WILD T/TC1010/1610

User Manual

Leica Heerbrugg AG, CH-9435 Heerbrugg (Switzerland)
Telephone +41 71 70 31 31, Fax +41 71 72 15 06

Leica

Index

1. Introduction

Successful surveying requires a versatile instrument that allows you to cope efficiently with a wide range of tasks and is designed to be both easy to use and extremely flexible. The consistent further development of the well-known, fully integrated modular approach to Wild instrument design in the established T1000/1600 theodolites and TC1000/1600 total stations has produced the new WILD T1010/1610 theodolites and the WILD TC1010/1610 total stations.

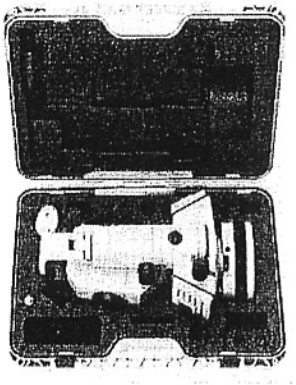
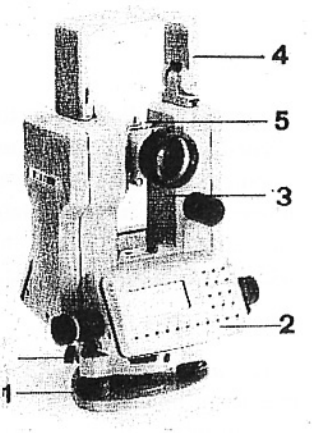


Fig. 1:
TC1610 in case

Both models have a slot accepting a REC module for data recording. Existing GRE3 or GRE4 data-recording units, or a GPC1, may be used. A built-in RS232 serial interface permits the instrument to be connected to a computer or another data-acquisition system.

When you have taken delivery of your new instrument, proceed as follows:

- Charge battery
- Set up instrument
- Release safety catch to rotary knob on tribrach
- Align EDM with telescope (T1010/1610 only)
- Point to reflector
- Use instrument as dscribed in section 4



Read the user manual with care. It will allow you to make the most of your new instrument. This is all the more important if this is your first electronic Wild instrument.

Fig. 2: WILD T1610

1 Footscrew
2 Keyboard
3 Optical sight
4 Carrying handle
5 Adapter for EDM
6 Rotary knob for tribrach

2. Setting up the instrument

Preferably use an original Wild tripod such as a GST-20 for setting up your instrument. If you use another make of tripod, check that it has a central fixing screw with a 5/8" thread. Always attach the tribrach securely to the tripod. Use the tribrach footscrews to level up the instrument, and centre it by adjusting the length of the telescopic legs. The setting-up procedure depends on whether the tripod has an optical plummet .To set up the instrument quickly and accurately, proceed as follows:

- **Tribrach with optical plummet:**
  Turn the tribrach footscrews to centre the crosshair on a ground mark, then alter the length of the tripod legs to centre the tribrach's circular bubble. Without turning the tribrach, move the instrument on the tripod plate to eliminate any residual error. To level up accurately, turn the tribrach footscrews and centre the bubble of the theodolite's tubular level.

- **Tribrach without optical plummet:**
  Attach the plumb-bob to the central fixing screw, then alter the length of the tripod legs to centre the plumb-bob on the ground mark. Turn the footscrews to centre the tribrach's circular bubble. To level up accurately, turn the tribrach footscrews and centre the bubble of the theodolite's tubular level.

3. Pointing to a reflector

3.1 With a T1010/1610

For close-range distance measurement with a WILD Distomat DI1001, DI1600, or DI2002, use a GPH1A single-prism holder. The target compensates the height difference in the optical axis of the theodolite and the infra-red beam used to measure distance. For medium- and long-range distance measurement, use a GPH3 or GPH11 prism holder and fit the appropriate number of reflectors for the distance you want to measure. Do not use other makes of prisms unless you have determined their additive constant on a suitable calibration range and set the constant in the instrument.

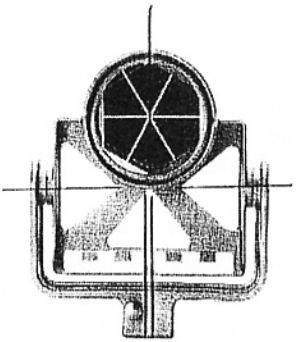


Fig. 3: GPH1A single-prism holder. Point the crosshair at the yellow target.

For accurate measurement, the EDM's infra-red beam and the telescope's line of sight must be parallel. The Distomat manual gives details of how to check and adjust this parallelism.

When the EDM is properly adjusted, a single pointing is all you need to measure angles and distance. Simply point the crosshair of the theodolite telescope at the target of the GPH1A.

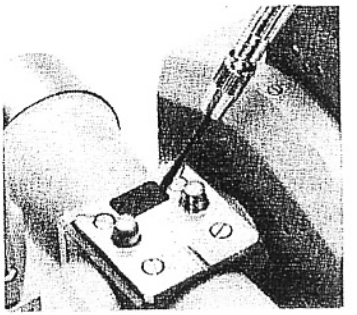


Fig. 4: Removal of protective cap to telescope adapter plate

A cable link between the theodolite and a WILD Distomat is unnecessary. The telescope's contact plate supplies power to the EDM and permits data flow.

3.2 With a TC1010/1610

For close-range distance measurement with a total station, use a GPH1 single-prism holder. The point of intersection of the prism edges coincides exactly with the intersection of the reflector's vertical and tilting axes; the prism centre can thus be used directly as the target for angle measurement. To ensure accurate pointing at longer range, fit a GZT4 target to the support of the prism holder. The telescope of the EDM module is factory-adjusted to ensure that the infra-red beam coincides with the optical line of sight. For medium- and long-range distance measurement, use a GPH3 or GPH11 prism holder for three or eleven prisms respectively, and fit the appropriate number of reflectors for the distance you want to measure.

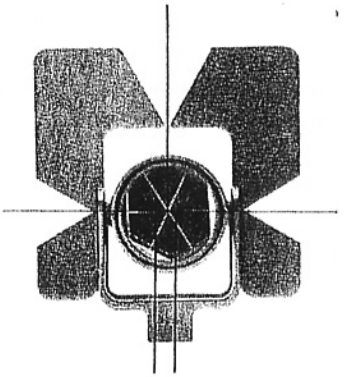


Fig. 5: GPH1 single-prism holder with target plate GZT4 attached; crosshair must intersect in centre of prism.

4. Getting started

4.1 Functional principles

A modern instrument for terrestrial surveys should be suitable both for simple angle measurement and for total-station applications in detail surveys and setting-out. Integrated functions and application-specific loadable software specially developed for these instruments give you a transparent, easy-to-learn control of both simple and complex surveying procedures.

Colour-coded keypads show you at a glance the keys and functions that belong together and help you with the input of data and commands.

The menu structure provides user guidance and helps you find the various functional levels. The header line in the display indicates your current position in the menu's tree structure. Three commands control the path within this structure:

CONT — Continues to next branch in menu.

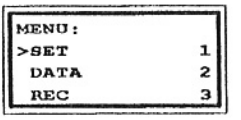
CE — Returns to previous level.

ESC — Quits path through menu tree. The system does not adopt the parameter or setting.

You can reach a function in the menu tree in one of two ways:

[MENU]

a) Calls function.



[↑] [↓]

Use cursor-control keys to move arrow to required function.

[CONT]

Confirmation.

or

[MENU] [1] [2]

b) Call function by its task number on right-hand side of display, for example: set station coordinates E_o, N_o

Skilled users are likely to prefer the direct method.

The appendix shows the tree structure of the menu. Spending some time studying this will repay you by giving you a better understanding of the built-in functional procedures.

4.2 Keyboard

The keyboard has two sets of keys, a standard numeric input keypad and a block of function keys. The keys are colour-coded as described below to indicate their functions:

- **Yellow**
  Numeric and alphanumeric keys with the following functions:

CE	Cancels input.
ENTR	Adopts input value.
αNUM	Permits alphanumeric input.

- **Green**
  Cursor-control keys for selecting a menu line and choosing one of the values proposed as measurement and theodolite parameters:

↑ ↓ ← →	Choose required options.
CONT	Confirmation.

- **Orange**
  To call user programs and system functions.

PROG	Calls library of system functions.
MENU	Calls library of system programs.
ESC	Quits function and returns to measurement mode.

- **White**
  Function and control keys for convenient input of frequently-used data-specific parameters, such as point numbers and coding.

4.3 Introductory examples

Frequently-used functions such as CODE, DSP, REC, NR, and REP are outside the menu tree. Like the measurement functions ALL, DIST, and STOP you can invoke these by direct-function keys. All other internal program procedures and functions are controlled by the system software in the program.

MENU

There is no fundamental difference in the use of these functions. The two following examples are designed to explain their use and help you understand the menu system.

Example 1: Set starting angle

This function is available in the MENU system-control program. Use the following key sequences:

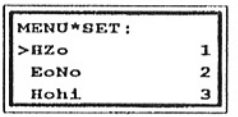
MENU

Calls function.

The arrow marks the SET sub-program. Press

CONT

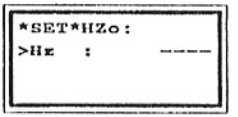
To confirm.



The arrow marks input of orientation HZ_o.

CONT

To confirm.



Set crosshair on target and input angle. For counterclockwise angle measurement, input the starting angle as a negative value.

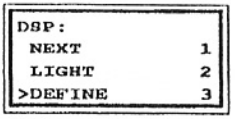
Hz_o.... [ENTR] Confirms input and quits function.

Example 2: Definition of display masks

The four-line display can be used for four measurements or computed results. You can adapt the display masks to your own requirements and define up to nine masks (DSP1....9), each with up to four values (LINE1....4).

[DSP] Calls function with direct-function key.

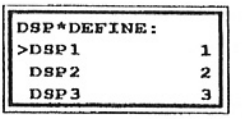
[↑] [↓]



Use cursor-control keys to make your choice.

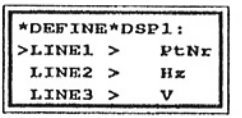
[CONT] Confirmation.

[↑] [↓]



Use cursor-control keys to choose a display (DSP1...9).

[CONT] Confirmation.



Use cursor-control keys to choose a line (LINE1...4).

[↑] [↓]

[←] [→] Find required elements in list.

Repeat assignment of elements line by line as necessary.

[CONT] Confirms and quits function. The instrument is again ready for measurement.

Now assign display just defined to its proper place in existing sequence of displays.

DSP — Calls function.

↑ ↓

```
DSP:
 LIGHT          2
 DEFINE         3
>ORDER          4
```

Choose menu point ORDER.

CONT — Confirmation.

```
DSP*ORDER:
>NEXT1      >DSP1
 NEXT2      >DSP2
 NEXT3      >DSP3
```

To define order in which display masks are shown, repeat procedure as for content of display masks: select NEXT(1....9).

↑ ↓ ← → Set DSP(1....9) and repeat this procedure until all display masks are in their correct order. Delete unwanted masks to save unnecessary checking through displays.

CONT — Confirms and quits function.

DSP — Calls function, to set current display.

CONT

```
DSP:
>NEXT           1
 LIGHT          2
 DEFINE         3
```

Switches to next display as defined in ORDER. Repeat until required mask is displayed.

When you switch the theodolite off and on again, the first mask defined in ORDER is displayed.

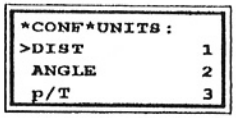
Instead of a detailed description of paths in the following sections, they are indicated in the menu structure by task numbers as described in 4.1. Develop a working method that suits

your specific needs. Many of the basic instrument settings are stored when you switch off, so that the setting-up procedure need only be performed once.

4.4 Preparations for measurement

Before the first measurement, you must define the units for angle and distance. Also specify the units for atmospheric pressure (p) and temperature (T); these enable the instrument to compute the ppm corrections for the EDM when weather data are input. Find the UNITS function in the menu tree or directly by assigned numbers as described in section 4.1.

MENU 4 5 — Calls function.



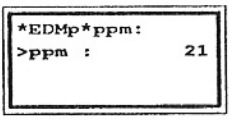
Use the cursor-control keys to select the units for distance and angle measurement and for meteorological data from the possibilities indicated.

↑ ↓ ← → — In the same manner, select the decimal position for the display of the results.

CONT — Confirms the choice. You are again in measurement mode. Call up the function again for further parameter settings.
All settings are retained after the instrument has been switched off.

MENU 1 6 — 1 ..... 4 — Calls up parameters for distance correction.

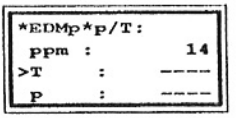
[1]



The individual distance correction factors must be calculated according to the formulas of section 17, or have to be interpolated from country specific tables to give correct distance measurements. Add the individual factors and enter them as

ppm... [ENTR] one value in the ppm variable. This value remains stored after the instrument has been switched off. Only whole numbers can be entered.

[2]



If only the atmospheric correction is required, the value can be computed using the formula of Barrel and Sears after entering temperature and pressure.

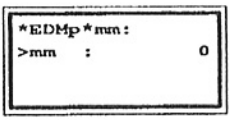
T ..... [ENTR]

Enter temperature

p ..... [ENTR] and pressure, using the units selected, and

[CONT] confirm. The ppm variable is computed and automatically input. Values for ppm and p/T cannot be entered simultaneously. Those entered for T and p have priority.

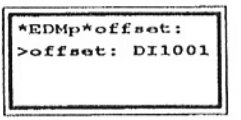
[3]



The additive constant for WILD circular prisms used in conjunction with WILD Distomats is 0. The constant for other prisms or for length corrections is to be entered in

mm... [ENTR] mm with the correct sign.

[4]



The path difference between the optical target beam and the infrared beam is computed from the "offset" value and the zenith angle.

This difference arises when fixed reflectors, or ones tiltable only in the centre such as the GPH3, are used as targets and the surveying instrument is a T1010/1610 with Distomat attached.

[←] [→] [CONT] Choose the Distomat from the list.

For steep sights (zenith angle <30 gon), suitable tiltable reflector carriers must always be used (e.g. GPH1A) and aligned on the theodolite. The offset correction value is to be set to "NO". If "**offset**" is engaged, an error report will appear.

5. Without data recording

5.1 Angle and distance measurement

After you switch on the theodolite, it briefly displays the instrument type and software version. The instrument performs a self-test and on completion displays the values stored for mask 1. Set the units and decimal places for the data in accordance with section 4.4. To display the values for horizontal angle, distance, and vertical angle, set the following functions and parameters:

MENU 1 1	Hz_o.... ENTR	Set the target point, enter the angle value for the circle position, and confirm. A negative value produces a counterclockwise angle display.
MENU 1 6 1	ppm... ENTR	Calculate values according section 17, or
MENU 1 6 2	T ..... ENTR	take meteorological data, temperature and
	p ..... ENTR	pressure, to compute ppm in accordance with section 4.4.
	CONT	Enter and confirm.
MENU 4 4	← → CONT	Calls up distance measurement program (DIST, DI, DIL or GDIST) (see section 9.4.).
DSP 3 3	CONT	Calls up mask (e.g. 3) and sets variables.

```
*DEFINE*DSP3
>LINE1 >    PtNr
 LINE2 >    Hz
 LINE3 >    V
```

Point number, horizontal and vertical angles, and distance (refer also to section 4.3, example 2).

[DSP] [4]	[↑][↓][←][→]	Set sequence for mask.
	[CONT]	Confirm.
		Angle values are displayed continuously. The instrument does not need to be initialized.
[DIST]		Initiates a distance measurement.
		Correction values ppm and mm for distance are displayed during measurement.
		On completion of the measurement, the instrument displays the data, using the specified display mask. If distance measurement is not possible, because for example the signal is too weak, the instrument gives an error report after about 30 seconds.

5.2 Target-point coordinates and height

To compute target-point coordinates, a coordinate system must be transferred to the field. Input the parameters Hz_o,E_o,N_o,H_o,hi,hr for the instrument station. Set the coordinate variables E,N,H in the display mask

[MENU] [1] [1]	Hz_o.... [ENTR]	Perform circle orientation in accordance with section 5.1 .
[MENU] [1] [2]	E_o.... [ENTR]	Enter E_o coordinate (station east) and
	N_o..... [ENTR]	N_o coordinate (station north), and

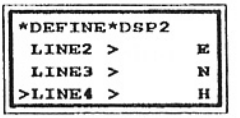
[CONT] confirm.

The coordinates may be entered with up to 5 digits before the decimal point and 3 decimal places. After the fifth digit has been entered, the system waits for the decimal point.

[MENU] [1] [3] H_o..... [ENTR] Enter station height (height of ground point)
hi..... [ENTR] and instrument height,
[CONT] and confirm.

[MENU] [1] [4] hr..... [ENTR] Enter reflector height.

[DSP] [3] [2]



To show the computed coordinates in the display, define any mask with the variables E, N and H, as in example 2 in section 4.3, and file it in the sequence of display masks.

5.3 Height tracking

Height tracking is the method for measurement indirectly to objects which cannot be equipped with a reflector, e.g. eaves, overhead cables etc.

[DSP] [3] Take the values for height (H) and height difference (ΔH) into a display mask, file the display mask in the list of masks, and activate the display in accordance with example 2 in section 4.3.

[MENU] [1] [3] H_o..... [ENTR] Enter station height (height of ground point)

hi..... ENTR and instrument height

CONT and confirm.

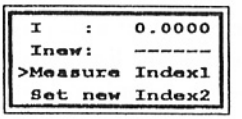
MENU 1 4 hr..... ENTR **Set reflector height to 0**

DIST Initiate length measurement to reflector vertically below or above the object, and point at the target. A change in the vertical angle causes a constant reassessment of the height ($H_o \neq 0$) and of the height difference to the target point in relation to datum (hi ≠ 0) or to the level of the tilting axis (hi = 0).

5.4 Vertical-index error

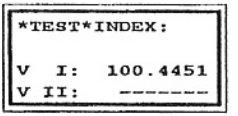
The vertical-index error is determined and stored before the instrument is delivered. This value is ensures an improvement to the vertical index whenever a vertical angle is measured. The corrected values are used for display, data storage and calculation. The vertical-index error should be inspected from time to time and redefined if necessary.

MENU 5 2 Displays present value



To inspect and redefine, call up measurement function for index correction.

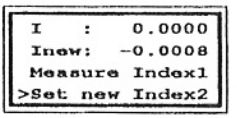
CONT Start measurement program.



Point at an easily-adjustable target mark about 100m away using both telescope faces. The measurements can be started with either face I or face II.

CONT

Store both measurements in the instrument.



The new value is computed and displayed.

CONT

Store the new value, or alternatively

ESC

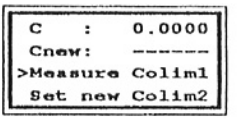
quit the function, in which event the previous value will be retained.

5.5 Collimation error

Before the instrument was delivered, the collimation error was determined and stored to ensure precise angle measurement even if only one telescope face is used. It is recommended that this stored value be inspected from time to time and, if necessary, redefined.

MENU 5 3

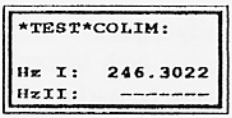
Displays the current value.



Call up the measurement function to inspect or update.

CONT

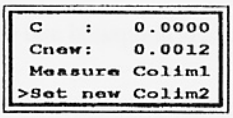
Start measurement program.



Using a near-horizontal trajectory, point to a clearly-visible mark about 100m away using both telescope faces. Either face I or face II can be used to start with.

CONT

Store both readings in the instrument.



The new value is computed and displayed.

CONT

Store the new value, or alternatively

ESC

quit the function, in which event the previous value will be retained.

6. With data recording

6.1 Plug-in REC module

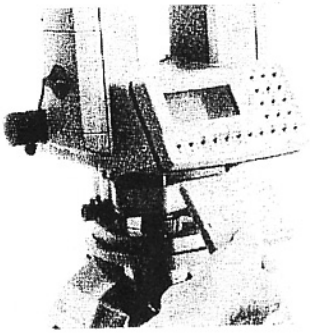


Fig. 6: Insertion of REC module in theodolite; to pull out press slightly forward.

Beneath the keyboard in face I is a slot accepting a GRM10 (64K) data-recording module. This system ensures that data and additional information are easily and reliably recorded. The maximum capacity in the standard format is about 2000 points. Provision is made in the module under file no. 1.

If data are to be recorded in other files (2-14), these files must be opened and dimensioned with their file number, using a GIF10 or a GIF12, before data is recorded. For more information about the GIF10/GIF12, please refer to the corresponding user manual.

MENU 3 3 ← → CONT Choose the storage unit MODUL

MENU 3 4

```
*REC*FILE:
>DATA:          1
 CORD:          2
```

i..... ENTR
j..... ENTR
CONT

File number (i) to store measurement data, and file number (j) for the CORD file, are then entered and confirmed.

Data can only be stored under DATA, and a file number must be assigned if the information is not to be stored in file no. 1 (standard value).

The number of the CORD file is only required in connection with the PROG functions, in order to read data (coordinates) from the file or to store manual input.

This file number is transferred to the PROG-functions. The file number assigned to CORD should differ from the one assigned to DATA. The CORD file must first be dimensioned as required, using a GIF 10 or a GIF 12.

6.2. GRE data terminal / GPC1 field computer

Because the theodolite, and the GRE or GPC1, have their own batteries, only the data cable between theodolite and GRE or GPC1 is required for data transfer. If desired, the theodolite and the GRE or GPC1 can be connected to a common external battery such as the GEB70, in which event a Y-cable must be used to link them for purposes of data transfer and power supply. When working with the various versions of the GRE, and with the GPC1, please follow the directions in the appropriate user manual.

[MENU] [3] [3] [←] [→] [CONT] Select the RS232 storage unit and the parameters for transferring data to the GRE4 or the GPC1. Set the corresponding interface parameters on the GRE4 or on the GPC1 (refer to the appropriate user manual). A GRE3 data terminal can be used, providing that the appropriate transfer parameters are set.

6.3. Recording a block of measurements

Before transferring the data to the recording unit, the elements to be used for recording must be defined in a recording mask. Up to 9 different masks can be defined in the theodolite and recalled individually.

[MENU] [3] [2] [1] ..... [9] Call the mask (1....9).

```
*DEFINE*REC 1:
 WI1      > PtNr
>WI2      > Hz
 WI3      > V
```

The point number **must be recorded in WI1** for each data record. The contents of WI1 are to be left unaltered. The remaining WIs(2...8) can be defined by elements.

[←] [→] [↑] [↓] Choose from the list the measurement elements for the line set. The lines must be sequentially by elements.

```
*DEFINE*REC 1:
 WI4      > REM1
>WI5      > ----
 WI6      > REM2
```

If an element is deleted from a line (----), data recording ceases before this element. Subsequent elements are no longer transferred to the recording unit.

[CONT] Terminates the function. In the recording of the data, the WIs are sorted in ascending order as far as the blank line (----) .

[MENU] [3] [1] [←] [→] [CONT] Choose one of the defined REC masks for data storage.

Only the keyboard of the theodolite is used to operate the theodolite, the Distomat and the recording unit. You can record a block of measurements in either of two ways.

[ALL] Initiates the distance measurement and records the data in the format of the recording mask being used.

If a distance cannot be measured, the measurement procedure is discontinued after about 30 seconds (ERROR 255) and the data is not recorded.

[REC] Recording in data terminal of data entered on REC mask.

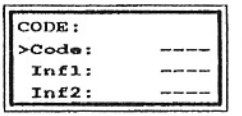
Note: If the variable for length measurement is entered on the recording mask and no length measurement was initiated before the data was recorded, a distance value of zero will be stored.

6.4 Recording a CODE block

Code blocks are used to record additional information for subsequent processing of the measurement data. They are recorded in

separate blocks and each consists of at least the CODE number, along with up to 7 freely-selectable units of additional information. Each of these units of information can contain up to 8 characters.

[CODE] Calls function.



Line-by-line input of code number and additional information, numerically or alphanumerically. Unlike with the data block, blank lines (----) between the information units in the code block are permitted. Only information-bearing elements are recorded.

[←][→][↑][↓] The last information to be entered and recorded can also be edited.

[←][→] The cursor appears in the line marked and can be positioned.

[↑][↓][CE][ENTR] Edits character at position of cursor, using alphabet and digits 0...9, or deletes character. After last alteration, confirm line by line.

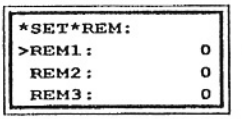
[REC] Records CODE information and quits function.

6.5 Input of REM word

REM words, like CODE words, serve as additional information for data processing, but they differ in being recorded along with the measurement data as **one united** data block. Up to three REM words can be added to a standard block consisting of point number,

horizontal and vertical angle, distance, and distance correction parameters.

[MENU] [1] [5] Calls function.



After the function is called, the latest information entered is displayed. The input can be either numeric or alphanumeric. The value "0" is to be entered for undefined REM words and is transferred during the data recording.

REM1.. [ENTR] Entering REM word 1,

REM2.. [ENTR] REM word 2, etc., overtypes the present contents.

[CONT] Quits the function. Data already entered can be changed by positioning the cursor and editing:

[←] [→] Positions the cursor.

[↑] [↓] [CE] Edits or deletes a character at the position of the cursor.

[ENTR] Confirms line by line.

[CONT] Quits function.

REM words taken into the mask are recorded unaltered along with each measurement block for as long as their content remains unchanged or until they are deleted from the recording mask.

6.6 Data display and editing

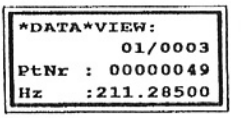
The display is used for inspecting data records stored in the REC module. Individual items of data cannot be manipulated, and data records

cannot be deleted. The contents of a file in the REC module can however be deleted. The file number is retained for subsequent recordings, and so re-initialization with a GIF10 or GIF12 is unnecessary. There is a choice of two formats for the display of data. The ALPHA format presents the recorded data in an easily-readable form with WI abbreviations in front, and is therefore recommended. The NUM format shows the data coded in GSI format.

MENU 2 4 ← → CONT Sets the format.

MENU 2 1 f..... ENTR After the file number (f) is entered there is no return to the measurement mode, and so

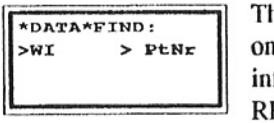
↑ ↓ CONT the editing functions VIEW and FIND can be called up directly.



With the function VIEW, the data are displayed, starting with the last recording.

← → Word-by-word display, forwards and backwards.

↑ ↓ Block-by-block display, forwards and backwards.

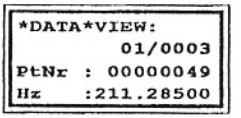


The function FIND permits a targeted search on the basis of point number, coding, code information Inf(1...8) and REM word REM(1...9).

← → CONT Selects and confirms search criterion.

XXXX.. ENTR Enters the word content and searches in the file named.

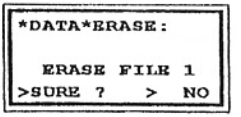
If the word is found, the cursor-control keys permit line-by-line or element-by-element display of data as with VIEW function.



The second line of the display indicates the file number and the block number.

[ESC] Quits function.

[MENU] [2] [5] f..... [ENTR] The content of a file (f) can be deleted from the REC module.



To prevent inadvertent deletion of a file, the number entered must be confirmed a second time with"YES".

[←] [→]

[CONT] Completely deletes contents of file.

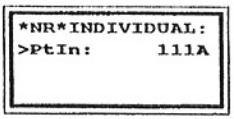
7. Input of point number

The parallel procedure possibilities for individual input, and the automatic generation, together ensure a convenient procedure for transferring point numbers to the data records.

7.1 INDIV

NR 1 Nr..... ENTR

Numeric or alphanumeric recall and input of an individual point number. When an individual point number is entered, the sequential number is suppressed for one data record.



The last point number entered can also be edited as a default value.

← → ↑ ↓ CE ENTR

Positions the cursor, pages in the character store, deletes at the cursor position, and confirms.

αNUM ↑ ↓

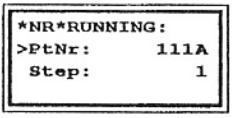
Enters letters: "A" flashes at the cursor position. Pages in steps through the letters of the alphabet.

ENTR

Transfers to the display.

7.2 RUNNING

[NR] [2] Recalls function.



No..... [ENTR] Enters starting point number and
Step... [ENTR] step.
[CONT] Transfers data and quits function.

Alphanumeric input for increment size is not possible. If you input an alphabetic character at the end of the starting number, the system counts to Z, then increments the adjacent character by one, and starts counting again with A.

Example: Starting value=202A, step=1

202A →202B....202Z →203A.... 203Z etc.

Example: Starting value=20JA, step=1

20JA →20JB.... 20JZ →20KA.... 20KZ etc.

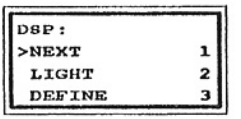
8. Display commands

Display commands control all parameters relevant to the display. They also control the lighting of the display and crosshair in selectable brightness steps.

8.1 NEXT

DSP

CONT



Switches to next display mask of four values as previously defined. If only one mask is defined, the instrument keeps displaying this.

8.2 LIGHT

DSP 2

Adjusts the brightness of display and crosshair in four steps.

← →

↑ ↓

The viewing angle can be adjusted to give the best contrast in the display, in accordance with the height of the instrument and the position of the observer.

← →

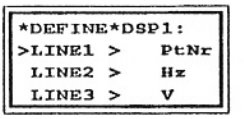
CONT

Quits function.

If the theodolite is switched off, the brightness setting has to be redefined, but the contrast setting is retained.

8.3 DEFINE

DSP 3 1 9



This function sets the content of the 4 lines for the display masks DSP(1...9) . Example 2 in section 4.3. details the possibilities.

8.4 ORDER

DSP 4

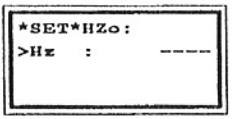
Defines the display sequence for the masks when the function "NEXT" is used (see section 4.3., page 13) .

9. Menu commands and functions

9.1 SET

The SET menu program is available for input of the station and target-point coordinates, REM words, and EDM correction values.

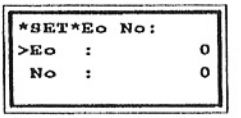
MENU 1 1 **Orientation of the horizontal circle Hz_o**



ENTR

See section 4.3., example 1

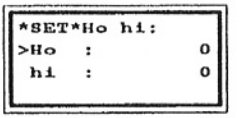
MENU 1 2 **Station coordinates E_o,N_o**



↑ ↓

See section 5.2.

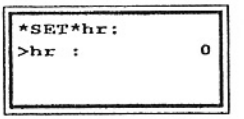
MENU 1 3 **Station height and instrument height H_o, hi**



↑ ↓

See section 5.2.

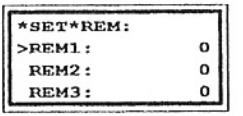
MENU 1 4 **Target height (reflector height) hr**



See section 5.2.

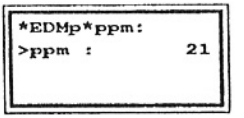
ENTR

MENU 1 5 **REM words**



See section 6.5.

MENU 1 6 1 ..... 3 **Setting distance parameters ppm and mm**

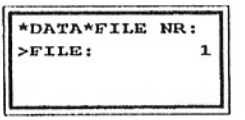


See section 4.4.

9.2 DATA

Data functions allow you to see recorded data. To ensure data security, you cannot alter or edit them.

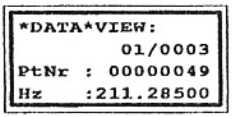
MENU 2 1 **To indicate the data file**



See section 6.1.

ENTR

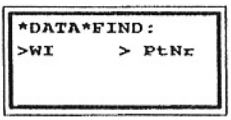
MENU 2 2 **To view data**



↑ ↓

See section 6.2.

MENU 2 3 **To search selectively for data**

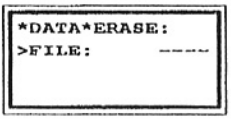


Data can be searched on the basis of these WI criteria: Point number, coding, code information (1...8) and REM words (1...9).

MENU 2 4 **Format for displaying the data**

See section 6.6.

MENU 2 5 **Deleting the contents of a file**

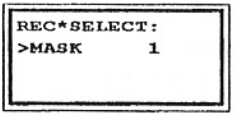


See section 6.6.

9.3 REC

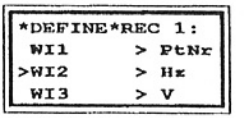
All parameters and settings relevant to the recording of data are together in the group of REC commands. The variables must be set appropriately before data recording commences.

MENU 3 1 **Setting the recording mask**

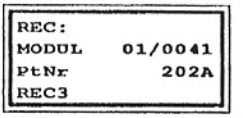


Selects, or redefines, one of the REC recording masks (1...9) for data storage. See section 6.3.

MENU 3 2 1 ..... 9 **Defining recording masks**

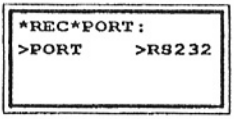


Line-by-line selection of WIs simplifies the use of logical abbreviations and symbols.



The content of the recording mask may differ from that of the display mask. During the recording of the data record, the number of the active recording mask can be superimposed to facilitate monitoring by the observer.

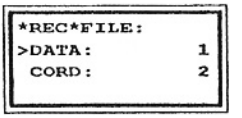
MENU 3 3 **Initiating data transfer**



See section 6.1.

MENU 3 4

Entering file numbers



See section 6.1.

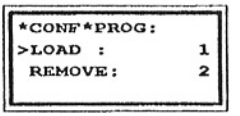
9.4 CONF

Within the group of configuration commands, the system parameters are matched as well as possible to the task required, and loadable programs are managed.

MENU 4 1

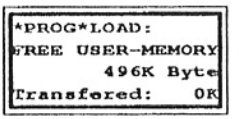
Loading programs

All standard programs specific to the particular model are already installed when the instruments are delivered.



CONT

Additional software can be read directly into the processor of the theodolite from an IBM-compatible computer. The programs are available on diskette.

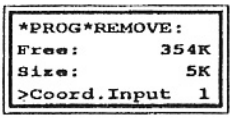


CONT

To begin, the LOAD function must be started on the theodolite. The transfer from computer to theodolite is ensured by the batch program supplied. During the transfer, the amount of data received is indicated in kilobytes. The parameters of the data communication must be set on theodolite and computer before transfer commences.

MENU 4 1 2

Deleting programs



↑ ↓

It is not normally necessary to remove programs from the program store. If however there is insufficient storage capacity to read in a program, programs can be deleted by entering their program numbers.

CONT ← → CONT

To avoid inadvertent deletion, the choice must be confirmed with "YES" a second time.

MENU 4 2 1 2

Loading and deleting code functions

The procedures are similar to those for loading and deleting programs. If a code function defined by a user is loaded, the code function of the system becomes inactive. After the code function entered by the user has been deleted from the program store, the system code function is reactivated.

MENU 4 3

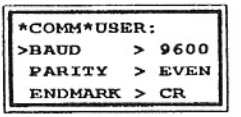
Setting the transfer parameters

The data traffic between theodolite and recording unit (e.g. GRE4) or computer is established through a data line.

The definitive settings for the transfer parameters are set out in the standard report form. This information enables data to be exchanged between theodolite and, for example, GRE4, without entering additional parameters.

MENU 4 3 2

Varying the transfer parameters



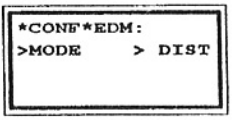
Deviating parameters can be established here. These parameters must be matched to the instruments which have been linked up.

↑ ↓ Selects the parameter line.

← → CONT Sets the parameters and confirms all changes.

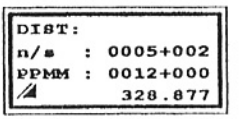
MENU 4 4

Selecting the distance measurement program



DIST	normal measurement (standard)
DI	rapid measurement
GDIST	precise measurement with DI2002
DIL	constant repetition of the measurement with averaging.

← → CONT Selects and confirms one of the above measurement programs.



In the DIL distance measurement program, the number of measurements is displayed and the standard deviation is computed continually. The mean value of the distance is used as the measurement value in the W131 variable (slope distance) after

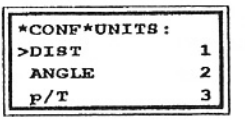
STOP has been used to interrupt the distance measurement.

CE Switches back to measurement mode.

After the theodolite has been switched off, the selected measurement program remains stored.

MENU 4 5

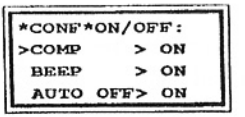
Establish measurement units



Enter the units to be used for measuring angles, distances, and meteorological data. At the same time you can enter the number of decimal places required for the display of data. This entry has no effect on the data to be stored in the recording unit, e.g. GRM10 or GRE4 (see section 4.4)

MENU 4 6

ON/OFF switch



The settings for the compensator, for the acoustic input signal and for automatic turning-off can be selected individually.

Do not switch off the pendulum alarm "**COMP**"; this is designed to warn you by an acoustic signal and an error report if the instrument is not properly levelled up.

The "**BEEP**" parameter switches the acoustic input signal on or off. Its setting does not influence the acoustic signal when error reports are transmitted.

The "**AUTO OFF**" function automatically switches the theodolite off if no functions are performed within a period of 10 minutes.

All settings are automatically switched to "**ON**" when the instrument is switched off.

9.5 TEST

The test functions serve for interrogations regarding instrument parameters and instrument status.

MENU 5 1

Battery inspection

The battery voltage is displayed (0-9V). An inadequate voltage during measurement is indicated by an acoustic signal and by the warning "**Battery low**". Under these circumstances, measurements cannot be performed and the instrument switches itself off. The internal temperature of the instrument is also displayed.

MENU 5 2

Vertical-index error

The stored vertical-index error is displayed in the units chosen. Adjust the error in accordance with section 5.4.

MENU 5 3

Collimation error

The stored collimation error is displayed as an angle value in the units chosen. Adjust the error in accordance with section 5.5.

MENU 5 4

Display test

The display test exhibits a changing, flashing checkerboard pattern. A second image indicates the functional fault which is to be corrected by the service workshop.

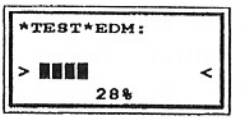
MENU 5 5

System test

The system test function is only for the service workshop and is of no direct benefit to the user.

MENU 5 6

EDM signal strength



The signal strength can be read from the display. This enables the infrared beam of the Distomat to be adjusted to the optical axis of the theodolite (T1010/1610). The adjustment is to be carried out in accordance with the user manual for Distomats, using the maximum signal strength.

MENU 5 7

Frequency test

The present fine frequency of the Distomat is indicated for the total stations TC1010/1610.

10. Direct-function keys

The concept of direct-function keys makes the instrument easier to work with and facilitates the input of parameters which frequently change.

10.1 ALL

ALL

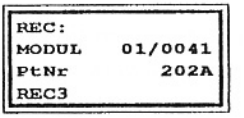
The ALL function continues the tried-and-proven Wild concept of simultaneous distance measurement and measurement-block recording. The data is only recorded if it was possible to complete the distance measurement successfully. You therefore have additional control over interrelated data. While the data is being recorded, the display shows the file number, the data record number, the point number, and the recording mask in use.

10.2 DIST and REC

DIST

The DIST function enables distances and angles to be measured separately for eccentric applications. The distance must always be measured before the angle (e.g. determination of the position of corners of buildings).

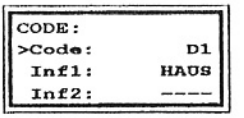
REC



During recording, file numbers, data record numbers and point numbers are displayed along with the current recording mask.

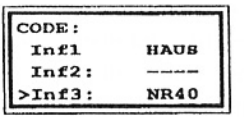
10.3 CODE and REC

CODE



The CODE function enables any additional information necessary for automatic data evaluation (e.g. WILDsoft) to be linked to the measurement. The CODE function permits numeric and alphanumeric inputs as required. To store this information, assign a value to at least the code number. The remaining variables may be filled as required or can remain unoccupied.

REC



Only elements with a defined content are stored. An "empty element" is denoted by ----. The WI number is used for filing.

10.4 Display functions

DSP

The function request assigns the group of display commands to a separate menu tree. Section 8 shows all possibilities in detail and indicates the individual functions for displaying the data and the results of the computations. The system also governs the lighting, and the contrast of the display.

10.5 REC

[REC] This function serves to transfer data from the theodolite, through the addressed interface, to the recording unit. Also, it advances the running point number (see section 7.2) by one step after a block has been recorded.

10.6 NR

[NR] Input of an individual or running point number and of the step in accordance with section 7.

10.7 REP

[REP]

```
REP:
>DIST        1
 REC         2
 ALL         3
```

After the function request, select from the menu the function required.

[DIST] Calls up the tracking function of the Distomat.

[REC] Repeats the recording of a block of measurements with the point number of the previous recording.

[ALL] Repeat measurement, and recording of data with unchanged point number.

10.8 STOP

STOP

Interrupts distance measurement in the measurement programs DIL and REP DIST.

10.9 ON/OFF

ON OFF

Switches theodolite on or off. The instruments have an "AUTO OFF" function which switches them off automatically, about 10 minutes after they were last used. Because of the absolute angle-scanning, the angle values are retained and are available when the instrument is switched on again. Initialization is not required.

11. Accessories

A wide choice of accessories is available for theodolites and total stations. Please consult your local Leica agent.

11.1 GIF10/12 data reader

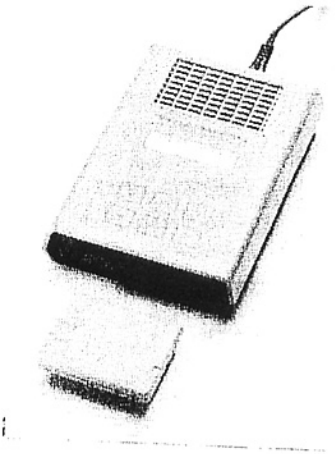


Fig. 7: WILD GIF10 REC module reader

Data readers for the GRM10 REC module for two-way data transfer can be connected to an IBM-compatible computer in accordance with the computer interface.

The GIF10 has a serial interface and can be used to copy data on to another REC module, even without a power or computer connection, or for direct linkage, for example to a printer with serial connection.

The GIF12, with its parallel ports, is only suitable for direct connection to the corresponding port of a computer.

11.2. Battery charging

Use a battery charger in a dry room only, never outdoors. Charge batteries only at an ambient temperature between 10°C and 30°C (50°F to 86°F).
The GKL12 charger is suitable for charging the theodolite's battery insert and the GEB70 compact battery. For the GEB71 universal battery, use a GKL14 charger.
Before you use new batteries for the first time, charge them for 20 to 24 hours. This also applies to batteries that have not been used for several months. NiCd batteries reach full capacity after two or three normal cycles each of a 14-hour charge followed by a full discharge. If battery performance drops noticeably, run one or two full cycles, i.e. charge for 14 hours and allow to discharge until the instrument automatically switches off and displays "Battery low".
Leave flat batteries to charge for fourteen hours. If you do not know a battery's state of charge, also leave it to charge for fourteen hours.
Set the battery charger's voltage selector to your AC mains voltage, 115 V or 230 V. Plug in the charger to the mains. The green indicator lamp should light. If it does not light, there is a power cut or the mains cable or charger is faulty.
Connect the battery to the charger. The red charging indicator should light. If it does not, the battery is not charging, i.e. the battery cable is faulty or the battery fuse has blown and should be replaced. On the GKL12, you may not have started the timer or it may have stopped at the end of the charging period.

11.3. Reflectors

The GPH1 reflector is recommended for use with the TC 1010/1610. For the model which is of modular design and has an attachable Distomat, choose the prism in accordance with the Distomat. The accessories brochure indicates the combination possibilities. Existing circular prisms from WILD can be used with the new instrument. Their additive constant does not need to be rechecked.

12. Inspecting and adjusting

12.1 Tripod

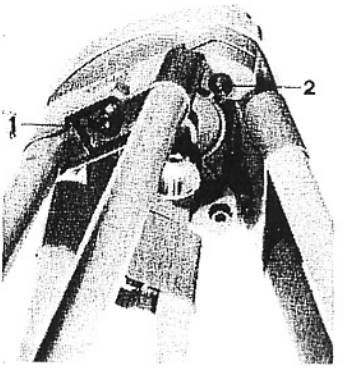


Fig. 8: Tripod GTS20

Metal and wooden tripod legs must always be securely fastened. If necessary, apply moderate torque to the hollow screws (1).Use the same key to adjust the joints on the head of the tripod (2). These joints should be tight enough for the legs of the tripod to remain splayed when the tripod is lifted from the ground.

12.2 Plate level

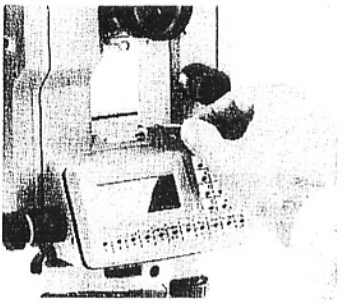


Fig. 9: Adjustment of plate level

When the instrument is level, the bubble must remain stationary in the centre of the divisions. If the play is more than one interval, correct it by adjusting the setscrew, using the key provided.

12.3 Circular level on tribrach

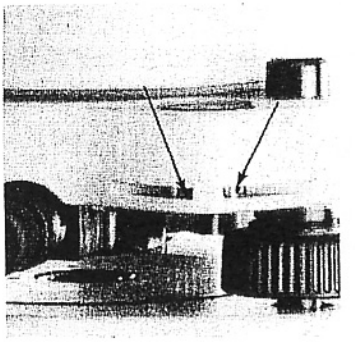


Fig. 10: Adjustment of circular bubble in tribrach

Level up the instrument and remove it from the tribrach. If the bubble is outside the setting circle, correct it with the two cross-headed screws, using the key.

12.4 Collimation error

The line of sight is factory-adjusted. The residual error is determined using the procedure in section 5.5 and is incorporated into the computation for each reading.

If the error exceeds 30", the instrument should be adjusted by your Leica workshop.

You can however carry out the adjustment yourself, using the following procedure:

- Using face I, point at a clearly-defined target.
- Set horizontal circle to 0.
- Set collimation error (with correct sign), using the lateral fine drive.
- If the vertical hair is left of the target, slightly loosen the adjustment screw on the

left and adjust to the right.
- Inspect the result.
- Correct in steps until the vertical hair
- corresponds with the target mark.
- Redetermine the residual error as indicated in section 5.5.
- Readjust the Distomat.

This adjustment procedure is only reliable for theodolites (T1010/1610). For total stations, the correction must by made by your Leica workshop, because otherwise the optical and electronic lines of sight will no longer be coaxial.

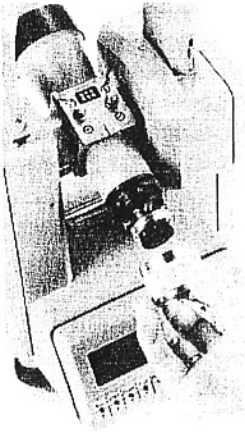


Fig. 11: Adjustment of horizontal collimation error

12.5 Optical plummet

Inspect the optical plummet of the tribrach at regular intervals. Any deviation of its line of sight from the vertical axis will result in a centring error.

Testing with plumb-bob: Mount the instrument on the tripod and level it up, turning the bayonet ring of the plumb-bob to

various positions in order to determine its eccentricity. Then note the ground mark. After removal of the plumb-bob, the crosshair of the optical plummet must coincide with the ground mark. The attainable accuracy is about 1mm.

Testing by rotation of the tribrach: Use the plate level to adjust the instrument, and record the ground mark. Use a sharp pencil to mark the outline of the tribrach base plate on the tripod head, then turn the tribrach by 120°, match it exactly to the outline, and mark the plumbing point. Repeat the procedure for the third position. If the three points do not coincide, adjust the crosshair to the centroid of the triangle.

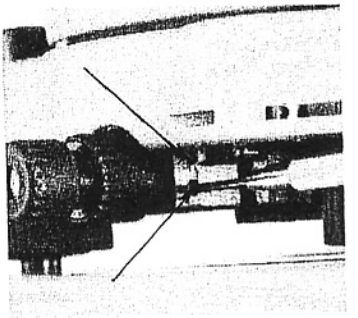


Fig. 12 Adjustment of optical plummet

Adjusting: Using the screwdriver to progressively displace the two screws. Move the crosshair in steps to coincide with the ground point.

13. Care and storage

Transport: Shockproof packing is required for transporting the instrument by land, sea or air. If possible, use the original Leica packaging.

Cleaning and drying: Before cleaning, blow off the dust from lenses and prisms. Treat the objective, the eyepiece and the prisms with particular care. Do not touch the glass with the fingers. To clean the glass, use a clean soft cloth, if necessary damped slightly with alcohol. Do not use any other fluids; they may attack synthetic components.

Cables and plugs: Keep plugs clean, and protect them from dampness. If the plugs on connecting cables do get dirty, clean them with pure alcohol and then dry them thoroughly.

Fogged prisms: The reflectors will become fogged if they are colder than the ambient temperature. It is not enough to wipe them; they must be warmed up to the ambient temperature by placing them for a time in the vehicle or beneath a jacket.

Storage: Unpack damp instruments. Dry out and clean the instrument, the transport case, the foam inserts, and the accessories. Do not repack until everything is perfectly dry.

14. Important notes

Never point the telescope directly at the sun, or the diodes of the Distomat may be damaged. This applies to the modular models T1010/1610 with attached Distomat, and to integrated instruments.

If the solar radiation is intense, shield the instrument with a sunshade. If it becomes too hot, the emitter diode will be less effective and the range of the Distomat will be reduced.

For best reception conditions over long distances, the reflectors should be protected from strong sunlight.

Only one reflector should be visible in the field of view of the telescope. If several reflectors are in the measurement beam, a blend of signals may cause errors in measurement.

Certain radio transmitters (walkie-talkies) can cause distance-measurement errors if their speaking key is pressed in the immediate vicinity of the instrument. It is advisable to try out the transmitters and, if necessary, to avoid using them while a distance is being measured.

Protect the REC module from direct sunlight. The maximum permissible temperature is +70°C

15. Reports and errors

The instruments have a fault-finding system which provides additional information enabling error reports to be grouped. The errors are classified as follows:

General errors	01-19
Transfer errors in GSI	20-29
Transfer errors in EDM	30-39
Instrument-specific errors	40-59
Word-index errors	60-69
Recording errors with REC module	70-79
System errors	90-99

Error report	Cause	Remedy
03: Invalid Value	Value entered is not valid.	Enter new value.
12: Battery Empty	Battery capacity too low.	Change battery.
14: Invalid command	Command not known, or not permitted during current operation.	Quit with STOP, and enter correct command.
16: Program Error	External influences have caused memory error in program.	Delete program and reload.
17: Setup Incomplete	System has lost SETUP variable.	Restart SETUP and check all parameters under MENU and DSP.
18: Memory Size	The system has insufficient memory.	CE

Error report	Cause	Remedy
19: Temperature	The internal temperature of the instrument is too high or too low.	Cool or warm the instrument.
21: Parity Error	Parity error at GSI interface.	Inspect interface parameters and cable.
22: RS232 Time Out	System receives no reaction at interface.	Inspect cable.
24: RS232 Overflow	Data transmitted too quickly.	Repeat with lower baud rate.
25: Wrong End-mark	Character string received does not correspond with defined communication.	Inspect communication parameters.
31: EDM Parity Error	Parity error at interface.	Inspect parameters.
36: EDM Overflow	Data received is transmitted too quickly.	Repeat with lower baud rate.
39: EDM Time-out	System receives no reaction at interface.	Inspect connection to Distomat.
41: EDM (ppm/mm/unit)	EDM parameters ppm, mm, unit, are set wrongly.	Set ppm and mm in Distomat to 0 and set unit to m.
44: Value > 1gon	Measured V-index or Hz-collimation error >1 gon.	Repeat determination, adjust reticle, or arrange for service

Error report	Cause	Remedy
48: Code Overwrite	A CODE function is already loaded in system.	Delete CODE function.
50: Angle Error	Measurement error in angle scanning.	Service.
58: Tilt	Pendulum is outside range of measurement.	Level up theodolite.
60: WI is not set	WI is not set in REC mask.	Change REC mask.
61: Too many WIs	Maximum number of WIs (8) already entered.	Change REC mask.
62: WI invalid	WI selected cannot be set.	Correct entry.
65: WI Not available	Data not available.	Measure corresponding data.
70: No Data	Information required is not in data for point number given.(File empty or does not contain GSI data).	Complete information.
71: Data Not Found	Data or WI number being sought could not be found in file.	CE
74: File Full	Memory is full. Last data record was not stored.	Change recording unit.

Error report	Cause	Remedy
76: Module error	Communication with REC module is disturbed, or file does not exist.	Clean contacts or change REC module.
77: Invalid Data	Wrong data format for transfer to REC module.	CE
78: No PtNo or Code	Point number or code number is lacking in recording.	Change recording mask or enter CODE number.
79: No REC Module	REC module is missing.	Insert REC module.
82: Out of Range	Data cannot be shown in display, or computation cannot be carried out.	CE
90: Hardware Error	An instrument component is defective.	Service.
94: Backup Battery	Voltage of back-up battery is too low.	Service.
97: Initialization	System is not initialized, or has lost constants for system.	Service.

Warning	Cause	Remedy
09: PtNo Overflow	Overflow of point numbers.	Inspect point numbers.
12: Battery Low	Battery is nearly flat (Level 0).	Change battery.
74: Near Full	Memory is almost full. 10 more standard measurement blocks can be recorded.	Change file number or REC module.

Interface Warning	Cause	Remedy
x00:	System is in active mode and so cannot serve interface.	Wait for activity, or de-activate with ESC.
x27:	GSI command is not recognized.	Eliminate error in interface program.

Note: x stands for instrument identification

16. Technical data

T/C1010		T/C1610
	Angle measurement continuous, with absolute encoders	
	Update time 0.1 to 0.3 seconds	
	Units 400 gon, 360°decimal, 360°sexagesimal, 6400mil	
10cc,1",0.001°, 0.001mil	**Angle display** selectable	1cc,1",0.0001°, 0.001mil
Hz: 1 mgon (3") V : 1 mgon (3")	**Standard deviation** in accordance with DIN 18723	Hz: 0,5mgon (1.5") V : 0,5mgon (1.5")
	Automatic vertical index Pendulum compensator Centring range: ±0.1gon Centring accuracy: ±0.3mgon	
	Sensitivity of level Circular level: 8'/2mm Plate level: 30"/2mm	
	Telescope Magnification 30X Free objective diameter:42mm Shortest sighting distance: 1.7m; Field of view: 27m/km Focusing: coarse/fine fully transitable	
196 mm	Hight of tilting axis above tribrach plate	196 mm

T/C1010		T/C1610
	Optical plummet In tribrach, focusable, magnification 2x	
	Range of tilt TC-models fully transiting	
Telescope face I	**Display** 4 lines of 16 characters	Telescope faces I and II
Telescope face I	**Keyboard** Weatherproof, 23 keys with multiple functions. Numeric and alphanumeric input, input pressure 30g	Telescope faces I and II
	Distance measurement T-models with Distomat attached	
Range: 2000m ±(3mm+2ppm)	TC-models with coaxial telescope for angle and distance measurement, measurement frequency 50MHz=3m, carrier wave 0.850 υm, infrared, consumption approx. 0.4A	Range: 2500m ±(2mm+2ppm)
	Data recording Plug-in CMOS recording module with 64K for about 2000 standard data blocks	

T/C1010		T/C1610
	Power supply 12V DC, through internal 0.45 Ah battery, or external source, consumption (without lighting) about 0.06A **Weights** T-models about 4500g TC-models about 5500g (without battery or tribrach) **Temperature range** Measurement: -20°C to +50°C Storage: -40°C to +70°C	

Operating life of rechargeable batteries

	Plug-in battery GEB77	Small battery GEB70	Large battery GEB71
T1010/1610	about 9 h	about 35 h	about 120 h
T1010/1610 with Distomat or TC1010/1610	about 250 measurements	about 1000 measurements	about 3500 measurements
Capacity Weight	0.45 Ah 0.2 kg	2.0 Ah 0.9 kg	7.0 Ah 3.0 kg

Range of TC1010/1610

Circular prisms	Atmospheric conditions poor[1]	medium[2]	excellent[3]
1	1.0/1.2 km	2.0/2.5 km	2.5/3.5 km
3	1.2/1.5 km	2.8/3.5 km	3.5/5.0 km
7	1.3/1.7 km	3.5/4.5 km	4.5/6.0 km
11	1.4/1.8 km	4.05.0 km	5.5/7.0 km

[1] strong haze, visibility about 3 km; or bright sunlight, severe heat shimmer

[2] light haze, visibility about 15 km; or moderate sunlight, light heat shimmer

[3] overcast, no haze, visibility about 30 km; no heat shimmer.

17. Scale correction

By entering a scale correction in ppm, distance-related reductions such as atmospheric correction, reduction to datum, and projection distortion can be taken into account. To enter a value in ppm which accommodates other factors as well as the meterorological corrections, the following procedure is suggested:

- Compute the meteorological correction in the theodolite by entering p/T
- Determine additional values from the formulae in 17.2 and 17.3 or from tables
- Add the individual values, taking account of the correct sign, and enter as a value in ppm
- The data for p/T are then automatically deleted in the theodolite.

17.1 Atmospheric correction

The distance displayed is only correct if the scale correction which has been entered corresponds to the prevailing atmospheric conditions. Section 4 details the input of meteorological data and indicates its units.
Taking into account the variables p = atmospheric pressure
and t = temperature,

the correction is calculated using the following formula:

$$d1 = 281.8 - \frac{0.29065p}{1+0.00366t}$$

If the atmospheric correction is measured with a precision of 1ppm, the air temperature must be measured to 1° centigrade and the atmospheric pressure to 3 millibars.

17.2 Reduction to height datum

The reduction of the distances to a certain level, generally sea level, is carried out with the variables H = height of Distomat
H_o = reduction datum
R = radius of the earth (6378 km)

in accordance with the formula:

$$d2 = -\frac{(H-Ho)}{R} * 10^3$$

The resulting linear reduction is 15.7 ppm per 100m height difference between the Distomat and the measuring level. The reduction value will generally be negative, but the correct sign must be observed, particularly in connection with reductions to mean level (Ho / sea level).

17.3 Correction for projection-scale factor

The magnitude and sign of the correction depend on the regional projection standards. The values are to be taken from the Survey Department. For cylindrical projections (e.g. Gauss-Krüger, UTM), which are frequently used, the correction can be computed with the following formula:

$$d3 = (mo - 1 + \frac{X^2}{2R^2}) * 10^6$$

using the variables: X = distance from the projection line
m_o = scale factor (generally 1.0000)
R = radius of the earth (6378 km)

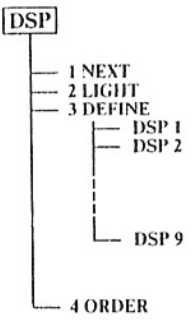
18. Appendix

Wordidentification (WI)

WI	Data word	Content	REC DSP	WI	Data word	Content	REC DSP
11	PtNr	Point No	RD	58	mm	Additive constant	RD
12	Fnr	Instrument No	R	59	ppm	Scale factor	RD
13	Typ	Instrument type	R	71	REM1	Remark 1	RD
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
21	Hz	Hz-angle	RD	79	REM9	Remark 9	RD
22	V	V-angle	RD	81	E	East coordinate	RD
31	◿	Slope distance	RD	82	N	North coordinate	RD
32	◿	Horizontal distance	RD	83	H	Height	RD
33	◿	Height difference	RD	84	Eo	Station east	RD
41	Code	Code number	D	85	No	Station north	RD
42	Inf1	Information 1	D	86	Ho	Station height	RD
⋮	⋮	⋮	⋮	87	hr	Height of reflector	RD
49	Inf8	Information 8	D	88	hi	Height of instrument	RD
51	PPMM	ppm/mm	RD				
52	n/δ	Number/Mean	RD				

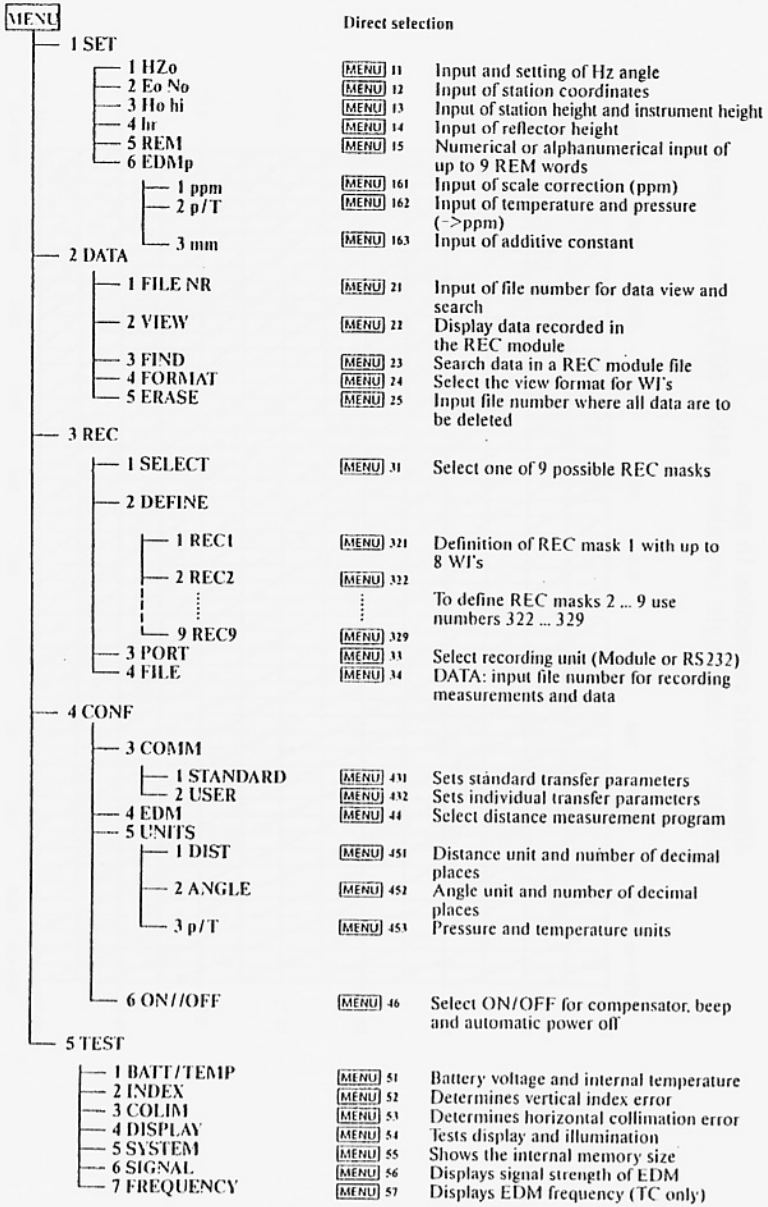
R = WI can be set in the REC mask
D = WI can be set in th display mask

Menustuctur of the DSP- and MENU- key

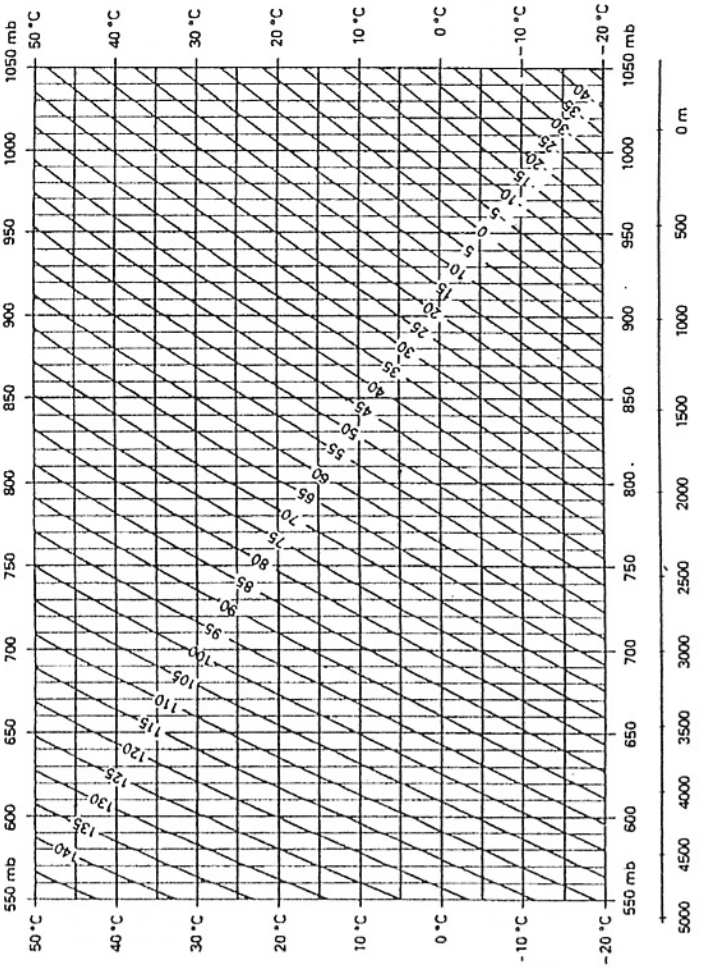


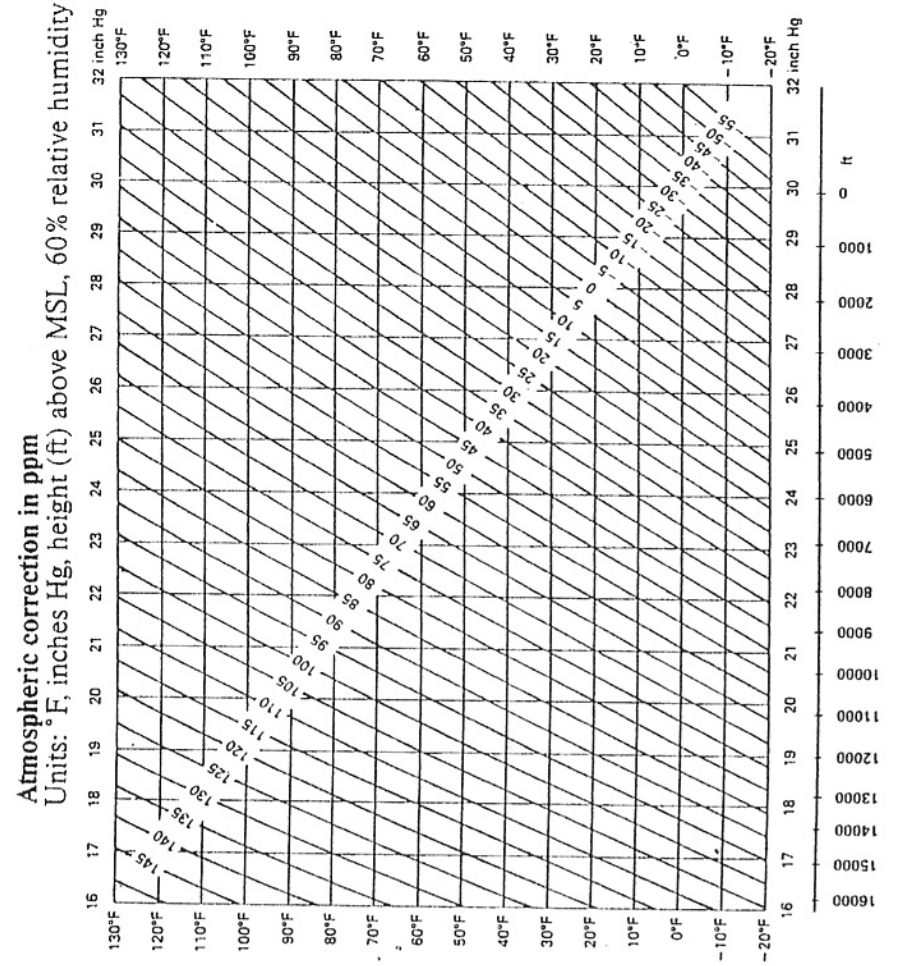
Direct selection

DSP 1	Select next display mask
DSP 2	Choose display illumination and contrast
DSP 31	Definition of first display mask
DSP 32	Select WI's for the four display lines of each display mask
⋮	To define display masks 2 ... 9 use numbers 32 ... 39
DSP 39	
DSP 4	Set order of display masks which should be displayed one after another using the NEXT function


MENU
Direct selection
1 SET
1 HZo
2 Eo No
3 Ho hi
4 hr
5 REM
6 EDMp
1 ppm
2 p/T
3 mm
2 DATA
1 FILE NR
2 VIEW
3 FIND
4 FORMAT
5 ERASE
3 REC
1 SELECT
2 DEFINE
1 REC1
2 REC2
9 REC9
3 PORT
4 FILE
4 CONF
3 COMM
1 STANDARD
2 USER
4 EDM
5 UNITS
1 DIST
2 ANGLE
3 p/T
6 ON//OFF
5 TEST
1 BATT/TEMP
2 INDEX
3 COLIM
4 DISPLAY
5 SYSTEM
6 SIGNAL
7 FREQUENCY
MENU 11 Input and setting of Hz angle
MENU 12 Input of station coordinates
MENU 13 Input of station height and instrument height
MENU 14 Input of reflector height
MENU 15 Numerical or alphanumerical input of up to 9 REM words
MENU 161 Input of scale correction (ppm)
MENU 162 Input of temperature and pressure (->ppm)
MENU 163 Input of additive constant
MENU 21 Input of file number for data view and search
MENU 22 Display data recorded in the REC module
MENU 23 Search data in a REC module file
MENU 24 Select the view format for WI's
MENU 25 Input file number where all data are to be deleted
MENU 31 Select one of 9 possible REC masks
MENU 321 Definition of REC mask 1 with up to 8 WI's
MENU 322
To define REC masks 2 ... 9 use numbers 322 ... 329
MENU 329
MENU 33 Select recording unit (Module or RS232)
MENU 34 DATA: input file number for recording measurements and data
MENU 431 Sets standard transfer parameters
MENU 432 Sets individual transfer parameters
MENU 44 Select distance measurement program
MENU 451 Distance unit and number of decimal places
MENU 452 Angle unit and number of decimal places
MENU 453 Pressure and temperature units
MENU 46 Select ON/OFF for compensator, beep and automatic power off
MENU 51 Battery voltage and internal temperature
MENU 52 Determines vertical index error
MENU 53 Determines horizontal collimation error
MENU 54 Tests display and illumination
MENU 55 Shows the internal memory size
MENU 56 Displays signal strength of EDM
MENU 57 Displays EDM frequency (TC only)

Atmospheric correction in ppm
Units: °C, mb, height (m) above MSL, 60% relative humidity




Atmospheric correction in ppm
Units: °F, inches Hg, height (ft) above MSL, 60 % relative humidity
32 inch Hg
ft

19. Software version 1.4

In response to many customer requests, changes and improvements have been introduced in the software version 1.4.

19.1. Pressure unit "inch Hg"

[MENU] [4] [5] [3]

Calls function.

The unit "inHg" has been added to the existing list of parameters.

[MENU] [1] [6] [2]

Calls the distance-related atmospheric correction.

The pressure can now be entered in 1/10 units.

19.2. Sexagesimal display

In the angle (up to 360°) in the sexagesimal display, not only the degrees and minutes are seperated by a point, but also the minutes and seconds. This prevents confusion between the 360° display and the 400gon display.

19.3. Calculation of coordinates

In all WILD theodolites and total stations, the current Hz angle has so far always been used for calculating the coordinates, irrespective of the telescope face. This means that if the circle is aligned in face 1, the measurements must also be carried out in face 1 to obtain the correct coordinates of the target points. With measurements in face 2, the coordinates of a point are calculated in the opposite sense to the line of sight.
This has been changed in software version 1.4 so that the target point coordinates are correctly calculated in both faces instead of merely in the face which was used for aligning the circle.

19.4. Distomat with laser pointer

MENU 4 4

```
*CONF*EDM:
>MODE     > DIST
 POWER    > AUTO
```

Selects the distance measurement program (see page 43).

POWER > AUTO :
The functionality of Distomats on electronic theodolites continues normally.

```
*CONF*EDM:
 MODE     > DIST
>POWER    > ON
```

POWER > ON :
Current is supplied to the distance adapter as soon as the theodolite is switched on, i.e. Distomats are no longer switched off automatically after a distance has been measured, but are switched to standby mode.

This makes it easier to mesure with the DIOR3002S attached, because the laser pointer of the DIOR remains constantly active after it has been switched on.

19.5. ALL key

If the instrument is moved after operating the ALL key, the distance and angle will not be recorded. This avoids incorrect distances and angles being recorded. In these cases a warning or error message "Error: 7; Not recorded" will be displayed.

PROGRAMS

User Manual

Leica AG, CH-9435 Heerbrugg (Switzerland)
Telephone +41 71 70 31 31, Fax +41 71 72 15 06

Leica

Contents

1. Introduction

The T/TC 1010/1610 electronic theodolites and total stations are equipped with programs for processing data. The systems are therefore highly functional and survey tasks are simplified appreciably. The use of a REC module for storing coordinates ensures that wrong entries are largely avoided. The module can be supplied with data through a computer; this is a convenient and reliable way of working.

The following programs are available for use with the T/TC 1010/1610:

- Input of coordinates
- Setting station coordinates
- Orientation of horizontal circle
- Height transfer
- Tie distance
- Setting-out
- Intelligent free-station survey (T/TC 1610 only)
- Resection (T/TC 1010 only)

The menu technique makes the system easier to use. A large memory (512Kbyte) ensures access to all programs which can at present be delivered and installed.

Additional software is available on conventional 5 1/4" diskettes. The user can upload it into the theodolite personally, using an IBM-compatible computer and the interface cable (stock no. 563 625). The transfer program for the computer is supplied with each program.

Proceed as follows:

- Switch off the computer and the theodolite
- Use the data cable to connect the computer to the theodolite, and then switch on

[MENU] [4] [1] [CONT] - Start the load function in the theodolite

- Start the batch program (PROG) in the computer

- PROG *Name.prg* ENTER

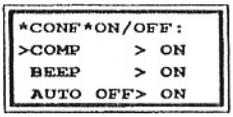
The program is uploaded into the theodolite, using the next free number. As a precautionary measure, the size of the program transferred is displayed in Kbyte.

In future, it will be possible to accomodate market-specific demands made on the program, and also user-specific modification requirements. Only alterations and new developments emanating from LEICA AG may be introduced. The user cannot freely program the theodolite.

2. Using the program

All program sequences are based on a unified structure. This ensures that the system is easy to learn and to use. The user can adapt program-specific parameters to changed circumstances. The possibilities are described in the directions for the various programs. The changes required can be set during the configuration, although in general the programs in the standard configuration already contain appropriate settings and default values.

MENU 4 6



Before starting up the program, deactivate the AUTO-OFF function of the theodolite, because when the theodolite switches off automatically the measurements made during the program sequence are lost and the program has to be restarted.

2.1. Preliminary remarks

The programs require a REC module for data storage. Before the program is started up, all files (1-14) to be used during the program run must be created with the GIF 10 or GIF12 data reader. Where appropriate, the coordinates of the fixed points must be transferred to a file in the REC module, and this file is to be defined as a CORD file by means of its number.

The following theodolite settings are incorporated into the program flow:

- Number of DATA file
- Number of CORD file
- Station parameters E_o,N_o,H_o,hi,hr,Hz_o
- Distance correction parameters ppm,mm
- Running point numbers and increment sizes PtNr, increment

If you need these values for a selected program, inspect them **before** starting up the program, and correct them if necessary before entering them in the instrument.

During the program flow, new values can be assigned, by means of input or computation, to the parameters indicated above. The computed or input values are then assigned to these parameters when using the normal measuring mode, outside the program.

The arrangement of CORD and DATA files can be defined by the user as required.

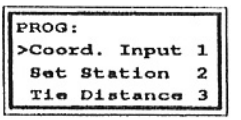
The CORD file serves as a memory for coordinates. Only the coordinates required for the program can be read out, on the basis of their point numbers. Alternatively, **manually**-entered coordinates can be stored by means of the theodolite keyboard.

All measurements, and the results of all computations, including coordinates computed from measuring elements, can be stored in the DATA file if required.

If coordinates computed by programs and stored in a DATA file are required later, this file is to be temporarily defined as a CORD file during the program run.

2.2. Program start

PROG — Calling up the program library



Either start up the program directly, using the program number given at the end of the line,

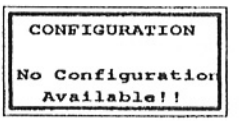
or

↑ ↓ CONT — select with the cursor and confirm.

The start menu specific to the program appears in the display for about two seconds, during which time the configuration menu can be called.

DSP — Switches to the configuration mode and enables you to set parameters for the program procedure required.

CONT — Skips the configuration menu. The program is started immediately, using the parameters from the last valid configuration.



If the program cannot be configurated, the display looks like this.

CONT — Confirms, and continues the program run.

2.3. General program operations

Only a few keys are active when the programs are being used. Their functions are described below.

CONT — Continues the program run after input, measurement, interludes for displaying results, etc. The further run of the program along permitted branches is marked by the cursor position.

↑ ↓ CONT — The branch along which the program should continue is selected by displacing the cursor and confirming.

CE — Erases messages and defective entries, or jumps a step backwards in the program run.

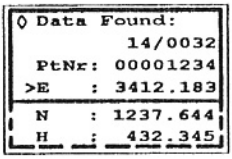
REC — Records measurements or the results of calculations after the program is stopped, and then continues,

or

records manually-entered coordinates in a predetermined recording format.

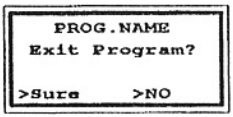
ALL — Triggers a distance measurement while recording all measured values in the DATA file in accordance with the recording mask defined, and then continues with the program run.

REP — Searches in the CORD file for coordinates having the same point number, if this is permitted in the configuration by REP-Find: 'YES'.



If the search is permitted, the coordinates found are displayed and you can repeat the command and search for additional coordinates, or can confirm acceptance of the existing ones.

ESC



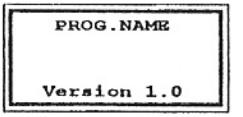
Quits program

← → CONT

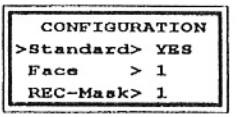
Returns to measuring mode by selecting and confirming 'YES'.

3. Configuration

DSP



The configuration menu can be called during the two-second start display.



In the setting 'YES' the standard parameters for the program sequence are used.

↑ ↓ These standard parameters can be viewed, but not altered, using the cursor.

← → CONT 'NO' sets the parameter values which you last entered and thus enables the system to be configurated in accordance with the task and without having to reconfigurate before each program run. Changes may only be made with the cursor keys in selection mode. During configuration, the numerical keyboard is not active for input (REC mask, DSP mask).

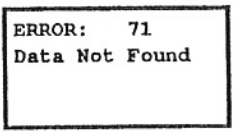
When configurating, make sure that the correct mask is set for recording the measurement data.

The measurements are displayed in accordance with the DSP mask selected.

The function REP-Find enables identical point numbers to be searched for within the selected CORD file. The file is always searched from the beginning to the end, and the coordinates found are displayed.

CONT Use this to continue with the program, or

[REP] Use this to search with the same point number.



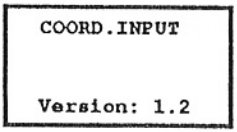
If no further data can be located under the point number given, the end of the data file is indicated by an error report.

[CE]

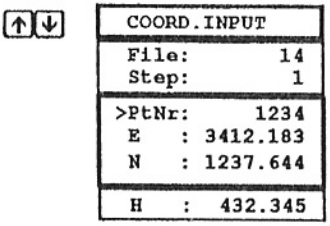
The program can then be continued, either by entering a new point number, or by entering coordinates manually.

4. Input of coordinates

Configuration is not permitted during coordinate input. The CORD file, the increment size for automatically generating the point number, and the running point number, are taken from the theodolite settings.



Start display



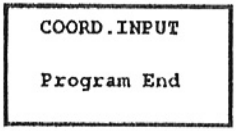
If necessary, use the cursor to select and alter the positions File and Step.

Enter the coordinates in this sequence: point number, easting, northing and (optionally) height.

REC Records the input in the CORD file, using a fixed REC mask, and continues the program run when the next data set is entered

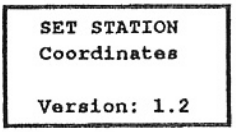
or

CE terminates the program.

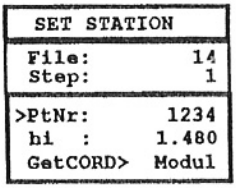


The theodolite is set to measuring mode by means of the function CE or ESC.

5. Setting station coordinates

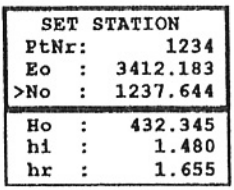


No Configuration is possible with this program. Instrument- and reflector heights are taken from the **theodolite,** even when hi and hr are already stored in the data set of the REC module.



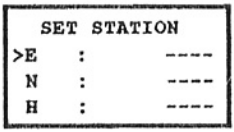
The CORD file of the REC module is searched for coordinates in accordance with their point number.

REP The function REP-Find is still active and so the search for identical point numbers can be resumed.



The coordinates of points having the same point number continue to be displayed until no further coordinates are found under that number.

↑ ↓ ← → CONT Optional manual input of coordinates after switching from **'Modul'** to **'Keyb.'**.



E = easting,
N = northing,
H = height (optional)

REC Stores coordinates in the CORD file,

or

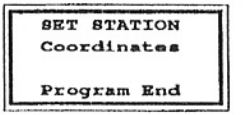
[CONT] the program proceeds without storing manually-entered values in the CORD file.

The coordinates must now be set in the theodolite, using one of the following two functions:

[CONT] Sets the station coordinates

or

[REC] sets the station coordinates and stores them together with the values for hi and hr in the DATA file (measurement protocol).



Final display for about two seconds, followed by a jump back to the program selection menu.

[MENU] [1] [2]

By contrast, the menu function (see section 5.2 of user manual) does not allow station coordinates to be stored for possible later recall.

6. Orientation of horizontal circle

One method for circle orientation was described in detail in section 5.1 of the user manual.

MENU 1 1

The use of this function assumes that the direction of a known target point has already been computed and that it has been entered as an azimuth angle in the theodolite.

The program **'Orientation'** assumes that the station coordinates are known and have been taken over from the theodolite. Before starting up the program, ensure that correct coordinates have been set in the instrument, either with the

MENU 1 2

system function

or with the program *Set Station* which has been described.

DSP

```
ORIENTIERUNG
Quality:100
 1-Face(s)
Version: 1.3
```

Configuration is possible after the program has been called.

CONT

```
CONFIGURATION
>Standard>    NO
 Face     >    1
 REC-Mask>     1
```

```
 DSP-Mask>     1
 REP-Find>   YES
 Quality >   100
```

For measurements in both telescope faces, the parameter **'Face'** must be set to **'2'**. The measurements in face I and face II must be carried out immediately after one another, altough either one can be used first.

The **'Quality'** statement for the accuracy of the bearing is requested in 'cc' units.

If other units than the 400-gon system were used, they can be recomputed into 'cc' by using the following conversion factors:

10 cc = 3"
10 cc = 0.0009°
10 cc = 0.016 mil

ORIENTATION	
Eo	9114.234
No	2345.345
>Ho	264.113
hi	1.602

CONT

As a check, the present station coordinates are displayed. They cannot be changed.

ORIENTATION	
File:	14
Step:	1
>PtNr:	1234
hr	1.652
GetCORD>	Modul

CONT

Change the CORD file and the increment size if required. Enter the point number of the target.
The reflector height is not important.
Search for coordinates in the CORD file, or enter them manually.

Data Found:	
	14/0032
PtNr:	00001234
>E	3412.183
N	1237.644
H	432.345

CONT

The coordinates found for the target point are displayed for inspection, provided that the REP-Find function is permitted. These coordinates cannot be changed.

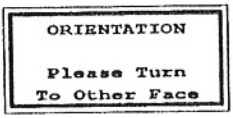
ORIENTATION	
PtNr:	1234
Hz	392.4456
V	101.6774

The measured values are displayed in accordance with the DSP mask selected.

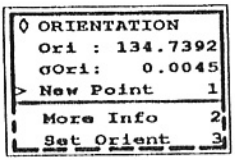
CONT The angle readings are transferred to the temporary memory and the program continues without storing the data

or

[REC] the programm proceeds and the data are stored in the DATA file in accordance with the REC mask selected. The direction to the target must not be changed before the second beep (control for successful storage), because the actual horizontal angle is always transferred to the system and used for the calculations.



If measurements are required in both faces, you will be asked to measure to the same target point using the other face.



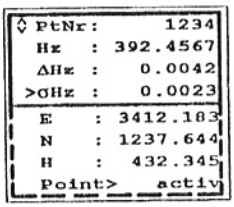
The orientation angle is computed immediately, but its standard deviation is not given until measurements have been made to at least two target points. A maximum of 10 target points can be measured.

[↑] [↓] [CONT] The cursor is used to select the branch; after confirmation, the program continues,

[1] [2] [3] or alternatively the numerical keys are used:

[1] Measures to an additional target point.

[2] Supplies information about the reliability of the measurement.



These parameters are displayed:
Number of target point,
direction of measurement,
angular difference from mean,
mean error in direction of observation,
coordinates of target point, and its point status.

With at least 3 measurements to different target points, unreliable measurements are recognized by the analytical software and are labelled in the ΔHz line with '*' so that they can be identified easily.

[←] [→] With the cursor, you can edit all target points measured and set their point status function:

- activ Target point is used for calculating orientation.

- passiv Target point is excluded from calculation.

- delete Target point is deleted from temporary memory and cannot be reactivated.

```
ORIENTATION
Point Already
  Measured !
>Overwrite>   NO
```

Multiple measurement to the same target point is not allowed. Observations to a point already measured are only accepted if the existing measurement data set is written over or if the point is removed from the temporary memory by using the **'delete'** function.

[3] Sets the orientation angle. The face used, and the circle position of the theodolite, are unimportant.

or

[↑] [↓] [3] [REC] the coordinates are stored in the DATA file along with the unknown orientation determination, the instrument height and target height, and the orientation angle is set.

```
ORIENTATION
    Set

Program End
```

Final display.

After about 2 seconds there is a jump back to the program selection menu.

7. Height transfer

The height transfer program computes the height of the instrument station by measuring the zenith angles and distances to a maximum of 10 target points of known height. Enter the position coordinates of the station (Eo, No) before you start measuring, because during recording they will be stored in the DATA file of the REC module along with the computed height.

[MENU] [1] [2]

Inputs station coordinates manually. Alternatively, use the program *Set Station*.

[DSP]

```
HEIGHT TRANS
Quality:25
1-Face(s)
Version:1.2
```

Configuration is possible after the program has been called.

[CONT]

```
CONFIGURATION
>Standard>     NO
Face     >      1
REC-Mask>       1
DSP-Mask>       1
REP-Find>     YES
Quality >      10
```

To measure in both faces, set the parameter **'Face'** to **'2'**. The measurements in face I and face II must follow one another point by point, although it does not matter which face is used first. Distances may be measured in both faces with the TC 1010/1610 total stations. Using a T 1010/1610 with an attached distomat the distance **must** be measured in face I only.

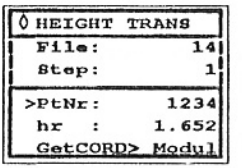
[←] [→]

The **'Quality'** statement for the accuracy of the station height to be computed is selected with the cursor, and is always given in mm, even if **'feet'** was chosen as the unit.

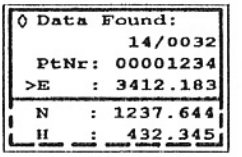
[CONT]

```
HEIGHT TRANS
>PtNr:      1000
hi   :     1.602
```

Enter station number and instrument height.



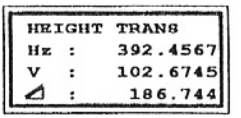
Enter target-point number and reflector height. Search for coordinates in CORD file of REC module, or enter them manually. If position coordinates of target point are not known during manual input, enter 0 for both values.



Displays coordinates found, for inspection, provided that the REP-Find function is permitted in the configuration.

CONT

DIST Measures distance to first target point.



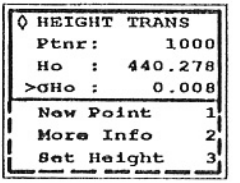
Displays measurement data.

CONT Program continues without storing measurement data, or

REC program continues after storage in accordance with REC mask set.

Note: If the coordinates (WI 81,82,83) are also defined in the REC mask used for recording the measurements, the computed coordinates of the target point will be stored in place of the coordinates which have been input manually or which have been read from the REC module.

ALL Distance measurement, data storage, and continuation with program.



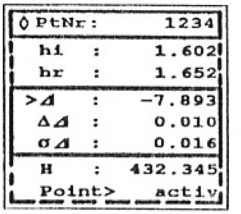
The following parameters are displayed:
Station number.
Computed station height.
Standard deviation of station height, if measurements to at least two different target points are already available.

[↑] [↓] [CONT] Program continues after branch is selected with cursor and confirmed,

[1] [2] [3] or, by using the numerical keys,

[1] an additional target point is measured.

[2] Information about the reliability of the measurement.



The following parameters can be viewed for the target point number indicated:
- Instrument height and reflector height
- Height diff. between station and target point
- Deviation of height from mean
- Mean error in height difference
- Target point height and point status.

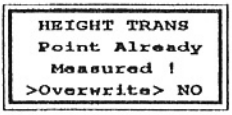
With at least three measurements to different target points, unreliable measurements are recognized by the analytical software and are labelled in the Δ height difference line with '*' so that they can be find easily.

[←] [→] With the cursor, all target points measured can be edited and their point status function set:

- active Target point is used for calculating station height.

- **passive** Target point is excluded from calculation.

- **delete** Target point is deleted from temporary memory and cannot be reactivated.

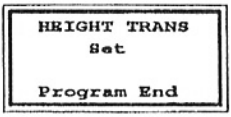


Multiple measurement to the same target point is not permissible. Observations to an already-measured point are only accepted if the existing measurement data set is written over or if the point is removed from the temporary memory using the function '**delete**'.

[3] The station height is set and is transferred to the theodolite,

or

[↑][↓][3] [REC] the coordinates are stored in the DATA file along with the instrument height and target height, and the station height is set.



Final display.

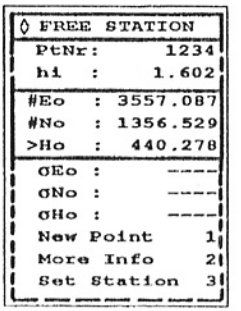
Jumps back to the program selection menu after about two seconds.

8. Free-station survey

This program can be used to deduce the three-dimensional coordinates of the station from measurements to a maximum of 10 target points the coordinates of which are known.

For simultaneous determination of the station height, hi and hr must already have been communicated, the heights of the target points must be known, and the distances to the target points must have been measured. The station height **cannot** be measured if no distance measurement was carried out, even if the heights of the target points are known. Under these circumstances, the computed station coordinates are combined with the station heights entered in the theodolite to give the station coordinates E_o,N_o und H_o.

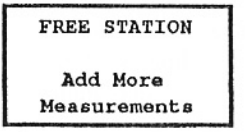
Directions to target points can be determined, as can any combination of direction and distance. To compute the position coordinates, at least three elements (2 directions and 1 distance) are necessary.



DSP

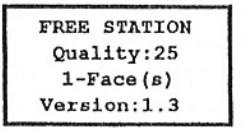
If the measured distance is shorter then the base line between the two reference points, the two possible solutions displayed are indicated by '#' in front of the coordinates.

It is up to the operator to find out the correct values by switching between the different solutions, or to measure a further element to allow a definite calculation.



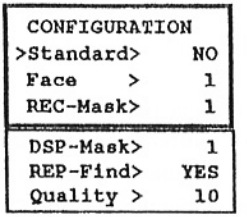
If the measured distance is longer than the base line between the reference points, a further measurement has to be added, to allow the definite solution out of 4 possibilities.

The station height can be deduced by measuring a zenith angle and the associated slope distance, but only if the position coordinates have been computed without error.



DSP

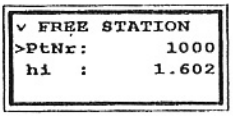
If necessary, change the configuration after starting the program.



CONT

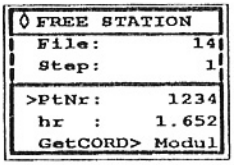
The **'Quality'** parameter is used to define the point accuracy required. The value is always given in mm, even if **'feet'** was selected as the unit. The point radius is computed from the mean coordinate errors m_E and m_N of the adjusted station coordinates and is compared with the quality specifications already entered.

The parameter **'Face'** must be set to **'2'** if measurements are to be made in both faces. The measurements in face I and face II must follow one another point by point, although it does not matter which face is used first. Using a TC 1010/1610 total station, the distances to the target points can be measured in both telescope positions. With the T 1010/1610 and attached distomat the distances **must** be measured in face I only.



Enter station number and instrument height.

CONT



Enter target point number and target height of reflector, and search in the CORD file of the REC module for the coordinates of the target point,

← → ← → CONT

or enter the coordinates manually after switching to '**Keyb.**', and enter them in the

REC CORD file if appropriate.

DIST Start measuring to the target point,

or

CONT continue the program, having measured the angle but not the distance, and ensuring that the target is set correctly, because the angular values transferred to the program are always the current ones.

REC Store the basic measurement data in the DATA file. Before changing the target, you have to wait on the second control signal (beep), because the actual horizontal circle position will be transferred.

or

ALL measure the distance, store the values, and continue with the program, but wait on the successful data storage, which is signalised by the second beep.

If the REC mask allows the target coordinates to be stored (WI 81, 82 and 83), these will not be correct in the DATA file, but will be coordinates, generated by the actual theodolite parameters Eo, No, Ho and Hzo. If no distance to the target is measured, the values for the coordinates are set to 0.

To select the program branch:

[1] Measures to an additional target point

[2] Computes the station coordinates if sufficient measurements are available:

FREE STATION	
PtNr:	1234
hi :	1.602
Eo :	3557.087
No :	1356.529
>Ho :	440.278
σEo :	0.004
σNo :	0.007
σHo :	0.012
New Point	1
More Info	2
Set Station	3

As a result, not only the computed coordinates of the station are displayed, but also the standard deviations of the computed easting and northing Eo and No; in addition, the station height Ho is also displayed if possible. σEo and σNo are used for assessing the quality of the measurement and are compared with the values for **'Quality'** which were entered. The value σHo imparts the mean error in the station height and is to be assessed by the user.

[↑] [↓] [CONT] If a result is already available, continue with the program, either by using the cursor to select a branch and then confirming,

[1] [2] [3] or by selecting directly with the numerical keys.

[1] This measures to an additional target point.

[2] This provides information about the reliability of the measurement.

For the target point number displayed, the following values can be viewed:

PtNr:	1234
hr :	1.602
ΔHz :	0.0042
ΔD :	0.004
>ΔH :	0.006
E :	3412.183
N :	1237.644
H :	432.345
Point>	activ

- Reflector height
- Angular difference } Difference between
- Distance difference } corrected and measured values
- Height difference }
- Target-point coordinates (E, N, H)
- Point status

Unreliable measurements are recognized by the analytical software and are labelled in the ΔHz or ΔD line with '*' so that you can find them easily. It is almost impossible to measure wrongly with an electronic theodolite, and so any errors which may occur are generally due to incorrect target points or to incorrectly entered coordinates.

[←] [→] With the cursor, all target points measured can be studied and their point status function set ready for an error search:

- **activ** Target point is used for calculating station coordinates

- **passiv** Target point is excluded from calculation.

- **delete** Target point is deleted from temporary memory and cannot be reactivated.

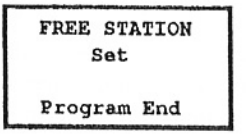
Multiple measurement to the same point is not permissible. Observations to an already-measured point are only accepted if the existing measurement data set is written over

or if the point is removed from the temporary memory using the function **'delete'.**

[3] The station coordinates are set and, together with the instrument height and the last reflector height to be entered, are transferred to the theodolite,

or

[↑][↓][3] [REC] the cursor is used for selection. The coordinates together with the unknown orientation determination, the instrument height and the last reflector height are entered in the DATA file. The station coordinates are then set.

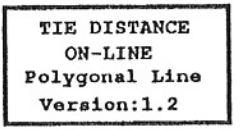


Final display.

Jumps back to the program selection menu after about two seconds.

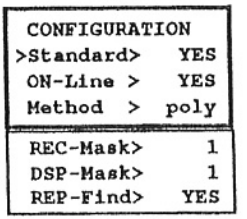
9. Tie distance

Tie distance can be determined in either of two ways.



DSP

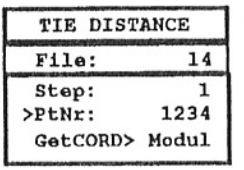
After the program commences, the start display indicates the current setting of the computation method, which can be matched to individual requirements by calling up the configuration. The following settings can be combined:



CONT

The **'poly'** method computes the tie distance from two successive points. In the **'centr'** setting, the tie distance is computed radially from the central point to the following points.

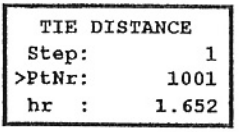
The computation can be carried out in **'ON-Line'** mode from measurements, or in **'OFF-Line'** mode from coordinates stored in the CORD file of the REC module or entered manually. A mixed calculation, involving stored coordinates (OFF-Line) and measurements (ON-Line) is not possible.



Display for 'OFF-Line' method

Enter the starting point or the central point number, depending on the method selected.

Now use the **'OFF-Line'** mode to locate the coordinates in the REC module, or to enter data manually and to store the coordinates in the CORD file of the REC module.



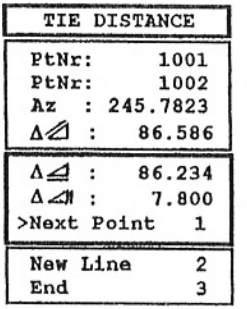
Display for 'ON-Line' method

[DIST] When using the **'ON-Line'** mode, measure the distance to the starting point or to the central point, and confirm,

or,

[ALL] measure and then store the data.

Set the next target and measure or record as previously.



Display of results, with assignation to points measured, and with the computed values for azimuth and for slope-, horizontal- and vertical distance.

Select program branch:

[1] In the **'poly'** method, each point in turn is used as the starting point for the next measurement or data input. In the **'centr'** method, point 1 is retained. The tie distance for subsequent points are successively measured to the central point.

[2] Starts a new measurement series.

[↑] [↓] Instead of the direct program branch using the numeric keys, the cursor keys allow the selection as well.

[CONT] Continue with the program, or

[REC] store the calculated results and continue with the program.

A fixed REC mask is used to store start- and endpoint of the line, the calculated horizontal and slope distance as well as the height difference and the azimuth. The calculation of the azimuth is based on the actual parameters Eo, No and Hzo which are set in the instrument.

[3] Ends program with display of

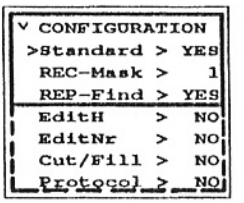
```
TIE DISTANCE

Program End
```

final information, and jumps back to program selection menu.

10. Setting-out

The coordinate system of the points to be set out serves as a basis for the setting-out. Transfer this coordinate system to the theodolite before starting work. In this connection, enter the station coordinates and the horizontal circle orientation along with the functions of the theodolite. The programs **'Set Station'** and **'Orientation'** or **'Free Station'** can also be used.

When the program starts, the configuration set is displayed.



- Edit H:YES The height of the point to be set out can be subsequently altered

- Edit H:NO An alteration of the height is not permitted

- Edit Nr:YES The point number of the point to be set out can be altered for recording in the DATA file

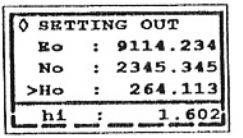
- Edit Nr: NO The data are stored under the same point number

-Cut/Fill:YES The height difference is displayed as an absolute value with the identifier Fill or Cut as appropriate.

-Cut/Fill:NO The height difference is displayed as the difference between the specified value and the actual value, with the correct sign (+ or -).

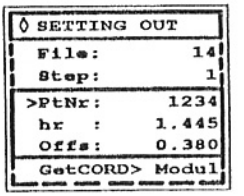
- Protoc.:YES When the data are recorded in accordance with the REC mask selected, the specified coordinates are also stored in a fixed recording format. Point number, coordinate differences and offset values are all stored in a CODE block.

- Protoc.:NO Only the measurement data set is stored (in accordance with the REC mask which was set).



CONT

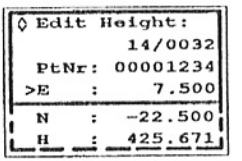
The current station parameters are displayed for inspection, and can no longer be altered.



Inspect the coordinate files of the points to be set out, and the numbering increment size, and alter them if necessary.
Enter the point number, the reflector height and the height offset, i.e. the amount by which the height of the point must be changed while the position coordinates remain the same (e.g. for fill work, templates etc.)

CONT Search for coordinates in the CORD file, or

↑ ↓ ← → CONT switch to **Keyb.** and enter the information manually.



CONT

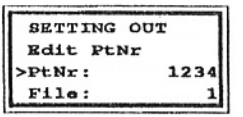
If permitted by the configuration, the point height for a point read from the REC module can be changed for the setting-out.

[1] ..... [3] To measure with simultaneous setting-out, one of the three methods is selected. The different procedures are described in more detail in the following chapters.

The setting 1, 2 or 3 remains effective until it is changed. You can switch between methods even after the distance has been measured.

[DIST] Measures the distance repeatedly until the specified coordinates are obtained, or until the setting-out elements are computed in accordance with requirements.

[DSP] Switches between the two displays of results.



The result of the setting-out can be recorded when the function is concluded. The point number of the coordinates set out can also be changed, provided this is permitted by the configuration.

[REC] This adopts the measurement values in accordance with the REC mask and continues with the program after a new point number is entered,

or

[ALL] the distance is measured and recorded and the program continues,

or

[CONT] the program is continued at the next point, without recording the data.

[4] ..... [6] These compute the setting-out values from the coordinates, using various methods.

Either the coordinates must be read from the CORD file of the REC module, or they must be entered manually for the calculation.

10.1. Polar setting-out

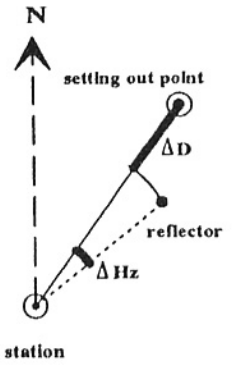
SETTING OUT 1	
PtNr:	1234
ΔHz :	-20.703
ΔD :	5.368

SETTING OUT 1	
PtNr:	1234
ΔH :	-5.097
H :	431.148

When the first distance has been measured, the differences between specified and measured angle and between specified and measured length are displayed and also (if a point height is available) the height difference and the measured height.

[DSP] Switches between the two displays.

[REP] [1] Calls the tracking function for consecutive measurement of distances.



The reflector must be displaced until the values for ΔHz and ΔD in the display are zero.

10.2. Orthogonal setting-out

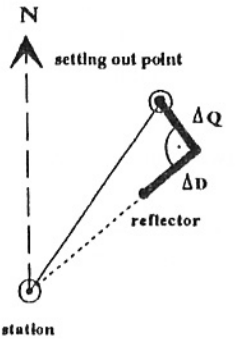
SETTING OUT 2	
PtNr:	1234
ΔQ :	-4.806
ΔD :	5.070

SETTING OUT 2	
PtNr:	1234
ΔH :	-5.097
H :	431.148

After the first distance measurement, the transverse and longitudinal displacements are displayed. If a point height is available, the height difference and the measured height are also shown.

DSP Switches between the two displays.

REP 1 Calls the tracking function for consecutive measurement of distances.



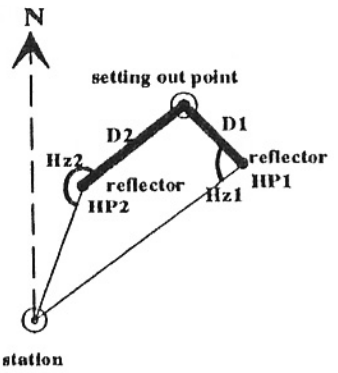
Displace the reflector until the values displayed for ΔQ and ΔD are zero.

10.3. Setting-out with auxiliary points

SETTING OUT 3	
PtNr:	1234
Hz1 :	92.135
D1 :	8.375

SETTING OUT 3	
PtNr:	1234
Hz2 :	235.262
D2 :	13.220

The function computes setting-out values for points which cannot be viewed directly.



Enter the point number of the point to be set out, and read the coordinates from the REC module or enter them manually.

Now measure to the auxiliary point HP1. The distance and direction to the point to be set out are computed. Measure to the auxiliary point HP2 in the same manner.

The specified coordinates of the point can be set out by resection on the basis of the two computed distances.

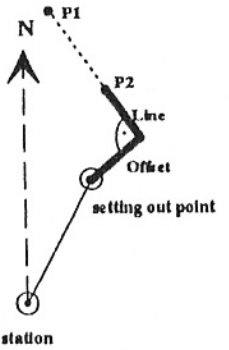
The auxiliary points HP1 and HP2 must be remeasured before each setting-out.

Dynamic setting-out (tracking) cannot be applied to the auxiliary points HP1 and HP2.

10.4. Sequential orthogonal setting-out values

SETTING OUT 4	
PtNr:	1234
LINE:	7.090
OFFS:	8.390
SETTING OUT 4	
PtNr:	1234
ΔH :	-0.900
sH :	426.051

The setting-out values of a point are computed in relation to the base formed by the last two points entered. If the specified height is known for the point to be set out, the setting-out values are computed for the height, in relation to the last base point (P2).



Read from the CORD file of the REC module the coordinates of the base points P1 and P2, or enter them manually.

Read from the REC module the coordinates of the point to be set out (P3), or enter them manually.

[4] The setting-out values LINE and OFFSET are displayed. The sign for the offset is positive if the point is located to the right of the base P1-P2.

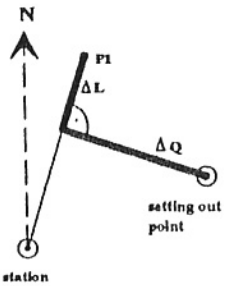
[CONT] Enter the next point to continue with the program.

The base point P1 is now replaced by the base point P2. The point set out (P3) becomes the base point P2. The new setting-out values will be computed to the latest point entered, and so on.

10.5. Sequential radial setting-out values

SETTING OUT 5	
PtNr:	1234
ΔQ :	20.677
ΔL :	-10.606
SETTING OUT 5	
PtNr:	1234
ΔH :	1.529
sH :	426.051

Setting-out values are computed at right angles. The base used is the line formed between the latest point entered and the instrument station. If the height is also known for the point to be set out, ΔH is given in relation to the auxiliary point (P1).



The coordinates of the points are read either from the REC module, or are to be entered manually starting with the auxiliary point P1 followed by the point to be set out.

[5] ΔQ and ΔL are displayed. The sign (+ or -) for ΔQ is determined by the coordinate system derived from the measurement line which has as its two ends the station point and the auxiliary point. A positive sign denotes a point lying to the right.

[CONT] Enter a new point.

The point previously set out now becomes the auxiliary point P1, and so on.

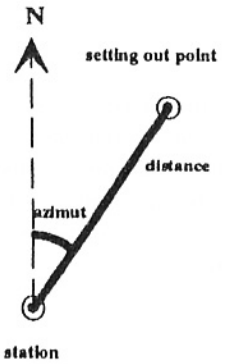
10.6. Displaying setting-out values

The point number is entered, and the coordinates are read from the CORD file of the REC module, or alternatively the coordinates are entered manually.

[6] The computed values are displayed in accordance with the diagram.

SETTING OUT 6	
PtNr:	1234
AZI :	40.595
∎◿ :	32.352
SETTING OUT 6	
∎◿ :	20.615
∎◿ :	24.933
∎H :	426.051

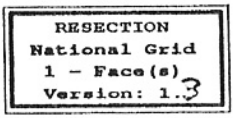
Point number
Azimuth
Slope distance
Horizontal distance
Height difference
Point height



[CONT] Input of next point number, and so on. selection menu.

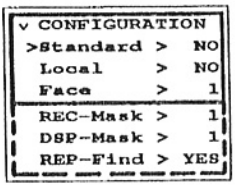
11. Resection

Instead of the program 'Intelligent free-station' the program 'resection', to calculate the station coordinates, is delivered with the models T/TC1010. A three dimensional computation will be carried out, if at least a height is stored for one of the two reference points. The distances **must** be measured to both reference points to find the correct solution out of four possibilities.



DSP

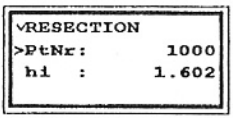
The coordinate system is fixed during the configuration. '**Local**' defines a system with the measurements to the first point and its coordinates (0,0,0) and a measurement to a further point to define the direction of the X-axis (north).



CONT

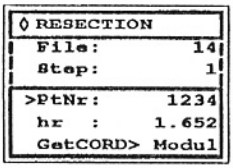
The '**National Grid**' selection requires the coordinates of the reference points. They are read out of a REC module's CORD file or input manually.

To measure in both faces, set the parameter '**Face**' to '**2**'. The measurements in face I and face II must follow one another point by point, although it does not matter which face is used first. Distances may be measured in both faces with the TC1010/1610 total stations. Using a T1010/1610 with an attached distomat the distance **must** be measured in face I only.



Enter station number and instrument height.

CONT



If **'National Grid'** is selected, check the CORD file and alter it if necessary. Enter target point number and search the coordinates in the CORD file of the REC module, or

CONT

↑ ↓ ← → CONT enter them manually after switching to **'Keyb.'**

DIST Measure the distance to the target point.

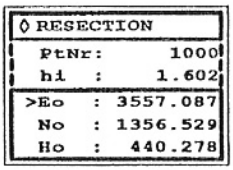
REC Record the measurements to the DATA file according to the selected REC-mask, but wait on the second control beep for the successful storage before you point to the next target, because the actual circle position is transferred to the REC module,

or,

CONT continue in the program and enter the second target point,

or,

ALL trigger measurements, data registration and continue in the program with the input of the next point number. Wait on the second beep as well before changing the horizontal circle reading



The coordinates will be calculated automatically after the second measurement. Point number and instrument height can be viewed but not changed.

CONT Coordinates and orientation are transferred to the instrument,

or,

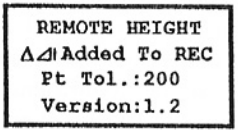
REC Set the coordinates in the instrument and store them according to a predefined REC-Mask. If the station height can not be calculated '0' will be stored together with the coordinates.

If **'Local'** is selected, the target coordinates will not be used. After entering the target point numbers, directions and distances to both reference points are to be measured. For these points, a set of coordinates will be calculated, according to the parameters E_o,N_o,H_o, and Hz_o set in the instrument. If in the REC-mask the coordinates E,N and H are defined, these 'accidental' coordinates will be stored instead of the original ones. The calculated station height is based on the origin (refence point 1) with the height 0.000

12. Remote heights

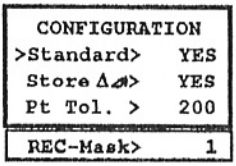
The elevation of a remote height is calculated from the zenith angle to the target and from the measured distance to a reflector situated vertically below or above that target. To ensure correct results, the target and the reflector must be lined up vertically. In practice it is not generally possible to maintain an exactly-vertical line, and so you must decide what lateral deviation can be tolerated. The horizontal distance to the inaccessible target must however coincide with the horizontal distance to the reflector. When the instrument is aligned and the station coordinates have been set, the position coordinates of the remote height can be calculated and stored in the memory.

When the program is started up, the display shows the present configuration:



DSP

- Storage of height difference value
- Measurement tolerance



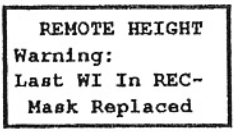
CONT

'Pt Tol.' refers to the lateral deviation of the remote point from the reflector point measured, and is given in millimetres even when the measurements are carried out in feet.

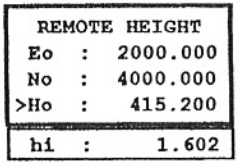
The setting 'OFF' permits all possible deviations from the vertical, i.e. any point can be targeted.

The coordinates of the target are calculated from the originally-measured distance, the present horizontal angle,and the zenith angle.

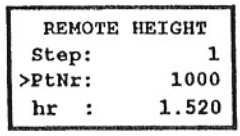
If the stored height difference ΔH is activated in the configuration, the component WI 37 is added to the REC mask selected here.



Note: Make sure that no more than seven values are defined in the REC mask selected, otherwise the last element in the mask will be replaced by the element ΔH (WI 37).



The station parameters (Eo, No, Ho and hi) are displayed as a check. They cannot however be altered here.



Enter the reflector height and the point number for the ground point and confirm, but only if you want to complete the measurement with

ALL and to store the data for the **reflector station.**

Then enter the point number for the inaccessible target.

If you do not enter this second number, the previous one will relate to the inaccessible target.

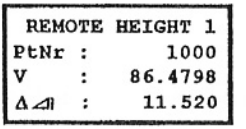
[DIST] Now only the distance to the reflector may be measured.

Point to the inaccessible target. The data will be constantly updated as the telescope is moved.

[1] [2] [3] Select one of the three possible displays.

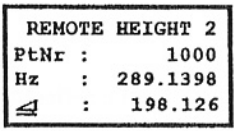
The setting 1, 2 or 3 is retained right to the end of the program, but can be changed at any time with the numerical keys.

[1]



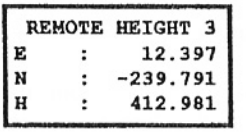
Display of current point number, V angle and height difference.

[2]



Display of current point number, Hz angle and horizontal distance.

[3]



Display of current target-point coordinates E, N and H.

[CONT] Set the next point, enter the point number and measure,

or,

[REC] store the data for the inaccessible target. The reflector height set here is **hr = 0.000.**

The data will only be stored if the point is located within the preset tolerances.

Additional inaccessible points can be accommodated without repeating the distance measurement to the ground point, provided that they are at the same horizontal distance from the instrument and are located within the preset tolerances.

If Δ H is selected (see configuration), the data stored will also include the height difference, expressed as the target-point height minus the ground point height at the reflector station.

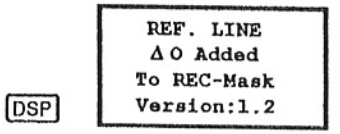
[CE] End of program.

13. Measuring to a reference line / building alignment

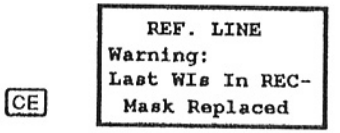
Before starting up the program, make sure that the station coordinates and the theodolite orientation form a unified coordinate system along with the two reference points of the base. The instrument height is taken over from the present theodolite parameters and cannot be altered during the program run.

A unified coordinate system is assured if you use the program *Resection* or *Intelligent free-station survey*, provided that both reference points of the base axis are incorporated in the measuring procedure.

The coordinates of both points of this base axis must either be stored in the CORD file of the REC module or must be entered manually during the program run.

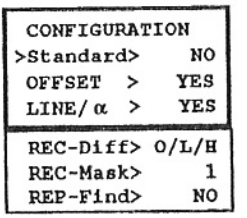


After the program starts, the configuration shows values added to the REC mask.



Note: Make sure that enough space is available in the REC mask to store the additional data, otherwise the final data words will be overwritten by the values already selected for ΔO, ΔL and ΔH.

If necessary, restart the program to define the appropriate REC mask.



The standard configuration only permits calculations which relate to the base axis or to lines parallel to it.

CONT

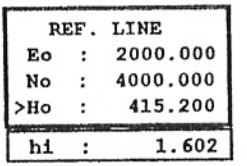
Starting with this base axis, further lines can be defined by using the elements **offset, line** and α :

- **offset** establishes the displacement parallel to the base axis.

- **line** establishes the distance from the first reference point to the starting point of the new reference line.

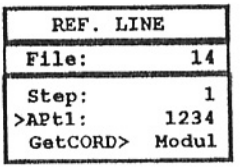
- α establishes the angle between the base axis and the new reference line.

The program then no longer needs to be started by entering a new base axis, because the values ΔL and ΔO resulting from the subsequent reflector measurements have the new reference line as standard.



The station parameters are displayed as a check. They can no longer be altered.

CONT



Enter the first axis point number (APt1). Search for the coordinates in the CORD file, or enter them manually after switching to 'Keyb.'.

CONT

Enter the second axis point (APt2) in the same way as the first point.

◊ REF. LINE	
APt1:	1000
APt2:	1001
Step:	1
>PtNr:	1010
hr :	1.8000
OFFS:	0.0000
LINE:	0.0000
α :	0.0000

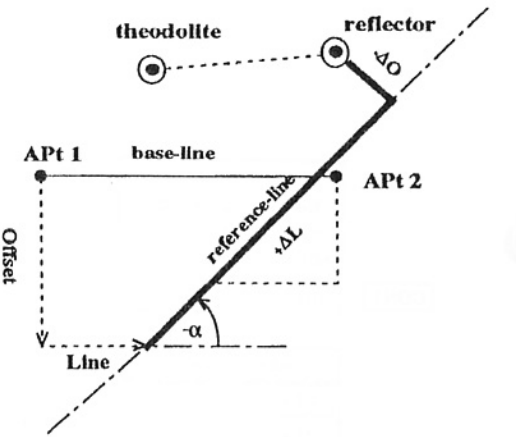
Enter the target height and the point number of the reflector station. If appropriate, enter the parameters of the new reference line in accordance with the configuration.

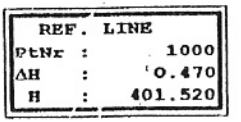
DIST Measure.

REF. LINE	
PtNr :	1000
ΔL :	6.479
ΔO :	1.520

DSP

The local coordinates are displayed as the result:
ΔL Abscissa (from first reference point to foot of perpendicular)
ΔO Ordinate (from foot of perpendicular to reflector).





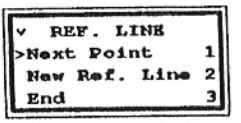
DSP

The second display of results shows the following values:
ΔH Height difference to first reference point
H Height of point measured

CONT or

REC record the results.

ALL It is not advisable to measure and record at the same time, because then the results are not displayed and you cannot check on the point measured.



1 2 3 Select the program branch.

1 Enter the point number of the next reflector station and measure on the same reference line, or alternatively enter the parameters for a new reference line.

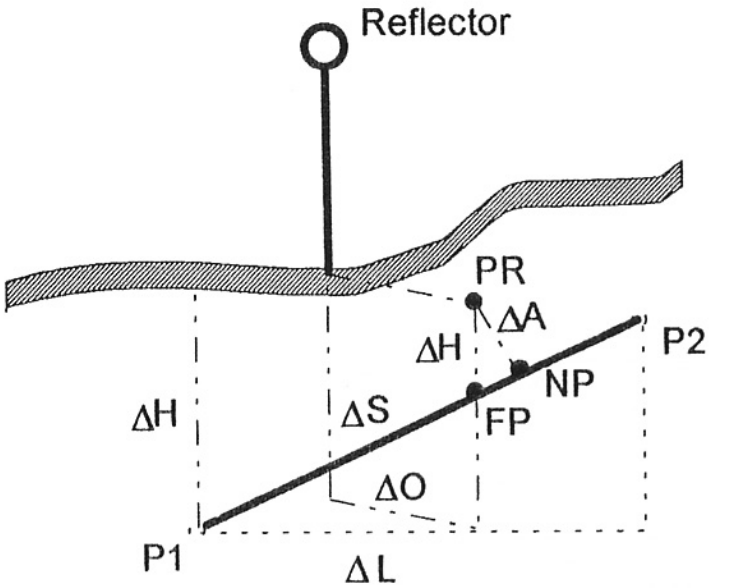
2 Enter the points for a new base axis. **Note:** Ensure that the coordinate system is correct (see above).

3 End of program.

Addenda for version 2.0

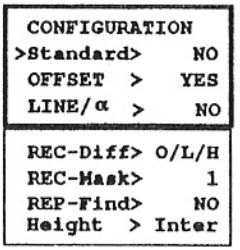
The earlier program version used the height of the reference line's starting point as the *reference height*. To meet the additional requirements of three-dimensional setting-out, version 2.0 provides further means of defining the *reference height*.

Description of computed values



PR	Projection of reflector point in vertical plane through P1 P2
FP	Point of intersection of vertical from PR with line P1 P2
NP	Point of intersection with line P1 P2 of perpendicular to P1 P2 from PR
ΔH	Height difference to start of line or FP
ΔO	Lateral offset of reflector point from reference line (ordinate)
ΔL	Horizontal distance from P1 to FP (abscissa)
ΔS	Spatial distance from P1 to NP
ΔA	Length of perpendicular from PR to NP

Configuration



The configuration menu has an additional item:
Height *Ref*
The computed height difference refers to P1.

Height *Inter*
The computed height difference refers to the interpolated height of point FP.

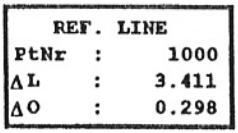
If you select *Inter*, you can choose to record either O/L/H or O/S/A.

If the reference height has been interpolated, you cannot move or rotate the reference line. The program automatically sets NO.

If you set LINE/α to YES, the height reference is P1 (*Ref*).

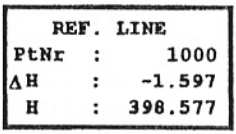
Display switch

DSP

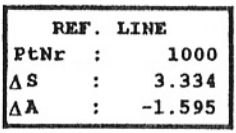


If you set *Inter* for the height reference, touch DSP and choose the values you want displayed.

DSP



DSP



VIP Program Data structure

Manual input of ENH co-ordinates (from Version 1.0)

By using REC, the following values are stored in the co-ordinate file:

WI's :	11	PtNo (Point number)
	81	E (Easting)
	82	N (Northing)
	83 *	H (Height)

* This value is only registered if a height entry takes place!

Setting station co-ordinates (from Version 1.0)

By using REC, the following values are stored in the data file:

WI's :	11	PtNo (Point number)
	84	Eo (Station co-ordinate)
	85	No (Station co-ordinate)
	86	Ho (Station height)
	87	hr (Reflector height)
	88	hi (Instrument height)

Orientation of horizontal circle
(from Version 1.3)

Measurement:
By using REC, the following measured values are stored in the data file according to the currently chosen REC-mask.

Display results:
By using REC, the following values are stored in the data file:

WI's:	11 *	PtNo (point number)
	25	ΔHz (orientation unknown "o"; o = Ori - Hz)
	84	Eo (Station co-ordinate)
	85	No (Station co-ordinate)
	86	Ho (Station height)
	87	hr (Reflector height)
	88	hi (Instrument height)

* As no station point number can be entered, the point number (WI11) is always stored as "ORIENTAT"!

Note:
With earlier program versions, the possibility to store the results was not given.

Height transfer
(from Version 1.0)

Measurement:
By using REC / ALL, the following measured values are stored in the data file according to the currently chosen REC-mask.

Display results:
By using REC, the following values are stored in the data file:

WI's:	11	PtNo (point number)
	84	Eo (Station co-ordinate)
	85	No (Station co-ordinate)
	86	Ho (Station height)
	87	hr (Reflector height)
	88	hi (Instrument height)

Intelligent free-station survey
(from Version 1.3)

Measurement:
By using REC / ALL, the following measured values are stored in the data file according to the currently chosen REC-mask.

Display results:
By using REC, the following values are stored in the data file:

WI's:	11	PtNo (point number)
	25	ΔHz (orientation unknown "o"; o = Ori - Hz)
	84	Eo (Station co-ordinate)
	85	No (Station co-ordinate)
	86	Ho (Station height)
	87	hr (Reflector height)
	88	hi (Instrument height)

Note:
With earlier program versions, the possibility to store the orientation unknown (WI25) was not given.

Compute tie distance (from Version 1.0)

Measurement:
By using REC / ALL, the following measured values are stored in the data file according to the currently chosen REC-mask.

Display results:
By using REC, the following values are stored in the data file:

WI's:	11	PtNo (point number of the second point)
	25	ΔHz (Azimuth)
	35	Δ◿ (Horizontal distance)
	37 *	Δ◿| (Height difference)
	39 *	Δ◿ (Direct distance)
	79	REM9 (Point number of the first point, resp. centre)

* These values are only registered when a height is entered!

Setting-out
(from Version 1.0)

Display results:
During configuration, if "Protocol > YES" is chosen, the following three registration blocks are additionally stored in the data file:

1st Block = Measurement data block according to the current REC-mask.

2nd Block = Data block with the planned co-ordinates.

WI's:		
	11	PtNo (Point number)
	81	E (Easting)
	82	N (Northing)
	83 *	H (Height)

* If no height has been entered, the value 0.000 is written to WI83!
If the height has changed, then the changed height is stored!

3rd Block = Code block with the co-ordinate difference and the height offset.

WI's:

41	Code (Number of the setting-out method)
42	Info1 ($\Delta E = E_{planned} - E_{measured}$)
43	Info2 ($\Delta N = N_{planned} - N_{measured}$)
44 *	Info3 ($\Delta H = H_{planned} - H_{measured}$ + Height offset)
45	Info4 (Height offset)

* If no height has been entered, the value 0.000 is written to WI44! The given height offset is stored in WI45!

Resection
(from Version 1.3)

Measurement:
By using REC / ALL, the following measured values are stored in the data file according to the currently chosen REC-mask.

Display results:
By using REC, the following values are stored in the data file:

WI's:	11	PtNo (point number)
	25	ΔHz (orientation unknown "o"; o = Ori - Hz)
	84	Eo (Station co-ordinate)
	85	No (Station co-ordinate)
	86	Ho (Station height)
	87	hr (Reflector height)
	88	hi (Instrument height)

Note:
With earlier program versions, the possibility to store the orientation unknown (WI25) was not given.

Remote height
(from Version 1.0)

Measurement and Display results:
By using **ALL**, the reflector position (on the ground) is stored in the data file according to the currently chosen REC-mask (without WI37).

By using **REC**, the measured values of the target point are stored in the data file according to the currently chosen REC-mask, but with the reflector height (WI87) reduced to 0.000.
If during configuration, "Store $\Delta\angle\parallel$" is set to "YES", the addition value is also stored:

WI: 37 $\Delta\angle\parallel$ (ΔH = Height difference between the reflector position and the ground point)

If more than 8 data words are to be registered, a warning is given, whereby the last WI in the chosen REC-mask is replaced by WI37!

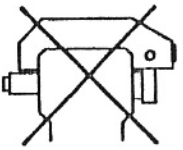
Measuring from a reference line / Building alignment (from Version 1.0)

Measurement and Display results:
By using REC / ALL, the measurement values are stored in the data file according to the currently chosen REC-mask.
According to the configuration setting of "REC Diff", the following values are also registered additionally to those in the REC-mask:

WI's:
- 35 $\Delta\trianglelefteq$ (ΔD = Distance perpendicular to parallel reference line)
- 37 $\Delta\measuredangle$ (ΔH = Height difference relating to the 1st axis point)
- 39 $\Delta\measuredangle$ (ΔL = Length difference relating to the 1st axis point)

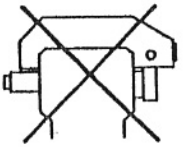
If more than 8 data words are to be registered, a warning is given, whereby the last three WI's in the chosen REC-mask are replaced by WI35, 37 and 39!

The data structure for the VIP-programs "Polar Setting-out", "Road-Stakeout", and "Road-Station and Offset" (from Version 1.0) can be found in the manuals accompanying these programs.



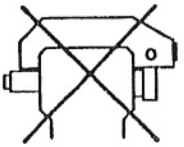
Distanzmesser während Transport nicht auf Theodolitfernrohr aufgesetzt lassen.

Die beim Transport auftretenden Vibrationen können die Justierung verändern und das Kippachslager eventuell beschädigen.



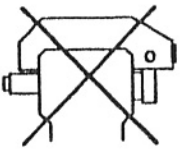
Do not leave the EDM attached to the telescope of the theodolite during transport

Vibration associated with transport can alter the adjustment and cause possible damage to the tilting axis.



Retirer le distancemètre de la lunette du théodolite lors d'un transport

Les vibrations dues au transport peuvent se répercuter sur le réglage et endommager l'axe de basculement.



Durante el transporte, retire el distanciómetro del anteojo del teodolito.

Las vibraciones causadas durante el transporte pueden repercutir en el ajuste y dañar el eje de basculación.