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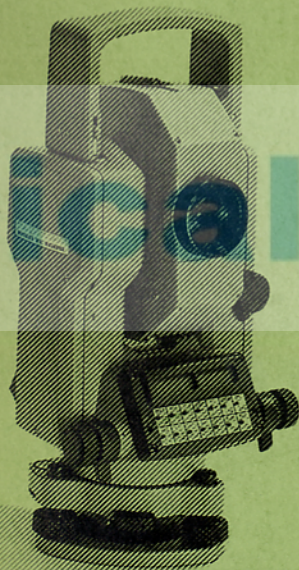
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Geodesic



WILD T1600 · TC1600

INSTRUCTION MANUAL

WILD[®]
HEERBRUGG

SURVEYORS-EXPRESS[™]GmbH



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Geodestical

Wild T1600
Universal electronic theodolite

Wild TC1600
Electronic total station



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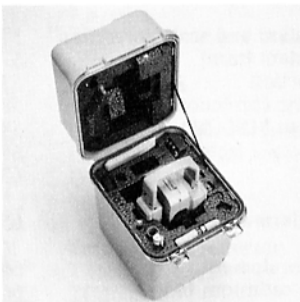


Fig. 1 TC1600 in case.

To pack, turn instrument to position the horizontal drive over one of the footscrews.

1. Introduction

The Wild T1600 is a highly accurate electronic theodolite. The TC1600 is identical with the T1600 but has a built-in electronic distance-measuring (EDM) unit.

In average atmospheric conditions, the TC1600 has a range of up to 4 km to 11 prisms. Its accuracy for distance measurement is 3 mm + 2 ppm.

The T1600 is the central element of the Wild surveying system. Any Wild DISTOMAT™ readily fits on top of its telescope: DI1000 for the short range to 1.6 km, DI55 for the middle range to 5 km, DI2000 for precision distance measurement, DI3000 for greater distances to 14 km and DIOR3002 for distance measurement without reflector.

For data acquisition, a Wild GRE data terminal may be connected to the theodolite. A GRM10 REC data-recording module may be used with the T1600/TC1600 model with a keyboard on one side and an insert for the REC module on the other.

After the instrument has been delivered and unpacked, proceed as follows:

- Charge battery
- Set up instrument
- Adjust DISTOMAT to instrument (T1600 only)
- Point to reflector
- Test functions

For best results, we recommend a thorough study of the contents of this manual.

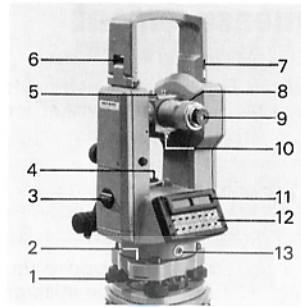


Fig. 2 Wild T1600

- | | |
|---------------------------------------|--|
| 1 Optical plummet, focusing | 9 Telescope eyepiece (bayonet fitting) |
| 2 Circular bubble | 10 Optical sight |
| 3 Battery insert cover | 11 Displays |
| 4 Plate level | 12 Keyboard |
| 5 Adapter plate for Wild DISTOMAT | 13 Socket for cable to external battery and/or GRE data terminal |
| 6 Clamping screw of carrying handle | |
| 7 Snap lock of carrying handle | |
| 8 Focusing ring, coarse/fine movement | |

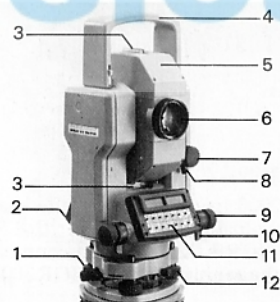


Fig. 3 Wild TC1600

- | | |
|---|--|
| 1 Footscrew | 7 Vertical drive |
| 2 Keyboard | 8 Clamp, vertical drive |
| 3 Optical sight | 9 Horizontal drive |
| 4 Carrying handle | 10 Clamp, horizontal drive |
| 5 Telescope with integrated EDM | 11 Keyboard or insert for REC module in position 2 |
| 6 Coaxial optics for angle and distance measurement | 12 Rotary knob to lock tribrach |

2. Preparations for measurement

The TC1600 needs no preparation. If the T1600 is to be used with a DISTOMAT, do the following before using the instrument for the first time:

2.1 DI5S, DI1000, DI1600, DI2000, DI3000, DIOR3002

Use a screwdriver or the blade of a pocket-knife to remove the black protective plastic cap on the theodolite's telescope adapter (fig. 4).

Check older DI1000 models to ascertain that the electrical contact is spring-loaded; if not, remove the two small screws at the sides of the contact plate.

Place DISTOMAT on telescope. On DISTOMAT:

- Set ppm and mm values to 0
- Set unit of measurement to metres

On theodolite:

- Set ppm and mm values
- Set DISTOMAT interface: 26

The DI5S, DI1000, DI1600 and DI2000 have counterweights that hold the telescope in balance. A spring-loaded relief module (fig. 5) is used to balance the DI3000 and DIOR3002. A special counterweight is available for steep sights (to the zenith) with the DIOR3002 (fig. 6).

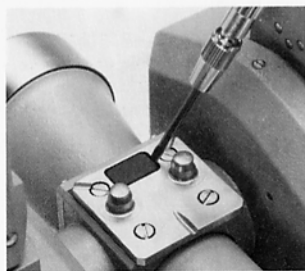


Fig. 4 Removal of protective cap to telescope adapter plate



Fig. 5 Relief pin for DI3000, DIOR3002



Fig. 6 DIOR3002 with counterweight and GLZ1 laser unit



Fig. 7 Cable linking Theodolite and DISTOMAT DI4/DI4L

2.2 DI4, DI4L, DI5

If a DI5 is to be fitted, use a screwdriver or the blade of a pocket-knife to remove the black protective plastic cap on the theodolite's telescope adapter (fig. 4), remove the two small screws at the sides of the electrical contact plate of the DI5.

Place DISTOMAT on telescope. On DISTOMAT:

- Set ppm and mm values to 0
- Set unit of measurement to metres

On theodolite:

- Set ppm and mm values
- Set DISTOMAT interface: 25

The DI4/DI4L has no electrical contact plate. Connect these models to the theodolite by a short cable 409 680 (fig. 7).

DI4/DI4L displays unambiguous measurements only up to 1999 m. To ensure that greater distances are correctly reduced, input the estimated approximate distance in kilometre units as follows:

20 n

Range	1 km to 3 km	n = 2
	2 km to 4 km	n = 3
	3 km to 5 km	n = 4
	4 km to 6 km	n = 5
	5 km to 7 km	n = 6
	etc.	etc.

3. Pointing to a reflector

3.1 T1600

For short-range distance measurement with a DI4, DI4L, DI5, DI5S, DI1000, or DI2000 fitted to the T1600, use the GPH1A single-prism holder. For greater distances, use a GPH3 three-prism holder or a GPH11 with eleven prisms. See the DI3000 manual for details of suitable prisms for the DI3000.

To ensure accurate measurements, the DISTOMAT's infra-red measuring beam must be parallel to the telescope's line-of-sight. See the relevant DISTOMAT manual for details of checks and adjustments.

With a properly adjusted DISTOMAT, only a single pointing is necessary to measure angles and distance.

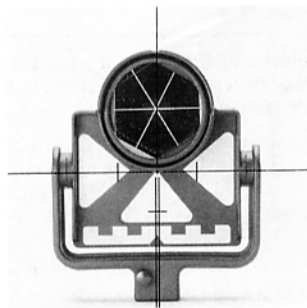


Fig. 8 GPH1A single-prism holder: cross-hairs must intersect on yellow target plate

3.2 TC1600

For short-range distance measurement with the TC1600, use the GPH1 single-prism holder. For greater distances, use a GPH3 three-prism holder or a GPH11 with eleven prisms.

With the GPH1, GPH3 and GPH11, always point to the centre of the reflector. The image of the rear point of the prism lies exactly at the intersection of the standing axis and tilting axis of the reflector. For pointing at longer range, fit the GZT4 target plate on the GPH1 single-prism holder.

The telescope of the TC1600 is adjusted at the factory to make the infra-red measuring beam coincide with the centre of the telescope's line-of-sight. When the cross-hairs point to the centre of the reflector prism, the received signal is at maximum strength.

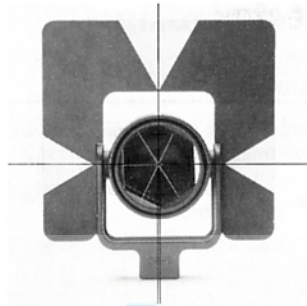



Fig. 9 GPH1 single-prism holder with GZT4 target plate attached: cross-hairs must intersect in centre of prism

4. Operating without recording

4.1 Angle and distance measurement

- ON** Switches theodolite on. Screen briefly displays software version, then measures vertical and horizontal angles.
- OFF** Switches theodolite off. 3 minutes after the last keyboard input or command, the theodolite automatically switches off.
-  Switches illumination of display and cross-hairs on/off. Press **REP** to change brightness of cross-hair illumination from level 0 to 3. **RUN** stores the new brightness level.
- TEST 0** Displays battery voltage level 1 to 9.
- CE** Cancels **TEST** function. Deletes wrong input not terminated by **RUN** one digit at a time. Deletes messages.
- DSP Hz V** Displays horizontal and vertical circle readings. Stored index error and horizontal collimation error are applied automatically.
- SET MODE 40 RUN REP RUN** Sets angle-measurement unit. Press **REP** to alter unit in the following sequence:
400 gon
360° decimal
360° sexagesimal
6400 mil
RUN stores the new angle unit.
- SET Hz0 • RUN** Resets Hz circle to 0.

SET Hz0 245.5734 RUN

Sets Hz circle to 245.5734 gon or 245°57'34". Enter negative value to select counterclockwise circle reading.

SET MODE 41 RUN REP RUN

Sets distance-measurement unit (metre or foot). Press **REP** to alter unit.

SET mm mm RUN

Input prism constant (-999 mm to +999 mm).

SET ppm ppm RUN

Input scale correction (-399 ppm to +399 ppm).

DIST

Measures distance. During distance measurement, the right-hand screen displays a short horizontal line.

DSP Hz

Displays horizontal circle reading and horizontal distance.

REP DIST

Starts tracking. When a DI4/DI4L is being used, press **DIST TEST** on DISTOMAT, before **REP DIST** on T1600.

STOP

Stops distance measurement.

SET MODE 69 RUN REP RUN

Assigns a given measuring program to **DIST** key. Applies only to TC1600 and to T1600 with DI2000 or DI3000.

DIST Normal distance measurement

DI Fast measurement

DIL Continuous distance measurement, with display of running arithmetical mean of all measurements, number (n) of measurements, and standard deviation (s) [mm] of single measurement. TC1600 display of n and s by **TEST 8** during or after distance measurement.

On switching off the T1600/TC1600, the **DIST** key is always reassigned to normal distance measurement.

4.2 Height and coordinates of target point

Input station height, i.e. height above datum.

Input station coordinates.

To set to 0.000, input the decimal point without digits.

Starts distance measurement.

Displays target-point height and height difference.

Displays target-point coordinates.

4.3 Setting-out with display of difference

Input setting-out elements (with decimal point, if required):

α = required bearing

S_0 = required horizontal distance

Measures distance.

Displays setting-out differences ΔH_z and $\Delta \sphericalangle$.

ΔH_z shows the angle through which the theodolite has to be turned.

$\Delta \sphericalangle$ shows the distance by which the reflector has to be moved.

After **OFF**, input of required values remains stored until new values are input.

SET **H₀** **H₀** **RUN**

SET **E₀N₀** **E₀** **RUN** **N₀** **RUN**

DIST

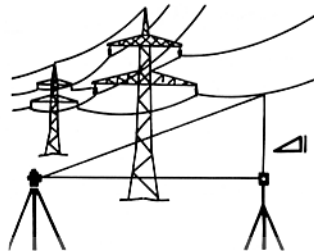
DSP **H** **↙**

DSP **E N**

SET **S₀** α **RUN** **S₀** **RUN**

DIST

DSP **DIFF**



4.4 Remote-object height

Determine the height of distant objects such as HT pylons or a power line as follows:

Set up reflector under object.

Point instrument to the reflector.

Measures distance.

Displays height and height difference of reflector.

Point telescope to top of pylon or power line; instrument computes and displays height to power line and height difference. These values cannot be recorded.

Records the initial measurement to the reflector.

DIST

DSP **H** **↙**

REC

4.5 Determination of vertical-index error

Before the instrument leaves the factory, its vertical-index error is determined and stored. This stored value is taken into account in every vertical angle measurement. The user can check the vertical-index error at any time and store another value as necessary.

Displays stored vertical-index error.

SET **MODE** 10 **RUN**

In position 1, point instrument to a well defined target at a distance of about 100 m.

Deletes display.

RUN

In position 2, point instrument to the same target.

Displays new vertical-index error.

RUN

Stores new value.

RUN or

Retains existing vertical-index error and terminates function.

CE

4.6 Determination of horizontal collimation error

Before the instrument leaves the factory, its horizontal collimation error is determined and stored. This stored value is automatically taken into account in every horizontal angle measurement. The user can check the horizontal collimation error at any time and store another value as necessary.

Displays stored horizontal collimation error.

SET **MODE** 11 **RUN**

In position 1, point instrument to a well defined target at a distance of about 100 m with telescope approximately horizontal.

Deletes display.

RUN

In position 2, point instrument to the same target.

Displays new horizontal collimation error.

RUN

Stores new value.

RUN or

Retains existing horizontal collimation error and terminates function.

CE

5. Data recording

5.1 Wild GRE data terminal

If the plug-in batteries are used to power the theodolite and GRE, connect the data terminal to the theodolite by a data-transfer cable, either 407 678 (1.2 m) or 424 248 (5 m).

With an external battery, use the Y-shaped data-transfer and battery cable 409 684 (fig. 10).

5.2 GRM10 REC module

Two different models of T1600 and TC1600 are available. One model has two keyboards, the other has a keyboard in position 1 and an insert for a recording (REC) module in position 2; insert the REC module into this. The REC module is controlled from the theodolite.

Fig. 10 T1600 with DI1000 and cable to GRE3 and GEB70 small battery

5.3 Setting the theodolite

[SET] [MODE] 74 [RUN] [REP] [RUN]

Selects command mode. Press [REP] to change from T1600 to T2000 command mode. T2000 setting is required when using Wild PROFIS programs.

[SET] [MODE] 76 [RUN] [REP] [RUN]

Selects recording unit. Press [REP] to change from GRE to REC module and back again.

[SET] [MODE] 78 [RUN] [RUN]

Sets theodolite to standard parameters: 2400 baud, even parity, CR LF.

[SET] [REC] 99 [RUN] [REC]

Sets standard recording format:

Pt n°	Hz angle	V angle	∇	ppm mm
Wi = 11	Wi = 21	Wi = 22	Wi = 31	Wi = 51

[SET] [REC] ±99 [RUN] [REC]

Deletes existing recording format.

[SET] [REC] Wi [RUN] [REC]

Input of any recording format.

[SET] [REC] 11 [RUN] 71 [RUN]
81 [RUN] 82 [RUN] [REC]

Sets the following recording format:

Pt n°	REM 1	Easting	Northing
Wi = 11	Wi = 71	Wi = 81	Wi = 82

Wi = 11 Point number Wi = 51 ppm mm

Wi = 21 Horizontal angle Wi = 71 REM 1

Wi = 22 Vertical angle Wi = 72 REM 2

Wi = 31 Slope distance Wi = 81 Easting

Wi = 32 Horizontal distance Wi = 82 Northing

Wi = 33 Height difference Wi = 83 Height

} target point

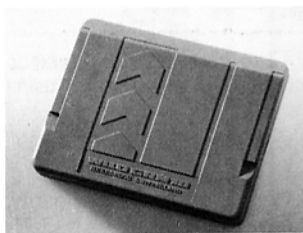


Fig. 11 Wild GRM 10 REC module

If the format used is not the standard recording format, the query OK? appears on the display before recording the first data block. Press **REC** to confirm and record the first block.

The above parameters remain stored when the instrument is switched off and need not be input again when the theodolite is switched on.

A measurement block may consist of up to eight words. See GIF 10 manual for complete table of word identifiers Wi.

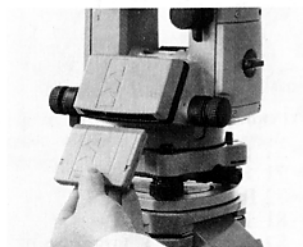


Fig. 12 Insertion of REC module in theodolite; to pull out, press slightly forward

5.4 Setting the data recorder

For the REC module, no preparatory work is necessary. On a GRE input the following:

GRE 3 input:

- SET** **FORM** \pm • **RUN** **REC** Deletes existing recording format.
- SET** **MODE** 70 **RUN** 2400 **RUN** **RUN** Transfer rate 2400 baud.
- SET** **MODE** 71 **RUN** 2 **RUN** **RUN** Even parity.
- SET** **MODE** 73 **RUN** 1 **RUN** **RUN** CR LF

GRE 4 input:

- SET** **FORM** \pm • **RUN** **REC** Deletes existing recording format.
- SET** **MODE** 78 **RUN** **RUN** Sets standard parameters: 2400 baud, even parity, CR LF.

5.5 Recording a block of measured data

Theodolite, DISTOMAT, and data recorder are all controlled from the theodolite keyboard, including input of additional numerical data, such as point number, code blocks, remarks, etc.

Point numbering

Displays point number to be recorded.

Input of sequential running point number. After recording the block of measured data, the point number is incremented by 1. Input a minus sign to set negative counting direction.

Reduces current point number by 1 and reverses counting direction (for observation of points in reverse order).

Input of non-sequential point number; interrupts sequential point numbering.

Deletes input of non-sequential point number; continues sequential point numbering.

Pt n°

±

Pt n°

±

or

Measurement and recording

Measures distance.

Records the entire block of measured data.

The horizontal angle stored refers to the pointing at the time of recording. The vertical angle stored refers to the pointing at the moment of concluding the distance measurement.

Measures distance and automatically records the block of measured data and increments current point number by 1.

Block of recorded data is given the same point number as the previous block.

5.6 Recording a code block

Code blocks are used to record code numbers and other numerical information needed for further processing of measured data.

Input of code number.

[CODE] Code n° [RUN] [REC]

[CODE] Code n° [RUN] Info 1 [RUN] ...

... Info 4 [RUN] [REC]

Input of code number and supplementary data. Up to four information words of additional numerical information may be input. Code numbers and such additional numerical information may each contain up to eight digits including a mathematical sign, but no decimal point.

5.7 Input of REM words

REM words are used to annotate a block of measurements. They must be defined in the recording format $W_i = 71$ and $W_i = 72$. REM words are recorded unchanged with each block of measurements, until they are changed. The REM word consists of eight digits from 0 to 9. The digits in a REM word may be input or altered as follows:

[SET] [REM] REM 1 (position/digit ...

... position/digit) [RUN] REM 2 [RUN] Input of REM-words REM 1 and REM 2.

[SET] [REM] 4582 [RUN]

Input 5 and 2 at positions 4 and 8: Display [00050002].
Other positions may have to be reset to 0.

5.8 Display of stored data

To display data recorded with a GRE data terminal, use the command described in the relevant manual.

To display data recorded in the REC module, use the [DATA] command.

Switches theodolite to data mode.

Terminates data function.

Displays data word for word by searching forward or backward.

Search for data block with specified point number. The [FIND] command searches the data file from the last position back to the beginning.

5.9 Delete data in REC module

Deletes all data in REC module. Selective deletion of data is not possible.

[DATA]

[RUN]

[DATA] [←] [→] [RUN]

[DATA] [FIND] Pt n° [RUN]

[SET] [MODE] 99 [RUN] ± • [RUN]

6. Coordinate geometry COGO functions

Several coordinate geometry functions are available for use with a REC module.

They are selected as follows:

or
 n

COGO 11	Storing coordinates in the REC module
COGO 12	Distance between the two last-measured points
COGO 13	Distance between the two recorded points
COGO 14	Area computation
COGO 21	Setting station coordinates
COGO 22	Resection
COGO 23	Orientation of horizontal circle
COGO 24	Setting-out

6.1 Storing coordinates in the REC module

Selects functions.

Enter point number.

Enter coordinates E and N.

Enter coordinates E, N and height H.

Records entered values

Ends function.

11

Pt. no

E N or

E N H

Likewise enter further points.



12

6.2 Distance between the two last-measured points

The two last points measured are stored in the theodolite. The distance and height difference between them can thus be computed without a REC module.

Point sequentially to the points for which the check measurement is to be computed and start distance measurement by .

Selects function. The horizontal distance and height difference are displayed.

Ends function.

6.3 Distance between two recorded points

The program computes the horizontal distance between two points stored in the REC module.

If the height of both points are stored, the height difference is also displayed.

Selects function.

Enter first point number.

Enter second point number. Horizontal distance and height difference are calculated and displayed.

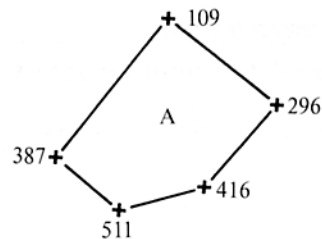
Ends function.

SET COGO 13 RUN

Pt. no RUN

Pt. no RUN

CE



SET COGO 14 RUN

n RUN

Pt. no 1 RUN

Pt. no 2 RUN

Pt. no n RUN

CE

6.4 Area computation

The program computes an area whose boundaries are (no more than ten) straight lines. The coordinates of the corner points must be stored in the REC module.

Manual input of coordinates, see 6.1.

Set recording format $W_i = 11$, $W_i = 81$ (E) and $W_i = 82$ (N) if points are to be measured.

Selects function.

Enter number of corner points.

Enter point number of first corner point (109 in sketch above).

Enter point number of second corner point (296 in sketch above).

Enter point number of last corner point (387 in sketch above). After input of last point number the computed area is displayed. The area cannot be recorded in the REC module.

Ends function.

6.5 Setting station coordinates

The program sets coordinates and height stored in the REC module as station coordinates E_0 , N_0 and height H_0 .

Selects function.

Enter station number. The coordinates of the point are set as station coordinates E_0 , N_0 .

If the height is also stored, it is set as station height H_0 .

Check with and .

Setting a reference direction, see 6.7.

21

Pt. no

6.6 Resection

Resection permits computation of the station coordinates by three bearings. The coordinates of the three known points must be stored in the REC module.

Manual input of coordinates, see 6.3.

The three known points must be observed in a clockwise sequence.

The known stations should be suitably located to avoid the «danger circle».

Selects function.

Enter point number of first known point (5001 in sketch above).

Theodolite stores angle measurement.

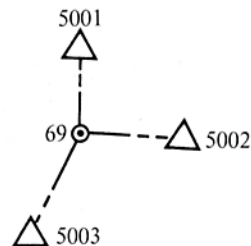
Likewise observe the other two points (5002 and 5003 in sketch above).

After the third known point has been observed, the station coordinates E_0 , N_0 are displayed.

Terminates function.

Sets station coordinates E_0 , N_0 in theodolite and terminates function.

Enter station number (69 in sketch above). Records point number, E_0 , N_0 in REC module. Sets station coordinates E_0 , N_0 in theodolite and terminates function. The Hz-circle orientation will not be reset.



22

Pt. no
Point to known target point.

Likewise observe the other two points (5002 and 5003 in sketch above).

or

or

Pt. no

6.7 Orientation of horizontal circle

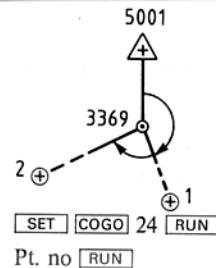
The program computes the bearing to a known point and sets it as the Hz-circle reading.

The coordinates of the reference point must be stored in the REC module and the station coordinates E_0, N_0 set on the theodolite.

Selects function.

Enter point number of reference point. The corresponding bearing is computed and displayed.

Sets bearing as Hz-circle reading on the theodolite. Terminates function.



[RUN]

[DIST] or [REP] [DIST]

6.8 Setting-out

The program computes the horizontal direction and horizontal distance to a point to be set out.

The coordinates of the point to be set out must be stored in the REC module, the theodolite orientated and the station coordinates E_0, N_0 set.

Selects function.

Enter point number of point to be set out. Horizontal direction and distance are computed and displayed.

Selects difference display (computed minus observed). Terminates function.

Measures distance. New setting-out differences are computed and displayed.

If other points have to be set-out, select again the COGO function.

[SET] [COGO] 23 [RUN]

Pt. no [RUN]

aim at reference point

[RUN]

7. Test commands

The following test programs can be called up at the theodolite:

terminates test commands.

0 Displays state of battery charge (1–9); 9 indicates that the battery is fully charged. When the battery charge is low, BAT flashes in display 2. When the battery voltage drops below 10.9 V, message 12 is displayed and the theodolite switches off automatically after the next keystroke.

1 Tests displays.

5 Switches DISTOMAT to test mode. For DI4, DI4L, or DI20, press on EDM.

7 Displays temperature inside theodolite.

8 Displays number of measurements (n) made and standard deviation (s) [mm] for a single measurement during and after DIL measuring program. Applies only to TC1600 and T1600 with DI2000 or DI3000.

9 Measures slope distance but without angle measurement. Applies only to TC1600.

8. SET MODE commands

Command strings: Z_1 Z_1 Z_2 or Z_1

Instead of the Z_2 input, press the necessary number of times to select the required function.

Z_1	Signifies	Z_2	Signifies
10	Display vertical-index error (see 4.5)		
11	Display horizontal collimation error (see 4.6)		
17	Switch off pendulum alarm. On switching on of instrument, alarm is always switched on.	0 1	OFF ON; if instrument is not levelled enough, error 58 is displayed.
20	For DI4 and DI4L measurements exceeding 2 km, input estimated distance in kilometers.	0–9	See 2.2 for kilometre table.
25	Interface for DI4, DI4L, DI5		
26	Interface for DI5S, DI1000, DI2000, DI3000, DIOR3002		

Z ₁	Signifies	Z ₂	Signifies
30	Acoustic signal. On switching on of instrument, signal is always switched on.	0	OFF
		1	ON
40	Set unit of angle measurement	2	400 gon
		3	360° decimal
		4	360° sexadecimal
		5	6400 mil
41	Set unit of distance measurement	0	metre
		1	foot
49	Display actual measuring frequency		
69	Select distance-measurement program on TC1600, DI2000, DI3000	0	normale measurement DIST
		1	fast measurement DI
		2	continuous measurement DIL
70	Set data transfer rate	0	110 baud
		1	300 baud
		2	600 baud
		3	1200 baud
		4	2400 baud
		5	4800 baud
		6	REP
		7	9600 baud
71	Set parity	0	no parity check
		1	odd
		2	even

Z ₁	Signifies	Z ₂	Signifies
73	Set end character	0	CR
		1	CR LF
74	Select command mode	0	T1600
		1	T2000. For use with Wild PROFIS programs
75	Set protocol for on-line link to computer, printer etc. On switching on, the theodolite is always set to 1.	0	without protocol
		1	with protocol
76	Select recording unit	0	GRE
		1	REC module
78	Set standard parameters: 2400 baud, even parity, CR LF		
79	Instrument address when several theodolites are connected ON LINE to a computer	0-9	Individual instrument addresses
95	Switch off automatic power-off. On switching on, the theodolite is always set to 0.	0	Power-off about 3 minutes after last keystroke
		1	No automatic power-off
98	Data transfer from REC module to GRE		
99	Delete all data in REC module and initialize REC module	<input type="checkbox"/> <input type="checkbox"/>	



Fig. 13 Wild GIF10 REC module reader

9. Data transfer from REC module to computer

Data stored in the REC module can be transferred to a computer as follows:

9.1 Wild GIF10 REC module reader

The GIF10 is a special interface between the REC module and a computer, printer, GRE, etc. It is used to display, transfer, and receive data and to copy them to another REC module.

In the field, instead of a mains supply, a 9 V battery may be used to power the GIF10 for about 12 hours.

For further details, see the GIF10 manual.

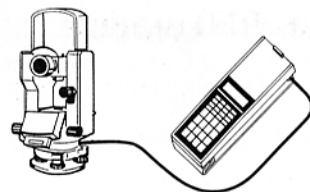


Fig. 14 Data transfer from REC module to GRE data terminal

9.2 Wild GRE data terminal

Data may be transferred from the REC module to a GRE data terminal and thence output to a computer.

To connect theodolite to GRE, set standard parameters on theodolite (78 .

See 5.4 for setting the GRE.

To transfer data from a REC module to a GRE, enter command 98 .

See the GRE manual for further details of data transfer from GRE to a computer.

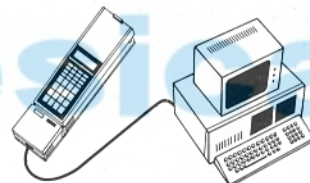


Fig. 15 Data transfer from GRE to computer

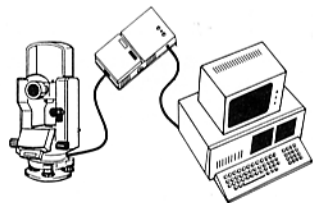


Fig. 16 Data transfer from REC module to computer

9.3 On-line link

Data may be transferred on-line from the REC module to a computer via a GIF2 and GIF7 interface. The data transfer from computer to REC module is not possible.

The theodolite parameters must be set to match those of the computer.

To transfer data from the REC module to a computer, enter command 98 .

The computer (DOS only) may be prepared by input of the following minimum data-transfer program:

```

10 OPEN "COM1:2400,E,7,2,LF,CS,DS,CD" AS #1
20 INPUT "Filename ";F$
30 OPEN F$ FOR OUTPUT AS #2
40 ON ERROR GOTO 50
50 LINE INPUT #1,A$
60 LINE INPUT #1,B$
70 PRINT A$
80 PRINT #2,A$
90 PRINT #1,"?"
100 GOTO 50

```

See GRE manual for further details on use of GIF2/GIF7 interface.

10. Messages and errors

Messages are shown as follows:

Error XX Wrong theodolite manipulation or fault at theodolite
 Error 0XX Error message from recording unit
 Error 2XX Error message from EDM

Error	Cause	Action
01	Illegal <input type="text" value="SET"/> <input type="text" value="MODE"/> command	<input type="text" value="CE"/> , correct input
02	Telescope not in position 1 for start of determination of vertical-index and horizontal collimation error	<input type="text" value="CE"/> , start measurement in position 1
03	Illegal input	<input type="text" value="CE"/> , correct input
04	Vertical-index or horizontal collimation error > 1 gon	<input type="text" value="CE"/> , redetermine vertical-index or horizontal collimation error
05	<input type="text" value="REC"/> during distance measurement	<input type="text" value="CE"/> <input type="text" value="CE"/> , repeat measurement
06	<input type="text" value="REP"/> <input type="text" value="REC"/> illegal; there is no previous point number	<input type="text" value="CE"/>
09	Point number has reached 99 999 999; in negative direction 0	<input type="text" value="CE"/> ; Next point number will be 0; in negative direction 99 999 9999
12, 212	Battery voltage too low (10.9 V)	Next keystroke switches off theodolite
13	Illegal measurement	<input type="text" value="CE"/> , repeat function
14	Illegal command during distance measurement	<input type="text" value="CE"/> <input type="text" value="CE"/> , repeat measurement

Error	Cause	Action
21	Parity error or wrong transfer rate for reception of data	<input type="checkbox"/> CE, check parameter settings and cable link
221-226	Interface error in EDM of TC 1600	<input type="checkbox"/> CE, if error recurs, notify service workshop
22	In command mode, theodolite is not receiving "?" after <input type="checkbox"/> REC.	<input type="checkbox"/> CE, check link to GRE and computer, check parameter settings
24	Too many data being transferred from external instrument; must not exceed 80 characters including CRLF	<input type="checkbox"/> CE
25, 26, 29	Wrong parameters	<input type="checkbox"/> CE, check link to other equipment, check parameter settings (as for error 22)
31	Wrong interface selected	<input type="checkbox"/> CE, see <input type="checkbox"/> SET <input type="checkbox"/> MODE 25 or 26
36	Too many data from DISTOMAT	<input type="checkbox"/> CE, check parameters set on EDM, check link
39	DISTOMAT does not acknowledge with "?".	<input type="checkbox"/> CE, check parameters set on EDM, check link
41	Wrong parameters set on DISTOMAT	<input type="checkbox"/> CE, reset EDM parameters to: metre, ppm = 0, mm = 0
50-57	Defect in angle-measuring system	<input type="checkbox"/> CE, if error recurs, notify service workshop
252, 253	Internal temperature of theodolite too high or too low	<input type="checkbox"/> OFF, leave instrument to cool (or warm)

Error	Cause	Action
255	Return-signal strength in DISTOMAT too low	<input type="checkbox"/> CE, increase number of reflector prisms
256	DIL measuring program: last measurement differs from mean by > 99.5 mm	<input type="checkbox"/> CE, repeat measurement
58	Instrument not level enough	<input type="checkbox"/> CE, level up instrument
60	Wi is not in recording format and cannot be deleted	<input type="checkbox"/> CE, check recording format
61	Maximum of 8 Wi has been reached	<input type="checkbox"/> CE
62	Illegal Wi	<input type="checkbox"/> CE, correct input
67	REM word missing in recording format	<input type="checkbox"/> CE, set Wi = 71
69	Point number missing in recording format	<input type="checkbox"/> CE, set Wi = 11
70	Computation cannot be performed; the block stored under this point number does not contain the required data	<input type="checkbox"/> CE
71	Values required are not stored under this point number	<input type="checkbox"/> CE
72	Memory of REC module almost full; space for another 20 blocks	<input type="checkbox"/> CE, preliminary warning, repeated when each further block is recorded
73	Required point number does not exist	<input type="checkbox"/> CE
74	Memory of REC module full; last point input has not been recorded	<input type="checkbox"/> CE, insert another REC module

Error	Cause	Action
75	Internal battery of REC module too weak	<input type="checkbox"/> CE , copy data; data secure for about two months; notify service workshop
76	Functional defect of REC module	<input type="checkbox"/> CE ; if error recurs, transfer data, notify service workshop
77	Wrong data format in REC module or for transfer to module	<input type="checkbox"/> CE , check data format
78	Wrong choice of recording unit	<input type="checkbox"/> CE , correct <input type="checkbox"/> SET <input type="checkbox"/> MODE 76
79	REC module missing	<input type="checkbox"/> CE , insert REC module
80	No recording possible in REC module, as $W_i = 11$ (point number) or $W_i = 41$ (code number) not set as first word	<input type="checkbox"/> CE , set correct recording format
82	Data cannot be displayed	<input type="checkbox"/> CE , check number of digits in front of decimal point
89	Instrument temperature too high	<input type="checkbox"/> OFF , leave instrument to cool
270-299	Instrument error	<input type="checkbox"/> CE , if error recurs, notify service workshop
91	Division by zero	<input type="checkbox"/> CE , check measurement sequency
92-98, 9A	System errors	<input type="checkbox"/> OFF <input type="checkbox"/> ON , repeat measurement; if error recurs, notify service workshop
9C-9E	EEPROM errors	<input type="checkbox"/> OFF <input type="checkbox"/> ON ; if error recurs, notify service workshop
9F	Instrument incorrectly initialized	<input type="checkbox"/> OFF , notify service workshop

11. Notes

- Avoid damage to the diodes; never point the telescope of the T1600 with DISTOMAT attached or of the TC 1600 at the sun.
- In strong sunlight, use an umbrella to protect the instrument. If the instrument becomes too hot, the performance of the diodes and the range of the instrument are affected.
- For maximum long-range performance, shade the reflectors from strong sunlight.
- Only a single prism should be visible in the telescope's field. If in the measuring beam there is more than one reflector, the signals may be mixed and produce measuring errors.
- Some walkie-talkie equipment may cause measuring errors if the 'transmit' key is used near EDM equipment. Test EDM for walkie-talkie interference; if present, do not transmit during measurement.
- Protect REC module from direct sunlight; maximum temperature $+70^{\circ}\text{C}$.
- If using a TC1600 or T1600 with DISTOMAT and battery is too low, the EDM may switch off automatically after touching **DIST**. In this case error 12 does not appear.

12. Checks and adjustments

12.1 Tripod

There should be no play between the various components. If necessary, moderately tighten the three Allen screws under the tripod plate (fig. 17.1).

When the tripod is lifted by its head, the legs should just remain spread out. Adjust the hinge screws if necessary (fig. 17.2).

The pouch of the GST20 and the yellow plastic head cover of the GST20-9 contain an Allen key for the tripod screws.

12.2 Plate level

Level up the instrument. Properly centred, the centre of the bubble must remain in the centre of the divisions. If the bubble moves off centre by more than a single division in any theodolite position, adjust as follows:

- 1: Set plate level parallel to two footscrews. Centre bubble by adjusting these two footscrews in equal and opposite directions.
- 2: Turn theodolite through 90°. Centre bubble with third footscrew.
- 3: Turn theodolite through 180°. Note position of bubble. Turn the third footscrew to bring the bubble to a point halfway between the position noted and the centred position. Use the adjusting pin to turn the adjustment screw until bubble is centred.
- 4: Repeat until bubble remains centred within a single division for any position.

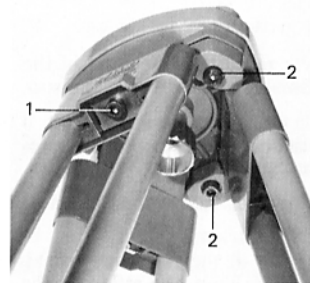


Fig. 17 Tripod GST20 and GST20-9



Fig. 18 Adjustment of plate level

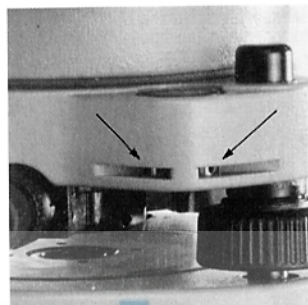


Fig. 19 Adjustment of circular bubble in tribrach

12.3 Circular bubble in tribrach

After the instrument has been levelled up with the plate level, the circular bubble should be in the centre of the setting circle. If not, use the adjusting pin to turn the adjustment screws (fig. 19).

As a screw is slackened the bubble runs toward it, and away from it as it is tightened. Turn one of the screws until the bubble is astride an imaginary line joining the centre of the setting circle to the second adjustment screw. Then turn the second screw to centre the bubble. Do not turn the screws further than necessary.

12.4 Horizontal collimation error (T1600 only)

The line-of-sight is adjusted as accurately as possible at the factory. Determine and store any residual error. This is then automatically taken into account in every angle measurement (see 4.6).

If the horizontal collimation error is greater than 30" (0.010 gon), ask your nearest Wild service workshop to make the adjustment. To adjust the horizontal collimation error in a T1600, unscrew the rear part of the focusing sleeve (fig. 20.1).

Point the telescope at a distant target, input 11 . With the telescope in position 1, add the horizontal collimation error, taking care to consider the correct sign, to the horizontal-circle reading; alternatively, with the telescope in position 2, subtract the error to the reading. Use the horizontal drive to set this computed value.

Example:	Hz circle reading pos 1	216° 04' 48"
	Hz collimation error	- 23"
	Required reading	216° 04' 25"

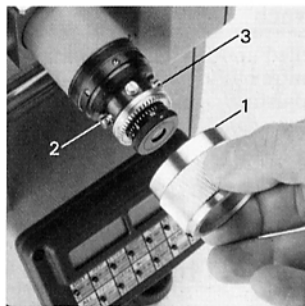


Fig. 20 Adjustment of horizontal collimation error

- 1 Rear part of focusing sleeve
- 2 Left adjustment screw
- 3 Right adjustment screw

If the vertical hair is to the left of the target, use the adjustment pin to slacken the left-hand setscrew by a small amount and tighten the right-hand setscrew by the same amount. Check the position of the vertical hair. Adjust a little at a time until the vertical hair is centred exactly on the target. Do not overtighten the setscrews.

Repeat the checking process. Screw the rear section of focusing sleeve back into place.

On completion of adjustment, determine and store the new residual error as described in 4.6.

In the TC 1600, do not attempt to adjust the horizontal collimation error in this manner, to avoid misalignment of parallel with infra-red beam of EDM.

12.5 Vertical-index error

Determine and store in accordance with 4.5.

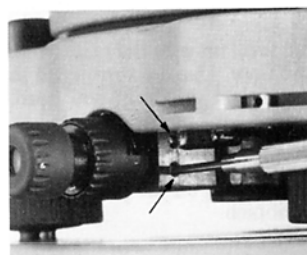


Fig. 21 Adjustment of optical plummet. Arrows mark adjustment screws.

12.6 Optical plummet

Check the optical plummet in the tribrach at frequent and regular intervals. Any deviation of its line-of-sight from the theodolite's vertical axis leads to centring errors.

Check by plumb-bob

In a room, set up the instrument on a tripod and level up with the plate level. Attach the plumb-bob.

Mark a piece of paper with a cross of thin lines, lay it on the floor and move it until the cross is exactly below the point of the plumb-bob. Turn the bayonet plug of the plumb-bob to various positions to check the position of the cross; if necessary, slightly move the ground mark. Remove the plumb-bob. If the cross-hairs of the plummet coincide with the ground mark, the plummet is properly adjusted; if not, adjust as described below.

This method is accurate to about 1 mm.

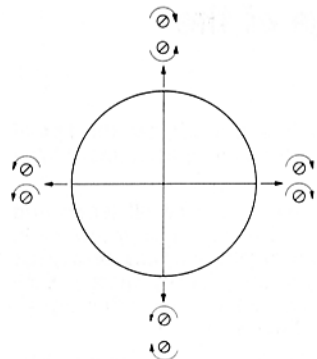


Fig. 22 To adjust the optical plummet, turn the adjustment screws as shown to move the cross-hairs in the direction indicated by the straight arrows.

Check by rotation of tribrach

Set up the instrument on a tripod and level up with the plate level. Secure a piece of graph paper on the floor. Use a sharp pencil to trace the outline of the tribrach base plate on the tripod head. Mark the position of the plummet's cross-hairs on the graph paper. Carefully turn tribrach 120° and fit into the outline previously traced. Tighten central fixing screw, level up instrument, and mark the new position of the plummet's cross-hairs on the graph paper. Repeat for the third position of the tribrach.

If all three marks coincide, the optical plummet is properly adjusted; if not, adjust the cross-hairs to point to the centroid of the three points obtained.

This method is accurate to about 0.5 mm.

Adjustment

Use a screwdriver to turn the two adjustment screws (fig. 21) as indicated (fig. 22) to move the cross-hairs a little at a time. Look through the plummet to check the position of the cross-hairs relative to the ground point.

13. Care and storage of the equipment

Transport: For transport by road, rail, sea, or air, use shockproof packing material for the instrument. If possible, use original Wild packaging.

Cleaning and drying: Before cleaning, blow dust off lenses and prisms. Handle lenses, eyepieces, and prisms with special care. Always use a soft, clean cloth or clean cottonwool. Breathe on glass components, then wipe gently. If necessary, slightly moisten cloth or cottonwool with pure alcohol. Do not use any other liquid. Never touch optical glass with your fingers.

Cables and plugs: Clean periodically. Do not let plugs get dirty. Protect from moisture. Use pure alcohol to rinse dirty cable connectors, then leave to dry thoroughly.

Condensation on prisms: When a prism is cooler than the ambient air, it may collect condensation. If this happens, warm the prism for some time by placing it in a warm environment (room, vehicle, inside clothing). Merely wiping the prism is useless.

Storage: If an instrument has become wet, unpack it on return to base. Carefully clean the instrument, accessories, case, and foam inserts. Wipe dry. Repack only after all the equipment is again thoroughly dry.

14. Technical data

Angle measurement Updates (continuous mode)	continuous, by absolute encoder 0.1 s to 0.3 s
Units	360° sexagesimal, 360° decimal, 400 gon, 6400 mil
Display (smallest unit)	1", 0.0001°, 0.0001 gon, 0.001 mil
Standard deviation to DIN 18723	Hz: 1.5" 0.0005 gon V: 1.5" 0.0005 gon
Automatic index Working range Setting accuracy	Pendulum compensator ±5' ±0.1 gon ±1" ±0.0003 gon
Telescope Magnification with standard eyepiece Objective aperture Shortest focusing range Field at 1000 m Focusing	erect image 30 x 42 mm 1.7 m 27 m coarse and fine

Telescope tilting range TC 1600, T1600 with DI 2000 T1600 with DI 1000/DI 55	fully transiting
Position 1	-55° (-60 gon) to zenith
Position 2	-30° (-33 gon) to zenith

Displays	2 liquid-crystal displays each for 8 digits, sign, decimal point and symbols for user guidance
-----------------	--

Two models	Keyboard and displays in both telescope positions or keyboard and displays in position 1 and REC module in position 2
-------------------	--

Keyboard	weatherproof, 14 multiple-function keys, contact pressure 30 g
-----------------	---

Distance measurement T1600 TC 1600	with Wild DISTOMAT attached coaxial telescope for angle and distance measurement
---	--

Automatic correction	Circle eccentricity Horizontal collimation error Vertical-index error Earth curvature and mean refraction
-----------------------------	---

Data recording GRM10 REC module	Plug-in data-recording and storage module
GRE	Data terminal can be connected to theodolite
REC module	<ul style="list-style-type: none"> - CMOS memory - Capacity 16 kbyte or about 500 data blocks - Dimensions 74 mm x 60 mm x 10 mm - Weight 70 g (2 oz)
Displayed values T1600 TC1600/T1600 with DISTOMAT	Pairs of values Horizontal angle Vertical angle Vertical angle Slope distance Horizontal angle Horizontal distance Target-point height Height difference Easting Northing Setting-out differences Point number
with recording unit	
Power supply Consumption	12 V DC about 0.06 A (without illumination of displays and reticle)
Automatic power-off	about 3 minutes after last keystroke

Plug-in battery GEB77 Fuse Weight	rechargeable 12 V 0.45 Ah NiCd 2 A microfuse with two contact pins 0.2 kg (0.45 lb)
Small battery GEB70 Fuse Weight	rechargeable 12 V 2 Ah NiCd FST 5020-T 2.5 A 5 x 20 0.9 kg (2.1 lb)
Large battery GEB71 Fuse Weight	rechargeable 12 V 7 Ah NiCd FST 5020-T 2.5 A 5 x 20 3.0 kg (6.6 lb)
Operating life	see page 67
Battery charger GKL12 Primary voltage	to charge 2 GEB70 or GEB77 115 V or 230 V +10% -15%, 50/60 Hz
Consumption	about 15 W
Charging current	2 x 0.2 A ±15%
Charging time	about 14 h
Charging temperature	+10°C to +30°C
Fuse	Temperature fuse in transformer

Battery charger GKL14	to charge a large battery GEB71
Primary voltage	115 V or 230 V $\pm 20\%$, 50/60 Hz
Consumption	about 25 W
Charging current	0.7 A $\pm 10\%$
Charging time	about 14 h
Charging temperature	+10°C to +30°C

Height of tilting axis above tribrach dish	196 mm, as T2, T1000, T2000
--	-----------------------------

Sensitivity of levels	
Circular bubble in tribrach	8' per 2 mm
Plate level	30" per 2 mm

Optical plummet (in tribrach)	focusing
Magnification	2x

Temperature range	
Measurement	-20°C to +50°C
Storage	-40°C to +70°C

Weights	
T1600, excluding tribrach and battery	4.5 kg (9.9 lb)
TC1600, excluding tribrach and battery	5.5 kg (12.1 lb)
Plug-in battery GEB77	0.2 kg (0.4 lb)
Tribrach GDF22	0.9 kg (2.0 lb)
Case	3.9 kg (8.6 lb)

Distance measurement with TC1600

Standard deviation

Normal distance measurement	3 mm + 2 ppm, time needed 5 s
DIL continuous measurement	3 mm + 2 ppm, time needed 5 s
Fast measurement	3 mm + 2 ppm, time needed 3 s
Tracking	10 mm + 2 ppm, time needed 1-2 s

Signal attenuation	automatic
---------------------------	-----------

Break in measuring beam	no effect on results
--------------------------------	----------------------

Range

Circular prisms	Atmospheric conditions		
	poor ¹⁾	medium ²⁾	excellent ³⁾
1	1.0 km	2.0 km	2.5 km
3	1.2 km	2.8 km	3.5 km
7	1.4 km	3.5 km	4.5 km
11	1.6 km	4.0 km	5.5 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

Carrier wave	0.850 μm , infra-red
---------------------	---------------------------------

Beam width at half power 2.5' = 0.70 m at 1000 m

Power consumption
during distance measurement about 5 W (0.4 A, 12 V)

Scale correction - 399 ppm to +399 ppm
in 1 ppm steps

Additive (prism) constant - 999 mm to +999 mm
in 1 mm steps

Automatic correction Circle eccentricity
Horizontal collimation error
Vertical-index error
Earth curvature and mean
refraction

15. Prism constant and scale correction

15.1 Prism constant [mm]

The prism constant must be set in the theodolite. Set the mm value stored in the DISTOMAT to 0.

To ensure that the correct distance is displayed, set the appropriate prism constant for the type of prism used. The constant for Wild circular prisms is 0.

For other makes or types of reflector, measure an accurately known base line to determine the prism constant.

15.2 Scale correction [ppm]

The scale correction in parts per million [ppm] must be input and stored in the theodolite. This applies automatic corrections proportional to the distance, such as atmospheric correction, reduction to mean sea level, projection-scale factor, etc. Set the ppm value stored in the DISTOMAT to 0.

SET mm mm RUN

SET ppm ppm RUN

15.2.1 Atmospheric correction ΔD_1

To ensure that the correct distance is displayed, a scale correction in ppm must be input for the atmospheric conditions prevailing at the time of measurement.

The atmospheric correction takes into account both atmospheric pressure and temperature.

To determine the atmospheric correction to an accuracy of 1 ppm, measure the ambient temperature to an accuracy of 1°C and atmospheric pressure to 3 mb.

For most applications, an approximate value for atmospheric correction (within about 10 ppm) is adequate. This can be obtained by taking the average temperature for the day and the height above mean sea level of the survey site. A temperature change of about 10°C or a change in height above sea level of about 350 m (= 35 mb) varies the scale correction by only 10 ppm.

The atmospheric correction is computed in accordance with the following formula:

$$\Delta D_1 = 281.8 - \frac{0.29065 p}{1 + 0.00366 t}$$

where: ΔD_1 = atmospheric correction [ppm]
p = atmospheric pressure [mb]
t = ambient temperature [°C]

15.2.2 Reduction to mean sea level ΔD_2

The correction in ppm for the reduction to mean sea level is shown in graph 2. For all locations above sea level, the correction is always negative.

Graph 2 is based on the formula:

$$\Delta D_2 = - 10^3 \cdot \frac{H}{R}$$

where: ΔD_2 = reduction to MSL in ppm
H = height of EDM above MSL
R = 6378 km (earth radius)

15.2.3 Correction for projection-scale factor ΔD_3

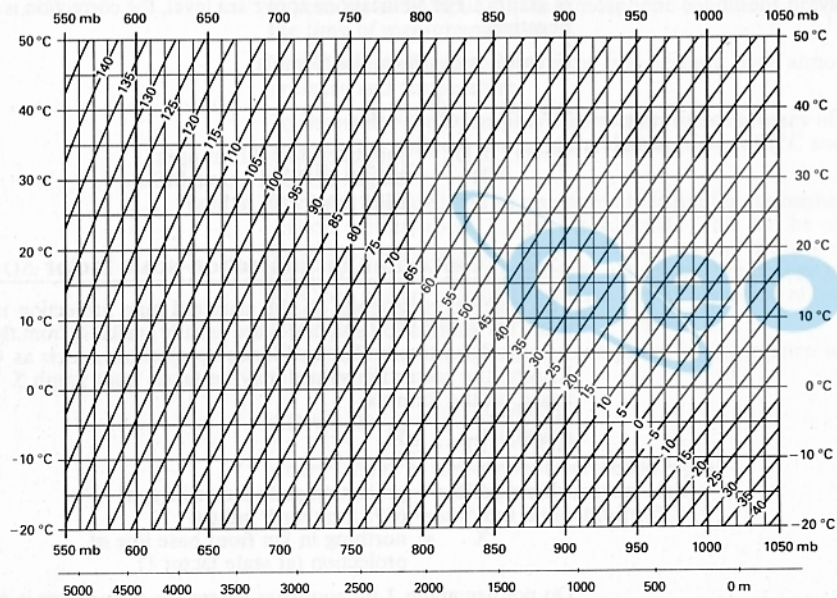
This correction depends on the standard map projection in local use. This information and tables are usually available from the local Survey Department. For cylindrical projections, such as Gauss-Kruger, the correction values may be taken from graph 3. This is based on the formula:

$$\Delta D_3 = 10^6 \cdot \frac{X^2}{2R^2}$$

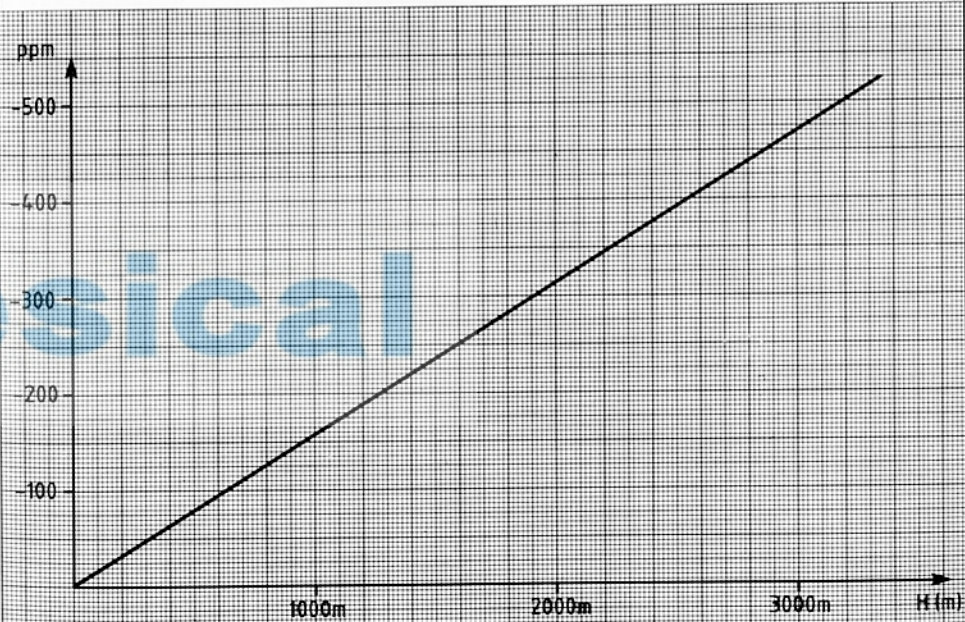
where: ΔD_3 = projection-scale factor in ppm
R = 6378 km (earth radius)
X = northing in km from base line of projection (at scale factor 1)

Do not use graph 3 for countries where the scale factor is not 1.

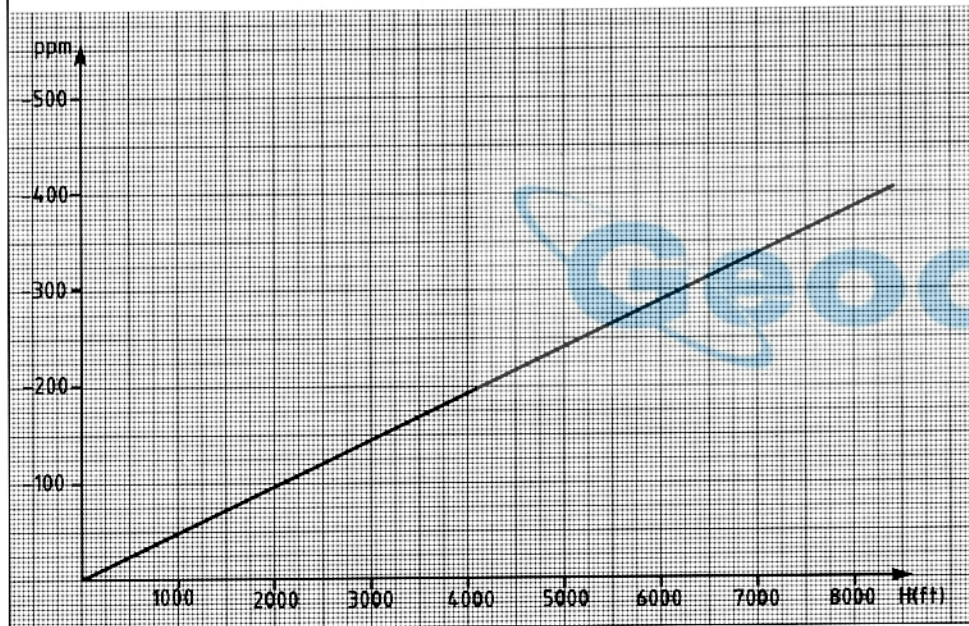
Graph 1: Atmospheric correction in ppm



Graph 2a: Correction to sea level in ppm (height in metres)



Graph 2b: Correction to sea level in ppm (height in feet)



15.2.4 Examples:

a: Atmospheric correction ΔD_1 only

$$t = +15^\circ\text{C} (+59^\circ\text{F})$$

$$H = 560\text{ m } (p = 1840\text{ ft})$$

$$\Delta D_1 = +20\text{ ppm (graph 1)}$$

b: Atmospheric correction ΔD_1 and reduction to MSL ΔD_2

$$t = +15^\circ\text{C} (+59^\circ\text{F})$$

$$H = 560\text{ m } (p = 1840\text{ ft})$$

$$\Delta D_1 = +20\text{ ppm (graph 1)}$$

$$\Delta D_2 = -90\text{ ppm (graph 2)}$$

$$\text{Total} = -70\text{ ppm}$$

c: Atmospheric correction ΔD_1 , correction to MSL ΔD_2 , and correction for projection-scale factor ΔD_3

$$t = +15^\circ\text{C} (+59^\circ\text{F})$$

$$H = 560\text{ m } (p = 1840\text{ ft})$$

$$X = 125\text{ km}$$

$$\Delta D_1 = +20\text{ ppm (graph 1)}$$

$$\Delta D_2 = -90\text{ ppm (graph 2)}$$

$$\Delta D_3 = +190\text{ ppm (graph 3 or from local tables)}$$

$$\text{Total} = +120\text{ ppm}$$

Graph 3: Correction for projection-scale factor in ppm

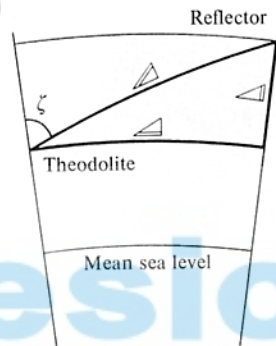
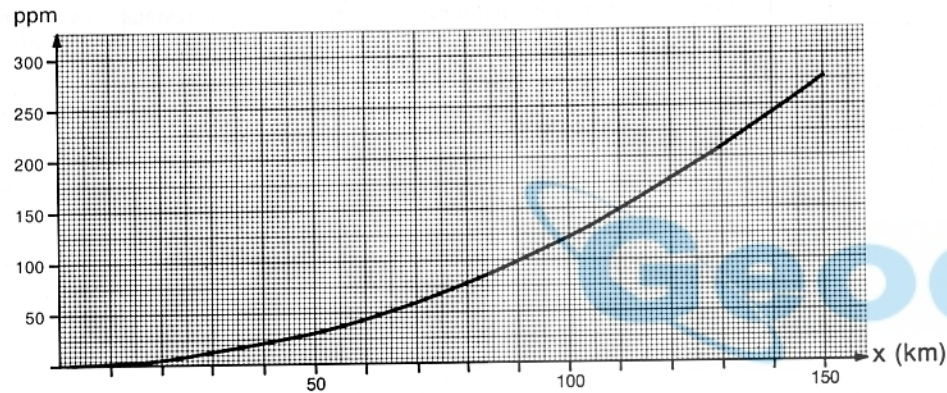


Fig. 23 Height measurement

16. Reduction formulae

The theodolite computes slope distance, horizontal distance, and height difference in accordance with the following formula, which takes into account earth curvature and mean refractive index ($k = 0.13$) for height difference Δ and horizontal distance Δ . The horizontal distance is computed for the instrument station, not for the reflector station.

$$\begin{aligned} \Delta &= \text{displayed slope distance} = D_0 \cdot (1 + \text{ppm} \cdot 10^{-6}) + \text{mm} \\ D_0 &= \text{measured (uncorrected) distance in metres} \\ \text{ppm} &= \text{scale correction in ppm} \\ \text{mm} &= \text{prism constant in mm} \end{aligned}$$

$$\begin{aligned} \text{Horizontal distance } \Delta &= Y - A \cdot X \cdot Y \\ \text{Height difference } \Delta &= X + B \cdot Y^2 \end{aligned}$$

$$\begin{aligned} Y &= \Delta \cdot |\sin \zeta| \\ X &= \Delta \cdot \cos \zeta \\ \zeta &= \text{measured vertical angle} \\ A &= \frac{1 - k/2}{R} = 1.47 \cdot 10^{-7} \text{ [m}^{-1}\text{]} \\ B &= \frac{1 - k}{2R} = 6.83 \cdot 10^{-8} \text{ [m}^{-1}\text{]} \\ k &= 0.13 \\ R &= 6.37 \cdot 10^6 \text{ m} \end{aligned}$$

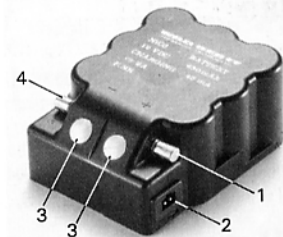


Fig. 24 Plug-in battery GEB77

- 1 Fuse
- 2 Socket for battery charger
- 3 Contacts
- 4 Spare fuse

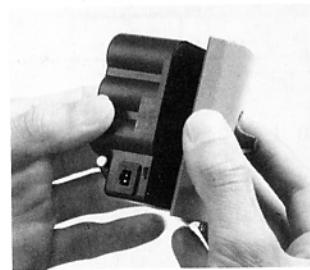


Fig. 25 Insert battery in cover and lock into position





17. Electrical equipment

17.1 12 V nickel-cadmium battery

The theodolite, recording module, and DISTOMAT require a 12 V DC power source. Three types of battery are available, but any other 12 V DC power source may be connected. A cable for connecting a 12 V vehicle battery is also available.

17.2 Plug-in battery GEB77

To insert the battery:

-  1: Turn knob on cover horizontal
-  2: Insert battery in cover
-  3: Turn knob vertical to secure battery to cover
- 4: Insert cover with battery attached into theodolite
-  5: Turn knob horizontal to lock

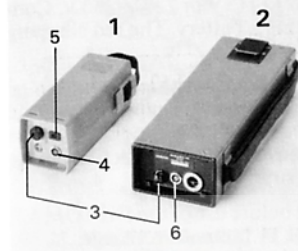


Fig. 26 Rechargeable 12V NiCd batteries

- 1 Small 2 Ah battery GEB70
- 2 Large 7 Ah battery GEB71
- 3 Fuse holder
- 4 Socket for battery cable
- 5 Socket for battery charger
- 6 Socket for battery cable and charging unit

17.3 External batteries GEB70 and GEB71

When the theodolite is being powered by an external battery, the plug-in battery is automatically switched off.

17.4 Operating life of batteries

Operating times shown are valid for new batteries at normal temperatures (20°C). Older batteries or low temperatures reduce the operating times.

	Plug-in battery GEB77	Small battery GEB70	Large battery GEB71
T1600	¹⁾ about 9 h	about 35 h	about 120 h
TC1600			
T1600 with DI1000	²⁾ about 250	about 1000	about 3500
T1600 with DI2000			
T1600 with DI3000			
T1600 with DI55	²⁾ about 200	about 800	about 2800

¹⁾ Continuous operation

²⁾ Angle and distance measurements

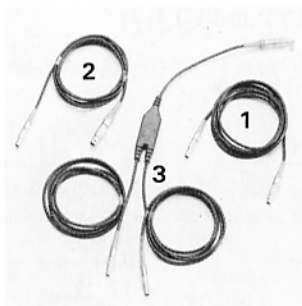


Fig. 27 Connecting cables

- 1 Data-transfer cable from theodolite to GRE
- 2 Cable from external battery to theodolite
- 3 Combined cable to link theodolite to GRE and external battery

17.5 Battery charging

Set voltage selector of battery charger to 115 V or 220 V/230 V. Connect charger to AC mains (line). Connect battery. The red charging indicator should light up.

If the red charging indicator does not light up, there is no mains supply, the battery fuse has blown and must be replaced, or one of the cable connections is faulty. The green power indicator of the GKL14 should also light up; if it does not, the connection to the mains is faulty or there is no mains supply.

Make sure the battery is fully charged before use of the DISTOMAT. A completely flat battery takes about 14 hours to recharge.

The battery charger GKL12 has a built-in overload protection timer. With a battery connected, simply press the red button to start a 14-hour charge. If there is a break in the AC mains supply, the timer restarts automatically. At the end of the charging period, it automatically switches off the power supply.

Do not leave the battery on charge for too long. A time switch for the GKL14 (available from electrical shops) is recommended for setting the charging time.

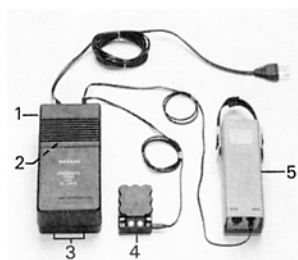


Fig. 28 Battery charger GKL12 for 2 plug-in or small batteries (charging unit GKL14 for large battery GEB71 not shown)

- 1 Battery charger GKL12
- 2 Mains-voltage selector switch 115 V/230 V (underneath)
- 3 Control lamps
- 4 Plug-in battery GEB77
- 5 Small battery GEB70

17.6 Discharge rate of 12V NiCd battery

Figure 29 is a graph of the typical discharge rate of a NiCd battery. The voltage of a fully charged battery drops rapidly from index 9 to 7. The voltage drop from index 7 to 3 takes longer. The drop from index 3 to 1 is again fairly rapid. When the battery voltage drops below 10.9V, message 12 is displayed.

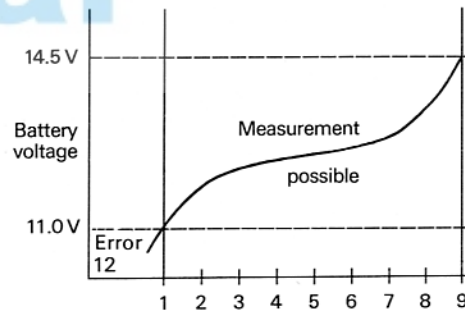


Fig. 29 Graph showing the rate of discharge of a 12V NiCd battery