WILD T2002 • T3000

WILD TC2002

Yellow pages

User Manual

This user manual contains important safety directions (chapter 25) as well as instructions for setting up the instrument and operating it. Read carefully through the user manual before you switch on the instrument.

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Contents

1 INTRODUCTION

The T2002 and T3000 theodolites are further developments of the T2000/T2000S series. The difference between T3000 and T2002 is similar to that between T2000 and T2000S: the T3000 telescope is more powerful and is panfocal. The functions have to a large extent been taken over from the earlier models, expanded, and improved.

1.1. Product identification

The model and serial number of your theodolite is on the side, at the standard. Enter the model and serial number in your manual and always refer to this information when you need to contact your agency or authorized service workshop.

Model number: Serial number:

1.2. Meaning of symbols

The symbols used in this manual have the following meanings:

⚠ **WARNING:**
Indicates a potentially hazardous situation which, if not avoided, could result in death or injury.

⚠ **CAUTION:**
Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury and/or appreciable material, financial and environmental damage. The symbol is also used to alert against unsafe practices.

☞ Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

1.3. About this manual

- Section 2 immediately after this introduction lists the technical data.
- The blue pages at the end list the error messages and give a summary of commands and input.
- The theodolite and keyboard are shown on the fold-out back cover.

☞ For optimal use of T2002/TC2002/T3000 read this manual carefully.

1.4. T2002 and T3000 at a glance

- Dynamic angle-scanning system ensures highest angle-measuring accuracy
- T2002 with standard telescope
- T3000 with high-performance panfocal telescope and optional built-in autocollimation eyepiece
- Two-axis compensator automatically determines and corrects standing-axis tilt
- Data recording by REC module or GRE3/GRE4 data terminal
- ON-LINE control by computer
- Built-in coordinate-geometry functions for ancillary calculations
- For special applications, compensator and corrective computations can be switched off
- Distance measurement with any DISTOMAT™ fitted as an add-on unit
- Vast range of accessories for special applications
- Task-oriented application software for GRE3/GRE4

⚠ To operate the T2002/TC2002/T3000 safely, observe the safety instructions in chapter 25.

2. TECHNICAL DATA

Angle measurement	Absolute encoder, dynamic system, whole-circle integration, diametrical scanning	
Resolution	0.03" 0.00001 gon	
Units (can be selected)	360° sexagesimal 360° decimal 400 gon 6400 mil	
Smallest unit in display	0.1" 0.00001° 0.00001 gon 0.0001 mil	
Angle-measurement program	Single measurement Continuous measurement	
Time taken for single measurement		
HZ, or HZ and V	0.9 s	
V only	0.7 s	
Updates, continuous measurements		
HZ, or HZ and V	0.6 s	
V only	0.3 s	
HZ measurements corrected for	Line-of-sight errors Tilting-axis errors Transverse tilt of standing axis	
Effective V range for HZ corrections	+72° to –72°	+80 gon to –80 gon
Maximum standing-axis tilt taken into account in corrections	3.2"	0.06 gon
V measurements corrected for	Index error	

Standard deviation to DIN 18723		
Horizontal angle	0.5"	0.00015 gon
Vertical angle	0.5"	0.00015 gon
Automatic index	Controlled by ON/OFF switch	
Type	Two-axis liquid compensator	
Scans	longitudinally and transversely	
Working range		
Maximum deviation from vertical	3.2'	0.06 gon
Setting accuracy	0.1"	0.00003gon
Keyboard	Waterproof	
18 short-travel keys	Contact pressure 30 g	
Displays	Liquid-crystal display with backlighting	
User guidance	alphanumeric, seven digits	
2 data displays	Eight digits, sign, decimal point	
Data display	in pairs:	
	HZ angle	V angle
	HZ angle	Horizontal distance
Height	Δ H	H
	Slope distance	Vertical angle
Coordinates	Easting	Northing
Setting-out differences	Δ HZ	Δ V
	Δ HZ	Δ Horizontal distance
	---	Point number
Data recording and storage		
REC module	Plug-in data-recording unit	
GRE3/GRE4	Data terminals can be linked to theodolite	
REC module		
Memory	CMOS	
Capacity	16 kbyte capacity (about 500 data blocks)	
	or	
	64 kbyte (about 2000 data blocks)	
Power supply		
Operating voltage	12 V DC	
Power consumption, angle measurement (excl. illumination of displays)	about 1.6 W (0.13 A at 12 V)	

Plug-in battery

GEB68	12 V/1 Ah, NiCd, rechargeable
Fuse	2A microfuse, 2 contact pins

External battery

Small battery GEB70	12 V/2 Ah, NiCd, rechargeable
Fuse	FST 5020/T 2.5 A/5 x 20
Universal battery GEB71	12 V/7 Ah, NiCd, rechargeable
Fuse	FST 5020/T 2.5 A/5 x 20
Any 12 V vehicle battery	

Battery charger GKL22

for charging	GEB68, GEB70 or GEB87 for TPS1000
Primary voltage	
GKL22	220 V (European plug) +/– 10%, 50/60 Hz
GKL22-1	115 V (US-plug), +/– 10%, 50/60 Hz
GKL22-2	100 V (Japan, US-plug, +/– 10%, 50/60 Hz
Charging current	240 mA DC
Charging time	ca. 14 h
Ambient temperature for charging	+10 °C bis + 35 °C
Fuse	self-activating thermo fuse

Battery charger GKL23

for charging	two GEB68, GEB70, GEB71 or GEB87 (for TPS1000)
Primary voltage	
GKL23	220 V (European plug), +10/–20%, 50/60 Hz
GKL23-1	90 V to 115 V (USA and Japan, US-plug) 50/60Hz
Charging current	maximum 1.8 A
Charging time	normal charging time after discharge: ca. 14 h fast charge: 1.5 Ah in 1 h, 7 Ah in 5 h
Discharge	ca. 0.7 A in 1 h
Ambient temperature for charging	+10 °C to +35 °C
Fuse	self-activating thermo fuse

Operating life	GEB68	GEB70	GEB71
Approximate number of angle and distance measurements at +20 °C (68 °F) with DI1000 or DI2000	800	800	2800
Automatic power-off			
selectable time after key last pressed	20 s	3 min	unlimited

Height of tilting axis

above tribrach dish	196 mm (as T2)

Levels, sensitivity	
Circular level	8' per 2 mm
Plate level	20" per 2 mm

Temperature range	
Measurement	–20 °C to +50 °C (–4 °F to 122 °F)
Storage	–40 °C to +70 °C (–40 °F to 158 °F)

Weight	
Theodolite without tribrach or battery	
T2002	7.0 kg (15.5 lb)
T3000	7.5 kg (16.5 lb)
Plug-in battery GEB68	0.9 kg (2.0 lb)
Small battery GEB70	1.0 kg (2.2 lb)
Universal battery GEB71	3.0 kg (6.6 lb)
GDF21 tribrach	0.8 kg (1.8 lb)
REC module	70 g (2¼ oz)
Case	4.9 kg (10.8 lb)

Telescope of T2002		
Image	Erect	
Magnification	32 x	
Objective aperture	42 mm	
Field diameter at 1000 m/1000 ft	27 m/27 ft	
Shortest focusing distance	1.7 m/5' 8"	
Factor for stadia lines	100	
Additive constant	0	
Focusing	coarse and fine	
Max. tilt of telescope, pointing down		
without DISTOMAT	–54°	–60 gon
with DI4/DI4L, angled socket		
Face I	–54°	–60 gon
Face II	–14°	–16 gon
with DI4/DI4L, straight socket		
Face I	–54°	–60 gon
Face II	– 7°	– 8 gon
with DI5S/DI1000/DI2000/DI1001/DI1600/DI2002		
Face I	–54°	–60 gon
Face II	–23°	–26 gon

Telescope of T3000

Type	Panfocal alignment telescope
Image	Erect
Objective aperture	52 mm
Field diameter at 1000 m/1000 ft	20 m/20 ft
Shortest focusing distance	
from front lens	0.51 m/1' 8"
from tilting axis	0.60 m/2' 0"
Focusing	Coarse and fine
Max. tilt of telescope	
without DISTOMAT	
pointing down	–54° –60 gon
pointing up	+47° +52 gon
with DISTOMAT	
Position I	As without DISTOMAT
Position II	Not possible

Angular field and magnification

Distance	Field	Magnification		
		Eyepiece FOK 73	Eyepiece FOK 53	Eyepiece FOK 117
∞	1°08'	43 x	59 x	26 x
100 m	2.08 m	41 x	56 x	25 x
10 m	0.26 m	32 x	44 x	20 x
3 m	0.11 m	24 x	33 x	15 x
0.6 m	0.04 m	13 x	18 x	8 x

Change in the line-of-sight depends on focusing distance:

Distance	Change in line-of-sight
1 m to 4 m	≤ 0.5" ≙ 0.0075 mm
4 m to 10 m	≤ 0.5" ≙ 0.015 mm
10 m to 20 m	≤ 0.5" ≙ 0.025 mm
20 m to ∞	≤ 0.5"

T3000 telescope with built-in autocollimation eyepiece

Autocollimation eyepiece	Green negative linear cross
Lighting	GEB58 plug-in lamp, keyboard switch-on

3 KEYBOARDS AND DISPLAYS (see fold-out back cover)

The theodolite has two control panels, each with a keyboard and display, and can be used in either face. Switching-on the instrument activates both displays.

3.1 Displays

Display 1 Display 2 Display 3

Display 1	8-digit alphanumeric display for user guidance, with identifying codes and symbols for input and displayed data.

The top line bears the following row of symbols:

Bat	Weak battery
◄	Code for angle and distance measurement
~~COMP~~	Compensator switched off
DEG	Angles measured in ° (decimal or sexagesimal units)
mil	Angles measured on 6400mil scale
ft	Distance measured in feet

Displays 2 and 3	8-digit display, mathematical sign, decimal point; display 2 is also used for messages.

Data input on the keyboard appears on display 3.

3.2 Keyboard

All keys are multiple-function keys and colour-coded.

Each key controls the function marked in vertical lettering. When you press this key, the instrument performs and completes this function without any further input, e.g. [DIST], [STOP], [REC].

Functions marked in italics require further input, e.g.:

[REP] [HZ V]	white function
[DSP] [HZ V]	green function
[SET] [FIX] 4 [RUN]	orange function
[DATA] [—>]	blue function

White: Main functions, e.g.:

[HZ]	starts horizontal angle measurement
[REP] [HZ]	starts continuous horizontal angle measurement

Green: Select display format

Displays 2 and 3 show the relevant pairs of values, e.g.:

[DSP] [HZ V]	HZ in display 2	V in display 3
[DSP] [E N]	E (easting) in display 2	N (northing) in display 3

Orange: SET commands

After [SET] always input another orange function, e.g.:

[SET] [ppm] -5 [RUN] Set scale factor

Each input must end with [RUN].

Blue: Search functions for REC module

[DATA] must always be followed by one of the three blue functions, e.g.:

[DATA] [<—] Reverse search of data stored in REC module

Yellow: Numeric input

Input numbers, decimal point, and mathematical sign (+) or (-). Always terminate numeric input by [RUN].

All data input with a [SET] command and the display formats obtained with [DSP] remain stored until replaced by other values, even when the theodolite is switched off, except for the following:

[SET] [MODE] 75
[SET] [MODE] 95

4 ON, OFF, CE, DATA, LIGHT

4.1 [ON]

Switches theodolite on and,

- if [SET] [MODE] 89 is ON, it automatically starts HZ and/or V angle measurement
- if [SET] [MODE] 89 is OFF, it reports CALC OFF

To switch the computation of corrections on/off by [SET] [MODE] 89, see section 6.3.1

4.2 [OFF]

Switches theodolite off; stored values are retained

4.3 [CE]

Deletes input data not yet terminated by [RUN].

Deletes figures one at a time.

Deletes messages, e.g. CALC OFF, ERROR, etc.

Aborts command strings.

4.4 [DATA]

1: Main key for blue functions
2: Single-step key to view menus and input menu command

4.5 [LIGHT]

To switch display and reticle light on and off, press the key with the lamp symbol. The following combinations are possible:

State	Display light	Reticle light
1	on	on (brightness levels 0 to 6)
2	off	on (brightness levels 0 to 6)
3	off	off

State 1:

There are two ways to switch on:
1: with access to potentiometer function for reticle light
2: without access to potentiometer function for reticle light

1: [ON] Switches on theodolite

[LIGHT] n [RUN] Press [LIGHT] for 2 seconds.
Switches on reticle light: n = 0 to 6

n: Brightness level (potentiometer) of reticle light, shown in display 3.

0 = off 6 = maximum brightness

The input value is stored after the light is switched off (state 3).

You may also input or change n by [DATA].

2:	[ON]	Switches on theodolite
	[LIGHT]	Press [LIGHT] briefly. Switches on reticle light; brightness level remains at the last stored value of n.

State 2:

[ON]	Switches on theodolite.
[LIGHT]	Press briefly to switch on light.
[LIGHT]	Press for 2 seconds. Switches off display light.
n [RUN]	n = 0 to 6

You may also input or change n by [DATA].

As in state 1, use n to define the required brightness level for the reticle light (see above). Select this function to dispense with display lighting and save battery power.

State 3: Switches off light

In state 1:	Briefly press [LIGHT]
In state 2:	Briefly press [LIGHT] twice

5 PREPARING FOR MEASUREMENT

Sections 5.4 to 5.8 describe a number of functions, settings, and adjustments to set up the theodolite for specific tasks. For other functions, refer to the summary of commands in section 14. Section 5.9 describes the preparations for using the theodolite with a DISTOMAT.

5.1 Levelling up with the plate level

Before attempting to level up the instrument, ensure that the plate level (15) is properly adjusted, i.e. the bubble must come to rest exactly in the centre of the scale divisions. To adjust the plate level, see section 17.2.

The bubble moves in the same direction as the left thumb as it turns the footscrew (22).

Uneven heating can make centring the bubble inaccurate. Ensure that during levelling up there is no direct sunlight on the plate level.

5.1.1 GDF21 tribrach

1. Centre spherical level (6).
2. Position plate level (15) above footscrew A. Turn footscrews B and C in opposite directions to centre plate level.
3. Turn alidade clockwise to position optical plummet (27) above footscrew A. Turn footscrew A to centre plate level.
4. Turn alidade clockwise through another 90° (100gon). Turn footscrews B and C equally to eliminate half the centring error.
5. Turn alidade clockwise through another 90° (100gon). Turn footscrew A to eliminate half the residual centring error.

Repeat steps 2 to 5 until the plate level remains exactly centred irrespective of the direction in which the theodolite is pointing.

5.1.2 GDF25K tribrach

This tribrach ensures a fixed tilting-axis height. For this purpose, a fixed bolt takes the place of one of the footscrews.

1. Centre spherical level (6).
2. Position optical plummet (27) of theodolite above the fixed bolt. Turn one of the footscrews to eliminate half the centring error of the plate level. Turn the other footscrew to centre the bubble exactly.
3. Position the scale-reading prism (9) for the horizontal circle above the fixed bolt. Turn one of the footscrews to eliminate half the plate level's residual centring error. Turn the other footscrew to centre the bubble exactly.

5.2 Centring by optical plummet

Use the built-in optical plummet (27) to centre the theodolite over a ground point. The focusing range is 0.5m (1'8") to ∞. For instrument heights up to 1.8m (6'0") and a clearly defined ground point, the mean centring error is about ±0.3mm (0.01").

To centre by optical plummet, set up the tripod (23) approximately over the ground point, treading the tripod feet firmly into the ground. Screw the tribrach (GDF21 or GDF25K) to the tripod plate and attach the theodolite. Peer through the optical plummet, turn the two setting rings to focus the cross-hairs and the image. Turn the tribrach's footscrews to bring the cross-hairs into coincidence with the ground point.

Extend or shorten the tripod legs to centre the tribrach's spherical level (6); the cross-hairs stay centred on or near the ground point. Level up the instrument by means of the plate level and check that the cross-hairs of the optical plummet are still centred. To eliminate any small centring error, slacken the central fixing screw and slide (but do not turn!) the instrument on the tripod plate as necessary, then moderately retighten the fixing screw.

Turn the alidade through 180° (200gon). If the centring error of the cross-hairs relative to the ground point is now excessive, slide (do not turn) the instrument on the tripod plate to eliminate half the error.

The instrument is perfectly centred when the plate level (15) remains centred and the cross-hairs remain on the ground point or, as you turn the theodolite, form a circle with the ground point as centre, irrespective of the direction in which the theodolite is pointing.

5.3 Using the telescope

Construction of the telescope

The main components of the telescope are its eyepiece (4), reticle, and objective (24). A bayonet ring (14) secures the interchangeable eyepiece to the telescope. There is a choice of two types of standard reticle; see extent of delivery for details of special reticles.

Observation

For taking observations, ensure that the reticle cross-hairs and the image of the target point are in sharp focus. Proceed as follows:

1. Before beginning observations, set the dioptric ring of the eyepiece to your personal setting, i.e. the cross-hairs must be in sharp focus. You may occasionally have to readjust this during a survey.
2. Set the telescope approximately on the target point (coarse or approximate pointing).
3. Focus the image of the target point.
4. Position cross-hairs exactly on target point (fine pointing).

Determining the personal dioptric setting

Point the telescope at the sky or some other evenly bright background. Turn the telescope eyepiece (4) to focus the cross-hairs, i.e. they must have a sharply defined outline and appear a deep black. For future use, note your personal setting on the dioptric scale ring.

Coarse pointing and focusing

Release the horizontal (19) and vertical (17) clamps. Point the telescope's optical sight (5) on the target, retighten the clamps, and use the horizontal (18) and vertical (16) drives to set the cross-hairs approximately on the target point.

Turn the focusing ring (12) to bring the target point into sharp focus.

Check that there is no parallax by moving the eye from side to side or up and down against the eyepiece; cross-hairs and target point must not appear to move relative to each other. If they do, adjust the focusing ring until there is no parallax.

Fine pointing

To measure a direction, turn the horizontal drive (18) to set the vertical hair exactly on the target. Depending on the target point, the double or single hair may be the more suitable.

To measure a vertical angle, turn the vertical drive (16) to set the horizontal hair exactly on the target.

5.4 Automatic power-off

To save battery power, you can specify the period from the last keyboard input or the last distance measurement after which the theodolite is to switch off automatically.

[SET] [TIME] 0 [RUN]	Switches off after 20 seconds
[SET] [TIME] 1 [RUN]	Switches off after 3 minutes

You may also input or change the time parameter by [DATA].

5.5 Continuous operation

You can deactivate the automatic power-off function as follows:

[SET] [MODE] 95 [RUN] 0 [RUN]	Switches off automatically as described in section 5.4
[SET] [MODE] 95 [RUN] 1 [RUN]	Continuous operation

You can also change or input the variable parameter 0/1 by [DATA].

5.6 Display format

You can choose the following sets of default values for display:

Green keyboard symbol	Meaning
HZ	Horizontal direction
V	Vertical angle (= zenith angle)
⊿	Slope distance
⊿	Horizontal distance
⊿	Height difference
E	Easting
N	Northing
H	Height of target point
NR	Point number
DIFF	Difference: 1: △HZ and △⊿ 2: △HZ and △V

Display of pairs of values:

User guidance	Display 2	Display 3
Symbols	First value	Second value

Example:

[DSP] [HZ V]	Display 2: Direction Display 3: Zenith angle
[DSP] [NR]	Display 3: Current point number

5.7 Units of measurement

You can specify the units of measurement as follows:

[SET] [MODE] 40 [RUN] 2 [RUN]	400gon
[SET] [MODE] 40 [RUN] 3 [RUN]	360° decimal
[SET] [MODE] 40 [RUN] 4 [RUN]	360° sexagesimal
[SET] [MODE] 40 [RUN] 5 [RUN]	6400mil
[SET] [MODE] 41 [RUN] 0 [RUN]	metres, display in 0.001m
[SET] [MODE] 41 [RUN] 1 [RUN]	feet, display in 0.01ft

In addition, and only for DI2000 with DIL measuring program:

[SET] [MODE] 41 [RUN] 2 [RUN]	metres, display in 0.0001m
[SET] [MODE] 41 [RUN] 3 [RUN]	feet, display in 0.001ft

You can also change or input the variable parameter 0 to 5 by [DATA].

Typical examples of display:

Unit of measurement	Display 1	Display 2 or 3
400gon		399.99999
360° decimal	DEG	359.99999
360° sexagesimal	DEG	359.59.599
6400mil	mil	6399.9999
Metres		12345.678
Feet	ft	123456.78

Display 1 indicates the appropriate unit of measurement. A blank display indicates gon and metres.

5.8 Decimal places in angle measurement

[SET] [FIX] n [RUN] n = 1, 2, 3, 4, 5

You can also change or input the variable parameter 0 to 5 by [DATA].

Table of display formats for n = 1 to 5

n	Units of measurement displayed: 400gon	360° decimal	360° seagesimal	6400mil
1	0.1gon	0.1°	10'	0.1mil
2	0.01gon	0.01°	1'	0.01mil
3	0.001gon	0.001°	10"	0.001mil
4	0.0001gon	0.0001°	1"	0.0001mil
5	0.00001gon	0.00001°	0.1"	0.0001mil

For mil scales, only four decimal places can be displayed. Data are recorded and computations are performed with the full number of decimal places.

Example:

Unit of measurement 360°, sexagesimal:

[SET] [FIX] 3 [RUN] Display 123.34.5 = 123°34'50"

5.9 Theodolite and DISTOMAT

Any Wild DISTOMAT fits on the T2002 or T3000. The DISTOMAT adapter (12) for the telescope is a factory-fitted standard. On delivery, a black plastic cover protects the adapter contacts. Before use remove this protective cover.

A counterweight balances the DISTOMAT on the telescope.

DISTOMAT on T2002 (fig. 1)

Attach the counterweight to the DISTOMAT. Except with a DI3000, the telescope remains fully transiting.

DISTOMAT on T3000

Remove the optical sight from the telescope and fit a counterweight adapter (fig. 2, 3). Attach the counterweight to the telescope.

With a DISTOMAT fitted, the telescope can be used only in position 1.

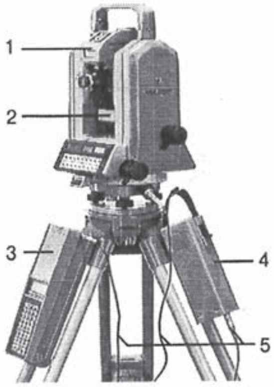


Figure 1:
T2002 with DISTOMAT DI2000 and GRE4 data terminal

1 DI2000
2 Counterweight
3 GRE4 data terminal
4 External battery GEB70
5 Battery and data cable

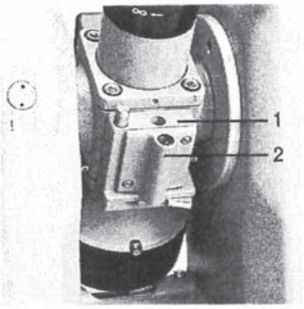


Figure 2: T3000
To fit counterweight adapter, remove optical sight, screw adapter to telescope, attach optical sight to adapter.

1 Counterweight adapter
2 Optical sight

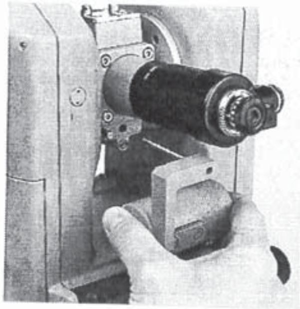


Figure 3: T3000
Fitting the counterweight to the adapter.

5.9.1 DI5S, DI1000, DI2000, DI3000, DIOR3002

Before using one of these models, fit the DISTOMAT on the telescope and proceed as follows:

On DISTOMAT	Set pp and mm values to 0. Set unit of measurement to metre.
On theodolite	Set the GSI serial interface for DISTOMAT: [SET] [MODE] 26 [RUN] Input the ppm and mm values you need.

In the case of an older DI1000, check whether the electrical contact is spring-loaded. If not, remove the two small screws at the side of the contact.

5.9.2 DI4, DI4L, DI5

Before using one of these models, fit the DISTOMAT on the telescope and proceed as follows:

On DI4/DI4L	Set scale switch to (8 + 0): ppm = 0. Constant switch: 400gon, circular prism, metre
On DI5	Set scale switch to position 16. Constant switch: red index to 400gon, circular prism, metre.
On theodolite	Set DISTOMAT interface: [SET] [MODE] 25 [RUN] Input the ppm and mm values you need.

On the DI5, remove the two small screws on the side of the electrical contact.

The DI4 and DI4L have no electrical contact. Use the short cable 409 680 to connect DISTOMAT and theodolite. Insert the cable in socket (13).

5.10 Horizontal setting circle

Use the horizontal setting circle (28) and reading prism (9) for approximate readings of the horizontal angle. You can turn the horizontal setting circle by hand to set it to a particular value, e.g. for the orientation of the horizontal circle in setting-out.

Setting the horizontal circle to 400gon or 360° (fig. 4):

Unscrew reading prism (9), slacken the two slotted screws to the diaphragm. Turn the diaphragm through 180° (index line on side facing prism). Tighten the slotted screws, screw back the reading prism.

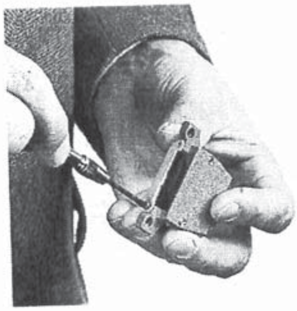


Figure 4:
Altering the unit of angle measurement on the horizontal setting circle

6 T2002/T3000 MEASURING PROGRAMS

6.1 Summary

6.1.1 Correction of standing-axis tilt

The theodolite has a liquid compensator that detects the amount of tilt by which the theodolite's standing axis deviates from the perpendicular. This permits the computation and elimination of errors affecting horizontal-circle readings due to standing-axis tilt.

6.1.2 Correction of instrument errors

The dynamic angle-scanning system with diametrically opposed scan points eliminates during the measuring process any errors due to the scale divisions or the eccentricity of the horizontal and vertical circles.

Generally, all theodolites have the following minute instrument errors:

- Horizontal collimation errors, because the line-of-sight is not absolutely perpendicular to the tilting axis
- Tilting-axis errors, because the tilting axis is not absolutely perpendicular to the standing axis

After determination of these errors by a suitable method, the T2002 and T3000 can compute and correct the effect of these errors on horizontal angle measurements.

To correct vertical angle measurements, determine and store the index error in the usual way by measuring the vertical angle to a clearly marked point in both telescope positions.

6.1.3 Measuring programs

The design of both theodolite models makes them eminently suitable for a wide variety of uses in industrial and engineering surveys. They can be used in the following modes:

- Compensator: switched on or off
- Corrections for instrument errors (horizontal collimation error, tilting-axis error) and standing-axis tilt in horizontal angle measurements: made or omitted

These choices result in the following four programs:

Measuring program	Compensator on	Compensator off	Corrections on	Corrections off
1 (standard)	x		x	
2	x			x
3		x	x	
4		x		x

6.2 Compensator

6.2.1 Switching the compensator on and off

[SET] [MODE] 17 [RUN] 1 [RUN]	Compensator on
[SET] [MODE] 17 [RUN] 0 [RUN]	Compensator off

You can also change or input the variable parameter 0/1 by [DATA].

~~COMP~~ on the user guidance display indicates that the compensator is switched off.

6.2.2 Measuring standing-axis tilt

You can continually measure and display the standing-axis tilt irrespective of the position of the telescope. The alidade must be at rest and the compensator switched on.

Measure the standing-axis tilt longitudinally, i.e. along the line-of-sight, and transversely, i.e. parallel to the tilting axis. The measured values are:

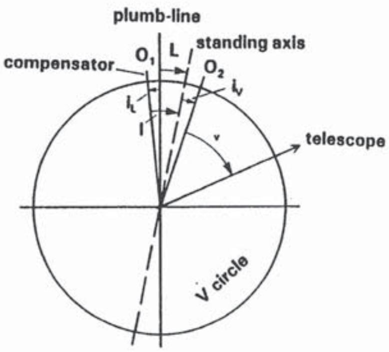
L Longitudinal standing-axis tilt
T Transverse standing-axis tilt

Each of these values is subject to an index error, i_L and i_T, which have to be determined and stored. See section 7.8 for further details.

6.2.3 Vertical angle measurement

Compensator	V =	V refers to
on	$v + i_v + L$	Plumb-line
off	$v + i_v$	Standing axis

where: V = Vertical angle displayed
v = Vertical angle with reference to zero point O_2 of vertical circle
i_v = Index error of vertical circle
L = Longitudinal standing-axis tilt
l = Measurement with reference to zero point O_1 of compensator
i_L = Index error of l
L = $l + i_L$



6.3 Computation of corrections

6.3.1 Switching the computation of corrections on and off

[SET] [MODE] 89 [RUN] 1 [RUN]	Computation of corrections on
[SET] [MODE] 89 [RUN] 0 [RUN]	Computation of corrections off

You can also change or input the variable parameter 0/1 by [DATA].

There is no permanent display to indicate that computation of corrections is switched off.

After [ON], the report CALC OFF appears on the display. Delete this message by [CE]. The theodolite is now ready to measure.

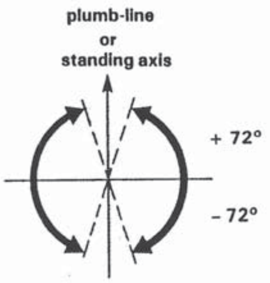
Request for status information when instrument is in use:

[TEST] 6	Requests status. Response: CALC ON Computation of corrections on CALC OFF Computation of corrections off
[STOP]	Terminates TEST 6.

6.3.2 What is corrected and when

Available measuring range when CALC ON:

As the vertical angle increases in either direction, the correction value may become very large or, in extreme cases, may no longer be capable of definition. The range in which the corrections are effective is therefore limited to vertical angles from +72° to -72° (+80gon to -80gon).



When the computation of correction values is switched on and the available range is exceeded, the following happens:

- The system automatically reduces the display of horizontal direction HZ and the difference △HZ to a single decimal place

Example:

V range within limits	HZ display: 123.4567gon
V range exceeds limits	HZ display: 123.5gon

- As a safety measure, the theodolite blocks recording and reports ERROR 02. Recording can continue only if the computation of correction values is switched off (also refer to section 6.5).

  Action:

  [CE] Deletes error report

  Switch off the computation of correction values and continue recording.

Corrections by the measuring programs:

The measuring programs correct HZ measurements as follows:

Correction	Measuring program			
	1	2	3	4
Horizontal collimation error	x	–	x	–
Tilting-axis error	x	–	x	–
Standing-axis error	x	–	–	–

x Correction
– No correction

6.4 Standard measuring program

If the definition of the relevant parameters is correct and has been stored, this program corrects all instrument errors and the effects of any residual standing-axis tilt. This program is suitable for most measuring applications, particularly for measurement in one telescope position only.

6.5 Measuring program 2

This program does not correct HZ measurements and is the program of choice for measuring horizontal angles in a near-zenith position, e.g. for astronomical purposes and in engineering surveys.

The computation of correction values must be switched off, as otherwise the system would limit display of horizontal direction to a single decimal place and block data recording for zenith angles from 0° to 18° (0gon to 20gon) (see 6.3.2).

6.6 Measuring programs 3 and 4

You can switch off the compensator for special applications in which the measurement of vertical angles has to refer to the theodolite's standing axis and not to the plumb-line.

Applications:

- Measurement with tilted theodolite set-ups
- Measurement subject to vibration
- Measurement on an unstable or a moving base, e.g. a marine platform

6.7 On-line link to computer

See detailed instructions G2 344 'On-line link for T2000', published November 1986.

☞ Index, line of sight, and tilting axis errors can change over time and with the temperature. They should therefore be redetermined after long periods of transport, before and after long periods of work, and if the temperature alters by more than 20 °C.

7 ANGLE MEASUREMENT

See section 8 for details of combined angle and distance measurement.

7.1 Introductory examples

[ON]	Switches instrument on, automatically measures both angles once

Select the pairs of values you want on display:

[DSP] [HZ V]	Display 2: Horizontal angle Display 3: Vertical angle
[DSP] [HZ ⊿] [DSP] [⊿ V]	Choice of displays, when only horizontal or vertical angle is measured, but without distance measurement.

Single measurement

Point telescope to point 1	
[SET] [HZ$_\circ$] 0 [RUN]	Sets horizontal circle to 0
Point telescope to point 2	
[HZ V]	Measures and displays both angles

Continuous measurement

Point telescope to point 1	
[REP] [HZ V]	Continuously measures and displays both angles
Point telescope to point 2	Read both angles
[STOP]	Ends continuous measurement

7.2 Single measurement

[HZ]	Takes about 0.9s to measure horizontal angle once, displays value
[V]	Takes about 0.6s to measure vertical angle once, displays value
[HZ V]	Takes about 0.9s to measure both angles simultaneously, displays values

The angle symbol that appears in display 1 indicates that angle measurement is in progress. These measurements remain on display until you effect a new measurement, even if you turn the telescope.

7.3 Continuous angle measurement

[REP] [HZ] or [REP] [V] or [REP] [HZ V]	Automatic repeat measurements The first measurement takes about 0.6s for a vertical angle, 0.9s for a horizontal angle or for both angles combined; each subsequent measurement takes about 0.3s for a vertical and 0.6s for a horizontal angle or for both angles combined. If you turn the alidade quickly, there is a horizontal update every 0.1s and the display is to a single decimal place only. If you turn it more slowly, the angle(s) is/are updated every 0.3/0.6s and there is a full display.
[STOP]	Ends continuous angle measurement

7.4 Initial horizontal setting

[SET] [HZ$_0$] 0 [RUN]	Sets horizontal circle to 0
[SET] [HZ$_0$] 123.4539	Initial setting of horizontal circle is one of the following: 123.4539gon 123.4539° 123°45'39" 123.4539mil

To count the horizontal circle counterclockwise, reverse the mathematical sign to input the initial setting as a negative value:

[SET] [HZ$_0$] [+/-] 123.45 [RUN]	Displays negative value, e.g. -123.4500°.

Use [CE] to delete input errors one digit at a time.

The instrument retains the stored initial horizontal setting and type of display when it is switched off.

7.5 Index error (vertical collimation error)

7.5.1 Definition

The index error i is the sum of the following errors (cf diagram 6.2.3):

i_V Index error on vertical scale circle (zero-point error)
i_L Longitudinal compensator-index error

You can determine the index error irrespective of whether the compensator is switched on or off. The correction is applied to every V measurement.

Compensator	Index error	Relates to	Theodolite code
ON OFF	$i_V + i_L$ i_V	Vertical Standing axis	V COLL V INDEX

7.5.2 Determination of error

The determination of the instrument errors can be started in any telescope face.

Compensator ON

To determine the index error, the instrument also determines and displays the longitudinal and transverse compensator-index errors i_L and i_T. To determine solely i_L and i_T, use SET MODE 12 as described in 7.8.2.

[SET] [MODE] 10 [RUN]	Display 1: V COLL Display 2: Existing value of i

In position 1 (2), point the telescope to a clearly defined point.

	Display 3: Vertical angle. Wait until value remains steady.
[RUN]	Measures and stores vertical angle

In position 2 (1), point the telescope to the same point.

	Display 3: New value of i
[RUN]	Displays and stores new value of i: Display 1: ¦ INDEX (¦ = longitudinal) Display 2: Existing value of i_L Display 3: New value of i_L
or [CE]	To retain existing value and end determination.
[RUN]	Stores new value of i_L. Display 1: -- INDEX (-- = transverse) Display 2: Existing value of i_T Display 3: New value of i^T
or [CE]	To retain existing values of i_L and i_T, store new i, and end determination of index error.
[RUN	Stores new value of i_T.
or [CE]	To retain existing values of i_L and i_T, store new i, and end determination of index error.

0.9° (1gon) is the maximum index error that can be stored.

ERROR 04 is displayed if i_L and i_T exceed 1'53" (0.035gon). If this error message recurs, inform the local Wild service workshop.

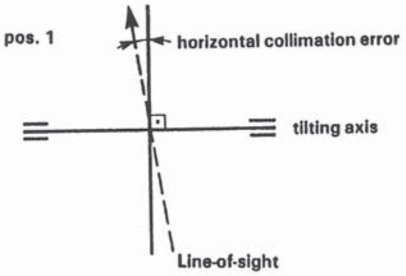
Compensator OFF

You can determine i_V only. The procedure is analogous to that with the compensator ON. The determination of i_L and i_T is omitted. Display 1 reads V INDEX instead of V COLL.

7.6 Horizontal collimation error (line-of-sight error)

7.6.1 Definition

If the line-of-sight is not perpendicular to the tilting axis, a horizontal collimation error results. The error is positive when in telescope position 1 the deviation is counterclockwise. Either correct or disregard the horizontal collimation error (see 6.3.2).



7.6.2 Determination of error

To determine the horizontal collimation error, point the telescope at a clearly defined point that lies as close to the horizontal as possible. The vertical angle must not deviate more than ±18° (±20gon) from the horizontal. If it exceeds this amount, ERROR 02 is displayed.

[SET] [MODE] 11 [RUN]	Display 1:	HZ COLL
	Display 2:	Existing horizontal collimation error

Within the permissible vertical range of 0° ±18° in position 1 (2), point the telescope to a clearly marked point.

[RUN]	Measures horizontal angle.

In position 2 (1), point the telescope to the same point.

Measures horizontal angle and computes the horizontal collimation error.

Display 3: New horizontal collimation error

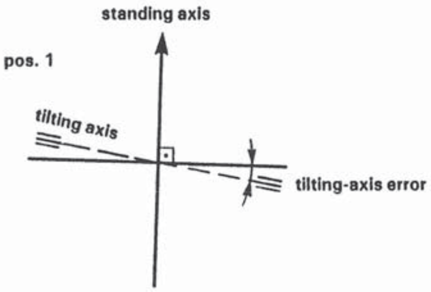
[RUN] or	Stores new value
[CE]	Retains existing value

0.9° (1gon) is the maximum horizontal collimation error that can be stored. Mechanical adjustment: see 17.5.

7.7 Tilting-axis error

7.7.1 Definition

If the theodolite's tilting axis is not perpendicular to the standing axis, a standing-axis error results. The error is positive when in telescope position 1 the offset is clockwise (see diagram below). You may either correct or disregard the tilting-axis error (see 6.3.2).



7.7.2 Determination

To determine the tilting-axis error, point the telescope at a clearly defined point within ±20° (±23gon) of a zenith angle of 45° or 135° (50gon or 150gon). If the tolerance is exceeded, ERROR 02 is displayed.

Unless the horizontal collimation error is known, you cannot determine the tilting-axis error. The procedure must therefore include determination of the horizontal collimation error.

[SET] [MODE] 13 [RUN]	Determines the line-of-sight error as for SET MODE 11 (see 7.6.2)

In position 1 (2), point the telescope to a clearly defined point.

[RUN]

In position 2 (1), point the telescope to the same point.

[RUN]	Stores the horizontal collimation error Display 1: AXIS Display 2: Existing tilting-axis error

Within the permissible vertical range and in position 2 (1), point the telescope to another clearly defined point.

[RUN]	Measures horizontal angle

In position 1 (2), point the telescope to the same point.

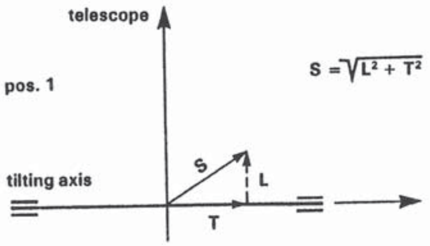
	Measures horizontal angle and computes tilting-axis error. Display 3: New tilting-axis error
[RUN]	Stores new value
[CE]	Retains existing value

7.8 Standing-axis tilt

7.8.1 Definition

If after accurate levelling-up there is still a minute residual aberration from the vertical by the theodolite's standing axis, this is known as standing-axis tilt. This error (S) affects the theodolite by a longitudinal (L) and a transverse (T) tilt. The theodolite computes and displays these two components.

For telescope position 1, the following rule applies to mathematical signs:



Example: Telescope position 1
L = +6"
T = +8" S = 10"

The telescope's standing axis tilts 10" forward and to the right.

7.8.2 Compensator adjustment

To ensure that the display of the standing-axis tilt is correct, determine the compensator indices i_L and i_T (see 6.2) before you begin a measuring mode that includes the computation of correction values. Always protect the instrument from direct sunlight.

Determination of i_L and i_T

Switch compensator on by SET MODE 17.

[SET] [MODE] 12 [RUN]	Display 1: Display 2: Display 3:	¦ INDEX (longitudinal) Existing i_L New i_L

Wait 3 to 4 seconds until the value in display 3 remains constant.

[RUN]

Turn alidade about 180°	Display 3:	New i_L

Wait 3 to 4 seconds until the value in display remains constant.

[RUN]	Display 1: Display 2: Display 3:	-- INDEX (transverse) Existing i_T New i_T
[RUN]	Stores new values	
[CE]	Retains existing values	

If i_L and i_T exceed ±1'53" (0.035gon), ERROR 04 is displayed. If this error report appears repeatedly, notify the nearest Wild service workshop.

When you determine the index error with the compensator on, the instrument also determines and displays the longitudinal and transverse compensator-index errors i_L and i_T (see 7.5). If you then determine i_L and i_T by SET MODE 12, the instrument automatically resets the index error for the new values.

Effect of plug-in battery GEB68

In the determination of i_T and in subsequent use of the thedolite, the difference in weight due to the presence or absence of the plug-in battery produces two different values for i_T, with and without GEB68. Ensure that the battery is either always inserted or always omitted (dummy cover fitted).

7.8.3 Determination of standing-axis tilt

Switch compensator on by SET MODE 17. Determine or check i_L and i_T by SET MODE 12. Clamp alidade in position.

[COMP]	Display 1:	TILT ¦—

Wait 3 to 4 seconds until the values in display 1 remain constant.

Display 2:	Longitudinal tilt L_1
Display 3:	Transverse tilt T_1

Turn alidade 180° and clamp in position.

Display 2:	Longitudinal tilt L_2
Display 3:	Transverse tilt T_2

The mathematical signs for L_2 and T_2 are opposite to those of L_1 and T_1.

The value of L_1 and L_2 on the one hand and of T_1 and T_2 on the other is identical only when i_L and i_T are correct, i.e. if the compensator has been adjusted. The correct standing-axis tilt is always the mean value $\frac{1}{2}(L_1 - L_2)$ and $\frac{1}{2}(T_1 - T_2)$. Note the mathematical signs.

[STOP]	Ends the process

The instrument can also display standing-axis tilt that lies beyond the compensator's centring range of 3.2" (0.06gon). In such a case, input of [STOP] causes ERROR 58 to appear on the display. This indicates that the theodolite is not properly levelled up.

Example:

$$\begin{array}{lcl} L_1 = +6'' & \qquad & T_1 = -4'' \\ L_2 = -2'' & & T_2 = +6'' \\ \hline L = +4'' & & T = -5'' \end{array}$$

7.8.4 Use of compensator to level up instrument

For most tasks, an accuracy of 10" to 20" is perfectly adequate. This accuracy is readily obtainable by use of the plate level to level up the instrument, as described in 5.1. In precision angle measurement, the computed corrections automatically correct the effect of instrument errors and of standing-axis errors.

However, in certain cases such as horizontal angle measurement near the zenith, i.e. in the zenith-angle range from 0° to 18° (0gon to 20gon), the computed corrections are ineffective. In these cases, always accurately level up the instrument with the aid of the compensator.

Procedure

For levelling up with maximum accuracy, the theodolite set-up must be extremely stable.

First determine or check i_L and i_T by SET MODE 12.

Position reading prism for the horizontal setting circle (9) above one of the footscrews.

Clamp alidade tightly in position.

[COMP] Display 1: TILT ¦—

Wait 3 to 4 seconds until the values in display 1 remain constant.

Display 2: Longitudinal tilt L_1
Display 3: Transverse tilt T_1

Turn the footscrew below the reading prism and one of the other footscrews until $L_1 \approx 0$ and $T_1 \approx 0$. Under ideal conditions, you can obtain a setting accuracy of ±1" by this means.

Turn alidade 180° and clamp in position. Check that $L_2 \approx 0$ and $T_2 \approx 0$.

[STOP] Ends the procedure

7.9 Display of differential values

Instead of HZ and V measurements, the instrument can compute and display differential values, i.e. the difference between specified and effective values (tracking). This display mode is useful for setting-out. To select this mode, input [DSP] [DIFF].

The following combinations are possible in the display of differential values:

Purpose	Display 2	Display 3
a: Setting-out by the polar method (see 8.8)	ΔHZ	Δ⊿
b: Angular tracking to search for a point, setting-out by means of angles	ΔHZ	ΔV

7.9.1 Introductory example

[SET] [MODE] 22 [RUN] 1 [RUN]	Selects HZ and V as setting-out parameters
[SET] [SO] 100 [RUN] 50 [RUN]	Input of specified values: HZ(specified) = 100gon V(specified) = 50gon
[DSP] [DIFF]	Display format: ΔHZ ΔV
[HZ V] or [REP] [HZ V]	Display 2: HZ(specified) - HZ Display 3: V(specified) - V

7.9.2 Definition

Display of difference △ = specified value minus effective value

Specified value = input
Effective value = measurement

7.9.3 Selecting the setting-out parameters

[SET] [MODE] 22 [RUN] 0 [RUN]	Parameters selected: HZ and ⊿
[SET] [MODE] 22 [RUN] 1 [RUN]	Parameters selected: HZ and V

You may also input and alter the parameters 0/1 by [DATA].

7.9.4 Input of specified HZ and V values

Select setting-out parameters HZ and V by SET MODE 22 (see 7.9.3)

[SET] [SO] α [RUN] V_s [RUN]

where: α = specified value for HZ (direction, bearing, azimuth)
V_s = specified value for V

The existing values appear in display 3. These are overwritten after termination by [RUN] of input of the new values. The input of specified values remains stored after [OFF].

[HZ V]	Starts single measurement
or	
[REP] [HZ V]	Starts continual measurement

Setting-out angles only

[SET] [SO] α [RUN] [RUN]	Input direction angle α
[HZ V]	Starts single measurement
or	
[REP] [HZ V]	Starts continual measurement

7.9.5 Zero tracking

Continual update of differential display △HZ and △V after input of:

[REP] [HZ]
[REP] [V]
[REP] [HZ V]

Turn the telescope or alidade in the appropriate direction until the difference for △HZ and △V in the display is 0. This indicates that the telescope is pointing to the specified target.

7.10 Display of index and axial errors

[SET] [MODE] 14 [RUN] [RUN] . [RUN]	On the display, the following values appear after each other: $i_V + i_L$, i_V, i_L, i_T, c, and k.

Use the SET MODE 14 function to display the following parameters:

Parameter	Term used in manual	Display
Index error relative to vertical	$i_V + i_L$	V COLL
Index error relative to standing axis	i_V	V INDEX
Compensator-index error, longitudinal tilt L	i_L	¦ INDEX
Compensator-index error, transverse tilt T	i_T	-- INDEX
Horizontal collimation error	c	HZ COLL
Tilting-axis error *	k	AXIS

* The messages BAT IN and BAT OUT in display 3 refer to the plug-in battery GEB68:

BAT IN	Battery inserted
BAT OUT	Battery not inserted

8 ANGLE AND DISTANCE MEASUREMENT

The following applies to the DISTOMAT models DI4, DI4L, DI5, DI5S, DI1000, DI2000, DI3000, and DIOR3002. Sections 8.10 to 8.12 describe the use of a T2002 and T3000 with a DI4 or DI4L and the possible applications for the instrument combination of a theodolite with a DI2000, DI3000, or DIOR 3002.

8.1 Introductory example

Prepare for measurement (see 5.9). Fit DISTOMAT on telescope. Point to reflector.

Theodolite input and displays:

[ON]	Switches theodolite on	
	Display 2	Display 3
[DSP] [⊿V]	---	Vertical angle
[DIST]	Slope distance	Vertical angle
[DSP] [HZ⊿]	Horizontal angle	Horizontal distance
[DSP] [E N]	Easting	Northing
Turn alidade		
[HZ]	New easting computed from stored distance and	New northing new direction
[DSP] [⊿H]	Height difference	Height of target point
Point telescope to high-lying point above prism		
[V]	Measures vertical angle to high-lying point: Height difference	 Height of high-lying point
Point telescope to prism		
[DSP] [HZ⊿]		
[REP] [DIST]	Tracking, i.e. measurement with continual updates Continual display of: Horizontal angle	 Horizontal distance
[STOP]	Terminates process	

8.2 Test function

Except for DI4 and DI4L, you can use the theodolite keyboard to set the DISTOMAT to TEST mode. On the DI4 and DI4L, you have to set the TEST function on the DISTOMAT. On all but DI4 and DI41, proceed as follows:

[TEST] 5	Switches TEST mode on DISTOMAT. DISTOMAT displays: • Return-signal strength • Battery voltage
[STOP].	Terminates function

8.3 Distance-measurement programs

8.3.1 General

Generally, start distance measurement by input of the requisite command on the theodolite keyboard. This automatically switches on the DISTOMAT. After distance measurement, the DISTOMAT switches off automatically.

Keyboard input for distance measurement:

[DIST]	Starts single measurement
[REP] [DIST]	Starts tracking
[ALL]	Distance measurement followed by recording of block of measured data
[REP] [ALL]	Distance measurement followed by recording of block of measured data; the last point number is repeated

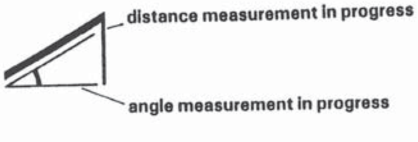
A distance measurement remains in memory until a further distance is measured or until the theodolite is switched off. You have two possibilities:

- Assign the distance to any horizontal angle, e.g. when the reflector prism is offset relative to the target point (see 8.4)
- Display intermediate heights (see height tracking, section 8.6)

8.3.2 Single measurement

[DIST]	Starts distance measurement and deletes display of last measurement.

During distance measurement, the instrument continually measures both angles. The following ancillary symbol appears in display 1:



For 2 seconds, display 2 shows the ppm value and display 2 shows the additive constant (mm).

Distance measurement ends with an acoustic signal and continuous angle measurement ceases. The symbol denoting angle and distance measurement disappears.

At the end of distance measurement, the instrument uses the last vertical angle measurement to compute the reduction of slope distance (see section 19.1).

8.3.3 Tracking

The term 'tracking' denotes the automatic repeat measurement of distance. Measurement is faster and therefore less accurate than in single mode. Tracking is useful for setting-out.

[REP] [DIST]	Starts tracking; continual updates of angles and distance.
[STOP]	Terminates function

Define the values for display: ⊿ , ⊿ , or ⊿ . See 8.12.2 for the special procedure applicable to DI4 and DI4L.

8.4 Coordinate display

After distance measurement, direct display of the target-point coordinates is possible. Plane coordinates are computed as eastings E and northings N. Before starting to measure, define the coordinate system:

1 Orient horizontal circle (see 7.4)
2 Set instrument-station coordinates E_o and N_o

Input of E_o and N_o

[SET] [E_o N_o] E_o [RUN] N_o [RUN]

The input values remain stored when the instrument is switched off, until they are superseded by a new set of values.

Display of target-point coordinates

[DSP] [E N]	After distance measurement, the coordinates are shown as follows: Display 2: E Display 3: N

Distance measurement to offset points

If the reflector prism is offset relative to the target point, e.g. in the case of the corner of a building, proceed as follows:

[DIST]	Distance measurement to reflector
[DSP] [E N]	Display 2: Easting of reflector Display 3: Northing of reflector

Point telescope to corner of building

[HZ]	Measures horizontal angle Display 2: Easting of corner Display 3: Northing of corner
or [REC]	Measures horizontal angle and records E and N of corner.

If the recording format is correctly set (see section 9.5), [REC] records the following parameters:

1 Slope distance to reflector
2 Vertical angle at the instant of distance measurement
3 Horizontal angle at the instant of [REC]
4 E and N computed from values 1 to 3 above

8.5 Height display

The system computes trigonometric heights and displays the results as follows:

1 Height difference between the theodolite's tilting axis and the target point
2 Height of target point above datum

To determine target-point height, ensure that the instrument-station height H_o is stored in the theodolite. H_o is the height above any datum, e.g. mean sea level. Depending on the type of task, input the height of the ground point or of the theodolite's tilting axis.

These computations take refraction and earth curvature into account.

Input of H_o

[SET] [H_o] H_o [RUN]	New value supersedes old value and is stored when the instrument is switched off

Display of target-point height

[DSP] [⊿ H]	After distance measurement, the displays show the following values: Display 2: Height difference Display 3: Target-point height $H = H_o +$ ⊿

8.6 Height tracking

Use height tracking to determine the height and height difference of high-lying points on which you cannot put a reflector prism, such as high-tension cables, but whose foot-points are measurable. Proceed as follows:

Set up the reflector under the object.

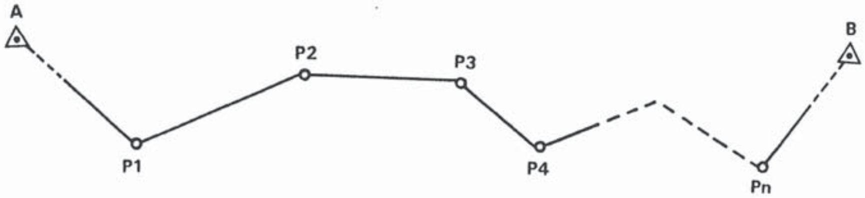
[DIST]	Measures distance
[DSP] [⊿H]	Displays target-point height of reflector station

Point telescope to high-lying point.

[V]	Measures vertical angle Display 2: Height difference from theodolite to high-lying point Display 3: Height of high-lying point
or [REP] [V]	Continually updates display of ⊿ and H
[REC]	Records original measurement: 1 Slope distance to reflector 2 Vertical angle at the instant of distance measurement 3 Horizontal angle at the instant of [REC]

8.7 Traversing

Coordinates, height, and horizontal direction (angle) of traverse stations can be stored in the theodolite and are then available as station coordinates for the next traverse station. This permits the continual computation of an open traverse with height transfer.



Set up the instrument over a known point P_1. Point telescope to A.

[SET] [$HZ_{\square}$] HZ_A [RUN]	HZ_A is the known bearing of A from P_1 (P_1A)
[SET] [$E_{\square}$] E_1 [RUN] N_1 [RUN]	E_1, N_1: Station coordinates of P_1

If you also wish to transfer height, input the instrument's tilting-axis height above datum, i.e. H_1 = height of ground point + instrument height, input:

[SET] [H_o] H_1 [RUN]

Point telescope to P_2.

[DIST]	Starts distance measurement
[SET] [MODE] 18 [RUN]	Stores E_2, N_2, H_2, and bearing HZ(P_1P_2) in internal buffer

Set up instrument at P_2. Point telescope to P_1.

[SET] [MODE] 19 [RUN]	Interprets E_2, N_2, H_2, and HZ(P_1P_2) stored with SET MODE 18 as new station coordinates. Automatically computes the bearing HZ(P_2P_1) = HZ(P_1P_2) + 180°.

Point telescope to P_2.

[DIST]	Starts distance measurement
[SET] [MODE] 18 [RUN]	etc etc

When you repeat SET MODE 18 RUN, new values replace the stored data. Note that this command does not store the coordinates and heights of traverse stations in an external memory.

When you have set up the instrument at P_2, first point the telescope to P_1 and input SET MODE 19 RUN before you measure to other points. However, if for example there is a wrong measurement, you can repeat SET MODE 19 RUN. If you have had to repeat this command, ERROR 07 is displayed as a warning. You can delete this message by [CE]. It does not affect further events.

In traversing with height transfer, check that the tilting-axis height of the theodolite and of the reflector above the tribrach plate is the same.

8.8 Setting-out with display of differential values

To simplify setting-out by the polar method, you may input the setting-out data, i.e. direction and horizontal distance, as specified values. This permits continual updating of the display of differential values, i.e. specified value minus measurement.

8.8.1 Input of specified horizontal angle and distance

[SET] [MODE] 22 [RUN] 0 [RUN]	Sets input format for HZ and ⊿
[SET] [SO] [RUN] α [RUN] D [RUN]	Input specified values where: α = setting-out direction D = setting-out distance

The existing values appear in display 3. Termination of input by [RUN] replaces these data by the new values.

On [OFF], the specified values remain stored.

[DIST] or	Measures distance
[REP] [DIST]	Starts tracking
[DSP] [DIFF]	Display 2: ΔHZ = HZ(specified) - HZ Display 3: Δ⊿ = ⊿(specified) - ⊿ Mathematical sign for Δ⊿ : + = increase distance - = reduce distance

8.9 Distance correction

Before the theodolite displays the measured slope distance, it automatically applies the input values for additive constant [mm] and scale correction [ppm].

Slope distance ⊿ = $(D_o + C)(1 + M)$

where:

D_o = uncorrected slope distance in metres or feet

C = additive constant; applies prism constants of reflectors:
= 0mm for circular Wild prisms
= -35mm for rectangular Wild prisms

M = scale factor; applies constants proportional to distance, i.e. atmospheric constant, reduction to mean sea level, projection factor, etc

Please refer to the manual for your DISTOMAT for the relevant correction values.

8.9.1 Input of additive constant

[SET] [mm] C [RUN]	Input additive constant C in mmm

The existing value appears in display 3. Termination of input by [RUN] replaces this by the new value. If there is no new input, the existing constant continues to apply.

Value of C: -999.0mm to +999.0mm

8.9.2 Input of scale factor

[SET] [ppm] M [RUN]	Input scale factor M in mm

The existing value appears in display 3. Termination of input by [RUN] replaces this by the new value. If there is no new input, the existing constant continues to apply. 1ppm = 1mm per km.

Value of M: -999.9ppm to +999.9ppm

Example:

Let the scale factor be +12.3mm per 100m, i.e. M = 123ppm.

[SET] [ppm] 123 [RUN]   Input 123ppm

8.10 Distance measurement with a DI2000

8.10.1 Summary

The DI2000 is a precision EDM. The main differences between this EDM and earlier DISTOMATs are:

1 You can assign different measuring modes to the theodolite's DIST key.
2 The theodolite can display distance to 0.0001m and 0.001ft.

Note that these features apply only to this DISTOMAT series. These settings are wrong for other DISTOMAT models. Do not try to use them with another model; the instrument may fail to perform any distance measurement

8.10.2 Reassignment of DIST key

Function	n	Effect
DIST	0	Single measurement (default setting)
DI	1	Fast measurement
DIL	2	Continual updates of single measurement, display of mean value and standard deviation

Command to reassign DIST key:

[SET] [MODE] 69 [RUN] N [RUN]   n = 0, 1, or 2

You may also input and alter parameter n by [DATA]. The setting of the DIST key on the DISTOMAT does not affect the theodolite.

Example:

Assign the DI function to the theodolite's DIST key.

[DIST]   Sets DI2000 to fast measurement

8.10.3 Display formats

You can define (or have to observe) the following display formats:

Measuring mode	Display format on:	
	Theodolite	DI2000
DIST DI2000 software versions 2.0 and 2.2	0.001m 0.01ft	any
DI2000 software version 2.4	0.001m 0.01ft	any
	0.0001m 0.001ft	any
DIL Generally for all DI2000 software versions	0.001m 0.01ft	any
	0.0001m 0.001ft	0.0001m 0.001ft

Example:

In the DIL measuring mode, the DI2000 must have a display format of 0.0001m or 0.001ft when the theodolite setting is for this display format.

8.10.4 Fast measurement in DI mode

In this mode, measurement is faster but less accurate than in DIST mode. The set display format is disregarded.

8.10.5 Continuous updates of measurement

[DIST]	Starts single measurement
[STOP]	Terminates measurement
[TEST] 8	Display 2: Number n of measurements Display 3: Standard deviation in mm of a single measurement

You may also perform TEST 8 during a measurement.

8.11 Measuring with a DI3000 or a DIOR3002

The following input on the DISTOMAT is necessary:

[SET] [MODE] 78 [RUN] [RUN]	Sets 2400 baud, even parity, CR LF
[SET] [MODE] 83 [RUN] [·] [RUN] [RUN]	Sets recording format wi31, wi51, wi52
[SET] [MODE] 69 [RUN] 0 [RUN]	Assign DIST function to DIST key of DISTOMAT

These settings remain stored when you switch off the instrument.

8.12 Measuring with a DI4 or DI4L

8.12.1 Definition of measuring range

A DI4 or DI4L has an unequivocal measuring range only up to 1999m. For the correct reduction of greater distances, you have to input the rounded-off estimated distance in kilometres on the theodolite keyboard, as follows:

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

Measuring range	0km to 2km	n = 0
	1km to 3km	n = 2
	2km to 4km	n = 3
	3km to 5km	n = 4
	4km to 6km	n = 5
	5km to 7km	n = 6
	etc	etc

When you switch off the theodolite, n is automatically reset to 0.

8.12.2 Tracking

Theodolite: [REP] [DIST]	The theodolite is in tracking mode and is standing by for measurements from the DI4/DI4L
DI4/DI4L: [DIST] [TEST]	Starts tracking
Theodolite: [STOP]	Terminates tracking

9 DATA RECORDING

There is a choice of two storage media for recording measured data:

1: Wild GRM10 REC module, a plug-in data-recording unit
2: Wild GRE3 or GRE4 external data terminal

9.1 REC module

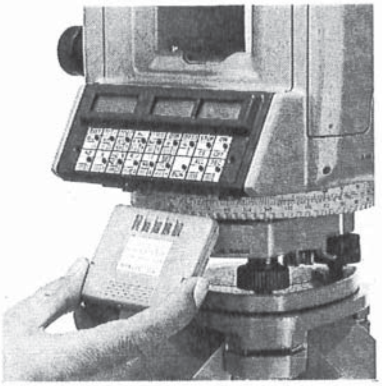


Figure 5:
Insert the REC module in the slot above the keyboard in position 2, contacts first and facing up.

The REC module stores all measured values obtained by theodolite and DISTOMAT, and manual or computer input of coordinates. You can call up these data on the theodolite's display, but cannot edit them. You can also delete the entire contents of the REC module.

You can divide the REC module into several files (see GIF10 manual). For delivery, only file 1 is defined at the factory, i.e. the whole of the module's memory is assigned to file 1. The theodolite transfers data only to file 1 and can receive data only from this file.

The REC module has a capacity of about 500 blocks (16kbyte), or about 2000 blocks (64kbyte), of measured data, averaging four data strings each, e.g. point number, HZ angle, V angle, and slope distance.

9.2 GRE4 data terminal

Instead of a GRE4, the earlier GRE3 can also be used. The following text refers only to the GRE4 but applies equally to the GRE3; where there are substantial differences in the use of the two models, this is specifically stated.

Connection between theodolite and GRE4:

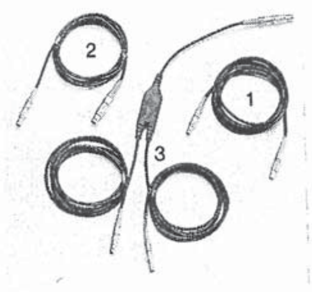


Figure 6:
Cable links

1 Data cable from theodolite to GRE4
2 Battery cable from external battery to theodolite
3 Combined data and battery cable for linking theodolite, GRE4, and external battery

The GRE4 data terminal is suitable for recording and storage of all survey data obtained by theodolite and DISTOMAT. It also permits manual input of measurements and the editing of data.

A BASIC program module is available and turns the GRE4 into a field computer for use in a wide range of complex field computations, such as free-station surveys, setting-out, sets of directions, etc. Programs from the Wild PROFIS software series are available free of charge.

Model range

	GRE4a	**GRE4n**
Keyboard	alphanumeric	numeric
Memory	64kbyte CMOS	64kbyte CMOS

64kbyte memory = 8000 words, about 2000 data blocks

9.3 Preparing the theodolite

1 Do you intend to store the data in a REC module or in a GRE4? To define the recording unit, see 9.3.1.

2 Which measured data and parameters do you intend to store? To define the recording format, see 9.5.

Examples:

Point number	HZ direction	V angle	Slope distance

or

Point number	Easting	Northing

3 For GRE4 only:
Is the communication between theodolite and data terminal defined? To set interface parameters, see 9.3.2.

9.3.1 Definition of the recording unit

[SET] [MODE] 76 [RUN] n [RUN]

n = 0: GRE4
n = 1: REC module

Input and alteration of variable n are also possible by [DATA].

9.3.2 Setting the interface parameters

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

Sets default values for interface parameters:
Transfer rate: 2400 baud
Parity: even
Terminator: CR LF

These parameters remain stored when the instrument is switched off.

The above are recommended values. In theory, for example, you may set a different transfer rate, but the settings on theodolite and data terminal must always be the same.

Section 14 (SET MODE commands) summarizes the various interface parameters.

9.4 Preparing the data terminal

Recording format

For manual input of measured data into the data terminal, set the terminal's recording format. As a general rule, if you intend to use the GRE4 in conjunction with the theodolite, set the recording format on the theodolite, not on the data terminal. If a recording format has previously been set on the data terminal, delete this first (see 9.4.1).

If for example the point number or remark REM is input on the GRE4 and not on the theodolite, the corresponding parameters must be defined once only, either in the theodolite or the data terminal; do not define them in both.

Interface parameters

Set default values. All settings remain in memory when the instrument is switched off (see 9.4.2).

9.4.1 Deletion of recording format

Input on GRE4:

[SET] [FORM] [+/-] [·] [RUN] [RUN]	Deletes existing recording format, i.e. all items in the recording profile.

9.4.2 Setting the interface parameters

We recommend using the default values. The remarks made in 9.3.2 also apply.

GRE3

[SET] [MODE] 70 [RUN] 2400 [RUN] [RUN]	Sets transfer rate at 2400 baud
[SET] [MODE] 71 [RUN] 2 [RUN] [RUN]	Sets even parity
[SET] [MODE] 73 [RUN] 1 [RUN] [RUN]	Sets terminator CR LF

GRE4

[SET] [MODE] 78 [RUN] [RUN]	Sets defaults as follows: Transfer rate: 2400 baud Parity: even Terminator: CR LF

9.5 Recording format

9.5.1 Word identifiers

The various measurements, i.e. bearing, vertical angle etc form a so-called measurement block and are stored as a block. The recording format of a measurement block defines the measurements and parameters to be recorded. Choose any combination.

Example:

Data block consisting of four words:

Point number	HZ direction	V angle	Slope distance
wi = 11	wi = 21	wi = 22	wi = 31

A two-digit word identifier (wi) identifies all measured data and parameters; see table below.

Table of word identifiers

wi =	Description		Remarks
11	Point number		
21	HZ direction		
22	V angle		
31	Slope distance		= 0 if there has been no distance measurement
32	Horizontal distance		
33	Height difference		
51	Scale factor and additive constant		
71	Remark REM 1		
72	Remark REM 2		
81	E	Target-point coordinates	E = E_o if there has been no distance measurement
82	N		N = N_o
83	H		H = H_o
84	E_o	Instrument-station coordinates	
85	N_o		
86	H_o		

The above word identifiers wi = 11 to wi = 86 are those most frequently used

Table continued on next page

Table of word identifiers (continued)

wi =	Description	Remarks
12	Instrument serial number	
13	Instrument type and software version	Requires external command @N13
24	HZ specified	
25	HZ specified - HZ measured	Differential display
27	V specified	
28	V specified - V measured	Differential display
34	⊿ specified	
35	⊿ specified - ⊿ measured	Differential display
52	n (= number of measurements)	DIL program
	s (= standard deviation)	
58	Additive constant in metres	Display: 0000.xxxx
59	Scale factor in ppm	Display: 0xxx.x000
61	Londitudinal tilt L	
62	Transverse tilt T	
	Code block	
41	Code number	Set automatically when a code block is recorded
42 to 45	Info 1 to Info 4	

wi = 11: Point number

As a rule, the point number is set on the theodolite. As an alternative, it may be input on the GRE4 keyboard, but in that case, delete w = 11 from the theodolite's recording format.

wi = 21: HZ direction

To show whether a horizontal angle is measured in telescope position 1 or 2, always record the vertical angle at the same time.

wi = 51: Constants (ppm, mm)

For a ready check, record these constants with the other data in distance measurement. In the default recording format, wi = 51 is set automatically.

9.5.2 Setting the default recording format on the theodolite

[SET] [REC] [·] [RUN] [REC]	Sets default recording format and automatically deletes any existing recording format.

Point number	HZ angle	V angle	⊿	ppm, mm
wi = 11	wi = 21	wi = 22	wi = 31	wi = 51

9.5.3 Setting a special recording format on the theodolite

Deletion of existing recording format

[SET] [REC] [+/-] [·] [RUN] [REC]	Deletes existing recording format.

Setting a special recording format

[SET] [REC] wi [RUN] [REC]	Sets word identifiers one at a time
[SET] [REC] [+/-] wi [RUN] [REC]	Deletes word identifiers one at a time

Example:

Add REM1 and REM2 (wi = 71 and wi = 72) to the default recording format.

[SET] [REC] [·] [RUN]	Sets default recording format
71 [RUN] 82 [RUN]	Wrong input code for REM2
[+/-] 82 [RUN] 72 [RUN] [REC]	Correction of input wi = 72

9.6 Recording a block of measured data

9.6.1 Introductory example

Insert REC module in theodolite.

[ON]	Switches theodolite on.
[SET] [MODE] 76 [RUN] 1 [RUN]	Selects REC module as recording unit.
[SET] [REC] [+/-] [·] 11 [RUN]	Deletes existing recording format and sets point number (wi = 11).
21 [RUN] 22 [RUN]	Sets HZ angle (wi = 21) and V angle (wi = 22).
71 [RUN]	Sets REM1.
[REC]	Sets recording format.
[SET] [NR$_0$] 100 [RUN]	Input first number of automatic point numbering sequence.
[REC]	Starts angle measurement and recording.
FORMAT?	This message appears when you press [REC] the first time if a format other than default is set.
[REC]	Confirms to execute angle measurement of point 100 and to record.
[REC]	Measures angle and records point 101.
[NR] 200 [RUN]	Input non-sequential point number 200.
[REC]	Measures angle and records point 200.
Fit DISTOMAT, point to reflector.	
[SET] [REC] [·] [RUN] [REC]	Sets default recording format (point number, HZ angle, V angle, slope distance, ppm and mm).
[DIST]	Starts distance measurement.
[REC]	Measures distance and records the entire measurement block as the next sequential point 102.
[ALL]	Measures angle and distance, and records measurement block as point 103.
[REP] [ALL]	Measures angle and distance, and records measurement block as repeat of point 103.

9.6.2 Point number

As a general rule, always set the point number wi = 11 in every recording format to identify each block of measurements. The maximum length of the point number is eight digits and a mathematical sign.

After input of the command to record data [REC], the following displays appear for about a second:

Display 1	Display 2	Display 3
REC	0062	103
	Block number in REC module	Point number

We distinguish between sequential and non-sequential numbering of points.

Sequential point numbers:	1	2		3		4	5	6	7	8	etc
			↑		↑						
Non-sequential point numbers:			28		19						

You may insert non-sequential numbers at any point in a series of sequential numbers. Input of point numbers is also possible while angle or distance measurement is in progress.

Sequential point numbers

[SET] [NR_o] NR_o [RUN] Sets positive starting point number
or
[SET] [NR_o] [+/-] NR_o [RUN] Sets negative starting point number

In sequential point numbering, the system automatically increments the point number by 1 whenever a new block is recorded. A negative sign reverses the counting direction, as follows:

Sign	Sequential point numbering	Overflow message
+	0, 1, 2, . 99999998, 99999999	ERROR 09
-	99999999, 99999998, . 2, 1, 0	ERROR 09

To continue measurement after ERROR 09, input [CE].

[SET] [NR_o] NR_o [RUN] Input a positive sequential point number.

[SET] [NR_o] [+/-] [RUN] Changes the counting direction; permits immediate remeasurement of the last point measured.

Non-sequential point numbers

[NR] NR [RUN]	Input the non-sequential point number. This is inserted in the running sequence, interrupts it, and is recorded with the next data block. On completion of data input for the non-sequential point, sequential numbering continues.
[NR] [+/-] [RUN]	Deletes a wrong non-sequential point number after input of that point number is complete. After deletion, input either a new non-sequential point number or continue sequential point numbering.

Display of point number

[DSP] [NR]	Display 1: NR + Current positive sequential point number NR - Current negative sequential point number NR Current non-sequential point number Display 3 shows the point number being recorded with the next data block.

Repeat point number

If you require a data block to have the same sequential or non-sequential point number as the last block, proceed as follows:

[REP] [REC]	Angle measurement.
[REP] [ALL] = [DIST] [REP] [REC]	Angle and distance measurement.

These commands are ineffective if they follow immediately upon input of a new point number. The message ERROR 06 appears on the display.

9.6.3 Measurement and recording

Irrespective of the display format and contents you have defined, all angles are recorded to five decimal places, i.e. to 0.1" or 0.01mgon (0.00001gon), except for mil units (4 decimals). Distance is recorded to as many decimal places as defined for the display format.

Without distance measurement

[REC]	Measures both angles and records them in a data block.

In continuous angle measurement [REP] [HZ] etc, the system measures both angles, even when the theodolite is set to measure only one, e.g. [REP] [HZ]. If the recording format is defined to record both angles, it records both V and HZ. The theodolite measures the angles of its position the instant that [REC] is pressed.

Including distance measurement (single measurement)

[DIST]	Starts distance measurement.

On completion of distance measurement:

[REC]	Measures both angles and records them in a measurement block, together with the measured slope distance. The record contains the horizontal angle at the moment of recording, and the vertical angle at the moment the system completes the distance measurement.

[ALL] combines the [DIST] and [REC] commands. It is particularly useful for tacheometric surveys with sequential point numbering.

[ALL]	• Starts distance measurement as with [DIST]. • During distance measurement the system also measures both angles. • An acoustic signal indicates when all measurements are available; point the telescope to the next target point. • The system records the measurement block. • The point number briefly appears on display 3. • The system automatically increments the point number.

Use [ALL] when there is no need for separate pointings for angle and distance measurement.

Tracking

The tracking program measures and continually updates slope distance and both angles. You can record a measurement block at any time.

[REC]	Records the last distance measured and the corresponding vertical angle, together with the last horizontal angle measured. The tracking program then continues.
[STOP]	Stops tracking program.

9.7 Recording a code block

9.7.1 Introductory example

Record instrument station 505 and instrument height 1.54m under code 14, as follows:

[CODE] 14 [RUN] 505 [RUN] 1540 [RUN] [REC]

9.7.2 Code-block structure

Use a code block for input of general information, such as date, name, instrument number, instrument height, point description, meteorological data, etc. A code block consists of the word with the code number and up to four words containing information:

CODE NR	INFO 1	INFO 2	INFO 3	INFO 4
wi = 41	wi = 42	wi = 43	wi = 44	wi = 45

Code number: Sign and up to eight digits; input without decimal point
Info 1 to 4: Sign and up to eight digits; input without decimal point

The code block may be any size, for example:

CODE NR	INFO 1
Date	Name

Code number and one word of information

CODE NR
Date

Code number only

9.7.3 Input of code block

Possible keyboard sequences:

[CODE] n° [RUN] [REC]
or
[CODE] n° [RUN] info1 [RUN] [REC]
or
[CODE] n° [RUN] info1 [RUN] info2 [RUN] [REC]
or
[CODE] n° [RUN] info1 [RUN] info2 [RUN] info3 [RUN] [REC]
or
[CODE] n° [RUN] info1 [RUN] info2 [RUN] info3 [RUN] info4 [RUN] [REC]

Display 2: Code number, permanent display
Display 3: All input

You may input a code block either before or after a measurement. As a rule the code block precedes a set of measurement blocks. You can also record a code block during continuous angle measurement or in tracking mode.

9.8 REM codes

9.8.1 Introductory example

You wish to identify measurements to a boundary marker by the REM code 00000050.

[SET] [REC] 71 [RUN] [REC]	Sets REM1 in recording format.
[SET] [REM]	Display 2: 1 (indicates REM1) Display 3: Existing REM1, e.g. 00367379
7	The 7th digit flashes to indicate standby for input, i.e.003673▒9
5	Input a 5 for the 7th digit, i.e. REM1 becomes 00367359; call up the other digits as above and replace by 0.
[RUN]	Terminates input.
[REC]	Records data block including REM1.

9.8.2 Structure of REM code

The REM code is used to mark and identify measured points. The REM code forms part of measurement block is stored with every record. If necessary, define it in the recording format.

Each measurement block may contain up to two REM codes:

Point number	Measurements	REM1 or REM2

Point number	Measurements	REM1	REM2
		wi = 71	wi = 72

A REM code consists of eight digits. Select the digits you want to replace and input the figures you require. The selected digit flashes.

The REM code is stored until you define it anew, even if you delete it from the recording format and later restore it.

9.8.3 Input of REM code

Set default recording format with two REM codes:

Point number	Default format	REM1	REM2

[SET] [REC] [·] [RUN] 71 [RUN] 72 [RUN] [REC]

Input

To alter REM1 and REM2:

[SET] [REM] └position digit┘ [RUN] └position digit┘ [RUN]
REM1 REM2

To alter REM1 only:

[SET] [REM] └position digit┘ [RUN] [RUN]

To alter REM2 only:

[SET] [REM] [RUN] └position digit┘ [RUN]

Display 2: 1 (= REM1) and/or 2 (= REM2)
Display 3: Existing value of REM code

Example:

REM1 = 00000000, REM2 = 00000000

[SET] [REM] 52 [RUN] [RUN]	REM1 00002000 = Road, curve REM2 remains unchanged
[ALL]	Measurements, REM1 = 00002000, REM2
[ALL]	Measurements, REM1 = 00002000, REM2
[ALL]	Measurements, REM1 = 00002000, REM2

Set default recording format with one REM code only:

[SET] [REC] [·] [RUN] 71 [RUN] [REC]
or
[SET] [REC] [·] [RUN] 72 [RUN] [REC]

[SET] [REM] [position digit] [RUN]	Alters REM code.

9.9 Display of recorded data

9.9.1 Data stored in REC module

Data stored in the REC module can be displayed in the theodolite.

[DATA]	Switches theodolite to DATA mode.
[RUN] or [STOP]	Ends DATA mode.
[DATA] [—>] [—>] ... ... [<—] [<—] ...	Displays data step by step forward or in reverse order
	Display 2: wi = 11 and block number or wi = 41 and block number or any other set of wi (see 9.5.1) Display 3: Data
[DATA] [FIND] n° [RUN]	Search for data block with the point number specified.

The FIND command searches the memory in reverse order only. If the same point number is stored more than once, the search can only find the last of these.

Example:

[DATA] [FIND] 103 [RUN]

Display 1	Display 2	Display 3
DATA	11 0056 wi Block n°	00000103 Point number
[—>]		
DATA	21 wi	90.38.23.9 HZ = 90°38'23.9"
[—>] . . [—>]		
DATA	41 0057 wi Block n°	00000008 Code number
[—>]		
DATA	42 wi	00000050 INFO 1

The display shows the point number wi = 11 and code number wi = 41 at the same time as the block number to indicate the beginning of data and code blocks respectively.

9.9.2 Data stored in GRE4

Data stored in a GRE4 data terminal can be displayed only on the data terminal itself, not on the theodolite. For details, refer to the GRE4 manual.

9.10 Deleting data in REC module

You can delete the entire set of data in file 1 of the REC module. Partial or selective deletion is not possible.

[SET] [MODE] 99 [RUN] [+/-] [REC]	Initiates deletion of data. As a safeguard against the accidental deletion on input of [REC], the system asks SURE?, requesting confirmation.
[RUN]	Confirms command to delete. The system acknowledges by an acoustic signal and executes the command. Press any other key to avoid deleting data.

10 RECORDING PRINCIPLES

For a detailed description of the data format, please refer to the manual for the GRE4 data terminal or the GIF10 data reader. This section limits itself to describing the general information necessary for identifying measurements. The system records these automatically with the measurements.

10.1 Measurement blocks, code blocks

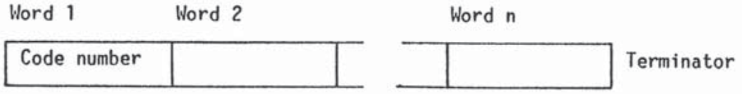
REC module and GRE4 data terminal record data as measurement blocks and code blocks. Each measurement block consists of measurements and a point number. The code blocks permit the storage of information and instructions.

Each block receives a sequential block number. This is automatically recorded with the rest of the block.

A measurement block has the following format:

The first word of a block of measured data always contains the point number. The theodolite's recording format determines the other words in the block. The theodolite can accommodate up to eight words in a measurement block.

A code block has the following format:



The first word of a code block always contains the code number. The theodolite can define up to five words, i.e. the code number and four words of information.

10.2 Structure of a word in a measurement block

Each word is fixed in length and consists of 16 characters.

W_1	W_2	.	.	.	.	+	1	2	3	4	5	6	7	8	b̸	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Position

Position	Meaning
1 and 2	Word identifier (see table in section 9.5.1)
3 to 6	General information
7 to 15	Data
16	Blank

A block of measurements always begins with 11, the word identifier for the point number. A code block always begins with its word identifier 41.

Positions 3 to 6 contain general information applicable to the data in positions 7 to 15.

Position	Description	Applies to
3	Not significant	
4	**Compensator information:** 0 = compensator off 3 = compensator on	Angles
5	**Type of input:** 0 = Measurement by T2000 1 = Manual input of measurement 2 = Measurement by T2002/T3000, CALC ON 3 = Measurement by T2002/T3000, CALC OFF 4 = Special measurement	Measured data Result obtained by coordinate-geometry computation
6	**Units of measurement:** 0 = Metre, last digit = 1mm 1 = Foot, last digit = 0.01ft 2 = Gon (circle = 400gon) 3 = Degree, decimal 4 = Degree, sexagesimal 5 = mil (circle = 6400mil) 6 = Metre, last digit = 0.1mm 7 = Foot, last digit = 0.001ft	Measured data
7	Mathematical sign: +/-	All words
8 to 15	**Data:** 8 numeric characters Certain words consist of two data sets, e.g. wi = 51: 0123 | -035 ppm | mm	wi = 51, wi = 52

11 COORDINATE-GEOMETRY FUNCTIONS

11.1 Generally

In conjunction with the REC module, the following built-in computing functions are available on the theodolite:

n	Function
11	Input ENH coordinates in REC module
12*	Tie distance between the last two points measured
13	Tie distance between any pair of points whose coordinates are stored in the REC module
21	Sets ENH coordinates of any point stored in the REC module as E_o, N_o, H_o (station coordinates)
22	Simple resection
23	Orientation of the horizontal circle
24	Setting-out by the polar method
25	Setting-out by horizontal and vertical angles
26	Height transfer and determination of station height
31**	Mean values of HZ and V from multiple pointings in one telescope position
32**	Mean values of HZ and V from observations in both telescope positions
33**	Use of subtense bar to compute horizontal distance

* REC module not required

** REC module required only if you want to store the results in the REC module

Accessing coordinate-geometry functions

Direct access:

[SET] [COGO] n [RUN]	n = number of the required coordinate-geometry function (see table above).

Access by menu:

[SET] [COGO] [RUN] [DATA]	Press [DATA] repeatedly until the required coordinate-geometry function appears on display. Display 2: Brief description of function Display 3: Number n of function
[RUN]	Selects the required function.

11.2 Coordinate input

Definition

Theodolite keyboard input of EN(H) coordinates and point number to the REC module.

Method

[SET] [COGO] 11 [RUN]	Accesses this function.
n° [RUN]	Input point number.
E [RUN]	Input easting.
N [RUN]	Input northing.
H [RUN] or [RUN]	Input height (optional). or Terminate input.

E and N point coordinates appear in display for checking.

[REC]	Stores coordinates.
n° [RUN]	Input next point number, etc.
[CE]	Terminates use of this function.

11.3 COGO 12: Tie distance between the last two points measured

Definition

Displays the tie distance between the last two points measured. The tie distance comprises the horizontal distance and the height difference.

Do not change the station coordinates or the initial direction HZ_0 between measuring to the first and the second point. The REC module is not required.

Method

Measure the angles and distance of both points after each other.

[SET] [COGO] 12 [RUN]	Accesses this function. Display 2: Horizontal tie distance ⊿ Display 3: Vertical tie distance ⊿
[CE]	Terminates use of this function.

11.4 COGO 13: Tie distance between any pair of points

Definition

Displays the tie distance between any two points whose coordinates are stored in the REC module. The tie distance comprises the horizontal distance and the height difference.

Method

[SET] [COGO] 13 [RUN]	Accesses this function.
n° [RUN]	Input number of first point.
n° [RUN]	Input number of second point. Display 2: Horizontal tie distance ⊿ Display 3: Vertical tie distance ⊿
[CE]	Terminates use of this function.

11.5 COGO 21: Set instrument-station coordinates

Definition

Input of the point number accesses the ENH coordinates of any point stored in the REC module and automatically sets them as station coordinates E_o, N_o, and optionally H_o.

Method

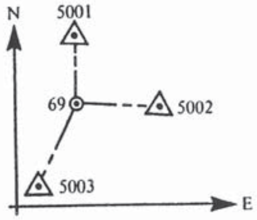
[SET] [COGO] 21 [RUN]	Accesses this function.
n° [RUN]	Input point number. Sets the coordinates of this point as station coordinates and terminates use of this function.

Check by:

[SET] [E_oN_o]
and
[SET] [H_o]

11.6 COGO 22: Resection

Definition



Measure the directions to three known points. From these this command computes and sets the station coordinates E_o, N_o.

The coordinates of the control points must be stored in the REC module.

Method

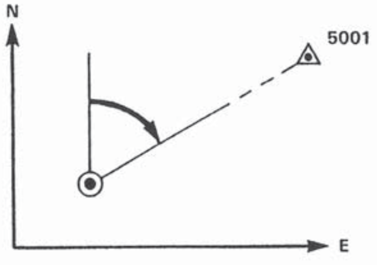
First make certain that the distribution of the control points is suitable, i.e. that the station is outside the critical circle, the distances between the control points is adequate, etc. Angles must not be less than 0.9° (1gon).

If you accidentally point twice to the same point, ERROR 13 is displayed.

[SET] [COGO] 22 [RUN]	Accesses this function.
n° [RUN] pointing [RUN]	Input number of the first control point (5001 in above diagram). Point the telescope to the first point, measure angles.
>n° [RUN] pointing [RUN]	Repeat for the other two points (5002 and 5003 in diagram). After measurement of the third point, the station coordinates E_0 N_0 are displayed.
[REC] n° [RUN]	Input point number of instrument station (69 in diagram). This command stores E_0 and N_0 in the REC module together with the point number. It then sets these station coordinates in the theodolite and terminates use of this function.
or [RUN]	Sets the station coordinates E_0 and N_0 in the theodolite and terminates use of this function.
or [CE]	Terminates use of this function.

11.7 COGO 23: Orientation of horizontal circle

Definition



Point the telescope to the control point and access the coordinate-geometry function. This command computes the bearing and sets the horizontal circle to this value.

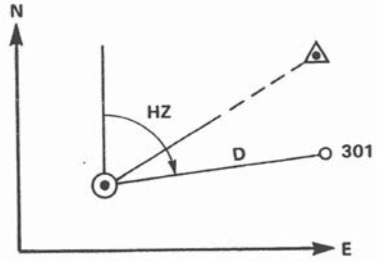
The coordinates of the control point must be stored in the REC module and the station coordinates set on the theodolite.

Method

[SET] [COGO] 23 [RUN]	Accesses this function.
n° [RUN]	Input the number of the control point (5001 in above diagram). Display 2: Bearing
pointing [RUN]	Orients horizontal circle and terminates use of this function.

11.8 COGO 24: Setting-out by the polar method

Definition



Computes and sets the horizontal angle and distance necessary for setting-out. It also sets the differential display.

The coordinates of the points must be stored in the REC module. Set the station coordinates on the theodolite. Before accessing this function, orient the horizontal circle by COGO 23.

Method

[SET] [COGO] 24 [RUN]	Accesses this function.
n° [RUN]	Input the number of the point you want to set-out (301 in above diagram). This command computes the setting-out elements. Display 2: Setting-out angle Display 3: Setting-out distance
[RUN]	Sets setting-out elements; switches on differential display and continual angle measurement. Display 2: ΔHZ Terminates use of this function.
[DIST] or [REP] [DIST]	Starts distance measurement or tracking. Display 2: ΔHZ Display 3: Δ⊿

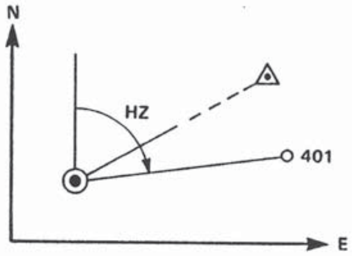
For setting-out further points, access this function again for each point.

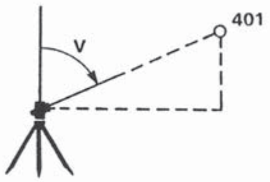
11.9 COGO 25: Setting-out by horizontal and vertical angles

Definition

This function computes and sets the elements necessary for setting-out, i.e. horizontal and vertical angles. It also sets the differential display.

The coordinates of the points must be stored in the REC module. Set the station coordinates and height on the theodolite. Before accessing this function, orient the horizontal circle by COGO 23.





Method

[SET] [COGO] 25 [RUN]	Accesses this function.
n° [RUN]	Input the number of the point you want to set-out (401 in above diagram). This command computes the setting-out elements. Display 2: Horizontal angle Display 3: Vertical angle
[RUN]	Sets the setting-out elements; switches on the differential display and continual angle measurement. Display 2: ΔHZ Display 3: ΔV Terminates use of this function.

For setting-out further points, access this function again for each point.

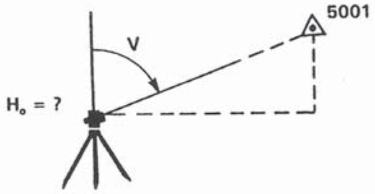
11.10 COGO 26: Height transfer

Definition

This function measures the height difference between the instrument station and a given point whose ENH coordinates are stored in the REC module, determines the height of the theodolite's tilting axis, and sets the station height.

The station coordinates E_o, N_o must be known and set. You can obtain these by resection (COGO 22), manual input, etc.

This method does not take either refraction or earth curvature into account. It is therefore suitable only for close-range work.



Method

[SET] [COGO] 26 [RUN]	Accesses this function.
n° [RUN]	Input the number of the control point (5001 in above diagram).
pointing [RUN]	Measures the vertical angle. This command computes the height of the instrument station and sets it on the theodolite, then terminates this function.

11.11 COGO 31: Mean values of HZ and V from multiple pointings

Definition

This function computes and continually updates the display of the mean value m and standard deviation s_m of the mean value of any number of repeat measurements of HZ and V angles, irrespective of the telescope position. The number n of measurements performed appears on display 1.

You can store these mean values; wi = 21 and wi = 22 are set automatically. When there are two measurements l_1 and l_2 available, the standard deviation s_m permits conclusions about the differences between them, i.e. $|l_2 - l_1| = 2s_m$.

Applications

- Multiple pointings for greater measuring accuracy, e.g. when the target point is not readily identifiable due to heat shimmer, poor visibility, etc
- Determination of target-point centre, for example by pointings to the left and right edge of a circular target
- Adjustment of an autocollimation mirror on an axle or roller

Method

[SET] [COGO] 31 [RUN]	Accesses this function. Display 2: 0.0000 Display 3: 0.0000
pointing [RUN]	Starts first measurement. Display 2: First HZ value Display 3: First V value
new pointing [RUN]	Starts second measurement. Display 2: Mean of HZ readings Display 3: Mean of V readings
etc . .	etc . .
[DATA]	Switch to standard deviations. Display 2: s_m of HZ measurements Display 3: s_m of V measurements
new pointing [RUN]	Starts next measurement and displays new standard deviations.
etc . .	etc . .
[DATA]	Switch to mean values.
[REC]	Prepares for recording. Display 3: Current sequential point number

n° [RUN]	Input of non-sequential point number, stores mean values.
or [RUN]	Stores mean values under current sequential point number.

Skip to start of program for next set of measurements.

[CE]	Terminates use of this function.

Press [DATA] to move back and forth from display of mean values and of standard deviations. In either modus, press [RUN] to measure.

11.12 COGO 32: Mean values of HZ and V in both telescope positions

Definition

After a single measurement in both telescope positions of the HZ and V angles, this function computes, displays, and stores the mean values for position 1.

Example

	HZ	V
Position 1	10°46'18"	76°34'10"
Position 2	190°46'16"	283°25'46"
Mean values for position 1	10°46'17"	76°34'12"

Application

This is a useful function for the fast measurement in both telescope positions of horizontal and vertical angles and for the automatic computation of the mean value. As a check, when you use the telescope in the second position, this function continually updates the display of the difference to the mean value.

You may start measurement in either telescope position. If you start in position 1, the measuring sequence is as follows:

Point 1:	Measure with telescope in position 1 Measure with telescope in position 2
Point 2:	Measure with telescope in position 2 Measure with telescope in position 1
etc	etc

If you start in telescope position 2, reverse the sequence.

Method

[SET] [COGO] 32 [RUN]	Accesses this function. Display 2: Current horizontal angle Display 3: Current vertical angle
pointing in position 1 [RUN]	Display 1: 2 (= ready for position 2) Display 2: Current difference from mean HZ Display 3: Current difference from mean V
pointing in position 2 [RUN]	Starts measurement. Display 2: Mean of HZ angle for position 1 Display 3: Mean of V angle for position 1
[REC]	Prepares for recording. Display 3: Current sequential point number
n° [RUN]	Input non-sequential point number; stores mean values.
or [RUN]	Stores mean values under current sequential point number.

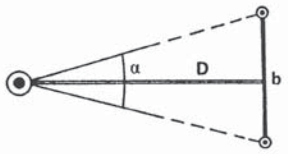
Skip to start of program for next set of measurements.

[CE]	Terminates use of this function.

11.13 COGO 32: Use of subtense bar to compute horizontal distance

Definition

This function makes use of the classic method for determining horizontal distance by means of a subtense bar.



$$D = \frac{b}{2} \cot \frac{\alpha}{2}$$

Method

[SET] [COGO] 33 [RUN]	Accesses this function.
b [RUN]	Input the length (in m or ft) of the subtense bar. Display 1: Arrow indicates pointing to left or right Number n of measurements made for this particular pointing Display 2: 0.0000
>point to left end of bar [RUN]	Repeat measurement any number of times. Display 2: Current mean value of HZ measurements
[DATA]	Change pointing direction; note arrow in display 1.
>point to right end of bar [RUN]	Repeat measurement any number of times. Display 2: Current mean value of HZ measurements
[DATA] (any number of times)	Change pointing direction any number of times; repeat measurements to opposite end of bar (see above).
etc . .	etc . .
End measurement by:	
[ALL]	Computes and displays horizontal distance. Display 2: Horizontal distance (in m or ft) Display 3: Standard deviation (in m or ft)
[REC]	Prepares for recording. Display 3: Current sequential point number
n° [RUN]	Input non-sequential point number and store horizontal distance in REC module (wi = 32).
or [RUN]	Stores mean horizontal distance in REC module under current sequential point number (wi = 32).
Skip to start of program for next set of measurements.	
[CE]	Terminates use of this function.

12 SPECIAL EQUIPMENT FOR T3000

12.1 Built-in autocollimation system

The T3000 is also available with a built-in autocollimation system (fig. 19, section 17.7).

Use the [RUN] key to switch the autocollimation light on and off:

[SET] [MODE] 29 [RUN] n [RUN]   n = 0 or 1

You can also input and alter the variable parameter n = 0/1 by [DATA].

n = 1	[RUN] synchronously switches the autocollimation light and the power supply to the DISTOMAT on and off.
n = 0	Default setting: permanent power supply to DISTOMAT; [RUN] does not affect the autocollimation light.

The setting is stored until altered.

12.2 Internal target for the mutual collimation of two theodolites

An internal target can be fitted to the T3000 telescope to facilitate the mutual collimation of two theodolites for precision angle measurement in industry or in the laboratory. Depending on the task in hand, this target is swung into or out of position (fig. 7).

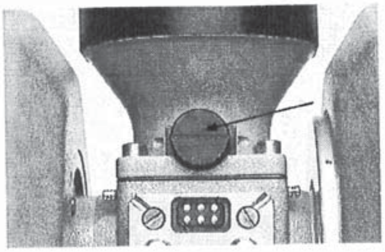


Figure 7:

Internal target swung into position.
The line is parallel to the tilting axis.

Internal target swung out of sight.
The line is parallel to the line-of-sight.

13 TEST COMMANDS

Test programs can run alone or concurrently with either continually updated angle measurement (REP HZ etc) or tracking (REP DIST).

13.1 TEST 1: Battery

This test indicates the battery state in steps from 0 to 9, as shown in the table below:

Display 3	Battery state	Message in display 1
9	Fully charged	
.		
.		
3		
	Weak	Bat
2		
1		
	Flat	ERROR 12

Bat is a preliminary warning. Measurement may continue.

On display of ERROR 12:

[CE] Switches off theodolite; replace battery.

See 20.5 for details of the rate of discharge of a nickel-cadmium battery.

13.2 TEST 1: Displays

[TEST] 1 Checks displays.
Hold down any key to stop test.

13.3 TEST 4: Software version

[TEST] 4 Display 3 shows software version.

13.4 TEST 5: DISTOMAT

[TEST] 5 Switches DISTOMAT to test mode; on DI4 and DI4L, press [TEST] on DISTOMAT.

13.5 TEST 6: Display of principal settings

[TEST] 6

Sequental display of the SET MODE settings listed below. Each setting remains on display for about 2 seconds.
Hold down any key to stop the test, release key to continue.

SET MODE	Display	Description
89	CALC ON / CALC OFF	HZ correction
76	MODULE / GRE	Indicates recording unit in use
26/25	GSI / DI4 DI5	DISTOMAT interface
22	HOR DIST / ANGLES	Setting-out parameters
70	e.g.: BD 2400	Transfer rate in baud
71	PAR E / PAR NO / PAR ODD	Parity
73	CR LF / CR	Terminator used for data or command block
69	DIST / DI / DIL	Function assigned to DIST key
29	COLL ON / COLL OFF	[RUN] key switches collimator light on/off
75	COMM / DATA	Command or data mode
77	ERR INT / ERR GSI	Internal or external display of interface error
79	e.g.: ADDR 0	Address of theodolite
95	TIME ON / TIME OFF	Automatic power-off on/off
30	BEEP HI / LO / OFF	Acoustic signal
20	e.g. RANGE 0	Kilometre range of DI4/DI4L

This list first gives the settings of the parameters that you will probably check most often.

13.6 TEST 7: Theodolite temperature

[TEST] 7

Displays theodolite temperature.

13.7 TEST 8: Standard deviation in DIL measuring mode

Do not run this test unless the system is in DIL mode; may be run while measurement is in progress.

[TEST] 8

Display 2: n = Number of measurements
Display 3: s = Standard deviation in mm of a single measurement

14 SET MODE COMMANDS

Command string: [SET] [MODE] Z_1 [RUN]

Z_1	Description
10	Determine vertical index error, and longitudinal and vertical components of compensator-index error (see 7.5)
11	Determine horizontal collimation error (see 7.6)
12	Determine longitudinal and vertical components of compensator-index error (see 7.8)
13	Determine horizontal collimation and tilting-axis errors (see 7.7)
14	Display instrument and index errors, i.e. stored results obtained by SET MODE 10, 11, 12, and 13 (see 7.10)
15	Analogous to [COMP]
18	Store coordinates of and bearing to next traverse point (see 8.7)
19	Set station coordinates and bearing to last traverse point (see 8.7)
25	Set DISTOMAT interface for DI4 and DI5 (see 5.9.2)
26	Set GSI* to DISTOMAT for DI5S, DI1000, DI2000, DI1001, DI1600, DI2002, DI3000, DIOR 3002 (see 5.9.1)
78	Set default parameters for GSI*: 2400 baud, even parity, CR LF (see 9.3.2)
98	Send data from REC module to GRE4 data terminal (see 16.2) or computer (see 16.3)

* Geodetic serial interface: standard interface of Wild surveying instruments

Command string: [SET] [MODE] Z_1 [RUN] Z_2 [RUN]
or
[SET] [MODE] Z_1 [RUN] [DATA] [RUN]

Instead of input of Z_2, press [DATA] until the required function is available.

Z_1	Description	Z_2	Description	Display
17	Switch compensator on/off (see 6.2.1)	1 0	On Off	COMP ON COMP OFF
20	Input kilometre range for DI4/DI4L (for measurement ≥ 2km, see 8.12.1)	0 to 9	Kilometres	RANGE Z_2
22	Set setting-out parameters HZ and or HZ and V (see 7.9.3)	0 1	HZ and HZ and V	HOR DIST ANGLES
29	[RUN] switches built-in autocollimation light on/off (see 12.1)	0 1	No Yes	COLL OFF COLL ON
30	Set loudness of acoustic signal	0 1 2	Off Quiet Loud	BEEP OFF BEEP LO BEEP HI
40	Set angle unit (see 5.7)	2 3 4 5	400gon 360° decimal 360° sexagesimal 6400mil	
41	Set linear unit (see 5.7)	0 1 2 3	0.001m 0.01ft 0.0001m* 0.001ft*	
69	Assign other measuring modes to [DIST] when DI2000, DI1600, DI2002 are in use (see 8.10.2)	0 1 2	Single measurement Fast measurement Continual update and display of standard deviation	DIST DI DIL
70	Set data-transfer rate on theodolite	0 1 2 3 4 5 6	110 baud 300 baud 600 baud 1200 baud 2400 baud 4800 baud 9600 baud	

* on DI2000 in DIL mode only

Z_1	Description	Z_2	Description	Display
71	Set parity on theodolite	0 1 2	No parity check Odd parity Even parity	PAR NO PAR ODD PAR E
73	Set terminator of data block	0 1	CR CR LF	
75	Set protocol for on-line link to data terminal, computer, printer, etc (see instructions 'On-line link for T2000')	0 1	No protocol With protocol Default after [ON]: $Z_2 = 1$	DATA COMM
76	Specify recording unit (see 9.3.1)	0 1	GRE4 REC module	
77	Display of error messages on theodolite or GSI	0 1	Theodolite GSI	ERR INT ERR GSI
79	Theodolite address when two or more theodolites are on-line to a computer (see instructions 'On-line link for T2000')	0 to 9		ADDR Z_2
89	Switch computation of corrections to HZ angle on/off (see 6.3.1)	0 1	OFF ON	CALC OFF CALC ON
95	Automatic power-off of theodolite (see 5.5)	0 1	ON OFF Default after [ON]: $Z_2 = 0$	TIME ON TIME OFF
99	Delete all data in REC module (see 9.10)	[+/-] [REC]	Data in file 1 only	

15 GENERAL PRECAUTIONS

15.1 Distance measurement

- To avoid damage to the diodes in the DISTOMAT, never point the telescope, with a DISTOMAT attached, directly at the sun.
- Heat affects the performance of the sender diode and reduces the range. Shade the instrument from direct sunlight.
- For maximum return-signal strength at long range, shade reflectors from direct sunlight.
- There should never be more than one reflector in the telescope's visual field. Stray signals may cause faulty readings if the measuring beam strikes more than one reflector.
- Some walkie-talkie equipment may interfere with distance measurement if the 'talk' button is pressed near an EDM during measurement. Test your equipment and if necessary avoid transmission while measurement is in progress.

☞ If the plug-in battery supplying power to the theodolite and DISTOMAT is weak, the DISTOMAT switches off automatically after input of the DIST command, without first displaying the ERROR 12 message.

15.2 REC module

- Protect the REC module against direct sunlight; the maximum permissible temperature is 70°C (158°F).
- Storage at high temperatures reduces the life of the battery in the REC module and may cause loss of data.

16 DATA TRANSFER FROM REC MODULE TO COMPUTER

There are three methods for transferring to a computer the data stored in the REC module:

1 Wild GIF10 data reader
2 Wild GRE4 data terminal
3 On-line

16.1 Data transfer by Wild GIF10 data reader

The GIF10 is a special interface unit between the REC module and a computer, printer, GRE4, etc. It is used to display, transfer, and receive data, and to copy data from one REC module to another.

In the field, a fully charged 9V battery powers the GIF10 for about nine hours.

☞ For further details, please refer to the GIF10 manual.

Figure 8:
Wild GIF10 data reader

16.2 Data transfer by Wild GRE4 data terminal

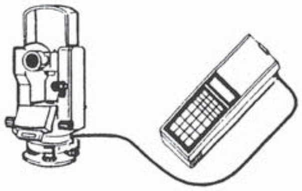


Figure 9

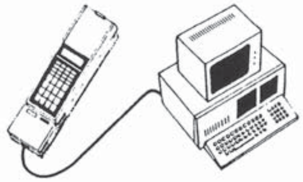


Figure 10

Output the data in the REC module to a GRE4 (fig. 9) and then to a computer (fig. 10).

[SET] [MODE] 78 [RUN] [RUN] Sets default parameters in the theodolite.

For input to GRE4, see 9.4.

[SET] [FORM] [+/-] [·] [RUN] [REC]	Delete recording format.
[SET] [MODE] 78 [RUN]	Set GRE4 to default recording format.

Input on theodolite:

[SET] [MODE] 98 [RUN]	Transfers data from REC module to GRE4.

For further details about data transfer from a GRE4 to a computer, please refer to the GRE4 manual.

For further details about data transfer from a GRE4 to a computer, please refer to the GRE4 manual.

16.3 On-line data transfer

Use a GIF2 and a GIF7 interface for on-line data transfer to a computer (fig. 11). Data flow is unidirectional only.

Set the theodolite parameters to conform with those of the computer.

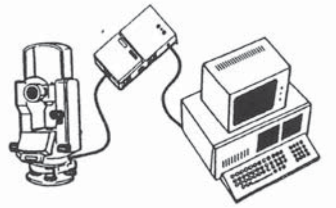


Figure 11

Do not establish the connection between computer and theodolite via the GIF2/GIF7 interfaces in a damp and raw environment. If humidity penetrates the components there will be the danger of electrocution.

Input on theodolite:

[SET] [MODE] 98 [RUN]	Transfers data from REC module to computer.

If your computer uses DOS, you may wish to use the following minimum communication program to prepare for data transfer:

```
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
```

17 CHECKS AND ADJUSTMENTS

17.1 Tripod

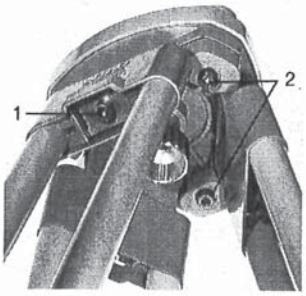


Figure 12:

GST20 tripod

1 Screw for tightening connection of wooden legs to metal cap piece
2 Screw for adjusting leg hinge to tripod head

A hexagonal key is supplied in the tripod pouch or the plastic cover for the tripod head.

There should be no slack between the various components of the tripod. If necessary, moderately tighten the three screws (1) with the hexagonal key supplied.

The legs are hinged to the tripod head. These hinges should be stiff enough to hold the fully extended legs spread out when you lift the tripod by its head. If necessary, use the hexagonal key to adjust the hinge screws (2).

17.2 Plate level

Figure 13

Setscrew for plate level (arrow)

Level up the theodolite as described in section 7.8.4

In a properly adjusted plate level the bubble comes to rest in the centre. If it is off centre by more than one interval, use the pin in the screwdriver handle to turn the setscrew (arrow).

17.3 Spherical levels

17.3.1 Theodolite

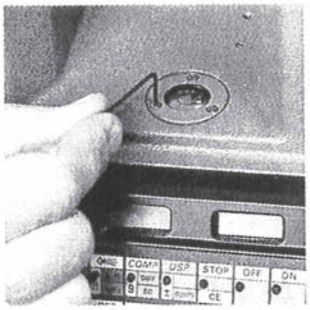


Figure 14:

Setscrews to spherical level of theodolite

Use the plate level to level up the instrument. If the bubble is not within the setting circle, use the small hexagonal key to adjust the setscrews.

Slacken a setscrew to move the bubble toward it, tighten it to move the bubble away from it. Turn one of the screws until the bubble is in line with the centre of the setting circle and another screw. Turn the other screw to centre the bubble.

☞ Do not **overtighten** these screws!

17.3.2 GDF21 or GDF22 tribrach

Use the plate level to level up the instrument and remove the theodolite from the tribrach. If the bubble is not within the setting circle, use the pin in the screwdriver handle to adjust the two setscrews (fig. 15) in the tribrach (arrows).

Slacken a setscrew to move the bubble toward it, tighten it to move the bubble away from it. Turn one of the screws until the bubble is in line with the centre of the setting circle and another screw. Turn the other screw to centre the bubble.

☞ Do not **overtighten** these screws!

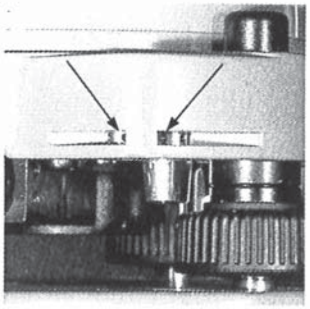


Figure 15:

Setscrews (arrows) to spherical level in tribrach

17.4 Optical plummet

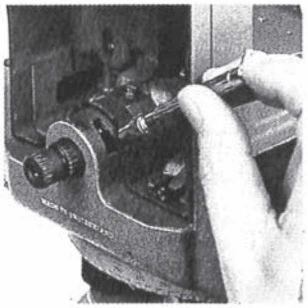


Figure 16:

Adjustment of the optical plummet

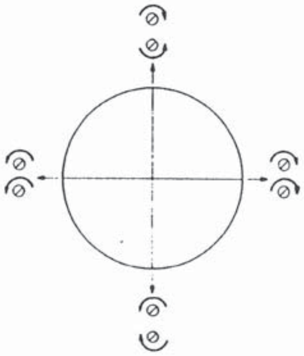


Figure 17:

Sense of rotation for turning the two setscrews to adjust the optical plummet

Mark a fine point on graph paper. Stick the paper on the floor. Set up the theodolite on the tripod over the paper. Look through the optical plummet, turn the eyepiece to focus the cross-hairs, and turn the inner focusing ring to focus the paper. Adjust the focus to eliminate parallax.

Turn the footscrews to set the cross-hairs exactly on the mark (point 1). Turn the alidade 180°. Note or mark the position of the cross-hairs on the paper (point 2). If points 1 and 2 coincide, the plummet is in adjustment. If not, adjust as follows:

Remove the plug-in battery to gain access to the setscrews for adjusting the optical plummet (fig. 16). Mark point 3 on paper halfway between points 1 and 2. Turn the footscrews to set the plummet cross-hairs on point 3.

There are two setscrews for the plummet (fig. 16). Use a screwdriver to turn these screws to set the cross-hairs on point 1. Figure 17 shows the direction in which the cross-hairs appear to move as you turn the screws.

Check the adjustment. Repeat if necessary. The plummet is in adjustment if the cross-hairs remain on the same point as you turn the theodolite through 180°.

Note: You may disregard the position of the bubble in the spherical and plate levels. It does not affect the above procedure.

17.5 Horizontal collimation error

Ideally, the line-of-sight should be at 90° to the tilting axis. The horizontal collimation error is any deviation of the line-of-sight from 90°.

The theodolite is adjusted as accurately as possible before leaving the factory, but this adjustment cannot completely eliminate the horizontal collimation error. As a rule, the residual error is extremely small. To apply an automatic correction of the horizontal collimation error to all angle measurements, determine and store the error as described in 7.6.2.

We advise against attempting to make the adjustments for correcting this instrument error; if the setscrews are too slack or too tight, the adjustment may become unstable. If the horizontal collimation error is greater than about ± 16" (0.005 gon), take the instrument to the nearest Leica workshop for adjustment.

If contrary to this advice you wish to make the mechanical adjustment (T2002 only) proceed as follows:

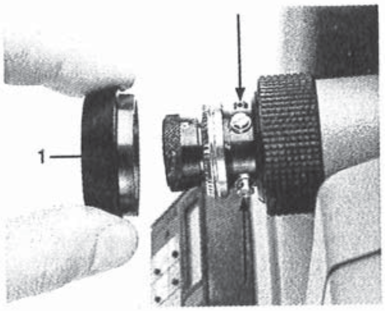


Figure 18:

Adjustment of T2002 line-of-sight to eliminate horizontal collimation error.

Unscrew the black ring between the eyepiece and the focusing sleeve to gain acces to the setscrews (arrows).

Unscrew the rear black ring between eyepiece and focusing sleeve.

[SET] [MODE] 11 [RUN]

Point the telescope to a clearly defined point.

[RUN]

Turn the alidade through 180°. Then continue to turn the alidade by the horizontal drive until display 3 shows a value of about 0.

Look through the telescope. If the vertical hair is to the left of the target point, slightly slacken the setscrew (see arrow) on the left of the telescope eyepiece (use the adjustment pin in the screwdriver handle) and tighten the setscrew on the right by the same amount. If the vertical hair is to the right of the target, slacken the setscrew on the right and tighten that on the left. Look through the telescope to check the effect.

Make the adjustment step by step, until the vertical hair and the target point coincide. Do not overtighten the screws. After a final check, screw the black ring back into place.

17.6 Tilting-axis error

If the tilting axis is not exactly at 90° to the theodolite's standing axis, a tilting-axis error results. When a theodolite leaves the factory, it has a small residual tilting-axis error of a few seconds of arc.

To apply an automatic correction of the tilting-axis error to all HZ angle measurements, determine and store it as described in 7.7.2.

Improper handling of the instrument and major temperature fluctuations can affect the tilting-axis error. If the theodolite has been subjected to these, remeasurement is advisable.

☞ Do not attempt to adjust the tilting axis. This must be done at a Leica workshop.

17.7 Built-in autocollimation system (T3000 option)

Set up a plane mirror about 5m (16ft) from the instrument. Set the reflecting surface at 90° to the telescope's line-of-sight.

Checking

Adjust the telescope to focus on the image of the negative linear cross formed on the reflecting surface; do not focus to infinity! The black reticle and the green linear cross should be in alignment and centred.

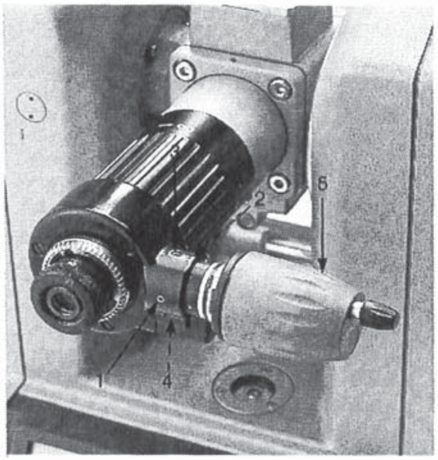


Figure 19:

T3000

Setscrews for the built-in autocollimation system

1 to 4 Setscrews
5 GEB58 plug-in lamp

Adjustment

If the two crosses do not coincide, adjust by means of the four setscrews 1 to 4 (fig. 19). Screws 1 and 2 move the linear cross from side to side, screws 3 and 4 move it up and down.

These screws are paired and reciprocal: 1 and 2, 3 and 4. When you slacken one of a pair, immediately tighten the other by the same amount. Do not overtighten.

17.8 Built-in target for the collimation of two theodolites (T3000 option)

Checking

At a distance of 2m (6'6") from the T3000 set up a second theodolite having a reading accuracy of 1".

```
T3000                                      Second theodolite
 x----------------------------------------------x
 1                  2m (6'6")                   2
```

Point the two theodolites at each other. Point the second theodolite at the built-in target of the T3000, read both angles obtained with the second theodolite, e.g.:

HZ = 11.3954°
V = 89.9861°

In telescope position 2, point the T3000 at the second theodolite. Again point the second theodolite to the built-in target of the T3000 and again read both angles, e.g.:

HZ = 11.3948°
V = 89.9849°

If at a distance of 2m between the two theodolites the difference in the angle measurements exceeds 0.0011° (4"), take your T3000 to the nearest Wild workshop to centre the built-in target.

18 CARE AND TRANSPORT

Transport

When dispatching the instrument, always use the complete original Leica packaging (case and cardboard box). When transporting the instrument in the field, always make sure that you:
- either carry the instrument in its original case, or
- carry the tripod with its legs splayed across your shoulder, keeping the **attached instrument upright.**

Cleaning and drying

Before cleaning the instrument, blow dust off lenses and prisms. Treat the objective, eyepiece and prisms with special care. Never touch the glass with your fingers. Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with pure alcohol. Use no other liquids; these may attack the polymer components.
- If the equipment gets wet, always dry it before repacking it in the case.
- After transport, or after storage for long periods, check the instrument adjustments again (e. g. line of sight error, V-index error).
- When storing the equipment, particularly in summer and inside a vehicle, take the storage temperature limits into account.

Cables and plugs

Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables, If you unplug connecting cables during the measurement, you may lose data. Always switch off the instrument before removing the cables.

Fogging of prisms

Reflector prisms that are cooler than the ambient temperature tend to fog. It is not enough simply to wipe them. Keep them for some time inside your jacket or in the vehicle to allow them to adjust to the ambient temperature.

Storage

If the instrument becomes wet, leave it unpacked. Wipe down, clean, and dry the instrument, transport case, foam inserts, and accessories. Pack up the equipment only when it is perfectly dry.

Instrument case

The foam inserts of the lower section are removable for cleaning and drying.

Silica gel

The instrument is accompanied by a sachet of silica gel, an amorphous hygroscopic granulate of quartz. The dry granules are blue, they turn pink when damp.

You can regenerate damp silica gel by spreading it on a hotplate. Heat this slightly above the boiling point of water; test the temperature of the hotplate by drops of water which should hiss. If the temperature is too high, the granules split. Put the blue, regenerated granules back into the sachet.

Always keep the sachet in an airtight container. Do not leave it lying about.

19 MATHEMATICAL FORMULAE

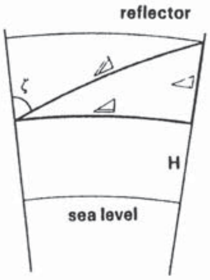
19.1 Reduction of slope distance

The theodolite's automatic computations are based on the following equations:

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

where:
$Y = ⊿ x |\sin V|$
$X = ⊿ x \cos V$
V = Vertical circle reading (= zenith angle)
$A = 1.47 x 10^{-7} x m^{-1} = (1-\frac{1}{2}k) \div R$
$B = 6.83 x 10^{-8} x m^{-1} = (1-k) \div 2R$
$k = 0.13$
$R = 6370 km$

These formulae take into account earth curvature and mean refraction ($k = 0.13$) for ⊿. ⊿ refers to the height of the instrument, not of the reflector.



19.2 Correction of horizontal angle

The corrections applied to the horizontal angle comprise the following:

- Horizontal collimation error (line-of-sight error)
- Tilting-axis error
- Transverse standing-axis tilt

$$HZ = HZ_u - c \div \sin V + (k + T) \div \tan V$$

where:
HZ = HZ value
HZ_u = Uncorrected HZ value
V = Vertical circle reading (= zenith angle)
c = Horizontal collimation error
k = Tilting-axis error
T = Transverse standing-axis error

When the compensator is switched off, $T = 0$.

No corrections are applied in the CALC OFF mode; i.e. when the computation of corrections is switched off $HZ = HZ_{im}$

19.3 Standard deviation

19.3.1 DIL measuring mode

After TEST 8 in the DIL measuirng mode, the following values appear on the display:

$\bar{D}$ = Slope distance as arithmetic mean of all measurements
s = Standard deviation of a single measurement
n = Number of distance measurements made

These values are computed as follows:

$$\bar{D} = 1/n \times \Sigma D_i$$

$$s = \sqrt{\Sigma_1^n (D_i - \bar{D})^2 \div (n-1)} = \sqrt{(\Sigma_1^n \times D_i^2 - \Sigma D_i^2 \div n) \div (n - 1)}$$

where: Σ = Sum of
D_i = Single measurement

The standard deviation $s_{\bar{D}}$ of the arithmetic mean of the distance is computed by:

$$s_{\bar{D}} = s \div \sqrt{n}$$

19.3.2 Coordinate-geometry functions

COGO 31: Mean of multiple pointings in one telescope position

Display of the standard deviation s_m of the arithmetic mean of the angle measurements:

$$s_m = s \div \sqrt{n}$$

where: s_m = Standard deviation of arithmetic mean
s = Standard deviation of a single measurement (see 19.3.1)
n = Number of measurements

COGO 33: Measurement to a subtense bar

Display of the standard deviation of the horizontal distance:

$s_{Dh} = D_h^2 \div b \times s_\alpha \qquad s_\alpha^2 = s_l^2 + s_r^2$

where:
s_{Dh} = Standard deviation of horizontal distance D_h
b = Length of subtense bar
s_α = Standard deviation of measured angle α
s_l = Standard deviation of measured directions left and right (computations as 19.3.1)

20 ELECTRICAL EQUIPMENT

20.1 12V power supply

A 12V DC supply is necessary to power the theodolite, recording unit, and DISTOMAT. There are three Wild NiCd batteries, but any other 12V DC source is also suitable. A cable link for a 12V vehicle battery is also available (fig. 20).

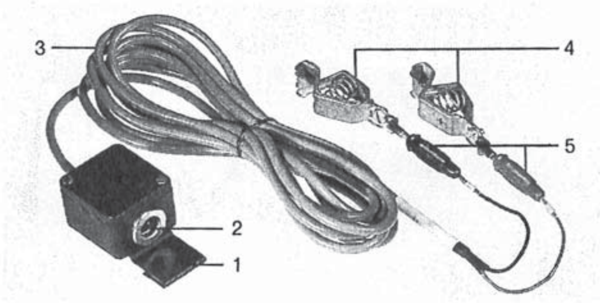


Figure 20:

Power cable for 12V vehicle battery with fuse against wrong polarity.

1	Hook for tripod leg
2	Socket for battery cable with fuse against wrong polarity and spare fuse; to open black box for changing fuse, remove two screws on top of housing
3	4m cable
4	Crocodile clips on banana plugs (5)
5	Banana plugs

20.2 Plug-in battery GEB68

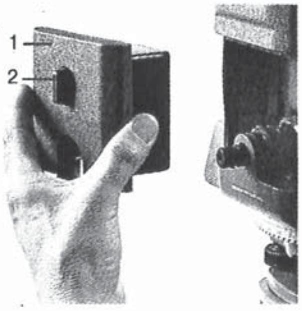


Figure 21:

Inserting and removing plug-in 2Ah battery

1	Plug-in battery GEB68
2	Locking knob: Knob vertical: Open to fit or remove battery Knob horizontal: Battery or cover locked

20.3 External batteries GEB70 and GEB71

When an external battery is connected to the theodolite, the plug-in battery is automatically switched off. The external battery does not charge the plug-in battery.

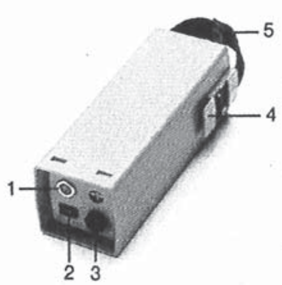


Figure 22 a

Small battery GEB70, 2 Ah, previous version

1 Socket for cable to theodolite
2 Socket for charger cable from GKL12 battery charger
3 Fuse holder, turn to remove
4 Hook for tripod leg
5 Carrying strap

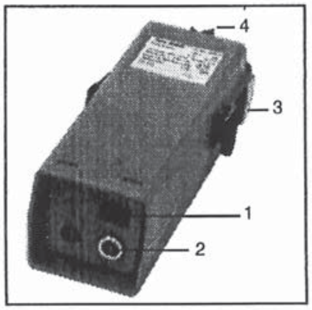


Figure 22 b

Small battery GEB70, new version

1 Socket for charger cable (charger GKL22, GKL23)
2 Socket for battery cable
3 Hook for tripod leg
4 Carrying strap

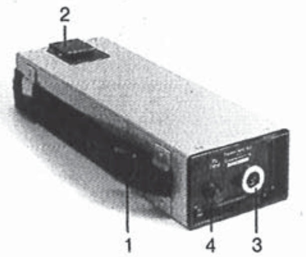


Figure 23

Universal battery GEB71, 2 Ah, previous version

1 Carrying strap
2 Hook for tripod leg
3 Socket for cable to theodolite and charger (2 pins)
4 Fuse holder, turn to remove

20.4 Battery charging with the previous chargers

Battery charger GKL12: Charges two GEB68 or GEB70 units
Battery charger GKL14: Charges GEB71

Select the required voltage on the selector switch, 115 V or 220/230 V. The mains voltage may fluctuate by –15% to +10% (GKL14 +20%) of the nominal voltage. Plug the charger into an AC mains socket. Connect the battery or batteries. The red charging lamp lights. If the charging lamp does not light, either the cable to the mains socket or the battery fuse is faulty, the supply to the mains socket is defective, or there is a mains power failure.

On the GKL14, the green mains lamp must also light. If it does not light, the mains cable is faulty, there is a break in the supply to the mains socket, or there is a mains power failure.

A flat battery is recharged in 14 hours. A normal timer can be used to select and limit the charging time, and is recommended for unsupervised charging (eg. over a weekend).

20.5 Battery charging with the new chargers

Battery charger GKL22:
Charges 1 battery, suitable for batteries with 5-pin plug, standard charging time up to 14h

Charger GKL22	with European plug	220 V
Charger GKL22-1	with US plug	110 V
Charger GKL22-2	with US plug	100 V, e.g. for Japan

Battery charger GKL23:
Automatically charges 2 batteries sequentially, microprocessor-controlled fast charge (approx. 1.5 h for 1.5 Ah battery or 5 h for 7 Ah battery), with 2 charging cables, discharging facility before new charge, suitable for batteries with 5-pin plug

Charger GKL23	with Europen plug	220 V
Charger GKL23-1	with US plug	115 V, full functionality also for voltages down to 90 V, e.g. for Japan

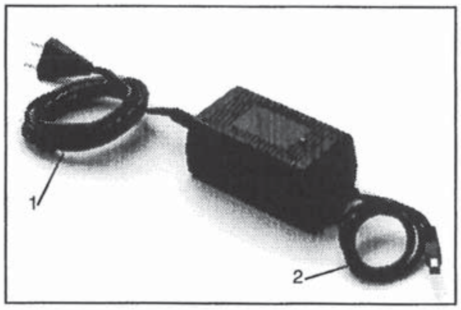


Figure 22

GKL22

1 Mains cable
2 Charging cable, 5 pin

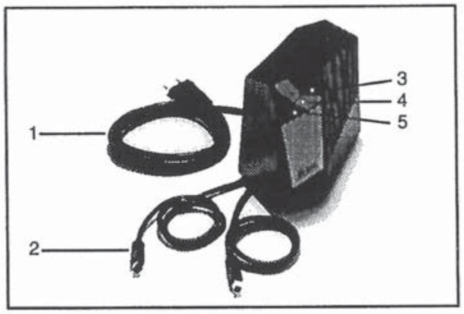


Figure 23

GKL23

1 Mains cable
2 Charger cable for the sequential charging of 2 batteries
3 Stand by indication (charger connected to mains)
4 Charging indication
5 End-of-charge indication

20.6 Compatibility of previous and new batteries and chargers

Two adapter cables are available for the combination of previous instruments with new ones:

Connection of previous chargers to the new batteries with 5 pin charging plug
Adapter cable A for battery, 5 pin, to charger GKL12 / 14

Connection of new chargers to the previous batteries with 2 pin charging plug
Adapter cable B for battery, 2 pin, to charger GKL22 / 23

20.7 Discharge of a 12 V NiCd-battery

Figure 26 shows the typical rate of discharge of a rechargeable NiCd battery. The voltage of a fully charged battery drops rapidly from level 9 to 7. The voltage drop from level 7 to 3 is spread over a longer period. From level 3, the voltage drop is again quite rapid. When the battery voltage drops below 11.0 V, ERROR 12 appears on the display.

If the capacity of a battery drops considerably, we recommend that you carry out 2 to 3 cycles of discharging and charging the battery completely. This may easily be done with the aid of the microprocessor controlled charger GKL23.
The time for discharge is about 1h per 0.7 A (see GKL23 manual).

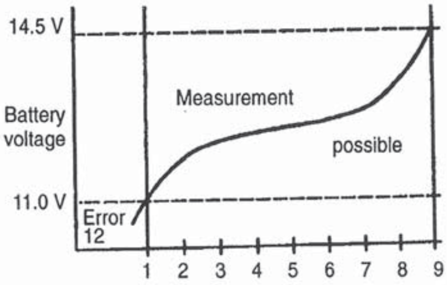


Figure 26

Rate of discharge of a 12 V NiCd battery

A NiCd battery performs best when you let it become practically flat and then leave it to recharge fully. Partial discharge and recharging can reduce the life and performance of a battery.

21 ERROR MESSAGES

21.1 General

Messages indicating operating errors and malfunctions appear in display 2. These messages consist of the word ERROR followed by a two or three-digit number.

Delete error messages by input of [CE]. Take no further action unless the message appears again.

If an operating error prevents cancellation of an error message by the [CE] or [OFF] key, briefly pull out the plug-in battery or the battery cable to break the circuit.

If the error message is a three-digit number, it comes from peripheral equipment. The first digit indicates the peripheral unit concerned, the second and third digits are a standard error message from the peripheral unit.

Definition of peripheral equipment:

0: GRE4 data-recording unit
2: EDM

21.2 Table of error messages

General messages

Message	Cause	Corrective action
01	Input SET MODE or COGO number does not exist	[CE] Input correct number
02	V-angle range not valid for a: recording in CALC ON mode b: determining horizontal collimation and tilting-axis errors	[CE] Set CALC OFF: SET MODE 89 Keep within V range (see 7.7)
03	Angle input with SET HZ_0 or SET SO exceeds 400gon, 360°, 60', 60.0", or 6400mil	[CE] Input correct angle
04	Index or horizontal collimation error exceeds 0.9° or 1 gon; index error of compensator exceeds 1'53" or 0.035gon	[CE] Determine again if necessary; if message recurs, notify Wild workshop
05	You touched [REC] while distance measurement was in progress	[CE] Wait until distance measurement is complete
06	You pressed [REP] [REC] after reversing counting direction or after input of a new point number	[CE] [REC]

General messages (contd)

Message	Cause	Corrective action
07	No valid target-point coordinates have been measured and stored by SET MODE 18	[CE] Determine coordinates
	or SET MODE 19 has been input twice in succession	[CE] Warning only
09	You have reached point n° 99999999 in the positive counting direction	[CE] Continue measurement; next point n° is 0
	or You have reached point n° 0 in the negative counting direction	[CE] Continue measurement; next point n° is 99999999
12	Low battery voltage	[CE] Change battery
13	Wrong pointing in COGO 22	[CE] Continue measurement
14	Illegal function while distance measurement is in progress	[CE]
15	Point number must not be changed during REP ALL	[CE]
16	This function is available only when the compensator is switched on	[CE] If necessary, switch on the compensator by SET MODE 17

Interface to data-recording unit

Message	Cause	Corrective action
21	Parity error or wrong transfer rate for received data	[CE] Check parameters set on theodolite and recording unit
22	No response from recording unit received by theodolite within 4s	[CE] Check link to GRE4 or computer, check parameter settings
24	Data string too long; must not exceed 80 characters including CR LF	[CE]
25 26	Theodolite receives incorrect response from recording unit	[CE] Check parameter settings and links

Interface to EDM

Message	Cause	Corrective action
31	Transfer error from DISTOMAT to theodolite, e.g. parity error	[CE] Check links and interface definition (SET MODE 25 or SET MODE 26) *
36	Data string from DISTOMAT too long	[CE] Check cables
39	Theodolite receives no response from DISTOMAT, or wrong definition of interface	[CE] Check cable links and interface definition (SET MODE 25 or SET MODE 26)
41	Linear unit set on DISTOMAT not metres	[CE] Set linear unit on DISTOMAT to metres
42	ppm setting on DISTOMAT not = 0	[CE] Set ppm = 0 on DISTOMAT
43	mm setting on DISTOMAT not = 0	[CE] Set mm = 0 on DISTOMAT

* If this message recurs, notify the nearest Wild service workshop

Angle measurement

Message	Cause	Corrective action
50 51	Fault in angle-measuring system	[CE] If either message recurs, notify Wild workshop
52	Time-out error; the theodolite cannot measure angles accurately within 6s	[CE] Set the theodolite at rest
58	Standing-axis tilt exceeds the compensator's working range	[CE] Level up the theodolite

Recording format

Message	Cause	Corrective action
60	wi not set, hence it cannot be deleted	[CE]
61	Maximum number of wi has been set	[CE]
62	wi invalid	[CE]
67	wi = 71 or wi = 72 is missing from the recording format	[CE] Set the missing wi
69	wi = 11 is missing from the recording format	[CE] Set wi = 11

REC module

Message	Cause	Corrective action
70	The data needed for this computation are missing from the data block; the computation cannot be executed	[CE]
71	This point number does not exist	[CE]
72	Memory almost full; when this message first appears, there is room for about 20 more data blocks	[CE] This preliminary warning is displayed after every further input
74	Overflow; the last data block was not recorded	[CE] Insert new REC module
75	Battery of REC module flat	[CE] Copy data; data secure for two months. Notify Wild workshop
76	Functional defect in REC module	[CE] If message recurs, note data and notify Wild workshop
77	Faulty data transfer between theodolite and REC module, or loss of data in REC module	[CE] Check connection or replace REC module
78	Incorrect setting; set to 'REC module'	[CE] [SET] [MODE] 76 [RUN] 1 [RUN]
79	REC module missing	[CE] Insert REC module
80	Recording impossible, because wi = 11 (point number) has not been set in the recording format	[CE] Set wi = 11

System messages

Message	Cause	Corrective action
82	Display overflow	[CE] Keep to the correct number of places before the decimal point
83	Correction of horizontal collimation error faulty	[CE] Redetermine and store the index and instrument errors If any of these messages recur, notify the nearest Wild workshop
84	Correction of tilting-axis error faulty	
85	Correction of index error faulty	
86	Correction of compensator-index error faulty	
87	Display of battery's charge state out of adjustment and incorrect	[CE] Continue measurement *
88	Temperature display out of adjustment and incorrect	[CE] Continue measurement *
89	The temperature inside the theodolite is too high	[CE] Leave instrument to cool

* Arrange for early adjustment by Wild workshop

System errors

Message	Cause	Corrective action
91 to 93	Arithmetical error	[CE]
8D 8E 95	Hardware error	[CE] If messages recur, notify Wild workshop
8B 8C 9A 97 to 99	Hardware error	[CE] Instrument needs servicing

22 SUMMARY OF COMMANDS

22.1 General functions (white)

[ALL]	Starts angle and distance measurement, records measured data
[CE]	Cancel entry: cancels messages and deletes input values digit by digit
[CODE]	Input code number and up to four words of information (see 9.7)
[COMP]	Displays longitudinal and transverse standing-axis tilt (see 7.8)
[DIST]	Starts distance measurement
[HZ]	Single HZ angle measurement
[HZ V]	Single measurement of HZ and V angles
[NR]	Input non-sequential point number (se 9.6.2)
[ON]	Switches on theodolite
[OFF]	Switches off theodolite
[REC]	Starts recording
[REP]	Starts continual measurement, e.g. [REP] [HZ], [REP] [DIST], etc
[RUN]	Confirms input and terminates a function, e.g. [SET] [mm] mm [RUN]
[STOP]	Breaks off a function or continual measurement in progress, e.g. tracking
[TEST]	Accesses a test function (see section 13)
[V]	Single V angle measurement
[LIGHT]	Switches display and reticle light on and off (see 4.5)

22.2 Select display format (green)

		Display 2	Display 3
[DSP] [HZ ⊿]		Horizontal angle	Horizontal distance
[DSP] [⊿ H]		Height difference	Target-point height
[DSP] [⊿ V]		Slope distance	Vertical angle
[DSP] [E N]		Easting	Northing
[DSP] [DIFF]	1:	ΔHZ	Δ⊿
	2:	ΔHZ	ΔV
[DSP] [HZ V]		Horizontal angle	Vertical angle
[DSP] [NR]		---	Point number

22.3 SET commands (orange)

[SET] [E_o N_o] E_o [RUN] N_o [RUN]	Set station coordinates
[SET] [H_o] H_o [RUN]	Set station height
[SET] [HZ_o] HZ_o [RUN]	Orient horizontal circle
[SET] [NR_o] NR_o [RUN]	Set starting number of sequential point numbering
[SET] [mm] mm [RUN]	Set additive constant
[SET] [ppm] ppm [RUN]	Set scale factor
[SET] [SO] HZ_s [RUN] ⊿ [RUN]	Input setting-out elements HZ and ⊿
[SET] [SO] HZ_s [RUN] V_s [RUN]	Input setting-out elements HZ and V
[SET] [COGO] nn [RUN]	Access a coordinate-geometry function (see section 11)
[SET] [MODE] nn [RUN]	Access SET MODE functions (see section 14)
[SET] [FIX] n [RUN]	Set number of decimal places for display of angle measurements
[SET] [REC]	Set recording format (see 9.5)
[SET] [REM]	Input REM code (see 9.8)
[SET] [TIME]	Set time for automatic power-off (see 5.4)

22.4 Data search functions for REC module (blue)

For details see 9.9.1.

[DATA]	1: Step key for scrolling menu choices 2: Selects DATA mode (see below)
[DATA] [—>] [—>] ... ... [<—] [<—] ...	Search for and display data forward and backward
[DATA] [FIND] n° [RUN]	Search for and display data by point number

23. VIEW OF T2002, T3000 AND KEYBOARD

23.1 Legend for view of T2002/T3000

1 Locking screw for carrying handle: unscrew to remove handle
2 Two-speed focusing sleeve
3 Black ring; permits user to hold telescope without changing the focus
4 Removable telescope eyepiece; turn bayonet ring (14) counterclockwise to remove eyepiece
5 Optical sight

6 Spherical level
7 Displays 1: User guidance
Displays 2 and 3: Data
8 Keyboard
9 Prism for reading horizontal setting circle
10 Removable carrying handle; hinges up for DISTOMAT

11 Spring-loaded catch for carrying handle
12 DISTOMAT adapter
13 Socket for cable to DI4, DI4L, and DI5S DISTOMAT
14 Eyepiece bayonet ring
15 Plate level

16 Two-speed vertical drive
17 Vertical clamp
18 Two-speed horizontal drive
19 Horizontal clamp
20 REC module, insert in face 2

21 Locking knob; turn to lock theodolite to tribrach, pull out small screw to block knob in locked position
22 Footscrews
23 GST20 tripod
24 Lens mount of T3000 telescope
25 GEB68 plug-in battery or dummy cover plate

26 Locking knob for battery
27 Optical plummet, reticle and image focusing
28 Horizontal setting circle
29 Socket for cable link to external battery and/or GRE4 data terminal

Precision Total Station

WILD TC2002

Supplement to T2002/T3000
User Manual

This user manual contains important safety directions (chapter 25) as well as instructions for setting up the instrument and operating it. Read carefully through the user manual before you switch on the instrument.

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Leica

CONTENTS

SAFETY DIRECTIONS

Laser class

The EDM module built into the total stations produces an invisible infra-red beam which emerges coaxially from the telescope objective. The product is a Class 1 laser product in accordance with

- IEC 825-1 "Radiation safety of laser products"

Class 1 laser products are safe under reasonable foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with the instructions.

Caution:
Allow only authorized Leica service workshops to service the total stations.

LED
CLASSE 1

EN 60825-1: 1994
IEC 825-1:1993

1. TECHNICAL DATA

Telescope	Coaxial telescope for angle and distance measurement
Image	Erect.
Magnification	30x
Objective aperture	42 mm
Shortest focusing distance	1.7m
Field diameter at 1000 m	27 m
Focusing	coarse and fine
Telescope tilting range	fully transiting

Weight

TC2002, Excluding tribrach and battery	7,6 kg
Plug-in battery GEB68	0,8 kg
Tribrach GDF21	0,8 kg
Case	5,5 kg

Distance measurement [1]

Normal Distance measurement	1 mm + 1 ppm, measuring time 4 s
DIL-continuous measurement	1 mm + 1 ppm, measuring time 4 s
Fast measurement	3 mm + 1 ppm, measuring time 3 s
Tracking	5 mm + 1 ppm, measuring time 1 to 2 s

[1] All Data are standard deviation

Data recording

REC-Module	- CMOS memory - Capacity 64 kByte or about 2000 data blocks - Dimensions 74 x 60 x 10 mm - Weight 70 g
Signal attenuation	automatic
Break in measuring beam	no effect on results

Range with Wild circular prisms

Circular prisms	Atmospheric conditions		
	poor 1)	medium 2)	excellent 3)
1	1,0km	2,0km	2,5km
3	1,2km	2,8km	3,5km
7	1,4km	3,5km	4,5km
11	1,6km	4,0km	5,5km

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.

Range with Leica tape target

Target size	Measurement range
20x20mm	2 ... 40m
40x40mm	20 ... 100m
60x60mm	60 ... ≈ 160m

Carrier wave	0,850 µm, infra-red
Measuring frequency	special frequency Base 50 MHz ~ 3m.
Beam width	
(at half power)	2,5' (70cm at 1000m)
Power consumption	
During distance measurement	about 5,4 W (0,45A / 12V)
Scale correction	-999,9 to +999,9 ppm
Steps	0,1 ppm
Additive (prism) constant	-999,9 to +999,9 mm
Steps	0,1 mm
Height of tilting axis	196mm as T2, T1000, T1610, T2002

2. INTRODUCTION

The TC2002 is identical with the T2002 but has a built-in electronic distance-measuring (EDM) unit, based on the Wild DISTOMAT DI2002. The telescope has a coaxial optics for angle and distance measurement. Power supply, recording equipment and the operating procedure are the same as for the T2002. The TC2002 is delivered with two control panels and one insert for REC module in position 2.

If a certificat for distance measurement was supplied together with the instrument the following facts should be known:

1. **Tape target certificate**
   Measurements are made to a target orientation which is perpendicular to the line of sight.
   If the target is inclined to the line of sight the measurement results might be different to the values presented in the certificate.
   Averaged distance measurements in two faces provide the same result as presented in the certificate.

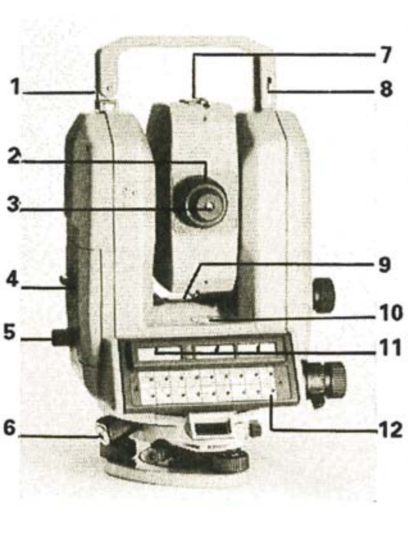


Fig 1: TC2002

1 Locking screw of carrying handle
2 Two-speed focusing sleeve
3 Telescope eyepiece (bayonet fitting)
4 Battery insert cover
5 Optical plummet, focusing
6 Socket for cable to external battery and/or GRE data terminal
7 Optical sight
8 Spring-loaded catch for carrying handle
9 Plate level
10 Circular bubble
11 Displays
12 Keyboard

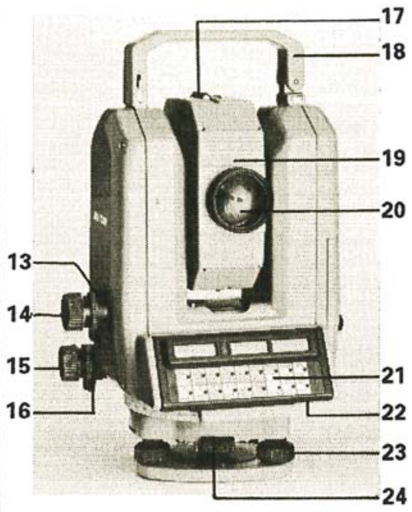


Fig 2: TC2002

13 Vertical clamp
14 Vertical drive
15 Horizontal drive
16 Horizontal clamp
17 Optical sight
18 Carrying handle
19 Telescope with integrated EDM
20 Coaxial optics for angle and distance
21 Keyboard
22 Keyboard and insert for REC module in position II
23 Footscrew
24 Locking knob

3. POINTING TO A REFLECTOR

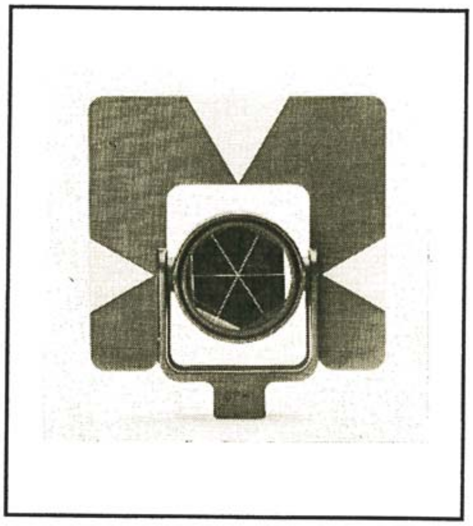


Fig 3

GPH1 single-prism holder with GZT4.
cross-hairs must intersect in center of prism.

For short-range distance measurement with the TC2002, 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 center of the reflectors. 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 TC2002 is adjusted at the factory to make the infra-red measuring beam coincide with the center of the telescope's line-of-sight When the cross-hairs point to the center of the reflector prism, the received signal is at maximum strength.

4. SCALE CORRECTION FACTOR (ppm)

The scale-correction factor in ppm (parts per million) applies correction for errors proportional to the measured distance, i.e. for atmospheric conditions, reduction for height above sea level and the projection scale factor.

4.1 Atmospheric correction ΔD_1

The displayed distance is correct only if the scale-correction factor stored in the DISTOMAT is correct to compensate the atmospheric conditions prevailing at the time of measurement.

The atmospheric correction takes into account atmospheric pressure, ambient temperature and relative humidity.

For very precise distance measurement within 1ppm, the ambient temperature must be determined accurately to within 1°C, atmospheric pressure to 3mb and relative humidity to within 20%.

The atmospheric correction may be taken directly from graph.

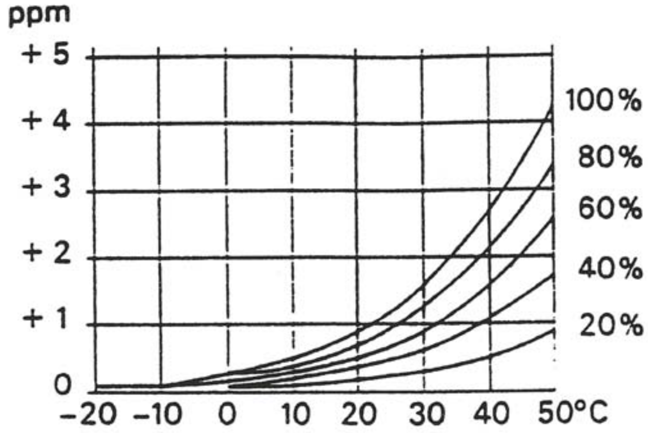


Fig. 12: Influence of relative humidity

Relative humidity does not greatly affect the accuracy of measurements. It is mainly of importance in very hot and humid conditions. For very precise distance measurement, relative humidity must be taken into account together with atmospheric pressure and ambient temperature.

The nominal refractive index n = 1.0002818 is computed in accordance with Barrel and Sear's formula as applied to the DISTOMAT carrier wave of 0.85µm for an atmospheric pressure p = 1013.25mb, an ambient temperature t = 12°C and a relative humidity h = 60%.

$$\Delta D_1 = 281.8 - \left[\frac{0.29065 \cdot p}{(1+\alpha \cdot t)} - \frac{4.126 \cdot 10^{-4} \cdot h}{(1+\alpha \cdot t)} \cdot 10^{x} \right]$$

where:

ΔD^1 = atmospheric correction in ppm
p = atmospheric pressure (mb)
t = ambient temperature (°C)
h = relative humidity (%)
α = 1/273.16

$$x = \frac{7.5t}{237.3+t} + 0.7857$$

If the default value of 60% relative humidity is retained, the greatest possible error in the correction is 2ppm.

4.2 Reduction to mean sea level ΔD_2

For places above sea level the correction is always negative, and based on the formula:

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

where:

ΔD_2 = reduction to mean sea level in ppm

H = instrument height (m) above sea level

R = earth radius 6378 (km)

4.3 Correction for projection-scale factor ΔD_3

The projection-scale factor depends on the locally used projection system. Useally, local tables are published. For cylindrical projections such as Gauss-Krüger the correction factor in ppm, is based on the following formula:

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

where:

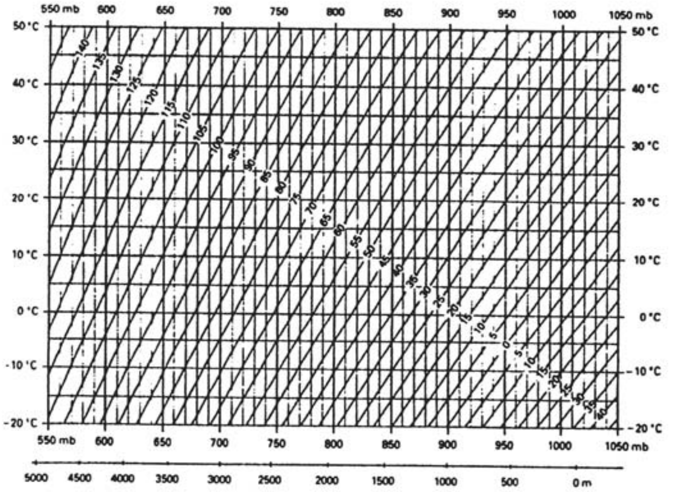
ΔD_3 = projection-scale factor in ppm

X = northing in km, offset from projection-line 0 at scale factor 1

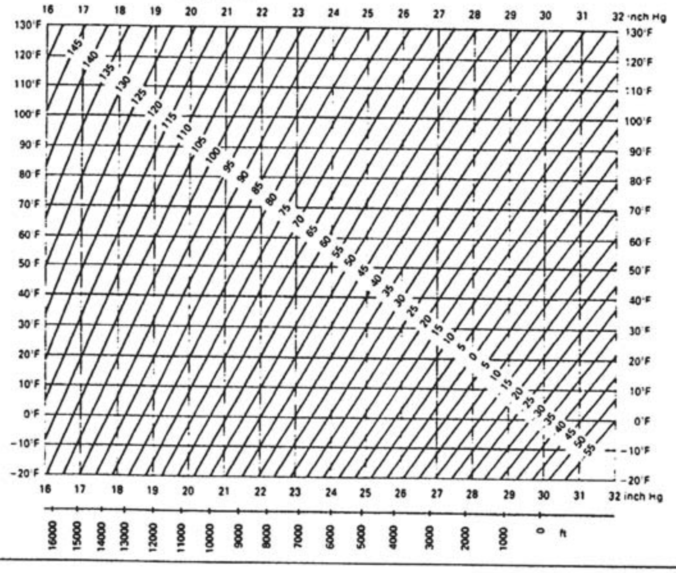
R = earth radius 6378 (km)

In countries where the scale factor is not 1, above formula cannot be used as it stands.

Atmospheric correction in ppm with °C, mb, H (Metre)
at 60% relative humidity



Atmospheric correction in ppm with °F, inch Hg, H (Feet)
at 60% relative humidity



5. REDUCTION FORMULAE

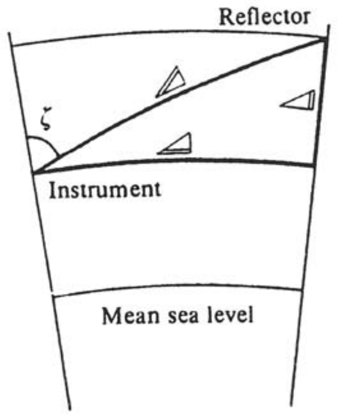


Fig. 13: Height measurement

The DISTOMAT 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.

⊿ = displayed slope distance = $D_0 \cdot (1 + \text{ppm} \cdot 10^{-6}) + \text{mm}$
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
$A = \frac{1 - k/2}{R} = 1.47 \cdot 10^{-7}\ [m^{-1}]$
$B = \frac{1 - k}{2R} = 6.83 \cdot 10^{-8}\ [m^{-1}]$
$k = 0.13$
$R = 6.37 \cdot 10^{6}\,m$

In the DIL program, the following values are displayed:

$\bar{D}$ = slope distance as arithmetical mean of all measurements
s = standard deviation of a single measurement
n = number of measurements made

These values are computed as follows:

$$\bar{D} = \frac{1}{n} \cdot \Sigma^{n}_{i=1} D_i$$

Σ = sum
D_i = single measurement

$$s = \sqrt{\frac{\Sigma^{n}_{i=1} (D_i - \bar{D})^2}{n-1}} = \sqrt{\frac{\Sigma^{n}_{i=1} D_i^2 - \frac{(\Sigma D_i)^2}{n}}{n-1}}$$

Standard deviation $S_{\bar{D}}$ of the arithmetical mean of the distance may be computed as follows:

$$s_{\bar{D}} = \frac{s}{\sqrt{n}}$$

6. OPERATING COMMANDS :

6.1 Angle measurement

☞ The commands and operating procedure are almost exactly the same as for the T2002 with DI2002.
(See section 7 in T2002/T3000 user manual.)

6.2 Distance measurement

Normal measurement DIST

Touching DIST switches on the EDM and starts the normal distance measurement.

If the display selection for distance is made for meter and 4 decimals or for feet and 3 decimals (SET MODE 41 RUN 2 RUN or SET MODE 41 RUN 3 RUN) the measured distance will be recorded with the full number of decimals (ALL or REC after measurement)

Tracking **TRK**

Touching **REP DIST** switches on the EDM and starts the tracking measurement. Touch **STOP** to stop the tracking measurement..

Different measuring modes

You can assign three different measuring modes to the theodolite's DIST key, standard mode, fast measurement, repeat mode.

Fast measurement **DI**

Distance measurement with half of the "standard" measuring time but lower accuracy . This program is also suitable for increasing the range under poor atmospheric conditions.

Repeat measurement mode **DIL**

The distance is displayed as arithmetical mean off all measurements taken. This alternates with a display of the number (**n**) of measurements and the standard deviation (**s**) in mm computed for a single measurement from n measurements. The number of measurements made and the standard deviation obtained can also be displayed by **TEST 8**.

If the display selection for distance is made for meter and 4 decimals or for feet and 3 decimals (SET MODE 41 RUN 2 RUN of SET MODE 41 RUN 3 RUN) the averaged distance will be recorded with the full number of decimals (REC after DIL program was finished). The number of measurements and the standard deviation (always in mm!) can also be recorded if the data format is set accordingly (WI 52).
(Refer also to par. 9.5. of T2002/T3000 manual)

6.3. Instrument and Reflector height

In addition to the station height Ho, also the instrument height i and the reflector height r can be set and defined in the recording format of the instrument.

SET Ho Ho RUN i RUN r RUN

Input of station height, instrument and reflector heights. These values remain stored after switching the instrument off.
With RUN, previous set values as displayed can be copied unchanged. To set to zero, input the decimal point without digits.
Set the instrument and reflector heights in the instruments recording format:

wi = 87 reflector height
wi = 88 instrument height

The height difference and target height as displayed and recorded with wi = 33 and wi = 83 automatically take into account the actually set instrument and reflector heights.

6.4 Signal

For a permanent display of return-signal strength touch **TEST 5** .An acoustic signal will be heard as soon as return signal is received, and in the display 3 you can see the signal strength. The telescope of the TC2002 is adjusted at the factory to make the infra-red measuring beam coincide with the center of the telescope's line of-sight. When the cross hairs point to the center of the reflector prism, the received signal is at maximum strength. **CE** terminates function.

☞ General Precautions

See section 15 in T2002/T3000 user manual.

7. SET MODE COMMANDS:

(See section 14 in T2002 / T3000 user manual)

7.1 Invalid SET MODE commands

The following SET MODE commands do not apply to the TC2002

SET MODE 20 RUN	Command not required as EDM of TC2002 is unambiguous up to 9999.999.
SET MODE 25 RUN	Interface for DI4, DI41 DI5.
SET MODE 26 **RUN**	Interface for all new Distomat's
SET MODE 29 RUN	Special setting for built-in autocollimation eyepiece only (special fitting).

7.2 Additional SET MODE commands (only for TC2002)

SET MODE 49 RUN	To display the actual measuring frequency used for the computation of the distance
SET MODE 50 RUN	Setting for retro-target measurement

The SET MOD 50 command allows to switch the TC2002 between retro-target mode and prism mode.

MEASURING TO RETRO-TARGETS

SET MODE 50 RUN 0 RUN	switches to retro-target mode. During the command imput the following information are displayed before the final RUN

Middle	Right
rEtro	0

If retro-target mode is selected the corrrect additional constant has to be set. If Leica retro-targets are used the constant is

+ 34mm.

The selected mode remains available also after power shut down.

MEASURING TO PRISMS

SET MODE 50 RUN 1 RUN	switches to prism mode. During the command input the following information are displayed before the final RUN.

Middle	Right
PrIS	1

When the mode is changed to prism the additional constant should be selected. If Leica standard prisms are used the constant should be

0mm.

The selected mode remains available also after power shut down.

8. TEST - commands

(See section 13 of T2002/T3000 user manual)

9. COGO FUNCTIONS

9.1 COGO FUNCTIONS WHICH APPLY TO TC2002 AND T2002

(see section 11 in T2002/T3000 user manual)

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 21:	Setting station coordinates
COGO 22:	Resection
COGO 23:	Orientation of horizontal circle
COGO 24:	Setting-out
COGO 25:	Setting-out with HZ- and V-angle.
COGO 31	Mean values of HZ and V from multiple pointing in one telescope position
COGO 32	Mean values of HZ and V from observations in both telescope position

9.2 COGO FUNCTIONS WHICH APPLY ONLY TO THE T2002

COGO 26	Height transfer 1
COGO 33	Use of substance bar to compute horizontal distance.

9.3 ADDITIONAL COGO FUNCTIONS WHICH APPLY ONLY TO THE TC2002

COGO 41	Height transfer 2
COGO 42	Setting-out heights

COGO 41 : Height transfer

To determine the station height, measure the vertical angle and distance to a tie point whose height is stored in the REC module.

Point to reflector.

DIST	Measure distance
SET COGO 41 RUN	Select height transfer.
Pkt . Nr. **RUN**	Input point number of tie point.
i **RUN** r **RUN**	Input instrument and reflector height; instrument displays station height.
RUN	Sets station height Ho instrument height i and reflector height r Ends height transfer

COGO 42 : SETTING-OUT HEIGHTS

This setting-out program permits computation of the height difference of setting-out points. The height of the setting-out points must be stored in the REC module. Station coordinates must be set on the instrument.

SET COGO 42 RUN	Select the function for setting-out.
Pkt. Nr. **RUN**	Input number of point to be set-out .To use the number of a point set-out earlier with COGO 24, press **RUN** only.
i **RUN**	Input instrument height. To adopt the instrument height used earlier, press **RUN** only.

r RUN	Input reflector height. To adopt the reflector height used earlier, press RUN only. After input of the reflector height, the instrument displays the height of the point to be set-out.
RUN	Sets display of height difference ΔH
DIST	Measure slop distance and displays difference ΔH between stored and measured height of setting-out point.

COGO 45 : FREE STATION (TC2002 V 4.0)

This program can be used to calculate the coordinates of station with measurements to a maximum of 6 (minimum 3) points. The coordinates of the reference points must be known and stored in the REC-module. If a minimum of one reference point is stored with its height, the height of the station will be calculated too.

NOTE: The measurements of the reference points must be stored in the standard data format (SET REC . RUN REC). An individual data format can be applied after the Free Stationing is completely finished.

SET COGO 45 RUN	Selects function for free station survey and displays NUMB ?
n RUN	Input the total number of reference points. The display switches to PT NR 1.
Number 1 **RUN**	Input the number of the first reference point. (If you press RUN without entering a point number, the coordinates of the station point will be calculated with the last n points stored in the REC module). The display switches to PT NR 2.
Number 2 **RUN**	Input the number of the second reference point etc.
Number n **RUN**	Input number of final reference point. Instrument displays calculated station coordinates E_0, N_0.

	The **REP** key allows the user to review the results of the calculation in the following order: - Orientation Hz_0 - Mean coordinate error M_0 - Residual error to first reference point - Residual error to second reference point, etc. - Station coordinates, etc.
DATA	Display switches to the results of the height calculation and displays S INST.
Instrument height* **RUN**	Input the instrument height. Instrument displays the calculated station height H_0. The **REP** key allows the user to review the results of the calculation in the following order: - Mean height error, M_0. - Difference (calculated height - measured height) of the first reference point. - Difference (calculated height - measured height) of the second reference point etc. - Station height, etc.
DATA	Switches to the results of the coordinates calculation.

Add a measurement for calculation:

DSP	Display switches to INS PNT.
RUN	Display switches to PT NR.
Point Number **RUN**	Input the point number to add to the calculation. (The measurement must be stored in the REC-module). Instrument displays calculated station coordinates E_0, N_0.

Eliminate a measurement from the calculation:

DSP	Display switches to INS PNT.
DSP	Display switches to DEL PNT.
RUN	Instrument displays the number of the first reference point. Press the **REP** key until the point to eliminate is displayed.

RUN	**The previously diplayed point number is removed from the calculation. Instrument displays newly calculated station coordinates E_0, N_0.**

There are three ways to end the COGO 45 function:

1.) STOP	**Ends function without setting any parameter in the TC2002**
2.) ALL	**If the instrument height has not been entered, the display switches to S INST.**
Instrument height RUN	**Input of the instrument height. Sets E_0, N_0, Hz_0 and H_0, ends function.**
3.) REC	**Displays REC Pt nr.**
Point Number RUN	**Input of the station point number. If the instrument height has not been entered until now, the display switches to S INST.**
Instr. Height RUN	**Input of the instrument height. Sets E_0, N_0, Hz_0 and station height H_0, stores the station coordinates and height in the REC-module, ends function**

The instrument height must not be entered in 2. or 3. above if it has been entered during the COGO 45 (see *).

10. Testing and adjusting

Sections 17.1 to 17.6 white pages, T2002/T3000 user manual, apply to the TC2002.

Section 17.7 and 17.8 do not apply.
The telescope is adjusted at the factory. The infra-red beam coincides with the line of sight.

With the cross hairs on the center of the prism, the return signal will be a maximum.

Safety directions

The following directions should enable the person responsible for the T(C)2002/T3000, and the person who actually uses the instrument, to anticipate and avoid operational hazards.
The person responsible for the instrument must ensure that all users understand these directions and adhere to them.

25.1 Intended use of the instrument

Permitted uses

The T/TC2002, T3000 electronic theodolites are intended for the following applications:

- Measuring horizontal and vertical angles
- Measuring distances (TC-models with integrated distance meter, T-models with removable distance meter)
- Recording measurements
- Computing by means of application software.

Prohibited uses

- Using the electronic theodolite or total station without previous instruction
- Use outside the range of conditions for which the instrument is intended
- Deactivation of safety systems and removal of hazard notices
- Opening the instrument by using tools (screwdriver etc.), unless this is specifically permitted for certain operations
- Modification or conversion of the instrument
- Use after misappropriation
- Use with accessories from other manufacturers without the prior express approval of Leica
- Aiming directly into the sun
- Inadequate safeguards at the measuring station (e.g. when measuring on roads, etc.).

⚠ **WARNING:**
Adverse use can lead to injury, malfunction, and damage.
It is the task of the person responsible for the instrument to inform the user about hazards and how to counteract them. The T2002/TC2002/T3000 electronic theodolites and total stations are not to be used until the user has been properly instructed how to use them.

25.2 Limits of use

See chapter 2 TECHNICAL DATA.

Environment:

Suitable for use in an atmosphere appropriate for permanent human habitation: not suitable for use in aggressive or explosive environments. Use in rain is permissible for limited periods.

25.3 Responsibilities

- Responsibilities of the manufacturer of the original equipment Leica AG, CH-9435 Heerbrugg (hereinafter referred to as Leica): Leica is responsible for supplying the product, including the user manual and original accessories, in a completely-safe condition.

☞ Responsibilities of the manufacturers of non-Leica accessories: The manufacturers of non-Leica accessories for the T2002/TC2002, T3000 electronic theodolites and total stations are responsible for developing, implementing, and communicating safety concepts for their products, and are also responsible for the effectiveness of those safety concepts in combination with the Leica product

- Responsibilities of the person in charge of the instrument:

WARNING:
The person responsible for the instrument must ensure that it is used in accordance with the instructions. This person is also accountable for the training and the deployment of personnel who use the instrument and for the safety of the equipment in use.

The person in charge of the instrument has the following duties:
- To understand the safety instructions on the product and the instructions in the user manual
- To be familiar with local regulations relating to accident prevention
- To inform Leica immediately if the equipment becomes unsafe.

25.4 Hazards of use

Main hazards of use

WARNING:
The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or prohibited use, and can give rise to accidents with far-reaching human, material, financial, and environmental consequences.

Precautions:
All users must follow the safety directions given by the manufacturer and the directions of the person responsible for the instrument.

WARNING:
The charger and the GIF10 interface must not be used in damp or inclement conditions. If moisture penetrates these devices, the user may receive an electric shock.

Precautions:
Use the charger and the GIF10 interface only indoors, in dry rooms. Protect them from damp. If the devices are damp, do not use them.

⚠ **WARNING:**
If you open the charger or the GIF10 interface, either of the following actions may cause you to receive an electric shock:
- Touching live components;
- Using the devices after incorrect attempts to carry out repairs.

Precautions:
Do not open the charger or GIF10 interface yourself. Only a Leica-approved service technician is entitled to repair them.

⚠ **CAUTION:**
Watch out for erroneous measurements if the instrument is defective or if it has been dropped or has been misused or modified.

Precautions:
Periodically carry out test measurements and perform the field adjustments indicated in the user manual, particularly after the instrument has been subjected to abnormal use and before and after important measurements.

⚠ **DANGER:**
Because of the risk of electrocution, it is very dangerous to use reflector poles and extensions in the vicinity of electrical installations such as power cables or electric railways.

Precautions:
Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their instructions.

⚠ **WARNING:**
By surveying during a thunderstorm you are at risk from lightning.

Precautions:
Do not carry out field surveys during thunderstorms.

⚠ **CAUTION:**
Be careful not to point the instrument directly towards the sun because the telescope functions as a magnifying lens and can injure your eyes or damage the internal components of the EDM.

Precautions:
For total stations: Avoid pointing the telescope directly at the sun.
For electronic theodolites: For observations to the sun or other highly reflective objects, use the appropriate accessories.

⚠ **WARNING:**
During target recognition or stakeout procedures there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around or between the instrument and the target (e.g. obstacles, excavations or traffic)

Precautions:
The person responsible for the instrument must make all users fully aware of the existing dangers.

⚠ **WARNING:**
Inadequate securing of the survey site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations.

Precautions:
Always ensure that the survey site is adequately secured. Adhere to the regulations governing accident prevention and road traffic.

⚠ **CAUTION:**
If a target lamp accessory is used with the instrument the lamp's surface temperature may be extreme after a long working period. It may cause pain if touched. Replacing the halogen bulb before the lamp has been allowed to cool down may cause burning to the skin or fingers.

Precautions:
Use appropriate heat protection such as gloves or a woollen cloth before touching the lamp, or allow the lamp to cool down first.

⚠ **WARNING:**
If computers intended for use indoors are used in the field there is a danger of electric shock.

Precautions:
Adhere to the instructions given by the computer manufacturer with regard to field use in conjunction with Leica instruments.

⚠ **CAUTION:**
During the transport or disposal of charged batteries it is possible for inappropriate mechanical influences to constitute a fire hazard.

Precautions:
Before transporting or disposing of equipment, discharge the battery (e.g. by running the instrument in tracking mode until the batteries are exhausted or discharging with the GKL23 battery charger).

CAUTION:
If the accessories used with the instrument are not properly secured and the equipment is subjected to mechanical shock (e. g. blows, falling, etc.), the equipment may be damaged or people may sustain injury.

Precautions:
When setting up the instrument, make sure that the accessories (e.g. tripod, tribrach, removable EDM with counterbalance, connecting cables, etc.) are correctly adapted, fitted, secured, and locked in position. Avoid subjecting the equipment to mechanical shock. Never position the instrument on the tripod baseplate without securely tightening the central fixing screw. If the screw is loosened, always remove the instrument immediately from the tripod.

WARNING
If the equipment is improperly disposed of, the following can happen:

- If polymer parts are burnt, poisonous gases are produced which may impair health;
- If batteries are damaged or are heated strongly, they can explode and cause poisoning, burning, corrosion, or environmental contamination;
- By disposing of the equipment irresponsibly you may enable unauthorized persons to use it in contravention of the regulations, exposing themselves and third parties to the risk of severe injury and rendering the environment liable to contamination;
- Leakage of silicone oil from the compensator can damage the optical and electronic subassemblies.

Precautions:
Dispose of the equipment appropriately in accordance with the regulations in force in your country. Always prevent access to the equipment by unauthorized personnel

25.5 Electromagnetic acceptability

The term "electromagnetic acceptability" is taken to mean the capability of the electronic theodolite or total station to function correctly in an environment where electromagnetic radiation and electrostatic discharges are present and without causing electromagnetic disturbances in other equipment.

WARNING:
Electromagnetic radiation can cause disturbances in other equipment.
Although the electronic theodolites and total stations meet the strict regulations and standards which are in force in this respect, Leica cannot completely exclude the possibility that other equipment may be disturbed.

CAUTION:
There is a risk that disturbances may be caused in other equipment if the electronic theodolites or total stations are used in conjunction with accessories from other manufacturers (e.g. field computers, personal computers, walkie-talkies, non-standard cables, external batteries, etc.).

Precautions:
Use the equipment only with accessories recommended by Leica. When combined with electronic theodolites or total stations, ensure that they meet the strict requirements stipulated by the guidelines and standards. When using computers and portable radios, pay attention to the information provided by the manufacturer regarding electromagnetic acceptability.

⚠ **CAUTION:**
Disturbances caused by electromagnetic radiation can result in the tolerance limits for measurements being exceeded.
Although the electronic theodolites and total stations meet the strict regulations and standards which are in force in this connection, Leica cannot completely exclude the possibility that an electronic theodolite or total station may be disturbed by very intense electromagnetic radiation, for instance near radio transmitters, walkie-talkies, diesel generators, etc..
Check the plausibility of results obtained under these conditions.

⚠ **CAUTION:**
If an electronic theodolite or total station is operated with cables attached at only one of their two ends (e.g. external power supply cables, interface cables, etc.), the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other instruments may be impaired.

Precautions:
While the instrument is in use, cables (e.g. instrument to external battery, instrument to computer, etc.) must be connected at both ends.

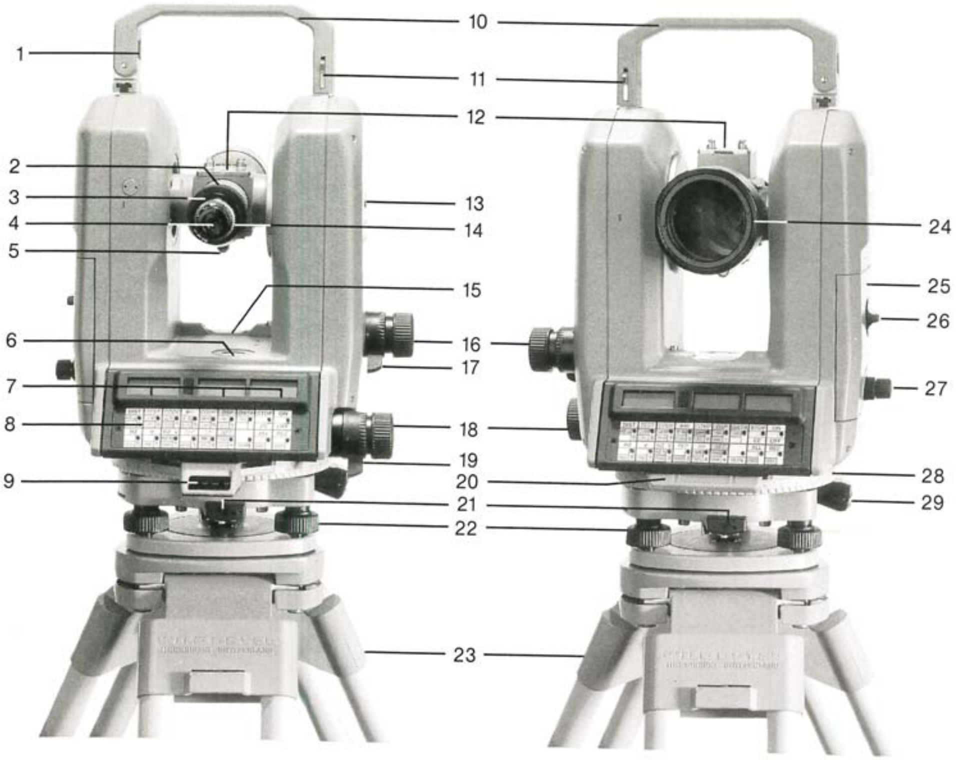
FCC statement (applicable in U.S.)

WARNING:
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

WARNING:
Changes or modifications not expressly approved by Leica for compliance could void the user's authority to operate the equipment.

WILD T2002 **WILD T3000**



Pos. I *Pos. II*