# WILD TC 500

## User manual



Leica

# WILD TC 500

## Electronic tachymeter

# Contents

*Figure 1: TC500 in case*

# 1 Introduction

The TC500 is specially designed for close-range survey tasks. Its angle-measuring accuracy perfectly matches the range and accuracy of its built-in EDM module. The serial interface permits transfer of measured data to an external data terminal.

After taking delivery of the instrument, proceed as follows:

- Charge battery
- Set up instrument
- Release lock on tribrach knob
- Point to reflector
- Start distance measurement

# 2 Instrument set-up

For tripod set-ups, always use a Wild tripod, such as a GST-20.

You may also use a different make of tripod, provided that it has a tribrach-clamping screw with a 5 / 8" screw thread.

Always screw the tribrach firmly to the tripod. To level up and centre the instrument, turn the footscrews on the tribrach and alter the length of the tripod's telescopic legs. For the quickest results, use either of the following methods, depending on the type of tribrach you are using.

**Tribrach with optical plummet:**

Turn the tribrach's footscrews as necessary to centre the cross-hairs on the ground mark. Then alter the length of the tripod's legs to centre the spherical level's bubble. Do not turn the tribrach as you move the instrument on the tripod plate to eliminate any residual centring error.

**Tribrach without optical plummet:**

Fit the plumb-bob to the clamping screw and alter the length of the tripod's legs to centre the plumb-bob on the ground mark. Then turn the tribrach's footscrews as necessary to centre the spherical level's bubble accurately.

# 3 Operating system

The instrument has a two-level operating system. The keys are colour-coded for these.

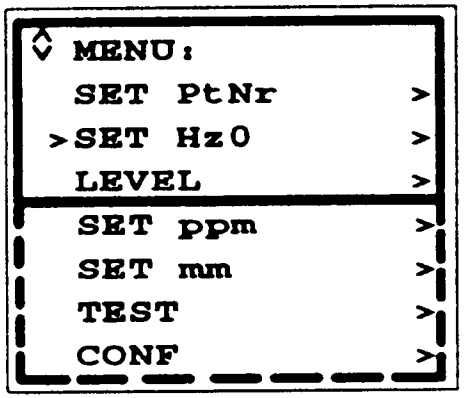
In measurement, the white keys are active. To activate the keys with orange lettering for the input of measuring and instrument parameters, touch the MENU function key.

| | |
|---|---|
| ON | On / off switch |
| DIST | Starts distance measurement |
| REC | Records measurements |
| DSP | Selects display |
| ☼ | On / off switch for display lighting |
| CE | Deletes error report |
| MENU | Selects second operating level |
| ▼ ▲ | Choose sub-program and input figures |
| ▶ | Confirms choice of sub-program; positions cursor for input of figures; selects parameters from a predetermined list |
| CONT | Confirms input and returns to measuring mode |
| CE | Quits sub-program but does not adopt parameter settings |

The appendix shows the menu structure and functions.

# 4 Electronic spirit-level

MENU




For horizontal-angle measurement in steep pointing, accurate levelling up of the instrument is essential. The built-in electronic spirit-level replaces the conventional tubular level. Touch the **MENU** key to switch on the level.

▼ ▶

Move the selector arrow to **LEVEL** and confirm.


The level displays the instrument's longitudinal and transverse tilt. Turn the tribrach's footscrews as necessary. The instrument is levelled up when the pointers lie between the marks.

If the instrument is not properly levelled up, the message **TILT** displays.

To level up, turn the instrument to place the keyboard parallel to a pair of the tribrach's footscrews. Turn both screws in opposite directions to correct for transverse tilt (lower display), then turn the third screw to correct the tilt of the telescope's axis.

The sun's rays and/or heat on one side of the instrument affect levelling accuracy. Always use as sunshade to protect the instrument from strong sunlight.

MENU

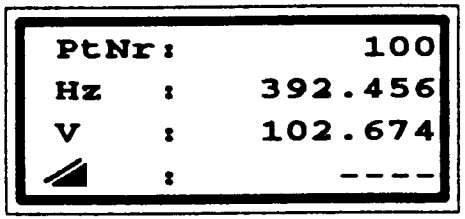
Returns to measuring mode when instrument is levelled-up.

When you determine the vertical-index error, you automatically adjust the electronic spirit-level (see section 11.3).

# 5 Angle measurement and display

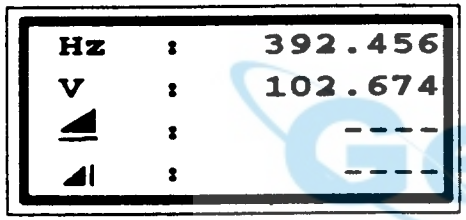
ON

After you have switched on and set up the instrument, it is immediately ready for use. It continually measures horizontal and vertical angles.




DSP

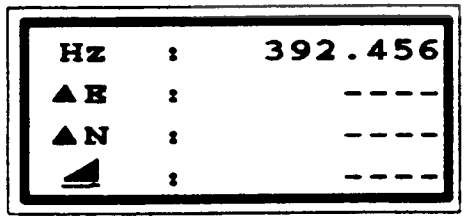
Choose the type of display you want from the three display modes available.




DSP

You can switch at any time to a different display mode.



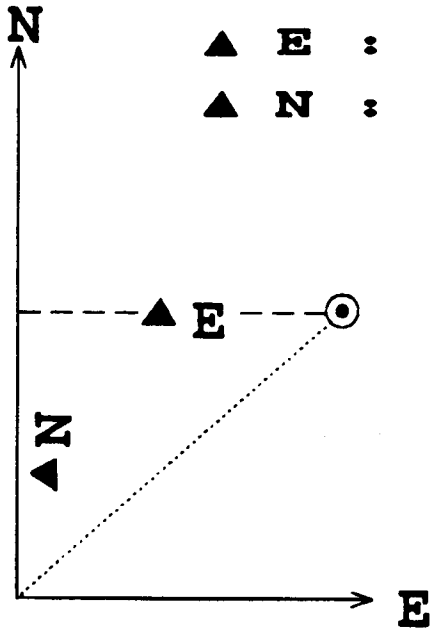



DSP

When you switch on the instrument, it automatically displays the last mode used before it was switched off.

**Display symbols:**

| | |
|---|---|
| PtNr : | Point number, applies only to data recording |
| Hz : | Horizontal angle |
| V : | Vertical angle |
| : | Slope distance |
| : | Horizontal distance |
| : | Height difference |
| ▲ E : | Coordinate difference, easting |
| ▲ N : | Coordinate difference, northing |




The coordinate difference always refers to the instrument station as origin. The northing is the angle with 0° on the horizontal circle, the easting is that with the 90° mark.

# 6 Pointing and distance measurement

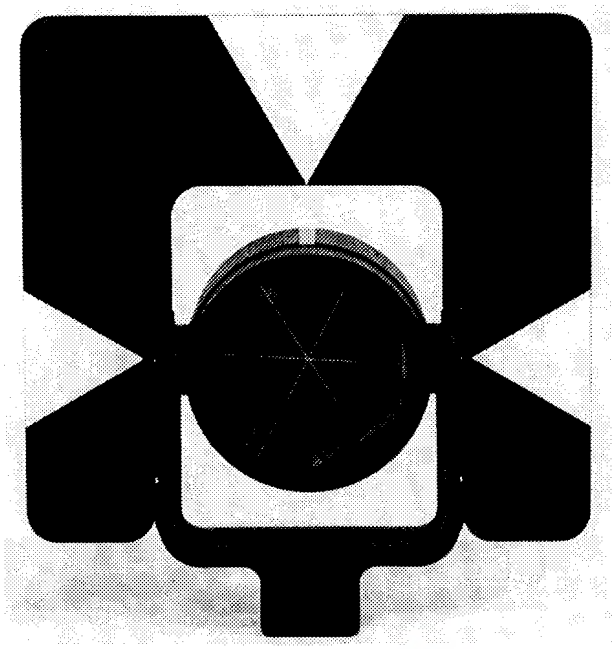


*Figure 2: GPH1 single-prism holder. Simply centre the cross-hairs on the reflector.*

For close-range distance measurement, we recommend the use of a GPH1 prism holder. The point of intersection of the prism's ridges coincides exactly with that of the reflector's rotational and tilting axes. You can also use the holder as a target for angle measurement.

An add-on GZT4 target plate makes it easier to find the reflector when the instrument is a long way from the prism, and allows you to point the instrument accurately.

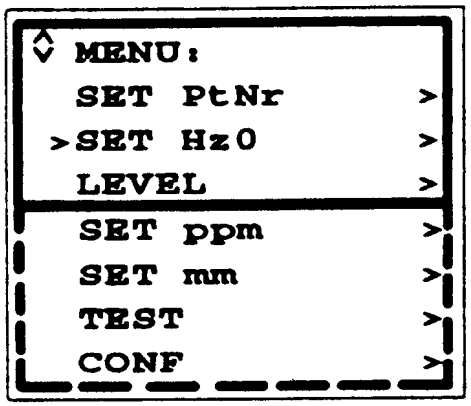


DIST

Starts distance measurement.

The measurement displays as horizontal or slope distance, in accordance with the mode you have selected.

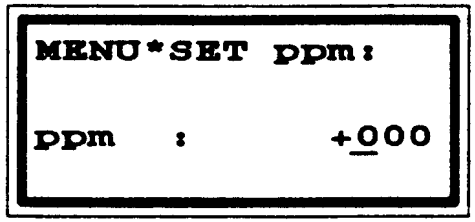
MENU




▼ ▶

Meteorological conditions affect the distance the instrument measures. For accurate results, always input the **ppm** parameter obtainable from the diagram in the appendix for the temperature and atmospheric pressure at the time of the survey. Instead of the atmospheric pressure, the mean height above sea level of the survey site may be used for interpolation. For example, 10°C temperature difference makes a difference of 1 mm in a measured distance of 100 m.

In the menu, choose and confirm **SET ppm.**

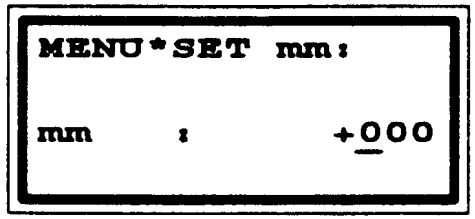



▼ ▲ ▶

Use the cursor keys to edit the mathematical sign and figures.

CONT

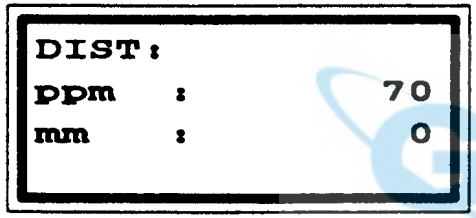
Confirm input. The instrument's memory stores the input value when you switch off.




▼ ▲ ▶

The prism constant **mm** for Wild circular prisms is 0. If you use another make or type of prism, determine this constant on a calibration range and store it in mm units in the instrument, as described above.

DIST




During distance measurement, the instrument displays both constants for your information.

The instrument automatically applies these constants to all measurements displayed.

For long range or surveys in unfavourable meteorological conditions, multiple prisms are necessary. We recommend the GPH3 three-prism holder.

**Tracking mode:**

DIST

Press this button for two seconds to switch the built-in EDM module to tracking mode.

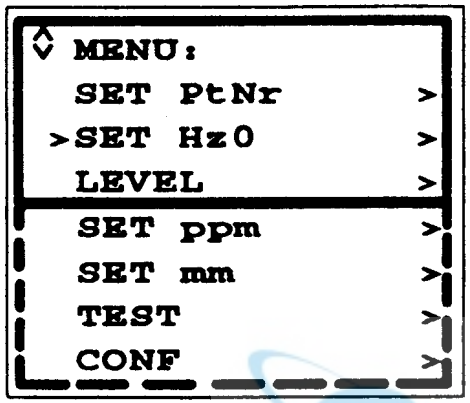
STOP

Stops tracking mode and returns to single-measurement mode.

# 7 Permanent settings

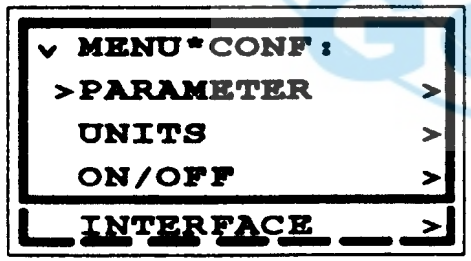
The basic instrument settings have to be made once only. They remain in the instrument's memory until you define new parameters.

MENU



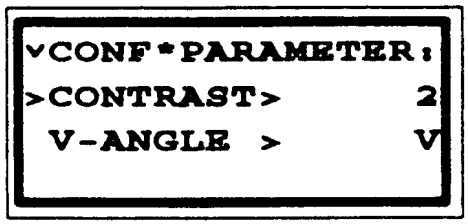

You can call up these settings in the **CONF** (configuration) sub-menu.

▼ ▶




Use the arrow keys to choose and confirm the **CONF** menu.

▶




Confirm the **PARAMETER** sub-menu.

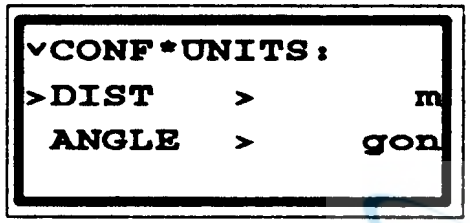
▶ Adjust contrast (viewing angle 0 to 3).

▼ ▶ Set vertical-angle display.

V = vertical angle (zenith = 0)
±V = vertical angle (horizon = 0)
V% = slope (horizon = 0%)

CONT Confirm values selected. The instrument is then again ready for measurement.

▼ ▶




In the **CONF** sub-menu, call up **UNITS** as described above, and choose the units you want from the list displayed.

▶ For distance measurement:
- m = metres
- ft = feet, in decimals
- ft/in = feet, inches, and 1/8″

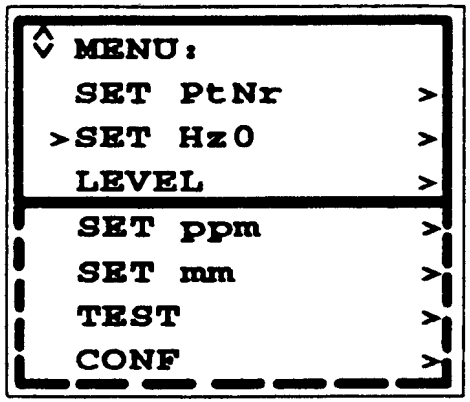
▼ ▶ For angle measurement:
- gon = 400 gon
- 360 s = 359°59′59″ (sexagesimal)
- 360 d = 359.999° (decimal)

CONT Confirm your choices. The instrument then returns to measuring mode.

# 8 Settings for angle measurement

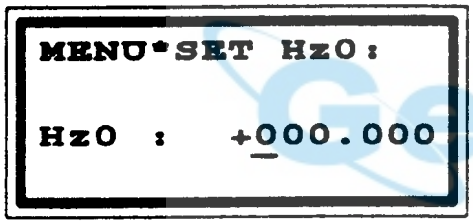
## 8.1 Circle orientation

MENU




Because there is a frequent need to reset the horizontal circle, the default position of the selection arrow when you call up this menu is at **SET Hz0.**

▶

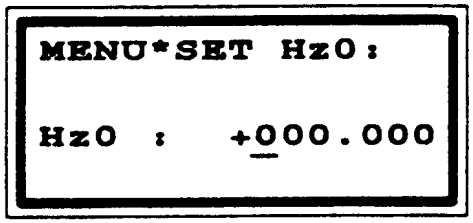



Confirm, point instrument at target, and



CONT

set circle to 0,




▼ ▲ ▶

or use the cursor keys to set any angle in the units you have chosen.

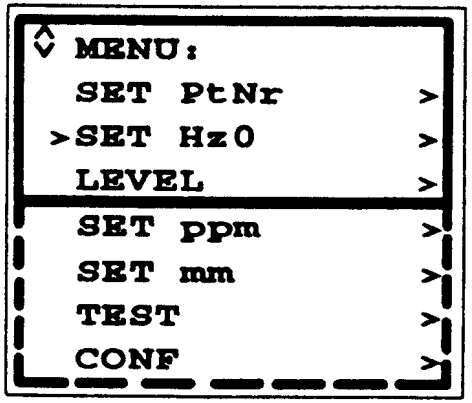
CONT

Confirm.

If you input a negative angle, the horizontal angle counts counter-clockwise and displays as a negative value.

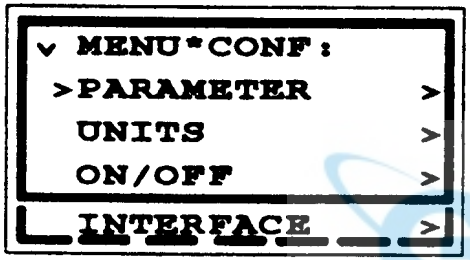
## 8.2 Setting-out right angles

MENU

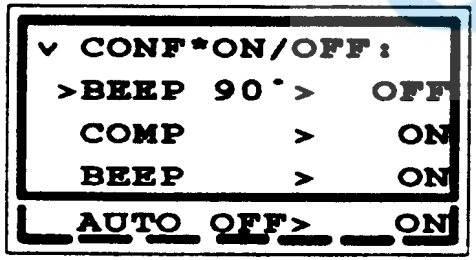



To simplify the setting-out of right angles, you can switch on an acoustic signal that indicates by an alternating «beep» when the angle is within ±5gon. The «beep» becomes continuous when the angle is within ±0.5gon of a right angle, and switches off at an offset of ±10mgon.

▼ ▶




In the **CONF** sub-menu choose and confirm **ON/OFF .**




The selector arrow's default position is at BEEP 90°.

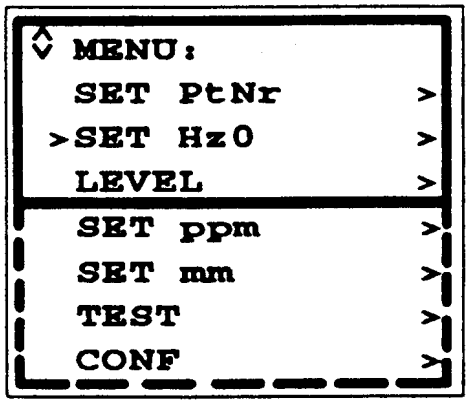
▶ CONT

Set **BEEP 90°** ON and confirm.

The setting is retained after the instrument has been switched off.

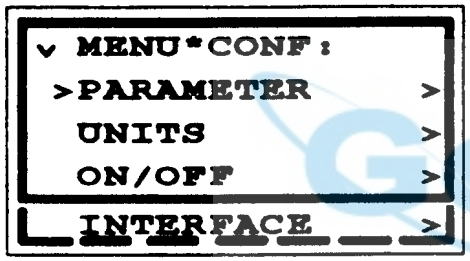
# 9 Theodolite settings

MENU

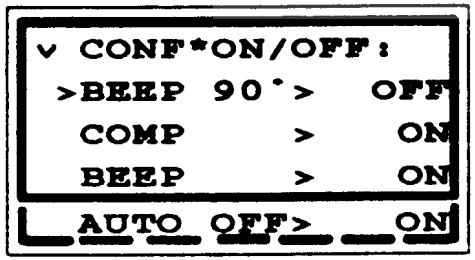



Call up the **CONF** sub-menu.

▼ ▶




Choose **ON / OFF.**




Choose ON or OFF line by line.

CONT

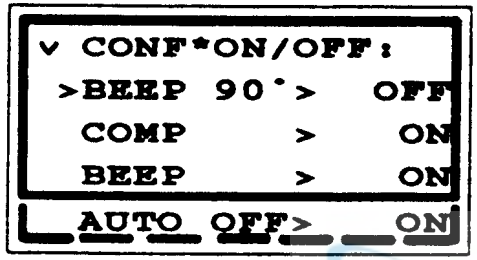
Confirm all together. The instrument is then again ready for measurement.

## 9.1 Compensator

If you wish, you may suppress the acoustic warning signal and the report Error 58 TILT when the instrument is not properly levelled up, but it is not advisable to switch off this signal.

When you switch off the theodolite or if it switches itself off, the instrument automatically reactivates this function to tell you when it is not properly levelled-up.

▶ CONT




Call up **COMP** and switch off or on, as the case may be.

**Note:**
When the compensator is switched off, the vertical angle displayed refers to the instrument's standing axis.

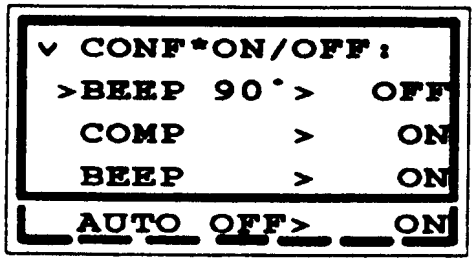


## 9.2 Acoustic input signal (beep)

Each time you touch a key, the instrument acknowledges the input by an acoustic signal.

You can switch off this signal. Each time you switch on the instrument, you activate the signal again.

▶ CONT



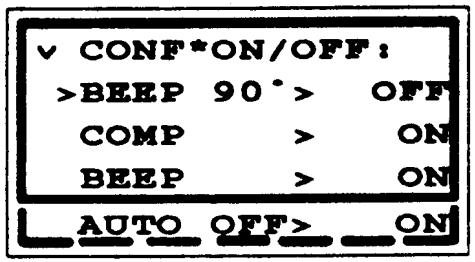

Choose **BEEP** and switch the signal on or off, as the case may be.

## 9.3 Automatic power-off

This function automatically switches off the instrument to save battery consumption when there is no input for ten minutes.

You may switch off this function, but it is automatically activated again whenever you switch on the instrument.

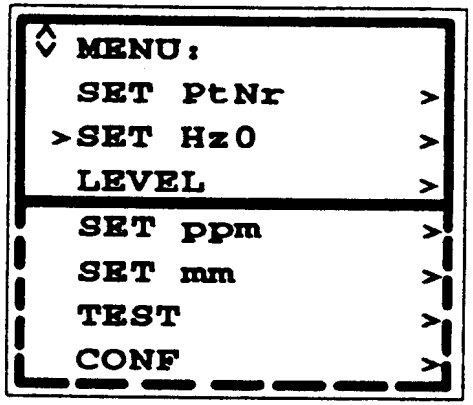
▶ CONT




Choose **AUTO OFF** and switch on or off, as the case may be.

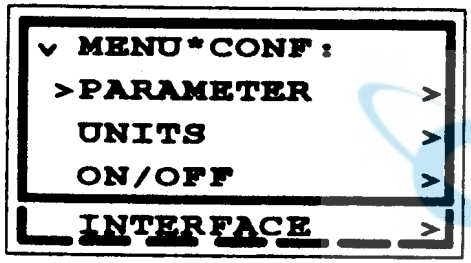
# 10 Data transfer

MENU



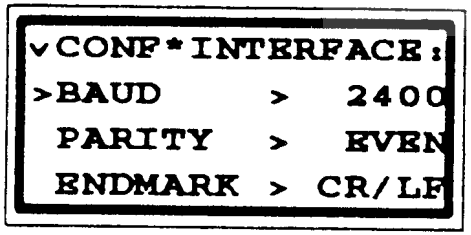

For data acquisition of measurements, you can connect a data-recording unit, such as a GRE4 of GPC1, to the instrument's RS232 serial interface.

▼ ▶




In the main menu, call up **CONF** and choose **INTERFACE.**






The parameters of the serial interface are set at the factory for data transfer to Wild equipment.

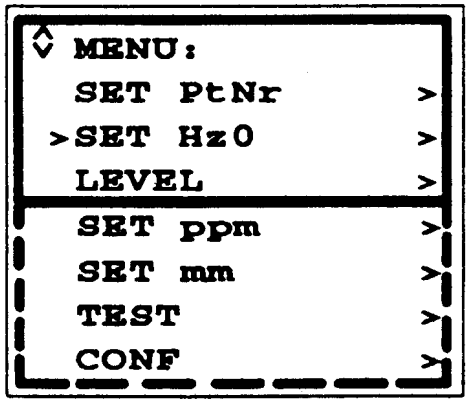
▼ ▶

For connecting other types of equipment, such as an IBM-compatible computer, adjust the parameters as necessary. For data transfer, a software protocol is necessary. For details, see the manual «Wild-instruments ON-LINE».

CONT

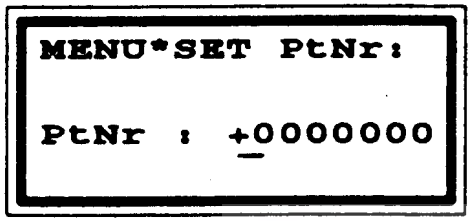
Confirm input. The instrument retains the input values when it is switched off.

MENU




**Point number:**
You must record a point number with each set of data. You can set this point number on the instrument.

▲ ▶




Whenever you call up this function in the menu, the point number displayed is 0.

▼ ▲ ▶ CONT

Set and confirm the point number.

Each record contains the following values:

Point number
Current horizontal angle
Vertical angle during distance measurement
Slope distance
Distance-correction parameters ppm and mm

The instrument automatically increments the point number by one after each record.

**Note:** Because the instrument always transfers the current horizontal angle, do not move the telescope during measurement until the measured data have been completely recorded.

## Settings for data transfer:

### GRE 4:

SET MODE 78 RUN RUN
SET FORM ± • RUN REC

Sets standard data-transfer parameters.
Deletes the block format.

### GPC 1:

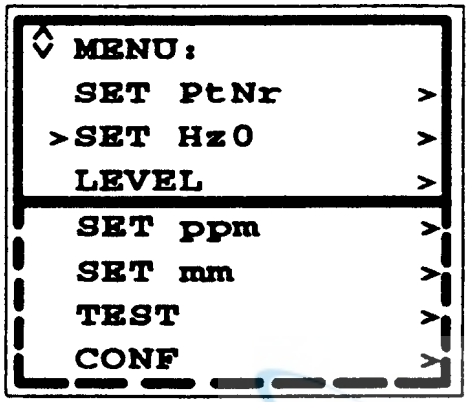
SET INTERF COM 2

In the GPC 1 menu, call up MAIN. Set the data-transfer parameters for the COM 2 interface, as follows: 2400 baud, EVEN, CRLF.

# 11 Instrument tests

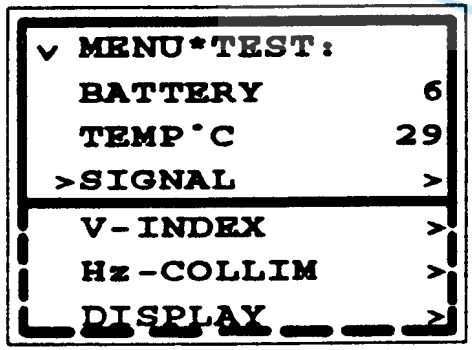
Test functions display instrument parameters and status, and permit adjustments to eliminate collimation and index errors.

MENU




In the main menu, select and confirm **TEST.**

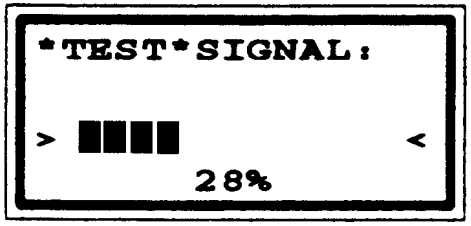
## 11.1 Battery, internal temperature




When you call up the TEST menu, the instrument automatically displays the internal temperature and battery status. When the battery is nearly flat, the instrument emits an acoustic signal and displays a «**Battery low**» warning. A flat battery no longer permits distance measurement and the instrument automatically switches off.

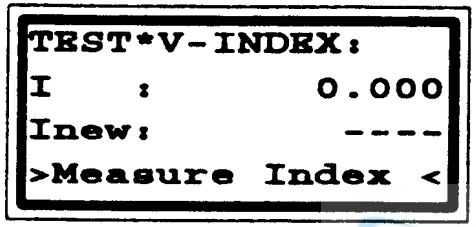
## 11.2 EDM signal

▶




In difficult survey conditions, you can adjust the EDM's signal strength to suit conditions. Adjust the fine drives until you obtain the maximum signal strength, then measure.

## 11.3 Vertical-index error

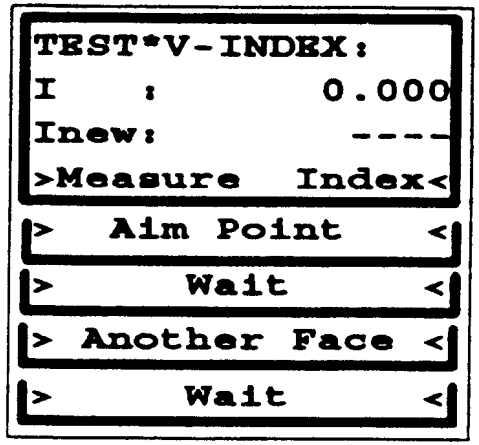



The vertical circle should read exactly 90° or 100$^{gon}$ when the line of sight is horizontal. If it does not, the deviation is known as the index or vertical collimation error I.

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

Before you check the instrument and set a new correction constant, use the built-in electronic spirit level to level it up and switch on the compensator.

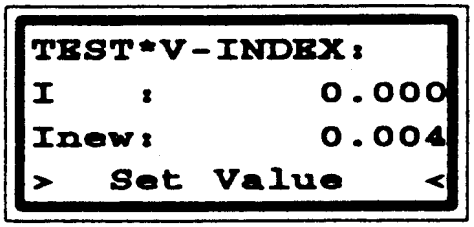
CONT




For this adjustment, point the instrument to a clearly visible target at about 100 m range and confirm. The target must not be more than 6° off level.

Then point to the same target with the telescope in face 2 and confirm.

CONT




Adopt the new value, or

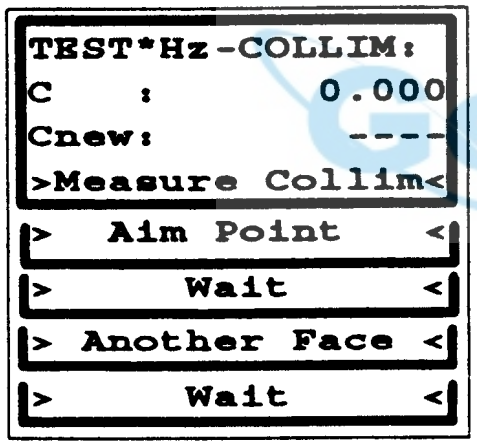
CE

retain the existing value and switch back to the test menu.

When you determine the vertical-index error, you automatically adjust the electronic spirit-level.

## 11.4 Collimation error

▼ ▶




The collimation error **C** is the deviation from the right-angle between the tilting axis and the line of sight. It is determined and stored in a similar manner to the vertical-index error and is taken into account whenever a horizontal angle is measured.

The stored collimation error (= line-of-sight error) displays in the preset units of measurement.

To check and determine this afresh, proceed as for the vertical-index error.

**Note:** Index- and collimation errors can change with time and temperature. They should therefore be redetermined after long periods of transport, before and after long periods of work, and if the temperature changes by more than 20°C.

## 11.5 Display

In the display test, the instrument displays a continually changing, flashing checkerboard pattern. If the image does not conform to this pattern, take the instrument to your local service centre.

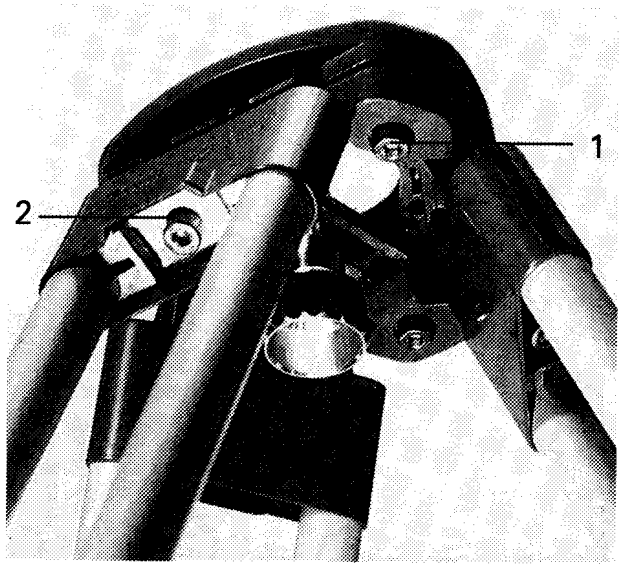



*Figure 3: GST 20 tripod*

# 12 Checks and adjustments

## 12.1 Tripod

The connections between metal and timber components must alwys be firm and tight. Tighten the Allen screws (2) moderately from time to time, as necessary.
The same key is also suitable for adjusting the articulated joints on the tripod head (1). Tighten these just enough to keep the tripod legs open when you lift it off the ground.

*Figure 4: Adjusting the spherical level*

## 12.2 Spherical level

In a properly levelled-up instrument, the spherical level's bubble must be centred in the circle. If it extends beyond the circle, use the adjusting pin supplied to change the setting of the setscrews.

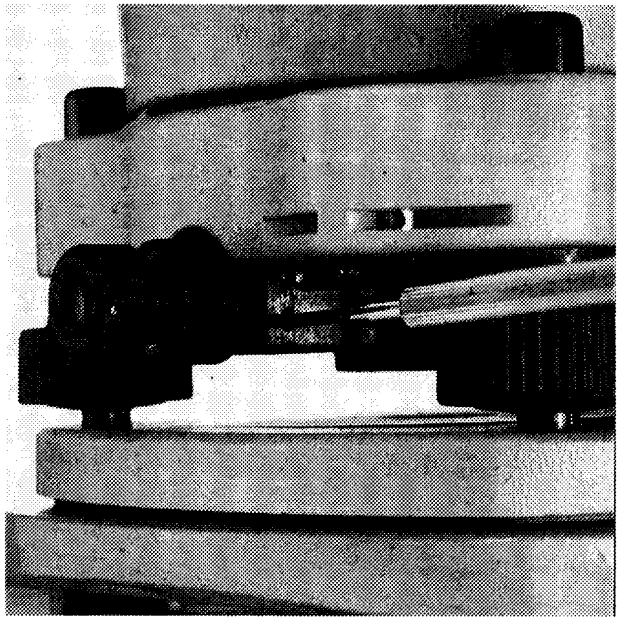


*Figure 5: Adjustments to the optical plummet*

## 12.3 Collimation error

At the factory, we adjust the optical and electronic lines-of-sight properly. Do not attempt to alter these settings. Adjust for the residual collimation errors (deviation from the right-angle between the tilting axis and the line of sight) as described in section 11; the instrument automatically takes these adjustments into account in all measurements.

## 12.4 Optical plummet

Check the tribrach's optical plummet at frequent and regular intervals; any deviation of the line-of-sight from the instrument's standing axis causes a centring error.

**Check by plumb-bob:** Set up and level up the instrument on the tripod. Check the centring sleeve for eccentricity by hanging it into place in various positions, then mark the ground point. Remove the plumb-bob. Check that the optical plummet's cross-hairs intersect the ground point.

**Check by turning the tribrach:** Level up the instrument by means of the electronic spirit-level. Mark the ground point. Use a soft, well-sharpened pencil to mark the tribrach's outline on the tripod plate; turn the tribrach 120°, level up the instrument, fit it into the outline, and again mark the ground point. Repeat this procedure in the third position. If the three points do not coincide, adjust the cross-hairs to the centre of the triangle formed by the three ground points.

**Adjustments:** Use a screwdriver to turn the two setscrews alternately by the same small amount to centre the cross-hairs on the ground point marked.

# 13 Maintenance, care, storage

**Transport:** For transport by land, water, or air, pack the instrument to prevent shock. If possible, use the original Leica packing material.

**Cleaning and drying:** Before cleaning the instrument, blow dust off lenses and prisms. Treat the lens, eyepiece, and prisms with special care. Never touch the glass with your fingers. Use only a clean, soft, lint-free cloth to clean. If necessary, moisten the cloth with pure alcohol. Use no other liquids; these may attack components made of plastic.

**Cables, plugs, sockets:** Keep plugs and sockets clean and protect them from damp. Blow out any dirt lodged in plugs and sockets.

**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 your 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.

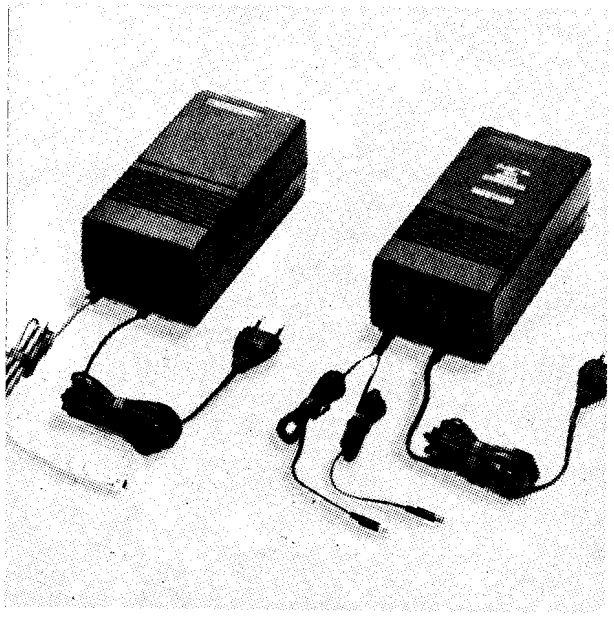


*Fig. 6*

*Right: GKL 12 charger for two compact batteries GEB 70.*
*Left: GKL 14 charger for universal battery GEB 71.*

# 14 Battery charging

Use a battery charger in a dry room only, never outdoors. Charge batteries only at an ambient temperature between 10°C and 30°C (50°F to 86°F).

The GKL 12 charger is suitable for charging the theodolite's battery insert and the GEB 70 compact battery. For the GEB 71 universal battery, use a GKL 14 charger.

Before you use new batteries for the first time, charge them for 20 to 24 hours. This also applies to batteries that have not been used for several months. NiCd batteries reach full capacity after two or three normal cycles each of a 14-hour charge followed by a full discharge. If battery performance drops noticeably, run one or two full cycles, i.e. charge for 14 hours and allow to discharge until the instrument automatically switches off and displays «Battery low».

Leave flat batteries to charge for fourteen hours. If you do not know a battery's state of charge, also leave it to charge for fourteen hours.

Set the battery charger's voltage selector to your AC mains voltage, 115 V or 230 V. Plug in the charger to the mains. The green indicator lamp should light. If it does not light, there is a power cut or the mains cable or charger is faulty.

Connect the battery to the charger. The red charging indicator should light. If it does not, the battery is not charging, i.e. the battery cable is faulty or the battery fuse has blown and should be replaced. On the GKL 12, you may not have started the timer or it may have stopped at the end of the charging period.

# 15 Important notes

Never point the telescope of the TC 500 directly at the sun, because this could damage the diodes in the EDM module.

In strong sunlight, use a sunshade to shield the instrument. Excessive heat affects the EDM module's sender diode and reduces its performance and range.

To ensure good reception at long range, also shield the reflector prisms from direct sunlight.

The telescope's visual field must never cover more than a single reflector unit. If the measuring beam strikes more than one reflector, the mixed signals may produce wrong measurements.

Walkie-talkie equipment may cause distance-measurement errors if the speech button is pressed near the instrument during measurement. Avoid using walkie-talkie speech communication during dinstance measurement.

# 16 Error reports and warnings

| | Error report | Cause | Remedy |
|---|---|---|---|
| 03 | Input error | Wrong input | Input a correct value |
| 12 | Flat battery | Flat battery | Replace battery |
| 19 | Temperature | The instrument's internal temperature is too high or too low | Cool or warm instrument, as applicable |
| 21 | Parity error | Parity error at interface | Check interface parameters and cable |
| 22 | RS 232 timeout | The system is getting no reaction at the interface | Check cable, external data-recording equipment, and baud rate |
| 24 | RS 232 overflow | Data transmission too fast | Repeat at lower baud rate |
| 44 | Value > 1 gon | Measured vertical-index or collimation error exceeds 1.1111°/1gon | Adjust instrument or have it serviced |
| 51 | | Compensator-system error | If this error recurs, have the instrument serviced |
| 50 | Angle error | Measurement error in angle-scan system | Have the instrument serviced |
| 55 | EDM signal | No EDM signal, signal too weak, or interference | Check that instrument is pointed correctly, or distance may be too great |

| | Error report | Cause | Remedy |
|---|---|---|---|
| 56 | EDM system | EDM system error | If this error recurs, have the instrument serviced |
| 82 | Out of range | Vertical angle more than ±6° off level for determination of index or collimation error | Set target within permitted range |
| 9× | | System fault | Have the instrument serviced |



| | Warning | Cause | Remedy |
|---|---|---|---|
| 09 | PtNo overflow | Overflow in point number | Check point number |
| 12 | Battery low | The battery is practically flat (Level = 0) | Replace battery |

# 17 Technical data

| | |
|---|---|
| **Angle measurement** | Continual, by absolute encoders |
| **Updates** | 0.3 seconds |
| **Units of measurement** | 400 gon, 360° decimal,<br>360° sexagesimal, V% |
| **Angle display** | Programmable: 5″; 0.001°, 1 mgon<br>(= 0.001 gon) |
| **Standard deviation** | Hz: 6″ (0.002 gon)<br>V: 6″ (0.002 gon) |
| **Automatic vertical index** | Centring range: ±5′<br>Accuracy: ±2″ (±0.0006 gon) |
| **Bubble sensitivity** | Spherical level: 2 mm = 4′<br>Electronic spirit-level: 5″ |
| **Telescope** | Magnification: 28×<br>Clear lens diameter: 28 mm<br>Minimum pointing distance: 2 m<br>Diameter of visual field at 1 km: 27 m<br>Height of tilting axis above tribrach plate: 196 mm |
| **Optical plummet** | In tribrach, focusing, 2× magnification |
| **Display** | On face 1: 4 lines × 16 characters |
| **Keyboard** | On face 1: 7 function keys<br>Contact pressure: 30 g |

| | |
|---|---|
| **Distance measurement** | Infra-red measuring<br>frequency 50 MHz<br>Carrier wave 0.860 µm<br>Consumption about 0.4 A |
| **Standard deviation** | 5 mm + 5 ppm |
| **Range** | 700 m to 1 prism |
| **Time per measurement** | about 4 seconds |
| **Power supply** | 12 V DC from internal 0.45 Ah battery or from external energy source<br>Consumption excluding lighting: about 0.06 A |
| **Weight** | about 4.2 kg (9 1/4 lb), excluding battery and tribrach |
| **Temperature range** | Operation: −20°C to +50°C (−4°F to 122°F)<br>Storage: −40°C to +70°C (−40°F to 158°F) |

| Operating life of batteries | GEB 77 battery module | GEB 70 compact battery | GEB 71 universal battery |
|---|---|---|---|
| | | | |
| TC 500 | about 300 | about 1200 | about 4000 |
| | angle and distance measurements | | |
| Capacity | 0.45 Ah | 2.0 Ah | 7.0 Ah |
| Weight | 0.2 kg (0.45 lb) | 0.9 kg (2 lb) | 3.0 kg (6.6 lb) |

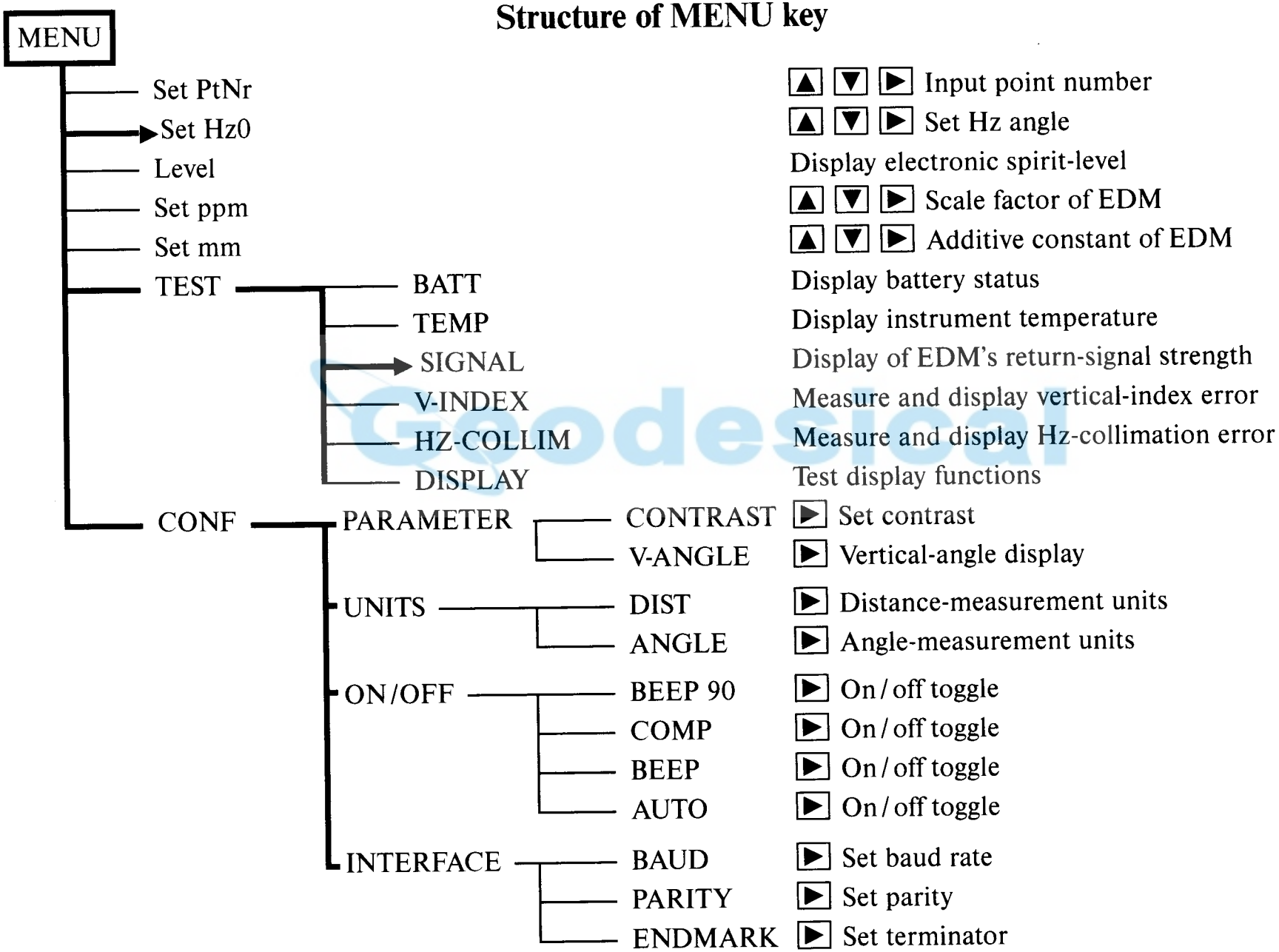
## Range of TC 500

| Wild circular prisms | Atmospheric conditions poor[1] | fair[2] | excellent[3] |
|---|---|---|---|
| 1 | 400 m | 700 m | 900 m |
| 3 | 600 m | 1100 m | 1300 m |

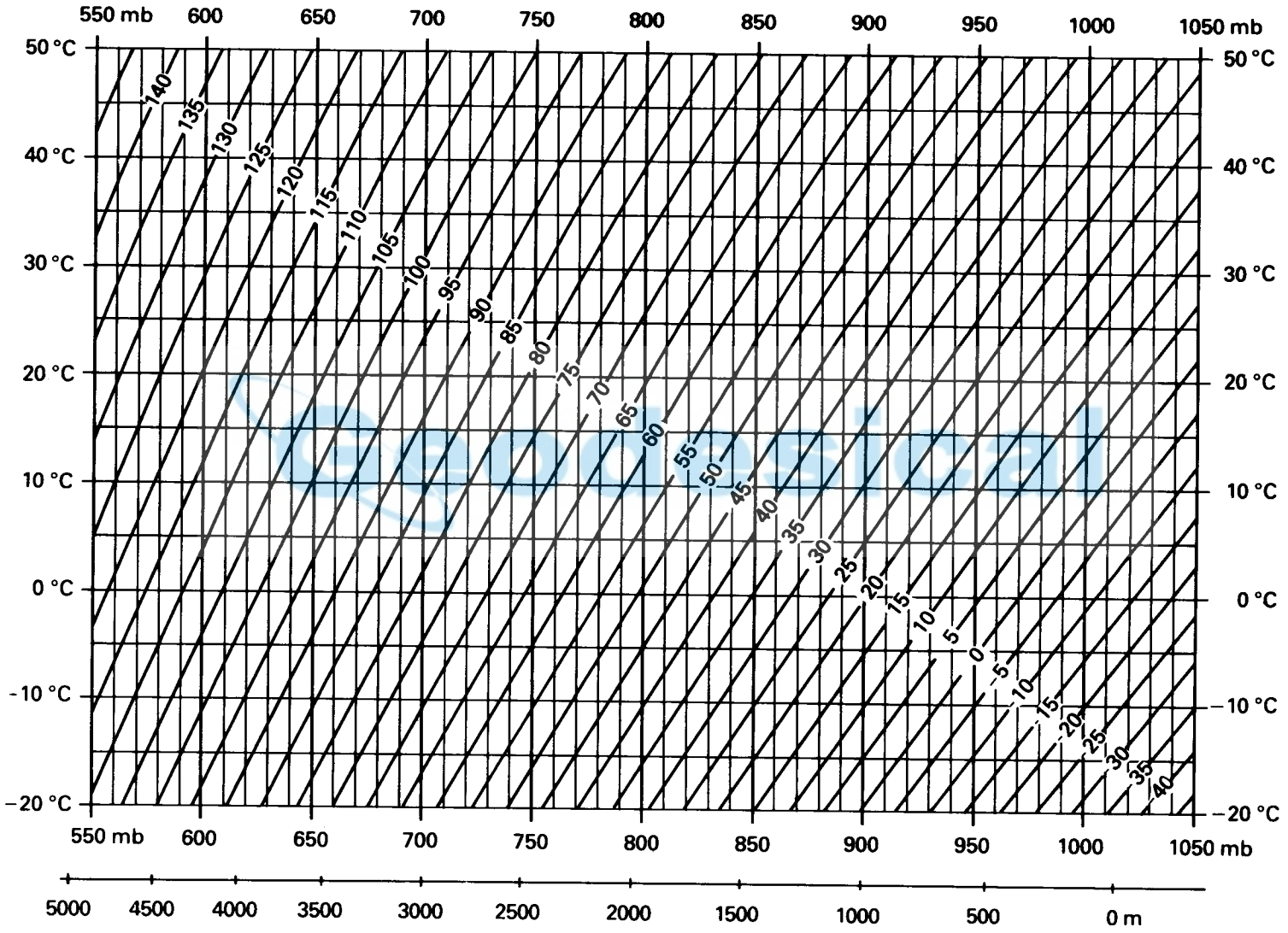
[1]) Very hazy, visibility 3 km, or strong sunlight and heavy heat shimmer
[2]) Light haze, or some cloud and slight heat shimmer
[3]) Overcast, no haze, visibility 30 km, no heat shimmer

# 18 Appendix

## Structure of MENU key



**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