664912-1.0.1en

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Translation of original text (667634-1.0.0de)

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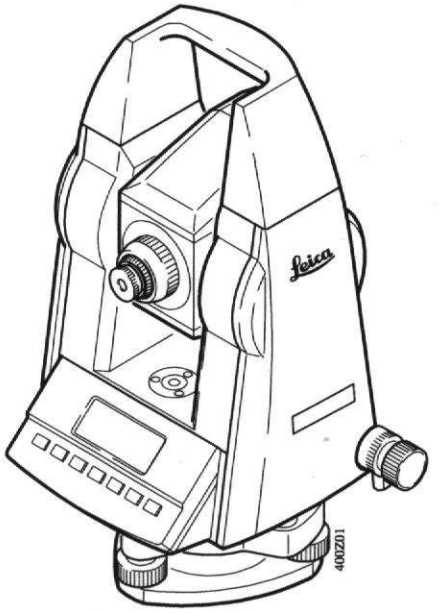
USER'S MANUAL

TC400N/TC400NL

Electronic total station

Version 1.0
English



Congratulations on your purchase of a TC400 total station.

This manual contains important safety directions *(refer to section "Safety directions")* as well as instructions for setting up the instrument and operating it. Read carefully through the User's Manual before you switch on the instrument.

TC400N/TC400NL

Electronic total station

Product identification

The model and serial number of your instrument are on the label inside the battery compartment. Enter the model and serial number in your User's Manual, and always refer to **this information** when you need to contact your **agency** or **service workshop**.

Model no.: _____ Serial no.: _____

Symbols used in this Manual

The symbols used in this User's Manual have the following meanings:

DANGER:
Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING:
Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.

CAUTION:
Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor injury and/or in appreciable material, financial and environmental damage.

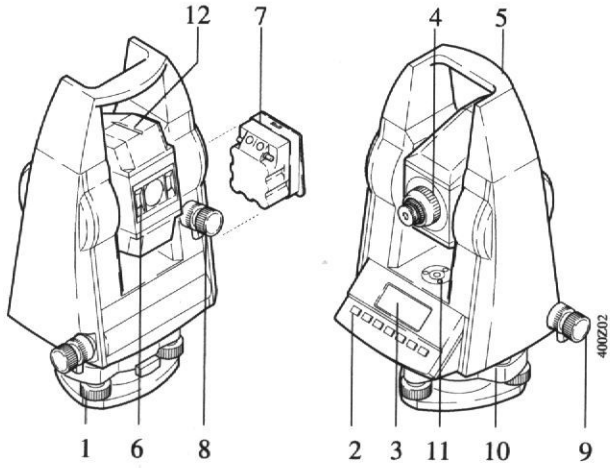
Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

Contents

Introduction

The TC400N/NL is particularly suitable for simple surveying tasks. Its angle-measuring accuracy, and the range and accuracy of its EDM module, are matched to one another.
The TC400NL differs from the TC400N in having a laser plummet incorporated into the standing axis. The laser plummet offers a simple and fast setting-up of the instrument. The built in laser plummet replaces the optical plummet.

Important parts

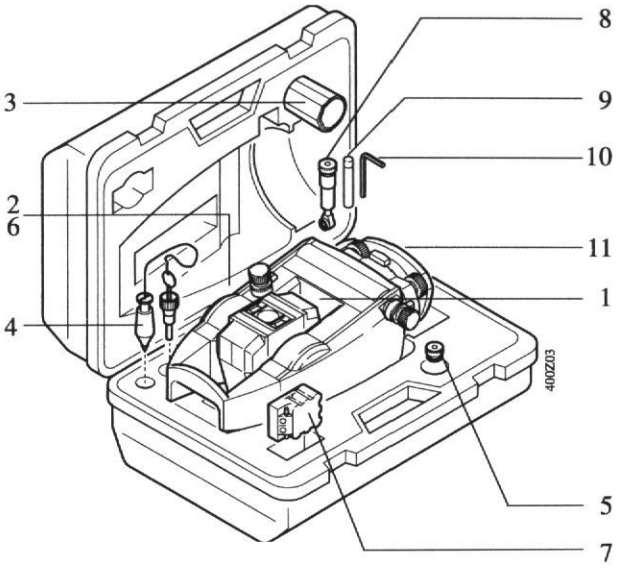


1 Foot screw
2 Keypad
3 Display
4 Focussing
5 Carrying handle
6 Exit EDM
7 Battery
8 Vertical drive screw
9 Horizontal drive screw
10 Interface RS-232
11 Circular level
12 Optical sight

Set-up, first steps

Unpacking

Remove TC400N/NL from carrying case and check for completeness:

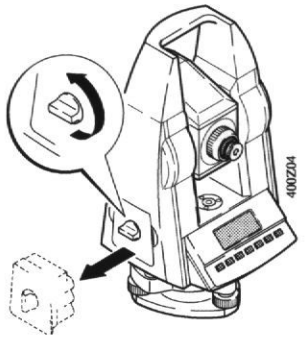


1 Instrument
2 User's Manual
3 Protective cover
4 Plummet (optional)
5 Eyepiece (optional)
6 Diskette with TCTOOLS
7 Spare battery (optional)
8 Eyepiece for steep angles (optional)
9 Set pins
10 Allen key
11 Tribrach (optional)

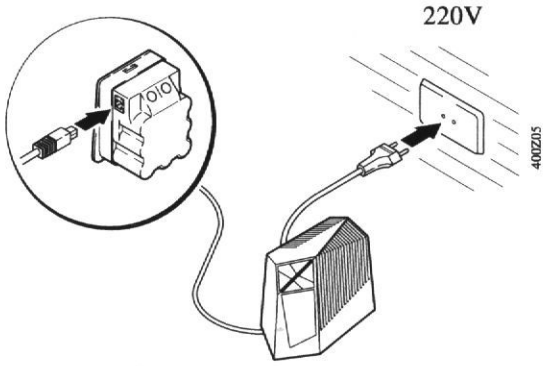
Charging battery

Charge batteries using Leica GKL12, GKL14, GKL22 or GKL23 chargers. More information for charging batteries *refer to section "Battery charging"*.

1



2

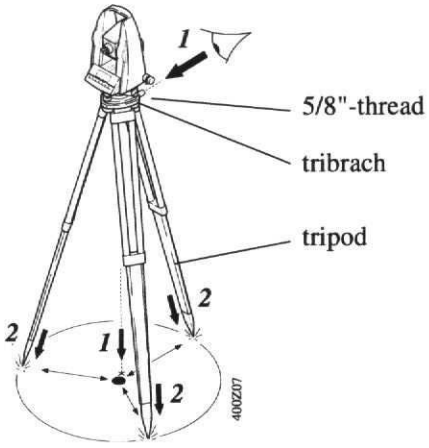


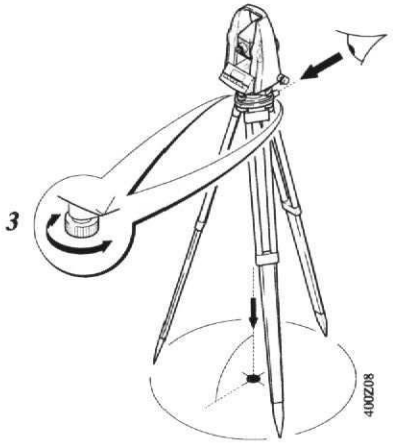
GKL23
Charging time: 1.5 h

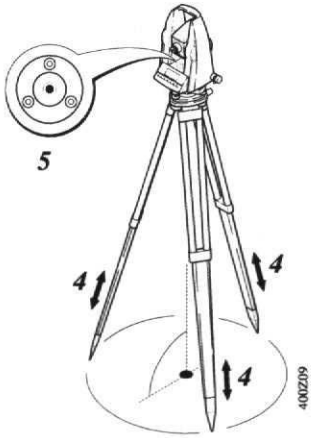
3

Tripod with optical plummet

Example: Set-up TC400N/NL with tribrach (with optical plummet) and tripod



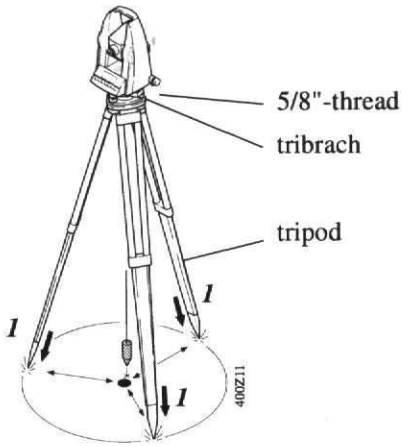


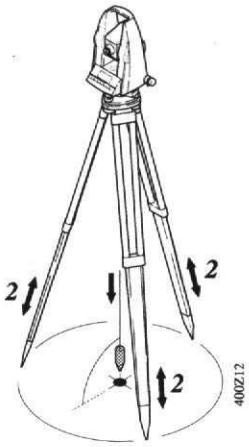


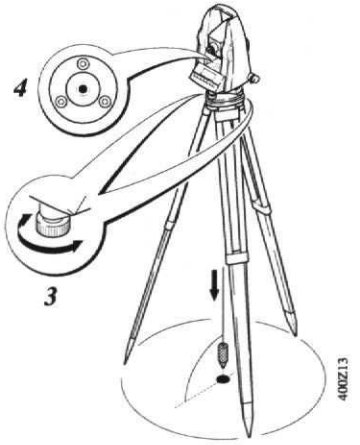
The laser plummet can not be used when using a tripod with optical plummet.

Tripod without optical plummet

Example: Set-up TC400N/NL with tribrach (without optical plummet) and tripod





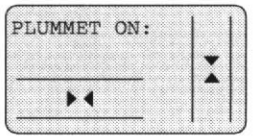


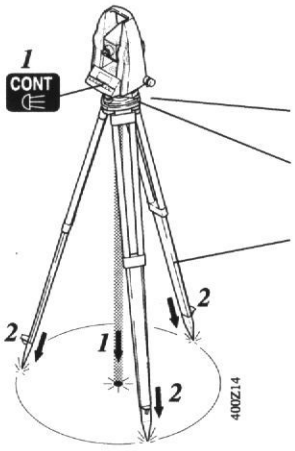
Instrument with laser plummet

The laser plummet is activated in the measuring display. Simultaneously, the instrument can be correctly levelled-up using the electronic level.

CONT

Press (for about 2 seconds) until the following display appears. The laser plummet is switched on (red spot on ground).

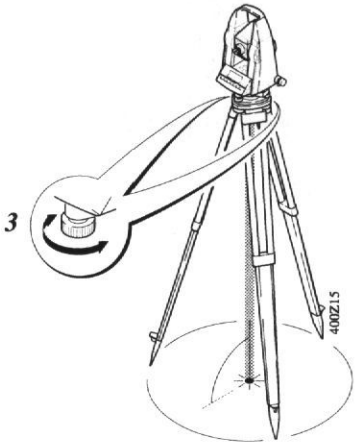


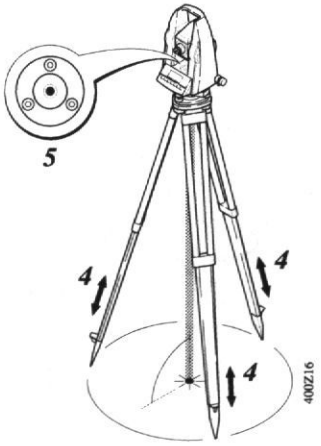


5/8"-thread

tribrach

tripod

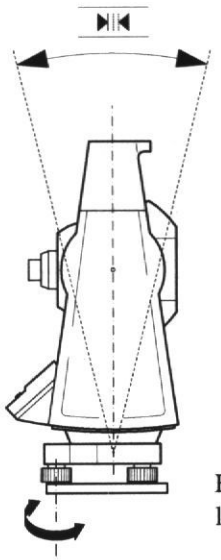




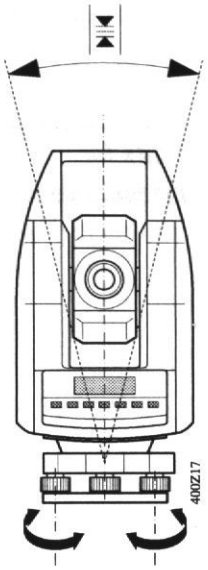
CONT or STOP CE

Switch off plummet and quit display.

Adjust electronic level



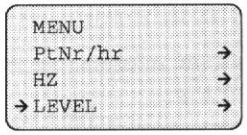
Foot screws for levelling-up



ON OFF

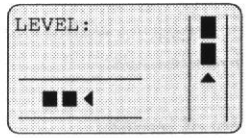
MENU

DIST

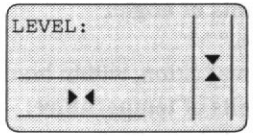


DSP

Insufficient levelling-up



Correct levelling-up



The TC400N/NL unit is correctly levelled-up when the triangles are visible or there are markers **between** the triangles.

Units for measurements

The following settings are possible:

Units for distance measurement :
- m = meters
- ft = feet (in decimals)
- ft/in = feet, inch and $^1/_8$ inch

Units for angle measurement :
- gon = 400gon
- 360d = 359°.999 (in decimals)
- 360s = 359°59'59"(sexagesimal)

Display number of decimal places (DSP ACC):
- high = 81°45'25" (5"/1 mgon Interval) or 3 decimals
- med = 81°45'30" (10"/2 mgon Interval) or 3 decimals
- low = 81°45'20" (20"/5 mgon Interval) or 3 decimals

For more informations refer to *section "Selecting units (UNITS)"*.

Units in this manual

Specifications within this manual always applies to the following units:

Units of length:
- in m (meter)
- in addition, within brackets in ft (feet)

Units of angle:
- in ° ' "
- in addition, within brackets in gon

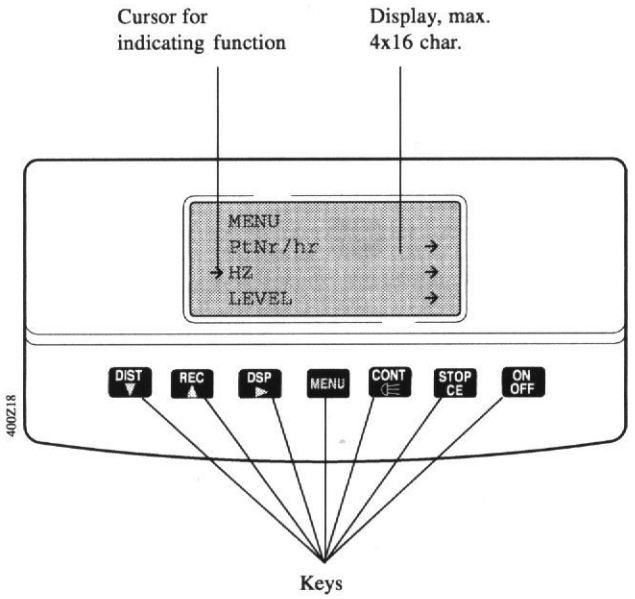
Units of temperature:
- in °C
- in addition, within brackets in °F

Display and keypad

The TC400N/NL unit has a dual-level user interface. Keys are color-coded for each level.

white keys: active during measurements.

orange keys: key MENU activates orange keys for input of measuring and instrument parameters.



DIST — Starting distance measurement

Selecting of functions and input lines;
Input of numbers;
Changing of data display lines.

REC — Recording measurements on RS232-interface

Selecting of functions and input lines;
Input of numbers;
Changing of data display lines.

DSP — Selecting display masks

Confirming selected sub-programs, functions;
Positioning of cursor for input of numbers; selecting parameters.

MENU — Calling of main menu (quick press)
Switching between numbers and characters during input of point nos.

Calling of configurations menu: long press (about 2 seconds);

Switching between numbers and characters during input of point nos.

CONT — Confirming of input and values.
Quitting of funtions.

Switching on/off display illumination

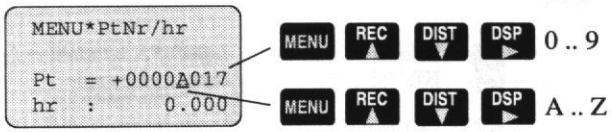
STOP CE — Interrupt active function;
Delete error messages;
Quitting inputs without accepting values.

ON OFF — Switching on/off

Inputs

Numeric / alphanumeric entry mode

Use the MENU-key to toggle between numeric or alphanumeric entry mode.



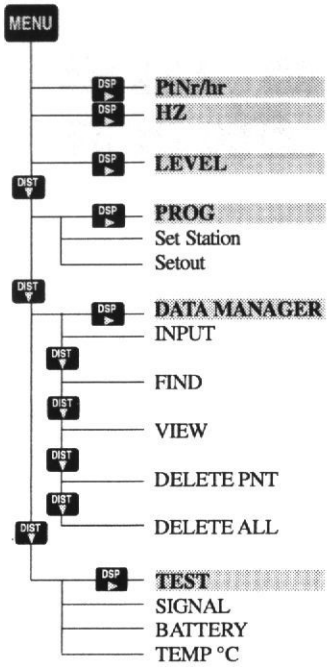
CONT — Quitting inputs and accepting inputs.

STOP CE — Rejecting inputs.

Entering reflector height

The reflector height is entered under **hr:**

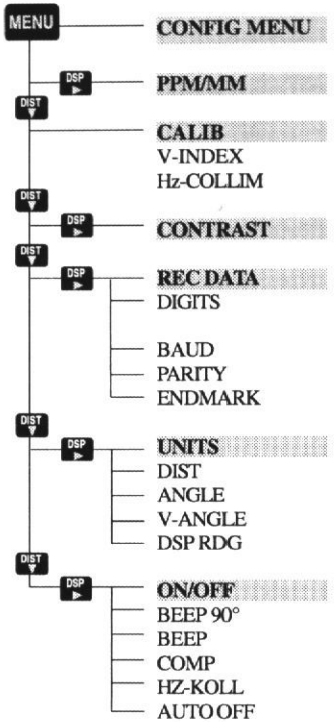
Menu tree (main menu)



Input of point number / reflector height	
Input of Hz-angle	
Display of electronic level sensor	
Program library:	
Input of station coordinates and orientation	
Setting-out	
Data management:	
Input of coordinates	
Enter point number for searching within the coordinate block	
Display of stored coordinate points	
Delete coordinate block	
Delet all stored coordinate	
Test funktions:	
Display of signal strength of EDM	
Display of battery voltage	
Display of internal temperature of instrument	

Menu tree (configuration)

MENU Press (for about 2 seconds) until the configuration menu appears.



Distance corrections	
Instrument error:	
Determination of vertical-index error	
Determination of line of sight error (Hz-collimation)	
Sets contrast of display	
Data and recording parameter:	
Selects number of digits for point number and coordinates (8 or 16 digits)	
Sets transfer rate	
Sets parity	
Sets line end mark	
Units and angle parameters:	
Sets distance units (m, ft or ft/in)	
Sets angle units (gon, 360d decimal, 360s sexagesimal)	
Selects ref. plane of V-angle (zenith, horizon, %)	
Selects angle resolution displayed (low, medium or high)	
On / Off:	
Beep at 0°, 90°, 180° and 270°	
Acoustic input signal	
Compensator	
Line of sight error (Hz-collimation)	
Automatic switch-off	

Measure (first steps)

ON OFF

After switching on and setting up the total station correctly, it is immediately ready for measuring.

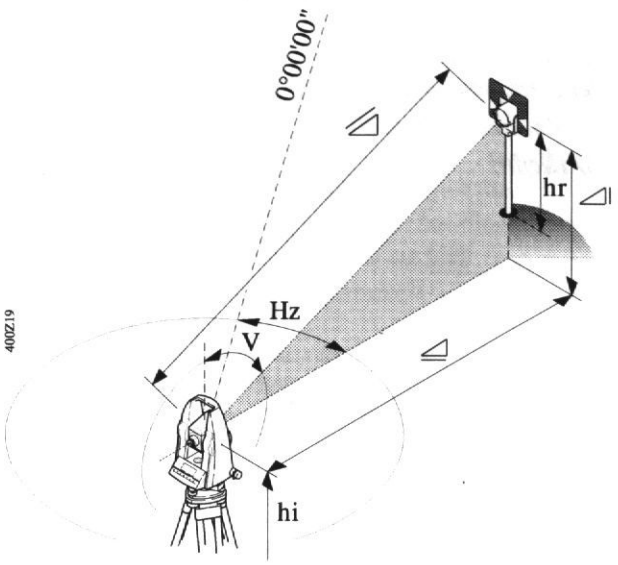
Display symbols

MENU

```
Pt  : +00000000
Hz  : 341°17'10
V   :  87°55'10
 ◿  :     3.782
```

PtNr : Point number
Hz : Horizontal angle
V : Vertical angle
◿ : Slope distance
⊿ : Horizontal distance
◿| : Height difference
E : Easting
N : Northing
H : Height
hr : Reflector height
hi : Instrument height
ppm : Atmospheric distance correction
mm : Prism constant (Leica multiple prism = 0)

Pointing and distance measurement



Hz : Horizontal angle
V : Vertical angle
◿ : Slope distance
⊿ : Horizontal distance
◿| : Height difference
hr : Reflector height
hi : Instrument height

Distance measurement

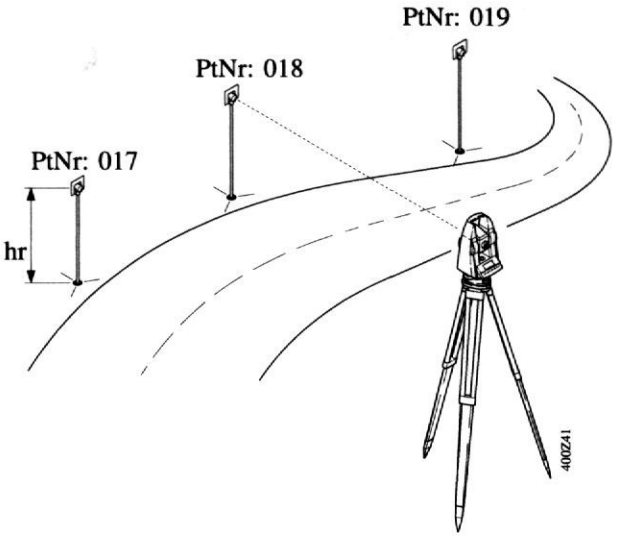
DIST

```
Pt  : +00000001
Hz  : 341°17'10
V   :  87°55'10
 ◿  :     3.782
```

After about 3 seconds the measured distance is displayed. Hz-angle and vertical angle always refer to the actual pointing direction of the telescope.

Additional measuring functions

Entering point number and reflector height (PtNr/hr)



MENU

```
MENU
→PtNr/hr          →
 HZ               →
 LEVEL            →
```

DSP ▶

```
MENU*PtNr/hr

Pt  : +00000017
hr  :     0.000
```


For offset or hidden points

DIST ▼ REC ▲

The combination of DIST ▼ and REC ▲ enables distances and horizontal angles to be measured separately including recording.
First determine the distance and then adjust the direction (eg, for surveying corners of buildings).
Record data via RS232 interface using REC ▲ *(see chapter "Data and recording parameters")*

The recorded V-angle refers to the time of the completed distance measurement.

Trackingfunktion

DIST ▼

Press (for about 2 seconds) to switch on the Tracking function.

STOP CE

Interrupts the tracking function and returns to the single measurement mode.

Setting the horizontal circle (Hz)

1st variant

= Hz auf 0° 00' 00"setting.

MENU
DIST

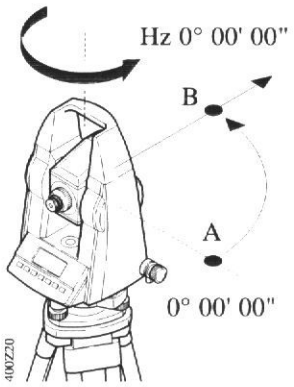
```
MENU
PtNr/hr          →
→HZ              →
LEVEL            →
```

DSP

```
MENU*HZ
Hz   :    0°00'00
 HZ input or
 CONT to hold
```

CONT

Hz - direction is held on 0° 00' 00" (0.0000 gon).



Aim on point B.

CONT

```
MENU*HZ
Hz   :    0°00'00

CONT to release
```

CONT

The Hz-angle to the new point (B) is now 0° 00' 00" (0.0000 gon).
Return to measuring display.

2nd variant

= sets Hz to a specified value by turning the instrument

MENU
DIST

```
MENU
PtNr/hr          →
→HZ              →
LEVEL            →
```

DSP

```
MENU*HZ
Hz   :    0°00'00
 HZ input or
 CONT to hold
```

Turn instrument until the required value for Hz = 45°00'00" (50.0000 gon) is indicated.

CONT

Hold value.

Aim on the corresponding point.

CONT

```
MENU*HZ
Hz   :   45°00'00

CONT to release
```

CONT

The Hz-value is now 45°00'00" (50.0000 gon) for the target point.

3nd variant **= enter Hz-value**

DSP

```
MENU*HZ
Hz  :  23°12'07
 HZ input or
 CONT to hold
```

DIST REC DSP Enter desired value Hz = 45°00'00" (50.0000 gon).

CONT

```
MENU*HZ
Hz  :  45°00'00

CONT to release
```

Aim on the corresponding point.

CONT The Hz-value is now 45°00'00" (50.0000 gon) for the target point.

Selecting the display mask (DSP)

DSP Depending on desired use, 3 different measuring displays can be selected on the TC400N/NL.

Display-masks

Display of mask 1 :

ON OFF
DSP

```
Pt  : +00000005
Hz  : 341°17'10
V   :  87°55'10
 ◿  :     3.782
```

Point number
Horizontal angle (Hz)
Vertical angle (V)
Slope distance

Display of mask 2 :

DSP

```
Hz  : 341°17'10
V   :  87°55'10
 ◿  :     3.780
 ◿| :     0.137
```

Horizontal angle (Hz)
Vertical angle (V)
Horizontal distance
Height difference

Display of mask 3 :

DSP

```
Pt  : +00000005
E   :    -1.213
N   :     3.580
H   :     0.137
```

Point number
Easting
Northing
Height

Measure and record

Measured values can be transfered to a connected field computer/PC via RS232 interface. For this purpose, the Leica GSI-format is used.

The point number is recorded together with the measurements. The point number is automatically incremental by "+1" after recording.

Find more information in chapter "Communication field computer-TC400N/NL".

For more detail information of the Leica GSI-format refer to the handbook "Leica - Instruments On-Line" which is available from your Leica representative.

Recording of angles without distance

REC

```
Pt  : 000000001
Hz  : 123°12'16
V   :  89°32'19
⊿   :      -----
```

If no distance is indicated only angles (Pt, Hz, V, ⊿ = 0.000, ppm/mm) are transfered to the interface.

Recording of angles and distances

DIST REC

```
Pt  : 000000001
Hz  : 123°12'16
V   :  89°32'19
⊿   :     55.123
```

After a distance measurement the distance is indicated in the display.
If REC is pressed subsequently, the angle and the distance (Pt, Hz, V, ⊿, ppm/mm) are transfered to the interface.

Measurements can also be initiated by the connected field computer/PC. For more information refer to the handbook "Leica - Instruments On-Line".

Data management (DATA MANAGER)

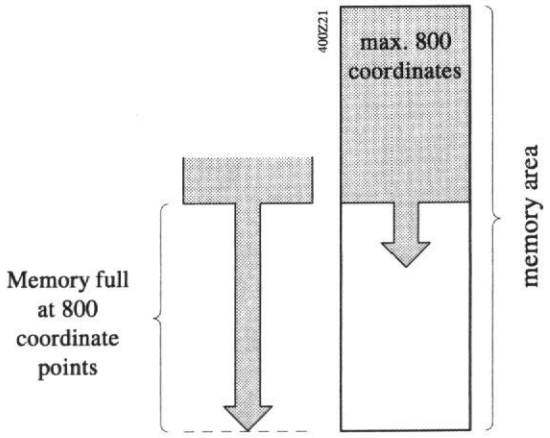
DATA MANAGER contains additional functions enabling to enter, to check and to erase coordinates on the instrument.

MENU
DIST

```
MENU
LEVEL          →
PROG           →
→DATA MANAGER  →
```

The following additional functions are possible:

- Input of coordinates **(INPUT)**
- Searching for point numbers **(FIND)**
- Display of stored points **(VIEW)**
- Erasing coordinates **(DELETE PNT)**
- Erasing the complete rage of coordinates **(DELETE ALL)**



Input of coordinates (INPUT)

With this function, coordinates can be entered via the keypad and appended to the existing set of coordinates.

DSP

```
*DATA MANAGER
→INPUT          →
 FIND           →
 VIEW           →
```

DSP

```
 Coord Input
→Pt  : +00000000
 E   :      0.000
 N   :      0.000
 H   :      0.000
```

DIST REC DSP — Input of coordinates.

CONT — Confirm input and store coordinates.

STOP CE — Quit function.

Searching for individual point numbers and for multiple recordings of the same point numbers (FIND)

This function enables display and search of coordinate points. The use of "Wildcards" is possible.

DIST
DSP

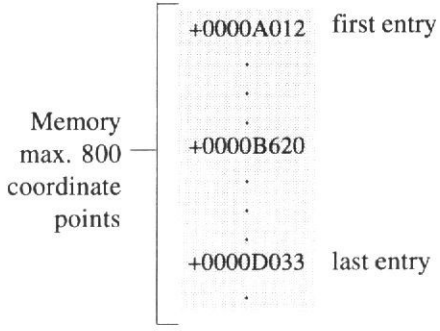
```
*DATA MANAGER
 INPUT          →
→FIND           →
 VIEW           →
```

DIST
DSP
REC

```
PtNr Coord/Find

Pt  = +0000A012
```

CONT

Activate search of entered point number. Always the last available point within the coordinate range is indicated.



Searching point numbers
Point numbers can be searched using *"Wildcards"*. Wildcards can be used to search for specific character groups.

Example:
+xAxx9xxx This example searches for all point numbers counting from left to right with an "**A**" at the 2nd position and a "**9**" at the 5th position and presents the points in a list. The character "**x**" is selected when scrolling between "**9**" and "**0**".
The following character sequence exists for numeric entries:
0 1 2 3 4 5 6 7 8 9 x 0 1 2 ... etc.

Searching for several data blocks with the same point number

If a specific point number is found, the cursor keys can be used to search for further identical point numbers. The direction of search is always from the last stored point towards the first point.

DIST
REC

```
PtNr Coord/Find

PtNr not found
```

Error message if point number was not found
Delete error message with STOP CE.

STOP CE

Quit function.

Display of stored coordinate points (VIEW)

DIST / DSP

```
*DATA MANAGER
INPUT          →
FIND           →
→VIEW          →
```

DSP

```
Coor:  0004/0047
Pt   : +00000072
E    :    40.000
N    :    45.500
```

Coord. line

Total stored coordinate points *(max. 800, see chapter "Data and recording parameters")*

DIST / REC — Searching can be made upwards and downwards and starts always with the last data line (z.B.**0004**). Holding the relevant key enables a fast scrolling of the points (downwards/upwards)

DSP — Display point coordinates.

STOP CE — Quit function

Deleting individual coordinate points (DELETE PNT)

This function deletes individual coordinate points from the internal memory.

DIST / DSP

```
*DATA MANAGER
FIND           →
VIEW           →
→DELETE PNT    →
```

```
Coor:  0004/0047
Pt   : +00000072
E    :    40.000
N    :    45.500
```

DIST / REC / DSP — Enter the point number to be deleted or select these using "Wildcards" *(see page 33)*.

CONT

```
PtNr Coord/Del.

Delete   >   No
```

DSP

```
PtNr Coord/Del.

Delete   >  Yes
```

CONT — The selected point is deleted.

STOP CE — Quit function

Delete the complete coordinate range (DELETE ALL)

DIST ▼ / DSP ▶

```
 *DATA MANAGER
 VIEW              →
 DELETE PNT        →
→DELETE ALL        →
```

DSP ▶

```
   Erase Data

Nr of Blks:    64
 Erase   >     No
```

The coordinate range is deleted completely.

REC ▲

```
   Erase Data

Nr of Blks:    64
 Erase   >     Yes
```

The complete coordinate range is deleted if "**Erase > Yes**" selected and confirmed with CONT.

CONT

Coordinate range is deleted.

CAUTION:
All coordinate points are erased. Erased points cannot be activated again.

User Programs

Introductions

Integrated programs ensure high functionality of the TC400N/NL total station.
Daily survey work is simplified by using internally stored coordinates. This largely eliminates the risk of entering wrong information. Coordinate points can be transferred from a computer to the total station.
The following programs are installed in the instruments:

- Set station and oriention (Set Station)
- Setting-out

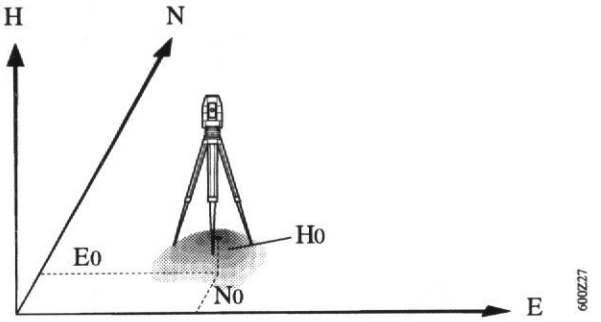
Programs are generally aborted using the key STOP CE.

In order to use the software correctly and reliably, you must follow the instructions given in the user manual or in the on-line help system. You must also adhere to the directions given in the user manual for the product with which you are using the software.

Set station coordinates and orientation (Set Station)

The program "Set Station" is used for setting station coordinates and orientation of horizontal circle. These can be entered manually or can be read from the internal memory.

Set station coordinates



With manual input, the entered coordinates can be stored in the COORD area. The station coordinates are set simultaneously.
The coordinates are stored in the format PtNr, E, N, H.

MENU DIST DSP

```
MENU
HZ
LEVEL
→PROG
```

DSP

```
MENU*PROG
→Set Station   →
Setout         →
```


Set station point manually (Keyb)

(for alphanumeric entering of point number refer to section "Input")

DIST DSP CONT

```
SET STATION
→Get COOR> Keyb.
 Pt :   00001100
 hi :      1.600
```

Select manual input (**Keyb.**) or point search from internal memory (**File**).
- Input point number entry (Pt)
- Input instrument height entry (hi)

DIST DSP CONT

```
SET STATION
→E   :    40.000
 N   :    45.500
 H   :    33.520
```

- Input of Easting (**E**)
- Input of Northing (**N**)
- Input of Height (**H**)

Display of entered coordinates

DIST
CONT

```
  SET STATION
• Pt  :  00001100
  EØ  :     40.000
  NØ  :     45.500
  HØ  :     33.520
  hi  :      1.600
  hr  :      1.650
```

REC stores the point in the **COORD** area of the internal memory, sets the station and quits the program.

CONT sets the displayed coordinates as the instrument station and quits the program.

```
  SET STATION

  Station SET
```

Confirms: The station coordinates have been set.

Set the instrument station from coordinates stored (IntMem)

(for alphanumeric Entering point number refer to section "Input")

DIST
DSP
CONT

```
  SET STATION
→Data>     IntMem
  Pt  :   00001100
  hi  :      1.600
```

On the basis of the point number entered, the coordinates are searched for in the COORD area of the internal COORD area.

```
  SET STATION
IntMem:Coordinate
→Pt   : 00000100
```

The search for the point number always proceeds from the end to the beginning of the COORD area.
If the same point number is stored more than once, the last point in memory will be found.

Display of found coordinates

DIST
CONT

```
  SET STATION
• Pt  :  00000100
  EØ  :     40.000
  NØ  :     45.500
  HØ  :     33.520
  hi  :      1.600
  hr  :      1.650
```

CONT sets the displayed coordinates as the instrument station coordinates.

CONT

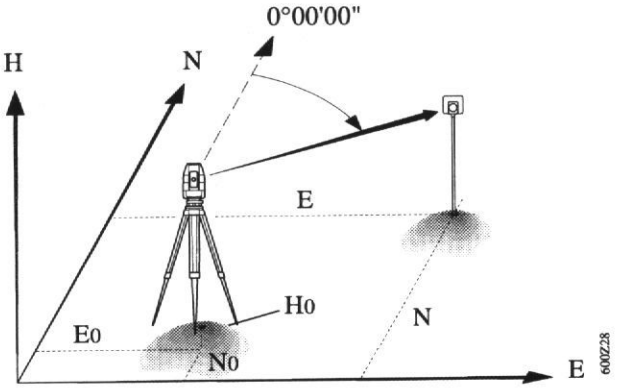
```
  SET STATION

  Station SET
```

Confirms: The station coordinates have been set

Orientation of horizontal circle

Calculation of horizontal circle orientation from angle measurements to one tie point.

The horizontal circle can be oriented either with internally stored coordinate points or with coordinates entered manually.
Before you start the function **"ORIENTATION"**, enter the correct station coordinates first by using "Station Coord"



Orientation with points in the internal memory

DSP ▶ / CONT

```
   ORIENTATION
→Data>     IntMem
  Pt :     00001100
```

- Select **IntMem**.
- Input of point number

The point in the "Orientation" is local and does **not** overwrite the system point number.

CONT

```
   ORIENTATION
IntMem:Coordinate
→Pt    : 00000100
```

Search for points in the internal COORD area.

```
   ORIENTATION
  Pt   : +00000100
  Hz   : 352°44'05
```

Sight the tie point.
With **Hz : 352°44'05"** (391.9257 gon) the calculated direction to the tie point is indicated.

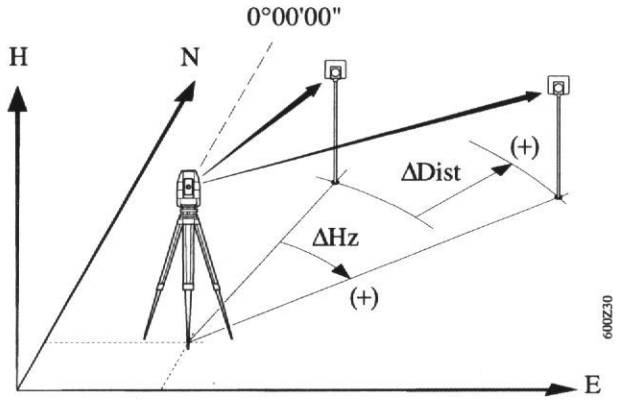
CONT

```
   ORIENTATION

  Orientation
      SET
```

Final display.
Returns to program selection menu after about two seconds. MENU returns to measuring mode.
To check the orientation to additional points use the program "Set-out".

Setting out

The program calculates setting out elements (angle and distance) from manually entered or stored coordinates. Additionally, the setout angles, the horizontal distance and the height can also be manually entered.
As a result, it is not always necessary to set a station. If coordinates or heights are used, make sure that the correct station is set and the instrument has been oriented before starting to set out.



The"Setout" program supports the polar setting out technique. The divergence between the computed direction and the measured direction is displayed. After a distance measurement, the divergence to the required distance is also displayed.

MENU DIST DSP

```
 MENU
 HZ
 LEVEL
→PROG
```

DIST DSP

```
 MENU*PROG
 Set Station   →
→Setout        →
```

CONT

```
      SETOUT
• PtNr: +00000100
  EØ  :   9114.234
  NØ  :   2345.543
  HØ  :    264.113
  hi  :      1.602
```

The present station coordinates are displayed for inspection, but cannot be changed here.

Setting out with coordinates from internal memory

DSP DIST CONT

```
      SETOUT
 Data>     IntMem
 Pt  :  +00001234
 hr  :      1.550
 Off:       0.000
```

Input of point number, reflector height and height offset **Off**. The amount of **Off** is added to or subtracted from the height to be set out, in accordance with its sign. This takes account of fills, slopes, etc... (Alphanumeric point entry or search, *refer to section "Input"*)

The entered point number is local within the application "Setout" and does **not** overwrite the system point number.
Search for coordinates in the COORD-area or for manual entries after switching to **Keyb**. It is possible to use "Wildcards" *(refer to section "Searching for point numbers"...(FIND)*.

```
PtN : +00001234
ΔHz :   0°21'31
Δ◿  :    0.482
Δ◿| :    1.592
```

Turn instrument until **ΔHz = 0°00'00"** (0.0000gon).
Repeat the measurements with **DIST** until the displayed difference in distance is within the required accuracy, i.e., close enough to 'zero'.

```
HZ  :  75°57'35
V   :  92°08'59
◿   :   82.325
H   :  410.800
```

MENU Switching between upper and lower display.

CONT Continue with the next point.

Setting out with manually entered coordinates

DSP
DIST
CONT

```
     SETOUT
Data>      Keyb.
Pt :  +00001234
hr :       1.550
Off:       0.000
```

Input of point number, reflector height and height offset **Off**. The amount of **Off** is added to or subtracted from the height to be set out, in accordance with its sign. This takes account of infill, etc... (Alphanumeric point entry or search, *refer to section "Input"*)

Input of point number is not relevant here - it has no influence.

DIST
DSP
CONT

```
     SETOUT
→E  :     40.000
 N  :     45.500
 H  :     33.520
```

- Input of Easting
- Input of Northing
- Input of Height

```
Pt  : +00001234
ΔHz :   0°21'31
Δ◿  :    0.482
Δ◿| :    1.592
```

Turn instrument until **ΔHz = 0°00'00"** (0.0000gon).
Repeat the measurements with **DIST** until the displayed difference in distance is within the required accuracy, i.e., close enough to 'zero'.

```
HZ  :  75°57'35
V   :  92°08'59
⊿   :   82.325
H   :  410.800
```

MENU Switching between upper and lower display.

CONT Continue with the next point.

Setting out with manually entered angle, distance and height

DSP
DIST
CONT

```
      SETOUT
Data>      Angle
Pt   :+00001234
hr   :    1.550
Off  :    0.000
```

DIST
DSP
CONT

```
      SETOUT
→Hz  :   0°00'00
⊿    :    0.000
H    :    0.000
```

- Input of required Hz-angle (**Hz**)
- Input of horiz. distance to be set out (⊿)
- Input of required height (**H**)

Enterd Hz-angles refer to actual horiz. circle orientation.
From entered data the setting-out values ΔHz, Δ⊿ and Δ⊿| calculated.

For setting-out heights (Display of Δ⊿|) , the entered height (H), the station height (HØ), the instrument height (hi) and the reflector height (hr) are considered.

```
Pt   : +00001234
ΔHz  :   0°21'31
Δ⊿   :    0.482
Δ⊿|  :    1.592
```

Turn instrument until **ΔHz = 0°00'00"** (0.0000gon). Repeat the measurements with **DIST** until the displayed difference in distance is within the required accuracy, i.e., close enough to 'zero'.

```
HZ  :  75°57'35
V   :  92°08'59
⊿   :   82.325
H   :  410.800
```

MENU Switching between upper and lower display.

CONT Continue with the next point.

Configuration / Parameter

Under Configuration, specific settings can be entered for the TC400N/NL unit so the instrument is optimally set up for particular survey tasks.

MENU Press (for about 2 seconds) in order to activate the configuration menu.

```
 CONFIG MENU
→PPM/MM          →
 CALIB           →
 CONTRAST>       2
```

All settings remain active even after switch-off.

Distance corrections

Meteorological correction (ppm)

The distance measurement is affected by the meteorological conditions. The distance can be corrected with appropriate **ppm** values. The ppm values for temperature and atmospheric pressure are obtainable from the diagram in *section 'Technical data'*. Instead of the atmospheric pressure the mean height above sea level of the survey site may be used for interpolation. For example, 10°C (18°F) temperature difference makes a difference of 1mm in a measured distance of 100 m = 10 ppm.

DSP

```
*PPM/MM

ppm =          +003
mm  :            0
```

DIST REC Enter value.

DSP Shift cursor.

CONT Confirm input and continue to enter the prism constant.

Prism constant (MM)

The prism constant **MM** for Leica circular prisms is 0. It must be determined when using other types of prism. The prism constant must be always entered in units of (mm).

CONT

```
*PPM/MM

ppm =        +003
mm  :            0
```

DIST REC Enter value.

DSP Shift cursor.

CONT Confirm input. The value is stored after switching off the total station.
During a distance measurement the instrument displays both correction values (**PPM**) and (**MM**) for your information.

Determine instrument errors (electronic)

DIST
DSP

```
 CONFIG MENU
 PPM/MM          →
→CALIB           →
 CONTRAST>       2
```

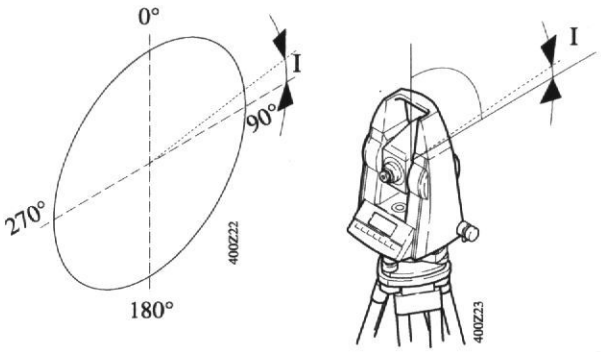
```
 *CALIB
→V-INDEX         →
 Hz-COLLIM       →
```

The measured angles are corrected with the opposite sign of the indicated instrument errors.

Vertical index error (V-Index)

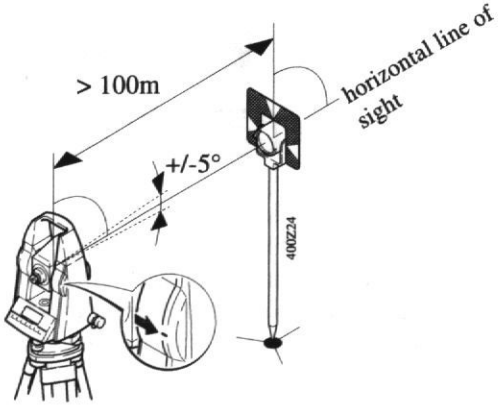
The vertical circle should read exactly 90° (100 gon) when the line of sight is horizontal. Any deviation from the horizontal line is termed vertical index error (I).

The stored vertical index error is displayed as an angular value in the units selected.

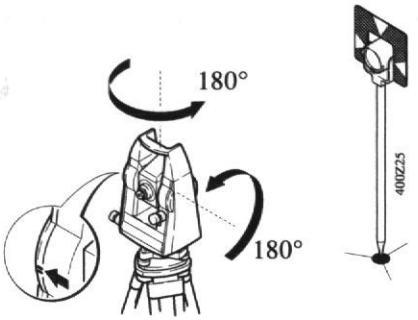


Procedure:
Before determining the vertical-index error use the electronic level to level up the instrument correctly. Select a point at a distance of about 100m which can be easily aimed and deviating no more than +/-5° from the horizontal line.

1st step



2nd step




```
CALIB*V-INDEX:
I :   0°00'00
Inew :      ----
> Measure Index<
```

```
>   Aim Point   <
>     Wait      <
> Other Face    <
>     Wait      <
>  Set Valve?   <
```

```
 CALIB*V-INDEX:
 I   :   0°00'00
 IneW:  -0°23'52
  >  SetValue?  <
```

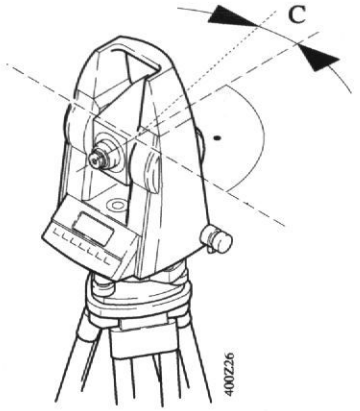
CONT Adopt the calculated value or

STOP CE retain the old value and switch back to menu **CALIB**

When you determine the vertical index error the electronic level is adjusted at the same time.

Line-of-sight error (Hz-collimation)

The line-of-sight error or collimation error (C) is the deviation from the perpendicular of the tilting axis. It is determined and stored in a similar manner to the vertical-index.



The correction of the Hz-angle relates to the vertical angle. This correction can be switched off.

DIST DSP

```
  *CALIB
  V-INDEX       →
→ HZ-COLLIM     →
```

CONT

```
CALIB*HZ-COLLIM
C          0°00'00
Cnew  :    0°16'12
>Measure Collim <
```

```
>   Aim Point   <
> Another Face  <
>   Set Value?  <
```

Index- and line-of-sight errors can change with time and temperature. They should, therefore be newly determined before the first use, before precision surveys, after long periods of transport, before and after long working breaks, and if the temperature changes by more than 10°C (18°F).

Contrast

DIST

```
CONFIG MENU
CALIB          →
→CONTRAST>     3
REC DATA       →
```

DSP

Adjusting the display contrast from **0** (low) to **3** (high).

Data and recording parameter

The coordinates (**COORDS**) are stored in the internal memory *(refer to section "Data management (DATA MANAGER)")*. The internal memory can store information for a maximum of 800 coordinate points. Coordinate points are always stored in the format PtNr, E, N, H.

DIST
DSP

```
CONFIG MENU
CALIB          →
CONTRAST>      3
→REC DATA      →
```

DIST
REC

```
*REC DATA
→DIGITS  >    16
BAUD     >  9600
PARITY   >  EVEN
```

```
ENDMARK > CR/LF
```

DSP

Setting the desired parameters.
Possible settings:

DIGITS	16 \ 8 - digit for PtNr. and coordinates
BAUD	300 \ 600 \ 1200 \ 2400 \4800 \ 9600
PARITY	NONE\ ODD\ EVEN
ENDMARK	CR/LF \ CR

Confirm the input.

CONT

To record measurements, a data recorder can be connected to the serial data port (RS232 interface). The parameters of the serial interface are already adapted for data transmission with Leica data recorders. They remain stored after switching off the total station. To use data recorders of other makes (eg, IBM-compatible PCs) the interfacing parameters may need changing. The communication via the RS232 interface requires a certain protocol containing the exact command structure (for more information refer to the handbook "Leica Instruments online").

Do not turn the total station during measurements until data recording is finished. The current horizontal direction is always transmitted !

Settings (Units and parameters)

DIST
DSP

```
 CONFIG MENU
 CONTRAST>      3
 REC DATA       →
→UNITS          →
```

Units for distance measurement

DSP

```
 *UNITS
→DIST    >     m
 ANGLE   >  360S
 V-ANGLE>     V
→DSP RDG >   low
```

Units

Parameters

DSP

Setting:
- m = Meter
- ft = feet (in decimals)
- ft/in = feet, inch and $^1/_8$ inch

CONT

Confirm the selected values.

Units for angle measurement

DIST
DSP

```
 *UNITS
 DIST    >     m
→ANGLE   >  360S
 V-ANGLE >    V
```

DSP

Setting:
- gon = 400gon
- 360d = 359°.999 (in decimals)
- 360s = 359° 59" 59""(sexagesimal)

CONT

Confirm selection.

V-Angle

DIST
DSP

```
 *UNITS
 DIST    >     m
 ANGLE   >  360S
→V-ANGLE >     V
```

DSP

Setting:
V = zenith angle (zenith = 0)
±V = vertical angle (horizontal = 0), rise (+), fall (-)
V% = slope: (horizontal = 0%), rise (+%), fall (-%)

CONT

Confirm selected values.

Rounding of displayed angles (DSP RDG)

DIST
DSP

```
 *UNITS
 ANGLE   >  360S
 V-ANGLE >     V
→DSP RDG >   low
```

DSP

Setting:
- high = 81°45'25" (5"/1 mgon Interval) i.e. 3 dec.
- med = 81°45' 30" (10"/2 mgon Interval) i.e. 3 dec.
- low = 81°45' 20" (20"/5 mgon Interval) i.e. 3 dec.

CONT

Confirm selection.

The rounding of the displayed angles has no affect on the instrument's accuracy.

DIST
DSP

```
CONFIG MENU
REC DATA        →
UNITS           →
→ON/OFF         →
```

DIST
REC

```
*ON/OFF
→BEEP 90° >  OFF
BEEP      >   ON
COMP      >   ON
HZ-COLL   >  OFF
AUTO  OFF>    ON
```

Setting-out right angles (BEEP 90°)

To simplify setting-out of right angles an acoustic signal (BEEP) can be activated. Set **BEEP 90°** to **ON** and confirm.

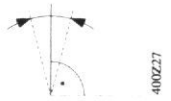
DIST
DSP

```
*ON/OFF
→BEEP 90°>   OFF
BEEP      >   ON
COMP      >   ON
```

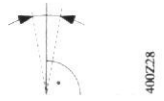
CONT

Confirm selection.

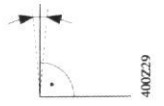
BEEP pulsating
+/- 4° (5gon)



BEEP continuous
+/- 30' (0.5gon)



no signal
+/- 30" (10mgon)



Input signal (BEEP)

DIST
DSP

```
*ON/OFF
BEEP 90°>   OFF
→BEEP    >   ON
COMP     >   ON
```

After each key touch, the instrument acknowledges the correct input by an acoustic signal.
The signal can be switched off but is reactivated each time the total station is switched on again.

Compensator (COMP)

The acoustic warning signal and the error message (Error **58 TILT**) can be suppressed if the total station is insufficiently leveled up. (eg, on swaying platforms or ships).

For normal use set **COMP = ON** in order to correct the V-angle with the index error (I).

DIST
DSP

```
*ON/OFF
BEEP 90°>   OFF
BEEP     >   ON
→COMP    >   ON
```

Hz-Collimation (HZ-COLL)

The line of sight error stored in the instrument corrects the Hz-angle in relation of the V-angle when set HZ-COLL=ON.

DIST DSP

```
  *ON/OFF
  BEEP     >     ON
  COMP     >     ON
→ HZ-COLL  >     ON
```

Automatic switch-off (AUTO OFF)

DIST DSP

```
  *ON/OFF
  COMP     >     ON
  HZ-COLL  >    OFF
→ AUTO OFF>     ON
```

In case of longer breaks (> 10 minutes) the function **AUTO OFF** automatically switches off the total station to save battery capacity.
Once the instrument is switched on **AUTO OFF** is always set to (**ON**) and so may need to be suppressed (**OFF**) again.

Test functions

Test functions are for displaying instrument parameters and status.

MENU DIST

```
  MENU
  PROG
  DATA MANAGER
→ TEST
```

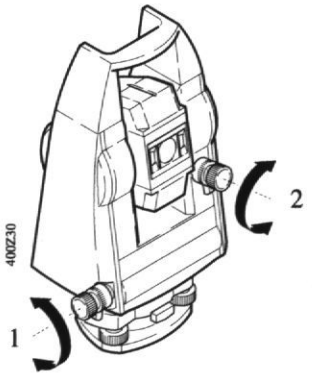
EDM Signal

DSP

```
  MENU*TEST
→ SIGNAL
  BATTERY        9
  TEMP °C       21
```

```
MENU*TEST*SIGNAL

 >■■■■■■■      <
      28%
```

Under difficult measuring conditions (e.g. fog) the TC400N/NL can be optimised to the prism for distance measurements using this function.
- Align TC400N/NL
- Adjust the fine drives (1, 2) until the max. value (eg,.28%) is reached.
- Measure the distance.



Battery charge

After this function has been called, the instrument temperature and the battery status is displayed.
Low battery capacity also triggers (even during a measurement) an acoustic signal and the warning **'Battery low' appears**.
With low battery capacity, distances cannot be measured and the instrument switches off automatically.

DSP ▶

```
 MENU*TEST
→SIGNAL
 BATTERY        9
 TEMP °C       21
```

9 = Battery full
1 = Battery low

Instrument temperatur

DSP ▶

```
 MENU*TEST
→SIGNAL
 BATTERY        9
 TEMP °C       21
```

internal instrument temperature in Celsius (°C)

TCTOOLS

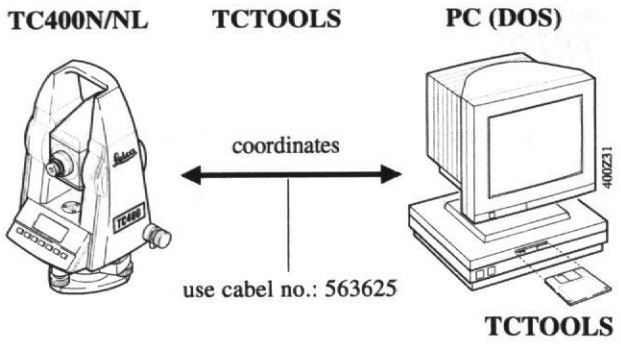
TCTOOLS is a program for IBM compatible PCs.
The program TCTOOLS manages the data of the TC400N/NL unit. The individual functions support the bidirectional data transfer.
Coordinates can be transfered directly from a text file to the instrument. These coordinates can be used in the field as station point, for orientations or for setting out.

Coordinates transfered to the instrument with TCTOOLS or entered and stored at the instrument can be transfered from the instrument back to the PC with TCTOOLS in several formats.

The program TCTOOLS consists of the following main functions:

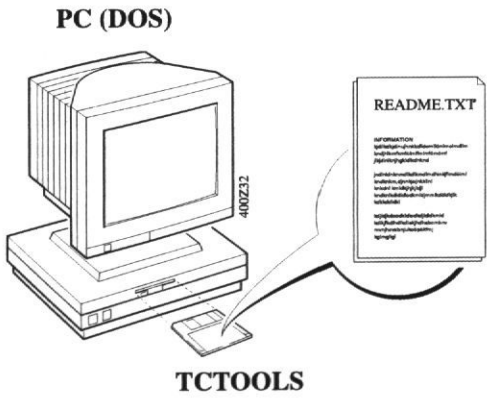
- Data transfer
  - Send data (PC to instrument)
    - Coordinates
    - Code list (*)
    - Format files
  - Receive data (Instrument to PC)
    - Coordinates
    - Measurements (*)
    - Code list (*)
  - Erase data (complete data areas)
    - Coordinates
    - Measurements (*)
    - Code list (*)
- Code lists (Editor) (*)
  - Recreate (*)
  - Edit (*)
  - Packetize (*)
  - Display (*)
  - Create print file (*)

(*) ... Is not supported by the TC400N/NL.



For data transfer the data cable (Part no. 563625) is needed. This cable is supplied with each instrument.

For more information about TCTOOLS refer to the file README.TXT on the diskette supplied with each instrument.



Data transfer

The transfer parameters set in the TC400N/NL (**CONFIG MENU - REC DATA**) and set in TCTOOLS must be the same:
The following parameters are recommended:

Baud	=	9600
Parity	=	Even
Endmark	=	CR LF

Sending data (PC to instrument)

• Coordinates

This function transfers coordinates-files from the PC to the internal memory of the instrument. On the PC the coordinates can be available in the Leica GSI-format or in a text format. From the text format relevant coordinates are filtered and transmitted.

• Format files

Format files contain formats for the data transmission from the instrument to the PC.
Two Leica GSI-formats are installed permanently in the instrument. Two additional formats can be transfered to the instrument and stored there.

For more information about the availability of additional formats please call your next Leica representative.

Receiving data (instrument to PC)

• Coordinates

Coordinates can be transfered from the internal memory of the instrument to the PC using the Leica GSI-format as well as individual format. For transmission of individual format the relevant format file must be loaded in the instrument (see "Sending data" -> "Format files" or call your next Leica representative).

Deleting data

• Coordinates / Measurements / Code list

The "Coordinate" area in the internal memory of the instrument can be erased on-line using a connected PC and TCTOOLS.

For more detail information refer to the On-Line Help in TCTOOLS program.

Communication Field computer-TC400N/NL

For more detail information of commands and data structures refer to the handbook "Leica Instruments On-Line" which is available from your Leica representative.

Set station coordinates

Station coordinates can be transmitted from a external data recorder via RS232 interface at any time without having to reset the instrument. However, the instrument must be in measuring mode.

	Command structure: (_ = space char.)
Point number (PtNr)	PUT/11....+12345678_CRLF
Easting (Eo)	PUT/84....+12345678_CRLF
Northing (No)	PUT/85....+12345678_CRLF
Height (Ho)	PUT/86....+12345678_CRLF
Instrument height (hi)	PUT/88....+12345678_CRLF

Set orientation

A new direction can be transmitted at any time provided that the instrument is in the measuring mode.

For the actual pointing of the instrument a new horizontal circle reading is set (correspond to an orientation).

	Command structure: (_ = space char.)
Hz	PUT/21...2+12345678_CRLF

Setting out by field computer

Function	Command structure: (- = space char.)
Call the function	"SETOUT" (setting-out)
Point number (PtNr)	PUT/11....+12345678_CRLF
Hz-angle to be set out:	PUT/24...2+12345678_CRLF
Horizontal distance to be set out:	PUT/34...0+12345678_CRLF
Height to be set out:	PUT/83...0+12345678_CRLF
Return to data transfer	(**c** for a new point)
Terminates program function	"setting-out" **x**

After the required 4 data lines are transmitted to the TC400 unit, the display changes automatically to the mode showing the divergence between specified direction and present instrument direction.

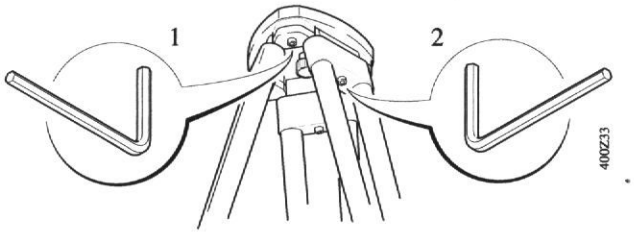
After distance measurement (**DIST**) the difference between the computed and measured horizontal distance as well as the difference in height between the instrument position and the setting-out point are displayed. At the same time, the key REC is active to send data to an external data recorder. Measurements and data recordings can also be activated from the external data recorder.

Checking and adjusting

Tripod

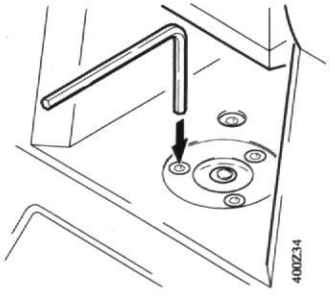
The connections between metal and timber components must always be firm and tight.

- 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.



Circular level

Level-up the instrument in advance with the electronic level. The bubble must be centered. If it extends beyond the circle, use the allen key supplied to center it with the adjustment screws.
Care has to be taken, that, after adjustment, no screw remains loose.



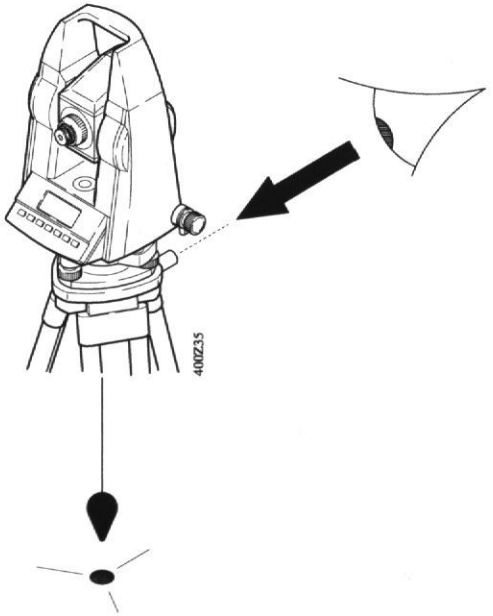
Line-of-sight error (mechanic)

At the factory and prior to delivery, the line-of-sight is adjusted. The residual line-of-sight error should be checked at regular intervals. *Refer to chapter "Determine instrument errors (Line of sight error)"*. It is automatically taken into account in all measurements.

Optical plummet

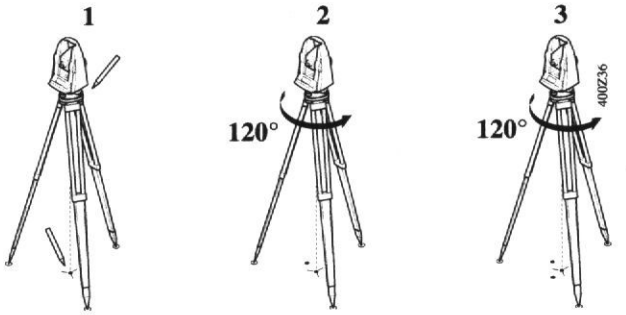
Check the optical plummet of the tribrach at regular intervals. Any deviation of the line-of-sight from the vertical axis of the instrument causes a centering error.

Checking by plumb-bob:
Set up and level up the instrument (with plummet) on the tripod. Mark the ground point. Remove the plumb-bob. Check that the crosshairs of the optical plummet intersect at the ground point. The accuracy achievable is about 1mm.

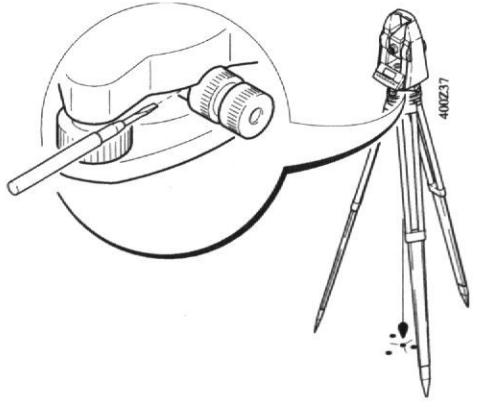


Checking by turning the tribrach:
1. Level up the instrument using the electronic level. Mark the ground point. Using a pencil, mark the outline of the tribrach on the tripod plate.
2. Turn the tribrach 120°, fit it into the outline, level up the instrument, and again mark the ground point.
3. Repeat this procedure in the third position.

If the three points do not coincide, adjust the crosshairs of the tribrach to the center of the triangle formed by the three ground points.



Adjustments:
Use a screwdriver to turn the two set screws alternately by the same small amount in order to center the crosshairs on the marked ground point.



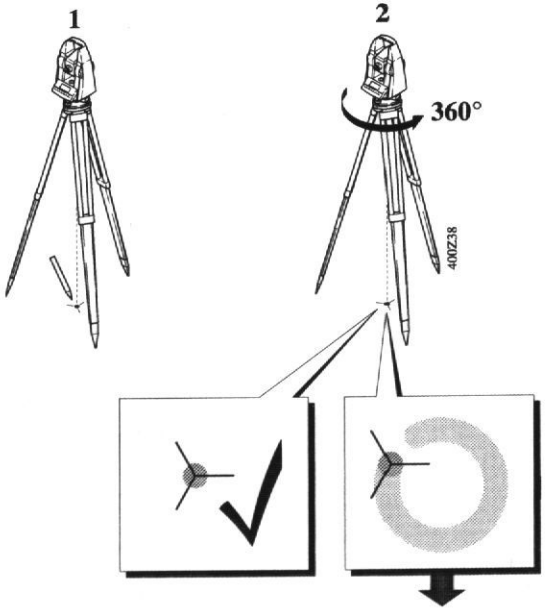
The laser plummet is integrated into the vertical axis of the instrument.

Under normal circumstances setting of the laser plummet is not necessary.

Checking by turning the instrument by 360°:

1. Install the instrument on the tripod and level up.
2. Switch on laser plummet and mark centre of the red point.
3. Turn instrument slowly by 360° and observe the red laser point.

If the centre of the laser point makes a clearly circular movement, contact the Leica service department for calibrating the laser plummet.

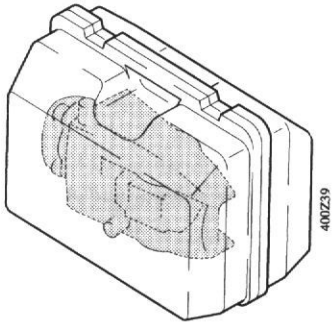


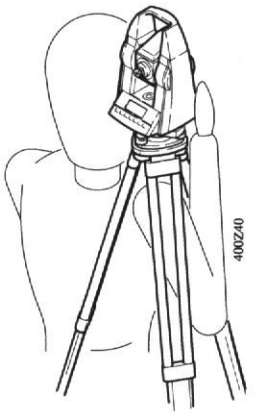
Leica service department

Care and storage

Transport:
When dispatching the equipment, always use the complete original Leica packaging (case and cardboard box). When transporting the equipment in the field, always make sure to:

- either carry the instrument in its original transport case or
- carry the tripod with its legs splayed across your shoulder, keeping the **attached instrument upright**.





Cleaning and drying:
Objective, eyepiece and prisms

- blow dust off lenses and prisms
- Never touch the glass with fingers
- Use only a clean, soft and lint-free cloth for cleaning. If necessary, moisten the cloth with pure alcohol.

Use no other liquids; these may attack polymer components.

When storing the equipment, particularly in summer and inside a vehicle, take the storage temperature limits (-40°C to + 70°C / -40°F to +158°F) into account.

Cables and plugs:
Keep plugs clean and dry. Blow out 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 connecting cables.

Fogging of prisms:
Reflector prisms that are cooler than the ambient temperature tend to fog. It is not enough to simply 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 (at not more than 40 °C/ 108°F), transport case, foam inserts, and accessories. Pack up the equipment only when it is perfectly dry.

After a longer period of storage or transport of your instrument allways perform the field ajustments indicated in this manual before using the instrument.

Battery charging

WARNING:
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). We recommend a temperature of 0°C to +20°C (32°F to 68°F) for storing the batteries.

Battery chargers GKL22 and GKL23

Charger GKL22:
The charger outputs constant current and charges a NiCd battery within 14 hours. The charging procedure starts automatically whenever a battery is connected to the charger and a red control lamp indicates a fully charged battery.
Charging batteries with 2 pole plug requires an adapter cable.

Fast charger GKL23:
Fast charging with the GLK-23 is possible with Leica NiCd-batteries equipped with a 5-pole plug. Fast charging requires 1.5 to 5 hours depending on the battery capacity.

Leica batteries with 2-pole plugs can be charged using an adapter cable - this charging procedure will take 14 hours.

Connecting 2 batteries at the same time, will charge the batteries sequentially. Batteries with fast charging capabilities are priority.
Charging modes and status of the GKL-23 is shown by three color-LEDs.
For more information about use, functions and displays refer to the user manual of the GKL-23.

Battery chargers GKL12 and GKL14

The GKL12 charger is suitable for charging the total station's battery insert (2-pole charging plug) and the GEB70 compact battery. For the GEB71 universal battery, use a GKL14 charger.

Before you use new batteries for the first time, charge them for 20 to 24 hours. This also applies to batteries that have not been used for several months. NiCd batteries reach full capacity after two or three normal cycles each of a 14-hour charge followed by a full discharge

If battery performance drops noticeably, run one or two full cycles, i.e. charge for 14 hours and allow to discharge until the instrument 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, **115V** or **230V**. Plug in the charger to the mains. The green indicator lamp should light. If it does not light, there is a power cut or the mains cable or charger is faulty.
Connect the battery to the charger. The red charging indicator should light. If it does not, the battery is not charging, i.e. the battery cable is faulty or the battery fuse has blown and should be replaced. On the GKL12, you may not have started the timer or it may have stopped at the end of the charging period.

Safety directions

The following directions should enable the person responsible for the TC400N/NL, 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.

Intended use of instrument

Permitted uses
The TC400N/NL electronic total stations are intended for the following applications:
- Measuring horizontal and vertical angles
- Measuring distances
- Recording measurements
- Computing by means of applications software
- Visualising the standing axis (with laser plummet)

Adverse uses
- Activation of the total station without previous instruction
- Use outside of the intended limits
- Disabling safety systems and removal of hazard notices
- Opening the instrument using tools (screwdriver, etc.), unless this is specifically permitted for certain functions
- Modification or conversion of the instrument
- Activation 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 TC400N/NL total stations are not to be used until the user has been properly instructed how to use them.

Limits of use

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.

Refer to section "Technical data".

Responsibilities

Area of responsibility for the manufacturer of the original equipment Leica Geosystems 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 TC400N/NL electronic total station 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 deployment of personnel who use the instrument and for the safety of the equipment when 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.

Hazards of use

Main hazards of use

WARNING:
The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or adverse 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 must not** be used in damp or inclement conditions. If moisture penetrates the charger, the user may receive an electric shock.
Precautions:
Use the charger only indoors, in dry rooms. Protect it from damp. If the charger is damp, do not use it.

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

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

CAUTION:
Watch out for erroneous distance 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 *(refer to section "Determine instrument errors" and "Checking and adjusting")*, 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 electrical 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 lightening.
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.
Precautions: Avoid pointing the telescope directly at the sun.

WARNING:
During target recognition or stakeout procedures there is a danger of accidents occuring if the user does not pay attention to the environmental conditions around or between the instrument and the target (for example: obstacles, excavations or traffic).
Precautions: The person responsible for the instrument must make all users fully aware of existing dangers.

CAUTION:
If a target lamp accessory is used with the instrument the lamps 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 wollen 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.

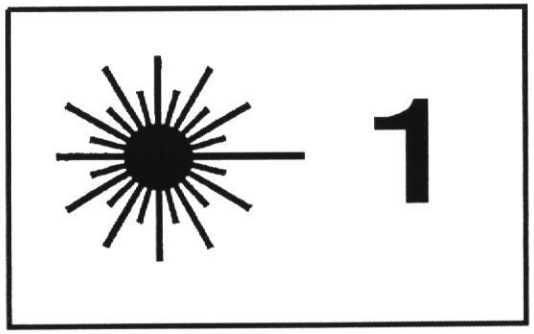
Laser classification

Integrated EDM

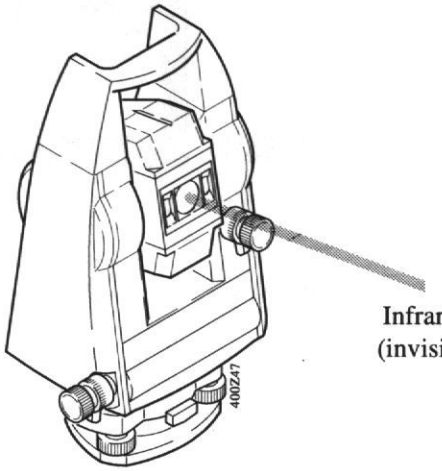
The EDM module built into the total station produces an invisible infrared beam which emerges from the telescope objective *(refer section "Important parts")*. The product is a Class 1 LED product in accordance with:

- IEC 825-1 : 1993 "Radiation safety of laser products".
- EN 60825-1 : 1994 "Radiation safety of laser products".

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



Beam divergence:	2.5 mrad
Impulse duration:	10 ns
Maximum power output:	100 µW peak
Measurement uncertainty:	± 5%



Infrared beam (invisible) exit

Laser plummet (just TC400NL)

The laser plummet built into the total station produces a visible laser beam which emerges from the bottom of the instrument *(refer to section "Instrument with laser plummet")*. The product is a Class 2 laser product in accordance with:

- IEC 825-1 : 1993 "Radiation safety of laser products".
- EN 60825-1 : 1994 "Radiation safety of laser products".

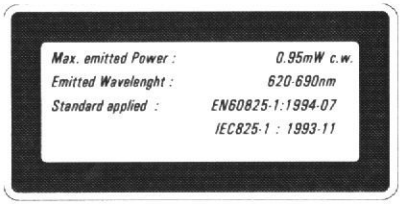
The product is a Class II laser product in accordance with:

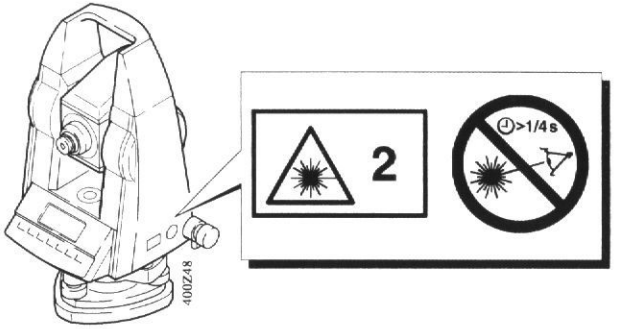
- FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations)

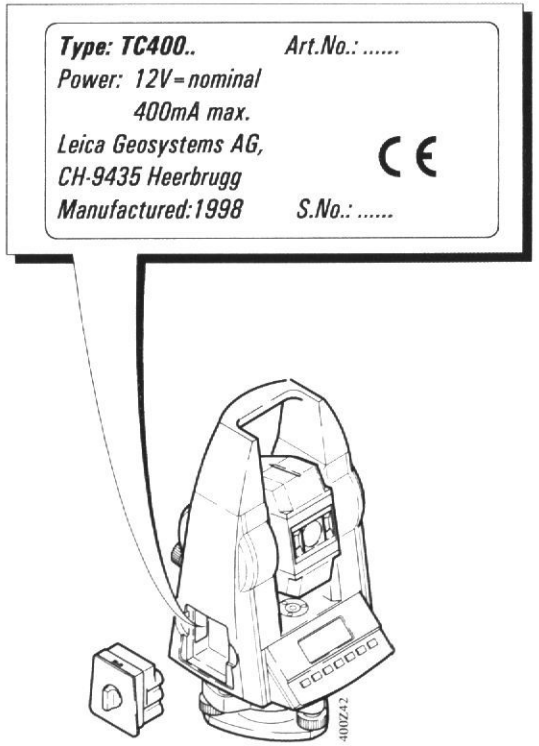
Laser class 2/II products: do not view into the laser beam and do not point it at other persons (unnecessarily). Normally, eye protection is achieved by turning away and by the eyelid closing reflex.

WARNING:
Viewing directly into the beam using optical aids (eg, binoculars, telescopes) could be dangerous.
Precautions:
Do not view into the beam using opcitcal aids.

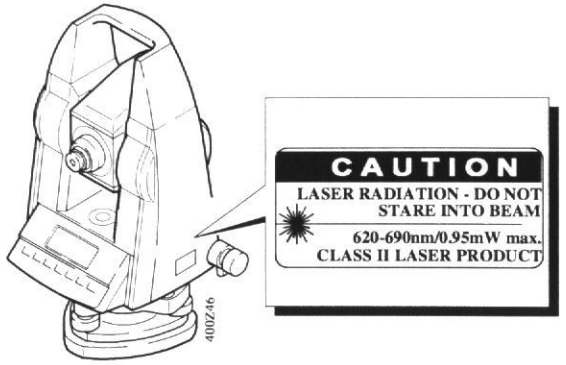
Labelling in accordance with IEC825-1, EN60825-1

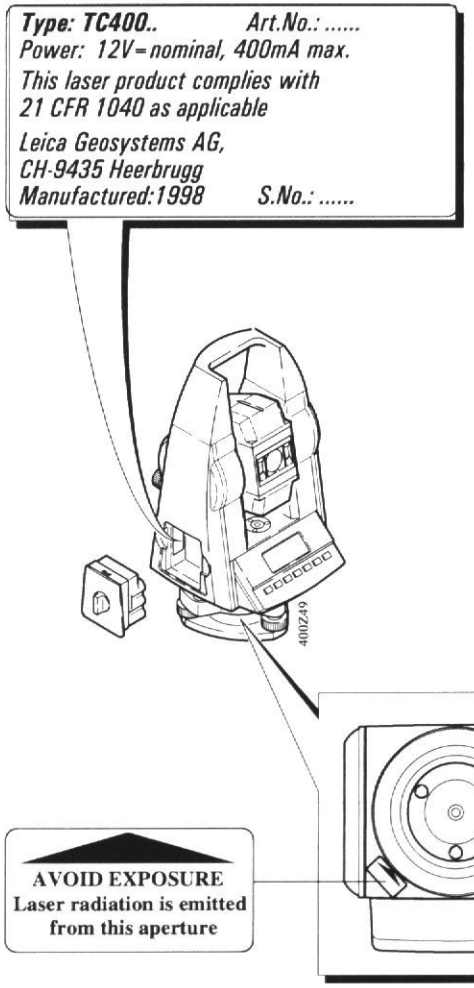




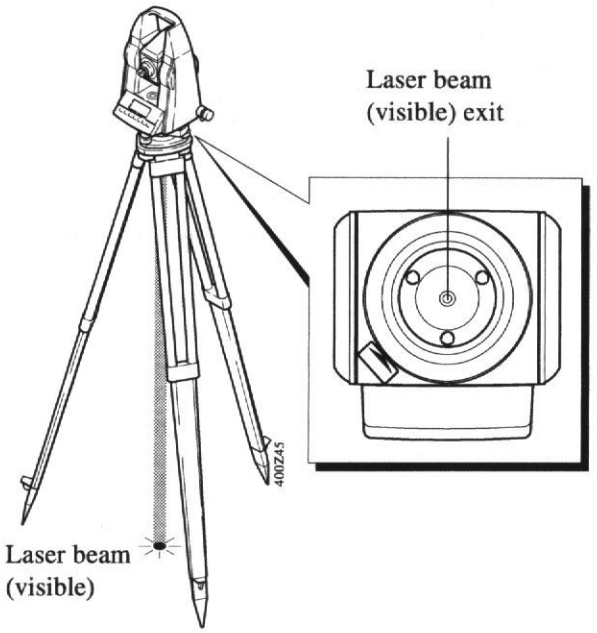


Labelling in accordance with FDA 21CFR





	in accordance with: IEC825-1: 1993 EN60825-1: 1994	in accordance with: FDA 21CFR Ch.I §1040: 1988
Beam divergence:	0.16 x 0.6 mrad	0.16 x 0.6 mrad
Impulse duration:	c.w.	c.w.
Maximum power output:	0.95 mW	0.95 mW
Measurement uncertainty:	± 5%	± 5%



CAUTION:
Allow only authorized Leica service workshops to service the total station.

Electromagnetic acceptability

The term "electromagnetic acceptability" is taken to mean the capability of the instrument 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 total station meets 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 total station is used in conjunction with accessories from other manufacturers (e.g. field computers, personal computers, portable radios, non-standard cables, external batteries etc.).
Precautions:
Use the equipment only with accessories from Leica. When combined with total stations, the strict requirements stipulated by the guidelines and standards are asured. 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 total station meets the strict regulations and standards which are in force in this connection. Leica cannot completely exclude the possibility that the total station may be disturbed by very intense electromagnetic radiation, for instance near radio transmitters, portable radios, diesel generators etc.
Precautions:
Check the plausibility of results obtained under these conditions.

WARNING:
If the 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 total station 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.)

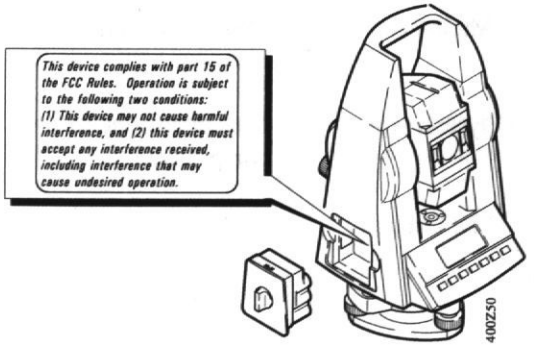
WARNING:
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate 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 the reveiver.
- 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.

Product labeling

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.



Error reports and warnings

	Error report	Cause	Remedy
02	Full	Internal memory is full	Erase internal memory or points
03	Invalid Value	Non-valid value was entered	Enter a valid value
12	Battery Empty	Battery exhausted	Change battery
19	Temperature	The inside of the instrument is too hot or too cold	Cool or warm the instrument
21	Parity Error	Parity error at interface	Inspect cables and interface parameters
22	RS232 Timeout	The system is receiving no response from the interface	Inspect cables, and functionality of external recording device. Inspect baud rate
24	RS232 Overflow	The data are being transmitted too quickly	Repeat using a lower baud rate
44	Value >1 gon	V-index measured, or line-of-sight error, is > 54' (> 1 gon)	Redetermine value, or contact service department
50	Angle Error	Measuring error angle scanning	Contact service department
51	System error	System error in compensator	If fault re-occurs, contact service department
55	EDM Signal	EDM signal faint, absent or distorted	Inspect pointing. Check that distance is not too great
56	EDM System	System error in EDM	If error occurs repeatedly, contact service department
58	TILT	Total station not leveled	Level the instrument or re-adjust the V-index, which adjusts also the electronic level
	Invalid Data	Invalid data for transfer to TC400N/NL	Press CONT key
82	Out of Range	For determination of index- or collimation error, V-angle is more than ±5° (5.5555 gon) off the horizontal plane	Bring target point within tolerance range
9x		System defective	Contact service department

	Warning	Cause	Remedy
09	PtNr Overflow	PtNr outside the upper and lower limits	Enter a new PtNr max. 8 digits
12	Battery Low	The battery is practically flat (Level=0)	Change battery or connect an external battery

Technical data

ANGLE MEASUREMENT	absolute, continuous	
	Updates	0.3 seconds
	Units of measurement (selectable)	400 gon, 360°decimal, 360°sexagesimal,V%
	Angle display (selectable)	5" / 10" / 20"; (1.5 / 3 / 5 mgon)
	Standard deviation	Hz: 10" (3mgon) V: 10" (3mgon)
	Automatic vertical index	Working range: ±5' (±0.018 gon) Accuracy: ±2" (±0.6mgon)
LEVEL	Level sensitivity	Circular level: 4'/2mm Electronic level: 5" (1.5 mgon)
TELESCOPE	Field of view at 1000 m	27m/km
	Height of tilting axis	196 mm
	Magnification	28X
	Objective aperture	28mm
	Shortest focusing distance	2m
OPTICAL PLUMMET	In tribrach, focusable, magnification	2X
LASER PLUMMET	Accuracy	0.8mm / 1.5 m
	Point dia. laser point	2.5 mm bei 1.5 m
DISPLAY	On face I, 4 lines of 16 characters	
KEYBOARD	On face I, 7 function keys Contact pressure: 30g	

DICTANCE MEASUREMENT

Infra-red measuring

frequency	50MHz 3 m,
Carrier wave 0.860 µm	
Standard deviation	3 mm + 3 ppm
Range	1100 m with 1 prism
Time per measurement	about 3 sec.

Number of circular prisms	Atmospheric conditions poor[1]	fair[2]	excellent[3]
1	800 m	1100 m	1300 m
3	1000 m	1600 m	2000 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

DATA MEMORY Internal data storage for about 800 coordinates

WEIGHT about 4.2 kg ($9^1/_4$ lb), excluding battery and tribrach

TEMPERATURE RANGE

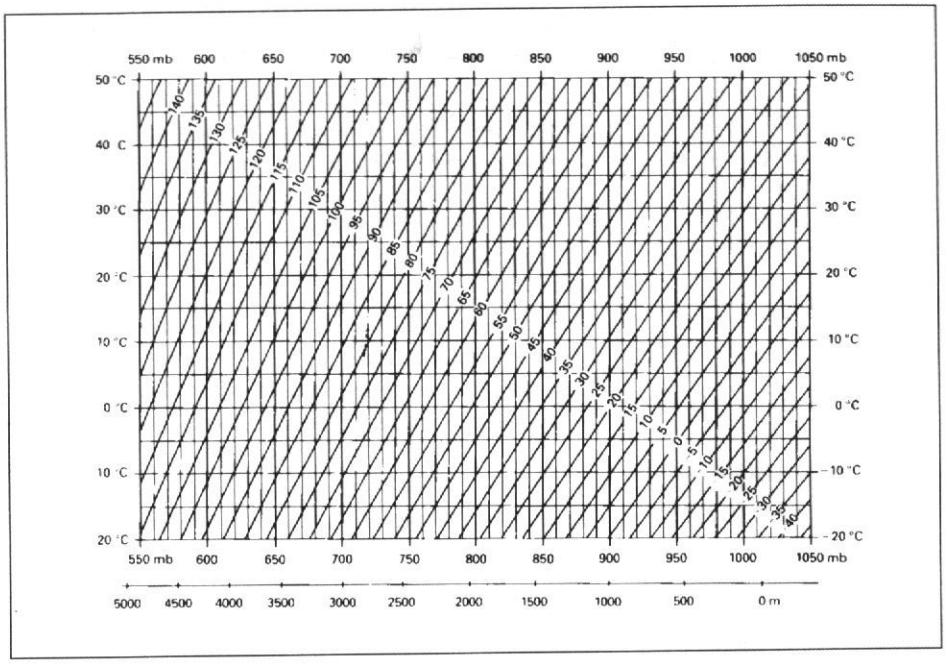
Operation:	-20°C to +50°C (-4° F to 122° F)
Storage:	-40°C to +70°C (-40° F to 158° F)

POWER SUPPLY The voltage must range from 10 to 16 V= (DC) when using external power cables.

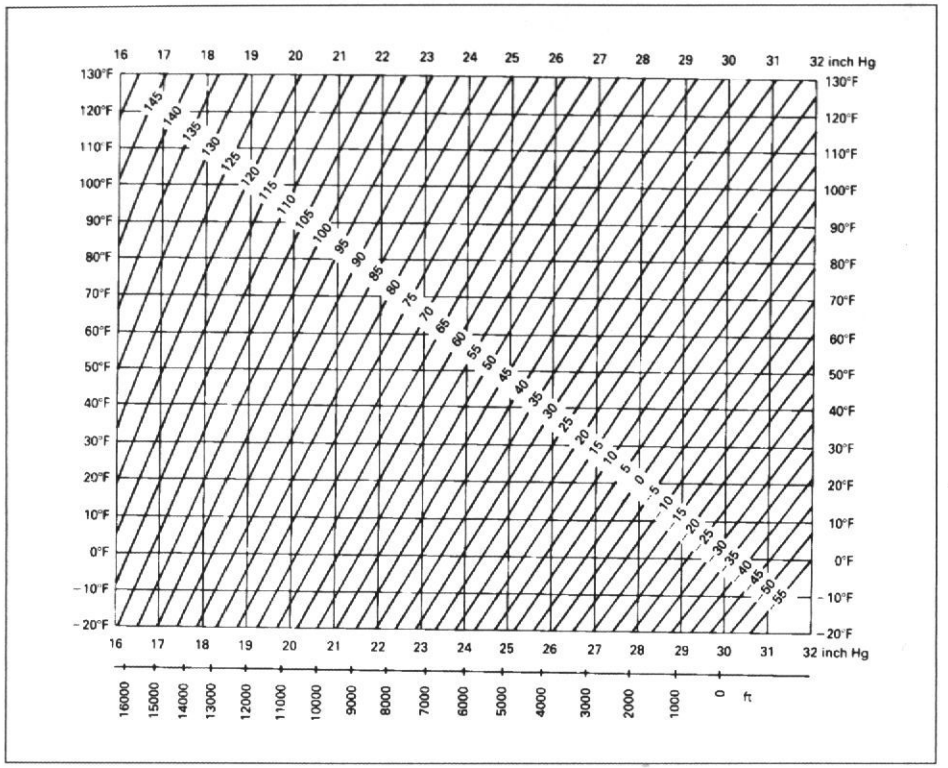
Operating life of batteries	battery module GEB77	compact battery GEB70	universal battery GEB71
Number of measurements	about 400	about 1200	about 4000
	(angle and distance measurements)		
Capacity	0.6 Ah	2.0 Ah	7.0 Ah
Weight	0.2 kg	0.9 kg	3.0 kg

Technical data are not binding and may be changed without notice.

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



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



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Leica Geosystems AG, Heerbrugg, Switzerland, has been certified as being equipped with a quality system which meets the International Standard of Quality Management and Quality Systems (ISO standard 9001)

Leica TQM ISO 9001

Total Quality Management- Our commitment to total customer satisfaction

Ask your local Leica agent for more information about our TQM program