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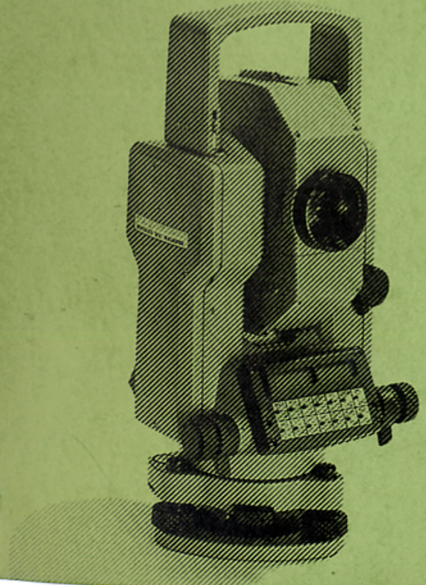
WILD T 1600 · TC 1600

INSTRUCTION MANUAL



WILD® HEERBRUGG

Wild T1600
Universal electronic theodolite

Wild TC1600
Electronic total station

Contents

		Page
1.	**Introduction**	4
2.	**Preparations for measurement**	6
2.1	DI5S, DI1000, DI2000, DI3000, DIOR3002	6
2.2	DI4, DI4L, DI5	7
3.	**Pointing to a reflector**	8
3.1	T1600	8
3.2	TC1600	9
4.	**Operating without recording**	10
4.1	Angle and distance measurement	10
4.2	Height and coordinates of target point	12
4.3	Setting-out with display of difference	12
4.4	Remote object height	13
4.5	Determination of vertical-index error	14
4.6	Determination of horizontal collimation error	15
5.	**Data recording**	16
5.1	Wild GRE data terminal	16
5.2	GRM10 REC module	16
5.3	Setting the theodolite	17
5.4	Setting the data recorder	19
5.5	Recording a block of measured data	20
5.6	Recording a code block	22
5.7	Input of REM words	22
5.8	Display of stored data	23
5.9	Delete data in REC module	23
6.	**Coordinate geometry COGO functions**	24
6.1	Storing coordinates in the REC module	25
6.2	Distance between the two last-measured points	25
6.3	Distance between two recorded points	26
6.4	Area computation	27
6.5	Setting station coordinates	28
6.6	Resection	29
6.7	Orientation of horizontal circle	30
6.8	Setting-out	31
7.	**Test commands**	32
8.	**SET MODE commands**	33
9.	**Data transfer from REC module to computer**	36
9.1	Wild GIF10 REC module reader	36
9.2	Wild GRE data terminal	37
9.3	On-line link	38
10.	**Messages and errors**	39
11.	**Notes**	43
12.	**Checks and adjustments**	44
12.1	Tripod	44
12.2	Plate level	44
12.3	Circular bubble in tribrach	45
12.4	Horizontal collimation error	45
12.5	Vertical-index error	46
12.6	Optical plummet	47
13.	**Care and storage of the equipment**	49
14.	**Technical data**	50
15.	**Prism constant and scale correction**	57
15.1	Prism constant [mm]	57
15.2	Scale correction	57
15.2.1	Atmospheric correction ΔD_1	58
15.2.2	Reduction to MSL ΔD_2	59
15.2.3	Projection-scale factor ΔD_3	59
15.2.4	Examples	63
16.	**Reduction formulae**	65
17.	**Electrical equipment**	66
17.1	12 V nickel-cadmium battery	66
17.2	Plug-in battery GEB77	66
17.3	External batteries GEB70 and GEB71	67
17.4	Operating life of batteries	67
17.5	Battery charging	68
17.6	Discharge of a 12 V NiCd battery	69

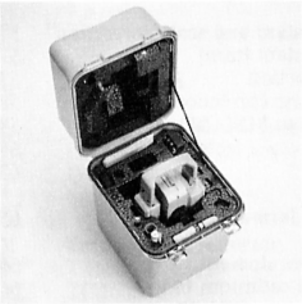


Fig. 1 TC1600 in case.

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, DI5S 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.

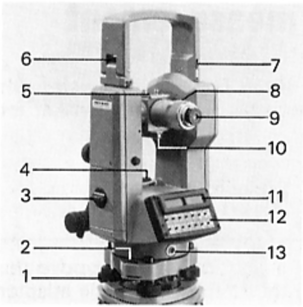


Fig. 2 Wild T1600

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

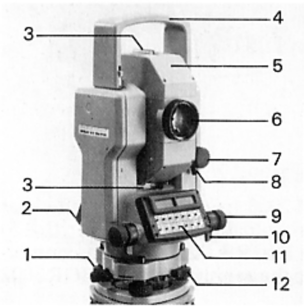


Fig. 3 Wild TC1600

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

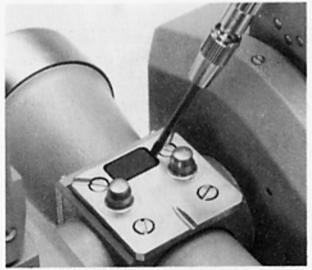


Fig. 4 Removal of protective cap to telescope adapter plate

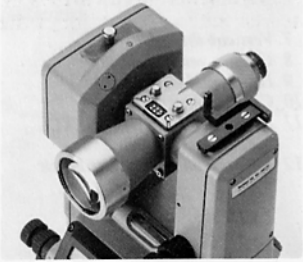


Fig. 5 Relief pin for DI 3000, DIOR 3002

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, DIOR 3002

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: [SET] [MODE] 26 [RUN]

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 DIOR 3002. A special counterweight is available for steep sights (to the zenith) with the DIOR 3002 (fig. 6).

Fig. 6 DIOR 3002 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: [SET] [MODE] 25 [RUN]

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:

[SET] [MODE] 20 [RUN] n [RUN]

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.

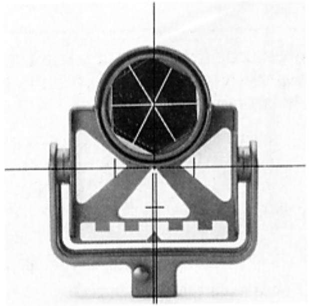


Fig. 8 GPH1A single-prism holder: cross-hairs must intersect on yellow target plate

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.

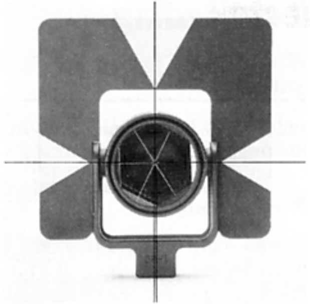


Fig. 9 GPH1 single-prism holder with GZT4 target plate attached: cross-hairs must intersect in centre of prism

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.

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 Hz_0 • RUN	Resets Hz circle to 0.

SET Hz_0 245.5734 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

SET H_0 H_0 RUN — Input station height, i.e. height above datum.

SET E_0N_0 E_0 RUN N_0 RUN — Input station coordinates.
To set to 0.000, input the decimal point without digits.

DIST — Starts distance measurement.

DSP H ⊿ — Displays target-point height and height difference.

DSP E N — Displays target-point coordinates.

4.3 Setting-out with display of difference

SET S_0 α RUN S_0 RUN — Input setting-out elements (with decimal point, if required):
α = required bearing
S_0 = required horizontal distance

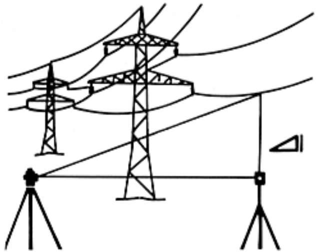
DIST — Measures distance.

DSP DIFF — Displays setting-out differences ΔHz and Δ⊿.

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

Δ⊿ shows the distance by which the reflector has to be moved.

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



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.

DIST — Measures distance.

DSP H ⊿ — 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.

REC — Records the initial measurement to the reflector.

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.

SET MODE 10 RUN	Displays stored vertical-index error.

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

RUN	Deletes display.

In position 2, point instrument to the same target.

RUN	Displays new vertical-index error.
RUN or	Stores new value.
CE	Retains existing vertical-index error and terminates function.

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.

SET MODE 11 RUN	Displays stored horizontal collimation error.

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

RUN	Deletes display.

In position 2, point instrument to the same target.

RUN	Displays new horizontal collimation error.
RUN or	Stores new value.
CE	Retains existing horizontal collimation error and terminates function.

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

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.

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 nº	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 nº	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 } target point
Wi = 32	Horizontal distance	Wi = 82	Northing } target point
Wi = 33	Height difference	Wi = 83	Height } target point

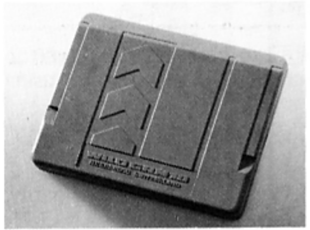


Fig. 11 Wild GRM 10 REC module

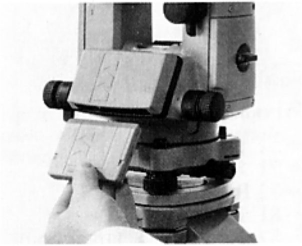


Fig. 12 Insertion of REC module in theodolite; to pull out, press slightly forward

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 consists of up to eight words. See GIF10 manual for complete table of word identifiers Wi.

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] ± • [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] ± • [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

[DSP] [NR]	Displays point number to be recorded.
[SET] [NR_0] Pt n° [RUN]	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.
[SET] [NR_0] ± [RUN]	Reduces current point number by 1 and reverses counting direction (for observation of points in reverse order).
[NR] Pt n° [RUN]	Input of non-sequential point number; interrupts sequential point numbering.
[NR] ± [RUN]	Deletes input of non-sequential point number; continues sequential point numbering.

Measurement and recording

[DIST]	Measures distance.
[REC]	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.
[ALL]	Measures distance and automatically records the block of measured data and increments current point number by 1.
[REP] [REC] or [REP] [ALL]	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.

[CODE] Code n° [RUN] [REC] — Input of code number.

[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 Wi = 71 and Wi = 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.

[DATA] — Switches theodolite to data mode.

[RUN] — Terminates data function.

[DATA] [←] [→] [RUN] — Displays data word for word by searching forward or backward.

[DATA] [FIND] Pt n° [RUN] — 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

[SET] [MODE] 99 [RUN] ± • [RUN] — Deletes all data in REC module. Selective deletion of data is not possible.

6. Coordinate geometry COGO functions

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

They are selected as follows:

[SET] [COGO] [RUN] [REP] [RUN] or
[SET] [COGO] n [RUN]

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

[SET] [COGO] 11 [RUN]	Selects functions.
→ Pt. no [RUN]	Enter point number.
E [RUN] N [RUN] [RUN] or	Enter coordinates E and N.
E [RUN] N [RUN] H [RUN]	Enter coordinates E, N and height H.
[REC]	Records entered values
— Likewise enter further points.	
[CE]	Ends function.

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 [DIST].

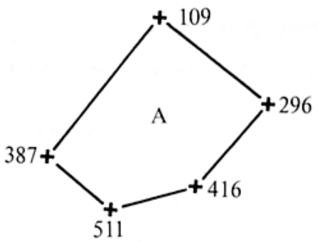
[SET] [COGO] 12 [RUN]	Selects function. The horizontal distance and height difference are displayed.
[CE]	Ends function.

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.

SET COGO 13 RUN	Selects function.
Pt. no RUN	Enter first point number.
Pt. no RUN	Enter second point number. Horizontal distance and height difference are calculated and displayed.
CE	Ends function.



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 Wi = 11, Wi = 81 (E) and Wi = 82 (N) if points are to be measured.

SET COGO 14 RUN	Selects function.
n RUN	Enter number of corner points.
Pt. no 1 RUN	Enter point number of first corner point (109 in sketch above).
Pt. no 2 RUN	Enter point number of second corner point (296 in sketch above).
Pt. no n RUN	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.
CE	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.

[SET] [COGO] 21 [RUN] — Selects function.

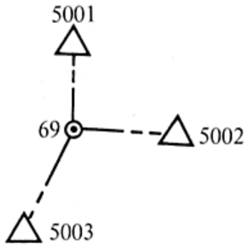
Pt. no [RUN] — Enter station number. The coordinates of the point are set as station coordinates E_0, N_0.

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

Check with [SET] [E_0N_0] and [SET] [H_0].

Setting a reference direction, see 6.7.

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».

[SET] [COGO] 22 [RUN] — Selects function.

→ Pt. no [RUN] — Enter point number of first known point (5001 in sketch above).
Point to known target point.

[RUN] — 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.

[CE] or — Terminates function.

[RUN] or — Sets station coordinates E_0, N_0 in theodolite and temrinates function.

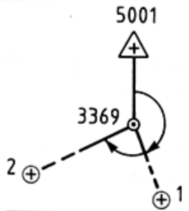
[REC] Pt. no [RUN] — Enter station number (69 in sketch above). Records point number, E_0, N_0 in REC module. Sets station coordinates E_0, N_0 in theodolite and terminates function. The Hz-circle orientation will not be reset.

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.

SET COGO 23 RUN	Selects function.
Pt. no RUN	Enter point number of reference point. The corresponding bearing is computed and displayed.
aim at reference point	
RUN	Sets bearing as Hz-circle reading on the theodolite. Terminates function.



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.

SET COGO 24 RUN	Selects function.
Pt. no RUN	Enter point number of point to be set out. Horizontal direction and distance are computed and displayed.
RUN	Selects difference display (computed minus observed). Terminates function.
DIST or REP DIST	Measures distance. New setting-out differences are computed and displayed.

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

7. Test commands

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

[CE] terminates test commands.

[TEST] 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.

[TEST] 1 Tests displays.

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

[TEST] 7 Displays temperature inside theodolite.

[TEST] 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.

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

8. SET MODE commands

Command strings:
[SET] [MODE] Z_1 [RUN]
[SET] [MODE] Z_1 [RUN] Z_2 [RUN] or
[SET] [MODE] Z_1 [RUN] [REP] [RUN]
Instead of the Z_2 input, press [REP] 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 1	OFF ON
40	Set unit of angle measurement	2 3 4 5	400 gon 360° decimal 360° sexadecimal 6400 mil
41	Set unit of distance measurement	0 1	metre foot
49	Display actual measuring frequency		
69	Select distance-measurement program on TC1600, DI2000, DI3000	0 1 2	normale measurement DIST fast measurement DI continuous measurement DIL
70	Set data transfer rate	0 1 2 3 4 5 6 7	110 baud 300 baud 600 baud 1200 baud 2400 baud 4800 baud REP 9600 baud
71	Set parity	0 1 2	no parity check odd even

Z_1	Signifies	Z_2	Signifies
73	Set end character	0 1	CR CR LF
74	Select command mode	0 1	T1600 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 1	without protocol with protocol
76	Select recording unit	0 1	GRE 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 1	Power-off about 3 minutes after last keystroke No automatic power-off
98	Data transfer from REC module to GRE		
99	Delete all data in REC module and initialize REC module	[±] [•]	

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 GIF 10 REC module reader

The GIF 10 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 GIF 10 for about 12 hours.

For further details, see the GIF 10 manual.

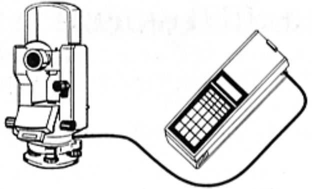


Fig. 14 Data transfer from REC module to GRE data terminal

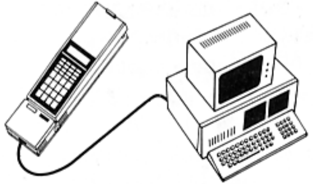


Fig. 15 Data transfer from GRE to computer

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 ([SET] [MODE] 78 [RUN] [RUN]).

See 5.4 for setting the GRE.

To transfer data from a REC module to a GRE, enter command [SET] [MODE] 98 [RUN].

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

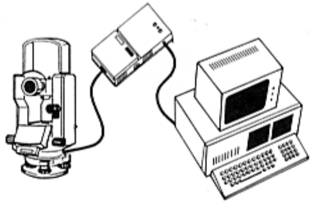


Fig. 16 Data transfer from REC module to computer

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 [SET] [MODE] 98 [RUN].

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 [SET] [MODE] command	[CE], correct input
02	Telescope not in position 1 for start of determination of vertical-index and horizontal collimation error	[CE], start measurement in position 1
03	Illegal input	[CE], correct input
04	Vertical-index or horizontal collimation error > 1 gon	[CE], redetermine vertical-index or horizontal collimation error
05	[REC] during distance measurement	[CE] [CE], repeat measurement
06	[REP] [REC] illegal; there is no previous point number	[CE]
09	Point number has reached 99 999 999; in negative direction 0	[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	[CE], repeat function
14	Illegal command during distance measurement	[CE] [CE], repeat measurement

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

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

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

11. Notes

- Avoid damage to the diodes; never point the telescope of the T1600 with DISTOMAT attached or of the TC1600 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°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.

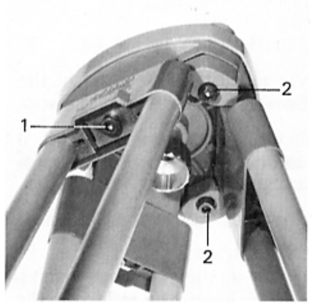


Fig. 17 Tripod GST20 and GST20-9

Fig. 18 Adjustment of plate level

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.

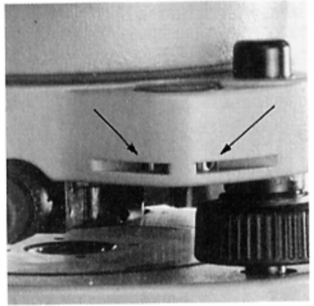


Fig. 19 Adjustment of circular bubble in tribrach

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 [SET] [MODE] 11 [RUN]. 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″

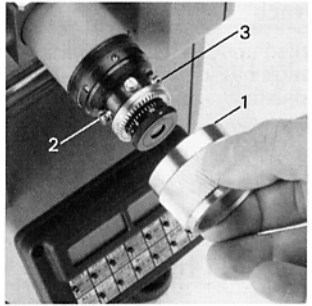


Fig. 20 Adjustment of horizontal collimation error

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.

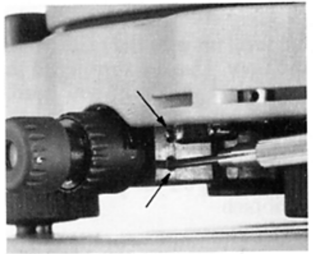


Fig. 21 Adjustment of optical plummet. Arrows mark adjustment screws.

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.

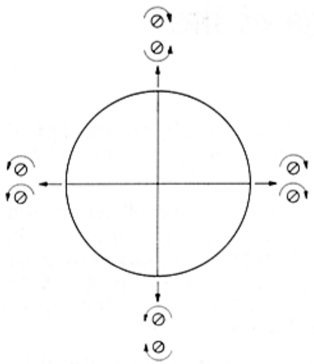


Fig. 22 To adjust the optical plummet, turn the adjustment screws as shown to move the cross-hairs in the direction indicated by the straight arrows.

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, T 1600 with DI 2000 T 1600 with DI 1000/DI 5S Position 1 Position 2	 fully transiting −55° (−60 gon) to zenith −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 T 1600 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	
GRM 10 REC module	Plug-in data-recording and storage module
GRE	Data terminal can be connected to theodolite

REC module	– 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	Pairs of values	
T1600	Horizontal angle	Vertical angle
TC1600/T1600 with DISTOMAT	Vertical angle	Slope distance
	Horizontal angle	Horizontal distance
	Target-point height	Height difference
	Easting	Northing
	Setting-out differences	
with recording unit	Point number	

Power supply	12 V DC
Consumption	about 0.06 A (without illumination of displays and reticle)
Automatic power-off	about 3 minutes after last keystroke

Plug-in battery GEB77	rechargeable 12 V 0.45 Ah NiCd
Fuse	2 A microfuse with two contact pins
Weight	0.2 kg (0.45 lb)
Small battery GEB70	rechargeable 12 V 2 Ah NiCd
Fuse	FST 5020-T 2.5 A 5 x 20
Weight	0.9 kg (2.1 lb)
Large battery GEB71	rechargeable 12 V 7 Ah NiCd
Fuse	FST 5020-T 2.5 A 5 x 20
Weight	3.0 kg (6.6 lb)
Operating life	see page 67
Battery charger GKL12	to charge 2 GEB70 or GEB77
Primary voltage	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 GKL 14	to charge a large battery GEB 71
Primary voltage	115 V or 230 V ±20%, 50/60 Hz
Consumption	about 25 W
Charging current	0.7 A ±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	2 x

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]

SET mm mm RUN

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]

SET ppm ppm RUN

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.

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

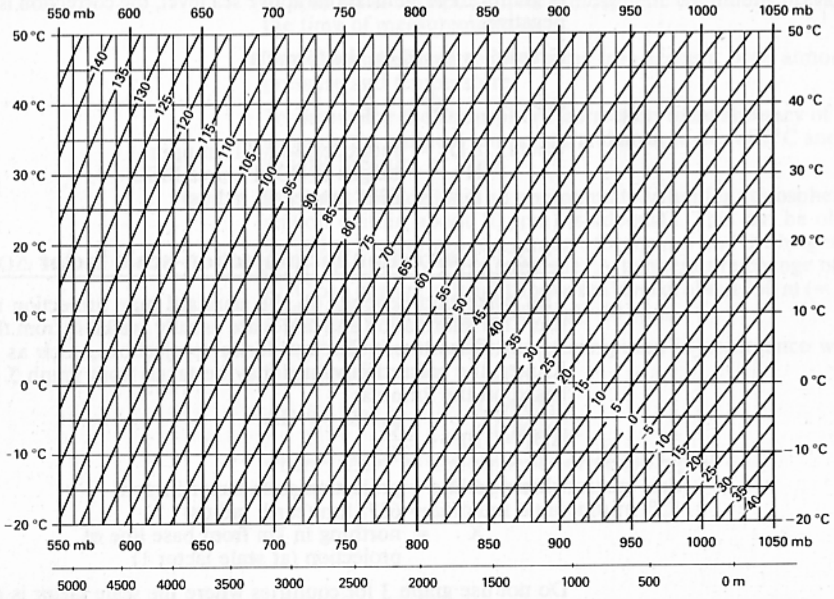
This correction depends on the standard map projection in local use. This information and tables are usually available from the local Survey Department. For cylindrical projections, such as Gauss-Kruger, the correction values may be taken from graph 3. This is based on the formula:

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

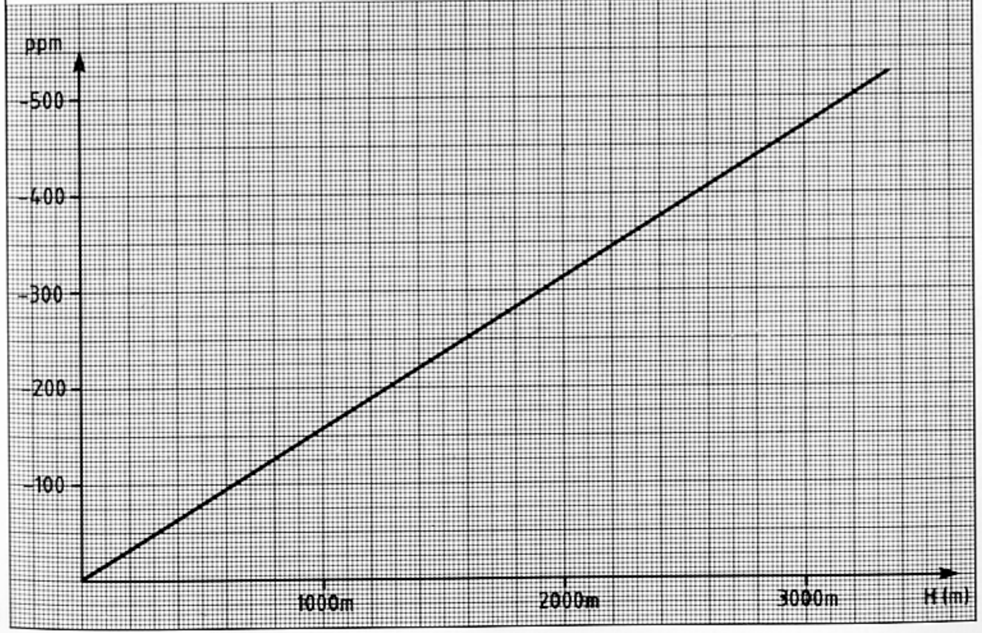
where: ΔD_3 = projection-scale factor in ppm
R = 6378 km (earth radius)
X = northing in km from base line of projection (at scale factor 1)

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

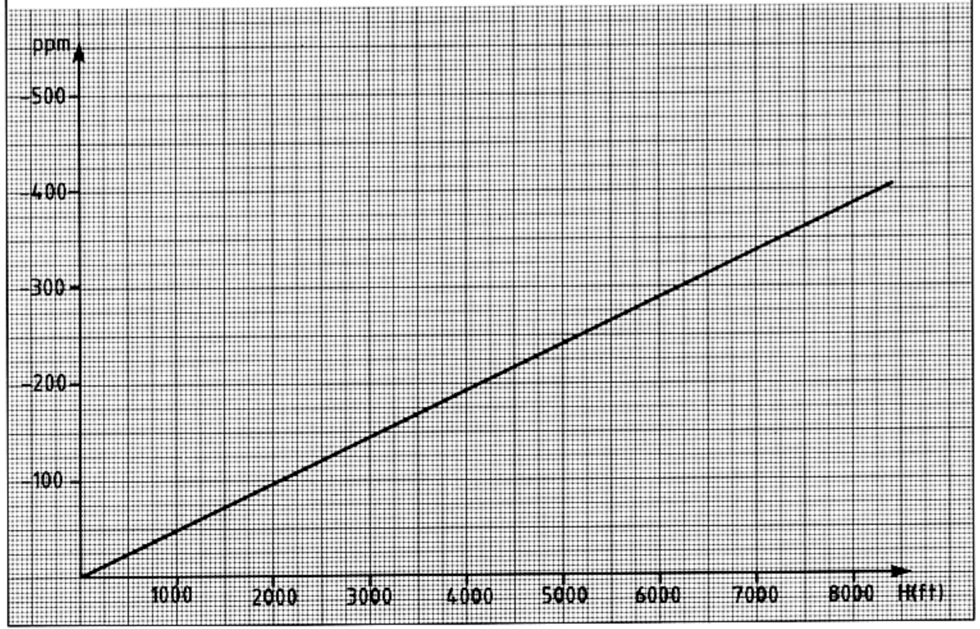
Graph 1: **Atmospheric correction in ppm**



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°C (+59°F)
H = 560 m (p = 1840 ft)

ΔD_1 = +20 ppm (graph 1)

b: Atmospheric correction ΔD_1 and reduction to MSL ΔD_2

t = +15°C (+59°F)
H = 560 m (p = 1840 ft)

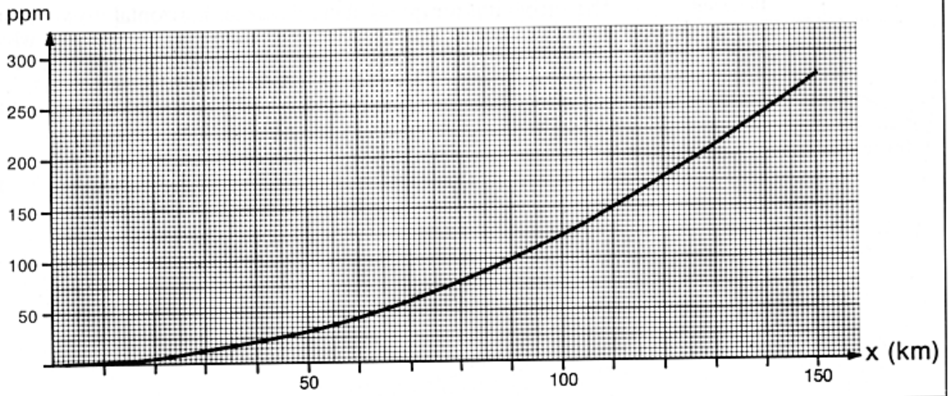
ΔD_1 = +20 ppm (graph 1)
ΔD_2 = −90 ppm (graph 2)
Total = −70 ppm

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

t = +15°C (+59°F)
H = 560 m (p = 1840 ft)
X = 125 km

ΔD_1 = +20 ppm (graph 1)
ΔD_2 = −90 ppm (graph 2)
ΔD_3 = +190 ppm (graph 3 or from local tables)
Total = +120 ppm

Graph 3: **Correction for projection-scale factor in ppm**



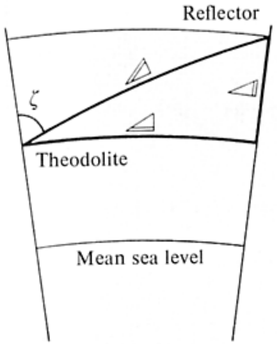


Fig. 23 Height measurement

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 ⊿ and horizontal distance ⊿. The horizontal distance is computed for the instrument station, not for the reflector station.

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

Horizontal distance ⊿ = $Y - A \cdot X \cdot Y$
Height difference ⊿ = $X + B \cdot Y^2$

Y = ⊿ $\cdot |\sin \zeta|$
X = ⊿ $\cdot \cos \zeta$
ζ = measured vertical angle

$$A = \frac{1 - k/2}{R} = 1.47 \cdot 10^{-7}\ [m^{-1}]$$

$$B = \frac{1 - k}{2R} = 6.83 \cdot 10^{-8}\ [m^{-1}]$$

k = 0.13
R = $6.37 \cdot 10^6$ m

17. Electrical equipment

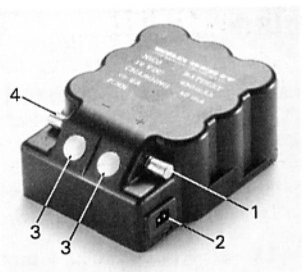


Fig. 24 Plug-in battery GEB77

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

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

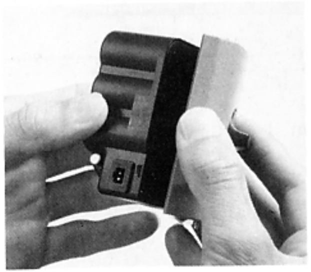


Fig. 25 Insert battery in cover and lock into position

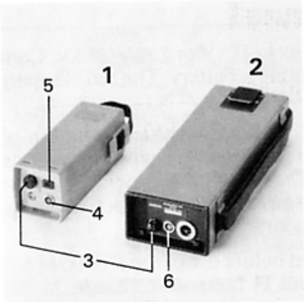


Fig. 26 Rechargeable 12 V NiCd batteries

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 T1600 with DI2000 T1600 with DI3000	2)	about 250	about 1000	about 3500
T1600 with DI5S	2)	about 200	about 800	about 2800

1) Continuous operation
2) Angle and distance measurements

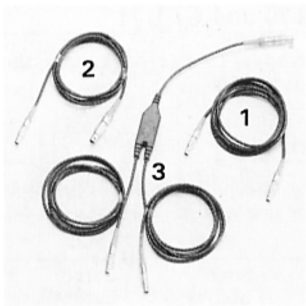


Fig. 27 Connecting cables

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 GKL 14 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 GKL 12 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 ent 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 GKL 14 (available from electrical shops) is recommended for setting the charging time.

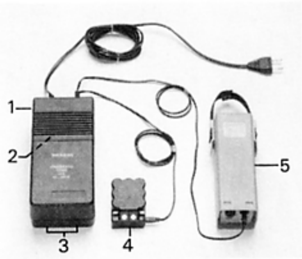


Fig. 28 Battery charger GKL 12 for 2 plug-in or small batteries (charging unit GKL 14 for large battery GEB 71 not shown)

1 Battery charger GKL 12
2 Mains-voltage selector switch 115 V/230 V (underneath)
3 Control lamps
4 Plug-in battery GEB 77
5 Small battery GEB 70

17.6 Discharge rate of 12 V 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 10.9 V, message 12 is displayed.

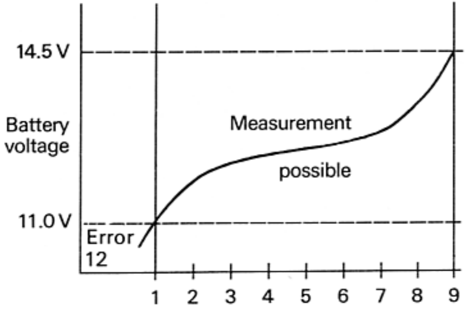


Fig. 29 Graph showing the rate of discharge of a 12 V NiCd battery