
DIM iWaitTime AS Integer
DIM Polar     AS TMC_Distance_Type
DIM lError    AS Logical
DIM lDone     AS Logical
```

```
'start distance measurement
ON ERROR RESUME    ' to get valid angles
TMC_DoMeasure( TMC_DEF_DIST )

iWaitTime = -1
lDone  = FALSE
lError = FALSE


DO                 'display measured values
  TMC_GetPolar( iWaitTime, Polar, iRetCode )
  SELECT CASE iRetCode
    CASE RC_OK
        'display all data
        'e.g. set lDone here
    CASE else
        'handle error
        lError = TRUE
  END SELECT
LOOP UNTIL lError OR lDone

'stop distance measurement
TMC_DoMeasure( TMC_CLEAR )
```

6.3.5 TMC_GetCoordinate

Description Calculate and read co-ordinates.

Declaration

```
TMC_GetCoordinate(
   BYVAL iWaitTime   AS Integer,
         Coordinate  AS TMC_COORDINATE_Type,
         iReturnCode AS Integer )
```

Remarks The function calculates and out put co-ordinates. Angle and possibly inclination are being measured. The co-ordinates are being corrected. The result is a point in Cartesian co-ordinates. The system calculates co-ordinates and tracking co-ordinates.

Simple and multiple measurements (distance-, altitude- and co-ordinate- tracking) are supported. The delay (`iWaitTime`) just works on the distance measure, not on the measuring of the angle.

As far as no new measure program is started, the results can be read. Additional to the normal return codes `iReturnCode` delivers also informational return codes which will not interrupt program execution.

Note	The measure program must have been started (see `TMC_DoMeasure`).

Parameters

`iWaitTime`	`in`	delay time [ms] until a result is available =0 returns already measured values >0 waits the maximal time `iWaitTime` for a result
`Coordinate`	`out`	point in Cartesian co-ordinates (output)
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_GetPolar`

Additional Codes in `iReturnCode`

`RC_OK`	measurement and values are OK
`TMC_ACCURACY_GUARANTEE`	Accuracy is not guaranteed, because the result are consist of measuring data which accuracy could not be verified by the system. Co-ordinates are available.
`TMC_NO_FULL_CORRECTION`	The results are not corrected by all active sensors. Co-ordinates are available.
`TMC_ANGLE_OK`	Angle values okay, but no valid distance. Co-ordinates are not available.
`TMC_ANGLE_ACCURACY_GUARANTEE`	No distance data available but angle data are valid. The return code is equivalent to the `TMC_ACCURACY_GUARANTEE` and relates to the angle data. Co-ordinates are not available.

TMC_ANGLE_NO_ FULL_ CORRECTION	No distance data available but angle data are valid. The return code is equivalent to the TMC_NO_FULL_CORRECTION and relates to the angle data. Co-ordinates are not available. Perform a distance measurement first before you call this function.
TMC_DIST_ERROR	No measuring, because of missing target point, co-ordinates are not available. Aim target point and try it again
TMC_DIST_PPM	No distance measurement respectively no distance data because of wrong EDM settings. The co-ordinates are not available. Set EDM –ppm and -mm to 0.

Return Codes

RC_OK	measurement and values are OK
TMC_ANGLE_ERROR	Problems with angle res. incline sensor. A valid angle could not be measured. At repeated occur call service.
TMC_BUSY	TMC resource is locked respectively TMC task is busy. Repeat measurement.
RC_ABORT	Measurement through customer aborted.

Example Start a distance measure, perform measurement.

```
DIM iretCode  AS Integer
DIM iWaitTime AS Integer
DIM Coord     AS TMC_COORDINATE_Type
DIM lError    AS Logical
DIM lDone     AS Logical

ON ERROR RESUME NEXT  ' to get valid angle data
TMC_DoMeasure( TMC_DEF_DIST )
lDone  = FALSE
lError = FALSE
```

```
DO                     ' display measured values
  TMC_GetCoordinate( 5, Coord, iRetCode )
  SELECT CASE iRetCode
    CASE RC_OK
        'display all data
        'e.g. set lDone
    CASE ANGLE_OK
        ' display coordinate
    CASE ELSE
        'handle error
        lError = TRUE
  END SELECT
LOOP UNTIL lError OR lDone
TMC_DoMeasure( TMC_CLEAR )
```

6.3.6 TMC_GetAngle

Description Measure angles.

Declaration

```
TMC_GetAngle( Angles      AS TMC_ANGLE_Type,
              iReturnCode AS Integer )
```

Remarks The function measures the horizontal and vertical angle and the possibly belonging inclination, if the inclination compensation is on. If the compensation is off and no valid inclination is present, there may be a delay if the inclination can't be measured immediately. The correction values for the inclination can be calculated with several methods.

As long as no new measure program is started, the results can be read. Additional to the normal return codes `iReturnCode` delivers also informational return codes which will not interrupt program execution.

Parameters

`Angles`	`out`	result of measuring the angle
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_DoMeasure`

Additional Codes in `iReturnCode`

RC_OK	Execution successful.
TMC_NO_FULL_ CORRECTION	The results are not corrected by all active sensors. Angle data are available. This message is to be considers as warning.
TMC_ACCURACY_ GUARANTEE	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system. Angle data are available. You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.

Return Codes

RC_OK	angle OK
TMC_ANGLE_ERROR	Problems with angle res. incline sensor. A valid angle could not be measured. Angle data are not available. At repeated occur call service.
TMC_BUSY	TMC resource is locked respectively TMC task is busy. Angle data are not available. Repeat measurement.
RC_ABORT	Measurement through customer aborted.

Example Read the currently valid angle.

```
DIM Angles AS TMC_ANGLE_Type
DIM RetCode AS Integer

TMC_GetAngle( Angles, RetCode )
```

6.3.7 TMC_GetAngle_WInc

Description Measure angles with inclination control.

Declaration

```
TMC_GetAngle_WInc(
              iIncProg    AS Integer,
              Angle       AS TMC_ANGLE,
              iReturnCode AS Integer )
```

Remarks The function measures the horizontal and vertical angle and in dependence of the configuration, the inclination.

As far as no new measure program is started, the results can be read. Additional to the normal return codes `iReturnCode` delivers also informational return codes, which will not interrupt program execution.

Parameters

`iIncProg`	`in`	The manner of incline compensation. Following settings are possible:
		Incline Program / **Meaning**
		`TMC_MEA_INC` — get inclination (apriori sigma)
		`TMC_AUTO_INC` — get inclination with automatism (sensor/plane)
		`TMC_PLANE_INC` — get inclination always with plane
`Angle`	`out`	result of measuring the angle
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_DoMeasure, TMC_GetAngle`

Additional Codes in `iReturnCode`

`RC_OK`	Execution successful.
`TMC_NO_FULL_CORRECTION`	The results are not corrected by all active sensors. Angle data are available. This message is to be considers as warning.

TMC_ACCURACY_GUARANTEE	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system. Angle data are available. You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.

Return Codes

RC_OK	angle OK
TMC_ANGLE_ERROR	Problems with angle res. incline sensor. A valid angle could not be measured. Angle data are not available. At repeated occur call service.
TMC_BUSY	TMC resource is locked respectively TMC task is busy. Angle data are not available. Repeat measurement.
RC_ABORT	Measurement through customer aborted.

Example Read the currently valid angle.

```
DIM Angles   AS TMC_Angle
DIM iRetCode AS Integer

TMC_GetAngle_WInc(TMC_AUTO_INC, Angles,iRetCode)
```

6.3.8 TMC_QuickDist

Description Measure slope distance and angles.

Declaration

```
TMC_QuickDist(
            Angle       AS TMC_HZ_V_ANG_type,
            Dist        AS Distance,
            iReturnCode AS Integer )
```

Remarks The function measures the horizontal and vertical angle and in dependence of the configuration, the inclination.

The function waits until a new distance is measured and then it returns the angle and the slope-distance, but no co-ordinates. Is no distance available, then it returns the angle values (hz, v) and the corresponding return-code.

At the call of this function, a distance measurement will be started with the rapid-tracking measuring program. If the EDM is active with the standard tracking measuring program already, the measuring program will not be changed to rapid tracking. Generally if the EDM is not active, then the rapid tracking measuring program will be started, otherwise the used measuring program will not be changed.

In order to abort the current measuring program use the function `TMC_DoMeasure`.

This function is very good suitable for target tracking, where high data transfers are required.

Note:	Due to performance reasons the used inclination will be calculated (only if incline is activated). if the basic data for the incline calculation is exact, at least two forced incline measurements should be performed in between. The forced incline measurement is only necessary if the incline of the instrument because of measuring assembly has been changed. Use the function `TMC_GetAngle_WInc(TMC_MEA_INC, Angle)` for the forced incline measurement. (For the forced incline measurement, the instrument must be in stable state for more than 3sec.).

Parameters

`Angle`	`out`	measured Hz- and V-angle
`Distance`	`out`	measured slope-distance
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_DoMeasure, TMC_GetAngle`

Additional Codes in `iReturnCode`

RC_OK	Execution successful.
TMC_NO_FULL_ CORRECTION	The results are not corrected by all active sensors. Angle data are available. This message is to be considers as warning.
TMC_ACCURACY_ GUARANTEE	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system. Angle data are available. You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.
TMC_ANGLE_ERROR	Problems with angle res. incline sensor. A valid angle could not be measured. Angle data are not available. At repeated occur call service.
TMC_ANGLE_OK	Angle measuring data are valid, but no distance data available. (Possible reasons are: –time out period to short –target out of view) This message is to be considers as warning.
TMC_ANGLE_NO_ FULL_CORRECTION	Angle measuring data are valid, but not corrected by all active sensors. The distance data are not available. (Possible reasons are: -see return code TMC_ANGLE_OK) This message is to be considers as warning.

TMC_ANGLE_ ACCURACY_ GUARANTEE	Angle measuring data are valid, but the accuracy is not guarantee, because the result (angle) consisting of measuring data, which accuracy could not be verified by the system. The distance data are not available. (Possible reasons are: -see return code TMC_ANGLE_OK)
	This message is to be considers as info.
TMC_DIST_ERROR	Because of missing target point no distance data available, but the angle data are valid respectively available. Aim target point and try it again.
TMC_DIST_PPM	No distance measurement respectively no distance data because of wrong EDM settings. The angle data are valid. Set EDM –ppm and –mm to 0.

Return Codes

RC_OK	angle OK
TMC_ANGLE_ERROR	Problems with angle res. incline sensor.
	At repeated occur call service.
TMC_BUSY	TMC resource is locked respectively TMC task is busy. Angle data are not available. Repeat measurement.
RC_ABORT	Measurement through customer aborted.

Example Fast tracking with QuickDist. See example program TRACKING for more details.

```
DIM iRetCode AS Integer
DIM HzV      AS TMC_HZ_V_ANG_Type
DIM dDist    AS Distance

TMC_DoMeasure( TMC_CLEAR ) ' clear distances
```

```
' measurement loop
DO
    ' get measurement values
    TMC_QuickDist( HzV, dDist, iRetCode )
    IF iRetCode = RC_OK OR
       iRetCode = TMC_NO_FULL_CORRECTION OR
       iRetCode = TMC_ACCURACY_GUARANTEE THEN
        ' Angles and distance are valid
        ' ...
      ELSE
        ' only Angles are valid
        ' ...
        END IF
LOOP UNTIL ....

' terminate
TMC_DoMeasure( TMC_CLEAR ) ' stop measurement
```

6.3.9 TMC_GetSimpleMea

Description Gets the results of distance and angle measurement.

Declaration

```
TMC_GetSimpleMea(
     Angles       AS TMC_HZ_V_ANG_Type,
     dSlopeDist   AS Double,
     iReturnCode  AS Integer )
```

Remarks This function returns the angles and distance measurement data. The distance measurement will be set invalid afterwards. It is important to note that this command does not issue a new distance measurement.

If a distance measurement is valid the function ignores `WaitTime` and returns the results.

If no valid distance measurement is available and the distance measurement unit is not activated (by `TMC_DoMeasure` before the `TMC_GetSimpleMea` call) the `WaitTime` is also ignored and the angle measurement result is returned.

Information about distance measurement is returned in the return- code.

Parameters

`Angles`	`out`	result of measuring: the angles
`dSlopeDist`	`out`	slope distance [m]
`iReturnCode`	`out`	return code, see Additional Codes

See Also `TMC_DoMeasure`

Additional Codes in `iReturnCode`

`RC_OK`	Angle OK
`TMC_NO_FULL_ CORRECTION`	The results are not corrected by all active sensors. Angle and distance data are available. This message is to be considers as warning.
`TMC_ACCURACY_ GUARANTEE`	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system. Angle and distance data are available. You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.
`TMC_ANGLE_OK`	Angle values okay, but no valid distance. Perform a distance measurement.
`TMC_ANGLE_NO_ FULL_ CORRECTION`	No distance data available but angle data are valid. The return code is equivalent to the `TMC_NO_FULL_CORRECTION` and relates to the angle data. Perform a distance measurement first before you call this function.

TMC_ANGLE_ACCURACY _GUARANTEE	No distance data available but angle data are valid. The return code is equivalent to the TMC_ACCURACY_GUARANTEE and relates to the angle data.
TMC_DIST_ERROR	No measuring, because of missing target point, angle data are available but distance data are not available. Aims target point and try it again.
TMC_DIST_PPM	No distance measurement respectively no distance data because of wrong EDM settings. Angle data are available but distance data are not available. Set EDM –ppm and -mm to 0.

Return Codes

RC_OK	Angle OK
TMC_ANGLE_ERROR	Problems with angle res. incline sensor. A valid angle could not be measured. Distance and angle data are not available. At repeated occur call service.
TMC_BUSY	TMC resource is locked respectively TMC task is busy. Distance and angle data are not available. Repeat measurement.
RC_ABORT	Measurement aborted.

Example This example measures the slope distance and angles.

```
DIM Angle   AS Double
DIM dSlope  AS Double
DIM RetCode AS Integer

TMC_GetSimpleMea( Angle, dSlope, RetCode )
```

6.3.10 TMC_Get/SetAngleFaceDef

Description Gets and sets the current face definition.

Declaration

```
TMC_GetAngleFaceDef( eFaceDef  AS Integer )

TMC_SetAngleFaceDef(
            byVal eFaceDef  AS Integer )
```

Remarks

Note	No distance may exist for setting the face definition. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

`eFaceDef`	`out/in`	`TMC_FACE_NORMAL` or `TMC_FACE_TURN`

See Also -

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results) or a distance exists

Example The example reads the current definition and sets the opposite one.

```
DIM face  AS TMC_FACE_DEF

TMC_GetAngelFaceDef(face)
IF (face = TMC_FACE_NORMAL) THEN
  TMC_SetAngelFaceDef(TMC_FACE_TURN)
ELSE
  TMC_SetAngelFaceDef(TMC_FACE_NORMAL)
END IF
```

6.3.11 TMC_Get/SetHzOffset

Description Gets and sets the current horizontal offset.

Declaration `TMC_GetHzOffset( dHzOffset AS Double )`

`TMC_SetHzOffset( byVal dHzOffset AS Double )`

Remarks

Note	No distance may exist for setting the Hz-offset. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

`dHzOffset`	`out/in`	Horizontal offset in radiant.

See Also -

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results) or a distance exists

Example The example reads the current offsets and sets it to an increased value.

```
DIM off  AS Double

TMC_GetHzOffset ( off )
TMC_SetHzOffset ( off + 1.0 )
```

6.3.12 TMC_Get/SetDistPpm

Description Gets and sets the correction values for distance measurements.

Declaration

```
TMC_GetDistPpm( PpmCorr  AS
TMC_PPM_CORR_Type)

TMC_SetDistPpm( PpmCorr  AS
TMC_PPM_CORR_Type)
```

Parameters

`PpmCorr`	`out/in`	Correction value for distance measurement.

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	TMC is in use and can not be changed.

Example -

6.3.13 TMC_Get/SetHeight

Description Gets and sets the current height of the reflector.

Declaration

```
TMC_GetHeight (        Height  AS Double )
TMC_SetHeight ( byVal Height  AS Double )
```

Parameters

`Height`	`out/in`	Height of reflector in Meters.

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results)

Example The example sets the reflectors height to the value of 1.0 m.

```
TMC_SetHeight ( 1.0 )
```

6.3.14 TMC_Get/SetRefractiveCorr

Description Gets and sets the refractive correction for measuring the distance.

Declaration

```
TMC_GetRefractiveCorr (
    Refraction AS TMC_REFRACTION_Type)

TMC_SetRefractiveCorr (
    Refraction AS TMC_REFRACTION_Type)
```

Parameters

`Refraction`	`out/in`	Refraction correction value(s).

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results)

Example -

6.3.15 TMC_Get/SetRefractiveMethod

Description Gets and sets the method of refractive correction for measuring the distance.

Declaration

```
TMC_GetRefractiveMethod (
          Method  AS Integer )

TMC_SetRefractiveMethod (
    byVal Method  AS Integer )
```

Parameters

`Method`	`out/in`	Method of refraction calculation: 1: method 1 2: method 2 else: undefined

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results)

6.3.16 TMC_Get/SetStation

Description Gets and sets station co-ordinates.

Declaration

```
TMC_GetStation (
          Station  AS TMC_STATION_Type )

TMC_SetStation (
          Station  AS TMC_STATION_Type )
```

Remarks

Note	No distance may exist for setting a new station. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

`Station`	`out/in`	Station co-ordinates.

Return Codes

`RC_OK`	Completed successfully.
`TMC_BUSY`	measurement system is busy (no valid results) or a distance exists.

Example -

6.3.17 TMC_IfDistTapeMeasured

Description Gets information about manual measurement.

Declaration

```
TMC_IfDistTapeMeasured (
          bTapeMeasured  AS Logical )
```

Parameters

`bTapeMeasured`	`out`	TRUE: if measurement has been done by hand. FALSE: if measurement has been done with EDM or if invalid.

Return Codes

`RC_OK`	Completed successfully.

Example -

6.3.18 TMC_SetHandDist

Description Sets distance manually.

Declaration

```
TMC_SetHandDist(
        byVal dSlopeDistance  AS Double,
        byVal dHgtOffset      AS Double )
```

Parameters

dSlopeDistance	in	slope distance [m]
dHgtOffset	in	Height to measured point. [m]

See Also -

Return Codes

RC_OK	Execution successful.
TMC_NO_FULL_ CORRECTION	The results are not corrected by all active sensors. This message is to be considers as warning.
TMC_ACCURACY_ GUARANTEE	Accuracy is not guaranteed, because the result consisting of measuring data which accuracy could not be verified by the system You can a forced incline measurement perform or switch off the incline. This message is to be considers as info.
TMC_ANGLE_ERROR	Problems with angle res. incline sensor. A valid angle could not be measured. At repeated occur call service.

`TMC_BUSY`	TMC resource is locked respectively TMC task is busy. Repeat measurement.
`RC_ABORT`	Measurement through customer aborted.
`RC_IVPARAM`	Invalid parameter

Example -

6.3.19 TMC_SetDistSwitch

Description Defines the distance measurement correction switches.

Declaration

```
TMC_SetDistSwitch(
        Switches AS TMC_DIST_SWITCH_Type )
```

Remarks This procedure sets the distance measurement correction switches.

Parameters

`Switches`	`in`	Distance switches

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_GetDistSwitch`

6.3.20 TMC_GetDistSwitch

Description Returns the distance measurement correction switches.

Declaration

```
TMC_GetDistSwitch(
        Switches AS TMC_DIST_SWITCH_Type )
```

Remarks This procedure returns the distance measurement correction switches.

Parameters

`Switches`	`out`	Distance switches

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_SetDistSwitch`

6.3.21 TMC_SetOffsetDist

Description Defines the distance measurement offset.

Declaration

```
TMC_SetOffsetDist(
        Offsets AS TMC_OFFSET_DIST_Type )
```

Remarks This procedure defines the offset to the prism pole. The `dLengthVal` defines the offset away from the prism pole, positive means in the line from instrument to prism. `dCrossVal` means right from the prism pole and `dHeightVal` means higher than prism pole.

Remarks

Note	No distance may exist for offset setting.. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

`Offsets`	`in`	Target point offset

Return-Codes

`RC_OK`	Successful termination.
`TMC_BUSY`	measurement system is busy (no valid results) or a distance exists.

See Also `TMC_GetOffsetDist`, `BAP_Offset`, `TMC_IfOffsetDistMeasured`

6.3.22 TMC_GetOffsetDist

Description Returns the distance measurement offset.

Declaration
```
TMC_GetOffsetDist(
        Offsets AS TMC_OFFSET_DIST_Type )
```

Remarks This procedure returns the actual offset to the prism pole. The `dLengthVal` defines the offset away from the prism pole, positive means in the line from instrument to prism. `dCrossVal` means right from the prism pole and `dHeightVal` means higher than prism pole.

Parameters

`Offsets`	`out`	Target point offset

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_SetOffsetDist`, `BAP_Offset`, `TMC_IfOffsetDistMeasured`

6.3.23 TMC_IfOffsetDistMeasured

Description Returns the EDM measurement mode.

Declaration
```
TMC_IfOffsetDistMeasured(
                lOffset AS Logical )
```

Remarks This function returns TRUE if an offset is defined.

Parameters

`lOffset`	`out`	Offset is valid

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_SetOffsetDist`, `TMC_GetOffsetDist`, `BAP_Offset`

6.3.24 TMC_GetFace1

Description Get face information of current telescope position.

Declaration `TMC_GetFace1( lFace1 AS Logical )`

Remarks This function returns the face information of the current telescope position. The face information is only valid, if the instrument is in an active measurement state (that means a measurement function was called before the `TMC_GetFace1` call). Note that the instrument automatically turns into an inactive measurement state after a predefined timeout.

Parameters

`lFace1`	`out`	`TRUE`: Face I `FALSE`: Face II

Return-Codes

`RC_OK`	Successful termination.

6.3.25 TMC_SetAngSwitch

Description Defines the angle measurement correction switches.

Declaration
```
TMC_SetAngSwitch(
       Switches AS TMC_ANG_SWITCH_Type )
```

Remarks This procedure sets the angle measurement correction switches.

> **Note** No distance may exist for setting the angle switches. Call `TMC_DoMeasure( TMC_CLEAR )` before this function.

Parameters

`Switches`	`in`	angular switches

Return-Codes

`RC_OK`	Successful termination.
`TMC_BUSY`	A distance exists

See Also `TMC_GetAngSwitch`

Example Change switches

```
DIM AngSwitches AS TMC_ANG_SWITCH_Type

TMC_DoMeasure( TMC_CLEAR ) ' clear distances
TMC_GetAngSwitch( AngSwitches )
AngSwitches.lInclineCorr = TRUE
AngSwitches.lCollimationCorr = FALSE
TMC_SetAngSwitch( AngSwitches )
```

6.3.26 TMC_GetAngSwitch

Description Returns the angle measurement correction switches.

Declaration

```
TMC_GetAngSwitch(
        Switches AS TMC_ANG_SWITCH_Type )
```

Remarks This procedure returns the actual angle measurement correction switches.

Parameters

`Switches`	`in`	Angular switches

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_SetAngSwitch`

6.3.27 TMC_SetInclineSwitch

Description Defines the compensator switch.

Declaration `TMC_SetAngSwitches( lOn AS Logical )`

Remarks This procedure enables or disables the dual axis compensator correction.

Note	No distance may exist for a switch setting.. Call `TMC_DoMeasure(TMC_CLEAR)` before this function.

Parameters

`lOn`	`in`	Switch

Return-Codes

`RC_OK`	Successful termination.
`TMC_BUSY`	A distance exists

See Also `TMC_GetInclineSwitch`

6.3.28 TMC_GetInclineSwitch

Description Returns the compensator switch.

Declaration `TMC_GetInclineSwitches( lOn AS Logical )`

Remarks This procedure returns the dual axis compensator correction state.

Parameters

`lOn`	`out`	Switch

Return-Codes

`RC_OK`	Successful termination.

See Also `TMC_SetInclineSwitch`

6.3.29 TMC_GetInclineStatus

Description Returns the inclination compensator status.

Declaration `TMC_GetInclineStatus( iStatus AS Integer )`

Remarks This procedure returns status of the inclination sensor.

Parameters

`iStatus`	`out`	`TMC_INC_OFF`	Incline-sensor is switched off
		`TMC_INC_OK`	Inclination is ok, recording is allowed
		`TMC_INC_TILT`	Incline-sensor is out of working area
		`TMC_INC_OLD`	Incline-values are not yet updated

TMC_INC_FAIL	Inclination - measurement fails

Return-Codes

RC_OK	Successful termination.

See Also TMC_SetInclineSwitch

Example See example file „meas.gbs".

6.4 FUNCTIONS FOR GSI

6.4.1 Summarizing Lists of GSI Types and Procedures

6.4.1.1 Types

type name	description
Wi_List	Array of GSI_WiDlg_Entry_Type.
GSI_Point_Coord_Type	Point co-ordinate data.
GSI_Rec_Id_List	Record mask array of integers (indicating WI–identifications)
GSI_WiDlg_Entry_Type	Dialog entry information.

6.4.1.2 Procedures

procedure name	description
GSI_Coding	Starts the active coding function of the TPS system.
GSI_CheckTracking	Returns if distance tracking is running.
GSI_CreateMDlg	Creates and shows the user definable measurement dialog.
GSI_DefineMDlg	Defines the entries of the user definable measurement dialog.
GSI_DefineRecMaskDlg	Defines the recording mask dialog.
GSI_ExecuteAutoDist	Executes an automatic distance measurement.
GSI_ExecQCoding	Executes the Quick-Coding.
GSI_GetDataPath	Get the name of the file with the import data.
GSI_GetIndivNr	Fetches the individual point number.
GSI_GetLineSysMDlg	Gets the definition of a line in the system measurement dialog.
GSI_GetMDlgNr	Returns the number of the system measurement dialog.
GSI_GetQCodeAvailable	This routine returns the status for Quick-

procedure name	**description**
	Coding.
GSI_GetRecMask	Get the definition and the format of a recording mask.
GSI_GetRecMaskNr	Returns the used recording mask.
GSI_GetRecOrder	Returns the recording order for Quick-Coding.
GSI_GetRecPath	Returns the recording path
GSI_GetRunningNr	Fetches the running point number and the increment.
GSI_GetWiEntry	Get data from the Theodolite data pool.
GSI_ImportCoordDlg	Show the co-ordinate import dialog.
GSI_IncPNumber	Automatically point number increment.
GSI_IsRunningNr	Queries if running number is being used.
GSI_ManCoordDlg	Show the manual co-ordinate input dialog.
GSI_Measure	Entry point for measure and registration dialog (measure and registration).
GSI_QuickSet	Show the Quickset dialog
GSI_RecordRecMask	Recording the given `wi` mask.
GSI_SelectCode	This routine shows the codelist-coding dialog.
GSI_SetDataPath	Set the file with the import data.
GSI_SetIndivNr	Sets the individual point number.
GSI_SetIvPtNrStatus	Switches the individual point number mode on/off.
GSI_SetLineMDlg	Sets one line in the user definable measurement dialog to system parameter.
GSI_SetLineMDlgPar	Sets a line in the user definable measurement dialog to an application parameter.
GSI_SetLineMDlgText	Puts a textline into the user definable measurement dialog.
GSI_SetLineSysMDlg	Sets a line in the system measurement dialog.
GSI_SetMDlgNr	Sets the number of the system measurement dialog.

procedure name	description
GSI_SetQCodeMode	Sets the Quick-Coding mode.
GSI_SetRecMask	Set the definition and the format of a recording mask.
GSI_SetRecMaskNr	Set the used recording mask.
GSI_SetRecOrder	Sets the recording order for Quick-Coding.
GSI_SetRecPath	Defines the recording path
GSI_SetRunningNr	Sets the running point number and increment.
GSI_SetWiEntry	Set data to the Theodolite data pool.
GSI_UpdateMDlg	Updates the user definable measurement dialog.
GSI_UpdateMeasurment	Update the measurement data.

6.4.2 Constants for WI values

Definitions for WI values:

Name	Data Type	Meaning
GSI_ID_PTNR	String	Point number
GSI_ID_FNR	Double	Serial number
GSI_ID_TYPE	String	Device type
GSI_ID_TIME_1	String	First time art
GSI_ID_TIME_2	String	Second time art
GSI_ID_HZ	Double	Horizontal angle
GSI_ID_V	Double	Vertical angle
GSI_ID_NHZ	Double	Nominal horizontal angle
GSI_ID_DHZ	Double	Difference horizontal angle
GSI_ID_NV	Double	Nominal vertical angle
GSI_ID_DV	Double	Difference vertical angle
GSI_ID_SLOPE	Double	Slope distance

Name	Data Type	Meaning
GSI_ID_HOR	Double	Horizontal distance
GSI_ID_HGT	Double	Height difference
GSI_ID_NHOR	Double	Nominal horizontal distance
GSI_ID_DHOR	Double	Difference horizontal distance
GSI_ID_NHGT	Double	Nominal height difference
GSI_ID_DHGT	Double	Difference height difference
GSI_ID_NSLOPE	Double	Nominal slope distance
GSI_ID_DSLOPE	Double	Difference slope distance
GSI_ID_CODE	String	Code information
GSI_ID_CODE_1	String	Information 1
GSI_ID_CODE_2	String	Information 2
GSI_ID_CODE_3	String	Information 3
GSI_ID_CODE_4	String	Information 4
GSI_ID_CODE_5	String	Information 5
GSI_ID_CODE_6	String	Information 6
GSI_ID_CODE_7	String	Information 7
GSI_ID_CODE_8	String	Information 8
GSI_ID_PPMM	String	mm and ppm
GSI_ID_SIGMA	String	Distance count and deviation
GSI_ID_MM	Double	mm
GSI_ID_PPM	Double	ppm
GSI_ID_REM_1	String	Remark 1
GSI_ID_REM_2	String	Remark 2
GSI_ID_REM_3	String	Remark 3
GSI_ID_REM_4	String	Remark 4
GSI_ID_REM_5	String	Remark 5
GSI_ID_REM_6	String	Remark 6
GSI_ID_REM_7	String	Remark 7
GSI_ID_REM_8	String	Remark 8
GSI_ID_REM_9	String	Remark 9
GSI_ID_E	Double	East co-ordinate

Name	Data Type	Meaning
GSI_ID_N	Double	North co-ordinate
GSI_ID_H	Double	Height
GSI_ID_E0	Double	East station co-ordinate
GSI_ID_N0	Double	North station co-ordinate
GSI_ID_H0	Double	Station height
GSI_ID_HR	Double	Reflector height
GSI_ID_HI	Double	Instrument height
GSI_ID_INDIV	String	Individual point number
GSI_ID_PTLA	String	Number of the last recorded point
GSI_ID_STEP	Double	Increment of the running point number
GSI_ID_SPTNR	String	Station point number
GSI_ID_SHZ	Double	Hz angle with no sign change
GSI_ID_CD_DSC	String	Code description
GSI_ID_PTCD_DSC	String	Point code description
GSI_ID_PV_CD	String	Preview code
GSI_ID_PV_PTCD	String	Preview point code
GSI_ID_ACT_PTID	String	Actual point ID
GSI_ID_BACKID	String	Backside ID
GSI_ID_APPDATA0	String/Double	Application data 0
GSI_ID_APPDATA1	String/Double	Application data 1
GSI_ID_APPDATA2	String/Double	Application data 2
GSI_ID_APPDATA3	String/Double	Application data 3
GSI_ID_APPDATA4	String/Double	Application data 4
GSI_ID_APPDATA5	String/Double	Application data 5
GSI_ID_APPDATA6	String/Double	Application data 6
GSI_ID_APPDATA7	String/Double	Application data 7
GSI_ID_APPDATA8	String/Double	Application data 8
GSI_ID_APPDATA9	String/Double	Application data 9
GSI_ID_APPDATA10	String/Double	Application data 10
GSI_ID_APPDATA11	String/Double	Application data 11
GSI_ID_FS_SCALE	Double	Free station scale

Name	Data Type	Meaning
GSI_ID_EMPTY		Blank line
GSI_ID_NONE		End mark
GSI_ID_UNKNOWN		Unknown WI

6.4.3 Constants for Measurement Dialog Definition

Definition of (user definable) application parameters for measurement dialogs, either Double or String. See also `GSI_SetLineMDlgPar` and `GSI_SetLineMDlgText`.

Name	Meaning
GSI_PAR_AppData0	Application parameter 0
GSI_PAR_AppData1	Application parameter 1
GSI_PAR_AppData2	Application parameter 2
GSI_PAR_AppData3	Application parameter 3
GSI_PAR_AppData4	Application parameter 4
GSI_PAR_AppData5	Application parameter 5
GSI_PAR_AppData6	Application parameter 6
GSI_PAR_AppData7	Application parameter 7
GSI_PAR_AppData8	Application parameter 8
GSI_PAR_AppData9	Application parameter 9
GSI_PAR_AppData10	Application parameter 10

Name	Meaning
GSI_PAR_AppData11	Application parameter 11

Definition of system (defined) parameters for measurement dialogs. See also GSI_SetLineSysMDlg and GSI_SetLineMDlg.

Name	Meaning
GSI_PAR_AddConst	Prism constant
GSI_PAR_Attrib1	Point Code Attribute 1
GSI_PAR_Attrib2	Point Code Attribute 2
GSI_PAR_Attrib3	Point Code Attribute 3
GSI_PAR_Attrib4	Point Code Attribute 4
GSI_PAR_Attrib5	Point Code Attribute 5
GSI_PAR_Attrib6	Point Code Attribute 6
GSI_PAR_Attrib7	Point Code Attribute 7
GSI_PAR_Attrib8	Point Code Attribute 8
GSI_PAR_AvgMeasNo	Maximal number of distance measurements of the average mode
GSI_PAR_BacksideId	Last used Backside
GSI_PAR_Code	Last used Code
GSI_PAR_CodeDescr	Last used free Code Description
GSI_PAR_CodeList	Codelist management (select, create etc)
GSI_PAR_CodeListSelect	Codelist selection (of an existing codelist)
GSI_PAR_DataJobSelect	Data job selection (of an existing job)
GSI_PAR_Date	Current date of the instrument. The displayed format depends on the setting of the parameter "Date form."
GSI_PAR_DisplayMask	Select display mask for standard measuring dialog. Max. 3 displaymasks can be defined for this dialog. The displaymasks can also be changed with the system function "Next Displaymask".
GSI_PAR_DataJob	Data job management (select, create etc)
GSI_PAR_TargetEast	Target point Easting
GSI_PAR_DistMeasProg	EDM measurement program selection.

Name	Meaning
	Attention: The available measurement programs depends on the selected target type and on the instrument type
GSI_PAR_TargetElev	Target point Elevation
GSI_PAR_ElevDiff	Elevation difference
GSI_PAR_HalfLineSpace	This item can be used to display a half line space in order to separate or group lines on instrument screen.
GSI_PAR_DistHoriz	Horizontal distance
GSI_PAR_AngleHz	Hz-Angle
GSI_PAR_PointIdIncr	defines the increment step. It is used to increment the Target Point Id after recording a target point.
GSI_PAR_IndivPointId	Individual point identifier
GSI_PAR_Info1	Shows the Free Code Info 1
GSI_PAR_Info2	Shows the Free Code Info 2
GSI_PAR_Info3	Shows the Free Code Info 3
GSI_PAR_Info4	Shows the Free Code Info 4
GSI_PAR_Info5	Shows the Free Code Info 5
GSI_PAR_Info6	Shows the Free Code Info 6
GSI_PAR_Info7	Shows the Free Code Info 7
GSI_PAR_Info8	Shows the Free Code Info 8
GSI_PAR_InstrHeight	Instrument Height (hi)
GSI_PAR_LastPointId	Last recorded target point identifier
GSI_PAR_MeasJobSelect	Measurement Job selection (of an existing Job or RS232 for online recording)
GSI_PAR_MeasJob	Measurement Job management (select, create, etc.)
GSI_PAR_NS	Number of measurements and standard deviation
GSI_PAR_TargetNorth	Target point Northing
GSI_PAR_OffsetCross	Cross Offset
GSI_PAR_OffsetElev	Offset Elevation

Name	Meaning
GSI_PAR_OffsetLength	Offset Length
GSI_PAR_OffsetMode	Defines the resetting of the offset
GSI_PAR_PointCode	Actual Feature Code
GSI_PAR_PointId	Actual Target point identifier, running or individual. The Value and the display text changes if an individual number is set.
GSI_PAR_PpmAtm	ppm atmospheric
GSI_PAR_PpmGeom	ppm geometric
GSI_PAR_PpmTotal	Total ppm
GSI_PAR_PpmMm	Total ppm and prism constant
GSI_PAR_PrevCode	Shows the second last used Code
GSI_PAR_PrevPointCode	Last used Feature Code
GSI_PAR_PointCodeDescr	Shows the Point Code Description of the actual Feature Code
GSI_PAR_RecMask	Selected Recording mask for target point measurements
GSI_PAR_ReflHeight	Reflector height (hr)
GSI_PAR_ReflName	Used reflector type
GSI_PAR_ReflSelection	reflector type selection. If there are user defined prism, then they will be added to this list. The User Refl1..User Refl3 are only valid, if these user definable prisms are defined.
GSI_PAR_RunningPointId	Running target point identifier
GSI_PAR_DistSlope	Slope distance
GSI_PAR_StationId	Identifies the Station
GSI_PAR_StationEast	Station Easting
GSI_PAR_StationElev	Station Elevation
GSI_PAR_StationNorth	Station Northing
GSI_PAR_TargetType	Definition of the target type (Reflector / reflectorless)
GSI_PAR_Time	Current time of the instrument. The displayed format depends on the setting of the parameter "Time form."

Name	Meaning
`GSI_PAR_AngleV`	V-Angle
`GSI_PAR_VangleFormat`	Vertical angle display format:Zenith angle = 0gon for zenith, angles are positive, Elev. angle = 0gon for horizontal, (+) above horizont and (-) below horizont. Elev.angle% = 0% for horizont, 100% for 50gon. V-angle is displayed (+) above and (-) below horizont but as percentage of the gradient.
`GSI_PAR_NONE`	Designates a line that is unused.

6.4.4 Relationship of GSI_ID's to GSI_PAR's

In general we can distinguish between two data value pools who are able to store values in it. Some of theses values are shared between the two pools.

GSI_ID_-Ids describe the values which can be stored and requested in the (WI) data value pool. GSI_PAR_-Ids describe the values which can be used for displaying in a measurement dialog. Their sets of id's are not associated directly in all cases. Moreover their sets of Id's can be distinguished in their meaning.

Association in this context means that both pools, the data value pool and the data display pool, share their values directly. Nonassociated values are unique to either the data value pool or the data display pool.

Many of the GSI_IDs are record-able. Two types of record-able Ids can be distinguished:

a) Measurement block ("Meas") (has to start with a GSI_ID_PTNR)

b) Code block ("Code") (has to start with a GSI_ID_CODE)

They may not be mixed.

Record-able	GSI_ID_-Ids	GSI_PAR_-Ids
	`GSI_ID_NHZ`	
	`GSI_ID_DHZ`	
	`GSI_ID_NV`	

	GSI_ID_DV	
	GSI_ID_NHOR	
	GSI_ID_DHOR	
	GSI_ID_NHGT	
	GSI_ID_DHGT	
	GSI_ID_NSLOPE	
	GSI_ID_DSLOPE	
	GSI_ID_INDIV	GSI_PAR_IndivPointId
	GSI_ID_PTLA	GSI_PAR_LastPointId
	GSI_ID_STEP	GSI_PAR_PointIdIncr
	GSI_ID_SPTNR	GSI_PAR_StationId
	GSI_ID_SHZ	
	GSI_ID_CD_DSC	GSI_PAR_CodeDescr
	GSI_ID_PTCD_DSC	GSI_PAR_PointCodeDescr
	GSI_ID_PV_CD	GSI_PAR_PrevCode
	GSI_ID_PV_PTCD	GSI_PAR_PrevPointCode
	GSI_ID_ACT_PTID	GSI_PAR_PointId
	GSI_ID_BACKID	GSI_PAR_BackSideId
Meas	GSI_ID_PTNR	GSI_PAR_RunningPointId
Meas	GSI_ID_FNR	GSI_PAR_SerialNr (undefined)
Meas	GSI_ID_TYPE	GSI_PAR_InstrType (undefined)
Meas	GSI_ID_TIME_1	See GSI_PAR_Date
Meas	GSI_ID_TIME_2	See GSI_PAR_Time
Meas	GSI_ID_HZ	GSI_PAR_AngleHz
Meas	GSI_ID_V	GSI_PAR_AngleV
Meas	GSI_ID_SLOPE	GSI_PAR_DistSlope
Meas	GSI_ID_HOR	GSI_PAR_DistHoriz
Meas	GSI_ID_HGT	GSI_PAR_ElevDiff
Meas	GSI_ID_PPMM	GSI_PAR_PpmMm
Meas	GSI_ID_SIGMA	GSI_PAR_NS

Meas	GSI_ID_MM	GSI_PAR_AddConst
Meas	GSI_ID_PPM	GSI_PAR_PpmTotal
Meas	GSI_ID_REM_1	GSI_PAR_Info1
Meas	GSI_ID_REM_2	GSI_PAR_Info2
Meas	GSI_ID_REM_3	GSI_PAR_Info3
Meas	GSI_ID_REM_4	GSI_PAR_Info4
Meas	GSI_ID_REM_5	GSI_PAR_Info5
Meas	GSI_ID_REM_6	GSI_PAR_Info6
Meas	GSI_ID_REM_7	GSI_PAR_Info7
Meas	GSI_ID_REM_8	GSI_PAR_Info8
Meas	GSI_ID_REM_9	GSI_PAR_Info9
Meas	GSI_ID_E	GSI_PAR_TargetEast
Meas	GSI_ID_N	GSI_PAR_TargetNorth
Meas	GSI_ID_H	GSI_PAR_TargetElev
Meas	GSI_ID_E0	GSI_PAR_StationEast
Meas	GSI_ID_N0	GSI_PAR_StationNorth
Meas	GSI_ID_H0	GSI_PAR_StationElev
Meas	GSI_ID_HR	GSI_PAR_ReflHeight
Meas	GSI_ID_HI	GSI_PAR_InstrHeight
Code	GSI_ID_CODE	GSI_PAR_Attrib1
Code	GSI_ID_CODE_1	GSI_PAR_Attrib2
Code	GSI_ID_CODE_2	GSI_PAR_Attrib3
Code	GSI_ID_CODE_3	GSI_PAR_Attrib4
Code	GSI_ID_CODE_4	GSI_PAR_Attrib5
Code	GSI_ID_CODE_5	GSI_PAR_Attrib6
Code	GSI_ID_CODE_6	GSI_PAR_Attrib7
Code	GSI_ID_CODE_7	GSI_PAR_Attrib8
Code	GSI_ID_CODE_8	GSI_PAR_Attrib9

`GSI_ID_APPDATA0` are for the purpose of exchanging data between applications and between application and MDlg. They cannot be recorded. Both can be of the form `GSI_ASCII` or `GSI_DOUBLE`.

	GSI_ID_APPDATA0	GSI_PAR_APPDATA0
	GSI_ID_APPDATA1	GSI_PAR_APPDATA1
	GSI_ID_APPDATA2	GSI_PAR_APPDATA2
	GSI_ID_APPDATA3	GSI_PAR_APPDATA3
	GSI_ID_APPDATA4	GSI_PAR_APPDATA4
	GSI_ID_APPDATA5	GSI_PAR_APPDATA5
	GSI_ID_APPDATA6	GSI_PAR_APPDATA6
	GSI_ID_APPDATA7	GSI_PAR_APPDATA7
	GSI_ID_APPDATA8	GSI_PAR_APPDATA8
	GSI_ID_APPDATA9	GSI_PAR_APPDATA9
	GSI_ID_APPDATA10	GSI_PAR_APPDATA10
	GSI_ID_APPDATA11	GSI_PAR_APPDATA11

Special Ids

	GSI_ID_NONE	
	GSI_ID_EMPTY	
	GSI_ID_UNKNOWN	
		GSI_PAR_NONE

The set of GSI_PAR-ids is not complete in this table. There exist several more Ids, which can be used for displaying.

6.4.5 Data Structures for GSI Functions

GSI_WiDlg_Entry_Type: Dialog entry information

Description This data structure is used to store information about the entries (data fields) of the WI dialog.

```
TYPE GSI_WiDlg_Entry_Type
  iId          AS Integer
```

The identifier of the dialog entry. For possible value see WI constants.

iDataType	AS Integer	The type of the date stored in dValue or sValue. For possible value see table below.

AS iDataType	**Meaning**
GSI_ASCII	ASCII data (stored in sValue)
GSI_ASCII_SIGN	signed ASCII data (stored in sValue)
GSI_DOUBLE	double data (stored in dValue)

lValid	AS Logical	TRUE if the value is valid.
dValue	AS Double	Data if value is of type Double.
sValue	AS String10	Data if value is of type String.

END GSI_WiDlg_Entry_Type

Wi_List: **An array of GSI_WiDlg_Entry_Type**

Description This array consists of GSI_MAX_REC_WI elements of the type GSI_WiDlg_Entry_Type.

GSI_Rec_Id_List: **An array of integers (indicating WI–identifications)**

Description This array consists of GSI_MAX_REC_WI elements of the type Integer. It is used to define the recorded values (recmask).

GSI_Point_Coord_Type: **Point co-ordinate data**

Description This data structure is used to store a point name and its co-ordinates.

TYPE GSI_Point_Coord_Type

sPtNr	AS String10	point number
dEast	AS Double	east co-ordinate
dNorth	AS Double	north co-ordinate
dHeight	AS Double	height co-ordinate
lPtNrValid	AS Logical	TRUE if point number is valid
lEValid	AS Logical	TRUE if east co-ordinate is valid
lNValid	AS Logical	TRUE if north co-ordinate is valid

`lHValid`	`AS Logical`	`TRUE` if height co-ordinate is valid

`END GSI_Point_Coord_Type`

6.4.6 GSI_GetRunningNr

Description Fetches the running point number and the increment.

Declaration

```
GSI_GetRunningNr( sPntId   AS String20,
                  sPntIncr AS String20 )
```

Remarks Fetches the running point number and increment for it.

Parameters

`sPntId`	`out`	the running point number
`sPntIncr`	`out`	the increment for the running point number

See Also `GSI_SetRunningNr`, `GSI_GetIndivNr`, `GSI_SetIndivNr`, `GSI_IsRunningNr`

Return-Codes

`RC_OK`	successful

Example

```
DIM sPntId  AS String20
DIM sPntInc AS String20

GSI_GetRunningNr( sPntId, sPntInc )
```

6.4.7 GSI_SetRunningNr

Description Sets the running point number and increment.

Declaration
```
GSI_SetRunningNr(
                 BYVAL sPntId   AS String20,
                 BYVAL sPntIncr AS String20 )
```

Remarks Sets the running point number and the increment for it. The running point number mode is switched on.

Parameters

sPntId	in	The user running point number.
sPntIncr	in	The increment for the user point running number.

See Also GSI_GetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr, GSI_IsRunningNr

Return-Codes

RC_OK	successful

Example
```
DIM sPntId  AS String20
DIM sPntInc AS String20

GSI_SetRunningNr( sPntId, sPntInc )
```

6.4.8 GSI_ GetIndivNr

Description Fetches the individual point number.

Declaration
```
GSI_GetIndivNr( sPntId AS String20 )
```

Remarks Fetches the individual point number.

Parameters

sPntId	out	The user-defined individual point number.

See Also GSI_GetRunningNr, GSI_SetRunningNr, GSI_SetIndivNr, GSI_IsRunningNr

Return-Codes

`RC_OK`	successful

Example

```
DIM sPntId AS String20

GSI_GetIndivNr( sPntId )
```

6.4.9 GSI_SetIndivNr

Description Sets the individual point number.

Declaration `GSI_SetIndivNr( BYVAL sPntId AS String20 )`

Remarks Sets the individual point number. After this call, the running point number mode is switched to the individual point number. This mode will be active until replaced by a running number or until the next save.

Parameters

`sPntId`	`in`	The user-defined individual point number.

See Also `GSI_GetRunningNr`, `GSI_SetRunningNr`, `GSI_GetIndivNr`, `GSI_IsRunningNr`

Return-Codes

`RC_OK`	successful

Example

```
DIM sPntId AS String20

GSI_SetIndivNr( sPntId )
```

6.4.10 GSI_IsRunningNr

Description Queries if running number is being used.

Declaration `GSI_IsRunningNr( lRunningOn AS Logical )`

Remarks If the running number is active the parameter will forced to `TRUE` otherwise to `FALSE`.

Parameters

`lRunningOn`	`out`	information about the running point number

See Also `GSI_GetRunningNr, GSI_SetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr`

Return-Codes

`RC_OK`	successful

Example

```
DIM lRunningOn AS Logical

GSI_IsRunningNr( lRunningOn )
```

6.4.11 GSI_SetIvPtNrStatus

Description Switches the individual point number mode on/off.

Declaration

```
GSI_SetIvPtNrStatus(
                   BYVAL lSwitch AS Logical )
```

Remarks Switch the individual point number on or off. When point number is shown in the display the number will change.

Parameters

`lSwitch`	`in`	switch for the individual point-number (`TRUE` = `on`, `FALSE` = `off`)

See Also `GSI_GetRunningNr, GSI_SetRunningNr, GSI_GetIndivNr, GSI_SetIndivNr, GSI_IsRunningNr`

Return-Codes

`RC_OK`	successful

Example

```
GSI_SetIvPtNrStatus( FALSE )
```

6.4.12 GSI_IncPNumber

Description Automatically point number increment.

Declaration `GSI_IncPNumber()`

Remarks This function increments the running alphanumeric point number.

Parameters none

See Also `GSI_GetRunningNr`, `GSI_SetRunningNr`, `GSI_GetIndivNr`, `GSI_SetIndivNr`

Return Codes

`RC_IVRESULT`	Point number is not incremented, possible reasons could be: wrong alphanumerically chars in point number alphanumerically chars in step overflow on a alphanumerically char step is longer as the point number

Example

```
GSI_IncPNumber()
```

6.4.13 GSI_Coding

Description Starts the active coding function of the TPS system.

Declaration `GSI_Coding( BYVAL Caption AS _Token)`

Remarks This routine starts the active coding function of the TPS system. Since there exist three possible locations, the TPS system follows a default ordering rule to invoke one of the programs. First it checks if there is an appropriate set up GeoBASIC coding program. If yes it will be executed, otherwise it examines the codelist management if a codelist is selected. If yes then the codelist will be opened, otherwise the standard coding will be activated.

Parameters

`Caption`	`in`	The left caption string of the dialog.

Return-Codes

RC_OK	successful
LDR_RECURSIV_ERR	GeoBASIC is already running

Example The example uses the GSI_Coding routine to open a dialog for coding.

```
GSI_Coding( "CODE" )
```

6.4.14 GSI_SelectCode

Description This routine shows the codelist-coding dialog

Declaration `GSI_SelectCode( BYVAL Caption AS _Token)`

Remarks This routine starts the codelist-coding function of the TPS system. It will be executed only if a valid codelist is selected.

Parameters

Caption	in	The left caption string of the dialog.

Return-Codes

RC_OK	successful
RC_ABORT	Coding was aborted by pressing of the ESC-button
RC_ABORT_APPL	Coding was aborted by pressing of the QUIT-button
COD_RC_LIST_NOT_VALID	No valid codelist selected

Example See example file „meas.gbs“.

6.4.15 GSI_GetQCodeAvailable

Description This routine returns the status for Quick-Coding.

Declaration

```
GSI_GetQCodeAvailable(lAvailable As Logical,
                      lEnabled   As Logical)
```

Remarks This routine returns if a valid codelist is selected and if Quick-Coding is enabled or not.

Parameters

`lAvailable`	`out`	TRUE: a valid codelist is selected.
`lEnabled`	`out`	TRUE: Quick-Coding is activated

See Also `GSI_SetQCodeMode, GSI_ExecQCoding`

Return-Codes

`RC_OK`	successful

Example See example file „`meas_od.gbs`“.

6.4.16 GSI_SetQCodeMode

Description Sets the Quick-Coding mode.

Declaration `GSI_SetQCodeMode(BYVAL lEnabled As Logical)`

Remarks This routine enables or disables the Quick-Coding. It can be only activated if a valid codelist is selected (see `GSI_GetQCodeAvailable`)

Parameters

`lEnabled`	`in`	TRUE: enable Quick-Coding

See Also `GSI_GetQCodeAvailable, GSI_ExecQCoding`

Return-Codes

`RC_OK`	successful

Example See example file „`meas.gbs`“.

6.4.17 GSI_ExecQCoding

Description Executes the Quick-Coding.

Declaration

```
GSI_ExecQCoding(
      BYVAL lRecEnable AS Logical
            iButtonId  AS Integer,
            lNewCode   AS Logical)
```

Remarks

This routine executes the Quick-Coding. If Quick-Coding is enabled, it checks the button `iButtonId` and searches the corresponding code. If the selected code needs mandatory attributes, it shows the coding dialog. As successful coding is indicated by `lNewCode=TRUE`. The results are stored in the Theodolite data pool (see `GSI_GetWiEntry`)

If `lRecEnable=TRUE`, this routine executes the ALL-button functionality too, it measures a distance and records the results. The recording order (measurement block – code block or vice versa) depends on the system setting (see `GSI_GetRecOrder`).

If `lRecEnable=FALSE`, this routine forces no new distance measurement and there is no recording.

Parameters

`lRecEnable`	in	TRUE: Quick-Coding including distance measurement. It records a code- and a measurement-block in the correct order. FALSE: Quick-Coding without measurement and without recording
`iButtonId`	inout	`In`: Pressed button. `Out`: If a Quick-Coding was possible, `iButtonId` is changed to `MMI_NO_KEY`, otherwise it is unchanged
`lNewCode`	out	`TRUE`: Quick-Coding was successful

See Also `GSI_GetQCodeAvailable, GSI_SetQCodeMode, GSI_SetRecOrder`

Return-Codes

`RC_OK`	successful

Example See example files „`meas.gbs`“ and „`meas_od.gbs`“..

6.4.18 GSI_SetRecOrder

Description Sets the recording order for Quick-Coding.

Declaration `GSI_SetRecOrder(BYVAL lCodeFirst As Logical)`

Remarks This routine defines the recording order for Quick-Coding.

`If lCodeFirst=TRUE`, then the code-block will be recorded before the measurement block.

Parameters

`lCodeFirst`	`in`	TRUE: code-block before measurement block

See Also `GSI_GetRecOrder, GSI_ExecQCoding`

Return-Codes

`RC_OK`	successful

Example See example file „`meas_od.gbs`“.

6.4.19 GSI_GetRecOrder

Description Returns the recording order for Quick-Coding.

Declaration `GSI_GetRecOrder(lCodeFirst As Logical)`

Remarks This routine returns the recording order for Quick-Coding.

`If lCodeFirst=TRUE`, then the code-block will be recorded before the measurement block.

Parameters

`lCodeFirst`	`out`	TRUE: code-block before measurement block

See Also `GSI_SetRecOrder, GSI_ExecQCoding`

Return-Codes

`RC_OK`	successful

Example See example file „`meas_od.gbs`“.

6.4.20 GSI_QuickSet

Description Shows the Quickset dialog.

Declaration `GSI_QuickSet(BYVAL sCaptionLeft AS _Token)`

Remarks This procedure shows Quickset for station setting.

Parameters

`sCaptionLeft`	`in`	Left caption for the Quickset dialog

Return-Codes

`RC_OK`	Successful termination.

Example Show the dialog:

```
GSI_QuickSet ( "BASIC" )
```

6.4.21 GSI_SetRecPath

Description Defines the recording path for the measurements.

Declaration

```
GSI_SetRecPath(
          BYVAL iPathInfo AS Integer,
          BYVAL sFileName AS FileName,
          BYVAL sFilePath AS FilePath )
```

Remarks This procedure defines where the measurements will be recorded. If `iPathInfo` is set to `GSI_INTERFACE`, then the measurements will be sent to the RS232 line and the other parameters are not be interpreted. If `iPathInfo` is set to `GSI_EXTERNAL`, then `sFileName` defines the filename i.e. "`MeasJob.GSI`" and `sFilePath` defines the file-path, i.e. "`A:\\GSI`".

Parameters

`iPathInfo`	`in`	Defines where the data are recorded
`sFileName`	`in`	Valid Filename (8+3 format)
`sFilePath`	`in`	file-path

Return-Codes

RC_OK	Successful termination.

See Also GSI_GetRecPath

Example This example shows the actual recording path and set it to the RS232 line:

```
DIM sFile      As FileName
DIM sPath      As FilePath
DIM iPathInfo  As Integer

GSI_GetRecPath(iPathInfo, sFile, sPath)
IF iPathInfo = GSI_EXTERNAL THEN
    MMI_PrintStr(0, 1,
          "RecFile-CARD: "+sFile, TRUE)
    MMI_PrintStr(0, 2,
          "   Path: " + sPath, TRUE)
  ELSE
    MMI_PrintStr(0, 1,
          "RecPath - serial line", TRUE)
END IF
GSI_SetRecPath( GSI_INTERFACE, sFile, sPath)
```

6.4.22 GSI_GetRecPath

Description Returns the recording path for the measurements.

Declaration

```
GSI_GetRecPath(
      iPathInfo AS Integer,
      sFileName AS FileName,
      sFilePath AS FilePath )
```

Remarks This procedure returns where the measurements will be recorded. If iPathInfo = GSI_INTERFACE, then the measurements will be sent to the RS232 line and the other parameters are not valid. If iPathInfo = GSI_EXTERNAL, then sFileName defines the filename i.e. "MeasJob.GSI" and sFilePath defines the file-path, i.e. "A:\\GSI".

Parameters

`iPathInfo`	`out`	Device info
`sFileName`	`out`	Filename (8+3 format)
`sFilePath`	`out`	File-path

Return-Codes

`RC_OK`	Successful termination.

See Also `GSI_SetRecPath`

Example see `GSI_SetRecPath`

6.4.23 GSI_SetDataPath

Description Set the file with the import data.

Declaration

```
GSI_SetDataPath(
          BYVAL iPathInfo AS Integer,
          BYVAL sFileName AS FileName,
          BYVAL sFilePath AS FilePath )
```

Remarks This procedure sets the file from which data will be imported. Only `GSI_EXTERNAL` is valid for the iPathInfo. `sFileName` defines the filename i.e. "`DataJob.GSI`" and `sFilePath` defines the file-path, i.e. "`A:\\GSI`".

Parameters

`iPathInfo`	`in`	Device info (Only `GSI_EXTERNAL` is valid)
`sFileName`	`in`	Valid Filename (8+3 format)
`sFilePath`	`in`	File-path

Return-Codes

`RC_OK`	Successful termination.

See Also `GSI_GetDataPath`

Example The example defines the file “A:\GSI\DataJob.GSI” as new import file.

```
GSI_SetDataPath(GSI_EXTERNAL, "DataJob.GSI",
"A:\\GSI")
```

6.4.24 GSI_GetDataPath

Description Get the name of the file with the import data.

Declaration

```
GSI_GetDataPath(
      iPathInfo AS Integer,
      sFileName AS FileName,
      sFilePath AS FilePath )
```

Remarks This procedure fetches the name and the path of the file from which data will be imported. If `iPathInfo` = `GSI_EXTERNAL`, then `sFileName` defines the filename i.e. "`DataJob.GSI`" and `sFilePath` defines the file-path, i.e. "`A:\\GSI`".

Parameters

iPathInfo	out	Device info
sFileName	out	Filename (8+3 format)
sFilePath	out	File-path

Return-Codes

RC_OK	Successful termination.

See Also `GSI_SetDataPath`

Example The example fetches the name and the path of the standard import data file:

```
DIM iPathInfo  AS Integer
DIM sFileName  AS FileName
DIM sFilePath  AS FilePath
GSI_GetDataPath(iPathInfo, sFileName, sFilePath)
```

6.4.25 GSI_GetWiEntry

Description Get data from the Theodolite data pool.

Declaration
```
GSI_GetWiEntry(
        WiIdentification  AS Integer,
        WiEntry AS GSI_WiDlg_Entry_Type )
```

Remarks This routine is used to fetch data from the Theodolite data pool. All existing wi's can be fetched (see the description of the WI constants for possible values).

Parameters

`WiIdentification`	in	The identification of the WI.
`WiEntry`	out	The WI entry data. See the description of `GSI_WiDlg_Entry_Type` for further information.

See Also `GSI_SetWiEntry`

Example See example `GSI_SetWiEntry`.

6.4.26 GSI_SetWiEntry

Description Put data to the Theodolite data pool.

Declaration
```
GSI_SetWiEntry(
        WiIdentification  AS Integer,
        WiEntry AS GSI_WiDlg_Entry_Type )
```

Remarks This routine is used to put data to the Theodolite data pool. See the description of the WI constants.

Parameters

`WiIdentification`	in	The identification of the WI.
`WiEntry`	in	The WI entry data. See the description of `GSI_WiDlg_Entry_Type` for further information.

See Also `GSI_GetWiEntry`

Example GSI_SetWiEntry does not set WI.iId according to the first parameter, instead it will just use the value stored in WI.iId. If that value is unequal to the first parameter value, then it comes to a conflict. Use a GSI_GetWiEntry() first, to be sure that all values

of the GSI_WiDlg_Entry_Type are initialized correctly. See also the example for the definition of a measurement dialog.
Save way:

```
GSI_GetWiEntry ( GSI_ID_HR, Wi )
Wi.lValid = TRUE
Wi.dValue = 2.12
GSI_SetWiEntry ( GSI_ID_HR, Wi )
```

6.4.27 GSI_GetRecMask

Description Get the definition and the format of a recording mask.

Declaration

```
GSI_GetRecMask(
     BYVAL iMaskNr AS Integer,
           sMaskName     AS String18,
           RecWiMask     AS GSI_Rec_Id_List,
           iRecFormat    AS Integer,
           lEditMask     AS Logical )
```

Remarks This routine fetches the definition and the format of the recording mask with the number `iMaskNr`. Valid formats are `GSI_RECFORMAT_GSI` and `GSI_RECFORMAT_GSI16.` A recording mask can be set with `GSI_SetRecMask`. If `lEditMask` is TRUE the elements of the recording mask can be changed in `GSI_DefineRecMaskDlg`. All unused elements of the recording list are set to `GSI_ID_NONE`. All values from 0 to 5 are valid for the mask number. Mask number 0 is predefined for the station recording mask.

Note	Only the first 16 characters of `sMaskName` are valid.

Parameters

`iMaskNr`	`in`	Number of the recording mask. `GSI_ACTUAL_RECMASK` can be used to retrieve settings of the actual mask
`sMaskName`	`out`	Name of the recording mask
`RecWiMask`	`out`	The definition of the recording mask. The elements of the array are the identification numbers of the `WI's`. See the description

		of the WI constants.
`iRec Format`	`out`	Recording format (`GSI_RECFORMAT_GSI`, `GSI_RECFORMAT_GSI16`)
`lEditMask`	`out`	Mask editable flag

See Also `GSI_SetRecMask, GSI_DefineRecMaskDlg`

Example The example uses the `GSI_GetRecMask` routine to fetch the definition and the format of the recording mask number 2.

```
DIM sMaskName   AS String18
DIM RecWiMask   AS GSI_Rec_Id_List
DIM iRecFormat  AS Integer
DIM lEditMask   AS Logical

GSI_GetRecMask( 2, sMaskName, RecWiMask,
                iRecFormat, lEditMask)
```

6.4.28 GSI_SetRecMask

Description Set the definition and the format of a recording mask.

Declaration
```
GSI_SetRecMask(
     BYVAL iMaskNr AS Integer,
     BYVAL sMaskName     AS String18,
     BYVAL RecWiMask     AS GSI_Rec_Id_List,
     BYVAL iRecFormat    AS Integer,
     BYVAL lEditMask     AS Logical)
```

Remarks This routine sets the definition and the format of the recording mask with the number `iMaskNr`. Valid formats are `GSI_RECFORMAT_GSI` and `GSI_RECFORMAT_GSI16.` If `lEditMask` is TRUE the elements of the recording mask can be changed in `GSI_DefineRecMaskDlg.` All unused elements should be set to `GSI_ID_NONE`. All values from 0 to 5 are valid for the mask number. Mask number 0 is predefined for the station recording mask.

Note	1) `WiEntries` must be unique, hence may not appear doubly. 2) Only `GSI_MAX_REC_WI` number of entries may be defined. 3) Only the first 16 characters of `sMaskName` are valid.

Parameters

`iMaskNr`	`in`	Number of the recording mask. `GSI_ACTUAL_RECMASK` can be used to set the values of the currently active mask.
`sMaskName`	`in`	Name of the recording mask.
`RecWiMask`	`in`	The definition of the recording mask. The elements of the array are the identification numbers of the `WI's`. See the description of the WI constants.
`iRec Format`	`in`	Recording format (`GSI_RECFORMAT_GSI` , `GSI_RECFORMAT_GSI16`)
`lEditMask`	`in`	Mask editable flag

See Also `GSI_GetRecMask, GSI_DefineRecMaskDlg`

Example The example sets the 4th element of the currently active recording mask on GSI_ID_HZ.

```
DIM sMaskName   AS String18
DIM RecWiMask   AS GSI_Rec_Id_List
DIM iRecFormat  AS Integer
DIM lEditMask   AS Logical

GSI_GetRecMask(GSI_ACTUAL_RECMASK, sMaskName,
               RecWiMask, iRecFormat, lEditMask)
RecWiMask(4) = GSI_ID_HZ
GSI_SetRecMask(GSI_ACTUAL_RECMASK, sMaskName,
               RecWiMask, iRecFormat, lEditMask)
```

6.4.29 GSI_SetRecMaskNr

Description Set the used recording mask.

Declaration `GSI_SetRecMaskNr(BYVAL iMaskNr AS Integer)`

Parameters

`iMaskNr`	`in`	Number of the recording mask. Number must be in the range `1.. GSI_MAX_REC_MASKS.`

See Also `GSI_GetRecMaskNr`

Example The example sets the next recording mask.

```
DIM i   AS Integer

GSI_GetRecMaskNr( i )
i = i + 1 ‘ take next mask
i = ((i - 1) MOD GSI_MAX_REC_MASKS) + 1
GSI_SetRecMaskNr( i )
```

6.4.30 GSI_GetRecMaskNr

Description Returns the used recording mask.

Declaration `GSI_GetRecMaskNr(iMaskNr AS Integer)`

Parameters

iMaskNr	out	Number of the recording mask.

See Also `GSI_SetRecMaskNr`

6.4.31 GSI_DefineRecMaskDlg

Description Defines the recording mask dialog.

Declaration `GSI_DefineRecMaskDlg()`

Remarks Defines the contents of the recording mask. Using a dialog with list-fields, the user can select the items for the user registration mask. This routine is an interactive equivalent to the routines `GSI_GetRecMask and GSI_SetRecMask.`

See Also `GSI_GetRecMask, GSI_SetRecMask,`

Example

```
GSI_DefineRecMaskDlg ()
```

6.4.32 GSI_ManCoordDlg

Description Show the manual co-ordinate input dialog.

Declaration

```
GSI_ManCoordDlg(
      BYVAL sCaption       AS _Token,
      BYVAL iPointType     AS Integer,
        Point   AS GSI_Point_Coord_Type,
      BYVAL iFlags         AS Integer,
      BYVAL sHelpText      AS _Token )
```

Remarks

This routine shows the manual co-ordinates input dialog and allows editing, coding and recording. The type of co-ordinates (station or target) can be selected using `iPointType`. Recording to the current data-file (defined in `GSI_ImportCoordDlg`) with `REC` or leaving this function with `CONT` is only possible if the point number is valid, and at least E- and N-co-ordinates are valid. If GSI_HEIGHT_MUST is included in `iFlags` the Height / Elevation-co-ordinate must be valid too. Leaving using `ESC` or `QUIT` (`Shift-F6`) is always possible. Recording and coding sets the according values in the Theodolite data-pool too.

Parameters

`sCaption`	in	The maximal five-character long left part of the title bar.
`iPointType`	in	station or target point. For the values for `PointType` see table below

Point Type	Meaning
`GSI_STATION`	station point number
`GSI_INDIV_TG`	individual target number
`GSI_RUN_TG`	running target
`GSI_BACKSIGHT`	backside number (analog target, only changed prompts)

		GSI_POINT_ CODE	PointId / CodeId (analog target, only changed prompts)
Point	in	only point number, co-ordinates will be set to 0	
Point	out	point number and -co-ordinates. For further information see the description of `GSI_Point_Coord_Type`	
iFlags	in	defines functionality	
		Valid Flags	**Meaning**
		GSI_ALLOW_ REC	allows recording and coding
		GSI_HEIGHT_ MUST	height must be entered
		GSI_NE_ OPTIONAL	only height must be entered, north & east are optional
		GSI_MULTI_ REC	Allows entering and recording of more than one data-set, without leaving this routine
		GSI_NO_FILE_ CHANGE	File changing is disabled
		Flags can be combined with '+'-operator (`iFlags` = iFlag1 + iFlag2)	
sHelpText	in	This text is shown, when the help button `SHIFT-F1` is pressed and the help functionality of the theodolite is enabled.	

See Also `GSI_ImportCoordDlg`

Example

```
DIM Point AS GSI_Point_Coord_Type

GSI_ManCoordDlg ( "TEST", GSI_STATION, Point,
                  GSI_HEIGHT_MUST+GSI_ALLOW_REC,
                  "This is the Helptext" )
```

6.4.33 GSI_ImportCoordDlg

Description Show the co-ordinate import dialog.

Declaration

```
GSI_ImportCoordDlg(
    BYVAL sCaption        AS _Token,
    BYVAL iPointType      AS Integer,
    Point    AS GSI_Point_Coord_Type,
    BYVAL iFlags          AS Integer,
    BYVAL iImportFile     AS Integer,
    BYVAL sImportHelp     AS _Token,
    BYVAL sInputHelp      AS _Token,
    BYVAL sF2Button       AS _Token,
    BYVAL sF4Button       AS _Token)
```

Remarks This routine contains three dialogues, the search-, the view- and the manual-input dialog. The type of co-ordinates (station or target) can be selected using `iPointType`. The search dialog allows selecting the data- or the measure file and editing a point-number. Depending on the pressed button, the manual co-ordinate input function (only if `GSI_ALLOW_MAN` is included in `iFlags`, see `GSI_ManCoordDlg`) or the view-co-ordinates dialog will be called.

The start of searching is always at the top of the file. With the two search keys, the user can step from one valid point to the next in both directions.

Rules for a valid point:

- point number found
- E- and N-coordinates (target or station) exists and are valid
- if `GSI_HEIGHT_MUST` is included in `iFlags`, a valid

height / elevation-coordinate must exist to within the file too.

If no valid point exists or no more valid points are in the desired search direction, a warning message will be displayed.

Parameters

sCaption	in	The maximal five-character long left part of the title bar.
iPointType	in	station or target point. For the values for PointType see table below

Point Type	Meaning
GSI_STATION	station point number
GSI_INDIV_TG	individual target number
GSI_RUN_TG	running target
GSI_BACKSIGHT	backside number (analog target, only changed prompts)
GSI_POINT_CODE	PointId / CodeId (analog target, only changed prompts)

Point	in	Only point number, the co-ordinates will be set to 0.
Point	out	point number and -co-ordinates. For further information see the description of GSI_Point_Coord_Type.
iFlags	in	defines functionality

Valid Flags	Meaning
GSI_ALLOW_REC	allows recording and coding
GSI_MULTI_REC	Allows multiple manual coord. entering

		`GSI_ALLOW_MAN`	allows manual coord. entering
		`GSI_HEIGHT_MUST`	height must be entered
		`GSI_DIRECT_SEARCH`	direct searching without dialog
		`GSI_NO_VIEW`	no coord view if found
		`GSI_NE_OPTIONAL`	only height must be entered, north & east are optional
		`GSI_SEARCH_FROM_END`	Starts searching from end of file
		`GSI_NO_FILE_CHANGE`	Changing of file is disabled
		`GSI_GET_NEXT`	Return the next valid data-set, ignore `sPtNr`
		Flags can be combined with '+'-operator (`iFlags` = iFlag1 + iFlag2)	
`iImportFile`	`in`	defines the source file for importing	
		Valid Import File	**Meaning**
		`GSI_FILE_MEAS`	MEAS file
		`GSI_FILE_DATA`	DATA file
		`GSI_FILE_LAST`	last used file
`sImportHelp`	`in`	Help text for import dialog. Only visible if the help functionality of the theodolite is enabled.	
`sInputHelp`	`in`	Help text for manual input dialog. Only visible if the help functionality of the theodolite is enabled.	
`sF2Button`	`in`	Text for activating F2 button.	
`sF4Button`	`in`	Text for activating F4 button	

See Also `GSI_ManCoordDlg`

Example

```
DIM Point AS GSI_Point_Coord_Type
GSI_ImportCoordDlg( "IMP", GSI_INDIV_TG,
        Point, GSI_ALLOW_REC + GSI_ALLOW_MAN,
        GSI_FILE_DATA, "Import Help Text",
        "Input Help Text", "F2", "F4" )
```

6.4.34 GSI_SetLineSysMDlg

Description Sets a line in the system measurement dialog.

Declaration

```
GSI_SetLineSysMDlg(
             BYVAL iDlgNr      AS Integer
             BYVAL iLineNr     AS Integer
             BYVAL iSysParamId AS Integer )
```

Remarks This routine sets one line in the system measurement dialog. To fetch information about a line, `GSI_GetLineSysMDlg` can be used. Unused lines should be set to `GSI_PAR_NONE`.

> **Note** 1) Parameters are identified by `GSI_PAR_*` values and not by `GSI_ID_*` values.
> 2) A line in the system measurement dialog can only be set to a system parameter not to an application parameter.

Parameters

`iDlgNr`	in	The number of the system measurement dialog where the line should be set. Possible values are:
		Value / **Meaning**
		`GSI_SYS_MDLG_1` Dialog 1
		`GSI_SYS_MDLG_2` Dialog 2
		`GSI_SYS_MDLG_3` Dialog 3
`iLineNr`	in	The number of the line to set. Valid numbers: `1.. GSI_MAX_DLG_LINES`
`iSysParamId`	in	Identification of the system parameter. Refer to the chapter

"Constants for Measurement Dialog Definition"

See Also GSI_GetLineSysMDlg
GSI_DefineMDlg

Example See sample program "meas.gbs".
This example uses GSI_SetLineSysMDlg to configure the first two lines of the first system measurement dialog.

```
GSI_SetLineSysMDlg( GSI_SYS_MDLG_1, 1,
                    GSI_PAR_Date )
GSI_SetLineSysMDlg( GSI_SYS_MDLG_1, 2,
                    GSI_PAR_Time )
```

6.4.35 GSI_GetLineSysMDlg

Description Gets the definition of a line in the system measurement dialog.

Declaration

```
GSI_GetLineSysMDlg(
            BYVAL iDlgNr      AS Integer
            BYVAL iLineNr     AS Integer
                  iSysParamId AS Integer )
```

Remarks This routine fetches the information about the setting of one line in the system measurement dialog. To set a line in the system measurement dialog the routine GSI_SetLineMDlg can be used.

Parameters

iDlgNr	in	The number of the system measurement dialog where the line should be fetched. Possible values are: **Value** / **Meaning** GSI_SYS_MDLG_1 — Dialog 1 GSI_SYS_MDLG_2 — Dialog 2 GSI_SYS_MDLG_3 — Dialog 3
iLineNr	in	The number of the line to fetch.
iSysParamId	out	Identification of the system parameter. Refer to the chapter "Constants for Measurement Dialog Definition"

See Also GSI_SetLineSysMDlg
GSI_DefineMDlg

Example See sample program "meas.gbs".
This example uses GSI_GetLineSysMDlg to get information about the configuration of the first system measurement dialog's first two lines.

```
DIM iParLine1 AS Integer
DIM iParLine2 AS Integer

GSI_GetLineSysMDlg( GSI_SYS_MDLG_1, 1, iParLine1)
GSI_GetLineSysMDlg( GSI_SYS_MDLG_1, 2, iParLine2)
```

6.4.36 GSI_SetMDlgNr

Description Sets the number of the system measurement dialog.

Declaration `GSI_SetMDlgNr( BYVAL iMDlgNr AS Integer)`

Remarks Sets the number of the system measurement dialog. The content of these dialogs can by changed by using of DefineMDlg.

Parameters

`iMDlgNr`	in	Number of the measurement dialog. Valid values: `0..GSI_MAX_MDLG_MASKS-1`

See Also `GSI_GetMDlgNr`

Example See sample program "`meas_od.gbs`".
This example sets the next dialog mask

```
GSI_GetMDlgNr( i )
i = (i + 1) MOD GSI_MAX_MDLG_MASKS
GSI_SetMDlgNr( i )
```

6.4.37 GSI_GetMDlgNr

Description Returns the number of the system measurement dialog.

Declaration `GSI_GetMDlgNr(iMDlgNr AS Integer)`

Remarks Returns the number of the system measurement dialog.

Parameters

`iMDlgNr`	out	Number of the actual measurement dialog

See Also `GSI_SetMDlgNr`

6.4.38 GSI_CreateMDlg

Description Create and show the user definable measurement dialog.

Declaration

```
GSI_CreateMDlg(
            BYVAL iFixLines     AS Integer
            BYVAL sCaptionLeft  AS _Token
            BYVAL sCaptionRight AS _Token
            BYVAL sHelpText     AS _Token )
```

Remarks This routine creates and shows the user definable measurement dialog with `iFixLines` fix lines, the left part of the title bar `sCaptionLeft`, the caption `sCaptionRight`, and the help text `sHelpText`.

Only one measurement dialog can exist at the same time. If `GSI_CreateMDlg` is called and there already exists a measurement dialog, the existing dialog (together with all attached buttons) is deleted and the new dialog is created.

Note	If a graphics dialog or a text dialog exist together with a measurement dialog, all button routines (`MMI_AddButton`, `MMI_GetButton`, `MMI_DeleteButton`) are related to the measurement dialog.

The shown parameters used in the dialog are defined in the user display mask (see `GSI_DefineMDlg`).

Parameters

`iFixLines`	`in`	The number of fix lines. (These lines are not scrolled.)
`sCaptionLeft`	`in`	The part of the title bar displayed on the left border (up to five characters wide)
`sCaptionRight`	`in`	The caption of the dialog.
`sHelpText`	`in`	This text is shown, when the help button `SHIFT-F1` is pressed and the help functionality of the theodolite is enabled.

See Also `GSI_UpdateMDlg`
`GSI_UpdateMeasurement`

Example See example file „`meas.gbs`“ too.

This example uses the measure dialog routines `GSI_CreateMDlg`, `GSI_UpdateMDlg` and `GSI_UpdateMeasurment` to execute a measure process.

```
DIM ValidForRec   AS Logical
DIM RetCodeForMsg AS Integer
DIM WaitTime      AS Integer
DIM iButton       AS Integer

WaitTime = 10 'ms

'user definition of measurement dialog
'can be placed here
```

```
GSI_CreateMDlg( 1, "WIR", "Measure Dialog",
                  "This is the Helptext")
DO
  GSI_UpdateMeasurment( TMC_MEA_INC,
                        WaitTime, ValidForRec,
                        RetCodeForMsg, FALSE )
  GSI_UpdateMDlg (iButton)
LOOP UNTIL iButton = MMI_ESC_KEY

GSI_DeleteDialog()
```

6.4.39 GSI_SetLineMDlg

Description Sets one line in the user definable measurement dialog to system parameter.

Declaration

```
GSI_SetLineMDlg(
             BYVAL iLineNr     AS Integer
             BYVAL iSysParamId AS Integer )
```

Remarks This routine sets the configuration of a line in the user definable measurement dialog to a system parameter. This measurement dialog is initialized automatically with the actual settings of the first system measurement dialog. Modifications of the user definable dialog have no effects on the system measurement dialog and will be lost after termination of the program. An unused line should be set to `GSI_PAR_NONE`. To add a user definable application parameter to the dialog use `GSI_SetLineMDlgPar`. To add a line of text (e.g. separator line) to the dialog use `GSI_SetLineMDlgText`.

Parameters

`iLineNr`	in	The number of the line to set. Valid numbers: `1.. GSI_MAX_DLG_LINES`
`iSysParamId`	in	Identification of the system parameter. Refer to the chapter “Constants for Measurement Dialog Definition”

See Also `GSI_SetLineMDlgPar`
`GSI_SetLineMDlgText`
`GSI_CreateMDlg`

Example This example uses `GSI_SetLineMDlg` to configure the user definable measurement dialog.

```
GSI_SetLineMDlg( 1, GSI_PAR_ReflHeight )
GSI_SetLineMDlg( 2, GSI_PAR_Info1 )
GSI_SetLineMDlg( 3, GSI_PAR_Info2 )
…
GSI_SetLineMDlg( 10, GSI_PAR_NONE )
GSI_SetLineMDlg( 11, GSI_PAR_NONE )
GSI_SetLineMDlg( 12, GSI_PAR_NONE )
```

6.4.40 GSI_SetLineMDlgText

Description Puts a text line into the user definable measurement dialog.

Declaration

```
GSI_SetLineMDlgText(
             BYVAL iLineNr  AS Integer,
             BYVAL iParamId AS Integer,
             BYVAL sText    AS _Token )
```

Remarks This routine inserts a pure text line into the user definable measurement dialog. To add an user definable application parameter to the dialog use `GSI_SetLineMDlgPar`. To add a system parameter to the dialog use `GSI_SetLineMDlg`.

Parameters

`iLineNr`	`in`	The number of the line to set. Valid numbers: `1.. GSI_MAX_DLG_LINES`
`iParamId`	`in`	Id of the system parameter.
`sText`	`in`	Contents of the line.

See Also `GSI_SetLineMDlg`
`GSI_SetLineMDlgPar`
`GSI_CreateMDlg`

Example This example uses `GSI_SetLineMDlg` and `GSI_SetLineMDlgText` to configure the user definable measurement dialog.

```
GSI_SetLineMDlg( 1, GSI_PAR_Date )
GSI_SetLineMDlg( 2, GSI_PAR_Time )
GSI_SetLineMDlgText( 3, GSI_PAR_APPDATA0,
                     "----------------" )
GSI_SetLineMDlg( 4, GSI_PAR_Info1 )
GSI_SetLineMDlg( 5, GSI_PAR_Info2 )
```

6.4.41 GSI_SetLineMDlgPar

Description Sets one line in the user definable measurement dialog to an application parameter.

Declaration

```
GSI_SetLineMDlgPar(
             BYVAL iLineNr      AS Integer
             BYVAL iApplParamId AS Integer
             BYVAL sLabel       AS _Token
             BYVAL lEditAble    AS Logical
             BYVAL iFormat      AS Integer )
```

Remarks This routine sets the configuration of a line in the user definable measurement dialog to an application parameter. The style of the application parameter is also defined in this routine. Any floating point format and strings are valid formats. The starting values of every application parameter is not predefined and hence has to be set explicitly. To initialize an application parameter the routine `GSI_SetWiEntry` can be used. To add a line of text to the dialog use `GSI_SetLineMDlgText`. To add a system parameter to the dialog use `GSI_SetLineMDlg`.

Parameters

`iLineNr`	in	The number of the line to set. Valid numbers: `1.. GSI_MAX_DLG_LINES`
`iApplParamId`	in	Id of the application parameter.
`sLabel`	in	Description of parameter on display.

`lEditAble`	in	Edit ability of the value in the measurement dialog.
`iFormat`	in	Format descriptor of the application parameter. The format defines if a dimension field is available. Following values can be used:

Value	**Meaning**
`MMI_FFORMAT_STRING`	string
`MMI_FFORMAT_DOUBLE`	double
`MMI_FFORMAT_DISTANCE`	distance
`MMI_FFORMAT_SUBDISTANCE`	sub-distance [mm]
`MMI_FFORMAT_ANGLE`	angle
`MMI_FFORMAT_VANGLE`	vertical angle
`MMI_FFORMAT_HZANGLE`	horizontal angle
`MMI_FFORMAT_TEMPERATURE`	temperature

See Also `GSI_SetLineMDlg`
`GSI_SetLineMDlgText`
`GSI_CreateMDlg`

Example See also sample file “`meas.gbs`”.
This example uses `GSI_SetLineMDlgPar` and `GSI_SetWiEntry` to configure the user definable measurement dialog.

```
DIM WI AS GSI_WIDLG_ENTRY_TYPE

WI.lValid    = FALSE
WI.iDataType = GSI_ASCII
GSI_SetWiEntry(GSI_ID_APPDATA0, WI)
GSI_SetLineMDlgPar(1, GSI_PAR_AppData0,
                   "Stat. Name:", TRUE,
                   MMI_FFORMAT_STRING)
WI.lValid    = TRUE
WI.iDataType = GSI_DOUBLE
WI.dValue    = 2.2
GSI_SetWiEntry(GSI_ID_APPDATA3, WI)
GSI_SetLineMDlgPar(8, GSI_PAR_AppData3,
                   "Distance : ", TRUE,
                   MMI_FFORMAT_DISTANCE)
```

6.4.42 GSI_UpdateMDlg

Description Updates the user definable measurement dialog.

Declaration `GSI_UpdateMDlg( iButton As Integer)`

Remarks This procedure updates the user definable measurement dialog with the actual values from the Theodolite data pool and returns pressed buttons.

Parameters

`iButton`	`out`	Contains pressed button identifier. For details see `MMI_GetButton` (`lAllKeys = TRUE`).

See Also `GSI_CreateMDlg`
`GSI_UpdateMeasurement`

Example See example `GSI_CreateMDlg` and example file „`meas.gbs`“.

6.4.43 GSI_DefineMDlg

Description Defines the entries of the user definable measurement dialog.

Declaration `GSI_DefineMDlg( BYVAL sCaption AS _Token)`

Remarks Interactively defines the contents of the user definable measurement dialog. Using a dialog with list fields, the user can select the items for the measurement dialog. This routine is an interactive equivalent to the routines `GSI_SetLineSysMDlg` and `GSI_GetLineSysMDlg`.

Parameters

`sCaption`	`in`	The left caption of the title bar. (Up to 5 characters wide.)

See Also `GSI_GetDlgMask`
`GSI_SetDlgMask`

Example

```
GSI_DefineMDlg( "DEF" )
```

6.4.44 GSI_UpdateMeasurment

Description Update the measurement data.

Declaration

```
GSI_UpdateMeasurment(
            iInclinePrg     AS Integer,
            iWaitTime       AS Integer,
            lValidForRec    AS Logical,
            iRetCodeForMsg  AS Integer,
            lChkIncRangeNow AS Logical )
```

Remarks This function updates the measurement values in the Theodolite data pool. The data are the incline program, angles, distances, time, reflector height.

Parameters

iInclinePrg	in	The manner of incline compensation. Following settings are possible: **Incline Program** / **Meaning** TMC_MEA_INC — get inclination TMC_AUTO_INC — get inclination with automatism TMC_PLANE_INC — get inclination always with plane
iWaitTime	in	The wait time for a result (in ms). This time is used for synchronising the TMC task.
lValidForRec	out	Indicates validity of the registration
iRetCodeForMsg	out	Return code of the measurement
lChkIncRangeNow	in	TRUE: check incline range immediate

See Also GSI_CreateMDlg
GSI_UpdateMDlg
GSI_DeleteDialog

Example See example GSI_CreateMDlg and example file „meas.gbs“.

6.4.45 GSI_Measure

Description Measure and registration dialog.

Declaration `GSI_Measure ( )`

Remarks This procedure opens the measure and registration dialog.

Parameters

none

Return Codes

`RC_OK`	Success

Example Do a measure and registration dialog.

```
GSI_Measure ( )
```

6.4.46 GSI_ExecuteAutoDist

Description Executes an automatic distance measurement.

Declaration `GSI_ExecuteAutoDist ( )`

Remarks This procedure starts a distance measurement on condition that “Auto Dist” is enabled and one of the distance measurement-program buttons (`FNC`-menu) was pressed.

Parameters

`none`

Return Codes

`RC_OK`	Success

Example See example file „`meas.gbs`“ or „`meas_od.gbs`“.

6.4.47 GSI_CheckTracking

Description Returns if distance tracking is running.

Declaration `GSI_CheckTracking(lTracking As Logical)`

Remarks This returns if a distance tracking is running.

An automatic start of distance tracking can be started on several conditions, i.e. by Quick-Coding, `GSI_ExecuteAutoDist` or by pressing buttons in the `FNC`-menu.

Tracking can be terminated by the instrument itself due several reasons, i.e. for laser security reasons (US-configuration)

Parameters

`lTracking`	In	`TRUE`: a distance tracking is running

Return Codes

`RC_OK`	Successful

Example See example file „`meas.gbs`“ or „`meas_od.gbs`“.

6.4.48 GSI_RecordRecMask

Description Recording the given wi mask.

Declaration

```
GSI_RecordRecMask (
                RecList AS GSI_REC_ID_LIST,
          BYVAL eProgFunction AS Logical,
          BYVAL bCheckStdMask AS Logical,
          BYVAL bIncAndSetRunPt AS Logical)
```

Remarks This procedure records the given wi list. The target can be the memory card or the interface. The parameter for the interface depends on the GSI communication settings. Errors will shown on the display, when recording list will be stored in the memory card. Otherwise the error messages will be given on the interface.

Parameters

`RecList`	in	recording list
`eProgFunction`	in	program flag in the wi's (`TRUE` = ON, `FALSE` = OFF)
`bCheckStdMask`	in	testing the standard recording mask
`bIncAndSetRunPt`	in	increment the point number

Return Codes

`RC_OK`	Success
`RC_IVRESULT`	registration failure

See Also

Example Record `RecList`.

```
DIM RecList AS GSI_REC_ID_LIST

' initialize RecList with adequate values
GSI_RecordRecMask ( RecList, TRUE, TRUE, TRUE )
```

6.5 CENTRAL SERVICE FUNCTIONS CSV

6.5.1 Summarizing Lists of CSV Types and Procedures

6.5.1.1 Types

type name	description
`TPS_Fam_Type`	Information about the current hardware.
`Date_Time_Type`	Date and time information.
`Date_Type`	Date information.
`Time_Type`	Time information.

6.5.1.2 Procedures

procedure name	description
`CSV_ChangeFace`	Do an absolute positioning to the opposite.
`CSV_CheckAltUserTask`	Returns if an alternative user-task was running.
`CSV_Delay`	Delay routine
`CSV_GetATRStatus`	Gets the current ATR state.
`CSV_GetDateTime`	Get the date and the time of the system.
`CSV_GetElapseSysTime`	Returns the difference between a reference time and the system time.
`CSV_GetGBIVersion`	Returns the release number of the GeoBASIC interpreter
`CSV_GetInstrumentFamily`	Get information about the system.
`CSV_GetInstrumentName`	Get the LEICA specific instrument name.
`CSV_GetInstrumentNo`	Get the instrument number.
`CSV_GetLaserPlummet`	Returns the laser plummet state
`CSV_GetLockStatus`	Gets the current state of the locking facility.
`CSV_GetLRStatus`	Returns the status of the system.

procedure name	**description**
CSV_GetPrismType	Returns the used prism
CSV_GetSWVersion	Get the version of the system software.
CSV_GetSysTime	Returns the system time.
CSV_GetTargetType	Get the target type for distance measurements.
CSV_GetTemperature	Returns the internal temperature of the instrument.
CSV_Laserpointer	Switch on / off the laser pointer.
CSV_LibCall	Call a GeoBASIC routine from another program.
CSV_LibCallAvailable	Check if GeoBASIC routine from another program is available.
CSV_LockIn	Starts locking (ATR)
CSV_LockOut	Stops locking (ATR)
CSV_MakePositioning	Do an absolute positioning.
CSV_ResetAltUserTask	Resets the “alternative user-task was running” flag.
CSV_SetATRStatus	Sets the current state of Automatic Target Recognition.
CSV_SetLaserPlummet	Switches the laser plummet
CSV_SetLightGuide	Switch on / off the light guide.
CSV_SetLockStatus	Sets the current state of the locking facility.
CSV_SetPrismType	Sets the used prism
CSV_SetTargetType	Set the target type for distance measurements.
CSV_SysCall	Call a system function.
CSV_SysCallAvailable	Check if system function is available.

6.5.2 Data Structures for the Central Service Functions

6.5.2.1 Date_Time_Type: Date and Time

Description These data structures are used to store date and time information.

`TYPE Date_Type`		
`  iYear`	`AS Integer`	year as a 4 digit number
`  iMonth`	`AS Integer`	month as a 2 digit number
`  iDay`	`AS Integer`	day as a 2 digit number
`END Date_Type`		
`TYPE Time_Type`		
`  iHour`	`AS Integer`	hour as a 2 digit number (24 hours format)
`  iMinute`	`AS Integer`	minutes as a 2 digit number
`  iSecond`	`AS Integer`	seconds as a 2 digit number
`END Time_Type`		
`Date_Time_Type`		
`  Date`	`AS Date_Type`	date (as defined above)
`  Time`	`AS Time_Type`	time (as defined above)
`END_Time_Type`		

6.5.2.2 TPS_Fam_Type: Information about the system

Description This data structure is used to store information about the hardware. Further information about the hardware can be obtained by your local Leica representative.

```
TYPE TPS_Fam_Type
  iClass               AS Integer
```

The class of the system. Values:

Id	Meaning
TPS1101	TPS1100 accuracy 1”
TPS1102	TPS1100 accuracy 2”
TPS1103	TPS1100 accuracy 3”
TPS1105	TPS1100 accuracy 5”

lEDMBuiltIn	AS Logical	EDM built-in
lEDMTypeII	AS Logical	EDM built-in, type II
lEDMTypeIII	AS Logical	EDM built-in, type III
lEDMReflectorless	AS Logical	Red Laser
lMotorized	AS Logical	Motorised
lATR	AS Logical	Automatic Target Recognition (ATR)
lEGL	AS Logical	EGL Guide Light
lLaserPlummet	AS Logical	Laser Plummet
lAutoCollimation	AS Logical	Auto-collimation lamp
lSimulator	AS Logical	Hardware is simulator on Windows-PC

```
END TPS_Fam_Type
```

6.5.3 CSV_GetDateTime

Description Get the date and the time of the system.

Declaration

```
CSV_GetDateTime(
       DateAndTime AS Date_Time_Type )
```

Remarks The `CSV_GetDateTime` routine reads the date and the time from the system's real-time clock (RTC) and returns the values in the structure `Date_Time_Type`. In the case of TPS_Sim the system clock will be read.

Parameters

`DateAndTime`	`out`	The structure for the date and the time.

Return Codes

`RC_UNDEFINED`	The date and time is not set (not yet/not any longer).

Example The example uses the `CSV_GetDateTime` routine to get the date and the time of the system and displays the values.

```
DIM DT AS Date_Time_Type

ON ERROR RESUME
CSV_GetDateTime( DT )

IF ERR = RC_OK THEN
  MMI_PrintInt(  0, 0, 5, DT.Date.iYear, TRUE  )
  MMI_PrintInt(  6, 0, 3, DT.Date.iMonth, TRUE )
  MMI_PrintInt( 10, 0, 3, DT.Date.iDay, TRUE   )
  MMI_PrintInt(  0, 1, 3, DT.Time.iHour, TRUE  )
  MMI_PrintInt(  4, 1, 3, DT.Time.iMinute, TRUE)
  MMI_PrintInt(  8, 1, 3, DT.Time.iSecond, TRUE)

ELSEIF ERR = RC_UNDEFINED THEN
  MMI_PrintStr(  0, 0,
                "Date and time not set.", TRUE )
ELSE
  MMI_PrintStr(  0, 0,
                "Unexpected error code.", TRUE )
END IF
```

6.5.4 CSV_GetTemperature

Description Returns the internal temperature of the instrument.

Declaration `CSV_GetTemperature( IntTemp AS Temperature )`

Remarks This routine returns the internal temperature.

Parameters

`IntTemp`	`out`	Internal temperature

6.5.5 CSV_GetInstrumentName

Description Get the LEICA specific instrument name.

Declaration `CSV_GetInstrumentName( sName AS String30 )`

Remarks The `CSV_GetInstrumentName` routine returns the name of the system in the string `sName`.

Parameters

`sName`	`out`	The LEICA specific instrument name.

Return Codes

`none`

See Also `CSV_GetInstrumentNo`, `CSV_GetInstrumentFamily`

Example The example uses the `CSV_GetInstrumentName` routine to get the instrument name and displays it.

```
DIM sName AS String30

CSV_GetInstrumentName ( sName )
MMI_PrintStr ( 0, 0, sName, TRUE )
```

6.5.6 CSV_GetInstrumentNo

Description Get the instrument number.

Declaration `CSV_GetInstrumentNo( iSerialNo AS Integer )`

Remarks The `CSV_GetInstrumentNo` routine returns the serial number of the system.

Parameters

`iSerialNo`	`out`	The serial number of the system.

Return Codes

`none`

See Also `CSV_GetInstrumentName`, `CSV_GetInstrumentFamily`

Example The example uses the `CSV_GetInstrumentNo` routine to get the instrument number and displays it.

```
DIM iSerialNo AS Integer

CSV_GetInstrumentNo( iSerialNo )
MMI_PrintInt( 0, 1, 20, iSerialNo, TRUE )
```

6.5.7 CSV_GetInstrumentFamily

Description Get information about the system.

Declaration
```
CSV_GetInstrumentFamily(
          Family AS TPS_Fam_Type )
```

Remarks The `CSV_GetInstrumentFamily` routine returns the class and the instrument type of the system (see description of the data structure `TPS_Fam` for return values).

TPS_Sim	Always sets `Familiy.lSimulator` to `TRUE`.

Parameters

`Family`	`out`	Contains the class and instrument type data. See description of the data structure `TPS_Fam` for return values.

See Also `CSV_GetInstrumentName`, `CSV_GetInstrumentNo`

Example The example uses the `CSV_GetInstrumentFamily` routine to get information about the instrument and displays it.

```
DIM Family AS TPS_Fam_Type

CSV_GetInstrumentFamily( Family )
MMI_PrintInt( 0, 1, 10, Family.iClass, TRUE )
IF (Family.lSimulator) THEN
  MMI_PrintString( 0, 2, 10, "ON TPS_SIM", TRUE)
END IF
```

6.5.8 CSV_GetSWVersion

Description Get the version of the system software.

Declaration

```
CSV_GetSWVersion( iRelease AS Integer,
                  iVersion AS Integer )
```

Remarks The `CSV_GetSWVersion` routine returns the Release number and the number of the system software version. These numbers can be interpreted together as software identification (`Release.Version`, e.g. 1.05).

TPS_Sim	Delivers the version of the simulator.

Parameters

`iRelease`	`out`	value of the Release number can be in the range from 0 to 99
`iVersion`	`out`	value of the version number can be in the range from 0 to 99

See Also

Example The example uses the `CSV_GetSWVersion` routine to get the system software version and displays it.

```
DIM iRelease AS Integer
DIM iVersion AS Integer

CSV_GetSWVersion( iRelease, iVersion )
MMI_PrintVal( 0, 0, 6, 2,
              iRelease + iVersion / 100, TRUE )
```

6.5.9 CSV_GetGBIVersion

Description Returns the release number of the GeoBASIC interpreter.

Declaration

```
CSV_GetGBIVersion(
           iRelease    as Integer,
           iVersion    as Integer,
           iSubVersion as Integer )
```

Remarks This function returns the release version of the running GeoBASIC interpreter.

Parameters

iRelease	out	Release number
iVersion	Out	Version Number
iSubVersion	out	Subversion number

Return-Codes

RC_OK	Successful termination.

Example This example shows the currently used GeoBASIC interpreter release number.

```
DIM iRel       As Integer
DIM iVer       As Integer
DIM iSubVer    As Integer

MMI_CreateTextDialog(
     6, "-CSV-", "Test CSV", "no help available")
CSV_GetGBIVersion (iRel, iVer, iSubVer)
MMI_PrintStr(0, 0,
     "GBI: "+Str$(iRel) + "." +
     Str$(iVer) +" ."+Str$(iSubVer), TRUE)
MMI_DeleteDialog()
```

6.5.10 CSV_GetElapseSysTime

Description Returns the difference between a reference time and the system time.

Declaration

```
CSV_GetElapseSysTime( iRefTime AS Integer,
                      iElapse  AS Integer )
```

TPS_Sim	Use PC time base. Time resolution is one second.

Remarks The routine `CSV_GetElapseSysTime` returns the difference of between a given reference time `iRefTime` and the systems time. Whenever the system starts up, the system time is reset.

Parameters

`iRefTime`	`in`	The reference time.
`iElapse`	`out`	The difference between `iRefTime` and the system time. The difference is returned in [ms].

See Also `CSV_GetSysTime`, `CSV_GetDateTime`

Example The example uses the routine `CSV_GetElapseSysTime` to get a time difference.

```
DIM iElapse  AS Integer
DIM iRefTime AS Integer

CSV_GetSysTime(iRefTime)'returns reference time
' do something. . .
CSV_GetElapseSysTime( iRefTime, iElapse )
MMI_PrintInt ( 0, 0, 20, iElapse, TRUE )
```

6.5.11 CSV_GetSysTime

Description Returns the system time.

Declaration `CSV_GetSysTime( iTime AS Integer )`

Remarks The routine returns the systems time. Whenever the system starts up, the system time is reset.

TPS_Sim	Delivers the system up time of the PC.

Parameters

`iTime`	`out`	The system time in ms.

See Also `CSV_GetElapseSysTime`, `CSV_GetDateTime`

Example See `CSV_GetElapsedTime`.

6.5.12 CSV_GetLRStatus

Description Returns the status of the system.

Declaration `CSV_GetLRStatus( iLRStatus AS Integer )`

Remarks The routine `CSV_GetLRStatus` returns the mode of the system. The system can either be in local or in Remote mode. For Release 1.0 this function always delivers local mode as an answer.

Note	This function is reserved for future purposes and has no special usage in the current implementation.
TPS_Sim	Always delivers `LOCAL_MODE`.

Parameters

`iLRStatus` The mode of the system. Possible values for the `iLRStatus` are:

Mode	Value	Comment
`LOCAL_MODE`	`0`	local mode
`REMOTE_MODE`	`1`	Remote mode

Example The example uses the routine `CSV_GetLRStatus` to get the mode of the system.

```
DIM iLRStatus AS Integer

CSV_GetLRStatus( iLRStatus )
MMI_PrintInt( 0, 0, 10, iLRStatus, TRUE )
```

6.5.13 CSV_SetGuideLight

Description Set the guide light intensity.

Declaration `CSV_SetGuideLight( BYVAL iLight AS Integer )`

Remarks Sets the guide light intensity.

Parameters

`iLight` `in` Guide light intensity

Value	Meaning
`CSV_EGL_OFF`	Switching off
`CSV_EGL_LOW`	Low intensity
`CSV_EGL_MID`	Middle intensity
`CSV_EGL_HIGH`	High intensity

Return Codes

`RC_SYSBUSY`	EDM is busy. Guide light cannot be switched.
`RC_NOT_IMPL`	Guide light Hardware is not available

Example Switch off the Light guide.

```
CSV_SetGuideLight( CSV_EGL_OFF )
```

6.5.14 CSV_Laserpointer

Description Switch on / off the laser pointer.

Declaration

```
CSV_Laserpointer( BYVAL lLaser AS Logical )
```

Remarks Switches on / off the laser pointer.

Parameters

lLaser	in	Switch on / off the Laser pointer (TRUE = on, FALSE = off)

Return Codes

RC_SYSBUSY	EDM is busy. Laser pointer cannot be switched.
RC_NOT_IMPL	Laser pointer Hardware is not available.

Example Switch off the laser pointer.

```
CSV_Laserpointer( FALSE )
```

6.5.15 CSV_MakePositioning

Description Do an absolute positioning.

Declaration

```
CSV_MakePositioning(BYVAL dHz AS Double,
                    BYVAL dV  AS Double)
```

Remarks Absolute positioning of the Theodolite axes to the desired angles with the currently active tolerance for positioning. If any control function is active at the point of call, it will be cancelled and the positioning will be performed. After the positioning the controller will be automatically activated for manual input for the moving device. When starting the positioning the calling application has to take care that a valid inclination plane is available for an angle measure, as it can normally not be redone during positioning.
The positioning is done with the planes valid at the beginning of

it. During the process no inclination will be measured. The used positioning method can cause inexact results, especially for steep V > ~25 GON

Parameters

`dHz`	in	Corrected Hz-angle [Radiant]
`dV`	in	Corrected V-angle [Radiant]

Return Codes

`RC_IVPARAM`	No valid positioning angle.
`CSV_DETENT_ERROR`	target angle is out of the limits or a collision is occurred.
`CSV_TIMEOUT`	time out at positioning of one or both axes
`CSV_MOTOR_ERROR`	error in subsystem
`CSV_ANGLE_ERROR`	error at measuring the angle
`RC_FATAL`	fatal error
`RC_ABORT`	system abort

See Also `BAP_PosTelescope`

Example Perform an absolute positioning.

```
CSV_MakePositioning( 0, 2*atn(1) ) ' (0, Pi/2)
```

6.5.16 CSV_ChangeFace

Description Do an absolute positioning to the opposite.

Declaration `CSV_ChangeFace( )`

Remarks Perform positioning into the position opposite to the current. If any control function is active at the point of call, it will be cancelled and the positioning will be performed. After the positioning the controller will be automatically activated for manual input for the moving device. When starting the positioning the calling application has to take care that a valid inclination plane is available for an angle measure, as it can normally not be redone during positioning.

The positioning is done with the planes valid at the beginning of it. During the process no inclination will be measured. The used positioning method can cause inexact results, especially for steep V > ~25 GON

Parameters

`none`

Return Codes

RC_IVPARAM	No valid positioning angle.
CSV_DETENT_ERROR	target angle is out of the limits or a collision is occurred.
CSV_TIMEOUT	time out at positioning of one or both axes
CSV_MOTOR_ERROR	error in subsystem
CSV_ANGLE_ERROR	error at measuring the angle
RC_FATAL	fatal error
RC_ABORT	system abort

See Also BAP_PosTelescope

Example Perform a change of face.

```
CSV_ChangeFace()
```

6.5.17 CSV_SetLockStatus

Description Sets the current state of the locking facility.

Declaration `CSV_SetLockStatus(BYVAL lOn AS Logical )`

Remarks It switches the locking facility on or off.

Parameters

lOn	in	Switches on / off the locking facility (TRUE = on, FALSE = off)

Return Codes

RC_FATAL	fatal error
RC_NOT_IMPL	if ATR hardware is not available
RC_ABORT	system abort

See Also CSV_SetLockStatus, CSV_LockIn, CSV_LockOut

Example Perform an absolute positioning.

```
CSV_SetLockStatus( TRUE ) ' switches locking on
```

6.5.18 CSV_GetLockStatus

Description Gets the current state of the locking facility.

Declaration `CSV_GetLockStatus( lOn AS Logical )`

Remarks It queries the TPS system if the locking facility is on or off.

Parameters

lOn	out	**meaning**	
		FALSE	Locking is switched off.
		TRUE	Locking is switched on.

Return Codes

RC_FATAL	fatal error
RC_NOT_IMPL	if ATR hardware is not available
RC_ABORT	system abort

See Also CSV_GetLockStatus, CSV_LockIn, CSV_LockOut

Example Perform an absolute positioning.

```
DIM l AS Logical
CSV_SetLockStatus( l ) ' queries locking
```

6.5.19 CSV_LockIn

Description Starts the locking facility.

Declaration `CSV_LockIn( )`

Remarks If ATR is switched on then locking to the target will be done. If no target available, then manual positioning will be started.

Parameters

`none`

Return Codes

`AUT_RC_NOT_ENABLED`	Theodolite without ATR or lock status not set
`AUT_RC_MOTOR_ERROR`	Error at motor control.
`AUT_RC_DETECTOR_ERROR`	Error at ATR
`AUT_RC_NO_TARGET`	No target at the detection range
`AUT_RC_BAD_ENVIRONMENT`	Bad environment at the detection range (bad light…)
`RC_NOT_IMPL`	if ATR hardware is not available

See Also `CSV_GetLockStatus`, `CSV_SetLockStatus`, `CSV_LockOut`

Example This example starts locking.

```
CSV_LockIn( )
```

6.5.20 CSV_LockOut

Description Stops a running locking function.

Declaration `CSV_LockOut( )`

Parameters

none

Return Codes

RC_OK	no error
RC_NOT_IMPL	if ATR hardware is not available

See Also CSV_GetLockStatus, CSV_SetLockStatus, CSV_LockIn

Example This example stops locking.

```
CSV_LockOut( )
```

6.5.21 CSV_SetATRStatus

Description Sets the current state of Automatic Target Recognition.

Declaration `CSV_SetATRStatus(BYVAL lOn AS Logical )`

Remarks It switches the ATR facility on or off.

Parameters

lOn	in	Switches on / off the ATR facility (TRUE = on, FALSE = off)

Return Codes

RC_FATAL	fatal error
RC_ABORT	system abort
RC_NOT_IMPL	if ATR hardware is not available

Example Perform an absolute positioning.

```
CSV_SetATRStatus( TRUE ) ' switches ATR on
```

6.5.22 CSV_GetATRStatus

Description Gets the current ATR state.

Declaration `CSV_GetATRStatus(lOnl AS Logical )`

Remarks It queries the TPS system if the ATR facility is on or off.

Parameters

`lOn`	`out`	**meaning**	
		`FALSE`	ATR is switched off.
		`TRUE`	ATR is switched on.

Return Codes

`RC_FATAL`	fatal error
`RC_ABORT`	system abort
`RC_NOT_IMPL`	if ATR hardware is not available

Example Get current ATR status.

```
DIM l AS Logical

CSV_SetATRStatus( l )
```

6.5.23 CSV_Delay

Description This routine delays the execution of a program.

Declaration `CSV_Delay( BYVAL iDelay AS Integer )`

Remarks This routine delay using the operating system, that means that other Theodolite tasks can run during the delay (It is not a busy waiting).

Note	Avoid busy waiting using `FOR` - or `WHILE` loops.

TPS_Sim	Delay resolution is one second. `iDelay` < 500 means no delay

Parameters

`iDelay`	in	Time to delay [ms]

Example This example „waits“ 2 seconds until it goes on.

```
CSV_Delay( 2000 )
```

6.5.24 CSV_SetTargetType

Description Set the target type for distance measurements.

Declaration

```
CSV_SetTargetType(
             BYVAL iTargetType as Integer )
```

Remarks This routine sets the target type for distance measurements. The target type defines if the next distance measurement happens with prism or without prism.

Parameters

`iTarget Type`	in	Target type

Valid target types	**Meaning**
`CSV_WITH_REFLECTOR`	With reflector
`CSV_WITHOUT_REFLECTOR`	Without reflector

Return-Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	Instrument don’t support this target type

See `CSV_ GetTargetType, BAP_SetMeasPrg, BAP_GetMeasPrg`

Example The example sets a target type without prism.

```
CSV_SetTargetType(CSV_WITHOUT_REFLECTOR)
```

6.5.25 CSV_GetTargetType

Description Get the target type for distance measurements.

Declaration `CSV_GetTargetType( iTargetType as Integer )`

Remarks This routine fetches the target type for distance measurements. The target type defines if the next distance measurement happens with prism or without prism.

Parameters

iTargetType	out	Target type

Valid target types	Meaning
CSV_WITH_REFLECTOR	With reflector
CSV_WITHOUT_REFLECTOR	Without reflector

Return-Codes

RC_OK	Successful termination.

See `CSV_ SetTargetType, BAP_SetMeasPrg, BAP_GetMeasPrg`

Example The example fetches the target type.

```
DIM iTargetType AS Integer

CSV_GetTargetType(iTargetType)
```

6.5.26 CSV_SetPrismType

Description Sets the used prism.

Declaration `CSV_SetPrismType( BYVAL iPrism as Integer)`

Remarks This routine sets the used prism `iPrism` (`BAP_PRISM_ROUND, BAP_PRISM_TAPE, BAP_PRISM_MINI, BAP_PRISM_360, BAP_PRISM_USER1, BAP_PRISM_USER2` or `BAP_PRISM_USER3`). If `iPrism` is one of the user defined prisms and this prism is actually not defined then this routine will return `RC_IVRESULT`.

Parameters

`iPrism`	`in`	Used prism

Return-Codes

`RC_OK`	Successful termination.
`RC_IVRESULT`	Prism not defined.

See `CSV_GetPrismType`

Example The example sets the 360 degrees prism.

```
CSV_SetPrismType(BAP_PRISM_360)
```

6.5.27 CSV_GetPrismType

Description Returns the used prism.

Declaration `CSV_GetPrismType(iPrism as Integer)`

Remarks This routine returns the used prism `iPrism`.

Parameters

`iPrism`	`out`	Used prism

Return-Codes

`RC_OK`	Successful termination.

See `CSV_SetPrismType`

Example The example returns the used prism.

```
DIM iPrism AS Integer

CSV_SetPrismType( iPrism )
```

6.5.28 CSV_SetLaserPlummet

Description Switches the laser plummet.

Declaration `CSV_SetLaserPlummet( BYVAL lOn as Logical )`

Remarks This function switches the optional laser plummet. The plummet will be switched off automatically after 3 minutes.

Parameters

`lOn`	`in`	`TRUE`: switch plummet on

Return-Codes

`RC_OK`	Successful termination.

See `CSV_GetLaserPlumet, CSV_GetInstrumentFamily`

6.5.29 CSV_GetLaserPlummet

Description Returns the laser plummet state.

Declaration `CSV_GetLaserPlummet( lOn as Logical )`

Remarks This function returns the state of the optional laser plummet.

Parameters

`lOn`	`out`	`TRUE`: plummet is switched on

Return-Codes

`RC_OK`	Successful termination.

See `CSV_SetLaserPlumet, CSV_GetInstrumentFamily`

6.5.30 CSV_CheckAltUserTask

Description Returns if an alternative user-task was running.

Declaration `CSV_CheckAltUserTask(lWasRunning AS Logical)`

Remarks This routine returns if an alternative user-task was running. One of these tasks can be started by pressing one of the buttons `FNC`, `Shift-FNC`, `PROG`, `Shift-PROG`, `Light` and `Level`.

Functions, executed by an alternative user task, can change several system settings. The `CSV_CheckAltUserTask` routine notifies the running GeoBASIC application that it was interrupted by another program. With this information, the GeoBASIC program is able to respond to these changes.

After processing this information, the subroutine `CSV_ResetAltUserTask` must be called.

Parameters

`lWasRunning`	`out`	`TRUE`: a task was running

Return-Codes

`RC_OK`	Successful termination.

See `CSV_ResetAltUserTask`

Example The example checks if an alternative task was running.

```
CSV_CheckAltUserTask( l )
IF l THEN
    send("AltUserTask: was running")
  ELSE
    send("AltUserTask: was NOT running")
    END IF
CSV_ResetAltUserTask( )
```

6.5.31 CSV_ResetAltUserTask

Description Resets the “alternative user-task was running” flag.

Declaration `CSV_ResetAltUserTask( )`

Remarks This routine restarts the alternative user-task tracking.

Parameters

`none`

Return-Codes

`RC_OK`	Successful termination.

See `CSV_CheckAltUserTask`

6.5.32 CSV_SysCall

Description Call a system function.

Declaration `CSV_SysCall( BYVAL CId AS CIdType)`

Remarks This routine works in two different forms depending on the parameter `CId`. If `CId` is a system function `CSV_SysCall` calls the function directly. In the other form the `CId` is a system event. In this case `CSV_SysCall` calls the system function (or dialog, menu, macro, application) which is defined in the current configuration to handle this event. See description of the system functions and system events in the appendix H.

Parameters

`CId`	`in`	System function or system event

Return-Codes

`RC_OK`	Successful termination.
`RC_IVPARAM`	No function defined to handle the event
`RC_NOT_IMPL`	System function not available

See `CSV_SysCallAvailable`

Example The example calls the system function electronic level.

```
CSV_SysCall(CSV_SFNC_Libelle)
```

6.5.33 CSV_SysCallAvailable

Description Check if system function is available.

Declaration

```
CSV_SysCallAvailable(
                   BYVAL CId AS CIdType,
                   lAvailable AS Logical )
```

Remarks This routine checks, if it is possible to call the function `CId` if `CId` is a system function or if there is a function defined and available to handle the event `CId` if `CId` is an system event. See the description of system functions and system events in appendix H.

Parameters

`CId`	in	System function or system event.
`lAvailable`	out	`TRUE`: System function is available or function (dialog, menu, macro, application) to handle the event is defined and available.

Return-Codes

`RC_OK`	Successful termination.

See `CSV_SysCall`

Example The example checks if the red laser is available.

```
DIM lAvailable AS Logical

CSV_SysCallAvailable(CSV_SFNC_ToggleRedLaser,
                     lAvailable)
```

6.5.34 CSV_LibCall

Description Call a GeoBASIC or C application routine of another program.

Declaration

```
CSV_LibCall( BYVAL PrgName  AS String255,
             BYVAL FuncName AS String255,
             BYVAL CptShort AS _Token )
```

Remarks This routine is used to call a GeoBASIC routine which is defined in another program. Please refer also to Appendix

Parameters

`PrgName`	`in`	Program name
`FuncName`	`in`	Function name
`CptShort`	`In`	Short caption for dialogs

Return-Codes

`RC_OK`	Successful termination.

See `CSV_LibCallAvailable`

Example See `IAC.GBS` and `IAC2.GBS` for an example.

6.5.35 CSV_LibCallAvailable

Description Check if the GeoBASIC routine from another program is available.

Declaration

```
CSV_LibCallAvailable(
             BYVAL PrgName  AS String255,
             BYVAL FuncName AS String255,
             lAvailable     AS Logical )
```

Remarks	This routine checks if a GeoBASIC routine which is defined in another program is available. Usually this means that it checks if the other program is loaded and the specified entry point exists.

Parameters

`PrgName`	`in`	Program name
`FuncName`	`in`	Function name
`lAvailable`	`out`	Routine is available

Return-Codes

`RC_OK`	Successful termination.

See `CSV_LibCall`

Example See `IAC.GBS` and `IAC2.GBS` for an example.

```
                                | "(" Expression ")" )

StatementSequence ::=     { [ ErrorLabel ] Statement }
ErrorLabel        ::=  HandlerLabel ":"
Statement         ::=  ( SequentialStatement |
                             SelectionStatement |
                             LoopStatement |
                             OnErrorStatement |
                             ExitStatement |
                             IOStatement )

SequentialStatement::=    ( Assignment | SubroutineCall )
Assignment        ::=  Variable "=" Expression

SelectionStatement ::=    ( IfStatement | SelectStatement )
IfStatement       ::=  "IF" Condition "THEN"
                             StatementSequence
                       { "ELSEIF" Condition "THEN"
                             StatementSequence }
                       [ "ELSE"
                             StatementSequence ]
                       "END IF"
Condition         ::=  LogicalExpression
SelectStatement        ::=   "SELECT CASE" Expression
                       { "CASE" ConstantList
                             StatementSequence }
                       [ "CASE ELSE"
                             StatementSequence ]
                       "END SELECT"
ConstantList      ::=  Constant { "," Constant }


LoopStatement ::=      ( WhileLoop | UntilLoop | ForLoop )
WhileLoop         ::=  "DO" [ "WHILE" Condition ]
                             StatementSequence
                       "LOOP"
UntilLoop         ::=  "DO"
                             StatementSequence
                       "LOOP" [ "UNTIL" Condition ]

ForLoop           ::=  "FOR" CounterName "=" Start "TO"
                             Finish [ "STEP" Step ]
                             StatementSequence
                       "NEXT" [ CounterName ]
Condition         ::=  LogicalExpression
Start             ::=  IntegerExpression
```

```
Finish              ::=  IntegerExpression
Step                ::=  IntegerExpression
ExitStatement       ::=  ( LoopExit | RoutineExit )
LoopExit            ::=  "EXIT"

RoutineDeclaration  ::=  ( SubroutineDeclaration |
                           FunctionDeclaration )
SubroutineDeclaration    ::=  [ "GLOBAL" ] "SUB"
SubroutineName
                              [ ParameterList ]
                                        Body
                              "END" [ SubroutineName ]
FunctionDeclaration ::=  "FUNCTION" FunctionName ParameterList
                              "AS" DataTypeName
                                        Body
                              "END" [ FunctionName ]
ParameterList       ::=  "(" [ ParameterSpecification { ","
                              ParameterSpecification } ] ")"
ParameterSpecification   ::=  [ "BYVAL" ] ParameterName
                              "AS" DataTypeName
Body                ::=  { CVTDeclaration |
                              LabelDeclaration } CodePart
CVTDeclaration      ::=  ( ConstantDeclaration |
                              VariableDeclaration |
                              TypeDeclaration )
CodePart            ::=  StatementSequence
ExitStatement       ::=  ( LoopExit | RoutineExit )
RoutineExit         ::=  "EXIT" ( "SUB" | "FUNCTION" )

SubroutineCall      ::=  [ "CALL" ] SubroutineName
                              [ ActualParameterList ]
FunctionCall        ::=  FunctionName ActualParameterList
ActualParameterList ::=  "(" [ Expression { "," Expression } ] ")"

LabelDeclaration    ::=  "LABEL" HandlerLabel
OnErrorStatement    ::=  "ON ERROR" ( "RESUME NEXT" | "GOTO"
                              ( HandlerLabel | "0" ) )
HandlerLabel        ::=  Name
ErrorLabel          ::=  HandlerLabel ":"

Program             ::=  "PROGRAM" ProgramName
                              { CVTDeclaration |
                              RoutineDeclaration }
                         "END" [ ProgramName ]
IOStatement         ::=  "WRITE" Expression
```

AppInfo Syntax

AppInfo	::=	**"APPINFO "** [GeneralSection] { GlobalSubSection } **"END" "APPINFO"**
GeneralSection	::=	**"GENERAL"** { GeneralSectionEntry } **"END" "GENERAL"**
GlobalSubSection	::=	**"ENTRYPOINT"** GlobalSubName { GlobalSubSectionEntry } **"END"** [GlobalSubName]
GeneralSectionEntry	::=	**"SET"** GeneralSectionKey StringConstant
GlobalSubSectionEntry	::=	**"SET"** GlobalSubSectionKey StringConstant
GeneralSectionKey	::=	**"AUTHOR"** | **"DESC"** | **"THEOMODEL"**
GlobalSubSectionKey	::=	**"CAPSH"** | **"DESC"** | **"HELP"**

Appendix B — GLOSSARY

ATR

Au**t**omatic **R**ecognition means that the TPS can search and recognise a target automatically.

BAP

This means **B**asic **A**pplication **P**rograms. This subsystem contains several basic functionalities:

- Setup the configuration
- Distance measurement and entering the manual distance
- Positioning the telescope

CSV

This abbreviation stands for **C**entral **S**er**V**ices.

The subsystem contains several administration functions:

- Clock and time functions
- Functions for instrument identification (instrument name, instrument family, ...)
- Functions for system information (local, Remote, locking,..)
- Functions for positioning the theodolite

External Routine

A routine that resides in a different part of the TPS-1100-System. Its interface must conform to certain rules, and it must be made known to the compiler, i.e. the definition must be compiled and linked to it. External routines can be called from a GeoBASIC routine like any other subroutine. They return an error code in the predefined variable `Err`.

TPS

Theodolite **P**ositioning **S**ystem

TPS-1100-System

The target hardware and its software, comprising, among others, the GeoBASIC loader objects.

Loader Object

Strictly speaking this is the result of the compilation of a program; a binary file that can be downloaded onto the target hardware. In a more general sense it also used as a synonym for "program".

GM

The section **G**eodesy **M**athematics contains mathematical functions, which are often used in geodesy applications, for example calculation of intersection , clothoid, average values, triangle etc. . Furthermore, the accuracy of deviated values can be calculated.

GSI

This abbreviation stands for **G**eodesy **S**erial **I**nterface.

The subsystem contains several functions:

- Functions for registration (point number, rec.-mask,..)
- Functions for create, show, update or delete dialogs
- Functions for fetching data from WIR data pool

MMI

The subsystem MMI (**M**an **M**achine **I**nterface) manages the user interaction with the system.

Module

A GeoBASIC subroutine that has been declared with the prefix `global` and can be called from the TPS-1100-System. Modules are numbered sequentially, and it is this number that is made known to the loader and the TPS-1100-System.

Predefined Type

Structured types used by external routines can be made known to the compiler in a way similar to the definition of the interface of an external routine. Their definition must be compiled and linked to the GeoBASIC compiler.

Predefined Variable

There is one GeoBASIC variable, `Err`, that is defined for all programs. It is used to contain the return code of an external routine. Its value is passed to the TPS-1100-System upon completion of the execution of a module.

Program

A collection of GeoBASIC modules that have some commonality, such as common (global) variables. A GeoBASIC program contains one or more modules, plus any number of global types, variables, subroutines, and functions. A program is compiled in its entirety; this produces a loader object that is subsequently downloaded onto the target hardware.

Routine

Generic name for subroutines, functions, modules, and external routines. Subroutines and functions are entirely local to a GeoBASIC program and not accessible from outside. Modules can be called from outside, i.e. from the TPS-1100-System. External routines are routines that reside somewhere else in the TPS-1100-System, but are called from a GeoBASIC routine.

TMC

The **T**heo **M**easurement function contains some fundamental measurement procedures.

_Token

Special kind of string parameters to be passed to TPS-1100-system software routines. Actual values of such parameters must be of type string literal or string constant. The compiler generates automatically a token number out the string value, which will be used as an index from the interpreter. But, of course, this has to be calculated during compile time and cannot be a runtime calculated one.

Appendix C — LIST OF RESERVED WORDS

The following words are reserved by GeoBASIC and cannot be used as names (identifiers) in a GeoBASIC program. They must be written as given, except that upper and lower case letters are not distinguished.

`AND`	`FOR`	`SELECT`
`AS`	`FUNCTION`	`STEP`
`BYVAL`	`GLOBAL`	`STRING`
`CALL`	`IF`	`SUB`
`CASE`	`LABEL`	`THEN`
`CONST`	`LOOP`	`TO`
`DIM`	`MOD`	`TYPE`
`DO`	`NEXT`	`UNTIL`
`ELSE`	`NOT`	`WHILE`
`ELSEIF`	`ON`	`WRITE`
`END`	`OR`	
`EXIT`	`PROGRAM`	

Appendix D — DERIVED MATHEMATICAL FUNCTIONS

The following is a list of non intrinsic mathematical functions that can be derived from the intrinsic math functions provided with GeoBASIC:

Function	GeoBASIC equivalent
Secant	Sec(X) = 1 / Cos(X)
Cosecant	Cosec(X) = 1 / Sin(X)
Cotangent	Cotan((X) = 1 / Tan(X)
Inverse Sine	Arcsin(X) = Atn(X / Sqr(-X * X + 1))
Inverse Cosine	Arccos(X) = Atn(-X / Sqr(-X * X + 1)) + 1.5708
Inverse Secant	Arcsec(X) = Atn(X / Sqr(X * X - 1)) + Sgn(Sgn(X) -1) * 1.5708
Inverse Cosecant	Arccosec(X) = Atn(X/Sqr(X * X - 1)) + (Sgn(X) - 1) * 1.5708
Inverse Cotangent	Arccotan(X) = Atn(X) + 1.5708

Function	GeoBASIC equivalent
Hyperbolic Sine	HSin(X) = (Exp(X) - Exp(-X)) / 2
Hyperbolic Cosine	HCos(X) = (Exp(X) + Exp(-X)) / 2
Hyperbolic Tangent	HTan(X) = (Exp(X) - Exp(-X)) / (Exp(X) + Exp(-X))
Hyperbolic Secant	HSec(X) = 2 / (Exp(X) + Exp(-X))
Hyperbolic Cosecant	HCosec(X) = 2 / (Exp(X) - Exp(-X))
Hyperbolic Cotangent	HCotan(X) = (Exp(X) + Exp(-X)) / (Exp(X) - Exp(-X))
Inverse Hyperbolic Sine	HArcsin(X) = Log(X + Sqr(X * X + 1))
Inverse Hyperbolic Cosine	HArccos(X) = Log(X + Sqr(X * X - 1))

Function	GeoBASIC equivalent
Inverse Hyperbolic Tangent	HArctan(X) = Log((1 + X) / (1 - X)) / 2
Inverse Hyperbolic Secant	HArcsec(X) = Log((Sqr(-X * X + 1) + 1) / X)
Inverse Hyperbolic Cosecant	HArccosec(X) = Log((Sgn(X) * Sqr(X * X + 1) +1) / X)
Inverse Hyperbolic Cotangent	HArccotan(X) = Log((X + 1) / (X - 1)) / 2
Logarithm	LogN(X) = Log(X) / Log(N)

Appendix E— GeoFont

Appendix F — SYSTEM RETURN CODES

Errors which may occur during execution of a GeoBASIC program are associated with several subsystems which are supported by GeoBASIC. For each subsystem we know a different range of return values which will be listed in the following tables. Since some of the explanations of the return values are dependent on the context see the descriptions of the system functions in the reference manual too.

TPS 0 0x0

RetCodeName	Value	Hex	Description
RC_OK	0	0x0	Function successfully completed.
RC_UNDEFINED	1	0x1	Unknown error, result unspecified.
RC_IVPARAM	2	0x2	Invalid parameter detected. Result unspecified.
RC_IVRESULT	3	0x3	Invalid result.
RC_FATAL	4	0x4	Fatal error.
RC_NOT_IMPL	5	0x5	Not implemented yet.
RC_TIME_OUT	6	0x6	Function execution timed out. Result unspecified.
RC_SET_INCOMPL	7	0x7	Parameter setup for subsystem is incomplete.
RC_ABORT	8	0x8	Function execution has been aborted.
RC_NOMEMORY	9	0x9	Fatal error - not enough memory.
RC_NOTINIT	10	0xA	Fatal error - subsystem not initialized.
RC_SHUT_DOWN	12	0xC	Subsystem is down.
RC_SYSBUSY	13	0xD	System busy/already in use of another process. Cannot execute function.
RC_HWFAILURE	14	0xE	Fatal error - hardware failure.
RC_ABORT_APPL	15	0xF	Execution of application has been aborted (SHIFT-ESC).
RC_LOW_POWER	16	0x10	Operation aborted - insufficient power supply level.
RC_IVVERSION	17	0x11	Invalid version of file, ...
RC_BATT_EMPTY	18	0x12	Battery empty
RC_NO_EVENT	20	0x14	no event pending.
RC_OUT_OF_TEMP	21	0x15	out of temperature range

RetCodeName	Value	Hex	Description
RC_INSTRUMENT_TILT	22	0x16	instrument tilting out of range
RC_COM_SETTING	23	0x17	communication error
RC_NO_ACTION	24	0x18	RC_TYPE Input 'do no action'
RC_SLEEP_MODE	25	0x19	Instr. run into the sleep mode

ANG 256 0x100

RetCodeName	Value	Hex	Description
ANG_ERROR	257	0x101	Angles and Inclinations not valid
ANG_INCL_ERROR	258	0x102	inclinations not valid
ANG_BAD_ACC	259	0x103	value accuracy not reached
ANG_BAD_ANGLE_ACC	260	0x104	angle-accuracy not reached
ANG_BAD_INCLIN_ACC	261	0x105	inclination accuracy not reached
ANG_WRITE_ PROTECTED	266	0x10A	no write access allowed
ANG_OUT_OF_RANGE	267	0x10B	value out of range
ANG_IR_OCCURED	268	0x10C	function aborted due to interrupt
ANG_HZ_MOVED	269	0x10D	hz moved during incline measurement
ANG_OS_ERROR	270	0x10E	troubles with operation system
ANG_DATA_ERROR	271	0x10F	overflow at parameter values
ANG_PEAK_CNT_UFL	272	0x110	too less peaks
ANG_TIME_OUT	273	0x111	reading timeout
ANG_TOO_MANY_EXPOS	274	0x112	too many exposures wanted
ANG_PIX_CTRL_ERR	275	0x113	picture height out of range
ANG_MAX_POS_SKIP	276	0x114	positive exposure dynamic overflow
ANG_MAX_NEG_SKIP	277	0x115	negative exposure dynamic overflow
ANG_EXP_LIMIT	278	0x116	exposure time overflow
ANG_UNDER_EXPOSURE	279	0x117	picture under-exposured
ANG_OVER_EXPOSURE	280	0x118	picture over-exposured
ANG_TMANY_PEAKS	300	0x12C	too many peaks detected
ANG_TLESS_PEAKS	301	0x12D	too less peaks detected
ANG_PEAK_TOO_SLIM	302	0x12E	peak too slim
ANG_PEAK_TOO_WIDE	303	0x12F	peak to wide
ANG_BAD_PEAKDIFF	304	0x130	bad peak difference
ANG_UNDER_EXP_PICT	305	0x131	too less peak amplitude
ANG_PEAKS_ INHOMOGEN	306	0x132	in-homogenous peak amplitudes
ANG_NO_DECOD_POSS	307	0x133	no peak decoding possible
ANG_UNSTABLE_DECOD	308	0x134	peak decoding not stable

RetCodeName	Value	Hex	Description
ANG_TLESS_FPEAKS	309	0x135	too less valid fine-peaks

ATA 512 0x200

RetCodeName	Value	Hex	Description
ATA_RC_NOT_READY	512	0x200	ATR-System is not ready.
ATA_RC_NO_RESULT	513	0x201	Result isn't available yet.
ATA_RC_SEVERAL_TARGETS	514	0x202	Several Targets detected.
ATA_RC_BIG_SPOT	515	0x203	Spot is too big for analyze.
ATA_RC_BACKGROUND	516	0x204	Background is too bright.
ATA_RC_NO_TARGETS	517	0x205	No targets detected.
ATA_RC_NOT_ACCURAT	518	0x206	Accuracy worse than asked for.
ATA_RC_SPOT_ON_EDGE	519	0x207	Spot is on the edge of the sensing area.
ATA_RC_BLOOMING	522	0x20A	Blooming or spot on edge detected.
ATA_RC_NOT_BUSY	523	0x20B	ATR isn't in a continuous mode.
ATA_RC_STRANGE_LIGHT	524	0x20C	Not the spot of the own target illuminator.
ATA_RC_V24_FAIL	525	0x20D	Communication error to sensor (ATR).
ATA_RC_HZ_FAIL	527	0x20F	No Spot detected in Hz-direction.
ATA_RC_V_FAIL	528	0x210	No Spot detected in V-direction.
ATA_RC_HZ_STRANGE_L	529	0x211	Strange light in Hz-direction.
ATA_RC_V_STRANGE_L	530	0x212	Strange light in V-direction.
ATA_SLDR_TRANSFER_PENDING	531	0x213	On multiple `ATA_SLDR_OpenTransfer`.
ATA_SLDR_TRANSFER_ILLEGAL	532	0x214	No `ATA_SLDR_OpenTransfer` happened.
ATA_SLDR_DATA_ERROR	533	0x215	Unexpected data format received.
ATA_SLDR_CHK_SUM_ERROR	534	0x216	Checksum error in transmitted data.
ATA_SLDR_ADDRESS_ERROR	535	0x217	Address out of valid range.
ATA_SLDR_INV_LOADFILE	536	0x218	Firmware file has invalid format.
ATA_SLDR_UNSUPPORTED	537	0x219	Current (loaded) Firmware doesn't support upload.

EDM 768 0x300

RetCodeName	Value	Hex	Description
EDM_SYSTEM_ERR	769	0x301	Fatal EDM sensor error. See for the exact reason the original EDM sensor error number. In the most cases a service problem
EDM_INVALID_COMMAND	770	0x302	Invalid command or unknown command, see command syntax.
EDM_BOOM_ERR	771	0x303	Boomerang error.
EDM_SIGN_LOW_ERR	772	0x304	Received signal to low, prism to far away, or natural barrier, bad environment, etc.
EDM_DIL_ERR	773	0x305	DIL distance measurement out of limit.
EDM_SIGN_HIGH_ERR	774	0x306	Received signal to strong, prism to near, stranger light effect.
EDM_DEV_NOT_ INSTALLED	778	0x30A	Device like EGL, DL is not installed.
EDM_NOT_FOUND	779	0x30B	Search result invalid. For the exact explanation see in the description of the called function.
EDM_ERROR_RECEIVED	780	0x30C	Communication ok, but an error reported from the EDM sensor.
EDM_MISSING_SRVPWD	781	0x30D	No service password is set.
EDM_INVALID_ANSWER	782	0x30E	Communication ok, but an unexpected answer received.
EDM_SEND_ERR	783	0x30F	Data send error, sending buffer is full.
EDM_RECEIVE_ERR	784	0x310	Data receive error, like parity buffer overflow.
EDM_INTERNAL_ERR	785	0x311	Internal EDM subsystem error.
EDM_BUSY	786	0x312	Sensor is working already, abort current measuring first.
EDM_NO_ MEASACTIVITY	787	0x313	No measurement activity started.
EDM_CHKSUM_ERR	788	0x314	Calculated checksum, resp. received data wrong (only in binary communication mode possible).

RetCodeName	Value	Hex	Description
EDM_INIT_OR_STOP_ ERR	789	0x315	During start up or shut down phase an error occured. It is saved in the DEL buffer.
EDM_SRL_NOT_ AVAILABLE	790	0x316	Red laser not available on this sensor HW.
EDM_MEAS_ABORTED	791	0x317	Measurement will be aborted (will be used for the lasersecurity)
EDM_SLDR_TRANSFER_ PENDING	798	0x31E	Multiple OpenTransfer calls.
EDM_SLDR_TRANSFER_ ILLEGAL	799	0x31F	No opentransfer happened.
EDM_SLDR_DATA_ ERROR	800	0x320	Unexpected data format received.
EDM_SLDR_CHK_SUM_ ERROR	801	0x321	Checksum error in transmitted data.
EDM_SLDR_ADDR_ ERROR	802	0x322	Address out of valid range.
EDM_SLDR_INV_ LOADFILE	803	0x323	Firmware file has invalid format.
EDM_SLDR_ UNSUPPORTED	804	0x324	Current (loaded) firmware doesn't support upload.
EDM_UNKNOW_ERR	808	0x328	Undocumented error from the EDM sensor, should not occur.

GMF 1024 0x400

RetCodeName	Value	Hex	Description
GM_WRONG_AREA_DEF	1025	0x401	Wrong Area Definition.
GM_IDENTICAL_PTS	1026	0x402	Identical Points.
GM_PTS_IN_LINE	1027	0x403	Points on one line.
GM_OUT_OF_RANGE	1028	0x404	Out of range.
GM_PLAUSIBILITY_ERR	1029	0x405	Plausibility error.
GM_TOO_FEW_ OBSERVATIONS	1030	0x406	To few Observations to calculate the average.
GM_NO_SOLUTION	1031	0x407	No Solution.
GM_ONE_SOLUTION	1032	0x408	Only one solution.
GM_TWO_SOLUTIONS	1033	0x409	Second solution.
GM_ANGLE_SMALLER_ 15GON	1034	0x40A	Warning: Intersection angle < 15gon.
GM_INVALID_	1035	0x40B	Invalid triangle.

RetCodeName	Value	Hex	Description
TRIANGLE_TYPE			
GM_INVALID_ ANGLE_SYSTEM	1036	0x40C	Invalid angle unit.
GM_INVALID_ DIST_SYSTEM	1037	0x40D	Invalid distance unit.
GM_INVALID_V_SYSTEM	1038	0x40E	Invalid vertical angle.
GM_INVALID_ TEMP_SYSTEM	1039	0x40F	Invalid temperature system.
GM_INVALID_ PRES_SYSTEM	1040	0x410	Invalid pressure unit.
GM_RADIUS_ NOT_POSSIBLE	1041	0x411	Invalid radius.
GM_NO_ PROVISIONAL_VALUES	1042	0x412	GM2: insufficient data.
GM_SINGULAR_MATRIX	1043	0x413	GM2: bad data
GM_TOO_MANY_ ITERATIONS	1044	0x414	GM2: bad data distr.
GM_IDENTICAL_ TIE_POINTS	1045	0x415	GM2: same tie points.
GM_SETUP_ EQUALS_TIE_POINT	1046	0x416	GM2: sta/tie point same.

TMC 1280 0x500

RetCodeName	Value	Hex	Description
TMC_NO_FULL_ CORRECTION	1283	0x503	Warning: measurement without full correction
TMC_ACCURACY_ GUARANTEE	1284	0x504	Info : accuracy can not be guarantee
TMC_ANGLE_OK	1285	0x505	Warning: only angle measurement valid
TMC_ANGLE_NO_ FULL_CORRECTION	1288	0x508	Warning: only angle measurement valid but without full correction
TMC_ANGLE_ ACCURACY_ GUARANTEE	1289	0x509	Info : only angle measurement valid but accuracy can not be guarantee
TMC_ANGLE_ERROR	1290	0x50A	Error : no angle measurement
TMC_DIST_PPM	1291	0x50B	Error : wrong setting of PPM or MM on EDM

RetCodeName	Value	Hex	Description
TMC_DIST_ERROR	1292	0x50C	Error : distance measurement not done (no aim, etc.)
TMC_BUSY	1293	0x50D	Error : system is busy (no measurement done)
TMC_SIGNAL_ERROR	1294	0x50E	Error : no signal on EDM (only in signal mode)

MEM 1536 0x600

RetCodeName	Value	Hex	Description
MEM_OUT_OF_MEMORY	1536	0x600	out of memory
MEM_OUT_OF_HANDLES	1537	0x601	out of memory handles
MEM_TAB_OVERFLOW	1538	0x602	memory table overflow
MEM_HANDLE_INVALID	1539	0x603	used handle is invalid
MEM_DATA_NOT_FOUND	1540	0x604	memory data not found
MEM_DELETE_ERROR	1541	0x605	memory delete error
MEM_ZERO_ALLOC_ERR	1542	0x606	tried to allocate 0 bytes
MEM_REORG_ERR	1543	0x607	can't reorganize memory

MOT 1792 0x700

RetCodeName	Value	Hex	Description
MOT_RC_UNREADY	1792	0x700	Motorization not ready
MOT_RC_BUSY	1793	0x701	Motorization is handling another task
MOT_RC_NOT_OCONST	1794	0x702	Not in velocity mode
MOT_RC_NOT_CONFIG	1795	0x703	Motorization is in the wrong mode or busy
MOT_RC_NOT_POSIT	1796	0x704	Not in posit mode
MOT_RC_NOT_SERVICE	1797	0x705	Not in service mode
MOT_RC_NOT_BUSY	1798	0x706	Motorization is handling no task
MOT_RC_NOT_LOCK	1799	0x707	Not in tracking mode
MOT_RC_NOT_SPIRAL	1800	0x708	Not in spiral mode

LDR 2048 0x800

RetCodeName	Value	Hex	Description
LDR_PENDING	2048	0x800	Transfer is already open
LDR_PRGM_OCC	2049	0x801	Maximal number of applications reached
LDR_TRANSFER_ ILLEGAL	2050	0x802	No Transfer is open
LDR_NOT_FOUND	2051	0x803	Function or program not found
LDR_ALREADY_EXIST	2052	0x804	Loadable object already exists
LDR_NOT_EXIST	2053	0x805	Can't delete. Object does not exist
LDR_SIZE_ERROR	2054	0x806	Error in loading object
LDR_MEM_ERROR	2055	0x807	Error at memory allocation/release
LDR_PRGM_NOT_EXIST	2056	0x808	Can't load text-object because application does not exist
LDR_FUNC_LEVEL_ERR	2057	0x809	Call-stack limit reached
LDR_RECURSIV_ERR	2058	0x80A	Recursive calling of an loaded function
LDR_INST_ERR	2059	0x80B	Error in installation function
LDR_FUNC_OCC	2060	0x80C	Maximal number of functions reached
LDR_RUN_ERROR	2061	0x80D	Error during a loaded application program
LDR_DEL_MENU_ERR	2062	0x80E	Error during deleting of menu entries of an application
LDR_OBJ_TYPE_ERROR	2063	0x80F	Loadable object is unknown
LDR_WRONG_SECKEY	2064	0x810	Wrong security key
LDR_ILLEGAL_LOADADR	2065	0x811	Illegal application memory address
LDR_IEEE_ERROR	2066	0x812	Loadable object file is not IEEE format
LDR_WRONG_APPL_ VERSION	2067	0x813	Bad application version number

BMM 2304 0x900

RetCodeName	Value	Hex	Description
BMM_XFER_PENDING	2305	0x901	Loading process already opened

RetCodeName	Value	Hex	Description
BMM_NO_XFER_OPEN	2306	0x902	Transfer not opened
BMM_UNKNOWN_ CHARSET	2307	0x903	Unknown character set
BMM_NOT_INSTALLED	2308	0x904	Display module not present
BMM_ALREADY_EXIST	2309	0x905	Character set already exists
BMM_CANT_DELETE	2310	0x906	Character set cannot be deleted
BMM_MEM_ERROR	2311	0x907	Memory cannot be allocated
BMM_CHARSET_USED	2312	0x908	Character set still used
BMM_CHARSET_SAVED	2313	0x909	Char-set cannot be deleted or is protected
BMM_INVALID_ADR	2314	0x90A	Attempt to copy a character block outside the allocated memory
BMM_CANCELANDADR_ ERROR	2315	0x90B	Error during release of allocated memory
BMM_INVALID_SIZE	2316	0x90C	Number of bytes specified in header does not match the bytes read
BMM_CANCELAND INVSIZE_ERROR	2317	0x90D	Allocated memory could not be released
BMM_ALL_GROUP_OCC	2318	0x90E	Max. number of character sets already loaded
BMM_CANT_DEL_ LAYERS	2319	0x90F	Layer cannot be deleted
BMM_UNKNOWN_LAYER	2320	0x910	Required layer does not exist
BMM_INVALID_ LAYERLEN	2321	0x911	Layer length exceeds maximum

TXT 2560 0xA00

RetCodeName	Value	Hex	Description
TXT_OTHER_LANG	2560	0xA00	text found, but in an other language
TXT_UNDEF_TOKEN	2561	0xA01	text not found, token is undefined
TXT_UNDEF_LANG	2562	0xA02	language is not defined
TXT_TOOMANY_LANG	2563	0xA03	maximal number of languages reached
TXT_GROUP_OCC	2564	0xA04	desired text group is already in use
TXT_INVALID_GROUP	2565	0xA05	text group is invalid
TXT_OUT_OF_MEM	2566	0xA06	out of text memory
TXT_MEM_ERROR	2567	0xA07	memory write / allocate error
TXT_TRANSFER_ PENDING	2568	0xA08	text transfer is already open
TXT_TRANSFER_ILLEGAL	2569	0xA09	text transfer is not opened
TXT_INVALID_SIZE	2570	0xA0A	illegal text data size

RetCodeName	Value	Hex	Description
TXT_ALREADY_EXIST	2571	0xA0B	language already exists

MMI 2816 0xB00

RetCodeName	Value	Hex	Description
MMI_BUTTON_ID_EXISTS	2817	0xB01	Button ID already exists
MMI_DLG_NOT_OPEN	2818	0xB02	Dialog not open
MMI_DLG_OPEN	2819	0xB03	Dialog already open
MMI_DLG_SPEC_ MISMATCH	2820	0xB04	Number of fields specified with OpenDialogDef does not match
MMI_DLGDEF_EMPTY	2821	0xB05	Empty dialog definition
MMI_DLGDEF_NOT_ OPEN	2822	0xB06	Dialog definition not open
MMI_DLGDEF_OPEN	2823	0xB07	Dialog definition still open
MMI_FIELD_ID_EXISTS	2824	0xB08	Field ID already exists
MMI_ILLEGAL_APP_ID	2825	0xB09	Illegal application ID
MMI_ILLEGAL_ BUTTON_ID	2826	0xB0A	Illegal button ID
MMI_ILLEGAL_DLG_ID	2827	0xB0B	Illegal dialog ID
MMI_ILLEGAL_ FIELD_COORDS	2828	0xB0C	Illegal field coordinates or length/height
MMI_ILLEGAL_FIELD_ID	2829	0xB0D	Illegal field ID
MMI_ILLEGAL_ FIELD_TYPE	2830	0xB0E	Illegal field type
MMI_ILLEGAL_ FIELD_FORMAT	2831	0xB0F	Illegal field format
MMI_ILLEGAL_FIXLINES	2832	0xB10	Illegal number of fix dialog lines
MMI_ILLEGAL_MB_TYPE	2833	0xB11	Illegal message box type
MMI_ILLEGAL_MENU_ID	2834	0xB12	Illegal menu ID
MMI_ILLEGAL_ MENUITEM_ID	2835	0xB13	Illegal menu item ID
MMI_ILLEGAL_NEXT_ID	2836	0xB14	Illegal next field ID
MMI_ILLEGAL_TOPLINE	2837	0xB15	Illegal topline number
MMI_NOMORE_BUTTONS	2838	0xB16	No more buttons per dialog/menu available
MMI_NOMORE_DLGS	2839	0xB17	No more dialogs available
MMI_NOMORE_FIELDS	2840	0xB18	No more fields per dialog available
MMI_NOMORE_MENUS	2841	0xB19	No more menus available
MMI_NOMORE_ MENUITEMS	2842	0xB1A	No more menu items available

RetCodeName	Value	Hex	Description
MMI_NOMORE_ WINDOWS	2843	0xB1B	No more windows available
MMI_SYS_BUTTON	2844	0xB1C	The button belongs to the MMI
MMI_VREF_UNDEF	2845	0xB1D	The parameter list for OpenDialog is uninitialized
MMI_EXIT_DLG	2846	0xB1E	The MMI should exit the dialog
MMI_KEEP_FOCUS	2847	0xB1F	The MMI should keep focus within field being edited
MMI_NOMORE_ITEMS	2848	0xB20	Notification to the MMI that no more items available

COM 3072 0xC00

RetCodeName	Value	Hex	Description
RC_COM_ERO	3072	0xC00	Initiate Extended Runtime Operation (ERO).
RC_COM_CANT_ENCODE	3073	0xC01	Cannot encode arguments in client.
RC_COM_CANT_DECODE	3074	0xC02	Cannot decode results in client.
RC_COM_CANT_SEND	3075	0xC03	Hardware error while sending.
RC_COM_CANT_RECV	3076	0xC04	Hardware error while receiving.
RC_COM_TIMEDOUT	3077	0xC05	Request timed out.
RC_COM_WRONG_ FORMAT	3078	0xC06	Packet format error.
RC_COM_VER_ MISMATCH	3079	0xC07	Version mismatch between client and server.
RC_COM_CANT_ DECODE_REQ	3080	0xC08	Cannot decode arguments in server.
RC_COM_PROC_ UNAVAIL	3081	0xC09	Unknown RPC, procedure ID invalid.
RC_COM_CANT_ ENCODE_REP	3082	0xC0A	Cannot encode results in server.
RC_COM_SYSTEM_ERR	3083	0xC0B	Unspecified generic system error.
RC_COM_FAILED	3085	0xC0D	Unspecified error.
RC_COM_NO_BINARY	3086	0xC0E	Binary protocol not available.
RC_COM_INTR	3087	0xC0F	Call interrupted.
RC_COM_ REQUIRES_8DBITS	3090	0xC12	Protocol needs 8bit encoded characters.
RC_COM_TR_ID_ MISMATCH	3093	0xC15	Transaction ID mismatch error.
RC_COM_NOT_GEOCOM	3094	0xC16	Protocol not recognizable.

RetCodeName	Value	Hex	Description
RC_COM_ UNKNOWN_PORT	3095	0xC17	(WIN) Invalid port address.
RC_COM_ERO_END	3099	0xC1B	ERO is terminating.
RC_COM_OVERRUN	3100	0xC1C	Internal error: data buffer overflow.
RC_COM_SRVR_ RX_CHECKSUM_ERROR	3101	0xC1D	Invalid checksum on server side received.
RC_COM_CLNT_ RX_CHECKSUM_ERROR	3102	0xC1E	Invalid checksum on client side received.
RC_COM_PORT_ NOT_AVAILABLE	3103	0xC1F	(WIN) Port not available.
RC_COM_PORT_ NOT_OPEN	3104	0xC20	(WIN) Port not opened.
RC_COM_NO_PARTNER	3105	0xC21	(WIN) Unable to find TPS.
RC_COM_ERO_ NOT_STARTED	3106	0xC22	Extended Runtime Operation could not be started.
RC_COM_CONS_REQ	3107	0xC23	Att to send cons reqs
RC_COM_SRVR_ IS_SLEEPING	3108	0xC24	TPS has gone to sleep. Wait and try again.
RC_COM_SRVR_IS_OFF	3109	0xC25	TPS has shut down. Wait and try again.

DPL 3328 0xD00

RetCodeName	Valu	Hex	Description
DPL_RC_NOCREATE	3328	0xD00	no file creation, fatal
DPL_RC_NOTOPEN	3329	0xD01	bank not open
DPL_RC_ALRDYOPEN	3330	0xD02	a databank is already open
DPL_RC_NOTFOUND	3331	0xD03	databank file does not exist
DPL_RC_EXISTS	3332	0xD04	databank already exists
DPL_RC_EMPTY	3333	0xD05	databank is empty
DPL_RC_BADATA	3334	0xD06	bad data detected
DPL_RC_BADFIELD	3335	0xD07	bad field type
DPL_RC_BADINDEX	3336	0xD08	bad index information
DPL_RC_BADKEY	3337	0xD09	bad key type
DPL_RC_BADMODE	3338	0xD0A	bad mode
DPL_RC_BADRANGE	3339	0xD0B	bad range
DPL_RC_DUPLICATE	3340	0xD0C	duplicate keys not allowed
DPL_RC_INCOMPLETE	3341	0xD0D	record is incomplete
DPL_RC_IVDBID	3342	0xD0E	invalid db project id
DPL_RC_IVNAME	3343	0xD0F	invalid name
DPL_RC_LOCKED	3344	0xD10	data locked
DPL_RC_NOTLOCKED	3345	0xD11	data not locked

RetCodeName	Valu	Hex	Description
DPL_RC_NODATA	3346	0xD12	no data found
DPL_RC_NOMATCH	3347	0xD13	no matching key found
DPL_RC_NOSPACE	3348	0xD14	no more (disk) space left
DPL_RC_NOCLOSE	3349	0xD15	could not close db (sys. error)
DPL_RC_RELATIONS	3350	0xD16	record still has relations
DPL_RC_NULLPTR	3351	0xD17	null pointer
DPL_RC_BADFORMAT	3352	0xD18	bad databank format, wrong version
DPL_RC_BADRECTYPE	3353	0xD19	bad record type
DPL_RC_OUTOFMEM	3354	0xD1A	no more (memory) space left
DPL_RC_CODE_ MISMATCH	3355	0xD1B	code mismatch
DPL_RC_NOTINIT	3356	0xD1C	db has not been initialized
DPL_RC_NOTEXIST	3357	0xD1D	trf. for old db's does not exist
DPL_RC_NOTOK	4864	0x1300	not ok
DPL_RC_IVAPPL	4865	0x1301	invalid database system appl.
DPL_RC_NOT_ AVAILABLE	4866	0x1302	database not available
DPL_RC_NO_CODELIST	4867	0x1303	no codelist found
DPL_RC_TO_MANY_ CODELISTS	4868	0x1304	more then DPL_MAX_CODELISTS found

FIL 3840 0xF00

RetCodeName	Value	Hex	Description
RC_FIL_NO_ERROR	3840	0xF00	Operation completed successfully.
RC_FIL_FILNAME_ NOT_FOUND	3845	0xF05	File name not found.
RC_FIL_NO_MAKE_ DIRECTORY	3880	0xF28	Cannot create directory.
RC_FIL_RENAME_ FILE_FAILED	3886	0xF2E	Rename of file failed.
RC_FIL_INVALID_PATH	3888	0xF30	Invalid path specified.
RC_FIL_FILE_ NOT_DELETED	3898	0xF3A	Cannot delete file.
RC_FIL_ILLEGAL_ORIGIN	3906	0xF42	Illegal origin.
RC_FIL_END_OF_FILE	3924	0xF54	End of file reached.
RC_FIL_NO_MORE_ ROOM_ON_MEDIUM	3931	0xF5B	Medium full.
RC_FIL_PATTERN_ DOES_NOT_MATCH	3932	0xF5C	Pattern does not match file names.
RC_FIL_FILE_ALREADY_	3948	0xF6C	File is already open with write

RetCodeName	Value	Hex	Description
OPEND_FOR_WR			permission.
RC_FIL_WRITE_TO_ MEDIUM_FAILED	3957	0xF75	Write operation to medium failed.
RC_FIL_START_ SEARCH_NOT_CALLED	3963	0xF7B	FIL_StartList not called.
RC_FIL_NO_STORAGE_ MEDIUM_IN_DEVICE	3964	0xF7C	No medium existent in device.
RC_FIL_ILLEGAL_FILE_ OPEN_TYPE	3965	0xF7D	Illegal file open type.
RC_FIL_MEDIUM_ NEWLY_INSERTED	3966	0xF7E	Medium freshly inserted into device.
RC_FIL_MEMORY_ FAILED	3967	0xF7F	Memory failure. No more memory available.
RC_FIL_FATAL_ERROR	3968	0xF80	Fatal error during file operation.
RC_FIL_FAT_ERROR	3969	0xF81	Fatal error in file allocation table.
RC_FIL_ILLEGAL_DRIVE	3970	0xF82	Illegal drive chosen.
RC_FIL_INVALID_ FILE_DESCR	3971	0xF83	Illegal file descriptor.
RC_FIL_SEEK_FAILED	3972	0xF84	Seek failed.
RC_FIL_CANNOT_ DELETE	3973	0xF85	Cannot delete file.
RC_FIL_MEDIUM_ WRITE_PROTECTED	3974	0xF86	Medium is write protected.
RC_FIL_BATTERY_LOW	3975	0xF87	Medium backup battery is low.
RC_FIL_BAD_FORMAT	3976	0xF88	Bad medium format.
RC_FIL_UNSUPPORTED_ MEDIUM	3977	0xF89	Unsupported PC-Card detected.
RC_FIL_RENAME_DIR_ FAILED	3978	0xF8A	Directory exists already

WIR 5120 0x1400

RetCodeName	Value	Hex	Description
WIR_PTNR_OVERFLOW	5121	0x1401	point number overflow
WIR_NUM_ASCII_CARRY	5122	0x1402	carry from number to ascii conversion
WIR_PTNR_NO_INC	5123	0x1403	can't increment point number
WIR_STEP_SIZE	5124	0x1404	wrong step size
WIR_BUSY	5125	0x1405	resource occupied
WIR_CONFIG_FNC	5127	0x1407	user function selected

RetCodeName	Value	Hex	Description
WIR_CANT_OPEN_FILE	5128	0x1408	can't open file
WIR_FILE_WRITE_ ERROR	5129	0x1409	can't write into file
WIR_MEDIUM_NOMEM	5130	0x140A	no anymore memory on PC-Card
WIR_NO_MEDIUM	5131	0x140B	no PC-Card
WIR_EMPTY_FILE	5132	0x140C	empty GSI file
WIR_INVALID_DATA	5133	0x140D	invalid data in GSI file
WIR_F2_BUTTON	5134	0x140E	F2 button pressed
WIR_F3_BUTTON	5135	0x140F	F3 button pressed
WIR_F4_BUTTON	5136	0x1410	F4 button pressed
WIR_F5_BUTTON	5137	0x1411	F5 button pressed
WIR_F6_BUTTON	5138	0x1412	F6 button pressed
WIR_SHF2_BUTTON	5139	0x1413	SHIFT F2 button pressed

AUT 8704 0x2200

RetCodeName	Value	Hex	Description
AUT_RC_TIMEOUT	8704	0x2200	Position not reached
AUT_RC_DETENT_ ERROR	8705	0x2201	Positioning not possible due to mounted EDM
AUT_RC_ANGLE_ERROR	8706	0x2202	Angle measurement error
AUT_RC_MOTOR_ ERROR	8707	0x2203	Motorization error
AUT_RC_INCACC	8708	0x2204	Position not exactly reached
AUT_RC_DEV_ERROR	8709	0x2205	Deviation measurement error
AUT_RC_NO_TARGET	8710	0x2206	No target detected
AUT_RC_MULTIPLE_ TARGETS	8711	0x2207	Multiple target detected
AUT_RC_BAD_ ENVIRONMENT	8712	0x2208	Bad environment conditions
AUT_RC_DETECTOR_ ERROR	8713	0x2209	Error in target acquisition
AUT_RC_NOT_ENABLED	8714	0x220A	Target acquisition not enabled
AUT_RC_CALACC	8715	0x220B	ATR-Calibration failed
AUT_RC_ACCURACY	8716	0x220C	Target position not exactly reached
AUT_RC_DIST_STARTED	8717	0x220D	Info: dist. Measurement has been started

BAP 9216 0x2400

RetCodeName	Value	Hex	Description
BAP_CHANGE_ALL_ TO_DIST	9217	0x2401	Command changed from ALL to DIST

SAP 9472 0x2500

RetCodeName	Value	Hex	Description
SAP_ILLEGAL_ SYSMENU_NUM	9473	0x2501	Illegal system menu number

COD 9728 0x2600

RetCodeName	Value	Hex	Description
COD_RC_LIST_NOT_ VALID	9728	0x2600	List not initialized.
COD_RC_SHORTCUT_ UNKNOWN	9729	0x2601	Shortcut or code unknown.
COD_RC_NOT_ SELECTED	9730	0x2602	Codelist selection wasn't possible.
COD_RC_MANDATORY_ FAIL	9731	0x2603	Mandatory field has no valid value.
COD_RC_NO_MORE_ ATTRIB	9732	0x2604	maximal number of attr. are defined.

BAS 9984 0x2700

RetCodeName	Value	Hex	Description
BAS_ILL_OPCODE	9984	0x2700	Illegal opcode.
BAS_DIV_BY_ZERO	9985	0x2701	Division by Zero occured.
BAS_STACK_ UNDERFLOW	9986	0x2702	Interpreter stack underflow.
BAS_STACK_OVERFLOW	9987	0x2703	Interpreter stack overflow.
BAS_NO_DLG_EXIST	9988	0x2704	No dialog is defined.
BAS_DLG_ALREADY_	9989	0x2705	Only one dialog may be defined at

RetCodeName	Value	Hex	Description
EXIST			once.
BAS_INSTALL_ERR	9990	0x2706	General error during installation.
BAS_FIL_INV_MODE	9995	0x270B	Invalid file access mode.
BAS_FIL_TABLE_FULL	9996	0x270C	Maximum number of open files overflow.
BAS_FIL_ILL_NAME	9997	0x270D	Illegal file name.
BAS_FIL_ILL_POS	9998	0x270E	Illegal file position, hence < 1.
BAS_FIL_ILL_OPER	9999	0x270F	Illegal operation on this kind of file.
BAS_MENU_ID_INVALID	10000	0x2710	Invalid menu id detected.
BAS_MENU_TABLE_ FULL	10001	0x2711	Internal menu id table overflow.

IOS 10240 0x2800

RetCodeName	Value	Hex	Description
IOS_CHNL_DISABLED	10240	0x2800	channel is disabled
IOS_NO_MORE_CHAR	10241	0x2801	no more data available
IOS_MAX_BLOCK_LEN	10242	0x2802	reached max. block length
IOS_HW_BUF_OVERRUN	10243	0x2803	hardware buffer overrun (highest priority)
IOS_PARITY_ERROR	10244	0x2804	parity error
IOS_FRAMING_ERROR	10245	0x2805	framing error
IOS_DECODE_ERROR	10246	0x2806	decode error
IOS_CHKSUM_ERROR	10247	0x2807	checksum error (lowest priority)
IOS_COM_ERROR	10248	0x2808	general communication error
IOS_FL_RD_ERROR	10280	0x2828	flash read error
IOS_FL_WR_ERROR	10281	0x2829	flash write error
IOS_FL_CL_ERROR	10282	0x282A	flash erase error

CNF 10496 0x2900

RetCodeName	Value	Hex	Description
CNF_INI_NOTOPEN	10497	0x2901	INI-file not opened
CNF_INI_NOTFOUND	10498	0x2902	Warning: Could not find section or key
CNF_CONT	10499	0x2903	Return code of system function
CNF_ESC	10500	0x2904	Return code of system function
CNF_QUIT	10501	0x2905	Return code of system function
CNF_DATA_INVALID	10502	0x2906	Config. file data not valid

RetCodeName	Value	Hex	Description
CNF_DATA_OVERFLOW	10503	0x2907	Config. file data exceed valid amount
CNF_NOT_COMPLETE	10504	0x2908	Config. file data not complete
CNF_DLG_CNT_ OVERFLOW	10505	0x2909	Too many executed dialogs
CNF_NOT_EXECUTABLE	10506	0x290A	Item not executable
CNF_AEXE_OVERFLOW	10507	0x290B	Autoexec table full
CNF_PAR_LOAD_ERR	10508	0x290C	Error in loading parameter
CNF_PAR_SAVE_ERR	10509	0x290D	Error in saving parameter
CNF_FILE_MISSING	10510	0x290E	Parameter filename/path not valid
CNF_SECTION_MISSING	10511	0x290F	Section in parameter file missing
CNF_HEADER_FAIL	10512	0x2910	Default file wrong or an entry is missing
CNF_PARMETER_FAIL	10513	0x2911	Parameter-line not complete or missing
CNF_PARMETER_SET	10514	0x2912	Parameter-set caused an error
CNF_RECMASK_FAIL	10515	0x2913	RecMask-line not complete or missing
CNF_RECMASK_SET	10516	0x2914	RecMask-set caused an error
CNF_MEASDLGLIST_ FAIL	10517	0x2915	MeasDlgList-line not complete or missing
CNF_MEASDLGLIST_SET	10518	0x2916	MeasDlgList-set caused an error
CNF_APPL_OVERFLOW	10519	0x2917	Application table full

Appendix G — GEODESY MATHEMATICAL FORMULAS

G.1 GENERALLY

The formula is valid for the following sections :

- distances and height differences in meter
- angle, direction and azimuth in radiant

generally used nomenclature:

ds_{X-Y}	: Slope distance from point X to point Y
dh_{X-Y}	: Horizontal distance from point X to point Y at sea level
Hz_{X-Y}	: Horizontal direction from point X to point Y
V_{X-Y}	: Vertical direction from point X to point Y (always means zenith distance)
Z_{X-Y}	: Azimuth from point X to point Y
N_i, E_i, H_i	: N, E Coordinate and height at the point P_i
ΔN_{X-Y}	: Coordinate difference in N-direction between point X and point Y
ΔE_{X-Y}	: Coordinate difference in E-direction between point X and point Y
ΔH_{X-Y}	: Height difference between point X and point Y

mathematics functions :

`Int(x)` : Function in order to calculate the integer part of the argument x

`Frac(x)` : Function in order to calculate the fraction of the argument x

`Abs(x)` : Function in order to calculate the absolute of the argument x

`Mod(x)` : Function in order to calculate the rest of an division

`sin(x)` : Function in order to calculate sine of the argument x

`cos(x)` : Function in order to calculate cosine of the argument x

`tan(x)` : Function in order to calculate tangent of the argument x

`asin(x)` : Function in order to calculate arcs sinus of the argument x

`acos(x)` : Function in order to calculate arcs cosine of the argument x

`atan(x)` : Function in order to calculate arcs tangent of the argument x

G.2 CONVERSION OF ANGLE

G.2.1 Generally

Nomenclature :

GIVEN :

α	angle to convert

Formula :

Radiant in Neugrad:	$f(\alpha) = \frac{200}{\pi} * \alpha$
Radiant in Altgrad:	$f(\alpha) = \frac{180}{\pi} * \alpha$
Radiant in Artilleriepromille	$f(\alpha) = \frac{3200}{\pi} * \alpha$
Neugrad in Radiant:	$f(\alpha) = \frac{\pi}{200} * \alpha$
Altgrad in Radiant:	$f(\alpha) = \frac{\pi}{180} * \alpha$
Artilleriepromille in Radiant:	$f(\alpha) = \frac{\pi}{3200} * \alpha$

G.2.2 Conversion decimal-sexagesimal

Nomenclature :

GIVEN :

α : angle to convert

WANTED :

min : minute

sek : second

Formula :

$$\text{min} = \text{Int}(\text{Frac}(\alpha) * 60)$$

$$\text{sek} = \text{Frac}(\text{Frac}(\alpha) * 60) * 60$$

$$f(\alpha) = \text{Int}(\alpha) + \frac{\text{min}}{10^2} + \frac{\text{sek}}{10^4}$$

Example :

$$\alpha = 3.562100$$

$$\text{min} = 33.000000$$

$$\text{sek} = 43.560000$$

$$f(\alpha) = 3.334356$$

G.2.3 Conversion sexagesimal-decimal

Nomenclature :

GIVEN :

α : angle to convert

Formula :

$$f(\alpha) = \mathrm{Int}(\alpha) + \frac{\mathrm{Int}(\mathrm{Frac}(\alpha) * 10^2) * 60 + \mathrm{Frac}(\mathrm{Frac}(\alpha) * 10^2) * 10^2}{3600}$$

Example :

$\alpha = 3.334356$

$f(\alpha) = 3.562100$

G.3 CONVERSION OF DISTANCE

Nomenclature :

WANTED :

US_{foot} : American foot

$Inter_{foot}$: International foot

Formula :

$US_{foot} = 3.937 / 12 = 0.32808$ m

$Inter_{foot} = 9.144 / 30 = 0.30480$ m

G.4 PHYSICAL CONVERSION

Nomenclature:

mmHg	: mm mercury column
mbar	: Millibar
t_K	: Temperature in Kelvin
t_F	: Temperature in degree Fahrenheit
t_C	: Temperature in degree centigrade

Formula :

Pressure :

1 mm Hg = 1.33322 mbar = 1 / 760 atm

Temperature:

Kelvin in °C $f(t_k) = t_k - 273.15$

°Fahrenheit in °C $f(t_k) = 5/9*(t_F - 32)$

G.5 CALCULATION OF AVERAGE :

G.5.1 Generally

Nomenclature :

GIVEN :

L_i	: Measurement
p_i	: Significance of the measurement L_i

WANTED:

L_{mean}	: Average of all measurements
v_i	: Rectification of measurement L_i
m_L	: middle error of any measurement
m_{mean}	: middle error of average

Formula :

$$L_{mean} = \frac{\Sigma\, p_i * L_i}{\Sigma\, p_i}$$

$$v_i = L_{mean} - L_i$$

$$m_L = \sqrt{\frac{\Sigma\,(p_i * v_i^{\,2})}{n - 1}}$$

$$m_{mean} = \frac{m_L}{\sqrt{\Sigma\, p_i}}$$

Authority : Lecture of surveying at the IBB Muttenz

G.5.2 Calculation of average for directions

Nomenclature :

GIVEN :

R_i	: i. direction element in array
R_1	: 1. direction element in array

WANTED :

R_{mean}	: arithmetical average direction
m_R	: middle error of any direction
m_{mean}	: middle error of average

Formula :

if Abs (R_1 - R_i) > π then

begin

  if (R_1 - R_i) > 0

    then $R_i := R_i + 2\pi$

    else $R_i := R_i - 2\pi$

end

Calculation of R_{mean}, m_R, m_{mean} see formula calculation of average: generally

if $R_{mean} < 0$

  then $R_{mean} := R_{mean} + 2\pi$

  else $R_{mean} := R_{mean} \bmod 2\pi$

Authority : Specification circle-orientation for UD2 Report No GA 08/91

G.5.3 Calculation of median for directions

Nomenclature :

GIVEN :

n	: Number of directions
R_i	: i. direction element in array
R_1	: 1. direction element in array
$R_{n/2}$	: middle direction element in array

WANTED :

R_{MEd}	: as median averaged direction

Formula :

if (n mod 2) = 0 then {even number of point}

begin

if Abs ($R_{n/2}$ - $R_{n/2+1}$) > π

$$\text{then } R_{med} := \frac{R_{n/2} + R_{n/2+1} + 2\pi}{2} \bmod 2\pi$$

$$\text{else } R_{med} := \frac{R_{n/2} + R_{n/2+1}}{2}$$

end

else $R_{med} := R_{n/2}$

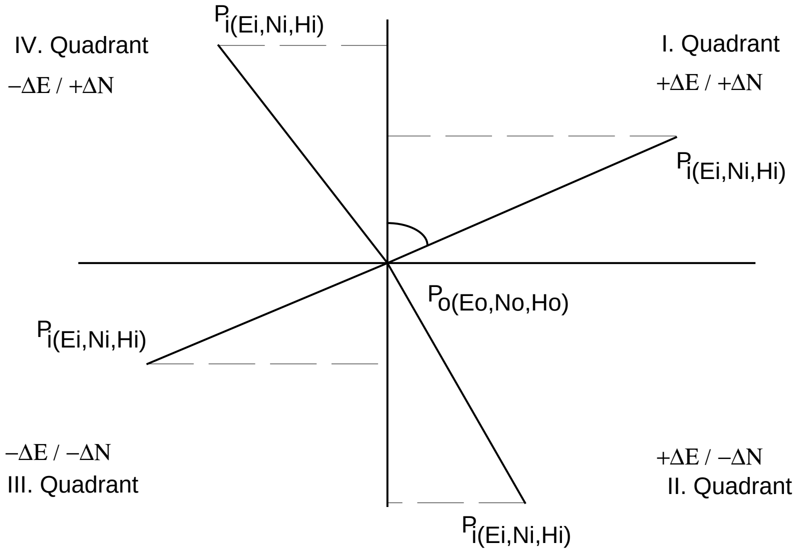
Authority : Specification circle orientation of UD2 Report No GA 08/91

G.6 CALCULATION OF COORDINATE

Nomenclature in general :

P_o (E_o,N_o,H_o)	: Position and the coordinates
P_i (E_i,N_i,H_i)	: Target point and the coordinates
ΔE	: Coordinate-difference in west-east direction
ΔN	: Coordinate-difference in north -south direction

Picture :



G.6.1 Calculation of azimuth and distance result from coordinate

Formula :

$\Delta E = E_i - E_0$ $\Delta N = N_i - N_0$

$$dh_{P_0 - P_i} = \sqrt{\Delta E^2 + \Delta N^2}$$

Case distinction :

if ((ΔN = 0) AND (ΔE = 0)) then error information

if (ΔN = 0)

then if (ΔE > 0)

then $Z_{P_o - P_i} := \pi / 2$

else $Z_{P_o - P_i} := 3/2\ \pi$

else begin

$$Z_{P_o - P_i} = \operatorname{atan}\left(\frac{\Delta E}{\Delta N}\right)$$

if (ΔN < 0)

then $Z_{P_o - P_i} := Z_{P_o - P_i} + \pi$

else if (ΔE < 0)

then $Z_{P_o - P_i} := Z_{P_o - P_i} + 2\pi$

end

G.6.2 Calculation of coordinate result from azimuth and distance :

Formula :

$$E_i = E_0 + \Delta E \qquad N_i = N_0 + \Delta N$$

$$\Delta E = dh_{P_0\text{-}P_i} * \sin(Z_{P_o - P_i})$$

$$\Delta N = dh_{P_0\text{-}P_i} * \cos(Z_{P_o - P_i})$$

G.6.3 Conversion polar - rectangular

see calculation of coordinate result from azimuth and distance

G.6.4 Conversion rectangular - polar

see calculation of azimuth and distance result from coordinate

G.6.5 Calculation of zenith angle and slope distance as a result from coordinate

Nomenclature :

GIVEN :

P_o (E_o,N_o,H_o)	: position and the coordinate
P_i (E_i,N_i,H_i)	: target point and the coordinate
i	: Instrument height
s	: Reflector height

Formula :

$$\Delta E = E_i - E_0 \qquad \Delta N = N_i - N_0$$

$$dh_{P_o-P_i} = \sqrt{\Delta E^2 + \Delta N^2}$$

$$\Delta H_{P_o-P_i} = H_i - H_o$$

if $((\Delta H_{P_o-P_i} - i + s) = 0)$ then $V_{P_o-P_i} = \dfrac{\pi}{2}$

else begin

$$V_{P_o-P_i} = \operatorname{atan}\left(\frac{dh_{P_o-P_i}}{\Delta H_{P_o-P_i} - i + s}\right)$$

if $(V_{P_o-P_i} < 0)$ then $V_{P_o-P_i} = V_{P_o-P_i} + \pi$

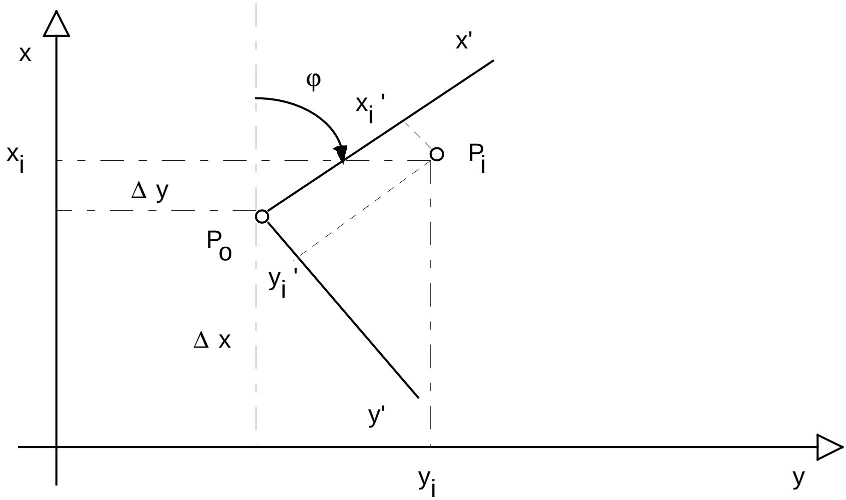
end

$$ds_{P_o-P_i} = dh_{P_o-P_i} * \sin(V_{P_o-P_i})$$

G.7 TRANSFORMATION OF COORDINATE

G.7.1 of mathematical coordinate systems

PICTURE :



Nomenclature :

GIVEN :

P_o	: centre point known in both system.
φ	: Angle of rotation between the two coordinate systems. This is the angle (clockwise is positive) between the old and the new system.
Δy, Δx	: Coordinate of centre point P_o of both coordinate systems.
y_i, x_i	: Coordinate in the old system (e. g. local system)

WANTED :

y_i', x_i'	: Coordinate in the new system (e.g. country coordinate system)

Formula :

$$\Delta y = y_0' - y_0$$

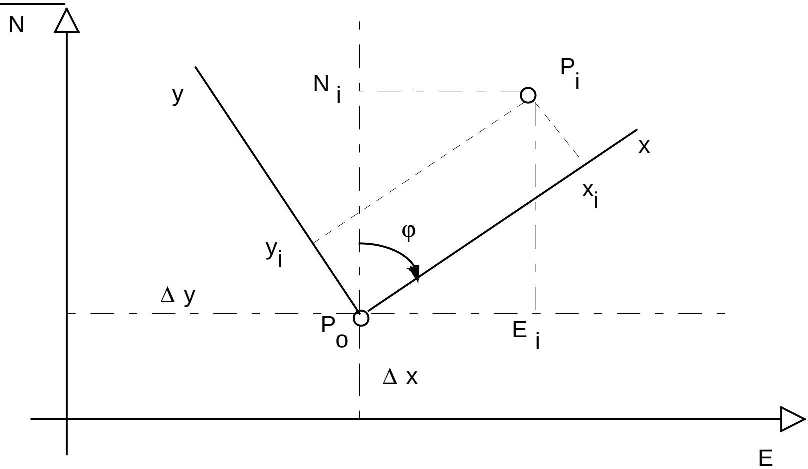
$$\Delta x = x_0' - x_0$$

$$y_i' = \Delta y + y_i * \cos(\varphi) - x_i * \sin(\varphi)$$

$$x_i' = \Delta x + y_i * \sin(\varphi) + x_i * \cos(\varphi)$$

G.7.2 of geodetical coordinate systems

Picture:



Nomenclature :

GIVEN :

P_o	: in both system known common points
φ	: Rotation angle between the two coordinate systems. This is the angle (clockwise is negative) between the old and the new system.
Δy, Δx	: Coordinate difference of the common point P_o of both coordinate systems.
Ei, Ni	: Coordinates in the old system (i.e. country coordinate system)

WANTED :

y_i, x_i : Coordinate in the new system (i.e. mathematics system)

Formula :

$$\Delta y = y_0 - E_0$$

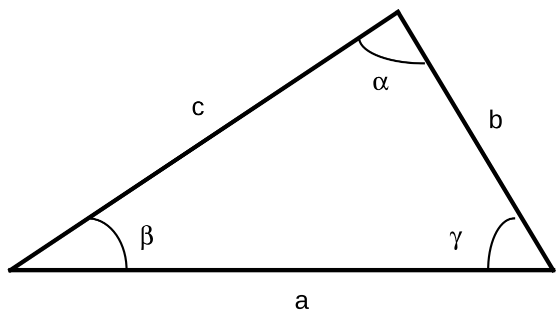
$$\Delta x = x_0 - N_0$$

$$y_i = \Delta y + N_i * \sin(\varphi) - E_i * \cos(\varphi)$$

$$x_i = \Delta x + N_i * \cos(\varphi) + E_i * \sin(\varphi)$$

G.8 CALCULATION OF TRIANGLE

Picture :



G.8.1 Case SWS

Nomenclature:

GIVEN :

b,c : given triangle sides

α : given angle

WANTED :

a : wanted triangle sides

β, γ : wanted angles

Formula :

$$a = \sqrt{b^2 + c^2 - 2bc\cos(\alpha)}$$

$$\beta = \operatorname{acos}\left(\frac{a^2 + c^2 - b^2}{2ac}\right)$$

$$\gamma = \operatorname{acos}\left(\frac{a^2 + b^2 - c^2}{2ab}\right)$$

G.8.2 Case SSS

Nomenclature :

GIVEN :

`a,b,c` : given triangle sides

WANTED :

α, β, γ : wanted angles

Formula :

Remark: if the sum of the two shorter sides are smaller than the longer side, there is no solution.

$$\alpha = \operatorname{acos}\left(\frac{b^2 + c^2 - a^2}{2bc}\right)$$

$$\beta = \operatorname{asin}\left(\frac{b * \sin(\alpha)}{a}\right)$$

$$\gamma = \pi - (\alpha + \beta)$$

G.8.3 Case SSW or WSS

Nomenclature :

GIVEN :

a,c : given triangle sides

γ : given angle

WANTED :

b_1, b_2 : wanted triangle sides

$\alpha_1, \alpha_2, \beta_1, \beta_2$: wanted angles

Formula :

Formula in general:

$\beta = \pi - (\alpha + \gamma)$

if ((γ = 0) OR (γ = π))

then if (γ = 0)

then b = a + c

else b = Abs (a − c)

else $b = \dfrac{c * \sin\beta}{\sin\gamma}$

First solution :

$$\alpha_1 = \operatorname{asin}\left(\frac{a * \sin\gamma}{c}\right)$$

Calculation of β_1 and b_1 with α_1 and γ, see above formula in general

Case -Distinction :

if (c > a) then 2. solution

begin

$\gamma_2 = \pi - \gamma$

$\alpha_2 = \alpha_1$

Calculation of β_2 and b_2 with α_2 and γ_2 see above formula in general

end

if (c = a) then only one solution, see above

if (c < a) then

if (a * sin γ > c) then no solution

if (a * sin γ = c) then only one solution ,see above

if (a * sin γ < c) then 2. solution

begin

$\alpha_2 = \pi - \alpha_1$

Calculation of β_2 and b_2 with α_2 and γ see above formula in general

end

G.8.4 Case WWS or SWW

Nomenclature:

GIVEN :

a	: given triangle side
α, β	: given angle

WANTED :

b,c : wanted triangle sides

γ : wanted angles

Formula :

if $((\alpha + \beta >= \pi)$ OR $(\sin\alpha = 0))$

then no solution

else begin

$$\gamma = \pi - (\alpha + \beta)$$

$$b = \frac{a * \sin\beta}{\sin\alpha}$$

$$c = \frac{a * \sin(\alpha + \beta)}{\sin\alpha}$$

end

Nomenclature :

GIVEN :

a : given triangle side

β, γ : given angle

WANTED :

b,c : wanted triangle sides

α : wanted angle s

Formula :

if (sin (β + γ) = 0) then no solution

else begin

$$\alpha = \pi - (\beta + \gamma)$$

$$b = \frac{a * \sin\beta}{\sin(\beta + \gamma)}$$

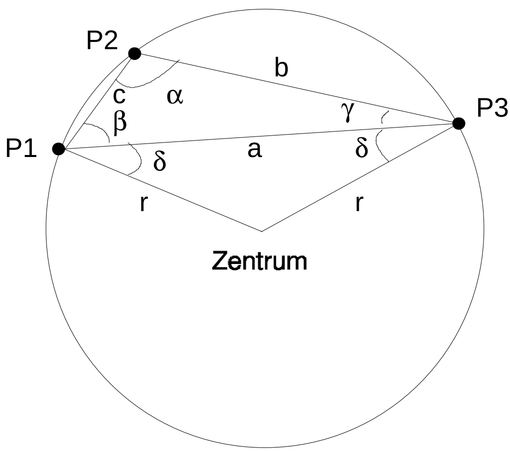
$$c = \frac{a * \sin\gamma}{\sin(\beta + \gamma)}$$

end

G.9 CALCULATION OF CIRCLE

G.9.1 Radius and center result from 3 point

Picture :



Nomenclature :

GIVEN :

P1,P2,P3 : Coordinate from point P1 - P3

WANTED :

a,b,c : Chords

r : Radius

Formula and proceeding of calculation :

1. Calculation of chord a, b and c (see calculation of coordinate, azimuth and calculation of distance result from coordinate).

2. Calculation of angle α,β and γ (see calculation of triangle case SSS)

3. $$\delta = \frac{\alpha - \beta - \gamma}{2}$$
$$r = \frac{a}{2 * \cos(\delta)}$$

4. Calculation of azimuth from point 1 to point 3 (see calculation of coordinate, azimuth and distance result from coordinate)

5. Important: The points P1 to P3 are marked clockwise.
$$Z_{P1\text{-centre}} = Z_{P1\text{-}P3} + \delta$$

6. Calculation of centre coordinates with $Z_{P1\text{-centre}}$ and r (see calculation of coordinate result from azimuth and distance)

7. Control of centre coordinates: Calculation of distance centre - P2

if ($D_{centre-P2}$ <> r $\pm$ 0.001) then

{ The calculated centre co-ordinates are wrong

Calculation of new centre co-ordinates }

begin

$Z_{P1-centre} = Z_{P1-P3} - \delta$

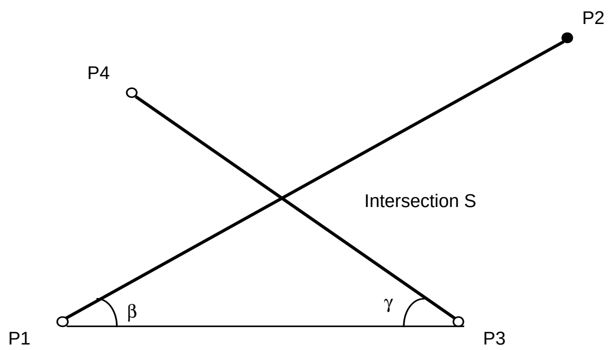
Repetition of point 6.

end

G.10 CALCULATION OF INTERSECTION

G.10.1 Intersection line - line without parallel displacement

Picture :



Nomenclature :

GIVEN :

P1 - P4 : Coordinate from P1 - P4

WANTED :

$Z_{P1\text{-}P2}, Z_{P1\text{-}P3}, Z_{P3\text{-}P4}, Z_{P3\text{-}P1}$: Azimuth

β, γ : Assistance angle

Formula and proceeding of calculation :

1. Calculation of azimuth $Z_{P1\text{-}P2}$, $Z_{P1\text{-}P3}$ and $Z_{P3\text{-}P4}$ (see calculation of coordinate, azimuth and distance result from coordinate)

2. $Z_{P3\text{-}P1} = Z_{P1\text{-}P3} + \pi$

3. Calculation of distance P1 to P3 (see calculation of coordinate, azimuth and distance result from coordinate)

4. $\beta = Z_{P1\text{-}P3} - Z_{P1\text{-}P2}$ $\gamma = Z_{P3\text{-}P4} - Z_{P3\text{-}P1}$

   if $\beta < 0$ then $\beta = \beta + \pi$ if $\gamma < 0$ then $\gamma = \gamma + \pi$

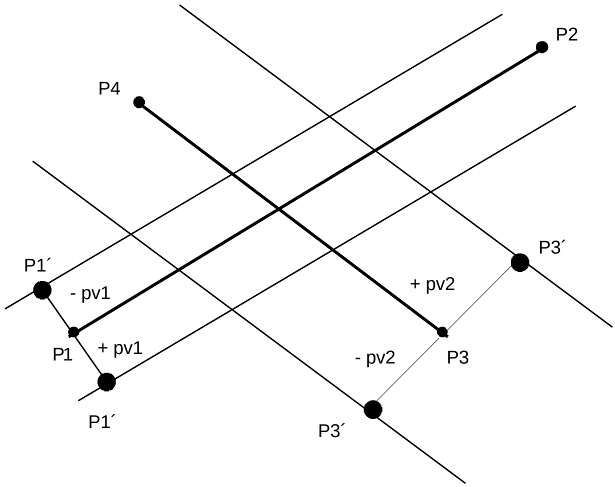
5. Calculation of distance P1 to P3 (see calculation of coordinate, azimuth and distance result from coordinate)

6. Calculation of distance P1 to S (see calculation of triangle, case WSW)

7. Calculation of intersection coordinate with the distance from P1 to S and azimuth $Z_{P1\text{-}P2}$ (see calculation of Coordinate result from azimuth and distance)

G.10.2 Intersection line - line with parallel displacement

Picture :



Remark: The parallel displacement on the left side of the line is negative, on the right side positive.

Formula and proceeding of calculation :

1. Calculation of azimuth (see calculation of intersection without parallel displacement, point 1. and point 2.)

2. Calculation of azimuth to the assistance point P1´ and P3´

$$Z_{P1\text{-}P1'} = Z_{P1\text{-}P2} + \pi$$

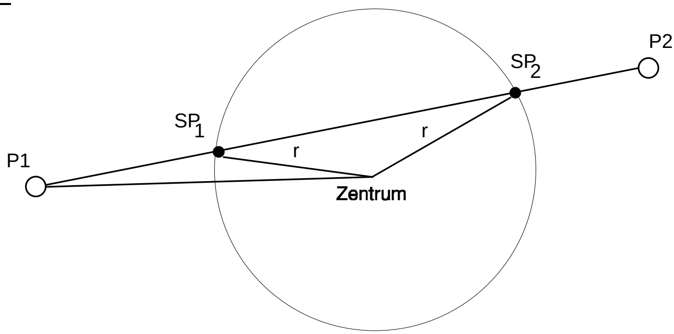
$$Z_{P3\text{-}P3'} = Z_{P3\text{-}P4} + \pi$$

3. Calculation of coordinate of assistance point P1´ and P3´ with azimuth $Z_{P1\text{-}P1'}$ and $Z_{P3\text{-}P3'}$ and parallel displacement pv1and pv2. (see calculation of coordinate result from azimuth and distance) Important : Consider the sign of the parallel displacement .

4. After substitute P1 = P1´ and P3 = P3´, calculation of intersection S (see calculation of intersection without parallel displacement : Points 3 - 7).

G.10.3 Intersection line - circle

Picture :



Formula and proceeding of calculation :

1. Calculation of azimuth $Z_{P1\text{-}P2}$ (see calculation of coordinate, azimuth and distance result from coordinate).

2. Calculation of azimuth $Z_{P1\text{-Centre}}$ and the distance P1-centre (see calculation of coordinate, azimuth and distance result from coordinate).

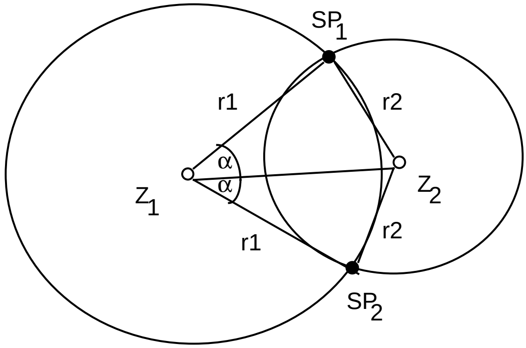
3. $\alpha = Z_{P1\text{-Centre}} - Z_{P1\text{-}P2}$

4. Calculation of distance P1-SP_1 and P1-SP_2 with α, distance P1-centre and radius r. (see calculation of triangle, case SSW or WSS)

5. Calculation of intersection coordinate with the distances P1-SP1 resp. P1-SP2 and the azimuth Z_{P1-P2} . (see calculation of coordinate result from azimuth and distance).

G.10.4 Intersection circle - circle

Picture :



Nomenclature:

Z_1	: centre of 1.circle
Z_2	: centre of 2.circle
r1	: radius of 1.circle
r2	: radius of 2.circle
SP_1,SP_2	: Intersection of both circles

Formula and proceeding of calculation :

1. Calculation of azimuth $Z_{Z_1-Z_2}$ and the distance Z_1-Z_2 (see calculation of coordinate, azimuth and distance resulting from coordinate)

2. Calculation of angle α with r1, r2 and the distance Z_1-Z_2 (see calculation of triangle, case SSS)

   if (α = 0)

   then only one intersection

   $Z_{SP_{1/2}} = Z_{Z_1 - Z_2}$

   else begin

   $Z_{P_1\text{-}SP_1} = Z_{Z_1 - Z_2} - \alpha$

   $Z_{P_1\text{-}SP_2} = Z_{Z_1 - Z_2} + \alpha$

   end

4. Calculation of intersection coordinate with $Z_{P_1\text{-}SP_1}$ resp. $Z_{P_1\text{-}SP_2}$ and r1 (see calculation of coordinate result from azimuth and distance).

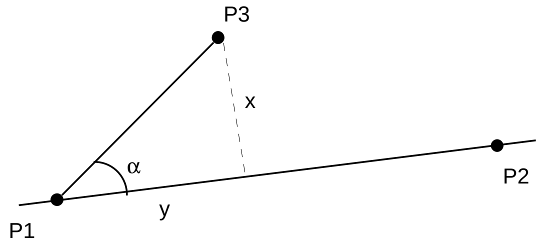
G.11 CALCULATION OF DISTANCE

G.11.1 Distance point - point

see calculation of coordinate, azimuth and distance result from coordinate.

G.11.2 Distance point - line

Picture :



Nomenclature :

GIVEN :

P1 - P3 : Coordinate from point P1 - P3

WANTED :

x,y : Distances

Formula and proceeding calculation :

1. Calculation of azimuth Z_{P1-P3} and the distance P1-P3 (see calculation of coordinate, azimuth and distance result from coordinate).

2. Calculation of azimuth Z_{P1-P2}

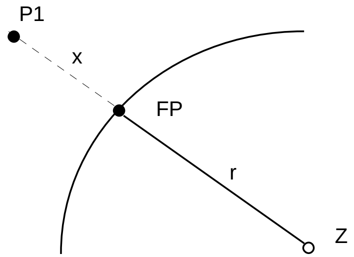
$$\alpha = Z_{P1-P2} - Z_{P1-P3}$$

$$x = a * \sin(\alpha)$$

$$y = a * \cos(\alpha)$$

G.11.3 Distance point - circle

Picture :



Nomenclature :

GIVEN :

Z and P1	: Coordinate of centre of the circle and of the point P1
r	: radius

WANTED :

x	: distance

Formula and proceeding calculation :

1. Calculation of distance $dh_{Z\text{-}P1}$(see calculation of coordinate, azimuth and distance result from coordinate)
2. $x = dh_{Z\text{-}P_1} - r$

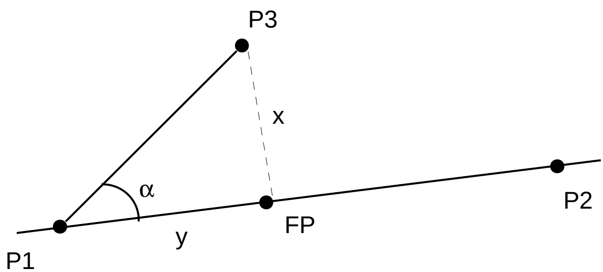
G.11.4 Distance point - Clothoid

see calculation of the base point of foot of a perpendicular observation, point on Clothoid

G.12 CALCULATION OF THE BASE POINT OF PLUMB LINE

G.12.1 Point on line

Picture :



Nomenclature :

GIVEN :

P1 - P3 : Coordinate from point P1 - P3

WANTED :

x,y : Distances

FP : Base point of plumb line

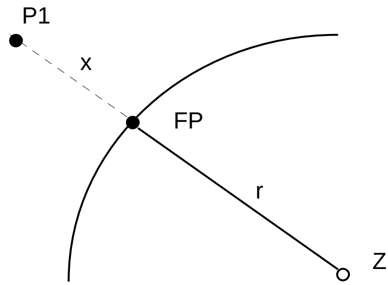
Formula and proceeding calculation :

1. Calculation of distance y. (see **calculation of distance**, *distance point - line*)

2. Calculation of the Base point of plumb line FP. (see *Point with distance on line*)

G.12.2 Point on circle

Picture :



Nomenclature :

GIVEN :

Z and P1	: Coordinate of the centre of the circle and the point P1
r	: radius

WANTED :

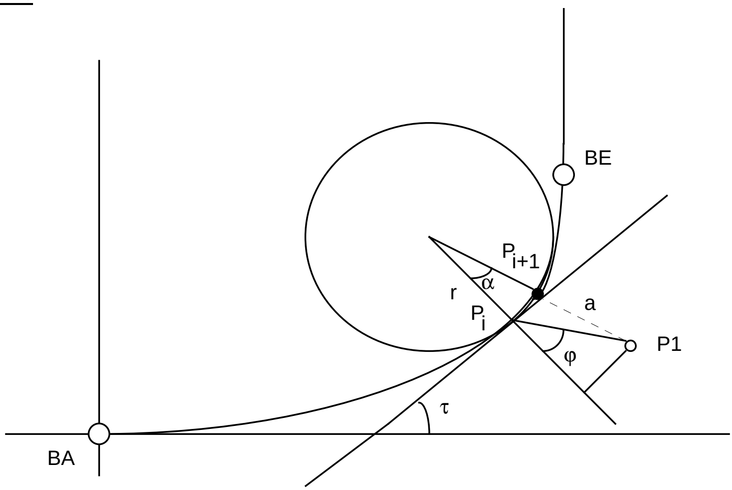
x	: distance

Formula and proceeding calculation :

1. Calculation of azimuth $Z_{Z\text{-}P1}$. (see calculation of coordinate, azimuth and distance result from coordinate)
2. Calculation of the Base point of plumb line with $Z_{Z\text{-}P1}$ and the Radius r. (see calculation of coordinate result from azimuth and distance)

G.12.3 Point on Clothoid

Picture :



Nomenclature :

GIVEN :

P1	: point to be plumbed out Point
A	: Clothoid parameter
BA, BE	: coordinates of the beginning (BA) and the end (BE) of the arc
P_i	: Base point of plumb line calculated at the i. iteration-step

WANTED :

r	: radius in the unitary clothoids
l	: length of the arc on the unity clothoid
a	: distance from P1 to the unity clothoid
P_{i+1}	: wanted base point of plumb line at the next iteration-step

Formula and proceeding calculation :

This iteration algorithm is only applicable for solutions in the range

$$0 < \tau < \frac{\pi}{2}$$

in the area of the clothoid.

First : Point P1 is transformed from the country-coordinate system to the mathematics system of the unity clothoid (A=1).

Second : the first approximation for the start-value of l_n is the X-coordinate of the point P1.

$$\text{if } (x_{P1} < \sqrt{\pi}) \text{ then } l_n = x_{P1} \text{ else } l_n = \sqrt{\pi}$$

iteration-algorithm for the calculation of the Base point of plumb line:

1. Calculation of coordinates of point P_i with $\tau = \frac{l_n^2}{2}$

 (see clothoid - Calculation , Calculated Coordinate)

2. Calculation of azimuth Z_{Pi-P1} and the distance a. (see calculation of coordinate, azimuth and distance see result from coordinate).

 Attention : The coordinates are located in the mathematics system, that means the substitution E=X and N=Y have to be used first, yet before the function is used .

$$gw\_l = 0.0001 \qquad \{\text{limit for arc-length}\}$$

$$\text{if } (l_n < gw\_l) \text{ then } l_n = gw\_l$$

$$\Delta l_n = \frac{\operatorname{atan}\left(\frac{a * l_n * \sin(\varphi)}{1 + a * l_n * \cos(\varphi)}\right)}{l_n}$$

$$l_{n+1} = l_n + \Delta l_n$$

$$\text{if } (l_{n+1} > \sqrt{\pi}) \text{ then } l_{n+1} = \sqrt{\pi}$$

4. Termination-condition :

$$\text{if } (\Delta l_n < 10^{-8}) \text{ OR } (n > 5)$$
$$\text{then terminate iteration}$$
$$\text{else next iteration-step with } l_n = l_{n+1} \text{ (see point 1-3)}$$

5. Error treatment :

$$\text{gw\_terminate} = 10^{-8} \quad \{ \text{limit for termination of iteration-algorithm} \}$$
$$\text{if } (\Delta l_n > \text{gw\_terminate}) \text{ OR } (n > 5) \text{ then no solution found}$$

6. The Base point of plumb line in the clothoid-calculation, which is found in this proceeding has to be retransformed into the country coordinate system. (see calculation of clothoid - transformation)

G.13 CALCULATE POINT WITH DISTANCE ON LINE

G.13.1 Point with distance on line

Nomenclature :

GIVEN :

P1,P2	: point on line
x	: distance of point to be calculated (P3) to point P1

WANTED :

P3	: point to be calculated

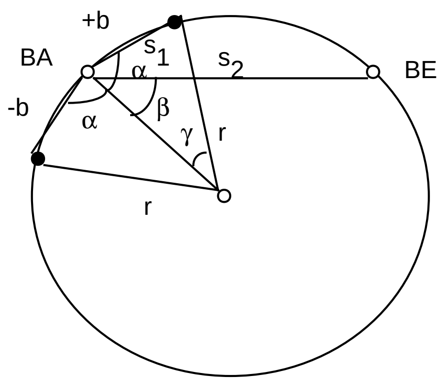
Formula and proceeding calculation :

1. Calculation of azimuth $Z_{P1\text{-}P2}$ (see calculation of coordinate, azimuth and distance, see result from coordinate).
2. Calculation of point P3 with $Z_{P1\text{-}P2}$ and x (see calculation of coordinate with azimuth and distance).

G.13.2 Calculate point on arc of circle with distance

G.13.2.1 Beginning and end point of arc are given :

Picture :



Nomenclature :

GIVEN :

BA : Start of arc

BE : End of arc

r : Radius

WANTED :

NP : new point

γ : displacement angle

b : arc-length (clockwise positive)

Formula and proceeding calculation :

1. Calculation of azimuth $Z_{BA\text{-}BE}$ and distance $dh_{BA\text{-}BE}$ (see calculation of coordinate, azimuth and distance result from coordinate).

2.

$$\text{if } b < +r\pi \text{ then } b = b - 2r\pi$$

$$\text{if } b < -r\pi \text{ then } b = b + 2r\pi$$

$$\gamma = \frac{b}{r}$$

$$s_1 = \text{Abs}\left(2r * \sin\left(\frac{\gamma}{2}\right)\right)$$

$$\alpha = \text{acos}\,\frac{s_1}{2r}$$

$$\beta = \text{acos}\,\frac{s_2}{2r}$$

$$\text{if } b < 0 \text{ then } \alpha = 0 - \alpha$$

$$Z_{BA\text{-}NP} = Z_{BA\text{-}BE} - (\alpha - \beta)$$

3. Calculation of coordinate from the new point with $Z_{BA\text{-}NP}$ and s_1 (see calculation of coordinate result from azimuth and distance).

G.13.2.2 Center of Circle is given :

Formula and proceeding calculation :

1. Calculation of azimuth $Z_{Z\text{-}P1}$ (see calculation of coordinate, azimuth and distance result from coordinate).

2.

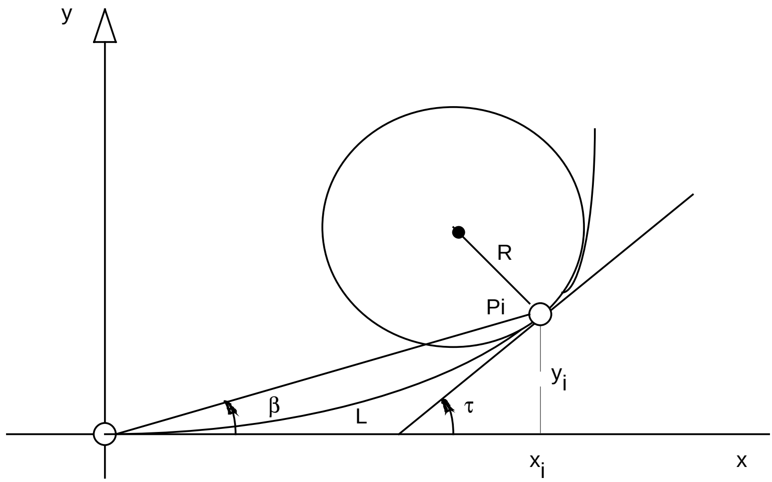
$$\gamma = \frac{b}{r}$$

$$Z_{Z\,-\,P_{NP}} = Z_{Z\,-\,P1} + \gamma$$

3. Calculation of the new point NP with $Z_{Z\text{ - }P1}$ and radius r. (see calculation of coordinate result from azimuth and distance).

G.14 CALCULATION OF CLOTHOID

Picture :



Nomenclature :

R	: Radius
L	: arc length
τ	: Tangent-angle
A	: Clothoid parameter If Clothoid rotates to the left, then A is negative; if to the right then A is positive .

Formula in general :

$$R = \frac{A^2}{L} = \frac{L}{2\tau} = \frac{A}{\sqrt{2\tau}}$$

$$L = \frac{A^2}{R} = 2\tau R = A\sqrt{2\tau}$$

$$\tau = \frac{L}{2R} = \frac{L^2}{2A^2} = \frac{A^2}{2R^2}$$

$$A = \sqrt{L * R} = \frac{L}{\sqrt{2\tau}} = R\sqrt{2\tau}$$

G.14.1 Calculated Coordinate

Nomenclature:

GIVEN :

τ : Tangent -angle

WANTED :

x_i, y_i : Coordinate in the unity-clothoid system

Formula :

The formulas are valid only for the calculation of coordinates in the unity-clothoid system (A=1).

$$x_i = \sqrt{2\tau} * \sum_{n=1}^{\infty}((-1)^{n+1} * \frac{\tau^{(2n-2)}}{(4n-3)*(2n-2)!})$$

$$y_i = \sqrt{2\tau} * \sum_{n=1}^{\infty}((-1)^{n+1} * \frac{\tau^{(2n-1)}}{(4n-1)*(2n-1)!})$$

G.15 TRANSFORMATION

Nomenclature :

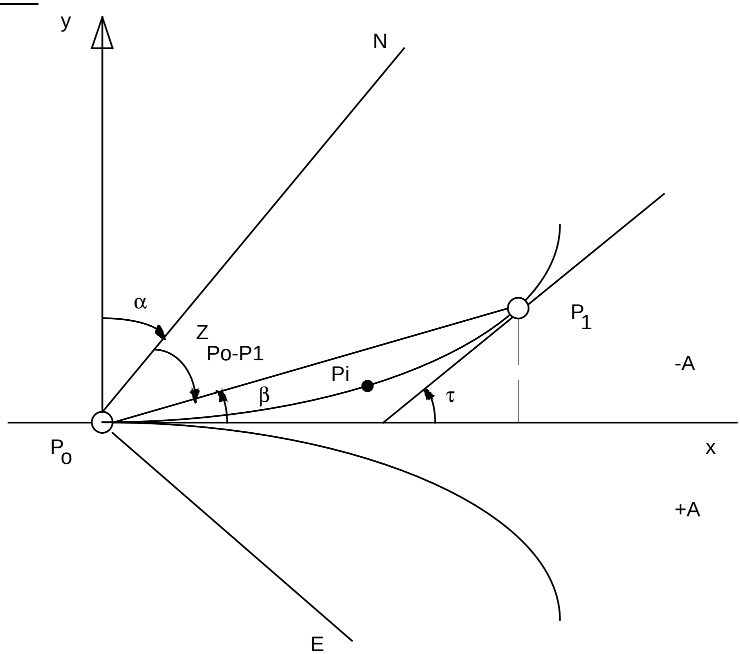
GIVEN :

A	: clothoid parameter
L	: arc length
P_o	: Zero-point coordinate of the clothoid system
P_1	: given point on the clothoid
Pi	: Coordinate of the point, which has to be transformed, in the old system.

WANTED :

Pi'	: Coordinate of the point, which has been transformed, in the new system.

Picture :



Formula and proceeding calculation :

1. Calculation of angle τ (see formula in general)

2. Calculation of coordinate of point Pi in the unity clothoid system (see calculation of coordinate)

3. Calculation of angle β:

$$\beta = \operatorname{atan}\left(\frac{y}{x}\right)$$

4. Calculation of rotation -angle

   if $(A > 0)$

   then $\alpha = (Z_{P_0 - P_1} - \beta)$

   else $\alpha = (Z_{P_0 - P_1} + \beta)$

   if (Transformation direction : Klothoidensystem into Country system)

   then $\alpha = 2\pi - \alpha$

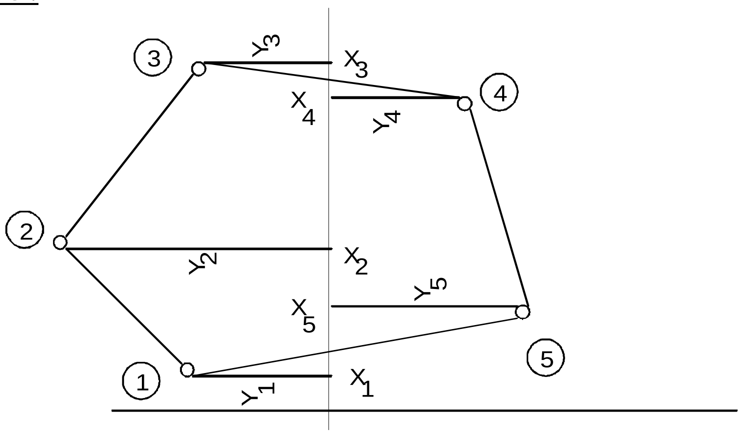
5. Calculated transformation with Po as common point, α as rotation angle and point Pi.

   (see coordinate -transformation [geodetic Systems])

G.16 PLANIMETRY

G.16.1 Planimetry result from coordinate (Gauss)

Picture :



Nomenclature :

GIVEN :

n : Number of corner-point

Y : Y-coordinate

X : X-coordinate

WANTED :

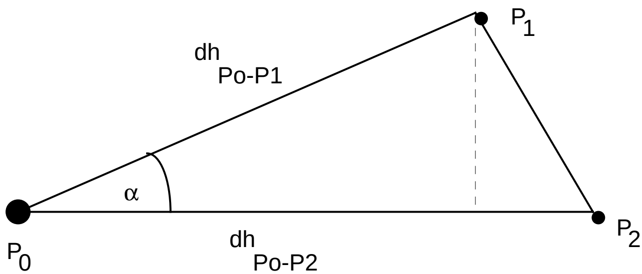
F : plane

Formula :

$$2F = \sum_{i=1}^{n} Y_i * (X_{i-1} - X_{i+1})$$

G.16.2 Planimetry result from measurement (triangle)

Picture :



Remark : The points P_1 and P_2 are defined clockwise. The result of exchanging the horizontal directions is a negative plane .

Nomenclature :

GIVEN :

$Hz_{Po\text{-}x}$: horizontal direction from point Po to point x

$dh_{Po\text{-}x}$: horizontal distance from point Po to point x

WANTED :

F : Triangle plane

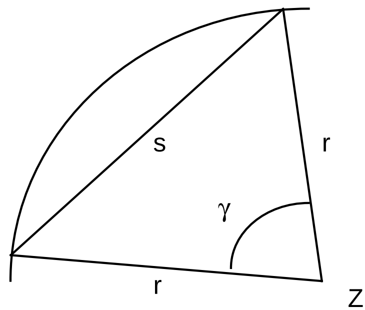
Formula :

$$\alpha = Hz_{P_0\text{-}P_2} - Hz_{P_0\text{-}P_1}$$

$$F = \frac{dh_{P_0-P_1} * dh_{P_0-P_2} * \sin(\alpha)}{2}$$

G.16.3 Segment Plane

Picture :



Nomenclature :

GIVEN :

s : Tendon length

r : Radius

WANTED :

F : Segment plane

Formula :

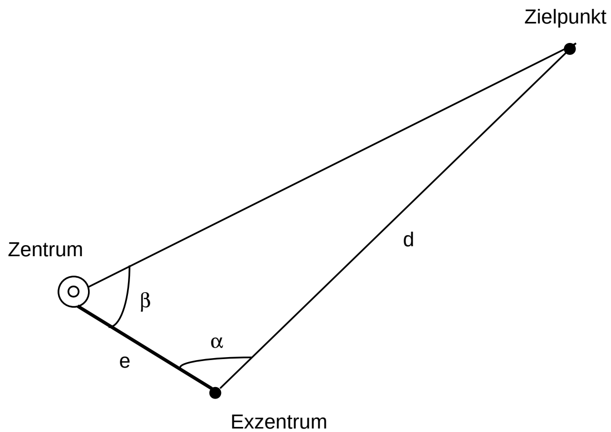
$$\gamma = \frac{s}{r}$$

$$F = \frac{r^2 (\gamma - \sin(\gamma))}{2}$$

G.17 EXCENTER OBSERVATION RE-CENTERED TO THE CENTER

G.17.1 Distance Measurement to the Mark

Picture :



Nomenclature :

GIVEN :

$Hz_{Ex\text{-}ZP}, V_{Ex\text{-}ZP}, ds_{Ex\text{-}ZP}$: Measure - element on the excenter

e : Horizontal-distance centre -excenter

WANTED :

$Hz_{Z\text{-}ZP}, V_{Z\text{-}ZP}, ds_{Z\text{-}ZP}$: on the centre re-centre measure - element

Formula and proceeding calculation :

1. Calculation of horizontal distance $dh_{Ex\text{-}ZP}$ (see geometry reduction of the measured distance).

2. $\alpha = Hz_{Ex\text{-}ZP} - Hz_{Ex\text{-}Z}$

3. Calculation of β and the horizontal distance $dh_{Z\text{-}ZP}$ with e, $dh_{Ex\text{-}ZP}$ and α (see calculation of triangle, case SWS)

4. Calculation of the re-centred horizontal direction

$$\text{if } (Hz_{Ex\text{-}ZP} >= 0) \text{ AND } (Hz_{Ex\text{-}ZP} <= \pi) \text{ then } Hz_{Ex\text{-}ZP} = Hz_{Ex\text{-}ZP} + 2\pi$$

$$\text{if } (Hz_{Ex\text{-}Z} >= 0) \text{ AND } (Hz_{Ex\text{-}Z} <= \pi) \text{ then } Hz_{Ex\text{-}Z} = Hz_{Ex\text{-}Z} + 2\pi$$

$$\text{if } (Hz_{Ex\text{-}ZP} > Hz_{Ex\text{-}Z})$$

$$\text{then } Hz_{Z\text{-}ZP} = 2\pi - \beta$$

$$\text{else } Hz_{Z\text{-}ZP} = \beta$$

5. Calculation of the re-centred vertical direction

$$\Delta V = \operatorname{atan}\left(\frac{\Delta H_{Z\text{-}Ex}}{dh_{Z\text{-}ZP}}\right)$$

$$\text{if } (V_{Ex\text{-}ZP} < \pi) \quad \{ \text{ test if the telescope is in I. position } \}$$

$$\text{then } V_{Z\text{-}ZP} = V_{Ex\text{-}ZP} + \Delta V$$

$$\text{else } V_{Z\text{-}ZP} = V_{Ex\text{-}ZP} - \Delta V$$

6. Calculation of the re -centred slope distance

$$ds_{Z\text{-}ZP} = dh_{Z\text{-}ZP} * \sin(V_{Z\text{-}ZP})$$

G.17.2 Distance is not measured to the mark

Remark : This assumes, that the coordinate of centre and mark are available.

Formula and proceeding calculation :

1. Calculation of $dh_{Z\text{-}ZP}$ (see calculation of coordinate, azimuth and Distance result from Coordinate).

2. Calculation of angle α

$$\alpha = Hz_{Ex\text{-}ZP} - Hz_{Ex\text{-}Z}$$

$$\text{if } (\alpha < 0) \text{ then } \alpha = \alpha + 2\pi$$

$$\text{if } (\alpha > \pi)$$

then begin

$$\alpha = \alpha - \pi$$

β of the 2. solution is OK (see calculation of triangle)

else β of the 1. solution is OK (see calculation of triangle)

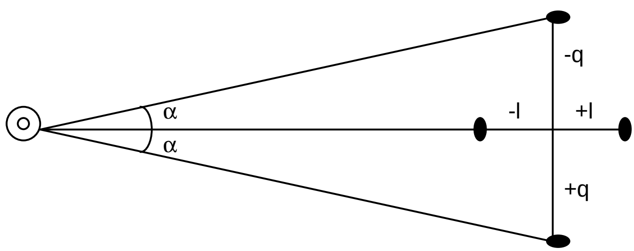
3. Calculation of β with $dh_{Z\text{-}ZP}$, e and α (see calculation of triangle, case SSW)

4. Calculation of the re-centred horizontal direction
   see above (Distance measured to the mark) point 4.

5. Calculation of the re-centred vertical direction
   see above (Distance measured to the mark) point 5

G.18 TRANSVERSE - AND LONGITUDINAL DISPLACEMENT IN THE MARK

Picture :



Nomenclature :

GIVEN :

L	: Longitudinal displacement
Q	: Transverse displacement
Hz_{gem}	: measured horizontal direction
dh	: reduced horizontal distance

WANTED :

dh_{korr}	:corrected horizontal distance
Hz_{korr}	:corrected horizontal direction

Formula :

Correction in consequence of longitudinal displacement :

$$dh_{korr} = dh + L$$

Correction in consequence of transverse displacement :

$$dh_{korr} = \sqrt{dh^2 + Q^2}$$

$$Hz_{korr} = Hz_{gem} + \operatorname{atan}\left(\frac{Q}{dh}\right)$$

G.19 CALCULATION OF LIMB ORIENTATION

Nomenclature :

GIVEN :

P_o (E_o,N_o,H_o)	: Position with the coordinate
P_i (E_i,N_i,H_i)	: Mark with the coordinate
Hz_i	: Horizontal direction
n	: Number of marks
T	: Test size of L1
h	: Auxiliary for analysis of observation

WANTED :

Z_i	: Azimuth from position P_o to the mark P_i
O_i	: Orientation of limb
O_{mean}	: Orientation unknown quantity as arithmetic average
O_{med}	: Orientation unknown quantity as median
V_{L1_i}	: Improvement at the direction Hz_i from L1
M_r	: Exactness of one single direction
M_{or}	: Exactness of the orientation unknown quantity O_{mean}
Q	: Limit for M_{or} (a priori exactness)

Formula and proceeding calculation :

The formulas are only valid for the units meter and gon

1. Calculation of azimuth Z_i from position P_o (E_o,N_o,H_o) to the mark P_i (E_i,N_i,H_i)

   (see calculation of azimuth and distance result from coordinate)

2. $O_i = (Z_i - Hz_i + 2\pi) \bmod 2\pi$

3. Calculation of average O_{mean} result from O_i
(see calculation of average for directions)

4. Calculation of average O_{med} result from O_i
(see calculation of median for directions)

5. $V_{L1_i} = Z_i - (O_{med} + Hz_i) \bmod 2\pi$

6. Calculation of the exactness of one single direction M_r and the exactness of the orientation unknown quantity M_{or}. (see Calculation of average in generally)

7. if M_{or} <= Q then result is accepted, no analysis of the observation has to be made

8. if (n < 3) then no analysis of the observation has to be made

9.

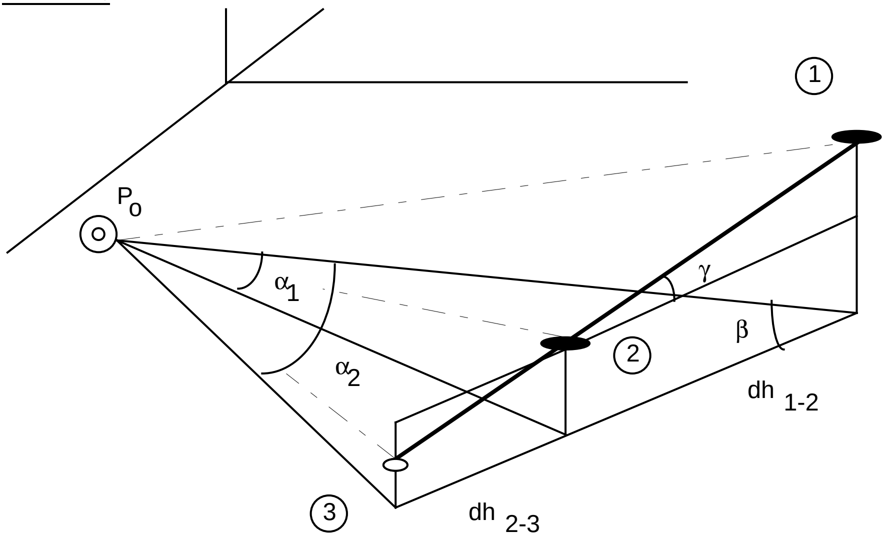
$h = O_{mean}$
if $abs(O_{med} - O_{mean}) > 2\pi$ then
begin
  if $(O_{med} - O_{mean}) > 0$ then $h = O_{mean} + 2\pi$
  if $(O_{med} - O_{mean}) > 0$ then $h = O_{mean} - 2\pi$
end

$T = 3*(O_{med} - h)$
if (T < 0.0003 gon) then no analysis of the observation has to be made

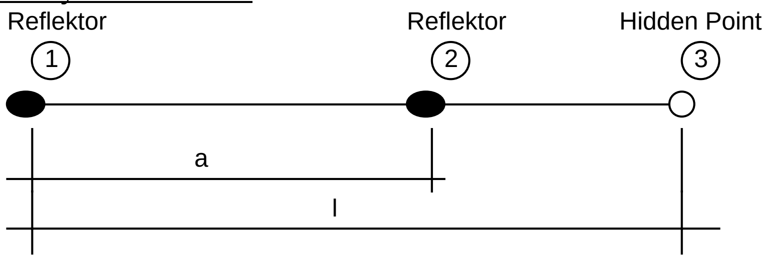
10. Analysis of the observation : if $(T < \left|V_{L1_i}\right|)$ then Hz_i is wrong

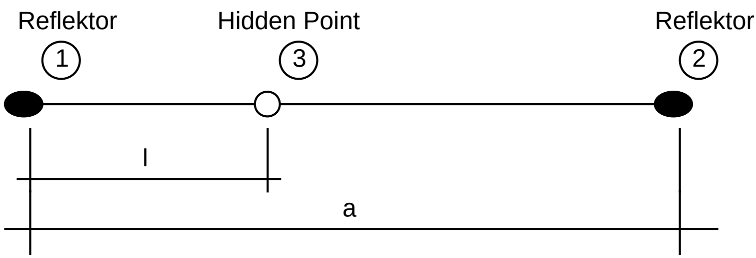
G.20 HIDDEN POINT

Picture :



Geometry of the Staff :





Nomenclature :

GIVEN :

$$Hz_{P_0-1},\ ds_{P_0-1},\ V_{P_0-1}$$
$$Hz_{P_0-2},\ ds_{P_0-2},\ V_{P_0-2}$$
: Measurement at the station Po

a : Distance of both reflectors

l : Distance of the hidden point from the reflector first measured (also possible that it is negative)

WANTED :

$$Hz_{P_0-3},\ ds_{P_0-3},\ V_{P_0-3}$$
: calculated measured values to the hidden point

Formula and proceeding calculation :

1. Calculation of the horizontal distance $dh_{Po\text{-}P1}$, $dh_{Po\text{-}P2}$ and the height differences ΔH_{P_0-1}, ΔH_{P_0-2}
   (see geometry reduction of the measured distance)

2. $\alpha_1 = Hz_{P_0\text{-}2} - Hz_{P_0\text{-}1}$

3. Calculation of the angle β with $dh_{Po\text{-}1}$, α_1 and $dh_{Po\text{-}2}$. (see calculation of triangle, case SWS)

   if $(l < 0)$ then $\beta = \pi - \beta$

4.

$$\gamma = \operatorname{asin}\left(\frac{\Delta H_{P_0-2} - \Delta H_{P_0-1}}{a}\right)$$

$$\Delta H_{1\text{-}3} = l * \sin(\gamma)$$

$$dh_{1\text{-}3} = \operatorname{Abs}(l) * \cos(\gamma)$$

5. Calculation of the distance $dh_{Po\text{-}3}$ and the angle α_2 with $dh_{Po\text{-}1}$, β and $dh_{1\text{-}3}$ (see calculation of triangle, case SWS).

   if $(l < 0)$ then $\alpha_2 = 0 - \alpha_2$

6. Calculation of the vertical direction $V_{Po\text{-}3}$

$$\Delta V = \operatorname{atan}\left(\frac{\Delta H_{1\text{-}3}}{dh_{P_0-3}}\right)$$

if $(V_{P_0\text{-}1} < \pi)$ { test if telescope in I. position }

then $V_{P_0\text{-}3} = V_{P_0\text{-}1} - \Delta V$

else $V_{P_0\text{-}3} = V_{P_0\text{-}1} + \Delta V$

7. Calculation of the slope distance $ds_{Po\text{-}3}$

$$ds_{P_0-3} = \text{Abs}\left(\frac{dh_{P_0-3}}{\sin(V_{P_0\text{-}3})}\right)$$

8. Calculation of the horizontal direction $Hz_{Po\text{-}3}$

$$\text{if } (Hz_{P_0\text{-}1} >= 0) \text{ AND } (Hz_{P_0\text{-}1} <= \pi) \text{ then } Hz_{P_0\text{-}1} = Hz_{P_0\text{-}1} + 2\pi$$

$$\text{if } (Hz_{P_0\text{-}2} >= 0) \text{ AND } (Hz_{P_0\text{-}2} <= \pi) \text{ then } Hz_{P_0\text{-}2} = Hz_{P_0\text{-}2} + 2\pi$$

$$\text{if } (Hz_{P_0\text{-}2} > Hz_{P_0\text{-}1})$$

$$\quad \text{then } Hz_{P_0\text{-}3} = (Hz_{P_0\text{-}1} + \alpha_2) \bmod 2\pi$$

$$\quad \text{else } Hz_{P_0\text{-}3} = (Hz_{P_0\text{-}1} - \alpha_2) \bmod 2\pi$$

Appendix H — CSV_SysCall Constants

The following is a list of all system functions and system events which are defined for creating user configurations and can be used in GeoBASIC applications, too.

A system function can be executed directly with the GeoBASIC routine `CSV_SysCall(`*`SystemFunction`*`)`. The same routine is also used to generate a system event. But the functionality is not the same. In the case of a system event, the system function (or dialog, menu, macro, application) will be executed which is connected to the event by the current configuration. If no system function (or dialog, menu, macro, application) is connected to the event, then the routine `CSV_SysCall(`*`SystemEvent`*`)` returns `RC_IVPARAM`. `CSV_SFNC_*` is the prefix of a system function, while `CSV_EFNC_*` denote an system event.

System Functions	**Description**
`CSV_SFNC_BeepAlarm`	Beep alarm: Alarm beep
`CSV_SFNC_BeepLong`	Beep long: Long beep
`CSV_SFNC_BeepNormal`	Beep normal: Normal beep
`CSV_SFNC_BeepShort`	Beep short: Short Beep
`CSV_SFNC_CallFreeCodingDlg`	Coding with codelists: Standard coding application. Priorities: 1. GeoBASIC code-function 2. OSW free coding 3. Standard coding
`CSV_SFNC_ChangeFace`	(I<>II) Change face: The dialog shows either the difference on non motorized theodolites or the turning info.
`CSV_SFNC_CheckMemCard`	Check PC-Card: Check PC-Card dialog
`CSV_SFNC_CheckOrientation`	Check orientation application (dialog)
`CSV_SFNC_ClearDist`	Release V-angle: Release of a frozen V-Angle and clears the measured distance. This function is only useful in a measurement dialog.
`CSV_SFNC_ClearOffset`	Set all Offs. to 0.0: Set the target point offset to 0.0
`CSV_SFNC_ConvertFile`	Data conversion: Converts coordinate files (Dialogs)
`CSV_SFNC_CreateNewJobDlg`	Create new job: Creates a new job (Dialog)

System Functions	Description
`CSV_SFNC_-CurrentSetPpmDlg`	Shows the ppm-setting dialog, depending on the predefinition (Full or reduced)
`CSV_SFNC_DataView`	Data view and edit: Standard data view and edit application (Dialog)
`CSV_SFNC_DefineMeasDlg`	Displ.mask definition: Definies the content of the standard measurement dialog (Dialog)
`CSV_SFNC_-DefineRecMaskDlg`	REC-Mask Definition: Defines the content of the recorded measurement data blocks (Dialog)
`CSV_SFNC_-DefSearchAreaDlg`	Defines the searching area (dialog)
`CSV_SFNC_-DeleteLastGsiBlock`	Delete last block: Deletes the last recorded GSI block (measurement data or code data)
`CSV_SFNC_EdmTest`	EDM Test signal/freq: Test EDM signal and frequency (Dialog)
`CSV_SFNC_-ExecAutoexecItem`	Autoexec-Handler: This handler is the standard function for the Autoexec event. It executes the pre-selected function/macro.
`CSV_SFNC_FetchLastPoint`	Get last rec. PointId: Sets the actual point number to the last recorded one.
`CSV_SFNC_FormatMemCard`	Format PC-Card: Formats after a query the PC-Card and shows the Card-Info dialog
`CSV_SFNC_-ImportStationCoordDlg`	Import station coord: Imports the station-coordinates of a given pointid. If the coordinates are available, then there is no dialog visible.
`CSV_SFNC_-ImportStationCoord-ViewDlg`	View/import stat.coor: Imports station-coordinates of the actual pointId. It shows the coordinates before importing (Dialog)
`CSV_SFNC_-InstrCorrections`	Instr. Calibration: Starts the instrument calibration application (Dialog)
`CSV_SFNC_Libelle`	Electronic Level: shows the standard electronic level dialog
`CSV_SFNC_Light`	Instrument lights: Shows the light configuration dialog
`CSV_SFNC_LoadApplDlg`	Shows the “Loading Application” dialog
`CSV_SFNC_LoadConfigFile`	Load configuration: Loads a new instrument configuration. After Loading, the instrument will restart. (Dialog)
`CSV_SFNC_LoadParamFile`	Load system parameter: Load the instrument parameter file (Dialog)
`CSV_SFNC_LoadSysLangDlg`	Shows the “Loading system language” dialog

System Functions	Description
CSV_SFNC_-ManageCodelistDlg	Codelist management: Codelist management dialog
CSV_SFNC_-ManageDataJobDlg	Data job management: Data job management dialog
CSV_SFNC_-ManageMeasJobDlg	Meas job management: Measurement job management dialog
CSV_SFNC_ManCoordDlg	Enter coordinate set: Manual entering of coordinates
CSV_SFNC_-ManStationCoordDlg	Enter station coord: Manual entering of station coordinates.
CSV_SFNC_-MeasAttributeCodeDlg	Attributes: Edit attributes of the current code
CSV_SFNC_MeasPrgm	EDM program selection: EDM measurement program and reflector selection (Dialog)
CSV_SFNC_MeasureDist	(DIST) Distance measure: Measure a distance and show the distance measurement dialog during the distance measurement. This function is only useful in a measurement dialog.
CSV_SFNC_-MeasureDistAndRec	(ALL) Measure and Rec: Forces a distance measurement and records the target point data. This function is only useful in a measurement dialog.
CSV_SFNC_PositCompassDlg	RCS Ori.with compass: RCS orientation with a compass (Dialog). This function is only at RCS mode available.
CSV_SFNC_PositHzVDlg	RCS Positioning Hz/V: Positioning with manual entering of the Hz- and V-angle (Dialog). This function is only at RCS mode available.
CSV_SFNC_-PositJoystickDlg	RCS Move by joystick: RCS moving using the joystick functionality (Dialog). This function is only at RCS mode available.
CSV_SFNC_PositLastPoint	Turn to last rec.Pt: Turns the instrument to the last recorded position. This function needs a motorised instrument.
CSV_SFNC_QuickSet	Quick station setup: Quick orientation to a backside point and setting of the station coordinates. (Dialog)
CSV_SFNC_-RecordStationData	(REC) Station data: Recording of the station data.

System Functions	Description
CSV_SFNC_-RecordTargetPoint	(REC) Target Point: Standard Recording of Target point according the selected REC-Mask and increments the running point number.
CSV_SFNC_SaveParamFile	Save param. to PC-Card: Saves the actual parameter setting to a PC-Card file (Dialog)
CSV_SFNC_-SetAccessoriesDlg	Accessories: Accessories definition dialog
CSV_SFNC_-SetDefaultSearchRange	Sets the searching area back to default.
CSV_SFNC_SetFullPpmDlg	PPM (atm. + geom.): Shows the full ppm correction dialog. It allows a more detailed configuration than PPM atmospheric dialog
CSV_SFNC_-SetGSIDefaultParam	Set GSI default param: Resets the GSI communication parameters to the default values
CSV_SFNC_SetHz	Set Hz to any angle: Set the Hz-circle orientation to any angle (Dialog)
CSV_SFNC_SetHz0	Set Hz to 0.0: Sets the Hz circle orientation to 0.0
CSV_SFNC_SetManDist	Horiz.distance entry: Manual entry of a horizontal distance (Dialog)
CSV_SFNC_SetMeasDlgMask1	Set Display Mask 1: Set display #1 for the measurement dialog
CSV_SFNC_SetMeasDlgMask2	Set Display Mask 2: Set display #2 for the measurement dialog
CSV_SFNC_SetMeasDlgMask3	Set Display Mask 3: Set display #3 for the measurement dialog
CSV_SFNC_-SetNextMeasDlgMask	Show next displ. mask: Show the next defined display mask (of the standard measurement dialog)
CSV_SFNC_SetOnlineDlg	GeoCOM On-Line mode: Leaves the manual control and switches to the GeoCOM controlled mode. Before switching, it shows a confirmation message
CSV_SFNC_SetRcsDlg	RCS (Remote) On/Off: Enables or disables the remote control
CSV_SFNC_SetRecMask1	Set Rec-Mask 1: Set recmask #1 for target point recording
CSV_SFNC_SetRecMask2	Set Rec-Mask 2: Set recmask #2 for target point recording
CSV_SFNC_SetRecMask3	Set Rec-Mask 3: Set recmask #3 for target point recording

System Functions	Description
CSV_SFNC_SetRecMask4	Set Rec-Mask 4: Set recmask #4 for target point recording
CSV_SFNC_SetRecMask5	Set Rec-Mask 5: Set recmask #5 for target point recording
CSV_SFNC_SetSimplePpmDlg	PPM Atmospheric: Shows the simple ppm dialog
CSV_SFNC_StdCodeDlg	Coding (standard): Standard coding application (without a codelist)
CSV_SFNC_SWInfoDlg	Instr. Information: Shows the instrument information dialog
CSV_SFNC_SwitchDirectOff	(OFF) Instr.power Off: Switches the instrument off without a message-box
CSV_SFNC_ToggleATR	Enable / Disable ATR: Enables or disables the ATR. This function is only at ATR instruments available
CSV_SFNC_-ToggleDisplayLight	Displ.illumin. On/Off: Toggles the display illumination
CSV_SFNC_ToggleEglIllum	EGL illumnin. On/Off: Toggles the EGL illumination. This function is only at instruments with a build-in EGL available
CSV_SFNC_-ToggleLaserPlummet	Laser plummet On/Off: Toggles the laser plummet. This function is only available on instruments with a build-in laser plummet
CSV_SFNC_ToggleLock	Enable / Disable LOCK: Enables or disables the Locking. This function is only at ATR instruments available
CSV_SFNC_ToggleLockInt	Interrupt/Resume LOCK: Suspend or resume the locking. This function is only at ATR instruments available
CSV_SFNC_-ToggleMeasPrgFast-RapidTrk	Toggles the measurement program (Fast / Rapid-Tracking)
CSV_SFNC_-ToggleMeasPrgRefRL	Toggles the measurement mode (Prism / Reflectorless)
CSV_SFNC_-ToggleMeasPrgStd Tracking	Toggles the measurement program (Standard / Tracking)
CSV_SFNC_-TogglePointNumbering	Indiv/running PointId: Toggles the target point numbering Individuell <-> Running
CSV_SFNC_ToggleQuickCode	Quick coding On/Off: Enables / disables the Quick-Coding

System Functions	Description
`CSV_SFNC_ToggleRedLaser`	EDM red laser On/Off: Toggles the red laser on or off. This function is only available on instruments with a build-in EDM with a visible laser light available
`CSV_SFNC_-ToggleReticuleIllum`	Retic.illumin. On/Off: Toggles the reticule illumination
`CSV_SFNC_-ToggleSearchArea`	Enables / disables the searching working area
`CSV_SFNC_-ToggleVAngleMode`	Toggles the V-Angle mode (Free / Fixed)

System Events	Description
`CSV_EFNC_ButtonCode`	Button CODE: Generates the same event like pressing the CODE button. Usually connected to the "Coding" function
`CSV_EFNC_ButtonFnc`	Button FNC: Generates the same event like pressing the Fnc button. Usually connected to the FNC menu.
`CSV_EFNC_ButtonLevel`	Button LEVEL: Generates the same event like pressing the level button. Usually connected to the "Electronic Level" function
`CSV_EFNC_ButtonLight`	Button LIGHT: Generates the same event like pressing the light button. Usually connected to "Instrument Lights" function
`CSV_EFNC_ButtonPowerOff`	Button Power OFF: Generates the same event like pressing the power off button. Usually not connected
`CSV_EFNC_ButtonPowerOn`	Button Power ON: Generates the same event like after switching on the instrument. Usually connected to the"Standard autoexec handler" function
`CSV_EFNC_ButtonProg`	Button PROG: Generates the same event like pressing the PROG button. Usually connected to user defined application program menu.
`CSV_EFNC_ButtonShiftCode`	Button Shift CODE: Generates the same event like pressing the shift CODE button. Usually not connected
`CSV_EFNC_ButtonShiftFnc`	Button Shift FNC: Generates the same event like pressing the shift Fnc button. Usually not connected

System Events	Description
CSV_EFNC_ButtonShiftProg	Button Shift PROG: Generates the same event like pressing the Shift PROG button. Usually not connected
CSV_EFNC_-CompensatorSetting	Compensator/Level: Global compensator setting event. Usually connected to an user-defined compensator setting dialog.
CSV_EFNC_DataView	Data View and Edit: Global Data View and Edit event. Usually connected to the "Data view and edit" function
CSV_EFNC_GeocomSetup	GeoCOM Setup: GeoCOM parameter setup event. Usually connected to a user-defined GeoCOM parameter dialog.
CSV_EFNC_GsiSetup	GSI Setup: GSI parameter setup event. Usually connected to a user-defined GSI parameter dialog.
CSV_EFNC_MeasDistance	(DIST) Distance meas: Global distance measurement event. Usually connected to the Distance measurement function
CSV_EFNC_-MeasDistanceRecord	(ALL) Measure and Rec: Global measure and record a distance event. Usually connected to the "Measure and Record" function
CSV_EFNC_MeasRecord	Measure and Record: Global measurement and recording event. Usually connected to a user-defined measurement dialog.
CSV_EFNC_RcsSetup	RCS Setup: RCS parameter setup event. Usually connected to a user-defined RCS parameter dialog.
CSV_EFNC_RecordStation	(REC) Station Data: Global station data recording event. Usually connected to the "Recording of station data" function
CSV_EFNC_RecordTarget	(REC) Target point: Global Recording event. Usually connected to the "Recording of target point" function
CSV_EFNC_RootFunction	System MAIN: Generates the same event like after the power-on. Usually connected to the Main-Menu
CSV_EFNC_SelectReflector	Reflector selection: Global reflector selection event. Usually connected to an user-defined reflector selection dialog.
CSV_EFNC_SetStation	Station setup: Global Station data setting event. Usually connected to an user-defined station setting dialog.

System Events	Description
CSV_EFNC_Setup	Job and Work settings: Global Setup event (setup station, jobs...). Usually connected to an user-defined setup dialog.
CSV_EFNC_TargetData	Target Data Settings: Global target data setting event. Usually connected to an user-defined target data dialog
CSV_EFNC_USER1	User Event 1: Usually not connected
CSV_EFNC_USER2	User Event 2: Usually not connected
CSV_EFNC_USER3	User Event 3: Usually not connected

Appendix I — CALLABLE C-APPLICATION FUNCTIONS

The entry points - listed below - are those, which can be called directly from a GeoBASIC application, if and only if the application is loaded already.

These entry points relate heavily on the application release, as the C-applications themselves relate to the firmware release. Please cross check this in future for new releases of either the C-applications and/or the TPS1100 firmware.

I.1 ENTRY POINTS

The table below lists all valid application names and entry points. An example of a valid call could be the following. Capitalisation is relevant!

```
CSV_LibCall ( "FreeSt_Ori_Res", "ORIMain", sCaptionShort )
```

Application - Version	**Entry Point** **Application Name – Entry Point Name(s)**
Area – 2.0	“Area” – “AreaApplMain”
Auto Record – 2.0	“AutoRecord” – “AutoRecApplMain”
COGO – 2.0	“COGO” – “CogoApplMain”
DTM Stakeout – 2.0	“DTM-Stakeout” – “TinStakeMain”
Face Scan – 2.0	“FaceScanning” – “FscanApplMain”
Free Station Orientation Resection – 2.0	“FreeSt_Ori_Res” – “FRSMain” “ORIMain” “RESMain”
File Editor – 2.0	“FileEditor” – “FileEdMain”
File View – 2.0	“Text-View” – “FileViewApplMain”
Hidden Point – 2.0	“HiddenPoint” – “HiddenPtrApplMain”
Local Resection – 2.0	“LocalRes” – “LocalResMain”
Reference Line – 2.0	“REFL” – “RefLineApplMain”
Remote Height – 2.0	“RemoteHeight” – “RemHtMain”
Road Plus – 2.02	“RoadPlus” – “RoadPlusApplMain”
Sets of Angles – 2.00	“Sets” – “SetsApplMain”
Stakeout – 2.02	“Stakeout” – “StakeOutApplMain”

Application - Version	**Entry Point** **Application Name – Entry Point Name(s)**
`Traverse – 2.0`	`“Traverse” – “TravMain”`
`Tie Distance – 2.0`	`“TieDistance” – “TieDistApplMain”`

Appendix J — List of Predefined Identifiers

J.1 TYPES

Type Name	Description
`Date_Time_Type`	Date and time information.
`Date_Type`	Date information.
`FileId`	File identifier
`FileName`	String * 100 for path and file name
`GM_4Transform_Param_Type`	Transformation parameters.
`GM_Circle_Type`	Definition of a circle.
`GM_Excenter_Elems_Type`	Elements of the eccentric observation.
`GM_Line_Type`	Definition of a line.
`GM_Mean_StdDev_Type`	Average, middle error of average, and middle error of any observation.
`GM_Measurements_Type`	Structure used for measurement (polar coordinates).
`GM_Point_Type`	Definition of a point.
`GM_QXX_Matrix_Type`	Coefficients of the cofactor matrix of the unknown.
`GM_Triangle_Accuracy_Type`	Accuracy of angle and side of the triangle.
`GM_Triangle_Values_Type`	Sides and angles of a triangle.
`GSI_Point_Coord_Type`	Point coordinate data.
`GSI_Rec_Id_List`	Array of integers (indicating WI–identificatoins).
`GSI_WiDlg_Entry_Type`	Dialog entry information.
`ListArray`	Array of String * 30 type
`SLine`	Display line
`String10`	String * 10 type

Appendix J — List of Predefined Identifiers

J.1 TYPES

Type Name	Description
`Date_Time_Type`	Date and time information.
`Date_Type`	Date information.
`FileId`	File identifier
`FileName`	String * 100 for path and file name
`GM_4Transform_Param_Type`	Transformation parameters.
`GM_Circle_Type`	Definition of a circle.
`GM_Excenter_Elems_Type`	Elements of the eccentric observation.
`GM_Line_Type`	Definition of a line.
`GM_Mean_StdDev_Type`	Average, middle error of average, and middle error of any observation.
`GM_Measurements_Type`	Structure used for measurement (polar coordinates).
`GM_Point_Type`	Definition of a point.
`GM_QXX_Matrix_Type`	Coefficients of the cofactor matrix of the unknown.
`GM_Triangle_Accuracy_Type`	Accuracy of angle and side of the triangle.
`GM_Triangle_Values_Type`	Sides and angles of a triangle.
`GSI_Point_Coord_Type`	Point coordinate data.
`GSI_Rec_Id_List`	Array of integers (indicating WI–identificatoins).
`GSI_WiDlg_Entry_Type`	Dialog entry information.
`ListArray`	Array of String * 30 type
`SLine`	Display line
`String10`	String * 10 type
`String18`	String * 18 type

Type Name	Description
String20	String * 20 type
String255	String * 255 type
String30	String * 30 type
Time_Type	Time information.
TMC_ANG_SWITCH_Type	Angle measurement switches
TMC_Angle_Type	Data structure for measuring angles.
TMC_ATMOS_TEMPERATURE_Type	Corrections for distance measurement: to define PPM values of atmosphere
TMC_Coordinate_Type	Data structure for the coordinates (tracking and fixed coordinates).
TMC_DIST_SWITCHES_Type	Distance measurement switches
TMC_Distance_Type	Data structure for the distance measurement.
TMC_GEOM_PROJECTION_Type	Corrections for distance measurement: to define PPM values of projection
TMC_GEOM_REDUCTION_Type	Corrections for distance measurement: to define PPM values of reduction to the reference
TMC_HZ_V_Ang_Type	Horizontal and vertical angle.
TMC_Incline_Type	Data structure for the inclination measurement.
TMC_OFFSET_DIST_Type	Target offset
TMC_PPM_CORR_Type	Correction for distance measurement.
TMC_REFRACTION_Type	Refraction correction for distance measurement.
TMC_STATION_Type	Station coordinates.
TPS_Fam_Type	Information about the current hardware.
Wi_List	Array of GSI_WiDlg_Entry_Type.

J.2 FUNCTIONS AND PROCEDURES

Name **Page**

Type Name	Description
`String18`	String * 18 type
`String20`	String * 20 type
`String255`	String * 255 type
`String30`	String * 30 type
`Time_Type`	Time information.
`TMC_ANG_SWITCH_Type`	Angle measurement switches
`TMC_Angle_Type`	Data structure for measuring angles.
`TMC_ATMOS_TEMPERATURE_Type`	Corrections for distance measurement: to define PPM values of atmosphere
`TMC_Coordinate_Type`	Data structure for the coordinates (tracking and fixed coordinates).
`TMC_DIST_SWITCHES_Type`	Distance measurement switches
`TMC_Distance_Type`	Data structure for the distance measurement.
`TMC_GEOM_PROJECTION_Type`	Corrections for distance measurement: to define PPM values of projection
`TMC_GEOM_REDUCTION_Type`	Corrections for distance measurement: to define PPM values of reduction to the reference
`TMC_HZ_V_Ang_Type`	Horizontal and vertical angle.
`TMC_Incline_Type`	Data structure for the inclination measurement.
`TMC_OFFSET_DIST_Type`	Target offset
`TMC_PPM_CORR_Type`	Correction for distance measurement.
`TMC_REFRACTION_Type`	Refraction correction for distance measurement.
`TMC_STATION_Type`	Station coordinates.
`TPS_Fam_Type`	Information about the current hardware.
`Wi_List`	Array of GSI_WiDlg_Entry_Type.

J.2 FUNCTIONS AND PROCEDURES

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