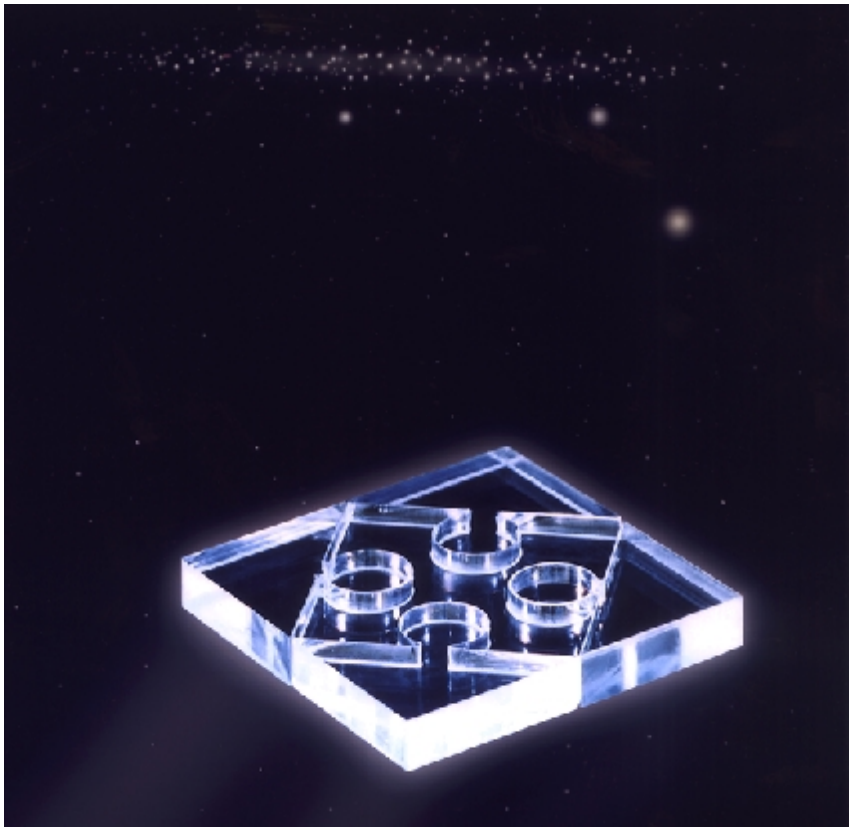
Axyz MTM/STM

Theodolite Module

Software Reference Manual
Hardware Installation Manual



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Contents

1. STM / MTM - the Theodolite Modules

1.1 About this manual

This manual has two main components:

1. It explains in detail how to operate the software interface to the ***Axyz*** STM/MTM Single/Multiple theodolite module. When individual modules are not identified, this may be simply referred to as the "Theodolite Manager".
2. It explains the installation of the hardware to run ***Axyz*** using a theodolite system for data acquisition.

The Theodolite Manager only operates from within the ***Axyz*** Core Data Module (CDM), which must therefore be installed. The operation of the Core Data Module is explained in the following document

- ***Axyz*** Core Data Module: Software Reference

The current manual explains in detail how to operate the software interface of the Theodolite Manager. The manual assumes the reader has an understanding of the measurement task and basic system concepts.

The following documents provide background information:

- ***Axyz*** "System Concepts" explains the general purpose and structure of the software.
- ***Axyz*** "Mathematics for Users" provides details of all relevant mathematical techniques.
- MS Visual Basic documentation explains the use of this programming language, except for functions and options specially created for ***Axyz***.

1.1.1 CAD users

The ***Axyz*** system offers an optional graphics module for graphically visualizing measurements and comparing them against imported CAD models.

This module has two configurations:

- ***Axyz*** View for simple data visualization
- ***Axyz*** CAD for data visualization plus manipulation of imported CAD models

See "***Axyz*** Graphics Module: Software Reference Manual" for more details.

Some features of the theodolite modules only function if ***Axyz*** CAD is installed. Functions specific to ***Axyz*** CAD will be indicated by the following label:

CAD only

1.1.2 Document conventions

The following text formatting conventions are in use:

This	Represents
italic	Italic type is used to indicate new or specialist names and terms. Look for a glossary definition or special section for more details.
ALL CAPITALS	The names of computers, folder names, filenames and acronyms.

1.1.3 Keyboard and menu conventions

Key combinations and key sequences have the following meanings:

Format	Meaning
KEY1+KEY2	A plus sign (+) between key names means to press and hold down the first key while you press the second key.
KEY1, KEY2	A comma (,) between key names means to press and release the keys one after the other.
ENTER or RETURN	The key equivalent to "carriage return" on a typewriter and which causes a new line when typing text. It may be labelled with a bent arrow.
SHIFT, Shift	The key which produces capital letters. It may be labelled with an upward pointing arrow.
CTRL, Ctrl, ALT, Alt	The "control" and "alternate" keys, generally labelled as "CTRL" and "ALT" on your keyboard.

1.1.4 Windows conventions

It is assumed that the user is familiar with the Microsoft WINDOWS™ environment. See MS Windows documentation for use of a mouse, windows features and shortcut keys.

In particular, the following standard buttons enable the user to respond to requested inputs.

Proceed with actions defined by the settings in the current dialogue box

Ignore any changes made in the current dialogue box. Return to the situation which existed before the current box was accessed.

Search folders on disk for the requested information.

Provide context-sensitive HELP.

The use of these buttons will in most cases not be further described.

1.1.5 On-line HELP

The on-line HELP is derived from this Software Reference Manual using Doc-To-Help ™. HELP and the manual each contain essentially the same information with the exception of menu screens. All menu screens are displayed in the manual. Most menu screens are not displayed in HELP because the screen can be viewed in the actual program when using HELP. However HELP does contain some example screens in order to properly explain the operation of particular features.

1.2 Individual theodolite modules

The Theodolite Module is designed to acquire data from theodolites and Total Stations (theodolites which measure both angle and distance) and process these data into 3D coordinates.

It is configured in one of three different ways, depending on which module is released by the copy protection device.

1. ***Axyz* STM** - the Single Theodolite Module
   (single Total Station, distance and angle readings)
2. ***Axyz* MTM** - the Multiple Theodolite Module
   (multiple theodolites and/or Total Stations but angle readings only)
3. ***Axyz* STM/MTM** - Combined single and multiple theodolite modules
   (multiple theodolites and/or Total Stations, angle and distance readings)

1.2.1 Supported theodolites and Total Stations

The ***Axyz* STM** Single Theodolite Module supports the following Leica total stations:

- TC 2002
- TDA 500x
- TDM 500x
- TC(M) 1800
- TC(M) 1700

Future total stations in the TCxxx range will be added to this list.

The ***Axyz* MTM** Multiple Theodolite Module supports the following Leica theodolites:

- All instruments supported by STM, but only for angle measurements. The distance measuring functions are ignored.
- T2002, T2000
- T3000, T3000A
- TM5xxx
- T(M) 1700
- E2, E2-I, E20, E20-I

The combined ***Axyz* STM/MTM** Theodolite Module supports the following instruments:

- E2 with E2/E20, E2-I/E20-I
- T/TC2000 with EPROM 1/10/84 or later (only angle measurements)
- T/TC/TM/TDM5xxx /TDA500x without restrictions
- T/TC2002/T3000 without restrictions.
- TPS1000 family.

1.2.2 Axyz STM - the Single Theodolite Module

The Single Theodolite Module ***Axyz* STM** implements the polar measuring method using a single total station.

The STM allows you to move the total station to different locations when measuring an object. Up to 99 stations are possible. Each new station is added to the measurement network using an orientation method which is equivalent to a 3D transformation. The new station must therefore measure at least 3 points which have already been measured by existing network.

Continuous update of measurements is not possible.

Axyz STM – selected features

Display

- Multiple X, Y and Z coordinate displays for viewing in different coordinate systems
- Running Data Window to monitor progress of measurements
- Variable display size to view from different ranges.

Measurement

- Measuring Modes:
  Standard
  Build/Inspect
  Auto Inspect (for TDA instrument series)
  CAD Build/Inspect
- Hidden point measurement
- Target thickness and reflector offset corrections

Sensor related functions

- Automatic Target Recognition (ATR) for TDA instrument series
- Lock-In (target following) for TDA instrument series
- Electronic instrument levelling
- On-site calibration and checking of instrument
- Control from sensor keyboard
- Operation with multiple reflector types

General

- Warning values for:
  Pointing errors (Deviations in Angle or Distance units),
  Measurement (standard deviations)
- Error messages to sensor

1.2.3 Axyz MTM - the Multiple Theodolite Module

The Multiple Theodolite Module ***Axyz* MTM** implements the method of triangulation using theodolites or Total Stations.

> **Note**
> Only angle measurements are accepted by the module, even if a Total Stations is connected.

In the **MTM** configuration the system makes use of one or more instruments which must occupy at least two stations. Various orientation methods are available to integrate the stations into a full 3D network.

Continuous update of measurements is possible.

Axyz MTM – selected features

Display

- Multiple X, Y and Z coordinate displays for viewing in different coordinate systems
- Running Data Window to monitor progress of measurements
- Variable display size to view from different ranges.

Measurement

- Measuring Modes:
  Standard
  Build/Inspect
  Auto Inspect (for TDA instrument series)
  CAD Build/Inspect
- Hidden point measurement
- Target thickness and reflector offset corrections

Sensor related functions

- Electronic instrument levelling
- On-site calibration and checking of instrument
- Control from sensor keyboard
- Operation with multiple reflector types

General

- Warning values for:
  Pointing errors (Deviations in Angle or Distance units),
  Measurement (standard deviations)
- Error messages to sensor

Mathematics functions

- Orientation methods:
  Accurate Collimation
  Approximate Collimation
  Local orientation (by gravity)
  Object orientation
- Optimizing Bundle Adjustment

1.2.4 The combined STM/MTM module

The **MTM** can be combined with the Single Theodolite Module ***Axyz*** **STM** to integrate polar and triangulation techniques. The user can then mix angle measurements (theodolites) with angle and distance measurements (total stations) in a unified **STM/MTM** system..

If one total station forms the network, this station is accepted as “oriented”. The coordinate system, origin and orientation are defined by the total station itself.

If two ore more theodolites are connected to the measuring network they must be oriented by the available method used in the MTM configuration before they can contribute to 3D calculations.

Continuous update of measurements is possible.

1.3 Starting up

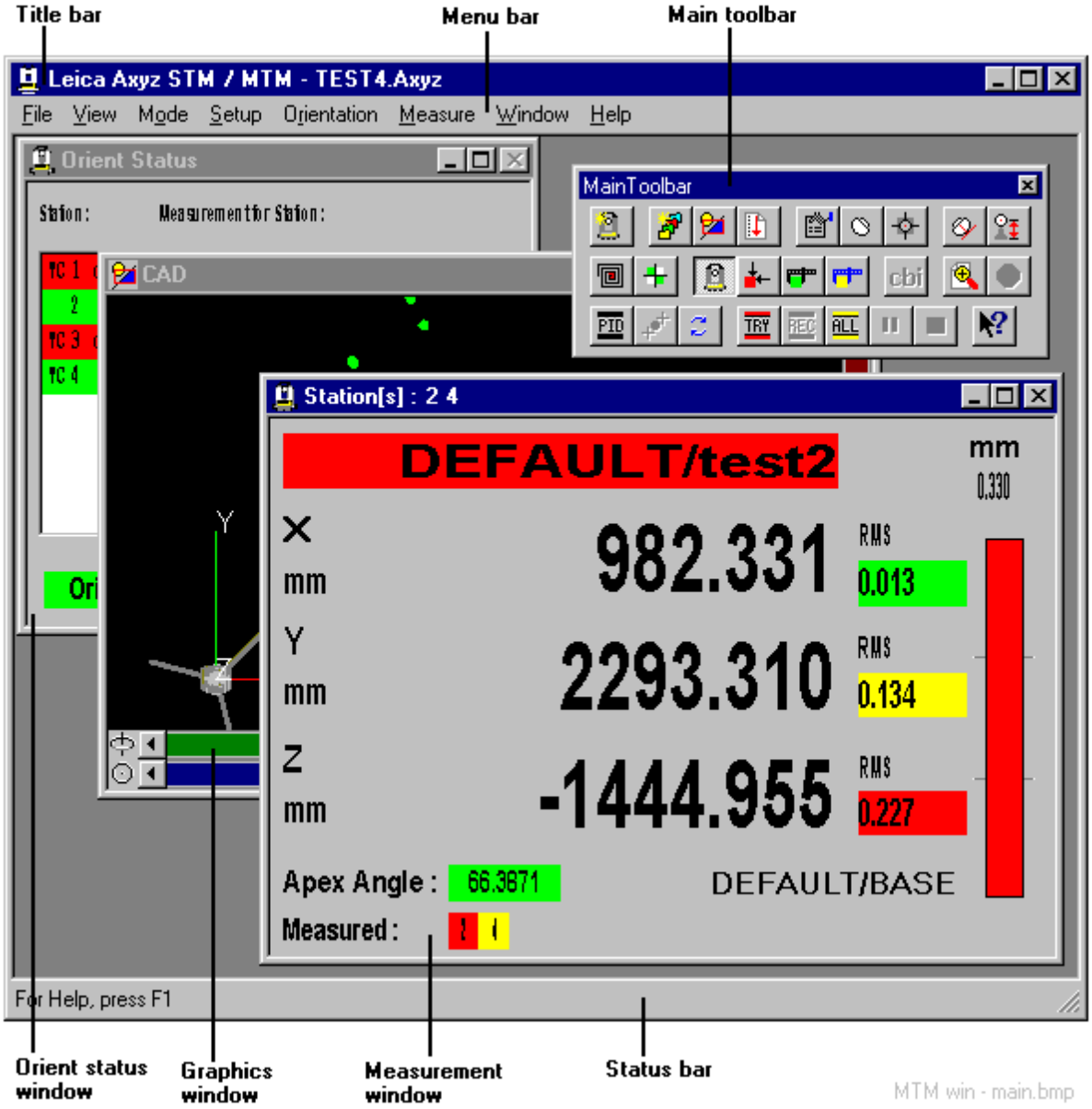
The Theodolite Manager is reached from within the ***Axyz*** core module (CDM).

Start the ***Axyz*** CDM by clicking on the ***Axyz*** icon in the program group or on your desktop.

Then start the Theodolite Manager (STM, MTM or combined STM/MTM) by clicking the theodolite button on the main toolbar.

2. STM / MTM graphical interface

2.1 Main screen



The sample display screen may look slightly different from your own display. The toolbars may be positioned elsewhere on the screen. Simply click on the toolbar's background and drag to a new location. You may have chosen not to display the toolbars or status bar. This option is available in the View Menu.

The **Orient Status** window is always present, even if minimized. It shows active and inactive stations, status of orientation and measurement history

One or more **Measurement windows** may be open. They display 3D results as they are calculated. The format of data presented in measurement windows depends on the mode of operation.

A **Data Manager** window can be opened. If this is also the active window then the DM toolbar is displayed. In the example a Data Manager window is not open.

A **Graphics window** can be opened by users of ***Axyz*** View and ***Axyz*** CAD. The example shows an open graphics window but it is not the active window and so the Graphics toolbar is not displayed.

Finally a **Running data** window may be started from the main window. It provides a numerical view of all raw data as it is generated.

The **Running Data** window can be positioned independently of the main window. All other windows appear within the main window.

2.2 Summary of toolbar buttons

2.2.1 Main toolbar

After starting the Theodolite Module, a reduced set of options is active, depending on configuration.


Open a new measurement window if oriented stations available


Open a new Data Manager window


Open the graphics window (**Axyz** CAD only)


Toggle the running data window on or off


Create a new station or modify parameters of an existing station


Specify or change the reflector type used by a Total Station


Automatically point at an existing location


Define and activate reflector offset correction


Define and activate target thickness correction


Bolt Hole Measurement


Average Measurement

PID (Set and Read Sensor)

Record angle values only from all sensors in the active measurement window

Record angle values and any distance values from all sensors in the active measurement window


Provide context sensitive help about selected options

MTM Table - Toolbar 01.bmp

Open a measurement window to make the following options active:


Measurement in Standard Mode (point measurement)


Measurement in Build Mode (set out points to design)


Measurement in Inspect Mode (check locations against design)


Toggle between full and reduced information in a measurement window


Continuously read the measurement sensors and update the measurement window, but no data storage

"Try" a measurement - used with REC and ALL to see results without storing data or incrementing point Ids

MTM Table - Toolbar 02.bmp

Users with ATR can open a measurement window and obtain the following:


Automatically inspect a set of existing locations


Pause the auto inspection sequence


Stop the auto inspection sequence

MTM Table - Toolbar 03.bmp

Users with ATR can double click the appropriate station in the **Orient Status** window and obtain the following:


Activate or switch off Auto. Target Recognition (ATR)


Activate or switch off target following (Lock-In)

MTM Table - Toolbar 05.bmp

Axyz CAD users can 0pen a graphics window to obtain the following:

CAD mode for building to or inspecting a CAD surface

MTM Table - Toolbar 04.bmp

2.3 Status bar

The left hand area of the status bar describes the action associated with a selected menu item or toolbar button. If after reading the description of the command associated with a toolbar button you do not wish to execute it, then release the mouse button while the pointer is off the toolbar button.

2.4 Orient Status window

In all theodolite modules (STM, MTM, STM/MTM) this window is always present although it may be minimized. It provides a summary of the orientation status and measurement history of all theodolites and Total Stations in the network.

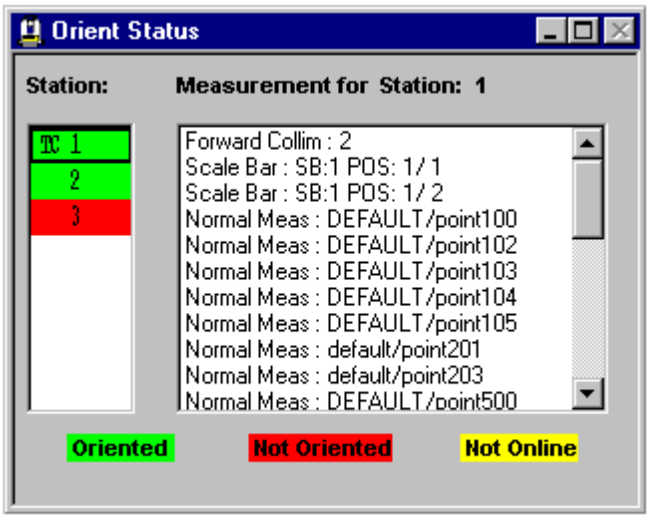
Note
Any laser tracker stations in the network are not listed.

The window is not accessed via a menu choice or toolbar button

2.4.1 Orient status information

In the **Stations** list, double click on a station to show its measurement history.

Example screen: Orient status



MTM win - ori stat.BMP

Station

A list of all theodolites and Total Stations in the network. Trackers are listed as unrecognized.

Stations are identified by colour-coded station number. Colour-coding identifies orientation status. To set colours, see "Theodolite Warnings" on page 69. The following labelling is in use:

Oriented (e.g. green background)
This station is oriented and on line.

Not oriented (e.g. red background)
This station is on line but not yet oriented into the network.

Not on line (e.g. yellow background)
This station is not on line, i.e. off line, no longer connected to the network.

"o" suffix
A letter "o" which follows a station displayed as "not on line" indicates that the off-line station is oriented to the network.

"TC" prefix
The letters "TC" before a station number indicates that it is a Total Station.

Measurement for Station

The box lists the measurement history of the corresponding station. A short label indicates the type of measurement, followed by the location measured.

Forward collim
A collimation measurement in face I. The following number is the number of the station acting as a target.

Reverse collim
A collimation measurement in face II. The following number is the number of the station acting as a target.

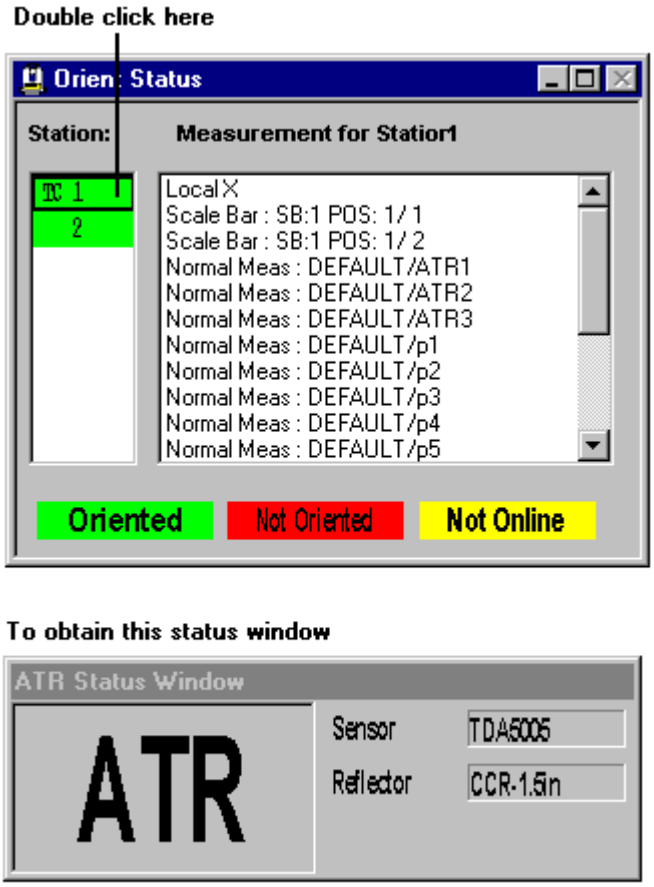
Approx collim
A approximate collimation measurement. The following number is the number of the station acting as a target.

Scale bar
A measurement to a scale bar target.
SB: 3 means that scale bar number 3 was measured.

POS: 2/1 means the scale bar was in position number 2 and target number 1 was measured.

Normal meas
A direct measurement to a targeted point. The point name is given in the standard format "workpiece ID / point ID"

2.5 "Big status" display



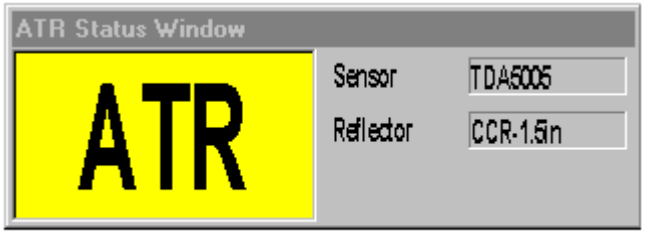
MTM Big status 01.bmp

A separate status window can be opened and re-sized for suitable viewing from a distance. (See "Big status" on page 32). This is primarily intended for use with Automatic Target Recognition (ATR) and therefore principally applies to instruments of the TDA series. (For more on ATR, see "Concepts" on page 35.) Together with ATR status, the sensor type and reflector type are displayed.

Since ATR can only be applied to one instrument at a time, a suitable instrument must be available from the ones currently connected. After

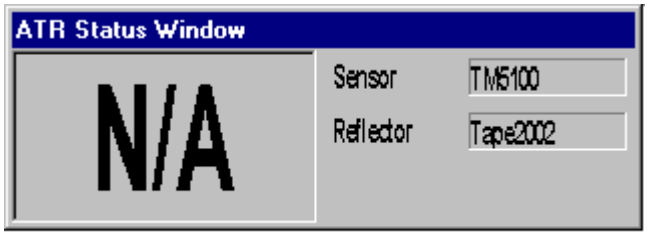
opening the window, double click on the relevant station in the **Orient Status** window to see the status information for that station.
If the selected instrument is from the TDA series and ATR is active (see "ATR Enabled" on page 52) then the display shows "ATR" together with the instrument type and the reflector associated with it.

If a measurement is made with this instrument, the display shows a yellow background as follows:



MTM Big status 02.bmp

If an instrument is selected which does not have the ATR capability, the display takes the following form, indicating that ATR is not available (n/a) at this instrument.



MTM Big status 03.bmp

2.5.1 Big status – shortcut menu on right mouse click

MTM Rt click - Big.bmp

Save properties
This saves the current display options for the window.

2.6 Running data window

There is a single Running Data window which displays data as it is generated.

Typically it is used to display any instrument readings as they are brought into the system. These values represent *raw measurements*, i.e. angles and

distances corrected only by the parameters of each instrument's software model (error correction model).
The Running Data window can also show coordinates as they are created or coordinate differences generated in **Build mode**.

This window can be placed independently of the theodolite module's main window and is always displayed on top of any other windows.

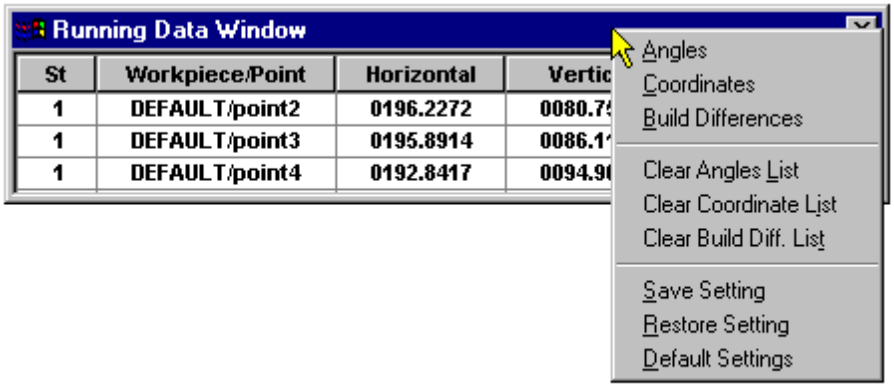
See "Running Data" on page 32 for information on accessing the window.

The grid layout in the window can be adjusted, see “Adjusting and editing grids” on page 127.

2.6.1 Running data information

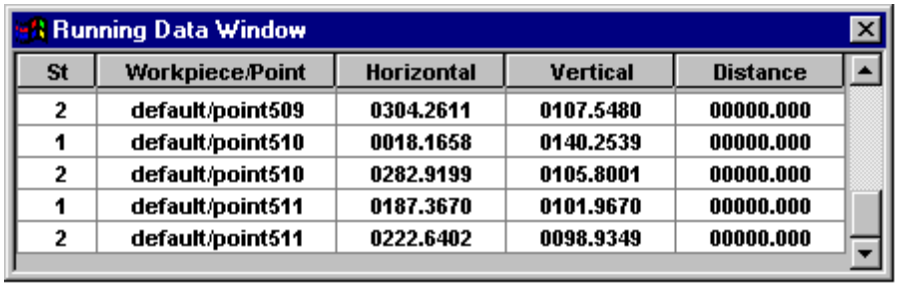
Right click on the title bar to get a shortcut menu offering display options for:

- Angles (measurements)
- Coordinates (3D values as they are created)
- Build differences (3D differences as they are calculated)



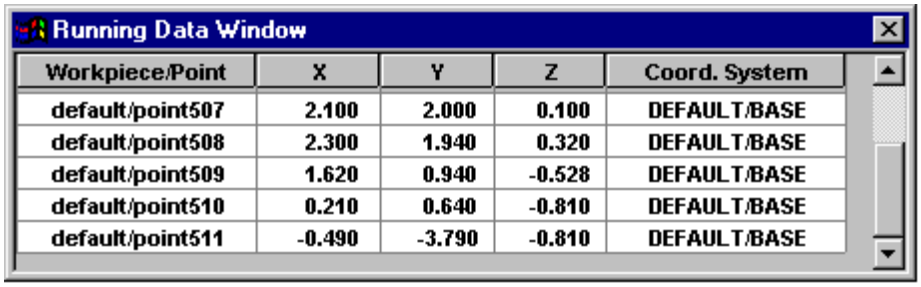
MTM win - run dat rt click.BMP

Example screen: Running data window, angles (measurements)



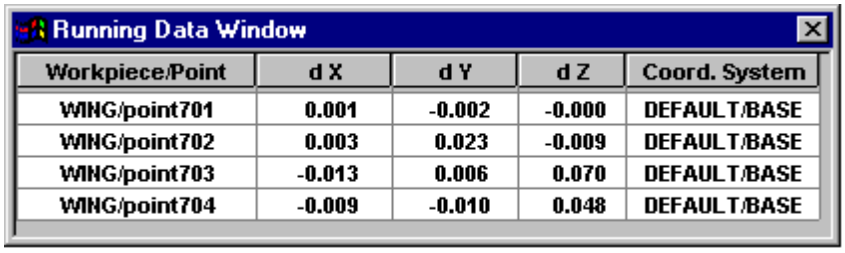
MTM win - run dat angles.BMP

Example screen: Running data window, coordinates



MTM win - run dat coords.BMP

Example screen: Running data window, build differences



MTM win - run dat bld diffs.BMP

2.7 Measurement window: Standard mode

The measurement window presents the 3D results of single point measurements made by a defined sub-group of the currently connected instruments.

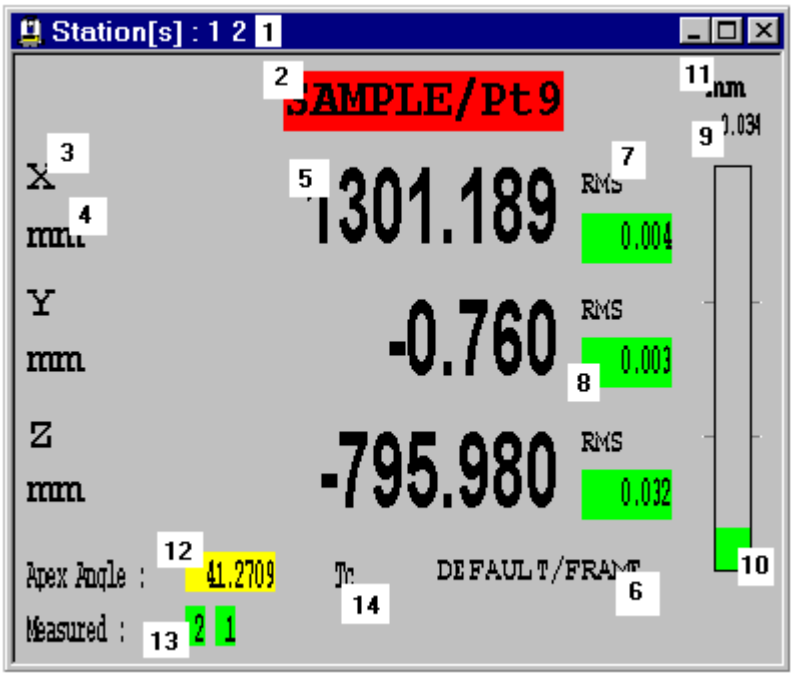
Standard mode: Displayed data and colour coding

The following items are displayed in a standard measurement window. See the example screen to locate the items.

To indicate accuracy, several data items use colour coding according to defined tolerance levels. To define the colours and warning levels (tolerance levels), see “Theodolite Warnings” on page 69:

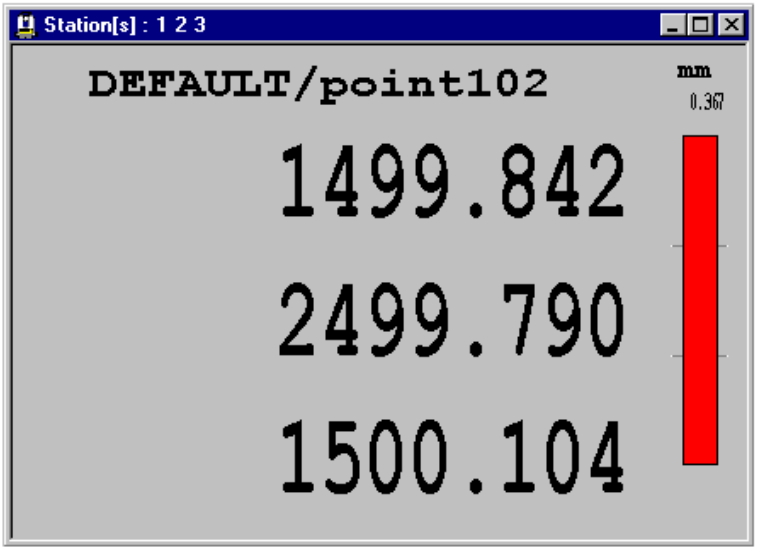
It is also possible to zoom in on the coordinates to provide a larger display for more convenient viewing from a distance. Not all information is then displayed. Click  to toggle between normal and zoomed displays.

Example screen: Standard mode, full information



MTM win - std full.bmp

Example screen: Standard mode, zoom in



MTM win - std reduced.BMP

Window title (1)

Window title specified when the window is created. See "Measurement window" on page 118

Workpiece and target point ID (2)

This is the full identifier for the currently measured point (workpiece ID/ point name).

A red background to the ID means that **Try** measurement is operating. When **REC** or **ALL** are then used to make a measurement, measurement values and 3D coordinates are not stored and the point ID is not incremented.

Coordinate (axis) labels (3)

The current labels in use for the currently active coordinate type are displayed here. Labels can be changed in the Core Module. See **CDM Settings menu / Axis labels**.

Coordinate units (4)

Units used for the current coordinate type are shown here. Units can be changed in the Core Module. See **CDM Settings menu / Units**.

Calculated point coordinates (5)

3D point coordinates in the coordinate system assigned to this window are shown here. Coordinate type (rectangular, cylindrical, etc.) can be changed in the Core Module. See **CDM Coordsys menu/ Coord type**.

Coordinate system name (6)

This is the full ID of the coordinate system used to display coordinates (workpiece ID/coordinate system name).

The coordinate system for this measurement window is chosen when the window is created. See "Measurement window" on page 118.

Selected quality statistic (7)

Point coordinates are calculated using the Single Point Solution. This takes into account the pointings from every oriented station, on-line or off-line, which has measured the current point. The calculation can generate one of two quality figures.

The standard deviation (std.) is a computed value based on the user’s estimates of the pointing quality of the instruments located at every station involved in the calculation. These estimates can be altered in the **Station setup** menu of the relevant instrument module. If the estimates are altered the calculated point quality will alter.

The Root Mean Square (RMS) value is based on the offsets of the computed 3D location from the pointings or polar locations of every station involved in the calculation. These offsets are split into their axial components using the selected coordinate system axes. An RMS value is then calculated for each group of axial components. The RMS tells you how much the rays miss the target point and does not depend on estimated pointing quality.

To specify which is displayed, see **CDM Settings menu/General.**

Statistical values for coordinates (8)

The values of standard deviation or RMS are shown here. Their colour-coding depends on the level defined by **Coordinate tol. (distance).**

Value of pointing error (9)

The pointing error is the largest offset between the calculated 3D point and the pointings from the individual instruments which measure it.

The error is given as either a linear or angular value.

If the pointing is purely angular then the linear offset is a perpendicular from the calculated target position to the relevant ray. If the pointing is a polar measurement then the linear offset is a spatial vector from the calculated target position to the relevant measured polar point. The largest of these offsets is the linear pointing error.

Angle offsets are calculated for every instrument as the spatial angle between the actual pointing and a line from the instrument through the calculated target location. The largest of these offsets is the angular pointing error.

Display of a linear or angular value depends on whether the warning level is set by the value for **Coordinate tol. (distance)** or **Coordinate tol. (angle).**

Pointing error bar (10)

The value of the pointing error, shown as a bar chart.

The bar is colour-coded according to the tolerance level set by either **Coordinate tol. (distance)** or **Coordinate tol. (angle)**, depending on whether a linear or angular display has been specified.

Pointing error units (11)

The pointing error can be expressed in linear or angular terms. Specify which to use in “Theodolite Warnings”.

Best apex angle (12)

Apex angles are calculated for all possible pairs of intersecting lines of sight to the measured point. This is the apex angle closest to the optimal value of 90 degs.

A colour-coded background depends on the warning level set for **Apex angle**.

Stations contributing to result (13)

All stations assigned to the measurement window are listed here.

No background colour indicates that the station was not used to measure the current point.

A background colour indicates the individual pointing error for the corresponding station, according to the defined warning levels.

Correction for target thickness and reflector offset (14)

If target thickness and reflector offset corrections are active, these are shown at this position as follows:

Tc
Target thickness is active. The coordinate system which defines the direction of the correction exists and the display shows the corrected values.

T
Target thickness is active. The coordinate system which defines the direction of the correction does not yet exist and the display shows the measured, uncorrected values.

The thickness information is stored for later use.

Rc
Reflector offset is active. The coordinate system which defines the direction of the correction exists and the display shows the corrected values.

R
Reflector offset is active. The coordinate system which defines the direction of the correction does not yet exist and the display shows the measured, uncorrected values.

The offset information is stored for later use.

2.8 Measurement window: Build/Inspect points

This window shows the 3D difference between the current target position and a reference location.

2.8.1 Build/Inspect points: Displayed data

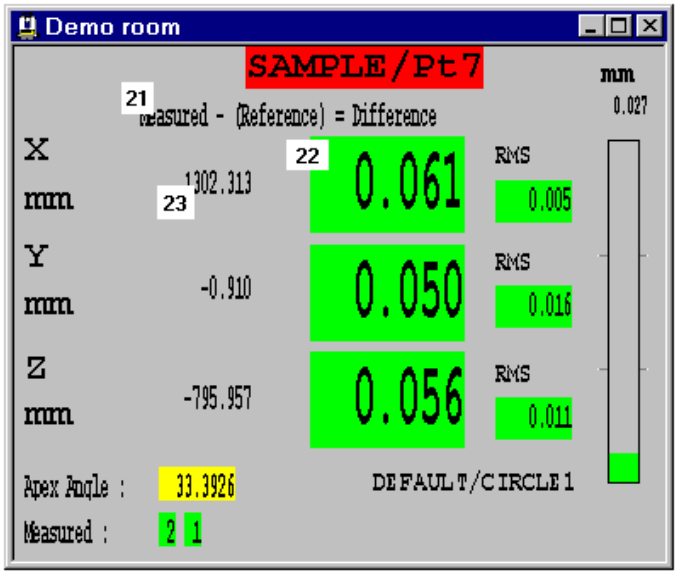
The following items are displayed in a build/inspect window. See the example screen to locate the items.

To indicate accuracy, several data items use colour-coding according to defined tolerance levels. To define the colours and warning levels, see “Theodolite Warnings” on page 69:

A number of data items are described for the **standard** mode window. See "Standard mode: Displayed data and colour coding" on page 17.

It is also possible to zoom in on the difference values to provide a larger display for more convenient viewing from a distance. Not all information is then displayed. Click  to toggle between normal and zoomed displays.

Example screen: Build points, full information



Build/Inspect indicator (21)

If building points:
Measured - Reference = Difference

If inspecting points:
Reference - Measured = Difference

Difference values (22)

For the current target, the difference between measured and reference coordinate values is displayed in large digits.

Measured coordinates (23)

Measured coordinates appear in smaller characters in front of the differences.

2.9 Measurement window: Auto Inspect

Auto Inspect simply provides an automated inspection of a sequence of points. Each individual inspection is therefore equivalent to the manual inspection of a single point.

The window display options are the same as for **Build/Inspect** points. See "Build/Inspect points: Displayed data" on page 22.

2.10 Measurement window: Vector mode

This window corresponds to **Build/Inspect** mode and shows the 3D difference between the current target position and an offset reference location. This difference is displayed in a local coordinate system. For more information see "Vector mode" on page 37.

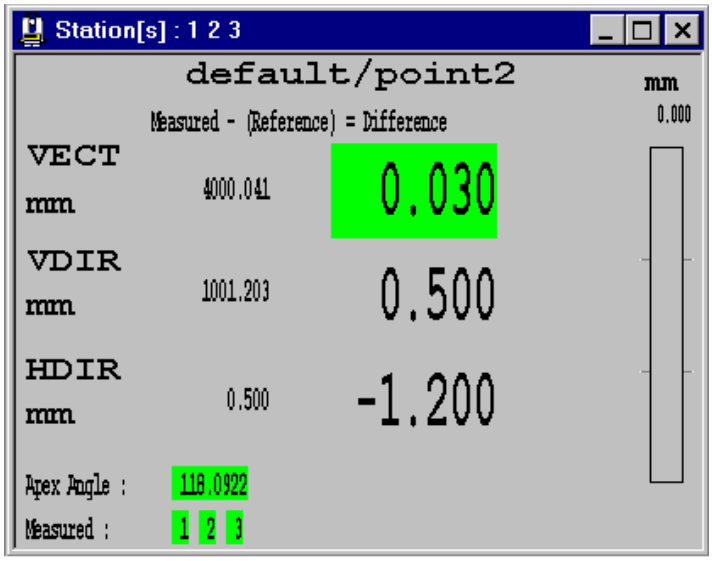
2.10.1 Vector mode: Displayed data

The following items are displayed in a vector mode window. See the example screen to locate the items. To indicate accuracy, several data items use colour-coding according to defined tolerance levels. To define the colours and warning levels, see “Theodolite Warnings” on page 69:

A number of data items are described for other measurement windows: See:
"Standard mode: Displayed data and colour coding" on page 17
"Build/Inspect points: Displayed data" on page 22.

It is also possible to zoom in on the difference values to provide a larger display for more convenient viewing from a distance. Not all information is then displayed. Click  to toggle between normal and zoomed displays.

Example screen: Vector mode, full information



MTM win vector full.bmp

Coordinate labels

Coordinate labels **VECT, VDIR** and **HDIR** as defined for vector mode are used.

3. Theodolite Manager menu summary

3.1 File summary

Exit	"Quit the MTM/STM"

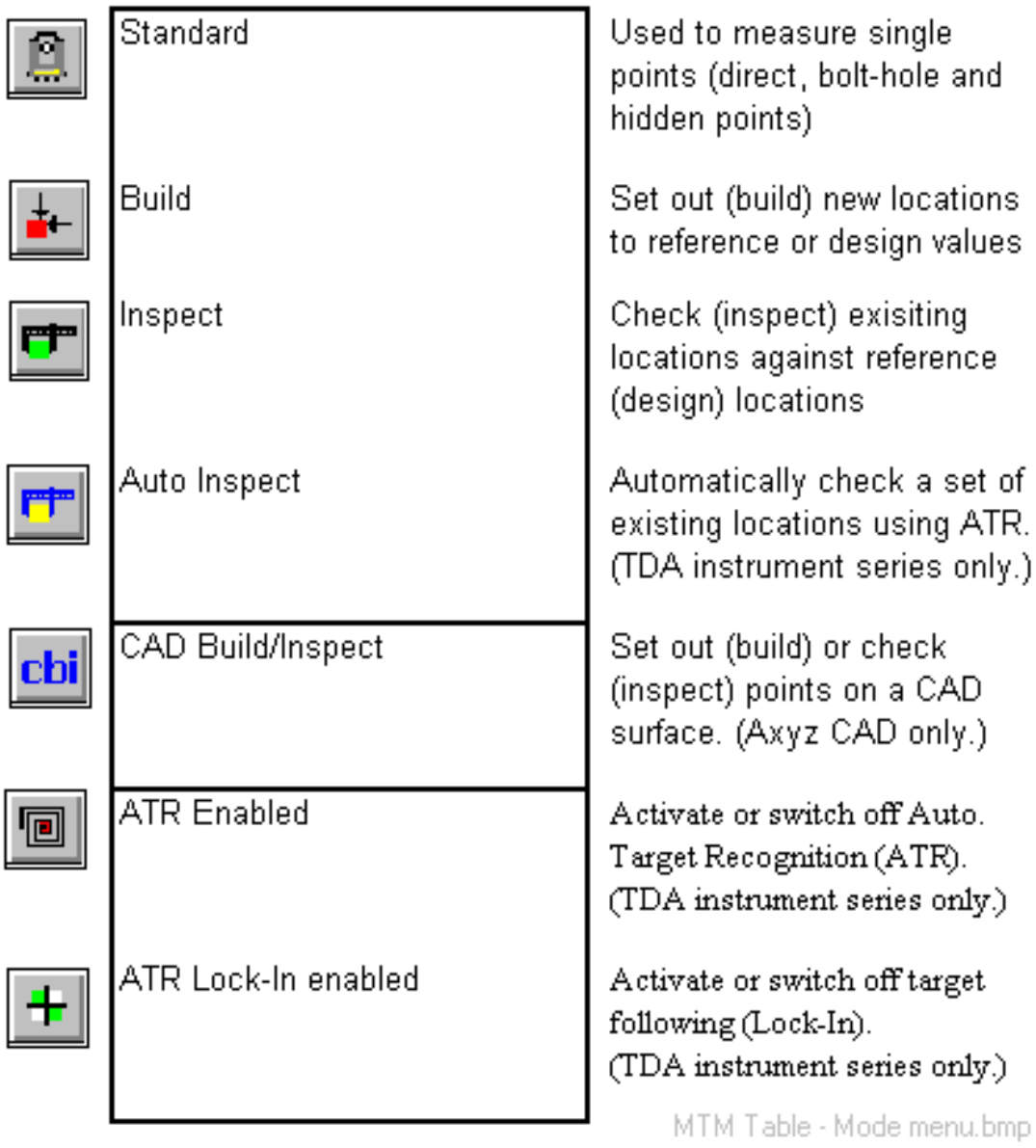
MTM Table - File menu.bmp

3.2 View summary

Running data	Toggle running data window on/off
Big Status	Show/hide measurement status (large display)
Toolbar	Show/hide the main toolbar
Status bar	Show/hide the status bar
Full display	Toggle between full/reduced info. in meas. window. (small/large digits)

MTM Table - View menu..bmp

3.3 Mode summary



(This menu is only available when a measurement window is open.)

3.4 Setup summary

Station	Create/edit a station definition
Initialize connected sensors	Re-establish communications to sensors, re-set IDs
Display station number	Display station number at instrument
Level theodolite	Active tilt compensator to correct angles to gravity ref.
Zero theodolite	Set current horizontal pointing to zero
Field check	Checks that angles give same pointing in both faces
Check target	Checks if pointings to fixed targets are same as before

Reflectors	Specify type of reflector used by Total Station
Atmospheric	Sets temp. and press.for distance measurements
Theodolite warnings	Define warning levels, e.g. for intersection error
General settings	Set "beep" and parameters for network configuration

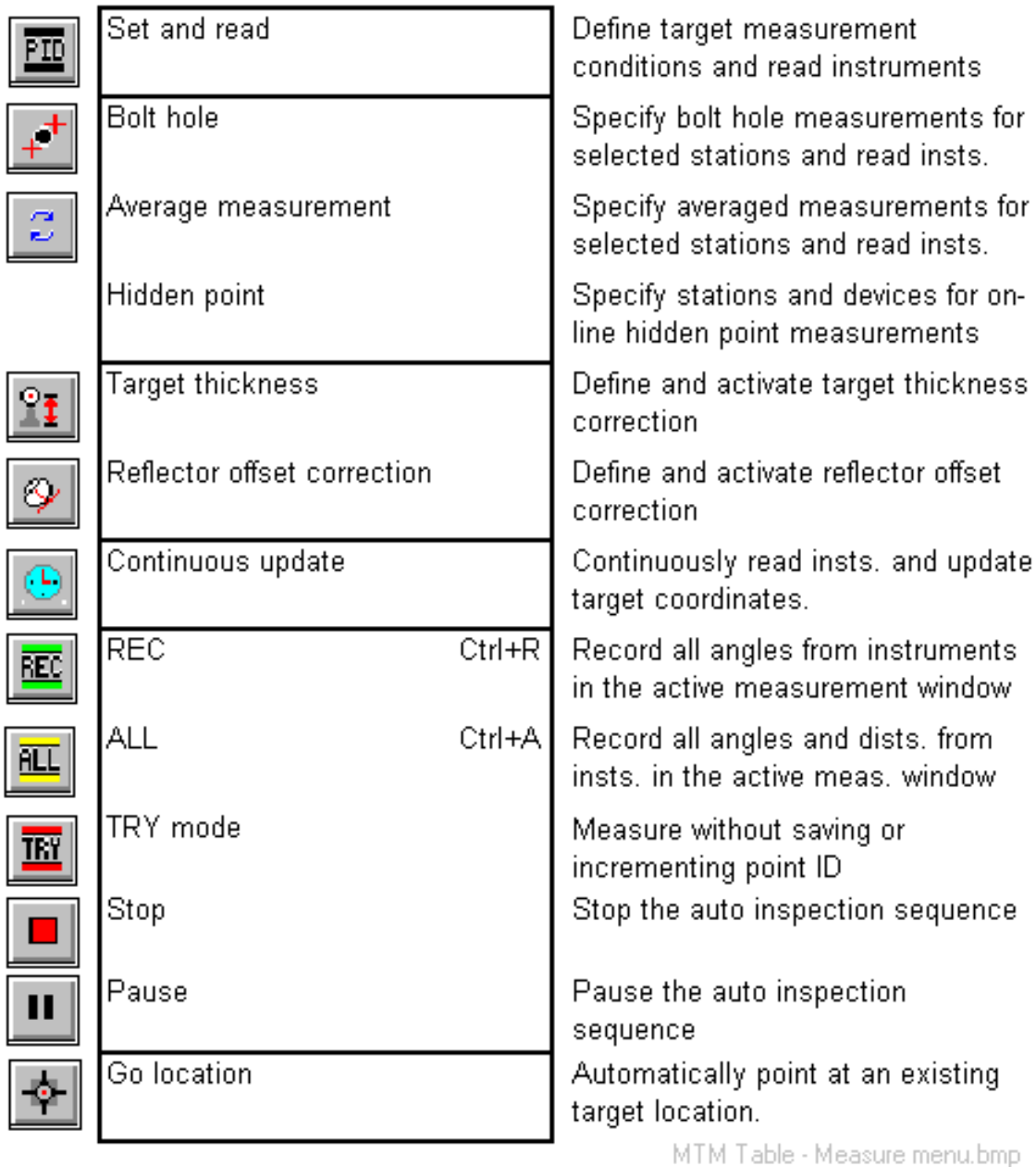
MTM Table - Setup menu.bmp

3.5 Orientation summary

Accurate collimation	Accurately point one station at another
Approximate collimation	Approximately point one station at another
Local orientation	Make local orientation measurements (ECDS method) from specified stations
Object orientation	Make object orientation measurements (ECDS method) from specified stations
Scale bar	Make measurements to specified scale bar targets from specified stations
Orient network	Create an oriented network

MTM Table - Orient menu.bmp

3.6 Measure summary



	Set and read	Define target measurement conditions and read instruments
	Bolt hole	Specify bolt hole measurements for selected stations and read insts.
	Average measurement	Specify averaged measurements for selected stations and read insts.
	Hidden point	Specify stations and devices for on-line hidden point measurements
	Target thickness	Define and activate target thickness correction
	Reflector offset correction	Define and activate reflector offset correction
	Continuous update	Continuously read insts. and update target coordinates.
	REC Ctrl+R	Record all angles from instruments in the active measurement window
	ALL Ctrl+A	Record all angles and dists. from insts. in the active meas. window
	TRY mode	Measure without saving or incrementing point ID
	Stop	Stop the auto inspection sequence
	Pause	Pause the auto inspection sequence
	Go location	Automatically point at an existing target location.

MTM Table - Measure menu.bmp

3.7 Window summary

Measurement window Ctrl+N	"Opens a new measurement window"
Data manager	Opens an Data Manager window
Graphics	Opens a graphics window
Cascade	"Arrange windows so they overlap"
Tile horizontally	Arrange windows in non-overlapping horizontal strips
Tile vertically	Arrange windows in non-overlapping vertical strips
Arrange icons	Arrange minimized windows in a row
Open window list	Shows a list of currently open windows within the main window. The active window has a check mark.

MTM Table - Window menu.bmp

3.8 Help summary

Help Topics	Lists the help topics
Using Help	Instructions on how to use help
Help Mode Shift+F1	On-screen, context sensitive help
About Axyz STM/MTM	"Display program information, version number and copyright"

MTM Table - Help menu.bmp

4. File menu

4.1 Exit

Exit command **(File menu)** **Alt,F,X**
"Quit the MTM/STM"

Use this command to shut down the Theodolite Manager. This will not close the ***Axyz*** program.

Shortcuts

Mouse:	Click the application's "Close" button. 
Toolbar icon:	none
Keys:	ALT+F4

5. View menu

5.1 Introduction

The options in this menu change if either the Data Manager or Graphics Module is active. Only options applying to the MTM are explained here.

For DM and graphics options, see the relevant manual or HELP file:
"***Axyz*** DM - Data Manager Software Reference Manual".
"***Axyz*** View/CAD - Graphics Modules Software Reference Manual"

5.2 Running Data

Running Data command **(View menu)** **Alt, V, R**
"Toggle running data window on and off"
The Running Data window displays actual instrument readings (raw data) as they are generated and brought into the system.

By right mouse click on the title bar you access options to display 3 different types of data:
1. Measurements generated by the instruments
2. 3D coordinates in **Standard** mode
3. 3D coordinate differences from **Build** and **Inspect** modes

For more information and sample displays, see "Running data window" on page 15.

Shortcuts

Toolbar icon: 
Keys none

5.3 Big status

Big status command **(View menu)** **Alt,V,B**
" Toggle ATR status window "
Use this command to display or hide the large display of measurement status. See ""Big status" display" on page 14.

Shortcuts

Toolbar: none
Keys: none

5.4 Tool Bar

Tool Bar command **(View menu)** **Alt, V, T**
"Toggle the toolbar on or off"

Use this command to hide and display the main toolbar. See "Main toolbar" on page 10.

A check mark appears next to the menu item when the toolbar is displayed.

Shortcuts

Toolbar:	none
Keys:	none

5.5 Status Bar

Status Bar command **(View menu)** **Alt, V, S**
"Toggle the status bar on or off"

Use this command to display and hide the Status Bar. The Status Bar is displayed at the bottom of the screen. It provides some help text and status information.

A check mark appears next to the menu item when the Status Bar is displayed.

Shortcuts

Toolbar icon:	none
Keys:	none

5.6 Full Display

Full Display command **(View menu)** **Alt, V, F**
"Toggle zoom measurement window"

This option is only available when a measurement window is open and relates to the information displayed in a particular measurement window. The setting applies to the currently active window so it is an individual setting for every window.

The option switches between a display showing the maximum amount of data about the measurement, and one which zooms in on the critical

dimensional information. This gives more space to the coordinate digits which can then be seen from a greater distance.

For examples, see "Standard mode: Displayed data and colour coding" on page 17.

Shortcuts

Toolbar icon: 
Keys: none

6. Mode menu

6.1 Concepts

A *measurement mode* implies a particular way of making measurements.

A mode can only be selected when a measurement window is open.

Each mode presents its results in a different way in the corresponding measurement window.

The first measurement window opened will correspond to the last mode selected.

6.1.1 Modes in brief

Standard mode is used to make 3D point measurements on an object, either by directly sighting a targeted point or by using a hidden point device.

Build and **Inspect** modes are used to either set out (build) specific points on an object to match a design (reference) location or to check (inspect) that specific points agree with reference information. Build and Inspect modes essentially display the difference between a measured location and a reference location and the only real difference is in the presentation of the results. **Vector mode** is a modified operation of these modes which allows for a difference between the location of an object surface and its CAD representation.

Auto Inspect mode can automatically check a set of fixed reflector locations. This mode requires motorized Total Stations with Automatic Target Recognition (ATR). This is currently provided by the TDA series of instruments.

Users of the ***Axyz*** CAD module can also build and inspect points on a CAD surface using **CAD Build/Inspect**. This mode essentially measures the perpendicular offset of the current point from the CAD surface.

A modification to instrument behaviour is available in the **STM** and **STM/MTM** modules, if at least one connected station has ATR. Once activated, **ATR enabled** will automatically find the reflector centre by spiral search when a measurement is subsequently made. The initial

pointing must be nearby. Once activated, **Lock-In** will force the instrument to follow the reflector as it is moved. These features can only be used with a single instrument, which must be specified if more than one is available. In addition they can only be used with hollow corner cube reflectors. Larger reflectors enable longer ranges to be used.

6.1.2 Standard mode

This is the most common mode and is used for normal shape measurement. **Standard** mode can display and record a point's 3D coordinates in any defined coordinate system.

This mode offers on-line correction for target thickness or offset and on-line calculation of hidden points with hidden point rods and frames. Directly measured targets and derived hidden points result in a measurement type **normal** .

6.1.3 Building and inspecting points

These modes are used to indicate on line how far a target point is from a reference value. In **Build mode** the target is physically moved to make the difference zero.

Results are displayed as a 3D difference calculated as follows:

- For Build mode, difference = **measured minus reference**
- For Inspect mode, difference = **reference minus measured**

These differences are displayed with background colours defined in “Theodolite Warnings” on page 69.

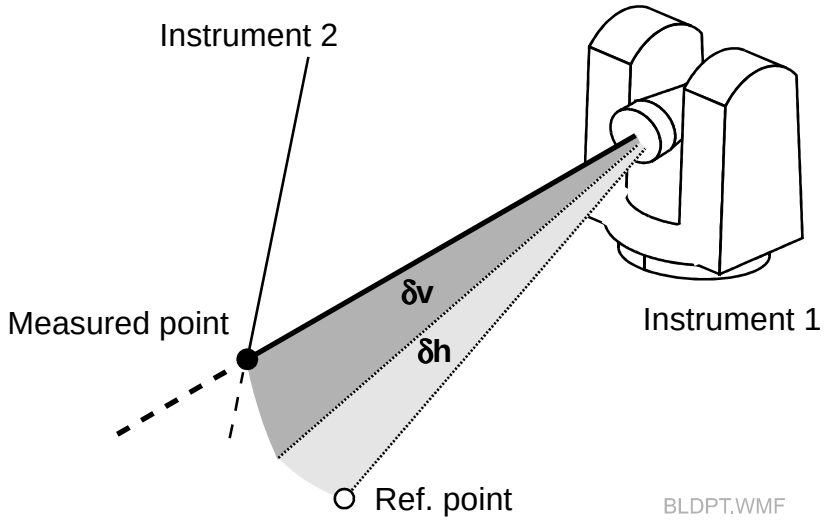
Distances can be updated singly (REC) or continuously. During continuous update, the difference is displayed but coordinates are not stored.

Differences are also calculated in angular terms and displayed at the instruments.

In a Build or Inspect sequence a list of reference points is specified. The coordinate system of the reference points must be known relative to the measurement network. If this coordinate system does not yet exist it must be created, for example by transformation or axis alignment.

As points are built or inspected their positions can be recorded. Different sub-groups of instruments can build or inspect different points on the list. Every connected instrument is assigned a starting point and works down the list from there. At instruments which permit code sequences, it is possible to change the current point by moving within the list using different commands.

Diagram: Angular build/inspect differences



Angular build/inspect differences

The diagram shows a point intersected by two instruments, together with its reference location. For each instrument the pointing to the measured location and the computed pointing to the reference location are compared. Two angular differences are then generated, δv in the vertical plane and δh in the horizontal plane. These differences are displayed at the instrument.

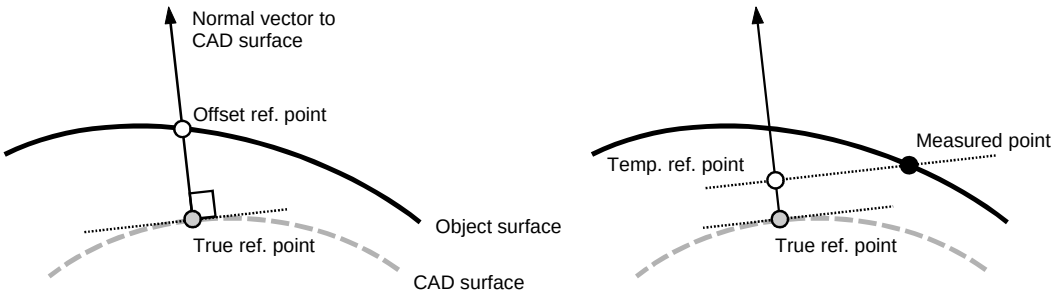
On the theodolite displays, four decimal places are used for Build mode and two decimal places for Inspect mode.

6.1.4 Vector mode

Vector mode is a variation of **Build** and **Inspect** in which the reference point is offset along the vector perpendicular to the CAD surface where the point is located.

Vector mode can only be applied if the reference points have the associated normal vector.

Diagram: Offset reference point in vector mode



True and offset reference points **Temporary reference point**

BLDVEC01.WMF

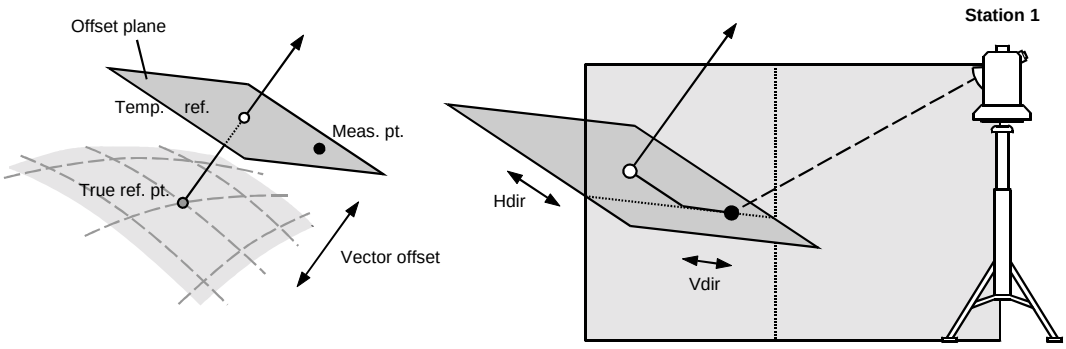
Offset reference point in vector mode

The simplified diagram shows the true and offset reference points. The current measured point is somewhere nearby on the object surface.

Since the exact tilt of the object surface cannot be determined from the single point measurement, the measured point is projected onto the normal vector to create a temporary reference point as indicated. The temporary point is the foot of the perpendicular from the measured point to the normal vector.

During the build process the measured point will be moved closer and closer to the offset reference point and so the temporary reference point will also become the offset reference point.

Diagram: Local coordinate system for vector mode



BLDVEC03.WMF

Local coordinate system for vector mode

The measurement window in **Vector mode** shows the current offset of the temporary reference point from the true reference point.

Two other offset components are shown in the offset plane. These are the values Vdir and Hdir. The direction of Vdir is created by intersecting the offset plane with a plane through the measuring point and the measuring instrument. The direction of Hdir is in the offset plane and perpendicular to the direction of Vdir.

If the measuring instrument is levelled, the intersecting plane is a vertical plane through the instrument and measured point.

If the instrument is not levelled, the intersecting plane is through the primary (standing) axis of the instrument and the measured point.

If the measured point is located from more than one station, the instrument at the lowest numbered station defines the intersecting plane.

6.1.5 Auto Inspection

1. A list of reference points defines the points to be inspected.
2. At each point a reflector is expected. Currently this must be a 1.5" corner cube reflector.
3. The instrument cycles through the list, searching for a nearby reflector at the nominal coordinates.
4. If a reflector is found its position is automatically measured and displayed for a short time before moving to the next point.
5. The measured points use the same workpiece ID and point ID as the reference points.
6. Problem points can be skipped.
7. The operator can make repeat measurements of the whole list.

If there are insufficient reflectors for all points, the operator can pause the inspection routine and shift reflectors from previously inspected points to new points.

Click the **All** button to start the sequence

If the **Rec** button is clicked, this does not start the sequence but simply records the current angles as for a normal single point recording.

6.1.6 CAD Build and Inspect

CAD Build and **Inspect** requires an imported CAD model. The objective is to set out or check random points on the surface of this model. The measurement window shows the perpendicular offset of the current target or reflector position from the CAD surface. The offset is not displayed as a single value but as components in the current coordinate system, not as a single offset value. These values should be zero.

When building points, it may be convenient to update continuously the current target or reflector position.

Corrections may be applied for target thickness or reflector offset. When a zero offset from the surface is shown this means:

- If correction not applied:
  Target/reflector centre is on the CAD surface
- If correction is applied:
  Target's back surface or reflector housing touches the CAD surface

The offset is calculated as a vector and its components in the currently active coordinate system are displayed. The offset is calculated as follows:

- For **Build**, offset = (Measured value minus reference value)
- For **Inspect**, offset = (Reference value minus measured value)

The reference value is the current foot of the perpendicular from the measured point to the CAD surface and its location changes as the target point is moved.

Note
CAD Build does not set out specific points with defined coordinates on the CAD surface. To do this you must either import points which lie on the CAD surface or create points on the CAD surface. You can then use **Build points** mode to set out these specific locations. Functions are available in ***Axyz*** CAD to extract points from a CAD model or create points on the surface of a CAD model.

6.1.7 Offset tolerances

Offset tolerances help the system and the operator recognize if the reference position has been reached. The current offsets are compared with

the tolerance values to see how close the reflector is to the reference position. The system recognizes the following conditions:

- Offset within tolerance
- Offset 1 - 2 times tolerance
- Offset 2 - 3 times tolerance
- Offset > 3 times tolerance

The display is colour-coded to indicate the first 3 levels, otherwise there is no colour coding.

If the reference points specified in the build list have associated tolerance values in the database, these are used in the build process.

If the database records zero values, then the tolerances are defined by the value defined for **Coordinate Tol. (Distance)** in the "Theodolite Warnings" dialogue box. See “Theodolite Warnings” on page 69.

6.2 Standard

Standard command **(Mode menu)** **Alt, O, S**
"Select standard mode"
See also "Concepts" on page 35.

In Standard Mode the measurement window shows the calculated point coordinates derived from intersecting angular pointings, from calculation of polar coordinates or by a combination of both.

Points can be measured using different methods:

- Directly, e.g. to a projected laser spot on the object surface
- With correction for target thickness
- With correction for a reflector offset
- Indirectly to bolt hole centres using the hole edges
- Indirectly, using a hidden point device (rod or frame)

For a detailed description of the corresponding measurement window, see "Example screen: Standard mode, full " on page 18.

Shortcuts

Toolbar icon: 
Keys: none

6.3 Build

Build command **(Mode menu)** **Alt, O, B**
"Select build mode"
See also "Concepts" on page 35.

This mode is used for manually setting out new points and displays a 3D difference between the current measured location and the corresponding reference location.

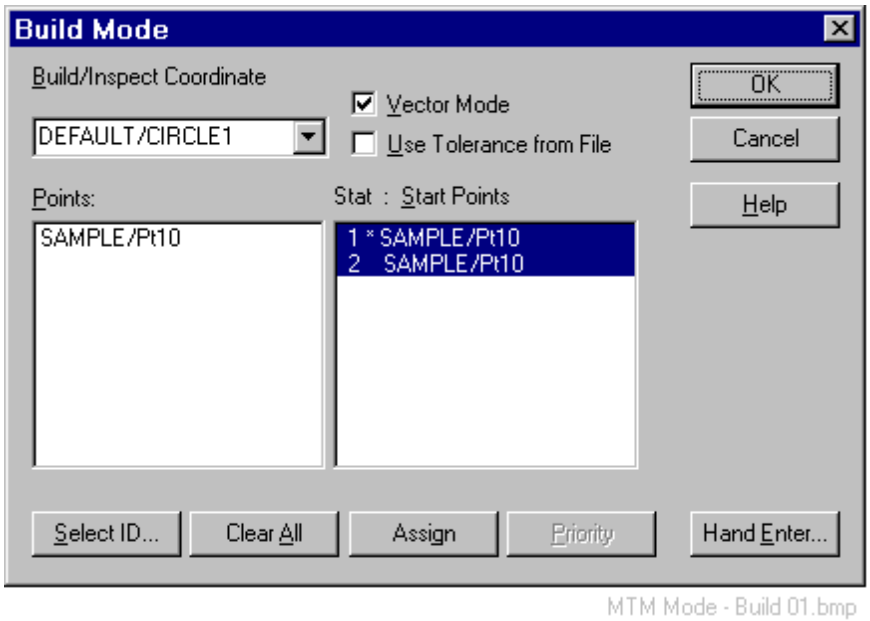
For a presentation of the corresponding measurement window, see the following:

- Build points: "Example " on page 18.
- Build points, vector mode: “Example screen: Vector mode” on page 24.

Shortcuts

Toolbar icon: 
Keys: none

6.3.1 Dialogue box: Build mode



MTM Mode - Build 01.bmp

Build/Inspect coordinate

From the drop-down list, select the coordinate system of the reference points. It the coordinate system does not exist it must first be created, for example by transformation or axis alignment.

Points

This list box shows an ordered list of all reference points chosen for the current build task. These points may be specified in several ways:

- Select from the reference area in the database using **Select ID** (button or right mouse click).
- Import into the reference area from an external file, using the **Import File** button, then use **Select ID**.
- Enter by hand using the **Hand Enter** button.

Select ID button

Click on this button to select the reference points to be built or inspected.

Stations: Start Points

This list indicates the first point on the build list to be measured by each station.

The list shows all theodolites and Total Stations in the network.

To change a starting point, first highlight a station, then double click a point in the **Points** list to assign it as a starting point.

Alternatively highlight a point, highlight a station, then click the **Assign** button.

Each station works sequentially down the list from the starting point assigned to it. At station with instruments allowing code sequences to be input, the current point can be changed using a code sequence. See "Code sequences for moving within the build/inspect list" on page 45.

Clear All button

Delete all items currently in the list of **Points**.

Assign button

Highlight a point, highlight one or more stations and click **Assign** to make the chosen point the starting point for each of the chosen stations.

Priority button

For use in vector mode. Currently not operational.

Use the button to define which station in the measurement view is used as the master, i.e. to which the correction values in the measurement window are related.

In the **Stations** list click on the appropriate station and then click **Priority**. This station will be marked with a ***** after the station number.

By default, the station with the lowest number is the master station.

Vector Mode

Select this option to build in vector mode. The target point to be built or inspected is not then the reference point itself but a point offset along the normal vector associated with it. The normal vector is a vector perpendicular to the local CAD surface through the reference point. The amount of offset is the separation of the actual object surface from the CAD surface.

When the measurement is on target, the measurement window shows an offset along the vector and two zero offsets perpendicular to the vector.

For an example of the corresponding measurement window, see “Example screen: Vector mode” on page 24.

Use tolerance from file

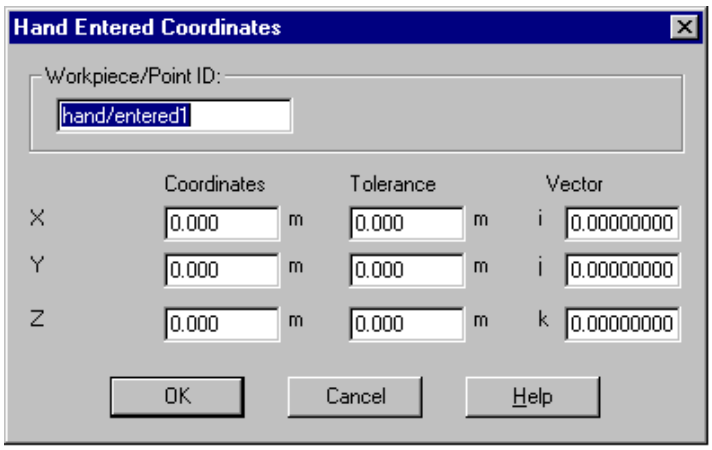
If selected, tolerance values stored in the job file will be used to determine the colour-coded display which indicates when you are close to the point.

Otherwise the **Coordinate tol. (distance)** set in the “Theodolite Warnings” is used.

Hand entered button

This option allows an operator to define a single reference point by entering details by hand. Click this button to reach the dialogue box.

6.3.2 Dialogue box: Hand entered coordinates



MTM Mode - Build 02.BMP

A single reference point can be manually defined here. The point is not entered into the list of reference coordinates.

Workpiece/Point ID

Choose a workpiece name and point identifier for the point. This is the name which will be used if the point is also measured.

Coordinates

Specify the point's coordinates here.

Tolerance

Specify here the estimated tolerances for each coordinate.

Vector

Optionally specify the components (direction cosines) of a unit vector perpendicular to the design surface at the reference point.

6.3.3 Code sequences for moving within the build/inspect list

Skip forward in reference file:
CODE 8 RUN **n** RUN REC

Skip **n** points forward in the current reference file.

Skip backward in reference file:
CODE 9 RUN **n** RUN REC

Skip **n** points backward in the current reference file.

Jump to specific point in reference file:
CODE 10 RUN **n** RUN REC

Jump to first point in reference file whose identifier has numeric suffix **n**

6.4 Inspect

Inspect command **(Mode menu)** **Alt, O, I**
"Select inspect mode"
See also "Concepts" on page 35.

This mode is used for manual on-line checking of point locations against reference values. The check shows the 3D difference between the current measured location and the corresponding reference location.

Inspect is essentially the same as **Build** except that the sign of the differences is changed. For a presentation of the corresponding measurement window, see the following:

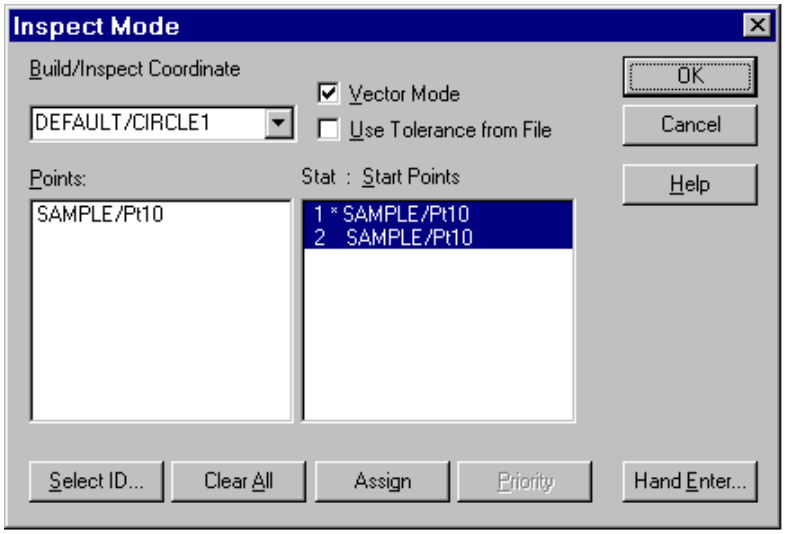
- Inspect points: "Example " on page 18.
- Inspect points, vector mode: “Example screen: Vector mode” on page 24.

Note
Measured points can also be checked off line using the **Comparison** function in the CDM.

Shortcuts

Toolbar icon: 
Keys: none

6.4.1 Dialogue box: Inspect mode



MTM Mode - Inspect.bmp

The dialogue options here as the same as for **Build mode**. See "Dialogue box: Build mode" on page 42.

6.5 Auto Inspect

Auto Inspect command **(Mode menu)** **Alt,O,I**
"Select Auto Inspect mode"
See also "Concepts" on page 35.

Automatically check a set of fixed reflector locations.

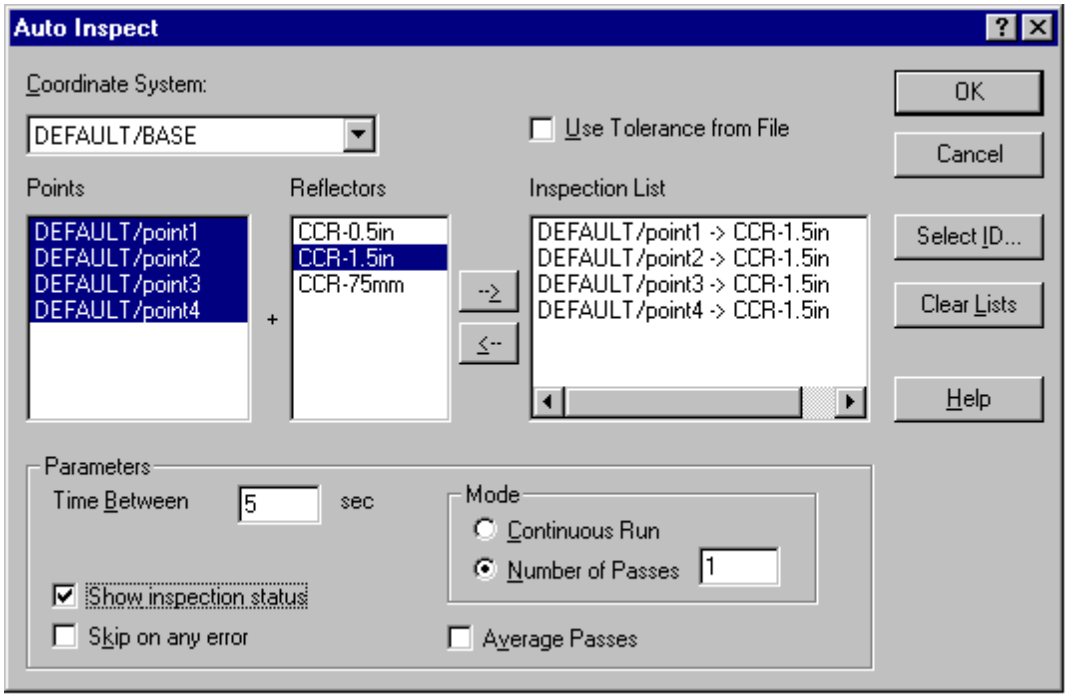
For an example of a corresponding measurement window, which is the same as the **Build points** window, see "Measurement window: Build/Inspect points" on page 22.

Note
This mode requires Automatic Target Recognition (ATR) which is available on the TDA series of Total Stations. Only one TDA can make an auto inspection.

Shortcuts

Toolbar icon: 
Keys: none

6.5.1 Dialogue box: Auto inspect



MTM Mode - Auto Inspect 01.bmp

Points

This box shows a list of all reference points chosen for the current build task. Select from the reference area in the database using **Select ID** (button or right mouse click in "Points" box)

Reflectors

This box shows a list of all possible reflector types. The inspected points do not all have to have the same type of reflector.

Inspection list

This list box shows the final ordered list of reference points with reflector types, chosen for the current inspection task.

Build up the inspection list by highlighting a point and an associated reflector type, then use the **Right arrow** button to place the point on the inspection list.

The order on the inspection list determines the order in which the points are measured.

A point can be removed from the inspection list by highlighting it and clicking the **Left arrow** button..

Use tolerance from file

If selected, tolerance values stored in the job file will be used to determine the colour-coded display which indicates when you are close to the point.

Otherwise the **Coordinate tol. (distance)** set in the "Theodolite Warnings" is used.

Button: Clear Lists

Click this button to delete all items from the **Points** box and **Inspection list**.

Parameters

Time between
This is an automatic pause between measurements. It is useful if you only have one reflector and do not wish to click the manual pause between points in order to move the reflector to the next point.

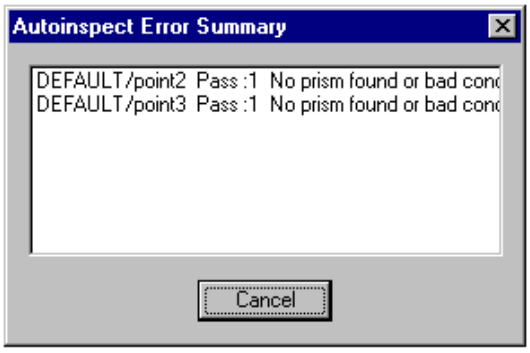
Show inspection status
After the inspection is complete a window is displayed which reports on results, e.g. if any point was missed.

Skip on any error
Select this option to automatically move to the next point if the current point cannot be measured. If not selected the inspection process will stop in this case.

Mode
You can choose either to cycle repeatedly through the list using **continuous run** until the **Stop** is activated, or you can define the **number of passes** through the list.

Average passes
Select this option to average the measurements at each inspected point during multiple passes. If not selected, succeeding measurements overwrite previous measurements.

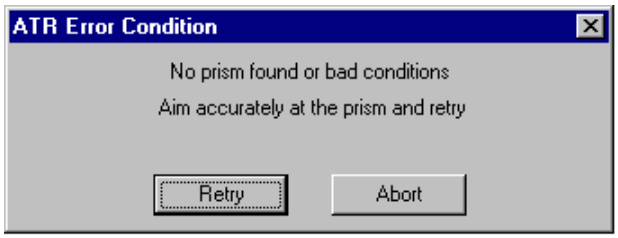
Sample window: Inspection status



MTM Mode - Auto Inspect 02.bmp

If the option to **Show inspection status** was chosen, this window appears after the auto inspect process.
It indicates the point where a fault occurred and during which pass.

Sample window: Position error



MTM Mode - Auto Inspect 03.bmp

If the option **Skip on any error** has not been selected, then this window appears when an error occurs. Either aim accurately at a prism and **Retry** or skip this point by **Abort**.

6.6 CAD build/inspect

CAD build command **(Mode menu)** **Alt,O,U**
"Select build to CAD mode"
See also "Concepts" on page 35.

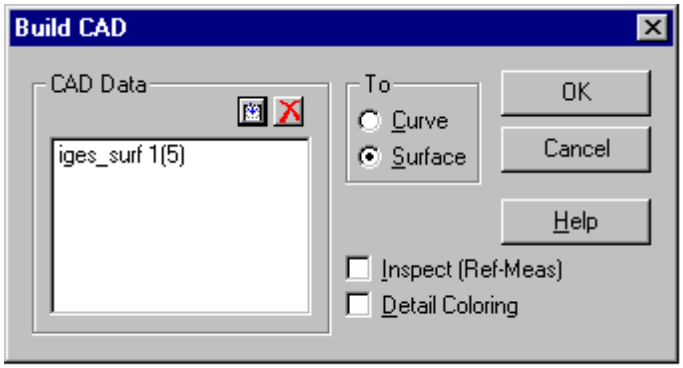
CAD only
Use this mode to manually set out points on the surface of an imported CAD model or check an existing surface against a CAD model.

Note
This option is only available if the graphics window is open.

Shortcuts

Toolbar icon: cbi
Keys: none

6.6.1 Dialogue box: Build CAD



MTM Mode - Build CAD.bmp

CAD data

This list defines the reference CAD data used for building or inspection. Pre-selected CAD data will appear in this list. You may change the listed data at any time before building by clicking in the graphics window and selecting the ones you want. Single or multiple selections can be made.

Selection in the graphics window does not automatically place items on the list. Buttons are available to add or delete from the list, as follows:

 Add the current selection to the list.
 Delete highlighted items from the list.

To

Specify if **curve** or **surface** data is to be used.

Inspect (Ref-Meas)

Select this option to specify **Inspect** mode. Offsets are then computed as (reference value – measured value).

The reference value is the foot of the perpendicular from the measured point to the CAD curve or surface.

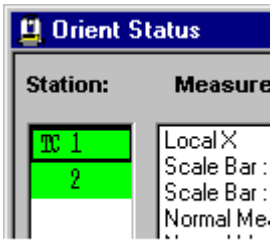
Detail colouring

If **Build** mode is active, this option will apply warning colours to the current build curve or surface. This can provide a sensitive display to indicate how well the current point conforms to the currently defined tolerance thresholds.

6.7 ATR Enabled

ATR Enabled command **(Mode menu)** **Alt,O,E**
"Select/Deselect the ATR mode for a TDA sensor"
See also "Concepts" on page 35.
This command activates Automatic Target Recognition (ATR). When measurements are subsequently made to the correct reflector type, the instrument automatically moves to point accurately at the reflector centre. Exact manual pointing is not then required.

ATR is currently only available on the TDA series of Total Stations. Only one instrument at a time can use this feature.



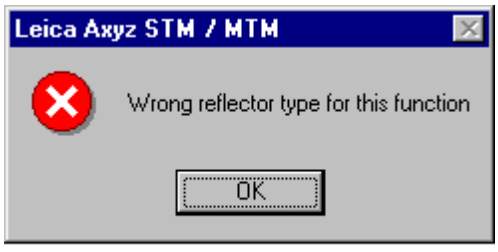
MTM Sel. ATR-Lock.bmp

If the network contains instruments of other types, or multiple TDA instruments, select the required instrument by double clicking in the **Orient Status** window.

In the example, a suitable instrument at Station 1 has been selected.

Note
Only when a TDA instrument has been selected will the command be available.

This mode requires use of a hollow corner cube reflector. If the wrong reflector is assigned, the following error message will appear:



MTM Mode - ATR.bmp

It will then be possible to select the correct reflector from the **Reflectors** dialogue box. Suitable reflectors are the 1.5" and 0.5" hollow corner cube reflectors. A larger reflector gives a greater operating range.

Shortcuts

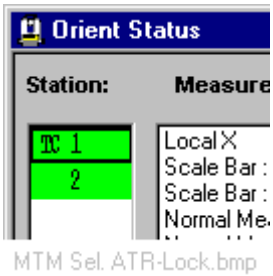
Toolbar icon: 
Keys: none

6.8 ATR Lock-In Enabled

ATR Lock-In Enabled command **(Mode menu)** **Alt,O,L**
"Select/Deselect the Lock-In mode for a TDA sensor"
See also "Concepts" on page 35.
This command activates Lock-In operation. This enables an instrument with Automatic Target Recognition (ATR) to follow the movements of a reflector of the correct type as it is moved around the workspace.

Note
There is no real-time update of the coordinate display in a measurement window during tracking.

Lock-In (and ATR) is currently only available on the TDA series of Total Stations. Only one instrument at a time can use this feature.



MTM Sel. ATR-Lock.bmp

If the network contains instruments of other types, or multiple TDA instruments, select the required instrument by double clicking in the **Orient Status** window.

In the example, a suitable instrument at Station 1 has been selected.

Note
Only when a TDA instrument has been selected will the command be available.

This mode requires use of a hollow corner cube reflector. If the wrong reflector is assigned, the following error message will appear:

MTM Mode - ATR.bmp

It will then be possible to select the correct reflector from the **Reflectors** dialogue box. Suitable reflectors are the 1.5" and 0.5" hollow corner cube reflectors. A larger reflector gives a greater operating range.

Shortcuts

Toolbar icon: 
Keys: none

7. Setup menu

7.1 Introduction

A communications port must be assigned to each station in the setup. A selection box enables the user to define the station information.

Leica theodolites are designed to suit industrial applications and this menu lets the user access a number of instrument functions and check the instrument's operation as follows:

- The theodolites have a built-in levelling system whose electronic sensor can be activated through an ***Axyz*** routine.
- Industrial environments are not generally free of vibration so a “Check Target” function can assist the user in detecting any movements.
- The adjustment of individual instruments can also be checked on site with the "Field check" facility
- Horizontal angles can be zeroed for orientation purposes.

7.2 Station

Station command **(Setup menu)** **Alt, S, S**
"Assign theodolites to stations, specify parameters"

Axyz MTM allows you to connect a maximum of 16 theodolites to the computer but the software can accommodate as many as 99 individual stations. The distinction between theodolites and stations gives the program flexibility, allowing for the expansion of your basic setup.

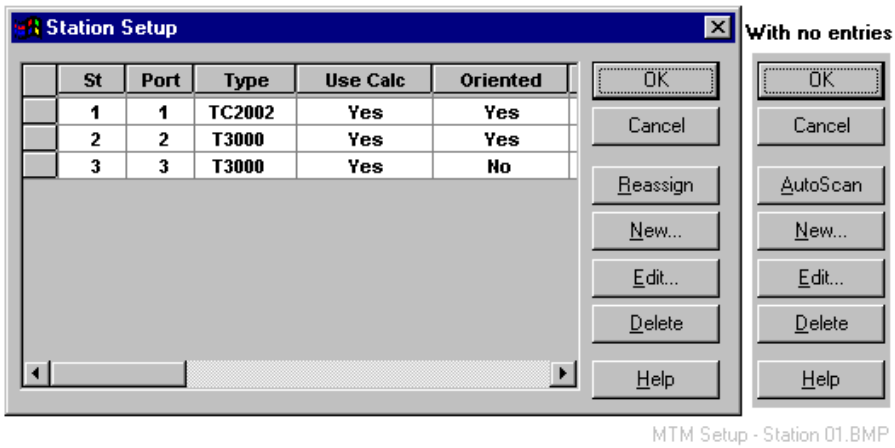
The primary purpose of the station setup is to define the measurement network by assigning instruments to stations and specifying some instrument parameters.

At each station in the measurement network, the setup records what the physical connection is. Most of this information can be input by the operator but some is generated as status information by the ***Axyz*** system itself.

Shortcuts

Toolbar icon:	none
Keys:	none

7.2.1 Dialogue box: Station setup



MTM Setup - Station 01.BMP

The grid layout in the dialogue box can be adjusted, see “Adjusting and editing grids” on page 127

Summary of data elements (fields) defining each station

Column label	Meaning
St	ID number of station in range 1 - 99
Port	Port number to which instrument is connected (1 - 16)
Type	Instrument type, e.g. T3000
Use calc	YES:Meas urements from this station are used by Orientation Module and Single Point Solution NO: All measurements at this station ignored
Oriented	YES: Station has been oriented NO: Station has not been oriented
Comp inst	ON: Level compensator is active OFF: Level compensator is not active
Comp solu	YES: Level constraint used by Orientation Module NO: Level constraint ignored by Orientation Module
Operator	Operator's name
Std H	Estimated standard deviation of horizontal angle
Std V	Estimated standard deviation of vertical angle
Std Dist	Estimated standard deviation of distance

Reassign button

Reassigns an instrument from an existing station to a new one, with the following actions:

- New station number automatically created (cannot be changed by user)
- Orientation status set to NO
- All other parameters copied over

AutoScan button

If no stations are assigned the system automatically searches for connected theodolites and creates new assignments.

Delete button

Deletes a highlighted station assignment.

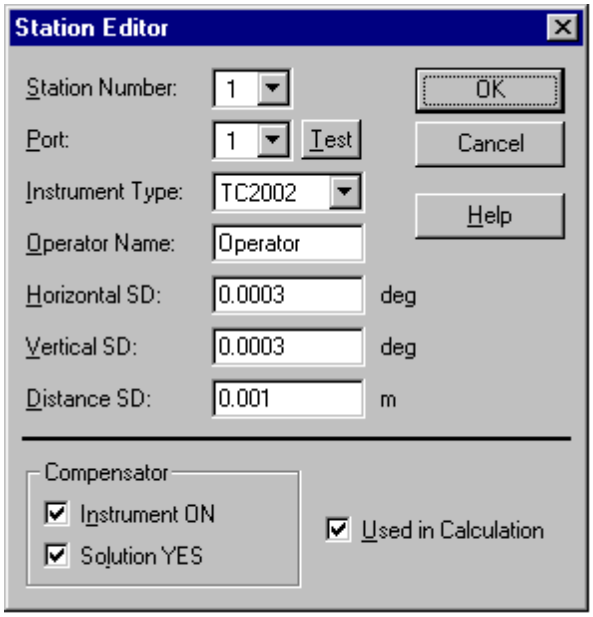
New button

Activates the Station Editor to create a new station assignment.
See further comments under **Station Editor** dialogue box.

Edit button

Activates the Station Editor to edit the highlighted station assignment.

7.2.2 Dialogue box: Station editor



MTM Setup - Station 02.BMP

The Station Editor is used for creating new station assignments and editing existing station assignments.

Station Number

For a new station, choose one of the numbers from the drop-down list.. Existing numbers do not appear on the list. For an existing station, the number cannot be changed

Instrument Type

Choose one of the existing types for either new or existing stations from the drop-down list.

Warning!
If the assignment is incorrect, data communication may fail or have errors.

Port

Choose one of the port numbers for either new or existing stations from the drop-down list. These port numbers must be interpreted as the 1st., 2nd, etc. ***Axyz*** ports and they may not be identical to the COM port number assigned by the controlling PC. For example, if 4 additional ports were installed for use by ***Axyz***, these might be configured by the PC as COM6, COM7, COM8, COM9 (depending on the computer system). In this dialogue box the 4 ports would be identified as 1,2,3,4.

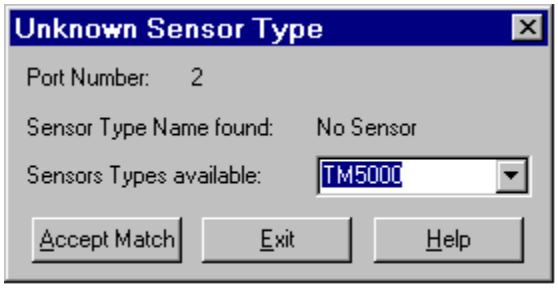
Warning!
If the chosen port number is already assigned to another station, the other station will be assigned port number N/A which effectively disconnects it from the measurement network.

Test button

This tests the connection on Port n. It will display a message box **Searching for sensor on Port: n**

If no instrument is connected, the message **No Sensor found** is displayed.

If an instrument is found which cannot be recognized, the following box appears:



MTM Setup - Station 03.bmp

To select the sensor manually, choose from the drop-down list and click the **Accept Match** button.

Operator name

Optionally enter a name here.

Horizontal SD, Vertical SD, Distance SD

Enter the estimated accuracy (standard deviation) of:

- Horizontal angles
- Zenith/Vertical angles
- Distances

These values are used to calculate quality figures for measured point coordinates, which in turn affect the calculated quality figures of derived elements such as shapes fitted to measured points.

This relies on a mathematical technique called *error propagation* which answers questions such as:
"If my angles are good to 1 arc second, how good are point coordinates 5m away when located from 3 stations?"

However this technique assumes the accuracy estimates of the original measurements are good. For example, if you estimate angular accuracy too low then estimated coordinate quality is too low and vice versa.

It is therefore important to make good estimates here if you want good quality estimates of point coordinates and shapes. If in doubt, accept the default values.

Used in Calculation

Select this checkbox if measurements at this station are to be used for orientation and 3D coordinate calculation.

If not selected, all measurements at this station will be ignored.

Compensator

Instrument ON
The instrument's tilt compensator at this station is switched on.

Solution YES
When selected, the orientation module constrains the station to be levelled

Note
The compensator must be ON for this to be meaningful

OK button

Select **OK** to store the assignment in the database.

7.3 Initialize connected sensors

Initialize connected sensors command **(Setup menu)** **Alt, S, I**

If you lose communications to the connected instruments, e.g. one is accidentally turned off, you can re-initialize it with this command and continue working.

This function will re-establish communications and set the station number and point ID.

Shortcuts
Toolbar icon: none
Keys: none

7.4 Display Station Number

Display Station Number command **(Setup menu)** **Alt, S, D**
"Send the current station number to sensor"

The command displays the station number on the local display of all connected instruments.

Shortcuts
Toolbar icon: none
Keys: none

7.5 Level Theodolite

Level Theodolite command **(Setup menu)** **Alt, S, L**
"Put selected sensors in level mode"

This command activates the tilt compensator (level sensor) to reference angles to the vertical. The instrument may have to be manually levelled to ensure the compensator is within its range of operation.

The command can only be executed before the first measurement at the corresponding station is recorded.

Shortcuts

Toolbar icon:	none
Keys:	none

7.5.1 Code sequence: Level theodolite

CODE 0 RUN REC

This sequence will turn on tilt compensation at the relevant instrument if:

- The instrument has a tilt sensor
- No measurements have yet been made at the corresponding station

7.5.2 Dialogue box: Level theodolite

MTM Setup - Level.BMP

Station

This list contains all stations which meet the following conditions:

- Connected to a port
- Have an electronic level mode command
- Have not measured anything.

Select the stations to be levelled by highlighting or use all stations on the list by pressing the **All** button.

7.6 Zero Theodolite

Zero Theodolite command **(Setup menu)** **Alt, S, Z**
"Set horizontal circle to zero"

This command is used to set the current horizontal pointing of an instrument to read zero. It can only be set before the first measurement at that station is recorded.

Warning!
Check that the instruments are pointing in the desired direction.

Shortcuts

Toolbar icon:	none
Keys:	none

7.6.1 Code sequence: Set Hz circle

CODE 1 RUN REC

This sequence will set horizontal angle to zero at the relevant instrument

7.6.2 Dialogue box: Zero theodolite

MTM Setup - Zero.bmp

The **Station** list contains all stations which have not yet recorded any data in the database.

Select the stations whose horizontal circles should be set to zero on the current pointing by highlighting or use all stations on the list by pressing the **All** button.

7.7 Field Check

Field Check command **(Setup menu)** **Alt, S, F**
"Carry out a field check"

A Field Check checks instrument adjustments by evaluating a pointing to fixed targets in both faces. In accurate instruments differences should be zero, except for random pointing error.

The user is responsible for interpreting the measurements and taking any corrective action.

The current function allows the user to decide which instruments (stations) to check. Each then sights a fixed target which may be different for each instrument. When the measurement has been made in both faces the results are displayed.

Shortcuts

Toolbar icon:	none
Keys:	none

7.7.1 Dialogue box: Field check sensors

MTM Setup - Field check 01.BMP

Station

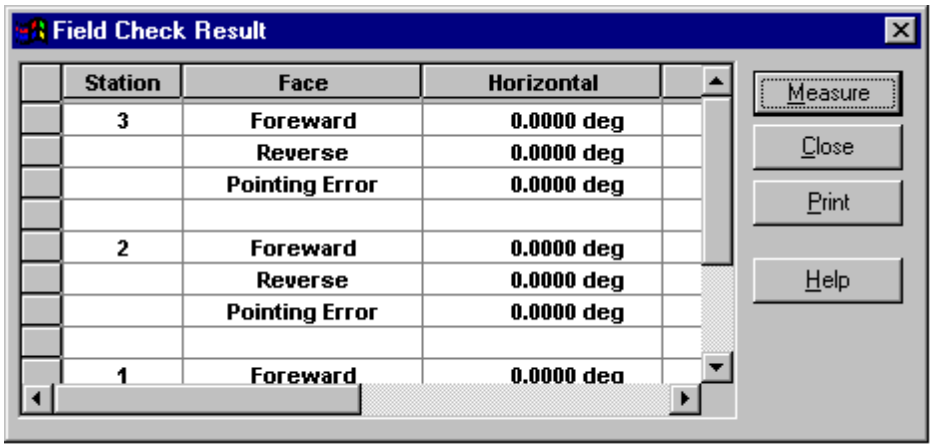
The **Station** list contains all stations which are currently connected.

Select the stations whose instruments are to be checked by highlighting or use all stations on the list by pressing the **All** button.

OK button

Click this button to move to a dialogue box where the field checks are specified and results calculated.

7.7.2 Dialogue box: Field check result



MTM Setup - Field check 02.BMP

The grid layout in the dialogue box can be adjusted, see “Adjusting and editing grids” on page 127. Column widths are adjustable.

Table of results

All stations specified on entry to this dialogue box are shown.

At each station the face 1 and face 2 horizontal and vertical pointings to a selected fixed target are shown. Initially these have zero values. Face 1 is indicated by the *forward* field, face 2 by the *reverse* field.

Point each instrument in either face and click the **Measure** button. The pointing will be displayed. The system automatically detects which face was used.

Reverse the telescope position(s), point again at the target(s), and again click **Measure**.

The difference between the faces is then calculated and should be zero, apart from random error.

Print button

By pressing **Print**, the field check results are printed or stored in the currently selected Online Output mode.

7.8 Check Target

Check Target command **(Setup menu)** **Alt, S, C**
"Check targets mode"

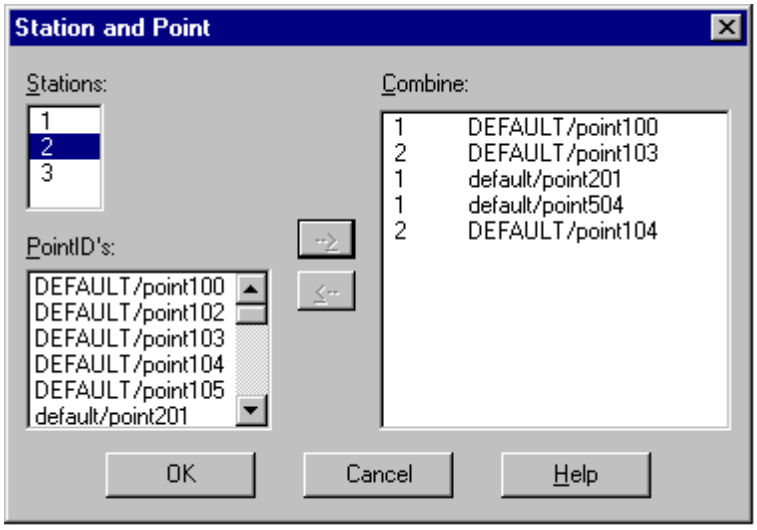
The purpose of the Check Target command is to see if any targets or instruments have moved during the measurement session. This is done by making a repeat (check) measurement and comparing it with the original value.

The check measurements are not stored in the job file.

Shortcuts

Toolbar icon:	none
Keys:	none

7.8.1 Dialogue box: Station and Point



MTM Setup - Stn & pt 01.BMP

With this dialogue box, the user defines combinations of check target and station from which it is sighted. These combinations must be unique but more than one check target can be specified for each station in the list of available stations. The check target can be any target already measured by a selected station. After specifying combinations, actual check measurements are made and compared with the existing measurements.

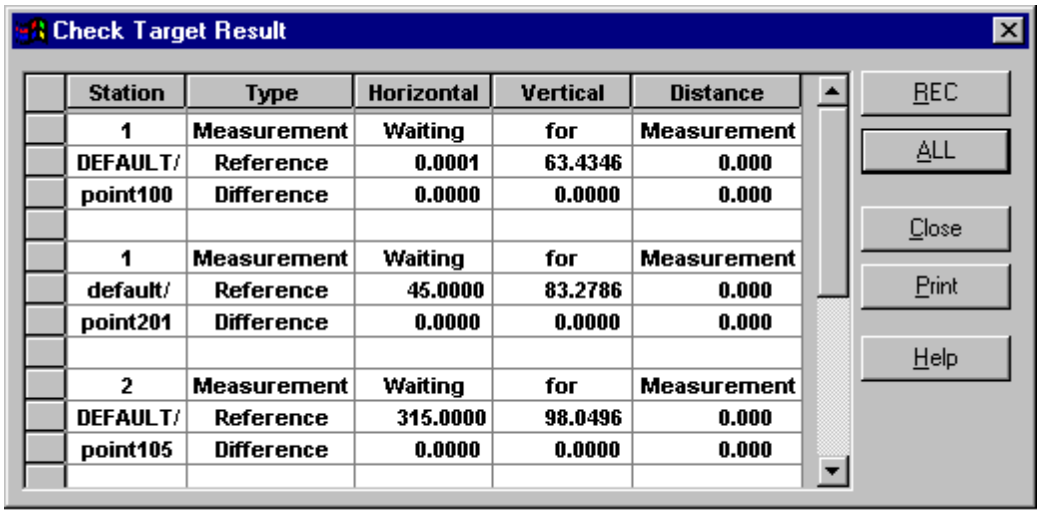
Operation of dialogue box

- Select one station from the **Stations** list.
  It is not possible to highlight more than one station in the list. All targets already measured by this station then appear in the list of point IDs.
- Select one target from the **Point IDs** list.
- Use the **right arrow** button to add the combination of station and check target to the **Combine** field.
- Remove a combination by highlighting it in the **Combine** field and using the **left arrow** button.

OK button

Click this button to move the measurement and results box.

7.8.2 Dialogue box: Check target result



MTM Setup - Stn & pt 02.BMP

The grid layout in the dialogue can be adjusted, see “Adjusting and editing grids” on page 127. Column widths are adjustable.

Station

The **Station** column shows the list of station/target combinations previously specified.

Type

For each station/target combination the **Type** column indicates:

Measurement
The actual check measurement.

If the Horizontal, Vertical and Distance columns to the right display the text "Waiting for measurement" then the first check measurement has not yet been made.

Reference
The original measurement

Difference
The difference value = Reference minus Measurement

Horizontal, Vertical, Distance

These columns show the actual values corresponding to **Measurement, Reference** and **Difference**.

Measure button

When a station is highlighted and indicating "Waiting for measurement" (no previous check made), point the relevant instrument at the appropriate target and click this button to make a check measurement.

The user can make check measurements in any order and can ignore check measurements on the list.

Notes:
Once a check has been measured, it can be re-measured.
The check measurement is not stored and does not overwrite the existing measurement.

Print button

Click Print to print or store results according to the currently selected Online Output mode.

7.9 Reflectors

Reflectors command **(Setup menu)** **Alt, S, R**
"Select a reflector"

The purpose of this command is to specify which type of reflector or reflective target is used by a particular Total Station. This information is needed by the instrument's electronic distance meter (EDM) in order to make suitable corrections. To make use of Automatic Target Recognition (ATR) a corner cube type of reflector is required, such as the 1.5 " STMCCR.

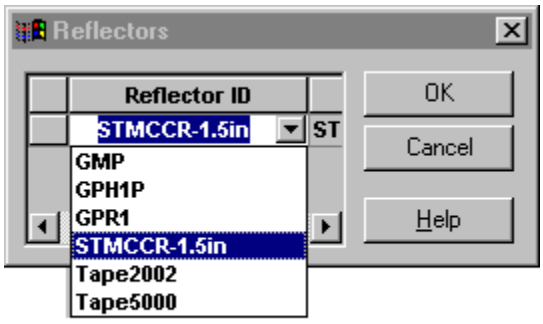
Different reflector types can be used during a measurement session. The selected type takes immediate effect and remains active until changed.

Note
This command is only available when Total Stations are connected.

Shortcuts

Toolbar icon: 
Keys: none

7.9.1 Dialogue box: Reflectors



MTM Setup - Reflectors.bmp

The grid layout in the dialogue can be adjusted, see “Adjusting and editing grids” on page 127.

St

Column listing all stations occupied by Total Stations.
Highlight the station(s) from the available list of station numbers.

Reflector Type

Select a reflector type from the pre-defined drop-down list of reflectors.

Description

Text description of reflector type.

7.10 Atmospheric

Atmospheric command **(Setup menu)** **Alt, S, A**
"Set atmospheric parameter"

The purpose of the Atmospheric command is to define atmospheric and ambient conditions so that corrections can be made as follows:

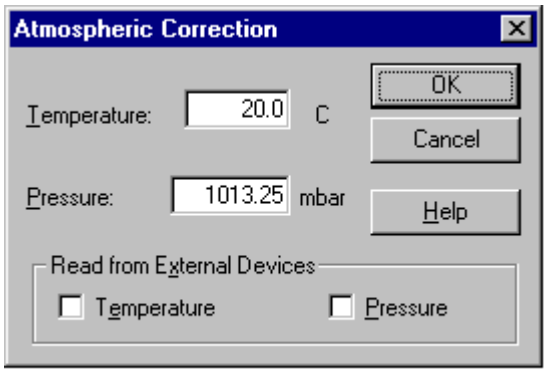
- Scale Bar and Hidden Point measurements are corrected for current **temperature** to a standard temperature at which the relevant devices are defined, usually 20°.
- Distance measurements in a Total Station are corrected for current **temperature** and **pressure**. No additional corrections are applied if you enter a pressure of 1013.25 bar and a temperature of 12° C

If values are provided by an external monitor it will be possible to view them here but not alter them. See "General Settings" on page 71.

Shortcuts

Toolbar icon:	none
Keys:	none

7.10.1 Dialogue box: Atmospheric correction



MTM Setup - Atmos.bmp

Enter values for current ambient **Temperature** and **Pressure**.

If an external monitor is connected, these values can be read in optionally from the monitor. Select the required value from **Read External Devices**. Values read from an external monitor cannot be manually altered.

7.11 Theodolite Warnings

Theodolite command **(Setup menu)** **Alt, S, T**
"Set warning display and colours"

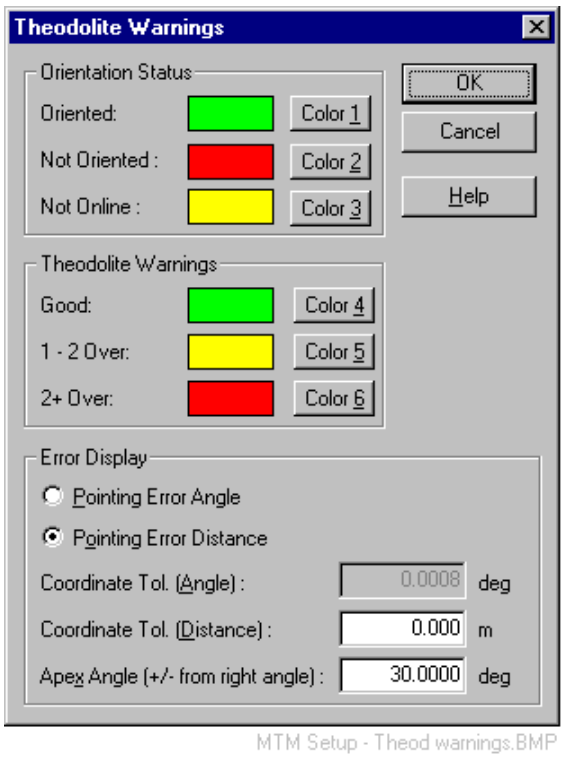
Theodolite warnings are used to visually highlight critical conditions or measurements which are above or below error limits defined by the user. Background colours are used as the visual warning cue and the relevant information is displayed in a measurement window.

Note
Colours defined here are independent of warning colours for analysis functions, as defined in the Core Data Module (CDM). See **CDM Settings/Analysis warnings.**

Shortcuts

Toolbar icon:	none
Keys:	none

7.11.1 Dialogue box: Theodolite warnings



MTM Setup - Theod warnings.BMP

Orientation Status

Oriented
The station is oriented

Not oriented
The station has not yet been oriented. It may or may not have sufficient measurements to enable an orientation to be calculated.

Not online
The station is not on line. It may or may not be oriented.
Colour buttons
Colours for each status can individually be set by accessing the colour palette with the colour button.

Theodolite Warnings

Colour-coded warnings are given in relation to the **error display** as follows:

Good
The value is less than the warning limit.

1 - 2 over
The value is between one and two times the limit.

2+ over
The value is more than twice the limit.

Colour buttons
Colours for each of the 3 levels can individually be set by accessing the colour palette with the colour button.

Pointing error angle/ pointing error distance

The pointing error represents the worst offset between the calculated target position and the pointings used to create it.

If the pointing is purely angular then the offset is a perpendicular from the calculated target position to the relevant ray.

If the pointing is a polar measurement the offset is a spatial vector from the calculated target position to the relevant measured polar point.

The error can be expressed in distance units or converted into an angle subtended at the relevant station.

Coordinate Tol.(Angle)

This error limit is used for:

- Pointing error bar (angle).
- Measured station indicator .

Coordinate Tol.(Distance)

This error limit is used for:

- Pointing error bar (distance).
- Measured station indicator.
- Standard deviation and RMS of coordinates.

Apex Angle

This error limit is used for the maximum deviation of the apex angle from the best case. The best case is when two rays intersect at right angles.

All possible pairs of intersections are computed from all pointings to the target and the maximum deviation from the best case is compared against the limit.

7.12 General Settings

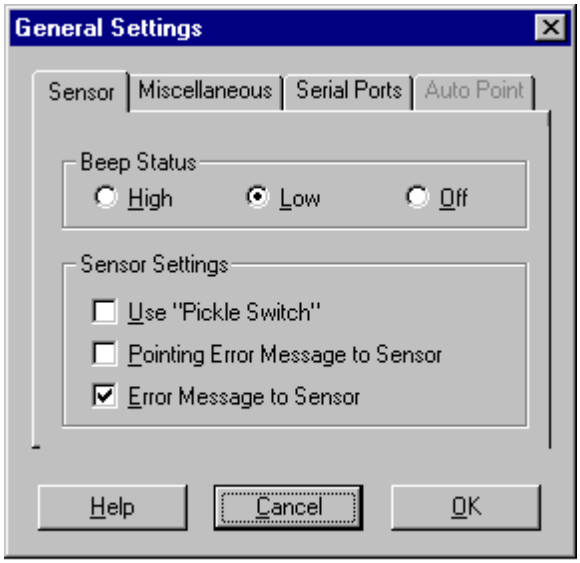
General Settings command **(Setup menu)** **Alt, S, G**
"Set general Theomanager parameters"

This command is used to generate tones (BEEPs) for any communications and error messages at the instruments.

Shortcuts

Toolbar icon:	none
Keys:	none

7.12.1 Dialogue box: Sensor tab



MTM Setup - Gen - Sensor tab.bmp

Beep

Choose one of the 3 options to set the intensity of a warning "Beep" at the instrument.

Use “Pickle Switch”

Select this check box to permit use of the Pickle Switch for triggering measurements. For reasons of general software performance, please cancel a selection if a “Pickle Switch” is not connected.

Pointing error message to sensor

Applies only to a pointing error message.

If this option is selected and the pointing error exceeds the set tolerance, a text message is sent to the TPS series of instruments:
“Pointing error with last measurement exceeded”

For all other instruments an error code is sent.

See the list of error messages and codes delivered with the software manual.

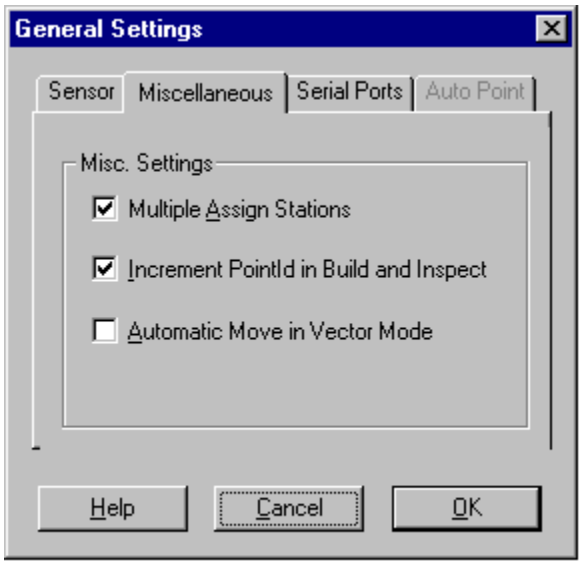
Error message to sensor

Applies to all error messages.

If this option is selected, a relevant text message is sent to the TPS series of instruments: For all other instruments an error code is sent.

See the list of error messages and codes delivered with the software manual.

7.12.2 Dialogue box: Miscellaneous tab



MTM Setup - Gen - Misc tab.bmp

Multiple Assign Stations

Select this option to allow the same station to be assigned to different measurement windows.

Increment PointID in Build and Inspect

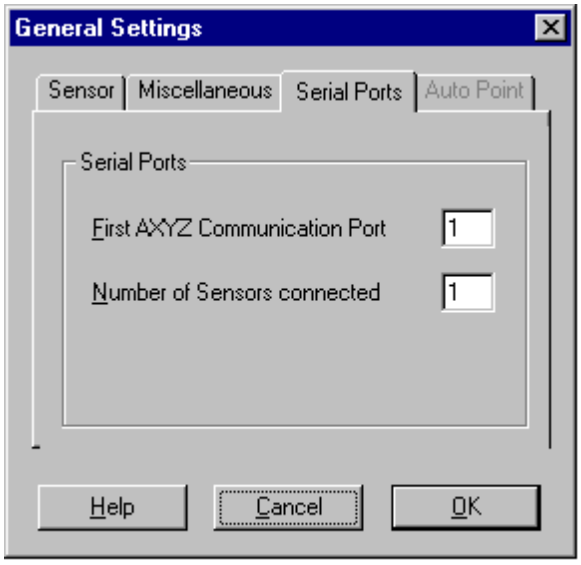
Select this option to allow the point name in Build and Inspect mode to be automatically incremented.

Automatic move in vector mode

This option is only relevant to motorized instruments.

In **Build** and **Inspect** modes motorized instruments are automatically driven to point at the reference coordinates. In **Vector** mode a reference point offset from the true reference point is used. Driving to the true reference point is then not required and will disturb the measurement process.
By selecting this option the automatic positioning is cancelled.

7.12.3 Dialogue box: Serial ports



MTM Setup - Gen - Serial tab.bmp

First AXYZ Communication Port:

First COM port used by the connected instruments.

Every on-line instrument must be connected to a COM port. The controlling PC must therefore be configured with sufficient COM ports to permit the maximum number of connected instruments.

COM ports have sequential numbers, for example:

- COM1, COM2 in a simple system with no additional boards
- COM1, COM2, .. COM6 in a system with 4 additional ports provided by an expansion board

Axyz must know the first COM port number in this sequence of COM ports used for connecting instruments. If an expansion board has been added, it is not recommended that the existing COM ports on the controlling computer be used for connecting instruments. For example:

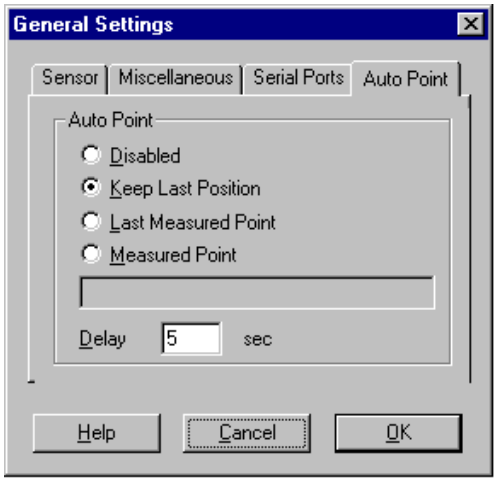
- Max. instruments 2, first COM port at COM1.
- Max. instruments 4, first COM port at COM3

This defines the range of ports currently accessible to ***Axyz***. The range can be altered at any time.

Number of Sensors connected:

Maximum number of theodolites which can be connected.

7.12.4 Dialogue box: Auto Point



MTM Setup - Gen - Auto point tab.bmp

This is relevant only for instruments with Automatic Target Recognition (ATR) and applies to Lock-In (tracking). The target may be lost during Lock-In. One of the following actions will then be automatically taken.

Disabled

No action is taken and the operator must manually re-point the instrument at the reflector.

Keep last position

This maintains the same pointing when tracking was lost. The reflector can be moved back into the beam to enable tracking.

Last measured point

This points the beam back to the last measured fixed point.

Measured point

This points the beam back to some other point already measured. Enter the point name in the input box.

Delay

This provides a pause between the interruption and re-pointing at the reflector. This is to gives the operator time to replace the reflector in the recovery position, if required. Relevant for pointing to:

- Last measured point
- Measured point

8. Orientation menu

8.1 Introduction

In a mobile system, instruments can be positioned at any location and procedures are needed which establish these locations. They are known as orientation procedures and they integrate your instrument into a measuring network which can then be used to locate the real world positions of the targets you wish to measure.

Axyz offers several different orientation methods. Each method is supported by scripts or programmed routines which help the operator to complete the orientation without mistakes.

Maths for Users

In this menu the basic elements of complete orientation procedures and their corresponding measurements are defined and executed. More than one of these elements may be required before sufficient data is available to compute an orientation. Once sufficient measurements have been made the user implements an orientation with the Orient command.

8.2 Accurate Collimation

Accurate Collimation command **(Orientation menu)** **ALT, R, A**
"Accurate collimation measurements"

Collimation involves simultaneously pointing two theodolites at each other and aligning the cross hairs of one telescope on the target mounted on the telescope of the other theodolite.

A collimation measurement triggers measurements from both instruments.

It is not generally possible to sight directly to the rotation centre of the target station, which defines its actual location. Usually an offset target on the instrument is sighted. Accurate collimation requires that theodolites sight each other in both Face 1 and Face 2, i.e. two collimations should be made with telescopes in reversed positions so that an accurate averaged collimation may be calculated.

The procedure therefore distinguishes between a *forward* collimation and a *reverse* collimation. In the forward collimation either instrument may be in either face. The reverse collimation simply repeats the procedure with faces reversed.

The accurate collimation command permits the user to define and execute more than one set of collimation measurements (between different pairs of instruments) at any one time.

Accurate collimations are used by the Orientation Module for the final optimized station location (Bundle Adjustment).

Shortcuts

Toolbar icon:	none
Keys:	none

8.2.1 Code sequences: Accurate collimation

Both these sequences must be implemented in order to generate an accurate collimation.

Accurate collimation forward

CODE 2 RUN **s** RUN REC

Forward collimate this instrument to instrument at station **s**
Measurements are generated from current station to station **s** and vice versa.

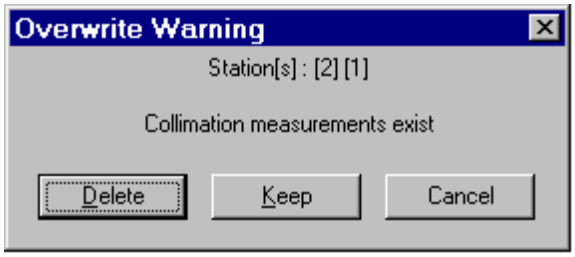
Accurate collimation reverse

CODE 3 RUN **s** RUN REC

Reverse collimate this instrument to instrument at station **s**.
This is the corresponding measurement pair to the forward collimation, but with telescopes in reversed positions.

Measurements are generated from current station to station **s** and vice versa.

8.2.2 Accurate collimation: Warning



MTM Measure - Coll exists warning.bmp

If an accurate collimation already exists between the listed stations to be oriented, then this warning appears.

Click **Delete** to delete the existing collimation measurements.
Click **Keep** to continue with the measurement.

8.2.3 Dialogue box: Accurate collimation

MTM Orient - Acc coll 01.BMP

This dialogue box is used to define which group of stations to include in the accurate collimation process.

Note
This box does not appear if only two stations exist in the network. In this case both must be used and a choice is unnecessary.

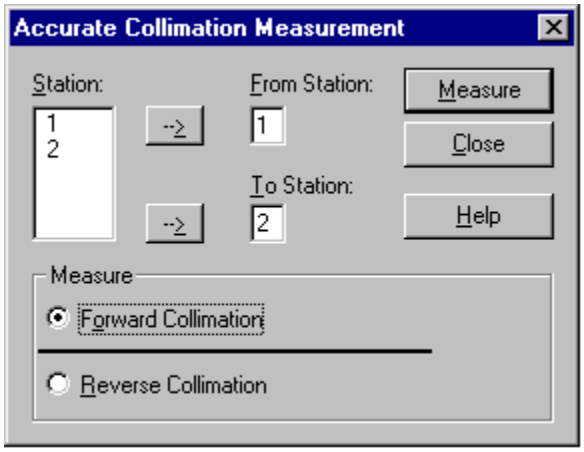
Station

All theodolites and Total Stations in the network are shown in the list box. Select individual stations or click the **All** button to include all stations.

OK button

Click this button to proceed to the dialogue box for **Accurate collimation measurement**.

8.2.4 Dialogue box: Accurate collimation measurement



MTM Orient - Acc coll 02.BMP

From the group of stations selected for collimation, this dialogue box is used to select the pair of stations for collimation.

Station

Group of stations previously selected for collimation.

From Station To Station

In the **Station** list highlight a station number.
Use a selection button (right arrow) to make this either a station **From** or a station **To.**
Repeat the process for the other station. If you wish to change a station number, simply highlight the correct number and repeat the selection process.

Measure field

Forward collimation
Collimation pointing with instruments in face I or II

Reverse collimation
Collimation pointing with instruments in face II or I (i.e. the reverse of the forward situation).

The field initially only offers forward measurement. After a forward measurement, the reverse option is activated and the station numbers are greyed out. No changes in the station to station arrangement are possible.

Measure button

Use this button to record the pointings corresponding to the selected collimation.

8.3 Approximate Collimation

Approximate Collimation command **(Orientation menu) ALT, R, C**
"Approximate collimation measurements"

Approximate collimation is accomplished by approximately pointing one instrument at the approximate location of another. The target instrument does not require special targeting and need not even be in position. However the Orientation Module requires both collimation pointings to be available, i.e. from station A to station B and from station B to station A.

Note
If each collimation direction is measured individually, you must remember to make the other collimation before starting the Orientation Module.

The measurements need only be approximate they are only used by the Orientation Module to find initial instrument positions. The measurements are not used in the final optimizing procedure (Bundle Adjustment).

The approximate collimation command permits the user to define and execute more than one collimation measurement (between different pairs of instruments) at any one time.

Shortcuts

Toolbar icon:	none
Keys:	none

8.3.1 Code sequence: Approximate collimation

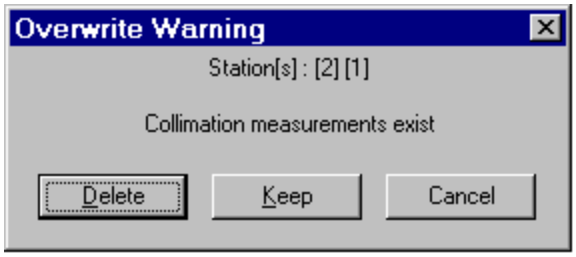
CODE 20 RUN **s** RUN REC

Approximately collimate this instrument to instrument at station **s.**

A measurements is generated from the current station to station **s**.

The measurement in the opposite direction must be made from the other instrument using the code 20.

8.3.2 Approximate collimation: Warning



MTM Measure - Coll exists warning.bmp

If an accurate collimation already exists between the listed stations to be oriented, then this warning appears.

Click **Delete** to delete the existing collimation measurements.
Click **Keep** to continue with the measurement.

8.3.3 Dialogue box: Approximate collimation

MTM Orient - Approx coll 01.BMP

This dialogue box is used to define which group of stations to include in the Approximate Collimation process.

Note
This box does not appear if only two stations exist in the network. In this case both must be used and a choice is unnecessary.

Station

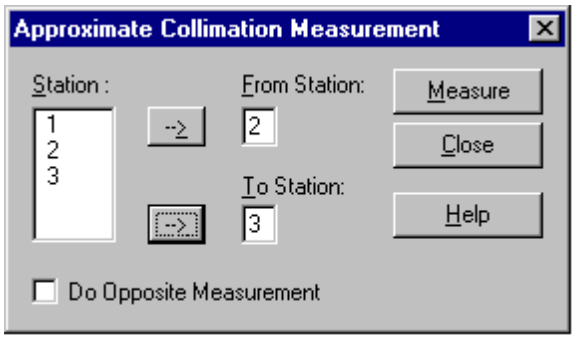
All theodolites and Total Stations in the network are shown in the list box.

Select individual stations or click the **All** button to include all stations.

OK button

Click this button to proceed to the dialogue box for **Accurate collimation measurement**.

8.3.4 Dialogue box: Approximate collimation measurement



MTM Orient - Approx coll 02.BMP

Once the group of stations selected for collimation has been defined, this dialogue box is used to select the pair of stations which are currently being collimated. A direction **From** and **To** helps you to define which theodolite is measuring and which is the target.

From Station To Station

In the **Station** list highlight a station number.
Use a selection button (right arrow) to make this either a station **From** or a station **To.**
Repeat the process for the other stations. If you wish to change a station number, simply highlight the correct number and repeat the selection process.

Do Opposite Measurement
Select this option to record an approximate collimation at the other station. This is only possible if the other station is occupied by an instrument which is on line.

Measure button

Use this button to record the defined measurement or measurements.

8.4 Local Orientation

Local Orientation command **(Orientation menu)** **ALT, R, L**
"Local station measurements"

The purpose of the Local Orientation command is to provide initial estimations of orientation parameters (position and angular attitude) in a **local coordinate system** defined by one of the instruments.

This command is equivalent to an ECDS Local Orientation procedure.

The estimations are made using approximate pointings and distances.

More than 2 stations can be approximately oriented at one time by this method.

The procedure has two stages:
1. Each instrument must be levelled and the vertical defines the Z axis. Each theodolite must then be pointed parallel to the positive X axis of the local coordinate system.
2. Each theodolite, except the station defining the origin, must be pointed at the origin station and an estimate of the distance must be entered. The horizontal and vertical angles are then read.

Shortcuts

Toolbar icon:	none
Keys:	none

8.4.1 Code sequences: Local orientation

Local orientation requires approximate measurements of the local X direction and approximate measurements to the station defining the origin.

Measure direction

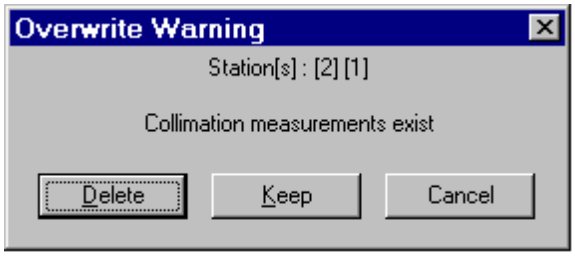
CODE 4 RUN **d** RUN **0** REC
At this station measure direction of axis **d**. (1=X, 2=Y, 3=Z)

Measure to station

CODE 40 RUN **s** RUN **d1** RUN REC
Measure to station **s** and record the distance with **d1** units before decimal point.

CODE 40 RUN **s** RUN **d1** RUN **d2** REC
Measure to station **s** and record the distance with **d1** units before dec. point and **d2** units after dec. point.

8.4.2 Local orientation: Warning

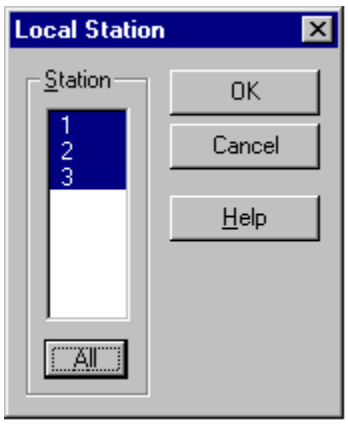


MTM Measure - Coll exists warning.bmp

If an accurate collimation already exists between the listed stations to be oriented, then this warning appears.

Click **Delete** to delete the existing collimation measurements.
Click **Keep** to continue with the measurement.

8.4.3 Dialogue box: Local station



MTM Orient - Local 01.BMP

This dialogue box is used for selecting stations to be oriented in a common local network..

Note
This box does not appear if only two stations exist in the network. In this case both must be used and a choice is unnecessary.

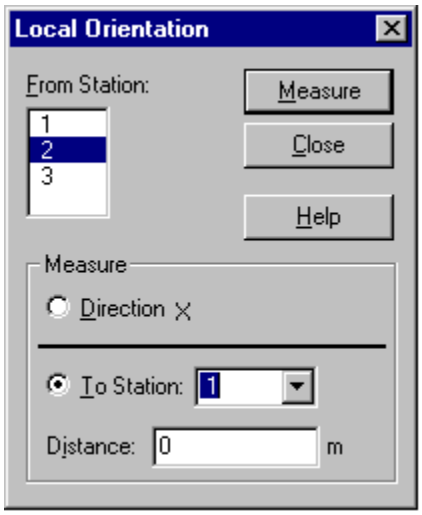
Station

All theodolites and Total Stations in the network are shown in the list box. Select individual stations or click the **All** button to include all stations.

OK button

Click this button to move to the next stage of local orientation.

8.4.4 Dialogue box: Local orientation



MTM Orient - Local 02.BMP

This box is used to guide the operator through the required local orientation measurements.

When the dialogue box is opened all stations selected for orientation are highlighted and **Direction X** is automatically selected. Stations cannot be removed from the list at this point.

Stage 1 (direction of local X axis)

Point all theodolites parallel to the chosen local X axis.

Press **Measure** button. All pointings from all stations are then recorded.

Go to stage 2.

Stage 2 (direction and distance to station defining local origin)

To Station is automatically activated. By default the lowest numbered station will appear in the field next to it. This station defines the local origin. Change the station in the drop-down list if this is not the local origin.

Procedure:
1. Highlight a station in the list **From Station**
2. Point the instrument at this station towards the station in the field next to **To Station.**
3. In the **Distance** field, enter an estimated distance between the stations.
4. Press **Measure** button. The pointing from the highlighted station is recorded.

Repeat this procedure for the remaining stations in the list **From Station.**

8.5 Object Orientation

Object Orientation command **(Orientation menu)** **ALT, R, O**
"Object station measurements"

The purpose of the Object Orientation command is to provide initial estimations of orientation parameters (position and angular attitude) in an **object coordinate system** defined by reference coordinates of critical points on the object.

This command is equivalent to an ECDS Object Orientation.

The estimations are made using approximate pointings and distances.

More than 2 stations can be approximately oriented at one time by this method.

The procedure has three stages:
1. Each theodolite telescope must be aligned parallel to the positive X (or Y, or Z) axis of the object coordinate system.
2. Each theodolite telescope must also then be aligned parallel to the positive Y (or X, or Z) axis of the object coordinate system. The angles are then measured at all instruments.
3. From each theodolite, an object point with known reference (design) coordinates must be measured. The operator sights this target, measures the angles and provides an estimate of distance.

Shortcuts

Toolbar icon:	none
Keys:	none

8.5.1 Code sequences: Object orientation

Object orientation requires approximate measurements of two axial directions and approximate measurements to an existing point.

Measure direction

CODE 4 RUN **d** RUN **1** REC

At this station measure direction of axis **d**. (1=X, 2=Y, 3=Z)

Measure to point

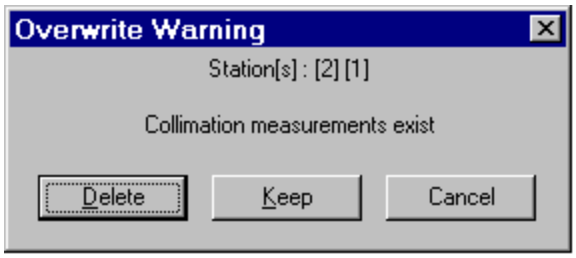
CODE 41 RUN **p** RUN **d1** RUN REC

Measure to point **p** and record the distance with **d1** units before dec. point.

CODE 41 RUN **p** RUN **d1** RUN **d2** RUN REC

Measure to point **p** and record the distance with **d1** units before dec. point and **d2** units after dec. point.

8.5.2 Object orientation: Warning



MTM Measure - Coll exists warning.bmp

If an accurate collimation already exists between the listed stations to be oriented, then this warning appears.

Click **Delete** to delete the existing collimation measurements
Click **Keep** to continue with the measurement.

8.5.3 Dialogue box: Object station

MTM Orient - Object 01.BMP

This dialogue box is used for selecting stations to be oriented in a common object network.

Note
This box does not appear if only two stations exist in the network. In this case both must be used and a choice is unnecessary.

Station

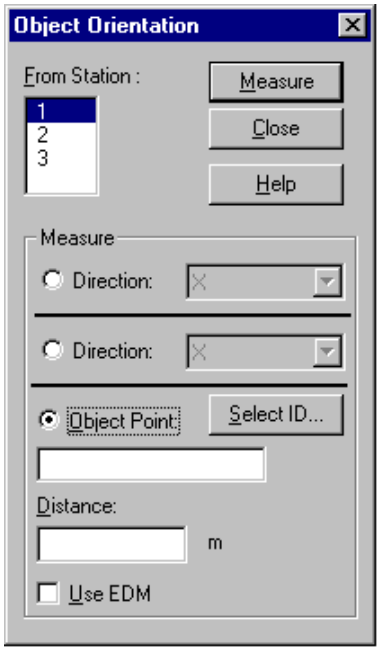
All theodolites and Total Stations in the network are shown in the list box.

Select individual stations or click the **All** button to include all stations.

OK button

Click this button to move to the next stage of object orientation.

8.5.4 Dialogue box: Object orientation



MTM Orient - Object 02.BMP

This box is used to guide the operator through the required object orientation measurements. When the dialogue box is opened all previously selected stations are highlighted and **Direction** (first selection) is automatically selected .

Stage 1 (align to first object axis)

1. Select the name of the first object axis from the pull-down list (X axis is the default selection).
2. Point all theodolites in this direction
3. Press **Measure** button. All pointings from all stations are then recorded.

Go to stage 2.

Stage 2 (align to second object axis)

Direction (second selection) is automatically activated and a default name for the second object axis is displayed in the pull-down list (i.e. the remaining Y or Z axis).

1. Select the name of the second object axis from the pull-down list
2. Point all theodolites in this direction
3. Press **Measure** button. All pointings from all stations are then recorded

Go to stage 3.

Stage 3 (measure object point)

Object Point is automatically activated.

1. Highlight a station in the list **From Station**
2. Select an object point from the job file using **Select ID** or equivalent.
3. Point the telescope at the target
4. Manually enter the estimated **Distance** from station to target or **use EDM** if the instrument occupying the station is a Total Station
5. Click **Measure** to record the pointing

8.6 Scale Bar

Scale Bar command **(Orient menu)** **ALT, R, B**
"Scale bar measurements"

The purpose of the scale bar command is to define and make station/scale bar measurements.

Use the Data Manager to define a new scale bar, see "***Axyz*** Data Manager Software Reference Manual".

Shortcuts

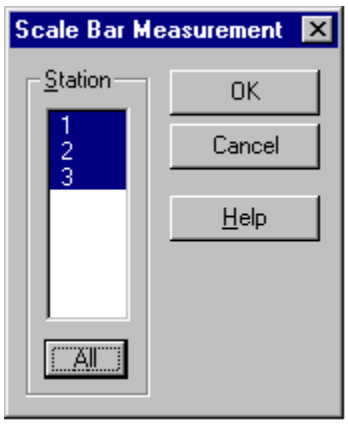
Toolbar icon:	none
Keys:	none

8.6.1 Code sequence: Scale bar measurement

CODE 5 RUN **p** RUN **t** RUN **n** RUN REC

Measure at position **p** the target **t** of scale bar **n.**

8.6.2 Dialogue box: Scale bar



MTM Orient - Scale bar 01.BMP

This dialogue box is used for selecting which stations measure scale bars.

Note
This box does not appear if only two stations exist in the network. In this case both must be used and a choice is unnecessary.

Station

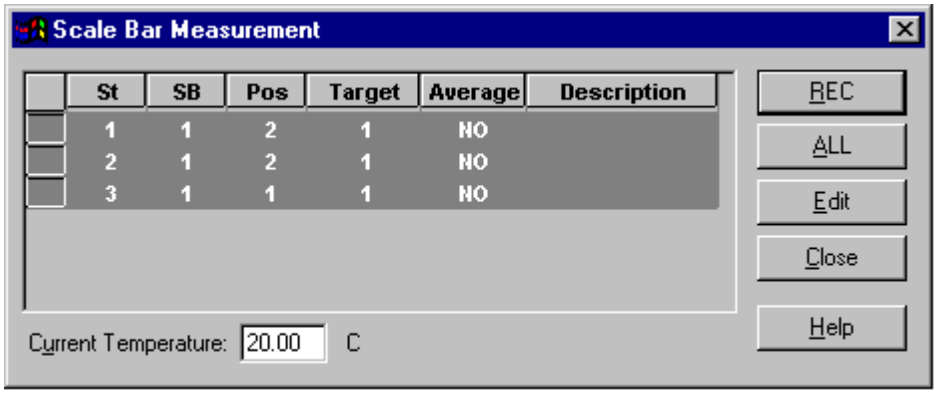
All theodolites and Total Stations in the network are shown in the list box.

Select individual stations or click the **All** button to include all stations.

OK button

Click this button to move to the next stage of scale bar measurement.

8.6.3 Dialogue box: Scale bar measurement



MTM Orient - Scale bar 02.BMP

The grid layout in the dialogue box can be adjusted, see “Adjusting and editing grids” on page 127.
The purpose of this dialogue box is to specify for each selected station the corresponding target on the scale bar to be measured and to record the measurements.

Summary of elements defining a scale bar measurement

Each measurement of a station to scale bar target is defined by a row in the table where the columns have the following meanings:

Column label	Meaning
St	ID number of station
SB	Scale bar number
Pos	Position number of the current scale bar location
Target	Number of scale bar target to be measured
Average	Number of measurements to be averaged
Description	Optional description of the measurement

Current Temperature

Enter the current temperature in order to correct the length of the scale bar for the actual temperature. Scale bars are calibrated at 20° C.

REC button

Use this button to measure horizontal and vertical angles only at all selected stations.
Select an individual station by clicking with the left mouse button to highlight it.
To select all stations, point to the title bar of the table and click the left mouse button.

ALL button

Use this button to measure distance as well as horizontal and vertical angles at the highlighted station, if this is occupied by a Total Station.

Edit button

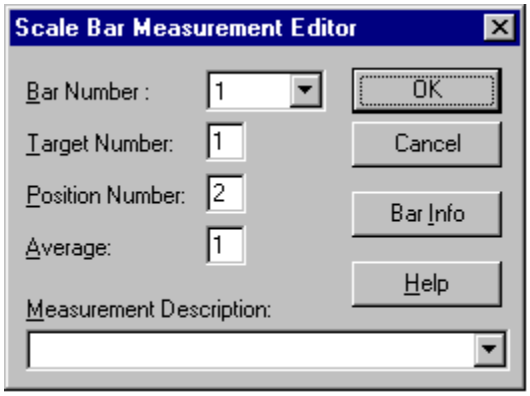
Individual or multiple measurement parameters can be edited by highlighting the stations and using this button to call up the **Scale Bar Editor**.

Make a multiple selection to enforce identical input for all selected measurements.

To select an individual measurement:
Clicking with the left mouse button to highlight it
Use up / down arrows and the space bar

To make a multiple selection:
Click one measurement and SHIFT+click a second measurement
CTRL+click individual measurements

8.6.4 Dialogue box: Scale bar measurement editor



MTM Orient - Scale bar 03.BMP

The Scale Bar Editor is used to enter or change the definition of an individual scale bar measurement.

Bar Number

Numeric identifier of bar used for measurement.

Target Number

Numeric ID of target on bar to which theodolites points.

Position Number

Numeric ID for this scale bar position.

Average

Number of measurements to be averaged.

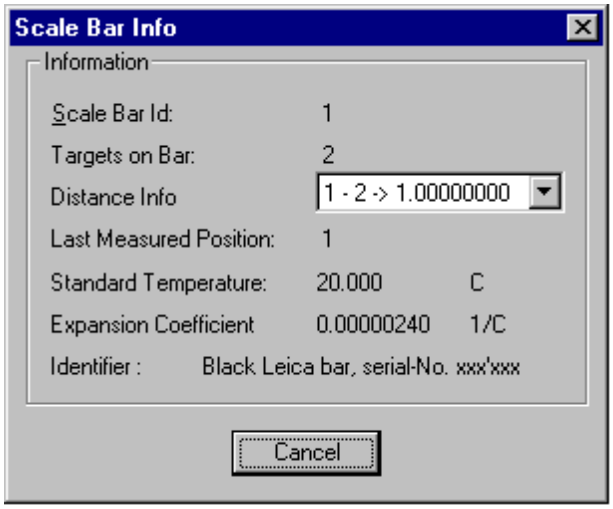
Measurement Description

Description of the actual measurement.

Bar Info button

Click this button to get summary information on the current scale bar.

8.6.5 Dialogue box: Scale bar info



MTM Orient - Scale bar 04.BMP

Scale bar ID

Number of this scale bar.

Targets on Bar

Number which can be 2 or more.

Distance Info

Pull-down list with target to target distance information.

Last Measured Position

Numeric ID of last measured position of this bar.

Standard Temperature

Temperature at which the calibrated scale bar length is defined.

Expansion Coefficient

Coefficient of expansion of the material of the scale bar. 1 metre of this material expands by this value per degree Celsius rise in temperature.

Identifier

Descriptive text for this scale bar

8.7 Orient Network

Orient Network command **(Orientation menu)** **Alt, R, R**
"Run bundle solution program"

The Orient command starts the Orientation Module which builds and optimizes the measurement network.

See the ***Axyz*** CDM Reference Software Manual for more details.

Shortcuts

Toolbar icon:	none
Keys:	none

9. Measure menu

9.1 Introduction

Once a single Total Station or a network of instruments has been set up for measurement, individual object features can be located in a local or object frame of reference. This menu provides options for recording data and specifying the way in which measurements are made.

For example, features may be recorded as single points, bolt holes or with the use of a hidden point device. Instruments can record angles only or distances as well, if they are Total Stations. Data may be displayed continuously or only when requested by the operator.

9.2 Set and Read

Set and Read command **(Measure menu)** **ALT, M, S**
"Set workpiece and point ID and measure"

The purpose of the Set and Read command is to define and record the next target measurements to be made from individually selected stations.

Shortcuts

Toolbar icon: 

Keys: none

9.2.1 Code sequence: Set point ID

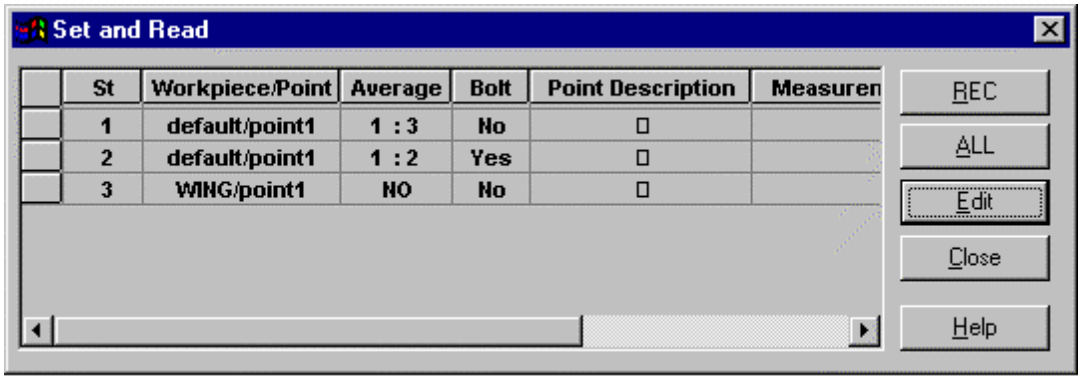
It is useful to be able to set point IDs directly at the instrument, for example when measuring hidden points out of sequence and where the hidden points themselves do not follow in sequence.

To change the numerical part of the point ID, the following code is available. (Relevant for users of older instruments such as T2002 and T3000. Users of more modern instruments can also alter the alpha part.)

CODE 70 RUN **n** RUN REC

Set the numeric part of the point ID to **n**.

9.2.2 Dialogue box: Set and read



MTM Measure - Set & read 01.BMP

The grid layout in the dialogue can be adjusted, see “Adjusting and editing grids” on page 127.

For all connected stations, this dialogue box defines the target identifier, target type and certain measurement methods for the next measurement from each listed station.

For the **REC, ALL, Edit** buttons, select individual stations by clicking the row buttons on the left hand side. These operations then apply to the selected stations.

To select an individual measurement:
Click with the left mouse button to highlight it
Use up / down arrows and the space bar

To make a multiple selection:
Click one measurement and SHIFT+click a second measurement
Click and drag
CTRL+click individual measurements

Summary of elements of next defined measurement

The next measurements are defined by a row in the table where the columns have the following meanings:

Column label	Meaning
St	ID number of station
Workpiece/Point	Workpiece name/point name of target point
Average	Max. number of measurements to be averaged
Bolt	YES - make a bolt hole measurement NO - make a direct point measurement
Point description	Optional description for this point (max. 40 characters)
Measurement description	Optional description of the measurement (max. 40 characters)

For more on bolt holes, see "Bolt Hole" on page 100.
For more on averaging, see "Average Measurement" on page 101.

REC button

The **REC** button records horizontal and vertical angles only at the selected stations, even if the relevant instrument is a Total Station.

ALL button

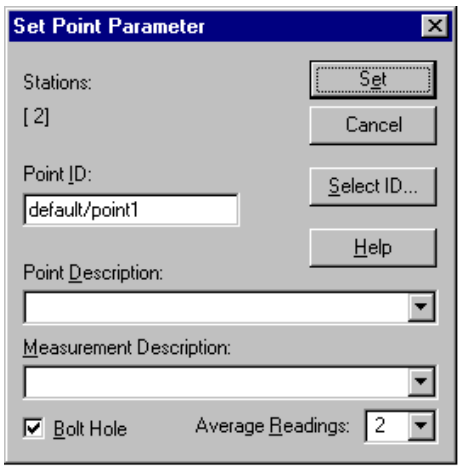
At the selected stations, the **ALL** button records distances as well as angles if any stations are occupied by Total Stations.

Edit button

At the selected stations, individual or multiple measurement parameters can be edited using the editor **Set Point Paramete**r.

Make a multiple selection to enforce identical input for all selected measurements.

9.2.3 Dialogue box: Set point parameter



MTM Measure - Set & read 02.BMP

Stations

A list of the stations previously selected for editing.

Point ID

Enter the next point ID or use **Select ID** to select an existing point.

Point description

Optionally enter a max. 40 character descriptive text for this point.

Measurement description

Optionally enter a max. 40 character descriptive text for the measurement(s) to be made.

Bolt_hole

YES - make a bolt hole measurement
NO - make direct measurements

Average readings

If averaged readings are required, select a value greater than 1 from the drop-down list (max 9). If bolt hole measurement has also been specified, averaging is only possible for even numbers of pointings.

Set button

Click this button to implement the changes.

9.3 Bolt Hole

Bolt Hole command **(Measure menu)** **ALT, M, B**
"Set bolt hole measurement parameters"
This command is used to measure the centre of a bolt hole by making symmetrical pointings to locations on the edge of the hole. An even number of pointings must be made. The diagram shows examples.

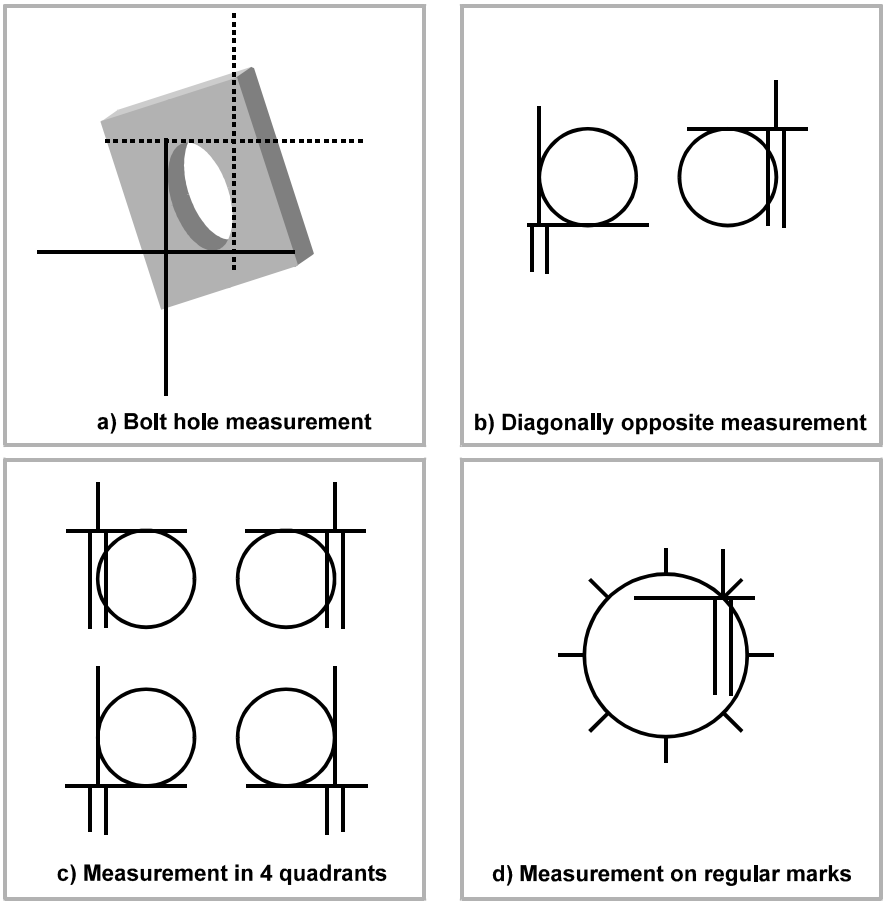
Bolt hole measurements are automatically computed as an average, although individual pointings are to different parts of the hole edge. The averaged value will have the same weight as a single direct pointing to the centre of the bolt hole (weight = 1).

The specification of bolt hole measurement is done in the Set and Read dialogue box. See “Set and Read” on page 96.

Shortcuts

Toolbar icon: 
Keys: none

9.3.1 Diagram: Bolt hole measurement



BOLT-HLE.WMF

9.3.2 Code sequence: Bolt hole measurement

CODE 6 RUN **n** RUN REC

Take **n** number of readings per bolt hole. **n** must be an even number since the hole edges are measured in pairs symmetrical about the centre.

9.4 Average Measurement

Average Measurement command **(Measure menu)** **ALT, M, A**
"Set average measurement parameters"

Every pointing can be calculated as the average of repeated pointings. A maximum of 9 pointings can be averaged to a single pointing. The specification is done in the Set and Read dialogue box. See “Set and Read” on page 96.

Averaged measurements are displayed in the Set and Read grid in the form **n : max**, where n is the number of measurements made so far and max is the maximum number of measurements accepted for averaging at this point.

Note
Averaging multiple pointings to the same target will improve the accuracy of the final pointing. However averaged pointings are not given any higher weight in the Orientation Module or Single Point Solution. The weight of an averaged pointing is the same as the weight of a single pointing.

Shortcuts

Toolbar icon: 
Keys: none

9.4.1 Code sequence: Average measurement

CODE 60 RUN **n** RUN REC

From this station average the recordings of **n** measurements for every pointing.

The weight of the resultant measurement = weight of single measurement.

9.5 Hidden Point

Hidden Point command **(Measure menu)** **ALT, M, H**
"Hidden point device measurements"

If a point to be measured is not visible from the measuring stations, a hidden point rod or frame can be used to transfer coordinates from temporary visible points to the hidden point.

This menu choice is used to define and execute measurements which must be made with a hidden point device.

Shortcuts

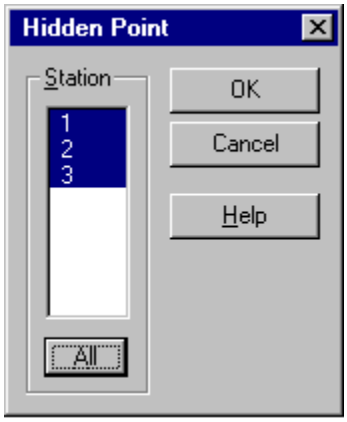
Toolbar icon:	none
Keys:	none

9.5.1 Code sequence: Hidden point measure mode

CODE 7 RUN **n** RUN **t** RUN REC

From this station, measure on hidden point device **n** the device point **t**.

9.5.2 Dialogue box: Hidden point



MTM Measure - Hid pt 01.BMP

This dialogue box is used for selecting which stations measure hidden point devices.

Note
This box does not appear if only two stations exist in the network. In this case both must be used and a choice is unnecessary.

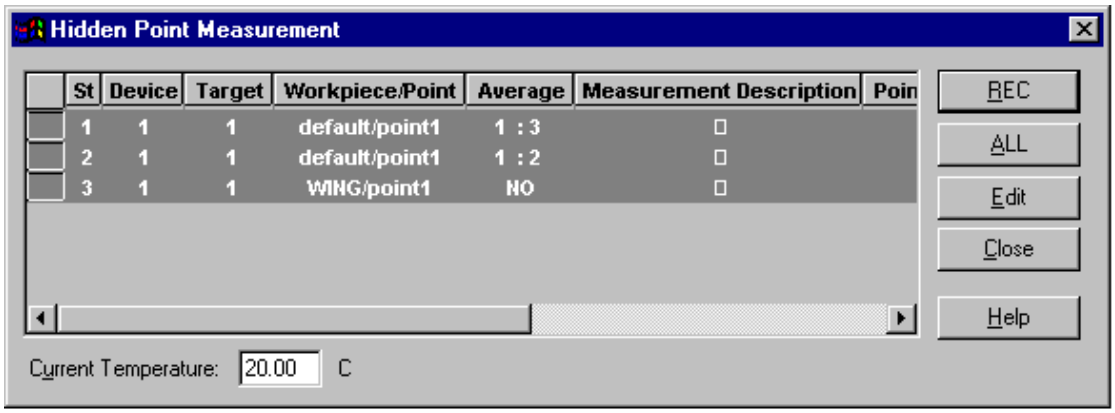
Station

All theodolites and Total Stations in the network are shown in the list box. Select individual stations or click the **All** button to include all stations.

OK button

Click this button to move to the next stage of scale bar measurement.

9.5.3 Dialogue box: Hidden point measurement



MTM Measure - Hid pt 02.BMP

The grid layout in the dialogue can be adjusted, see “Adjusting and editing grids” on page 127.

The purpose of this dialogue box is to specify and record the station/hidden point measurements.

Summary of elements defining a hidden point measurement

Each measurement of a station to a device target (offset target on hidden point device) is defined by a row in the table where the columns have the following meanings:

Column label	Meaning
St	ID number of station
Device	Hidden point device number
Target	Number of scale bar target to be measured
Workpiece/Point	Workpiece name / hidden point name
Average	Number of measurements to be averaged for each device target
Measurement description	Optional description of the measurement(s)
Point description	Optional description of the hidden point

Current Temperature

Enter the current temperature in order to correct the length of the Hidden Point Device for the actual temperature. Devices are calibrated at 20° C.

REC button

Use this button to measure horizontal and vertical angles only at all selected stations.
Select an individual station by clicking with the left mouse button to highlight it.
To select all stations, point to the title bar of the table and click the left mouse button.

ALL button

Use this button to measure distance as well as horizontal and vertical angles at the highlighted station, if this is occupied by a Total Station.

Edit button

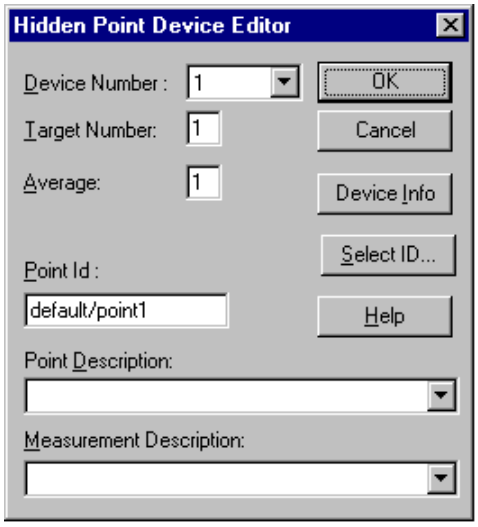
Individual or multiple measurement parameters can be edited by highlighting the stations and using this button to call up the **Hidden Point Device Editor**.

Make a multiple selection to enforce identical input for all selected measurements.

To select an individual measurement:
Clicking with the left mouse button to highlight it
Use up / down arrows and the space bar

To make a multiple selection:
Click one measurement and SHIFT+click a second measurement
CTRL+click individual measurements

9.5.4 Dialogue box: Hidden point device editor



MTM Measure - Hid pt 03.BMP

The Hidden Point Device Editor is used to enter or change following information:

Device Number

Numeric identifier of hidden point device used for measurement

Target Number

Numeric ID of target on device to which theodolites point

Average

Number of readings to be averaged for each device target.

Point ID

Manually enter the hidden point name, or selected and existing name with **Select ID** or equivalent.

Point Description

Optional descriptive text for the hidden point (40 char max.)

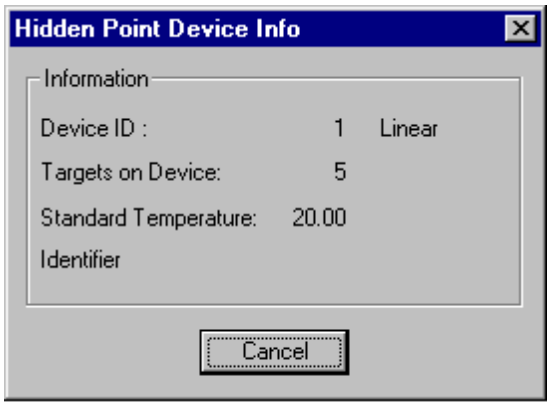
Measurement Description

Optional descriptive text for the hidden point measurements (40 char max.)

Device Info button

Press this button to get summary information on the current hidden point device.

9.5.5 Dialogue box: Hidden point device info



MTM Measure - Hid pt 04.BMP

Information concerning the Hidden Point Device:

Device ID

Device Number and type as follows:

LINEAR
2 or more offset targets (device points) co-linear with the hidden point

NONLINEAR
3 or more offset targets (device points) which form a triangle in a local coordinate system

Targets on Device

Number which can be 2 or more

Standard Temperature

Temperature at which the calibrated target positions are defined.

Identifier

Descriptive text for this Hidden Point Device

9.6 Target Thickness

Target Thickness command **(Measure menu)** **ALT, M, T**
"Set the current target thickness"

The target thickness command allows you to adjust measured points for target thickness. "Thickness" is not just a small value due to the thickness of material of an adhesive target. It may also be a significant offset due to a target adapter.

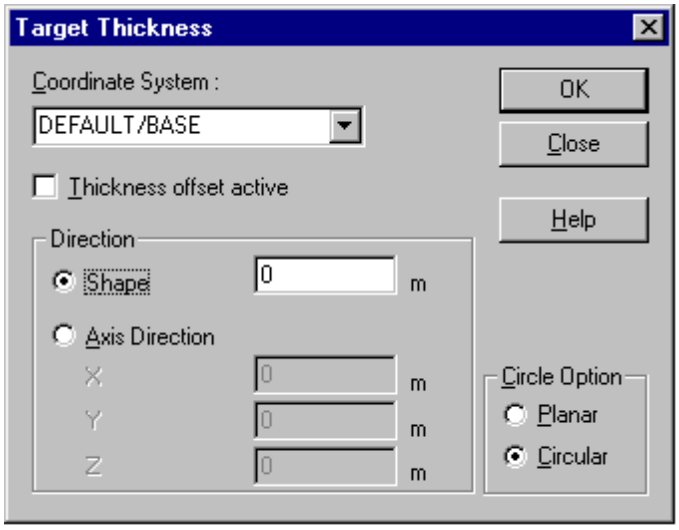
This function defines the direction in which the offset must be applied and if it is to be active, i.e. applied to subsequent measurements. Corrections can be applied along the axes of a particular coordinate system or standard shape or perpendicular to the surface of a particular standard shape.

This correction may be combined with reflector offset correction.

Shortcuts

Toolbar icon: 
Keys: none

9.6.1 Dialogue box: Target thickness



MTM Measure - Tar thick.BMP

Coordinate System

Select the name of the coordinate system or shape used for defining the direction of the offset. The name need not yet exist.

Thickness offset active

Select this option to apply the correction to subsequent measurements. Cancel the option to stop recording target thickness parameters.

Direction

Choose either:
Shape - perpendicular to the shape surface
Axial direction - along a combination of axial directions defined by the selected shape or coordinate system.

Shape
If shape is selected, specify the amount of correction. The value is positive if the offset is on the outside of the shape.

Shape surfaces have the following sides:

- **Plane, circle**
  The positive side is the side of the positive local z axis.
- **Sphere**
  A point on the positive side is further from the centre than the radius. From the positive side the surface looks convex.
- **Cylinder**
  The negative side is on the same side as the axis.
  From the negative side the surface looks concave. From the positive side it looks convex.
- **Cone**
  The negative side is on the same side as the axis.
  From the negative side the surface looks concave. From the positive side it looks convex.
- **Paraboloid**
  The negative side is on the same side as the focus.
  From the negative side the surface looks concave. From the positive side it looks convex.

Axis direction
Specify the amount by which the target is offset along each axis. A positive amount means it is offset in the positive direction.

Circle option

If the shape surface is a circle, two directions of correction are possible:

Planar
Select this option to apply the correction perpendicular to the surface of the circle.

Circular
Select this option to apply the correction along a radius of the circle.

Indication of active thickness correction

An active target thickness correction is shown in the measurement window as:

T - thickness active but not yet corrected
Tc - thickness active and corrected

9.7 Reflector offset correction

Reflector offset correction command **(Measure menu)** **ALT, M, L**
"Enable or disable reflector offset correction"

If a Total Station measures to a reflector in a spherical housing, the actual object point of interest is usually the contact point between the reflector housing and the object surface or a target adapter on the surface.

This function defines the direction in which the offset must be applied and if it is to be active, i.e. applied to subsequent measurements. Corrections can be applied along the axes of a particular coordinate system or standard shape or perpendicular to the surface of a particular standard shape.

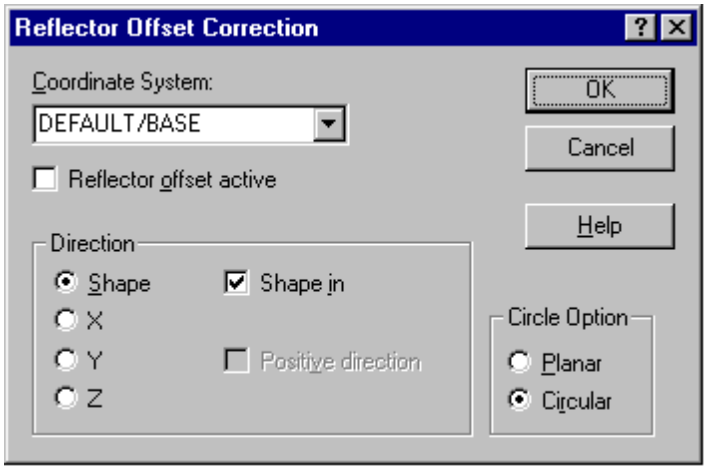
The size of the correction is taken as the radius of the reflector housing, as defined in the database. It is not explicitly entered.

This correction may be combined with target thickness correction.

Shortcuts

Toolbar icon: 
Keys: none

9.7.1 Dialogue box: Reflector offset correction



MTM Measure - Refl offset.BMP

Coordinate system

Select the name of the coordinate system or shape used for defining the direction of the offset. The name need not yet exist.

Reflector offset active

Select this option to apply the correction to subsequent measurements.

Direction

Choose either:
Shape - perpendicular to the shape surface
X,Y,Z - along the X,Y or Z axis of the selected shape or coordinate system

Shape in
Relevant when correcting to shape surfaces. If the reflector contacts the negative side (inside) of the shape, select this option.

Shape surfaces have the following sides:

- **Plane, circle**
  The positive side is the side of the positive local z axis.
- **Sphere**
  A point on the positive side is further from the centre than the radius. From the positive side the surface looks convex.
- **Cylinder**
  The negative side is on the same side as the axis.
  From the negative side the surface looks concave. From the positive side it looks convex.

- **Cone**
  The negative side is on the same side as the axis.
  From the negative side the surface looks concave. From the positive side it looks convex.
- **Paraboloid**
  The negative side is on the same side as the focus.
  From the negative side the surface looks concave. From the positive side it looks convex.

Positive direction
Relevant when correcting along axes. Select this option if the reflector is offset in the positive axial direction.

Circle option

If the shape surface is a circle, two directions of correction are possible:

Planar
Select this option to apply the correction perpendicular to the surface of the circle.

Circular
Select this option to apply the correction along a radius of the circle.

Indication of active reflector correction

An active refletcor offset correction is shown in the measurement window as:

R - offset active but not yet corrected
Rc - offset active and corrected

9.8 Continuous Update

Continuous Update command **(Measure menu)** **ALT, M, C**
"Continuously measure the stations in this view"

Continuous Update means that the system will continuously read the angles from connected instruments and update the target coordinates at specified time intervals.

The display windows on the instruments will also be updated at the same intervals

This provides a display function for the specified measurement windows. The **REC** and **ALL** buttons retain their normal recording functions when **Continuous** is active and are used to record and store data. Unlike the **Try** function, **Continuous** does not block any actions of **REC** and **ALL**.

Conditions

- Not available if **TRY** is active
- Not available in STM, only MTM or STM/MTM
- A measurement window must be open

Note
If only one theodolite in a measurement window is pointing at a target, its coordinates cannot be updated and the last coordinates remain displayed.

Shortcuts

Toolbar icon: 
Keys: none

9.8.1 Code sequence: Continuous display for all stations

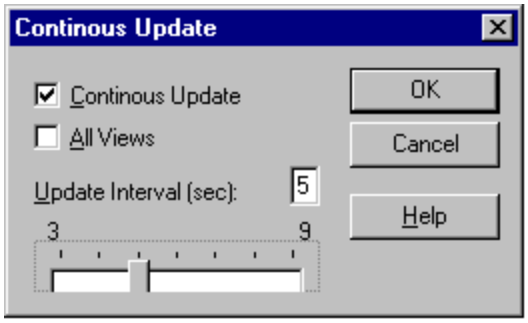
CODE 11 RUN **n** RUN REC

Continuously read and display measurements of all connected instruments with a time interval of **n** seconds

Range of **n** = 3 - 99 seconds. 0 = OFF.

Any 3D point coordinates will also be calculated and displayed in ***Axyz*** measurement windows, but will not be stored.

9.8.2 Dialogue box: Continuous update



MTM Measure - Cont update.BMP

Continuous_Update

Select this option to activate continuous updating

All Views

Select this option to activate continuous updating in all measurement windows.

If not selected, only the currently active measurement window will be updated.

Update Interval (sec)

Enter the time interval after which a new calculation is made. A number between 3 sec and 9 sec can be selected either by using the slider or the number entry field.

9.9 REC

REC command **(Measure menu)** **ALT, M, R**
"Record all sensors in this view (angles only)"

This command is used to record horizontal and vertical angles from one or more instruments currently connected to the computer.

Measurements are subsequently combined with any existing measurements to the target points and any corresponding 3D coordinates are calculated or updated, if possible. This action may cause more than one 3D point to be created.

If **Try** is not active, the measurements and any resulting 3D points are stored in the job file

Conditions

- The instruments need not be oriented
- A measurement window need not be open
- If a measurement window is open and active, only the instruments at stations assigned to the window are read
- If no measurement windows are open or no open measurement window is active, then all connected instruments are read

Shortcuts

Toolbar icon: 

Keys: Ctrl+R

9.10 ALL

ALL command **(Measure menu)** **ALT, M, L**
"Record all sensors in this view (angles and distances)"

The command is used to record distances as well as horizontal and vertical angles from one or more instruments currently connected to the system. Distances are only obtained from Total Stations, other instruments can only supply horizontal and vertical angles.

Measurements are subsequently combined with any existing measurements to the target points and any corresponding 3D coordinates are calculated or updated, if possible. This action may cause more than one 3D point to be created.

If **Try** is not active, the measurements and any resulting 3D points are stored in the job file

Conditions

- Only available when a Total Station is connected to the system.
- The instruments need not be oriented
- A measurement window need not be open
- If a measurement window is open and active, only the instruments at stations assigned to the window are read
- If no measurement windows are open or no open measurement window is active, then all connected instruments are read

Shortcuts

Toolbar icon: 

Keys: Ctrl+A

9.11 Try Mode

Try Mode command **(Measure menu)** **ALT, M, Y**
"Measure without saving"

This allows you to "try" results without storing any data and is useful for checking a location as you home in on a target position.

Try is used in conjunction with **REC** and **ALL** and modifies their actions. As long as **Try** is active it applies to all connected stations and blocks the following actions by **REC** and **ALL**, as well as measurements triggered directly at the instruments:

- Storage of measurements and any derived 3D coordinates
- Incrementing point ID for next measurement

To use this recording feature therefore, you click on **Try** then use **REC** or **ALL** as required in order to update results on screen.

Conditions

- Not available if Continuous Update is operating
- A measurement window must be open

Shortcuts

Toolbar icon: 

Keys: none

9.11.1 Code sequence: Try mode for all stations

CODE 12 RUN REC

This toggles **TRY** recording ON/OFF for all on-line stations. When active, any measurements made with **REC** or **ALL** will cause the instrument's display to be refreshed and 3D coordinates will be calculated if this is possible.

Any 3D results will be displayed in an ***Axyz*** measurement window if one is open for the station concerned, but the coordinates will not be stored in the job file.

9.12 Stop

Stop command **(Measure menu)** **ALT, M, P**
"Stop the auto inspect measurements"

This option is only relevant in Auto Inspect mode in which a set of fixed reflector locations are measured by one motorized Total Station with ATR (TDA series). The action will end the inspection sequence at the current position.

Shortcuts

Toolbar icon: 
Keys: none

9.13 Pause

Pause command **(Measure menu)** **ALT, M, U**
"Pause the auto inspect measurements"

This option is only relevant in Auto Inspect mode in which a set of fixed reflector locations are measured by one motorized Total Station with ATR (TDA series). If it is not possible to place a reflector at every location the sequence can be paused to permit reflectors from previously measured locations to be moved to the next locations in the sequence.

Shortcuts

Toolbar icon: 
Keys: none

9.14 Go location

Go location command **(Measure menu)** **Alt, M, O**
"Position sensor to selected position"

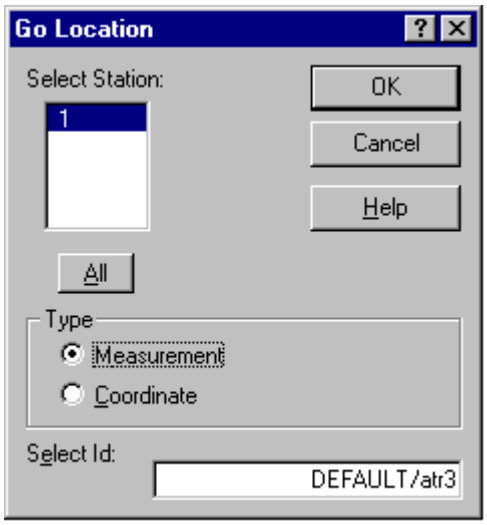
This command allows you to place the reflector in a previously measured target position and point selected instruments to it. The position may be defined by either coordinate values or a measurement from the appropriate station.

Note
Only motorized instruments can make full use of this feature.

Shortcuts

Toolbar: 
Keys: none

9.14.1 Dialogue box: Go location



MTM Setup - Go Location.bmp

Select station

The list shows the current on-line stations which are occupied by instruments of the TDA series. (Only one in above example.) Select the stations to be pointed at the specified target location by highlighting, or use all stations on the list by pressing the **All** button.

Type

Measurement
Select this option if the location is to be found using a previous measurement from this station (h,v).

Coordinate
Select this option if the location is to be found using its existing coordinates (x,y,z). A corresponding pointing (h,v) will be computed using these values and the location and tilt of the tracker. This pointing will be used to find the reflector.

Birdbath
Select this option to lock onto the reflector in the Birdbath.

Select ID

Specify the ID of the corresponding measurement or coordinate values by direct entry or selection from the database. To select from the database use a right mouse click to get a popup menu which offers **Select ID.**

10. Window menu

10.1 Measurement window

Measurement window command **(Window menu)** **Alt,W,M**
"Open new Theomanager measurement window"
Opens a measurement window configured for the current operational mode.

The window provides on-line 3D results as well as a range of additional relevant information such as:

- Workpiece name
- Current point ID
- Coordinate system name
- Coordinate (axis) labels
- Error values
- etc

Multiple measurement windows can be opened at the same time. The various windows may use the same or different theodolite groups and different coordinate systems. This feature enables users to work simultaneously with different combinations of theodolites, coordinate systems, workpieces, shapes or targets.

Shortcuts

Toolbar icon: 
Keys: CTRL+N

10.1.1 Feature summary of measurement windows

A measurement windows show the 3D results created by a selected sub-group of the currently on-line and oriented instruments.

Up to ten measurement windows can be opened and used for measurements at the same time. Each window can use a different coordinate system (but not a different coordinate type).

The same instrument can appear in different views. For example:

- Window 1 shows theod. 1 and theod. 2 measuring workpiece A.
- Window 2 shows theod. 2 (again) and theod. 3 measuring workpiece B.

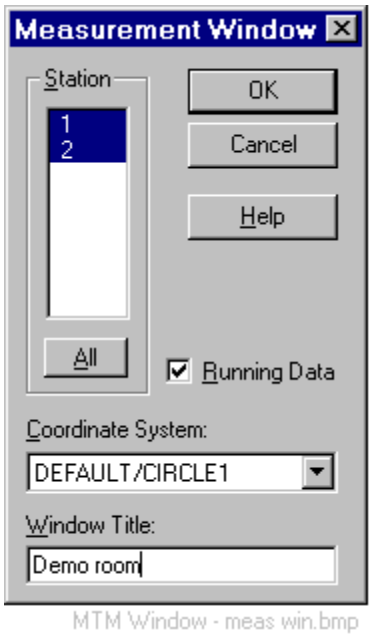
The (x, y, z) coordinates or coordinate differences (Build/Inspect mode) are displayed in letters as large as possible within the window area.

Minimum information can be optionally displayed in order to make the 3D digits as large as possible for easier viewing from a distance.

Certain items have different background warning colours to indicate if measurements are within or outside defined error limits.

For details of displayed data in measurement windows, see the sample windows as follows:
"Measurement window: Standard mode" on page 17.
"Measurement window: Build/Inspect points" on page 22.

10.1.2 Dialogue box: Measurement window



Station

Select the stations assigned to this window from the list available. Stations which are currently on line and oriented are offered. Click the **All** button to select all stations.

Running data

The running data window displays results from all connected instruments. If you have several measurement windows open, with groups of instruments performing different tasks or showing results in different

coordinate systems, you may prefer to show only the output from selected instruments in the running data window. Typically you might show only the output from instruments assigned to a particular window.

If this option is selected, the output from the instruments assigned to this window will be shown in the running data window.

Coordinate system

Select the coordinate system to apply to this window from the drop-down list of currently defined systems and shapes.

The currently active system, as chosen in the Core Module, is offered as the default choice.

To change the active system, see **CDM Coordsys menu/ Active coordsys**.

Window title

Optionally change the window title here.

10.2 Data Manager

Data Manager command **(Window menu)** **Alt,W,D**
"Open an instance of the Integrated Data Manager"

Opens a Data Manager window.

Shortcuts

Toolbar icon: 
Keys: none

10.3 Graphics

Graphics command **(Window menu)** **Alt,W,G**
"Open an instance of the Integrated Graphics Manager"
If ***Axyz*** View or ***Axyz*** CAD installed, this will opens a single Graphics Window.

Shortcuts

Toolbar: 
Keys: none

10.4 Cascade

Cascade command **(Window menu)** **Alt,W,C**
"Arrange windows so they overlap"

Any windows inside the main Theodolite Manager window which are not minimized will be arranged in overlapping "cascade" fashion.

Does not apply to the Running Data window.

Shortcuts

Toolbar icon:	none
Keys:	none

10.5 Tile horizontally

Tile command **(Window menu)** **Alt,W,H**
"Arrange windows as non-overlapping tiles"

Any windows inside the main Theodolite Manager window which are not minimized will be arranged in non-overlapping horizontal strips.

Shortcuts

Toolbar icon:	none
Keys:	none

10.6 Tile vertically

Tile command **(Window menu)** **Alt,W,T**
"Arrange windows as non-overlapping tiles"

Any windows inside the main Theodolite Manager window which are not minimized will be arranged in non-overlapping vertical strips.

Shortcuts

Toolbar icon:	none
Keys:	none

10.7 Arrange Icons

Arrange icons command **(Window menu)** **Alt,W,R**

This command arranges any miminized windows inside the main Theodolite Manager window in a row along the bottom of the window.

Shortcuts

Toolbar icon:	none
Keys:	none

10.8 Open window list

1, 2, 3, 4 command **(Window menu)** **ALT,W,1..10**
if number > 10 **ALT, W, M**

At the bottom of the Window menu is a list of the currently open windows.

Use the shortcut numbers or click on the window name to make it the active window. If the window has been minimized, it will be automatically restored. (This can also be done by simply clicking on the relevant window itself. See also MS Windows documentation.)

11. Help menu

11.1 Help topics

Help topics command **(Help menu)** **Alt,H,H**
"List Help topics"

This takes you to the **Contents** section of the on-line HELP. From here you also have acess to the **Index** and **Find** tabs.

Note
The on-line HELP is relevant to the currently active module.
If and MTM window is active, help on MTM is provided.
If a Data Manager window is active, help on the DM is provided.
If a graphics window is active, help on graphics is provided.

Shortcuts
Toolbar icon: none
Keys: none

11.2 Using help

Using help command **(Help menu)** **Alt,H,U**
"Display instructions about how to use Help"

This command displays the standard Windows 95 Help file about using Help systems.

Shortcuts
Toolbar icon: none
Keys: none

11.3 Help mode

Help mode command **(Help menu)** **Alt,H,H**
"Display Help for clicked on buttons, menus and windows"

This provides an on-screen, context-sensitive HELP. When chosen, the mouse pointer changes to a Help pointer. You can then click on windows, buttons and menu choices to display context-sensitive Help relating to the chosen item.

Shortcuts

Toolbar icon: 
Keys: SHIFT+F1

11.4 About Axyz STM/MTM

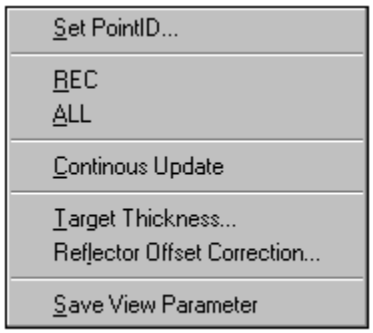
About Axyz STM/MTM command **(Help menu)** **Alt,H,A**
"Display program information, version number and copyright"

Shortcuts

Toolbar icon: 
Keys: none

12. Shortcut menus on right mouse click

12.1 Shortcut menu for all measurement windows



MTM rt click - meas.BMP

For **Set Point ID**, see “Set and Read” on page 96

For **REC**, see “REC” on page 113.

For **ALL**, see “ALL” on page 114

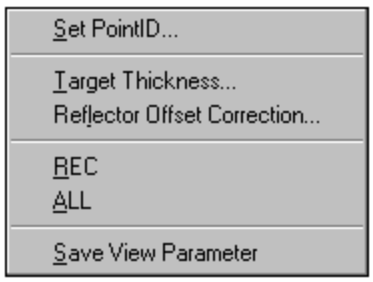
For **Continuous update**, see “Continuous Update” on page 111

For **Target thickness**, see “Target Thickness” on page 107

For **Reflector offset correction**, see "Reflector offset correction" on page 109.

Save View Parameter
This menu choice saves the current size and position of the window.

12.2 Shortcut menu for Orient Status window



MTM rt click - ori stat.BMP

For **Set Point ID**, see “Set and Read” on page 96

For **Target thickness**, see “Target Thickness” on page 107

For **Reflector offset correction**, see "Reflector offset correction" on page 109.

For **REC**, see “REC” on page 113.

For **ALL**, see “ALL” on page 114

Save View Parameter
This menu choice saves the current size and position of the window.

12.3 Shortcut menu for Running Data window

A right mouse click on the title bar gives the following menu:

MTM rt click - run dat.BMP

For **settings** see "Grid settings" on page 127.

Angles
Displays measurement values.

Coordinates
Displays 3D coordinate values.

Build differences
Displays 3D differences as they are calculated

Clear angles list
Removes the currently recorded list of angles.

Clear coordinate list
Removes the currently recorded list of coordinates.

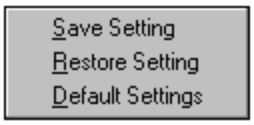
Clear build diff. list
Removes the currently recorded list of coordinates.

12.4 Adjusting and editing grids

A number of dialogue boxes display information in a grid. The layout of the grid may be altered. Column widths can be changed by dragging the column dividers and columns may be moved to different positions by clicking and dragging. Some grid data can also be edited.

12.4.1 Grid settings

A right mouse click on the title bar displays the following menu:



MTM rt click - adj grid.BMP

Save Setting
Select this option to save the actual layout of the dialogue

Restore Setting
Select this option to restore previously saved settings

Default Setting
Select this option to implement a default layout. The default cannot be altered.

12.4.2 Editing grid data

A right mouse button click below or to the right of the grid offers the **Edit Dialogue Box**. If an Editor is assigned to this dialogue box, selecting the option will open the Editor.

MTM rt click - ed dialg.BMP

12.4.3 Which grids can be edited?

The layout of the following dialogue boxes uses a grid which can be adjusted:

- Running Data Window
- Station Setup
- Field Check result
- Check Target Results
- Reflector Setup
- Scale Bar Measurement
- Set and Read
- Hidden Point

13. Axyz STM/MTM Codes and Error Messages

13.1 CODE Functions

0 **Level theodolite**
Electronically level the theodolite
CODE 0 RUN REC

1 **Set Hz circle**
Set horizontal angle to zero at current theodolite position
CODE 1 RUN REC

2 **Accurate collimation forward**
Forward collimate this theodolite to station **s**
CODE 2 RUN **s** RUN REC

3 **Accurate collimation reverse**
Reverse collimate this theodolite to station **s**
CODE 3 RUN **s** RUN REC

20 **Approximate collimation**
Approximate collimate this theodolite to station **s**
CODE 20 RUN **s** RUN REC

4 **Measure direction**
Measure axis direction **d** and orientation method **t**
CODE 4 RUN **d** RUN **t** RUN REC
d (1=X, 2=Y, 3=Z)
t (0=LOCAL, 1=OBJECT)

40 **Measure to station**
Measure to station **s** and record distance **d**
CODE 40 RUN **s** RUN **d1** RUN REC
CODE 40 RUN **s** RUN **d1** RUN **d2** REC
d1 (units before dec. point)
d2 (units after dec. point)

41 **Measure to point**
Measure to point **p** and record distance **d**
CODE 41 RUN **p** RUN **d1** RUN REC
CODE 41 RUN **p** RUN d1 RUN **d2** RUN REC
d1 (units before dec. point)
d2 (units after dec. point)

5 **Scale bar measurement**
Measure at position **p** the target **t** of scale bar **n**
CODE 5 RUN **p** RUN **t** RUN **n** RUN REC

6 **Bolt hole measurement**
Take **n** number of readings per bolt hole
CODE 6 RUN **n** RUN REC

7 **Hidden point measure mode**
Measure on hidden point rod **n** the device point **t**
CODE 7 RUN **n** RUN **t** RUN REC

8 **Skip forward in reference file**
Skip **n** points forward in current reference file
CODE 8 RUN **n** RUN REC

9 **Skip backward in reference file**
Skip **n** points backward in current reference file
CODE 9 RUN **n** RUN REC

60 **Average measurement**
Average the recordings of **n** measurements
CODE 60 RUN **n** RUN REC

10 **Jump to specific point in reference file**
Jump to first point in reference file with ID **n**
CODE 10 RUN **n** RUN REC **n** (numeric part only)

11 **Continuous display for all stations**
Continuous display with time interval of **n** seconds
CODE 11 RUN **n** RUN REC **n** (3 - 99) (0=OFF)

12 **Try mode for all stations**
Try mode ON/OFF (toggle)
CODE 12 RUN REC

70 **Set point ID**
Sets the numeric part of the point ID to **n**.
CODE 70 RUN **n** REC

98 **Clear error message**
Clear error message / no overwrite
CODE 98 RUN REC

99 **Accept error message**
Accept error message / overwrite
CODE 99 RUN REC

13.2 ERROR Messages

General error

0 ERR System not ready for measurement
1 ERR Previous measurement not processed yet
2 ERR Invalid target number
3 ERR Invalid CODE number or sequence
4 ERR Cannot electronically level sensor at station with measurements taken
5 ERR Cannot set Hz angle to 0 at station with measurements taken
7 WRN Maximum pointing error exceeded with last recording
8 ERR Overwrite existing measurement ?
9 ERR Overwrite existing point coordinates ?

Collimation/direction & distance measurement error

20 ERR Cannot measure station with itself
21 ERR Station to measure to is not connected to the system
23 ERR Invalid station number
24 ERR Sensor is not in foreward face
25 ERR Sensor is not in reverse face
30 ERR Sensors foreward and reverse collimation measurement out of tolerance
400 ERR Invalid distance
410 ERR Point to define distance and direction to does not exist

Axis direction error

40 ERR Invalid axis number

Scale measurement error

50 ERR Invalid scale bar position number
51 ERR Invalid scale target number
52 ERR Invalid scale bar number

Bolt hole measurement error

60 ERR Invalid number of readings for bolt hole

Hidden point measurement error

70 ERR Sensor is already in hidden point mode
71 ERR Invalid hidden point device number

Average measurement error

600 ERR Invalid number of repetitions for average measurements

Skip in file error

80 ERR Invalid number of points to skip in file

Build/inspect error

100 ERR Invalid point ID for current reference file
101 ERR Sensor is not in build or inspect mode
102 ERR No more points to measure from this station
111 ERR Entered time interval must be between 3 - 99 seconds