# Leica TPS1100 Professional Series

## User Manual

**Version 2.2**
**English**

Leica
**Geosystems**

# *Electronic total stations*

**Congratulations on your purchase of a TPS1100 Professional Series instrument.**

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

# *Product identification*

The instrument model and the serial number of your product are indicated on the label in the battery compartment.

Enter the model and serial number in your manual and always refer to this information when you need to contact your agency or authorized service workshop.

Type: _____    Serial number: _____

Software version: _____    Language: _____

# *Symbols used in this manual*

The symbols used in this User 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 or moderate injury and / or 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.

# View of chapters

# Contents

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# Contents (continued)

# Contents (continued)

# Introduction

**TPS1100** stands for **T**otal **S**tation **P**ositioning **S**ystem. The TPS1100 instruments are available as various models with differing classes of accuracy. New technologies have enabled the measuring sequence to be largely automated, bringing advantages such as shorter measuring times, simpler operation and more efficient use. Further elements in the basic equipment are described below.

The **R** versions have a laser with a visible red beam. The EDM can be switched between two operational modes: measurements with normal infrared or with the visible red laser respectively. With the red laser, reflectors are not required for measuring distances. With infrared, distances of up to seven kilometres can be measured.

All TPS1100 instruments are routinely supplied with a laser plummet located in the vertical axis. The TPS1100 can therefore be set up quickly and accurately over the ground point with the help of the red laser dot.

The A-versions have an automatic target recognition (**ATR**), which permits rapid, fatigue-free measuring. In ATR mode the fine-pointing is automatic. In LOCK mode an already-targeted point is tracked automatically.
For TPS1100 plus instruments an optional PowerSearch module is available which allows an automatic prism detection within a short period of time.

The **EGL** guide light is an optional accessory for assistance with targeting. It is located within the telescope and it flashes, so that the person carrying the reflector can

place this in the line of sight of the instrument.
The RCS1100 remote control system is an additional option, which allows the remote control of all total stations. The instrument can be controlled either directly on the instrument or at the RCS1100. Especially the A-versions enable the surveyor to work alone.
The measurements can also be triggered, inspected and controlled from the target area.

Leica Geosystems offers **applications programs** for many different tasks in surveying. Just choose the software which best meets your needs.

Within the special **GeoBasic** programming environment, you can create your own application-specific programs for the TPS1100 instruments.

## Validity

## Documentation

The **PC cards** familiar in the computer industry are also used as the medium for storing data in the TPS1100. The data structures are compatible with those in existing Leica Geosystems total stations.

Leica **Survey Office** is a PC-program package which supports the TPS1100 and RCS1100 instruments and which enables data to be exchanged between software and hardware components.

This manual applies to all TPS1100 Professional Series instruments.

Differences between the various models are clearly set out and assigned.

General text applies to all types.

For purposes of pictorial illustration, we have selected a TCA model of the TPS1100 Professional Series with EGL options. The illustrations are valid for all models.

Printed short instructions for the system and for the applications are available as well as the present user manual. The enclosed CD ROM contains the entire documentation in electronic form.

- **User manual:**
  This includes all directions for using the instrument and provides an overview of the system together with important instructions and safety directions.

- **System Field Manual:**
  This describes the functions of the system in standard use (in instrument case).

- **Application Programs Field Manual 1 + 2:**
  This describes the functions of the programs in standard use (in instrument case).

- **Application Programs Reference Manual:**
  All programs are described in detail.

# Description of the system

## Instrument descriptions
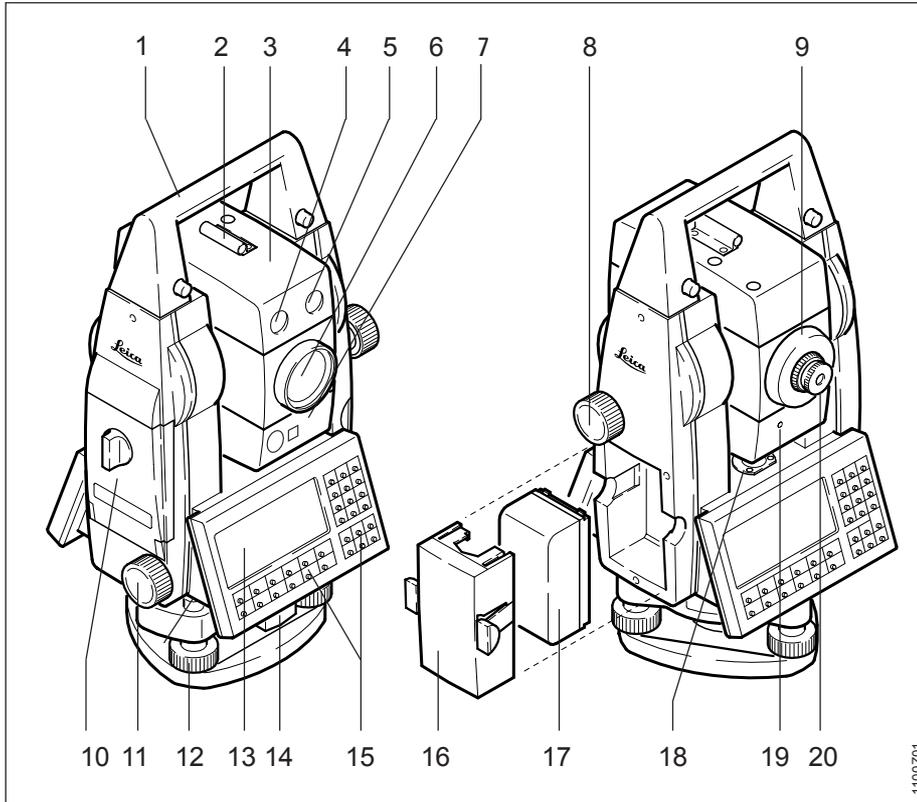


1 Carrying handle
2 Optical sight
3 Telescope with integrated EDM, ATR, EGL and PowerSearch
4 EGL flashing diode (yellow)
5 EGL flashing diode (red)
6 Coaxial optics for angle- and distance measurement;
  Exit port of visible laser beam (only R-model instruments)
7 PowerSearch sensor
8 Vertical drive screw
9 Focusing ring
10 PC-card housing
11 Horizontal drive screw
12 Footscrew (tribrach)
13 Display
14 Tribrach securing knob
15 Keyboard
16 Batteryholder
17 Battery
18 Bull's-eye bubble
19 Laser emission indicator lamp - only XR-instruments (yellow)
20 Interchangeable eyepiece

# *Distance measurement*

A laser distancer (EDM) is incorporated into the instruments of the new TPS1100 series.
In all versions, the distance can be determined by using an invisible infrared beam which emerges coaxially from the telescope objective.

☞ **Very short distances may be measured reflectorless in Infrared-mode (e.g. to well reflecting targets like traffic signs). In this case the distances are corrected with the addition constant defined for the active reflector.**

For applications **without reflector**, the TCR and TCRA version also use a **visible red laser beam** which emerges in the same manner. A special arrangement of the EDM, and appropriate arrangement of the beam paths, enable ranges of over five kilometres to be attained with standard prisms; miniprisms, 360° reflectors, and reflector tapes can also be used, and measurement is also possible without a reflector.

☞ **When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment.**

When measurements are being made using the Reflectorless Red Laser EDM, the results may be influenced by objects passing between the EDM and the intended target surface.
This will occur because reflectorless measurements are made to the first surface returning sufficient energy to allow the measurement to take place. For example, if the intended target surface is the surface of a road, but a vehicle passes between the EDM and the target surface as DIST or ALL is pressed, the measurement may be made to the side of the vehicle. The result will be the distance to the vehicle, not to the road surface.
If you are using the Long Range Red Laser EDM while measuring to a prism, and an object passes within

30 m of the EDM as DIST or ALL is pressed, the distance measurement may be similarly effected.

In practice, because the measuring time is very short, the surveyor can always find a way of avoiding critical situations.



*Wrong result*

1100Z46



*Correct result*

1100Z47

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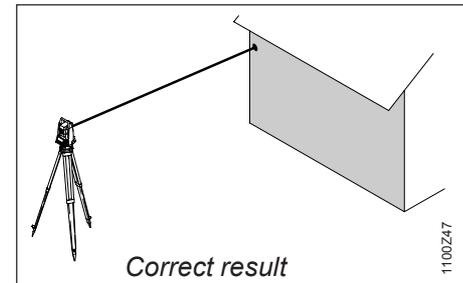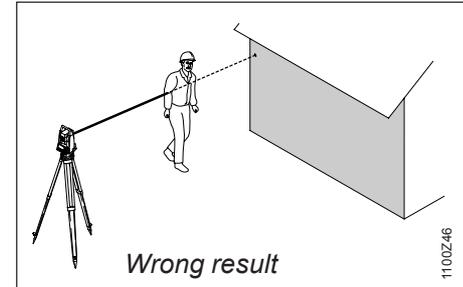
## *Extended Range (Option)*

The optional "Extended Range (XR)"-laser is a visible red laser with in-creased measurement range. The coaxial XR - laser makes it possible to measure distances over 170 m (560 ft) reflectorless and over 10 km (6.2 miles) to one prism (*refer to the chapter "Technical specifications"*).

The operation of an XR - instrument is equivalent to a conventional TPS with red laser. Please consider the following points when measuring with the XR - laser (RL & Long Range).

☞ The objective lens should always be clean. Dirt on the lens (dust, fingerprints, ...) can lead to reduced accuracy.

**Reflectorless**

☞ Be sure that the laser beam is not reflected by anything close to the line of sight (e.g. highly reflective objects).

☞ When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment. In case of temporary obstruction (e.g. a passing vehicle) or heavy rain, fog or snow, the EDM may measure to the obstruction.

☞ When measuring longer distances, any divergence of the red laser beam from the line of sight might lead to less accurate measurements. This is because the laser beam might not be reflected from the point at which the crosshairs are pointing.

Therefore, it is recommended to verify that the XR - laser is well collimated with the telescope line of sight (*refer to the chapter "Checking and adjusting"*). This should be done at regular intervals.

☞ Do not measure with two instruments to the same target simultaneously.

**Long Range to prisms**

⚠ **WARNING:**
Due to laser safety regulations and measuring accuracy, using the Long Range Program is only allowed to prisms that are more than 1000 m (3300 ft) away.

☞ Whenever possible accurate measurements to prisms should be made with the standard program (IR).

**Long Range to reflector tape**

The Long Range Program can also measure to reflector tape. To guarantee the accuracy the laser beam must be perpendicular to the reflector tape and the XR - laser must be well adjusted (*refer to the chapter "Checking and adjusting"*).

## Automatic Target Recognition ATR / LOCK

TCA and TCRA instruments are motorized and equipped with Automatic Target Recognition (ATR) coaxially in the telescope. The guide light (EGL), mounted on the telescope, is optional.

### ATR mode

These instruments permit automatic angle and distance measurements to normal prisms and reduce the tedium of precise visual sighting to prisms. The prism is sighted with the optical sight only. Initiating a distance measurement will turn the instrument with the help of the motors to sight the prism-centre automatically. The angles V and Hz are measured to the centre of the prism completion of the distance measurement.

☞ As with all other instrument errors, the collimation error of the automatic target recognition (ATR) must be redetermined periodically (*Refer to chapter "Checking and Adjusting"*).

### LOCK mode

Lock mode will enable TCA instruments to follow a moving prism. Distances can be measured whenever the prism stops for a short time ("Stop and Go mode").

☞ If the assistant changes the location too quickly, the target may be lost. Make sure that the speed does not exceed the figure given in the technical data.

## Quick Prism Search with PowerSearch

The PowerSearch sensor consists of a transmitter (1) and a receiver (2). Both are installed in the lower part of the telescope.
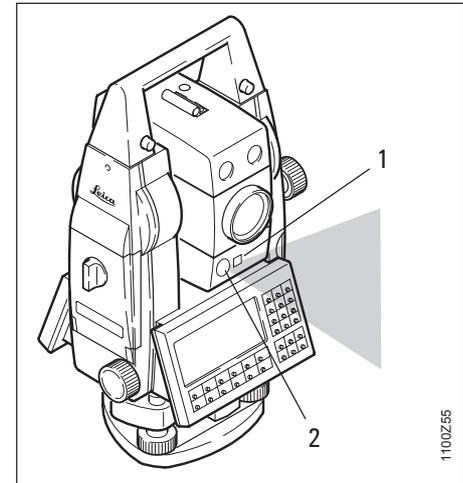


When PowerSearch is activated, the instrument starts to rotate around its standing axis. The transmitter emits a vertical laser swath.

If the laser swath detects a prism, the reflection is detected by the receiver and the rotation of the instrument is stopped. Afterwards a fine aiming in vertical direction is performed by the ATR.

PowerSearch can be started at any time by pressing the PowerSearch function key (PS) in the menu PROG.

If RCS mode is activated, then PowerSearch can be switched on during an ATR prism search.

| Working range: | 5-200 m |
|---|---|
| Swath divergence Hz: | 0.025 gon |
| Swath divergence V: | ±20 gon |

The optionally available Guide Light EGL consists of two coloured flashing lights in the telescope of the total station.
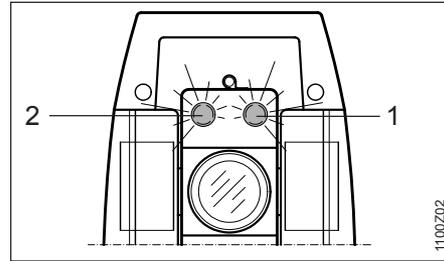


1 Flashing red diode
2 Flashing yellow diode

All TPS1100 instruments can be equipped with this Guide Light. The person at the prism can be guided by the flashing lights directly to the line of sight. It becomes much easier to set out points.
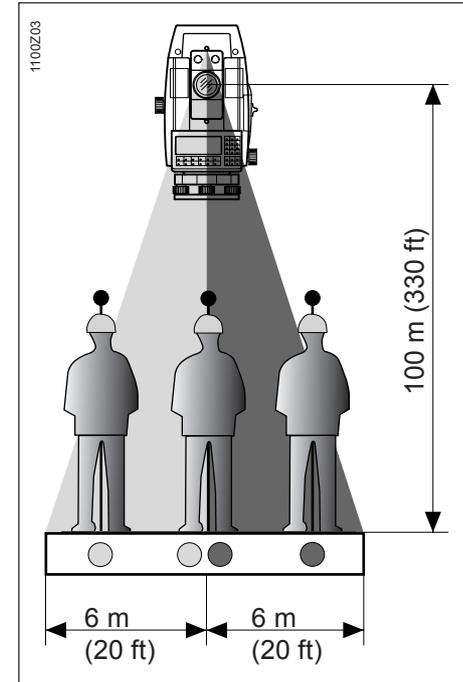
# RCS (Remote Controlled Surveying)

At a target distance of 100 metres (330 ft) a red/yellow flashing cone of light with a width of 6m (20 ft) is formed on each side. As a result, guiding to the line of sight of the instrument is much easier and faster.

Between the two cones of light a sector about 30mm wide is created. Within this sector both colours are flashing simultaneously. In this case the prism is already right in the line of sight.

**Operating range:**
    5 - 150 m (15 -500 ft)
**Divergence**:
    10 m (33ft) at 100m (330 ft)

The RCS option (Remote Controlled Surveying) permits all models to be controlled from the target area. Especially qualified for this purpose are the TCA and TCRA instruments.
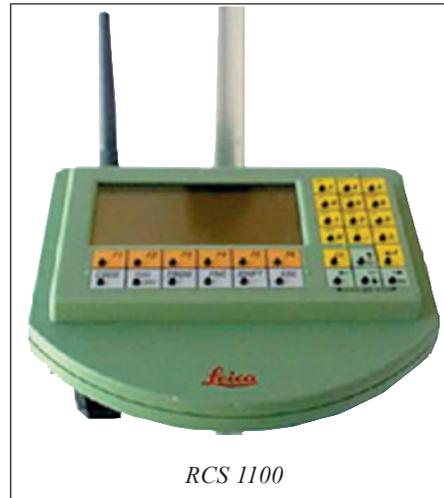
*RCS 1100*

Combined operation, partly at the TPS1100 and partly at the prism, is also possible.
As a result, surveys can be performed solo. It is also possible to monitor the operation on the RCS 1100 and / or to enter the coding on the RCS 1100.

All functions of the TPS1100, including the applications programs, are available on the RCS 1100. The display and the use of the keys are as for the TPS1100.

☞ For further information, refer to the RCS1100 user manual.

# System concept

All of TPS 1100 models use the same software architecture and the same concept for data storage and data flow.

**Software architecture**

The software of the TPS1100 can be divided into two groups:
• The **system software**, which covers the basic functions
• The **applications software**, which supports survey- specific applications and procedures.

The system software forms a coherent unit, whereas the applications software can be compiled in accordance with the individual requirements of the user. Using the Leica **Survey Office** software provided, both the system software and the applications software can be loaded across the serial interface by the user, who is in a position to install improved software versions.
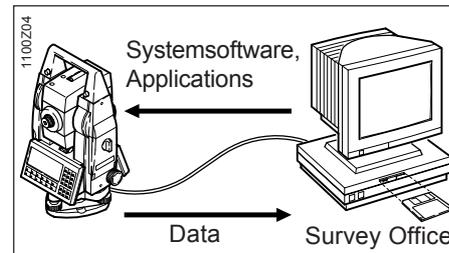


The software permits up to three languages to remain stored simultaneously and one of them to be selected. The range of language versions available is constantly being expanded. If you need a particular language version, please ask your agency about its availability.

**Storage concept and data flow**
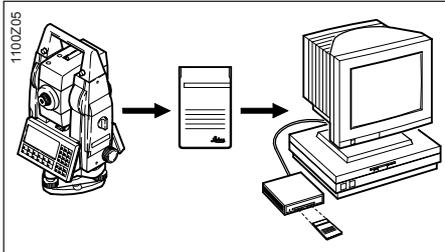


Survey data is generally stored on a SRAM or ATA flash card corresponding to PCMCIA standards (referred to here as a PC card). The data are stored in MS-DOS file format. Data is exchanged with a PC through either a PCMCIA drive on that PC, or an OMNI drive (optional), or the serial interface (cable link between instrument and PC).
The Leica Survey Office software supplied with the instrument includes a program for transferring data across the serial interface.

Instead of using the PC card, the data can be output in GSI format at the serial data interface.

☞ When data is transferred across the serial interface for storage in an external PC, no data from the applications is output in the report file. Fixed-point coordinates can be read only from the PC card.

**GeoBasic**

The GeoBasic development environment permits the professional development of additional applications for the TPS1100.

# Leica Survey Office PC software package

The Leica Survey Office software includes a series of help programs which support you in your work with the TPS1100 total station.

**Installing in the PC**
The installation program for Leica Survey Office is located on the TPS1100 CD-ROM supplied with the present handbook. Please note that Survey Office can only be installed on the following operating systems: MS Windows 95/98/Me and MS Windows NT4.0/2000/XP.

To install the program, first call up the program "**setup.exe**" from the directory **\SurveyOffice\ English\Disk1\** on the CD-ROM, and carry out the instructions given. For further information, refer to the handbook or to the on-line help provided by your operating system.

**Range of programs**

After the installation is complete, the following programs are available:
• **Data Exchange Manager:** Exchange of data between the instrument and the PC.
• **Codelists Manager:** Creates code lists.
• **Software Upload:** Loading and deleting systems software, applications programs, systems texts and applications texts.
• **Coordinate Editor:** Editing of coordinates.

Optionally, additional programs can be installed.

☞ For additional information about Leica Survey Office, please refer to the comprehensive on-line help.

# Batteries and chargers



GEB111

GEB121

1100Z06



Vehicle battery cable

Charger GKL122

Power cable

Charging cable
Adapter plate GDI121

1100Z07



Charger GKL23

Adapter plate GDI121

1100Z08
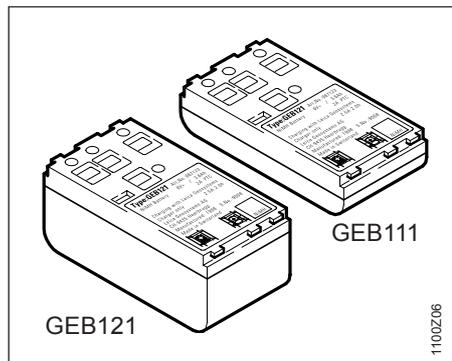
Your Leica Geosystems instrument is powered by rechargeable battery modules. The Pro battery (GEB121) is recommended for the TPS1100 Professional Series. The basic battery (GEB111) is an optional alternative.

☞ Use only the Leica Geosystems batteries, chargers and accessories, or accessories recommended by Leica Geosystems.
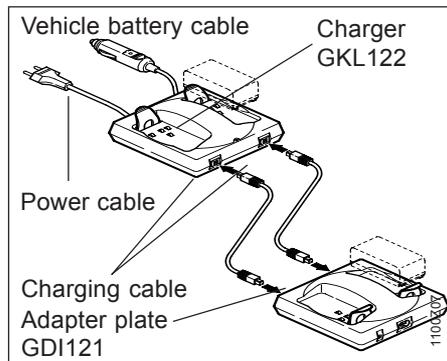
The Professional charger (GKL122) will charge up to four batteries, either from a 230V or 115V power source using a power plug or from the 12V or 24V source provided by the cigarette lighter in a vehicle. At any one time, either two Pro / Basic batteries can be charged or, by using the adapter plate (GDI121), four Pro / Basic batteries.
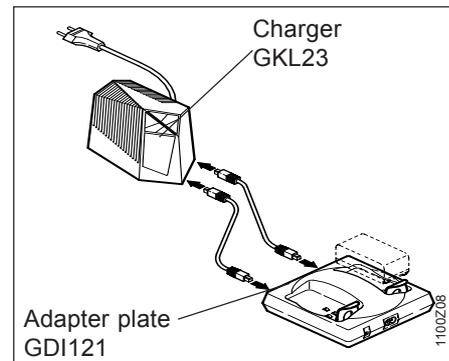
The adapter plate GDI121 can be connected to the Pro charger (GKL122) or to the GKL23 charger, and enables two Pro / Basic batteries to be charged simultaneously.

# *Preparation, setting up*

## *Unpacking*

Take the instrument out of the transport container and check that it is complete:
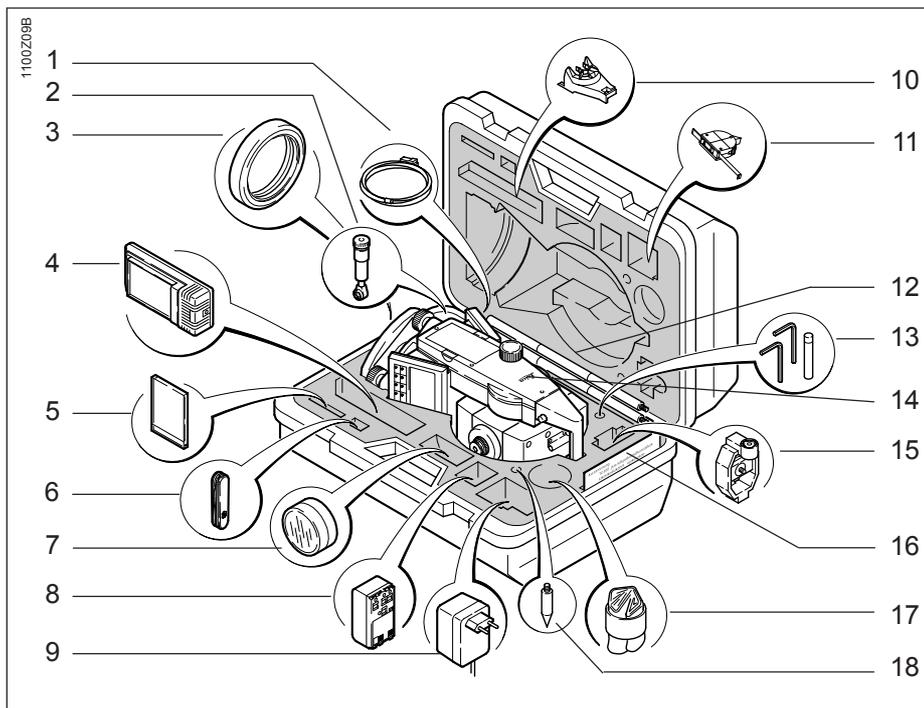


1 PC cable (optional)
2 Eyepiece for steep sights / Zenith eyepiece (optional)
3 Counterweight for eyepiece for steep sights (optional)
4 Charger GKL111 (optional)
5 PC card (optional)
6 Pocket knife (optional)
7 Auxiliary lens (optional)
8 Spare battery (optional)
9 Power plug for GKL111 (optional)
10 Spacing bracket (optional)
11 Height meter (optional)
12 Mini prism rod (optional)
13 Tool set, comprising 2 adjusting pins, 1 Allen key each for adjusting bull's-eye bubble and EDM.
14 Instrument
15 Mini prism + holder (optional)
16 Short instructions/ target plate (only for reflectorless measuring instruments)
17 Protective cover, sunshade
18 Tip for mini prism (optional)

# *Charging the battery*



Charger GKL111



Charger GKL122

Adapter plate GDI121

☞ To attain full battery capacitance, it is essential to subject new GEB111 / GEB121 batteries to between three and five complete charge/discharge cycles.
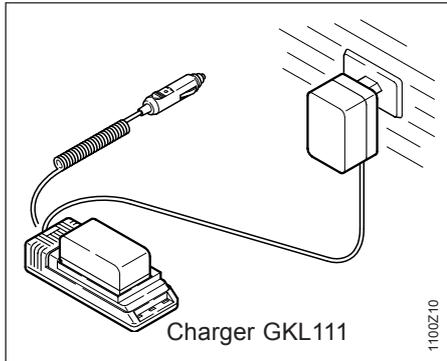
The battery chargers GKL111 or GKL122 are used to charge the batteries. Please refer to the corresponding battery charger user manual for more information.
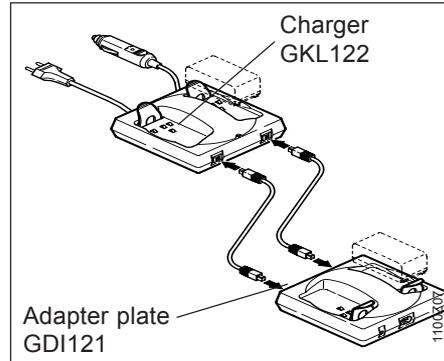
⚠ **WARNING:**
The battery chargers are intended for indoor use only. Use the battery charger in a dry room only, never outdoors. Charge batteries in an ambient temperature between 0°C and 35°C ( 32°F to 95°F ). We recommend a temperature of 0°C to +20°C (32°F to 68°F) for storing the batteries.

# Inserting / replacing battery
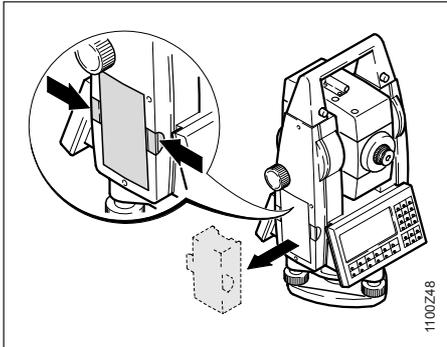


1. Remove battery holder.



2. Remove battery and replace.



3. Insert battery into battery holder.
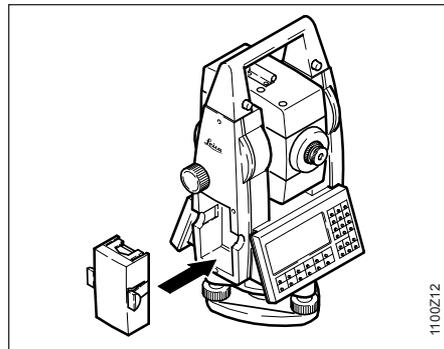


4. Insert battery holder into instrument.

☞ Insert battery correctly (note pole markings on the inside of the battery cover). Check and insert battery holder true to side into the housing.

# *External power supply for total station*

To meet the conditions stipulated for electromagnetic acceptability when powering the TPS1100 from an external source, the supply cable used must be equipped with a ferrite core.

☞ The Lemo plug with the ferrite core always has to be attached at the instrument side.


1100Z57
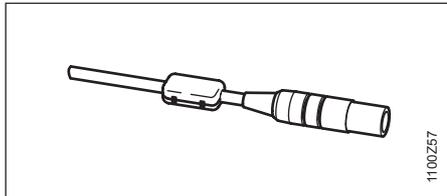
The cables supplied along with your instrument include a ferrite core as standard.
If you are using older cables without ferrite core, it's necessary to attach ferrite cores to the cable.
If you need additional ferrite cores, please contact your local Leica Geosystems agency. The spare-part number of the ferrite core is 703 707.


1100Z58
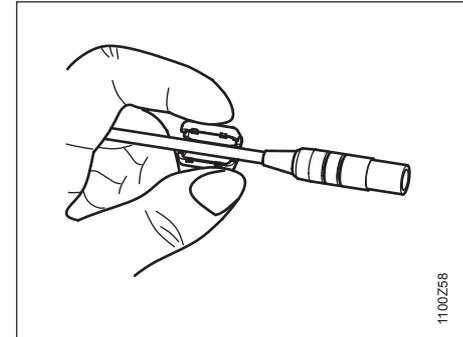
For assembling open up one ferrite core and clip it around the supply cable, about 2cm away from the Lemo plug, before using the supply cable for the first time together with a TPS1100 instrument.

## *Insert PC-card*
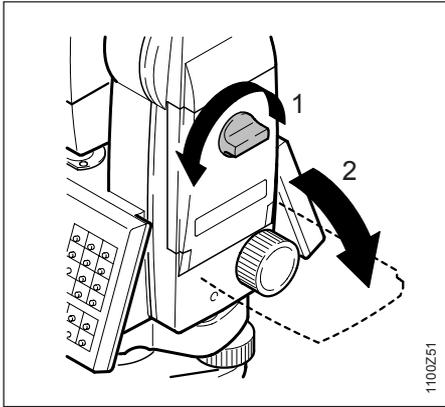
1. Open PC-card housing.
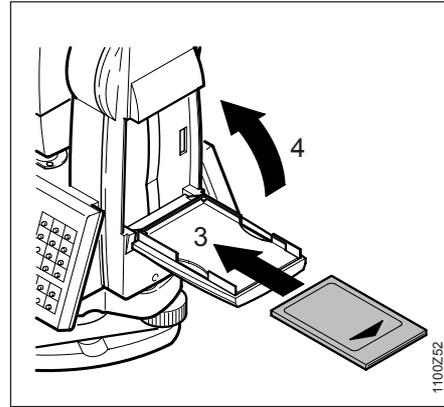
2. Insert PC-card with TPS- arrow symbol facing up.
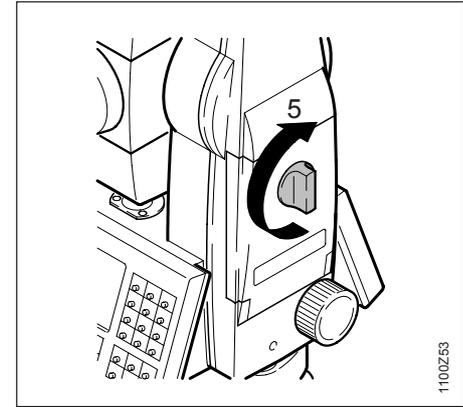
3. Closing PC-card housing.

☞ **When closing the PC-card housing the connector must face upwards!!**

# Setting up the instrument with optical plummet or laser plummet



5/8"-thread

Tribrach GDF121 or GDF122

Tripod GST120
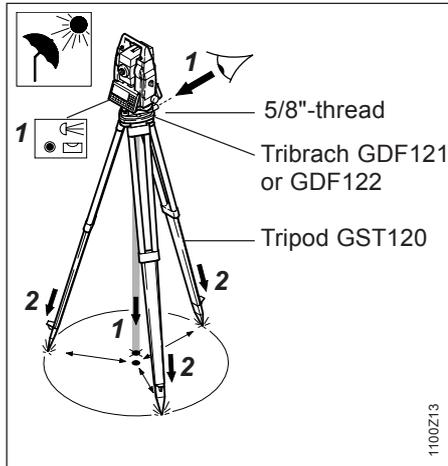




1. Target the ground point or activate the laser plummet.
2. Set up the GST20, centring it as well as possible.

The laser plummet is built into the vertical axis of the TPS1100 instruments. Projecting a red dot on to the ground makes it appreciably easier to centre the instrument.
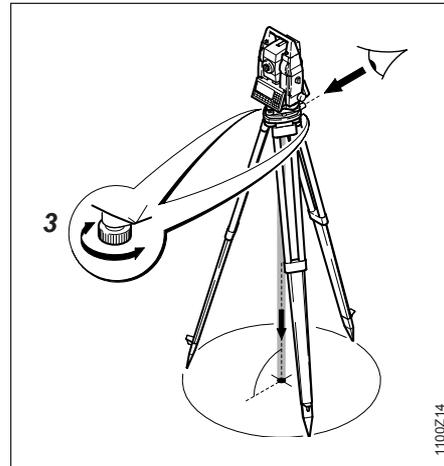
3. Using the footscrews of the tribrach, centre the plummet to the ground point.

4. Move the legs of the tripod to centre the bull's-eye bubble.

☞ The laser plummet cannot be used in conjunction with a tribrach which already has an optical plummet.
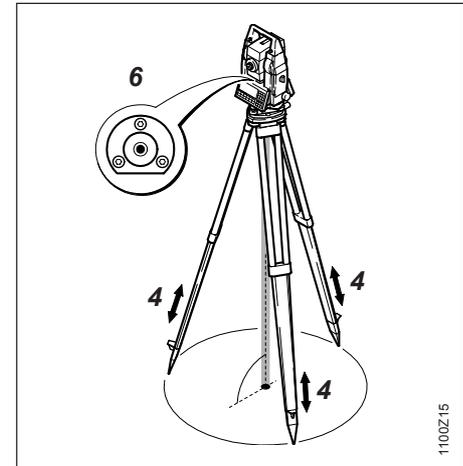
5. Level-up precisely, using the electronic bubble (*see the chapter "Levelling-up with the electronic bubble"*).

6. Centre precisely by shifting the tribrach on the tripod plate.

Repeat steps 5 and 6 until the required accuracy is reached.

# Levelling-up with the electronic bubble

SHIFT ☐ Graphical and numerical display of the longitudinal and transverse tilt of the instrument's vertical axis.

The current settings of the laser plummet are indicated numerically as a percentage.

```
┌─────────────────────────────────┐
│   Elect. Level          ▱   MC   │
│                                  │
│ Tilt L  : -0°03'40"              │
│ Tilt T  : -0°18'30"              │
│                                  │
│ L.Plumet: 50%▼   X               │
│                                  │
│ CONT            L.Pl+            │
└─────────────────────────────────┘
  SHIFT
  ●
     F1    F2    F3    F4    F5    F6
```
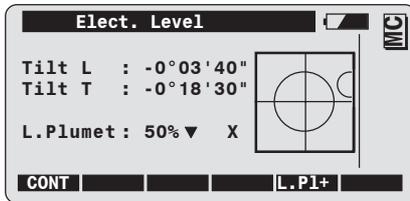
F5  Switches the laser plummet on or off.

← →ON  Varies the intensity of the laser dot.

Using the footscrews, the instrument can be levelled-up without having to turn it through 90° (100 gon) or 180° (200 gon).

In the display which is closest to the bull's-eye bubble, the movement of the small circle runs parallel to the movement of the bubble in the alidade. The other display shows the movement in the opposite direction.

When the bubble is centred, the TPS1100 has been perfectly levelled up.

```
┌─────────────────────────────────┐
│   Elect. Level          ▱   MC   │
│                                  │
│ Tilt L  : -0°00'10"              │
│ Tilt T  : -0°00'20"              │
│                                  │
│ L.Plumet: 50%▼   X               │
│                                  │
│ CONT            L.Pl+            │
└─────────────────────────────────┘
  SHIFT                      QUIT
  ●
     F1    F2    F3    F4    F5    F6
```

# Checking and adjusting
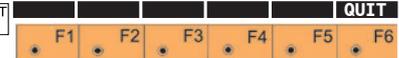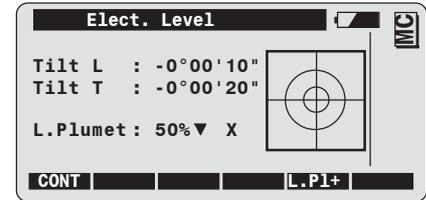
## Electronically

All instruments basically have inherent mechanical defects which can affect the measurement of angles. The electronic angle-measuring system of the TPS1100 routinely corrects the mechanical instrument errors listed below; the vertical angles relate to the plumb line and the horizontal measurements are corrected for line-of-sight error, for tilting-axis error and for vertical-axis tilt:

• l, t    Compensator index error
• i       Vertical-index error
• c      Line-of-sight error
• a      Tilting-axis error
• ATR   ATR zero-point error (only for TCA and TCRA versions)

The instrument errors listed on the left can change over time and with temperature.

They should, therefore, be redetermined in the order shown below:
• before the first use
• before each precision survey
• after long periods of transport
• after long periods of work
• if the temperature alters by more than 20°C

Before determining the instrument errors, level-up the instrument using the electronic bubble. The instrument should be secure and firm, and should be protected from direct sunlight in order to avoid thermal warming on one side only.

☞ Take note that the procedure for determining the relevant instrument error has to be followed precisely and carefully.

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

☞ Immediately after the first measurement has been completed, motorized instruments change automatically to the second face, after which the user merely needs to carry out the fine pointing.

## *Electronic checking and adjusting, continued*

Activating the "Instrument calibration" function.

```
Main\  Instr. calibration  ▭▯    MC
                        current
l Compens.long.:     0°00'37"
t Compens.trans:    -0°00'34"
i V-index error:     0°00'28"
c Hz-coll.error:     0°00'20"
a Tilting-axis :     0°00'26"
 l,t │  i  │ c/a │i/c/a│ATR +│ EXIT
SHIFT    LOGF+                  QUIT
  F1     F2    F3    F4    F5    F6
```
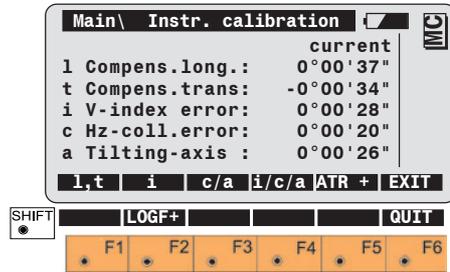
**F1** Determines the compensator index error.
Simultaneous adjustment of the electronic bubble.

**F2** Determines the index error for the vertical circle (V-index error).

**F3** Defines line-of-sight errors and, if required, tilting-axis errors.

**F4** Joint determination of the V-index errors, line-of-sight errors and, if required, tilting-axis errors.

**F5** Determines the collimation error of the ATR (TCA and TCRA versions only).

**SHIFT F2** Enables the calibration Log-file (*see next page*).

The instrument errors reported are displayed in the sense of an error. When measurements are being corrected, they are used in the sense of corrections and have the opposite sign to the error.

**Calibration Log-File**

If the Log-File is enabled [LOGF+], the measurements and results of the calibration are stored in an ASCII-file. This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

☞ New data is always appended to the calibration Log-file.

```
TPS1100 - Instrument Calibration
Instrument      : TCRA1102plusSerial 619216


Compensator Index Error l,t
Date/Time     :     03/04/2000     15:43

Old values    :   l=    0.0000g          t=        0.0000g
Measurements
                    L=   -0.0126g        T=        0.0298g
                    L=    0.0368g        T=        0.0164g

New values    :   l=    0.0010g          t=        0.0023g


Vertical Index Error i
Date/Time     :     03/04/2000     15:45

Old value     :   i=     0.0000g
Measurements
                    Hz= 377.0597 g       V=       104.2828 g
                    Hz= 177.0562 g       V=       295.7176 g

New value     :   i=    0.0001g
```

*Example of a Calibration Log-file (here compensator and vertical index errors)*

Vertical axis
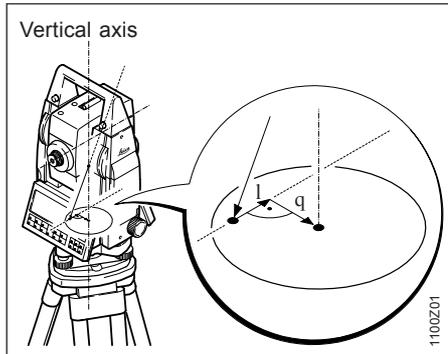
The determination of the index error for the longitudinal and transverse axes of the compensator ( l, t ) corresponds to the determination of the centre of the bubble used in the level.

The instrument should be set up away from warmth coming from one side some time before the calibration so that it can adjust to the ambient temperature.The index error for the longitudinal and transverse axes is determined at the factory and adjusted to zero before delivery.

F1  Activate the calibration procedure. (*Refer to display on page 30)*

The longitudinal and transverse axes (l, t) are displayed afterwards in the following dialog.

```
Main\ Compens.Index Error
1st tilt measurement in any
face

L Compens.:      0°00'25"
T Compens.:      0°00'04"

MEAS
```
SHIFT                          QUIT
F1  F2  F3  F4  F5  F6
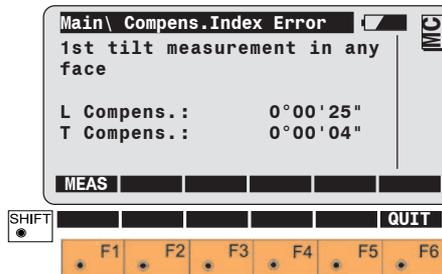
F1  Initiate the measurement of the longitudinal and transverse tilt ( l, t ).

If the tilt cannot be measured, e.g. due to an unstable instrument, the error message **ERROR: 557** is displayed and the following keys are defined:

F5  Repeat measurement.

F6  Abort measurement.

Non-motorized instruments perform the second measurement after the alidade of the instrument has been turned 180° (200 gon), with an accuracy of ±4° 30' (±5 gon).
After the initial measurement has been started by pressing the key F1, motorized instruments will automatically complete the determination of l and t without any other assistance.
The following dialog is displayed after completing the first tilt measurement with non-motorized instruments.

After the first measurement of tilt, the menu for non-motorized instruments is the following:

```
┌─────────────────────────────────┐ ▭ MC
│  Telescope Positioning    ▭▭     │
│ Hz- and V-positioning:           │
│ set direction(s) to zero.        │
│                                  │
│ Δ Hz      :      180°00'00"      │
│ Δ V       :        ------         │
│                                  │
│              OK      ABORT       │
└─────────────────────────────────┘
```
SHIFT

F1  F2  F3  F4  F5  F6
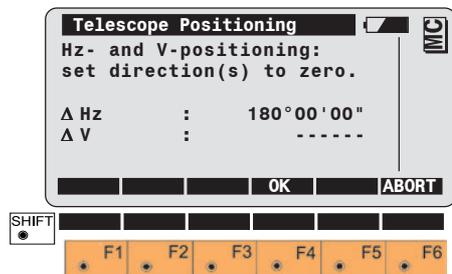
Turn the instrument through 180° (200 gon) so that ΔHz = 0° 00' 00" (0.0000 gon).

```
┌─────────────────────────────────┐ ▭ MC
│  Telescope Positioning    ▭▭     │
│ Hz- and V-positioning:           │
│ set direction(s) to zero.    II  │
│                                  │
│ Δ Hz      :        0°00'00"      │
│ Δ V       :        ------         │
│                                  │
│              OK      ABORT       │
└─────────────────────────────────┘
```
SHIFT                        QUIT

F1  F2  F3  F4  F5  F6
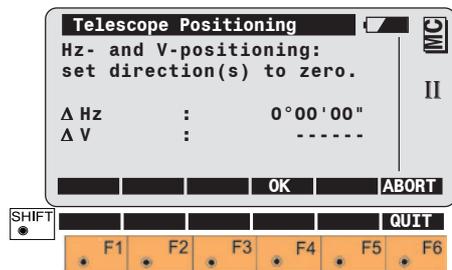
If the differences between the horizontal and vertical angles lie within ±4° 30' (±5 gon), the display can be quitted with ⊙F4 .

The user is made aware by an acoustic signal that the ⊙F4 -key is redefined as "OK".

⊙F4  Activates the second tilt measurement.

⊙F6  Terminates the determination of the compensator indexes.

The following dialog shows the two newly-determined values for the longitudinal and transverse compensator-index errors.

```
┌─────────────────────────────────┐ ▭ MC
│ Main\ Compens.Index Error  ▭▭    │
│                        new       │
│ l Comp:            0°03'02"      │
│ t Comp:           -0°02'06"      │
│                                  │
│ Accept new value(s)?             │
│               YES  RETRY   NO    │
└─────────────────────────────────┘
```
SHIFT                        QUIT
⊙

F1  F2  F3  F4  F5  F6
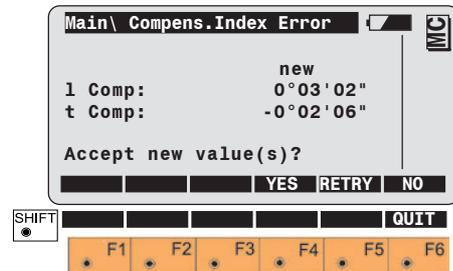
⊙F4  Stores the new values.

⊙F5  Repeats the complete calibration procedure.

⊙F6  Leaves the previous values unchanged.

☞  If the values for the index errors **(l, t)** exceed 5' 24" (0.1 gon), the complete calibration procedure repeat, but first check that the instrument is correctly levelled and is free of vibration. If these values are exceeded repeatedly, please notify service.

```
Main\     V-Index Error          MC
Aim accurately at a target
positioned at a dist. >100m

Hz        :      343°18'54"
V         :       93°47'41"

MEAS
SHIFT                           QUIT
     F1    F2    F3    F4    F5    F6
```
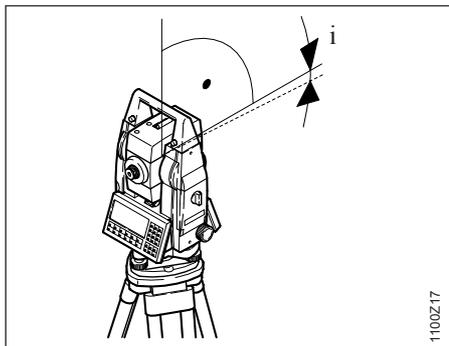
The V-index error is the zero-point error of the vertical encoding circle in relation to the  vertical axis of the instrument.
The V-index error is set to "0.00" before delivery.
All vertical angles are corrected with the V-index error.

The instrument should have adapted to the ambient temperature and should be protected against warming from one side.
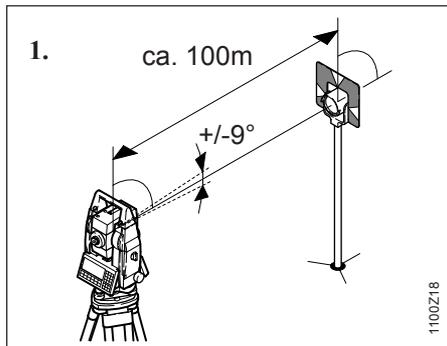
To determine the V-index error, aim the telescope at a target about 100m distant. The target must be positioned within ±9° (±10 gon) of the horizontal plane.

**F2** Activate the calibration procedure (*Refer to display on page 30*). The two-axis compensator is turned off automatically when determining the V-index error.

This fact is shown by the symbol.
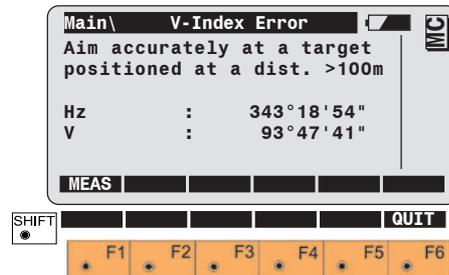
**F1** Starts the measurement for the vertical circle.
Afterwards, the display shows a message asking for the telescope to be turned to the other face.

If the differences between the horizontal and vertical angles do not exceed ±27' ( ±0.5 gon ), the display shows that the instrument is ready to measure. The user is made aware by an acoustic signal that the F4 key is redefined as 'OK'.

```
Main\      V-Index Error          MC
Aim accurately at the same
target in other face

Hz       :      163°18'54"
V        :      266°12'19"

 MEAS
SHIFT                              QUIT
      F1   F2   F3   F4   F5   F6
```

Sight the target accurately again.

F1    Starts the second measurement.

After the measurements are complete, the older and newly-determined V-index errors are displayed.

```
Main\      V-Index Error          MC

              old       new
i Vind:   0°00'03"  -0°00'22"

Accept new value(s)?

                    YES  RETRY  NO
SHIFT                              QUIT
      F1   F2   F3   F4   F5   F6
```
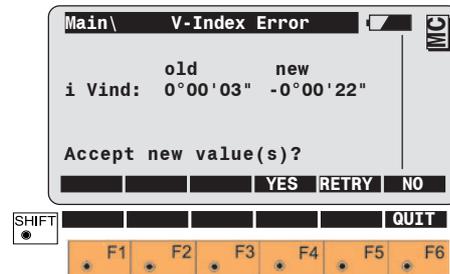
F4    Stores the new values.

F5    Repeats the complete V-index error determination procedure.

F6    Leaves the old values unchanged.

```
     Telescope Positioning        MC
Hz- and V-positioning:
Set direction(s) to zero.

Δ Hz      :       0°00'00"
Δ V       :       0°00'00"

                 OK       ABORT
SHIFT                              QUIT
      F1   F2   F3   F4   F5   F6
```

F4    Confirms the readiness to measure and changes the display.

☞    If the value of the V-index error (**i**) exceeds 54' (1 gon) you should repeat the measurement procedure. If this value is exceeded repeatedly, please contact service.

The line-of-sight error **c** is the divergence of the line of sight from a line perpendicular to the tilting axis. The line-of-sight error is adjusted and reduced to "0.00" before delivery from the factory.
Horizontal angles are only corrected by this line of sight error when the correction is turned "**ON**" (setting in accordance with *section "Deactivating the instrument-error correction"*).
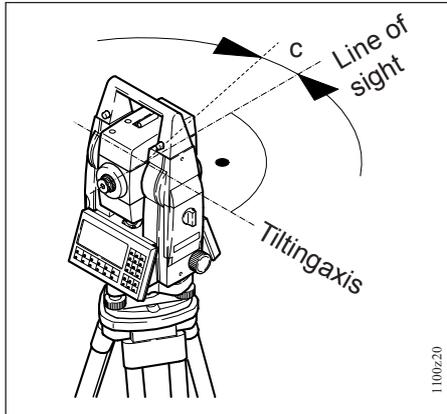


To determine the line-of-sight error, aim the telescope at a target about 100m distant. The target must lie within ±9° (±10 gon) of the horizontal plane.
The procedure is analogous to that of determining the V-index error.

F3  Activates the calibration procedure. (*Refer to display on page 30*).

The two-axis compensator is turned off automatically when determining the line-of-sight error.

This fact is shown by the 🔷 symbol.
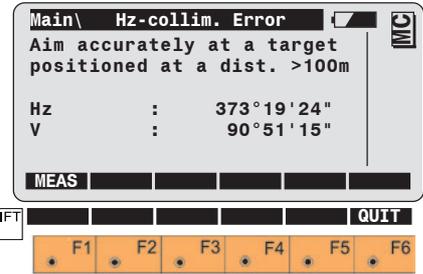


F1  Perform the measurement.

Afterwards, a message in the display prompts you to change telescope face.

If the differences between the horizontal and vertical angles do not exceed ±27' ( ±0.5 gon ), the display shows that the instrument is ready to measure. The user is made aware by an acoustic signal that the F4 key is redefined as "OK".

```
 Telescope Positioning        [===]  MC
 Hz- and V-positioning:
 set direction(s) to zero.
                                     ◇
 Δ Hz     :        0°00'00"
 Δ V      :        0°00'00"


                          OK    ABORT
```
SHIFT ◉                               QUIT
F1    F2    F3    F4    F5    F6
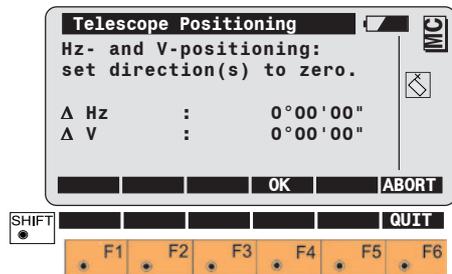
**F4** Confirms readiness for measurement and goes to the measuring menu.

```
 Main\    Hz-collim. Error    [===]  MC
 Aim accurately at the same
 target in other face
                                     ◇
 Hz       :      193°19'24"
 V        :      269°08'45"

 MEAS
```
SHIFT ◉                               QUIT
F1    F2    F3    F4    F5    F6

Sight the target accurately.

**F1** Perform the second measurement.

After successful completion of the second measurement, the older and the newly-determined line-of-sight errors are displayed.

```
 Main\   Hz-Collim. Error    [===]  MC
             old        new
 c Hz-c:  -0°00'03"  0°00'08"


 Accept new value(s)?
                     YES  RETRY  NO
```
SHIFT ◉                               QUIT
F1    F2    F3    F4    F5    F6
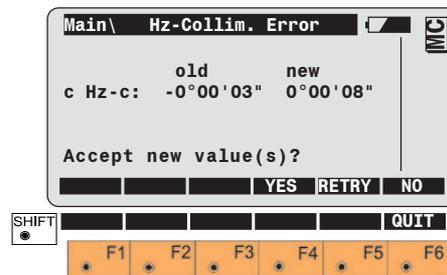
**F4** Stores the new values.

**F5** Repeats the complete line-of-sight error determination procedure.

**F6** Leaves the old values unchanged.

☞ If the value of the line-of-sight error ($c$) exceeds 5' 24" (0.1 gon), the collimation error is to be redetermined. If the limit is repeatedly exceeded, please notify service.

When the new line-of-sight error has been confirmed, the tilting-axis error can be determined.

```
 Main\   Hz-Collim. Error    [===]  MC

 Continue to determine the
 tilting-axis errror?


                     YES        NO
```
SHIFT ◉
F1    F2    F3    F4    F5    F6
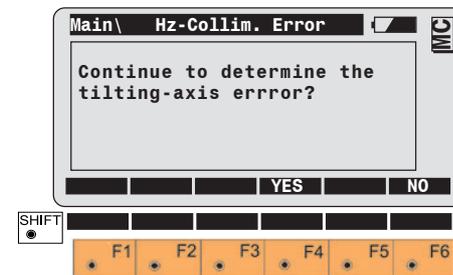
**F4** Confirms that the tilting-axis error should also be determined.

**F6** Ends the function and returns to the calibration dialog.

The tilting-axis error a is the deviation of the tilting axis from a line perpendicular to the vertical axis. The tilting-axis error is adjusted to "0.00" before delivery.
The horizontal angles are only corrected by the tilting axis error when the Hz-correction is turned "**ON**" (setting in accordance with *section "Deactivating the instrument-error correction"*).
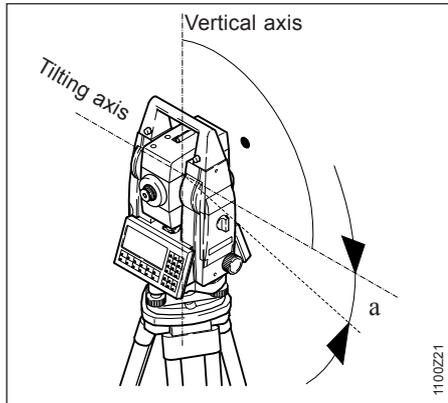


To determine the tilting-axis error, aim the telescope at a target about 100m distant. The target must be positioned at least ±27° (±30 gon) above or beneath the horizontal plane. The two-axis compensator is turned off automatically during determination of the tilting-axis error.

This fact is shown by the symbol.

```
Main\   Tilting-Axis Error
Aim accur. at high/low target
positioned at a dist. > 100m

Hz        :      373°19'24"
V         :       90°51'15"

MEAS                          QUIT
SHIFT
     F1    F2   F3   F4   F5   F6
```
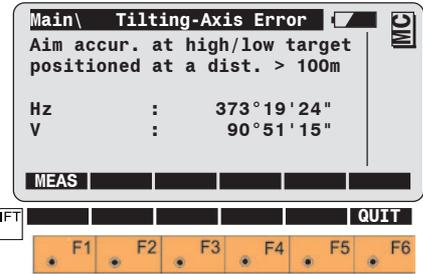
**F1** Start measurement. Afterwards, a message in the display prompts the user to change telescope face.

If the differences between the horizontal and vertical angles do not exceed ±27' (±0.5 gon), the display shows that it is ready to measure. The user is made aware by an acoustic signal that the **F4** key is redefined as "**OK**".



Vertical axis

Tilting axis

a

1100Z21

```
Telescope Positioning        [ / ]  MC
Hz- and V-positioning:
set direction(s) to zero.

ΔHz      :       0°00'00"
ΔV       :       0°00'00"

                      OK        ABORT
SHIFT                           QUIT
```

```
Main\   Tilting-Axis Error   [ / ]  MC
Aim accurately at the same
target in other face
                                  ◇
Hz       :       193°19'24"
V        :       269°08'45"

MEAS                          QUIT
SHIFT                         QUIT
```

```
Main\   Tilting-Axis Error   [ / ]  MC
              old       new
a Tilt:  -0°00'03"  0°00'17"

Accept new value(s)?
                    YES  RETRY  NO
SHIFT                         QUIT
```
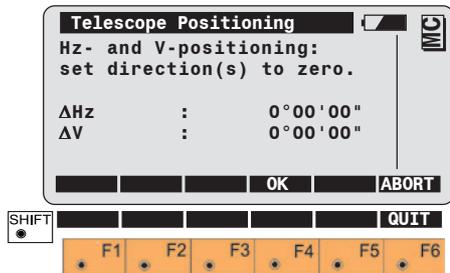
**F4** Confirms readiness to measure and the display changes as follows.
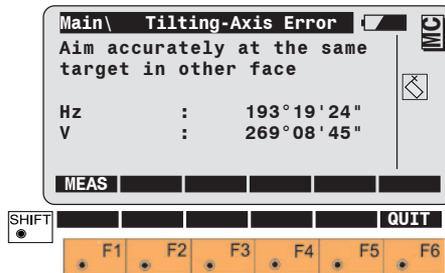
Sight the target accurately.

**F1** Performs the second measurement of the horizontal angle.

After the second measurement has been completed, the old and newly-determined tilting-axis errors (a) are displayed.
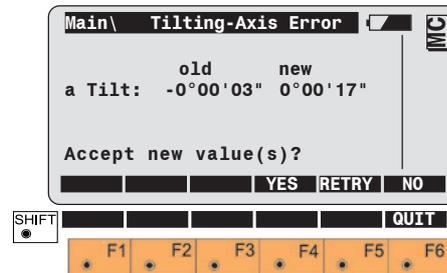
**F4** Stores the new values.

**F5** Repeats the complete tilting-axis error determination procedure.

**F6** Leaves the old values unchanged.

☞ If the value of the tilting axis error (**a**) exceeds 5' 24" (0.1 gon), the measurements are to be repeated. If this happens often, please notify service.

By using the key $\boxed{\bullet\ \text{F4}}$ in the *display on page 30*, it is possible to determine the errors for vertical index, line of sight and tilting axis (**i**/**c**/**k**) with a single operation.

The V-index and line-of-sight errors can be determined using a common target which does not lie more than ± 9° (± 10 gon) away from the horizontal plane. The determination of the tilting-axis error requires a target which lies at least ± 27° (± 30 gon) above or beneath the horizontal plane.

**For exact procedural details, please refer to the previous chapters.**

Also the mechanical instrument-error correction can be deactivated if the need is to display and record only raw data. To deactivate, set the compensator correction and the horizontal-circle correction to OFF, i.e. the vertical angles relate to the vertical axis and the horizontal corrections are not taken into account.

```
Main\      Compensator      ▭  MC
Compensator ON/OFF
Hz corrections ON/OFF


compensat.:              ON ▼
Hz-corr.  :              ON ▼

[      ][      ][      ][      ][      ][      ]

SHIFT [    ][      ][      ][      ][      ][QUIT]
  •
    F1    F2    F3    F4    F5    F6
    •     •     •     •     •     •
```
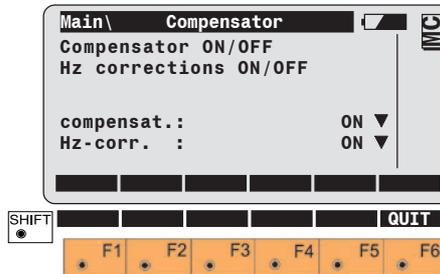
**(Available for TCA and TCRA versions only)**
The ATR collimation error is the combined horizontal and vertical angular divergence of the line of sight from the axis of the CCD camera. The collimation procedure includes, optionally, the determination of the line-of-sight error and the vertical-index error.
The correction for the ATR collimation errors is always applied regardless of the "ON/OFF" status of the Hz-correction setting. (*See section "Deactivating the instrument-error correction"*).
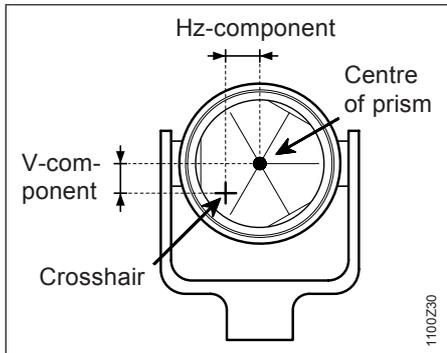


To define the ATR collimation error, a prism must be accurately targeted at a distance of about 100 m. The target must lie within ±9° (±10 gon) of the horizontal plane. The procedure is analogous to that of determining the V-index error.

F5    Activates the calibration procedure (*Refer to display on page 30*). The ATR target recognition is automatically switched on. This fact is shown by the symbol. The display shows the current horizontal and vertical ATR collimation errors.
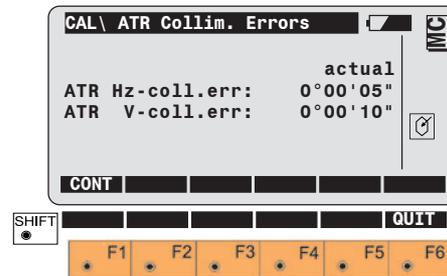


F1    Starts the calibration.

The two-axis compensator is turned off automatically when determining the ATR collimation error.
This fact is shown by the symbol.
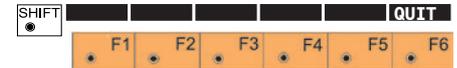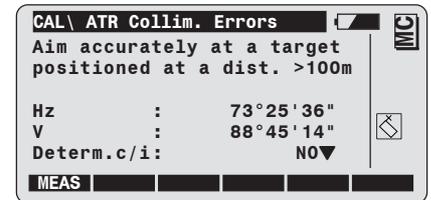


Sight the prism accurately with the crosshair.

F1    Starts the measuring procedure.

⌖ / ⌖ Toggles between simple and combined error determination.

YES = Simultaneous determination of ATR-collimation error, line-of-sight error and vertical-index error

NO = Only determination of ATR-collimation

☞ It is advisable to determine the ATR-collimation error, the line-of-sight error and the vertical-index error at the same time.
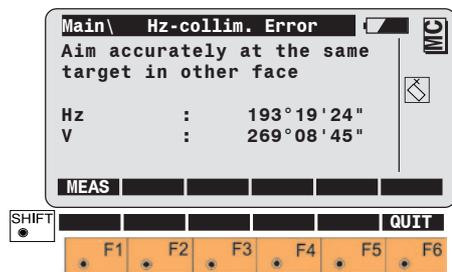
**Changes face automatically directly after completing the initial measurement.**

```
CAL\ ATR Collim. Errors    ▭    MC
Aim accurately at the same
target in other face.

Hz      :       253°25'36"
V       :       271°14'46"

 MEAS
SHIFT                             QUIT
   F1    F2    F3    F4    F5    F6
```
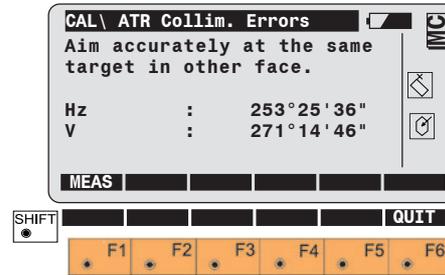
Sight the prism accurately with the crosshair.

F1 Performs the second-face measurement of the collimation errors.

If the differences between the horizontal and vertical angles exceed ±27' ( ±0.5 gon ), the display gives an error message. The user is made aware of this by an acoustic signal and the F4 key is redefined as "OK".
The measurement procedure can be repeated.

When the second measurement has been taken, the accuracy of ATR and, if previously selected, the accuracy of the index and the line-of-sight errors are displayed.

```
CAL\   ATR Accuracy           [   ]  MC
No. of Meas:              2
σATR Hz    :      0°00'05"
σATR V     :     -0°00'08"
σ i V-Ind. :         -----
σ c Hz-col :         -----
Take more measurements?
[ CONT ][    ][    ][ MORE ][    ][ ABORT ]
```

SHIFT ◉

F1  F2  F3  F4  F5  F6
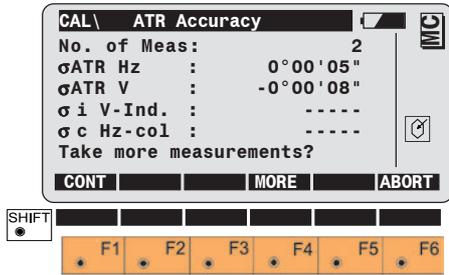
**F1** No further repeat measurements are required. The old and the newly-defined ATR-collimation errors become optional, and are displayed together with the line-of-sight errors (c) and the V-index errors (i).

**F4** The calibration can be repeated as often as necessary until the required level of accuracy is obtained. The result is the mean of all the measurements taken. It is recommended that at least two measuring sequences be carried out.

**F6** The calibration process is interrupted. The old values will be left intact.

```
CAL\ATR Collim. Errors        [   ]  MC
               old       new
ATR Hz    : 0°00'08"  0°00'05"
ATR V     : 0°00'10"  0°00'09"
i V-ind   : 0°00'00"  0°00'10"
c Hz-c    : 0°00'10"  0°00'02"
Accept new value(s)?
[    ][    ][    ][ YES ][ RETRY ][ NO ]
```

SHIFT ◉

F1  F2  F3  F4  F5  F6
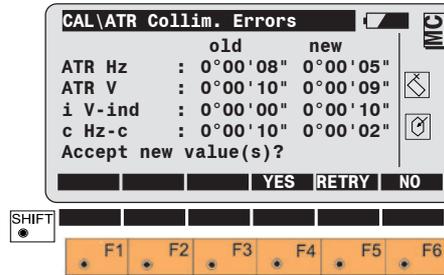
**F4** Stores the new values.

**F5** Repeats the ATR1 error determination procedure.

**F6** Leaves the old values unchanged.

☞ If the value of the ATR horizontal and vertical collimation errors exceeds 2' 42" (0.05 gon), repeat the measurement procedure.
Similarly, if the value of the V-index error (i) exceeds 54' (1 gon) or if the value of the line-of-sight error (c) exceeds 5' 24" (0.1 gon) , the measurements are to be repeated.
If these values are often exceeded, please contact service.

# Mechanically

### Tripod
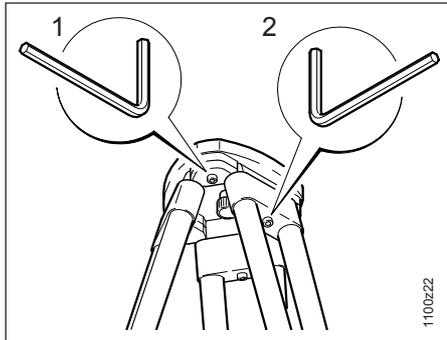


The connections between timber and metal must always be firm and tight.

• Moderately tighten the Allen screws (2).
• Tighten articulated joints (1) just enough to keep the tripod legs open when you lift the tripod off the ground.

### Bull's eye bubble on instrument
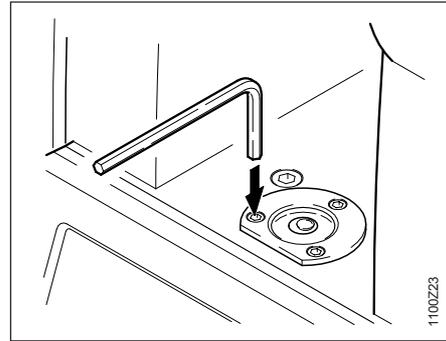


Level-up the instrument in advance with the electronic bubble. The bubble must be centred. If it extends beyond the circle, use the adjusting pin supplied to centre it with the adjustment screws.

After adjustment no screw shall be loose.

### Bull's eye bubble on the tribrach
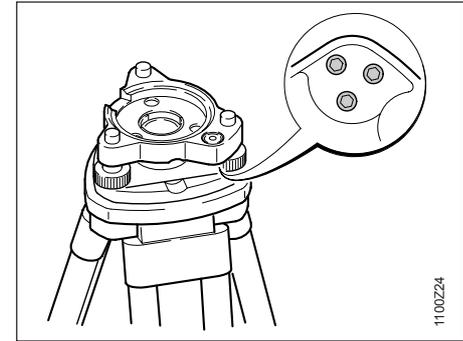


Level the instrument and then remove it from the tribrach. If the bubble is not centred, adjust it using the adjusting pin in conjunction with the two cross-headed adjustment screws (GDF121 bzw. GDF122). Turning the adjustment screws:
• to the left: the bubble approaches the screw
• to the right: the bubble goes in the other direction.
After adjustment no screw shall be loose.

**Checking by plumb-bob:**
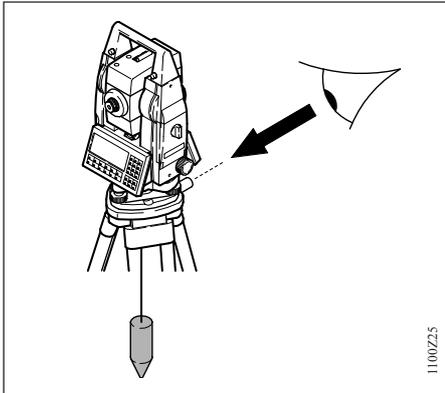


Set-up and level the instrument on the tripod. Check the centring sleeve for eccentricity by hanging it in place in various positions, then mark the ground point. Remove the plumb-bob. Check that the crosshairs of the optical plummet intersect at the ground point. The accuracy achievable is about 1mm.

**Checking by turning the tribrach**
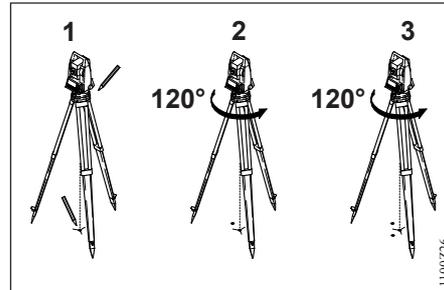


1. Level-up the instrument using the electronic bubble. Mark the ground point. Using a soft, well-sharpened pencil, mark the outline of the tribrach on the tripod plate.
2. Turn the tribrach 120 ° and level-up the instrument, fit it into the outline, and again mark the ground point.
3. Repeat again in the third position.

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

**Adjustment**
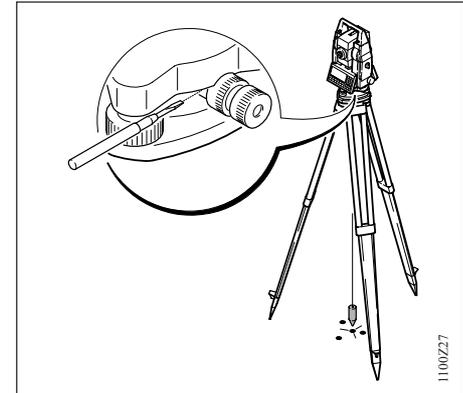


Use a screwdriver to turn the two set screws alternately by the same small amount in order to centre the crosshairs on the ground point marked.

☞ Inspect the optical plummet of the tribrach regularly, because any deviation of its line of sight from the vertical axis will result in a centring error.

The laser plummet is located in the vertical axis of the instrument.

Under normal conditions of use the laser plummet does not need adjusting. If an adjustment is necessary due to external influences the instrument has to be returned to any Leica Geosystems service department.

**Inspecting by turning the plummet 360°:**
1. Place the instrument on the tripod and level it up.
2. Switch on the laser plummet and mark the centre of the red dot.
3. Slowly turn the instrument through 360°, carefully observing the movement of the red laser dot.

Inspection of the laser plummet should be carried out on a bright, smooth and horizontal surface (e.g. a sheet of paper).



Laser dot:
Diam. 2.5 mm / 1.5 m

≤ 3 mm / 1.5 m
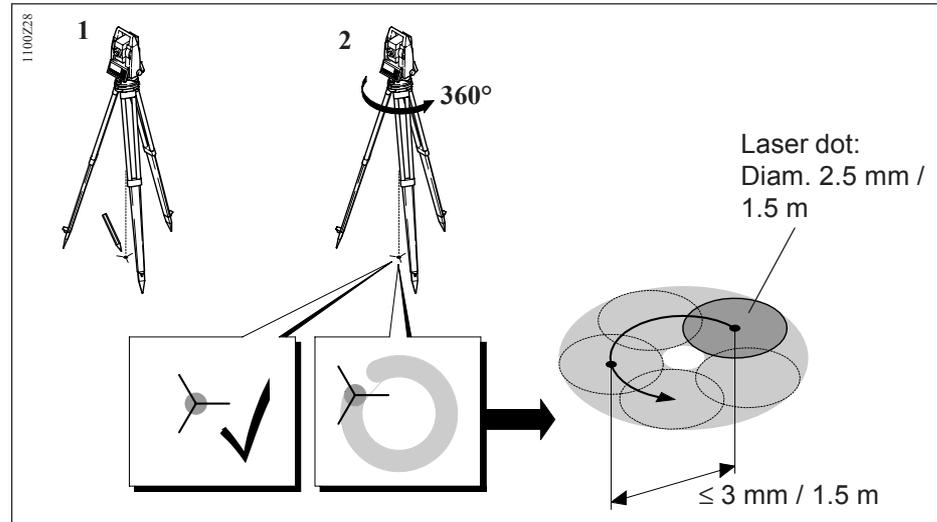
If the centre of the laser dot describes a perceptible circular movement or moves more than 3 mm away from the point which was first marked, an adjustment may be required. Inform your nearest Leica Geosystems service workshop.

Depending on brightness and surface, the diameter of the laser dot can vary. At a distance of 1.5 m it will be about 2.5mm.
The maximum diameter of the circular movement described by the centre of the laser point should not exceed 3 mm at a distance of 1.5m.

The red laser beam used for measuring without reflector is arranged coaxially with the line of sight of the telescope, and emerges from the objective port. If the instrument is well adjusted, the red measuring beam will coincide with the visual line of sight. External influences such as shock or large temperature fluctuations can displace the red measuring beam relative to the line of sight.

☞ The direction of the beam should be inspected before precise measurement of distances is attempted, because an excessive deviation of the laser beam from the line of sight can result in imprecise distance measurements.

**Inspection**

A target plate is provided. Set it up between five and 20 metres away with the grey reflective side facing the instrument. Move the telescope to face II. Switch on the red laser beam by activating the laser-point function. Use the telescope crosshair to align the instrument with the centre of the target plate, and then inspect the position of the red laser dot on the target plate. Generally speaking the red dot cannot be seen through the telescope, so look at the target plate from just above the telescope or from just to the side of it.
If the dot illuminates the cross, the achievable adjustment precision has been reached; if it lies outside the limits of the cross, the direction of the beam needs to be adjusted.

If the dot on the more reflective side of the plate is too bright (dazzling), use the white side instead to carry out the inspection.
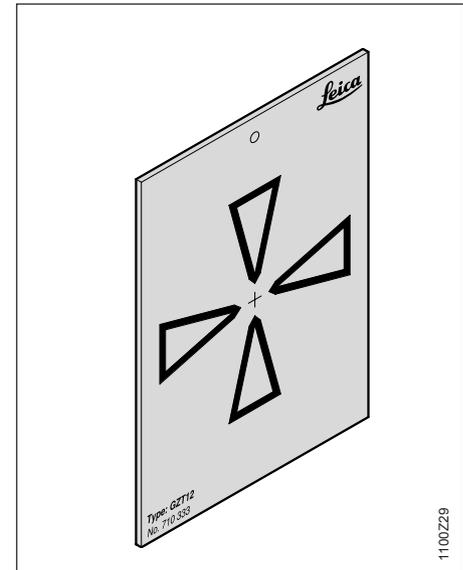
**Adjusting the direction of the beam**

Pull the two plugs out from the adjustment ports on the top side of the telescope housing.
To correct the height of the beam, insert the screwdriver into the rear adjustment port and turn it clockwise (dot on target plate moves obliquely upwards) or anticlockwise (dot moves obliquely downwards).
To correct the beam laterally, insert the screwdriver into the front adjustment port and turn it clockwise (dot moves to the right) or anticlockwise (dot moves to the left).
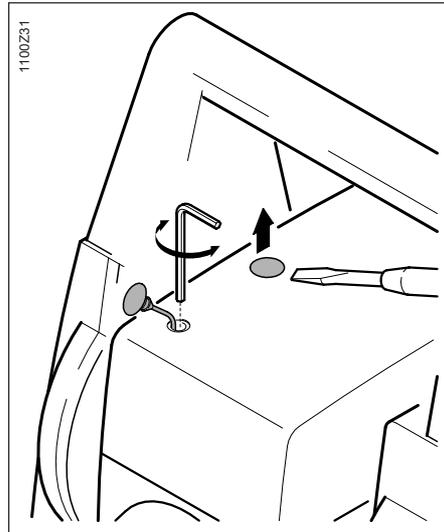


☞ Throughout the adjustment procedure, keep the telescope pointing to the target plate.

☞ After each adjustment, replace the plugs in the ports to keep out damp and dirt.

## Data configuration
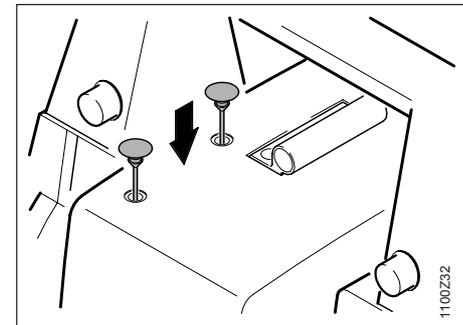
This section describes the system functions of the TPS1100 instruments.
The presentation of the dialogs, and the sequence and names of the individual functions, are in accordance with the basic TPS1100 configuration.

### Data job (D JOB) and meas. job (M JOB)

A distinction is made between:
• Input data, which are generally fixed-point coordinates, and
• Output data, which are generally measurements, coordinates, or values derived from "new points."

It is useful to store the input data and the output data in two separate files, although they can be stored together in one file.

Up to 60 files can be managed. The names of the files can be chosen freely, but the extension must always be GSI (e.g. "PROJ2563.GSI").

In the directory \LOG, additional data from most of the loadable applications can be stored in a protocol file.

The data can be output in GSI format to the serial interface instead of on to the PC card.

☞ If the data is stored on the serial interface, no data from the applications will be output to the protocol file. Fixed-point coordinates can be read only from the PC card.

The following dialog (e.g. measurement file) can be basically used to create, edit and delete files.

```
 \Selection  (          )  [    ] MC
Meas Job
DEFAULT.GSI          PC-Card
RS232                RS232



 CONT | NEW | EDIT |      | DEL | αNUM
SHIFT |  | <<-- | -->> |  |  |  | QUIT
 F1    F2    F3    F4    F5    F6
```
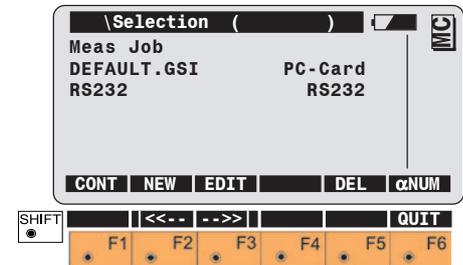
F1   Selects the file required.

F2   Creates new measurement file (see dialog opposite).

F3   Displays and edits files.

F5   Deletes file.

SHIFT  F2   Jumps to the first file in the list. This key is not assigned if the file displayed is already at the beginning of the list.

SHIFT  F3   Jumps to the last file in the list. This key is not assigned if the file displayed is already at the end of the list.

```
\   Create new job
Device        :    PC-Card
REC format    :        GSI
Job name      :   12345678


CONT
```
SHIFT

F1 | F2 | F3 | F4 | F5 | F6
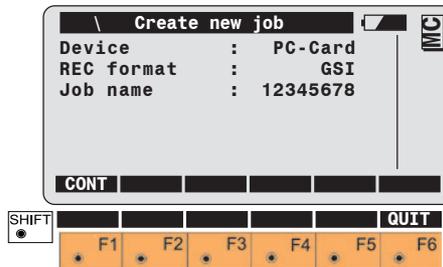
F1   Creates a new file having the file name which was entered.

This function enables to create a standard codelist. Existing standard codelists, point codelists and mixed codelists can be edited, deleted and copied. For the instrument to recognize the codelist and to access it, the codelist must be saved under the name *.CRF in the "CODE" directory.

The assignations of the keys, and the subsequent course of the program, are the same as in the dialog "Meas. job", with the exception of the additional function on F4 (COPY).

## Creating a new codelist (NEW)

Only so-called "standard codelists" can be created on the instrument.

```
\        New Codelist        [   ]  MC

Name of the new codelist
Name          :  12345678

Device        :  Internal  ▼

CONT
SHIFT                              QUIT
     F1    F2    F3    F4    F5    F6
```
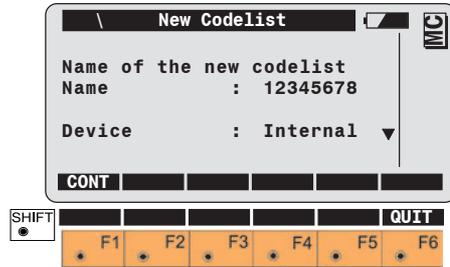
**F1**  Creates a codelist with the file name entered.

## Copying a codelist (COPY)

This function enables a codelist to be copied from one data carrier to another.

```
\        Copy codelist       [   ]  MC

Codelist      :  12345678

From          :    PC-Card
To            :  Internal

CONT
SHIFT                              QUIT
     F1    F2    F3    F4    F5    F6
```
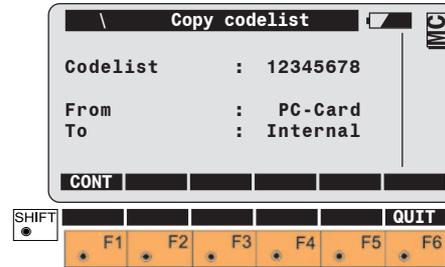
Display of the selected codelist, the "source data carrier" and the "target data carrier".

**F1**  Copies the codelist.

## Data management

The following three general dialogs are also then reused in the descriptions of the functions "OPEN", "VIEW", "SEARC" and "INPUT".

**Selecting and searching for file / point**

```
\ File & Pt.Selection  [   ]  MC
Rec.device :        PC-Card
Mem. size  :        511.5 KB
Free       :        193,0 KB
PtId/Code  :          100
File       :FILE01.GSI  A:
File size  :          4.0 KB
SEARCH        INPUT        VIEW
SHIFT                              QUIT
     F1    F2    F3    F4    F5    F6
```
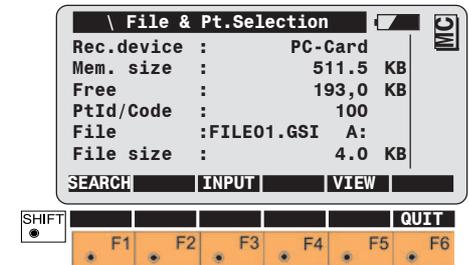
Selecting the file name and entering the search criterion and the complete point number or code number.

**F1**  Starts a search in the current file.

**F3**  Enters the coordinates.

**F5**  Displays the data found.

## Display of point data found

```
  \   Data View and Edit   ▭▭       ⎕MC⎕
  ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮      1/20
  Point ID      :        1
  East          :    0.000   m
  North         :    0.000   m
  Elev.         :    0.000   m

  CONT NEW S  <--   -->  <<REP REP>>
```

```
SHIFT           INS-C  <<-  ->>   DEL   QUIT
  •     F1    F2    F3    F4    F5    F6
        •     •     •     •     •     •
```
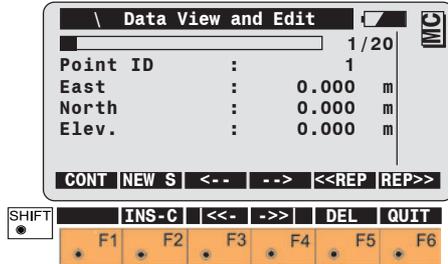
In the first line, the bar provides a graphical representation of the position of the point within the complete file. There follows the running number, and then the total number of data sets within the file.

**F1** Transfers the displayed values to the appropriate function or application.

**F2** Starts a search for new points. Jumps to the display "File & Pt. Selection".

**F3** Displays the points in a sequence going towards the beginning of the file.

**F4** Displays the points in a sequence going towards the end of the file.

**F5** Repeats the search for the point number, going towards the beginning of the file, in order to find points stored more than once with the same point number or with wild cards (placeholders).

**F6** Repeats the search for the point number, going towards the beginning of the file, in order to find points stored more than once with the same point number or with wild cards (placeholders).

**SHIFT F2** Inserts a codeblock (Code, Info1…8) in the active file before the displayed measurements.

**SHIFT F3** Jumps to the first block in the file. This key is not assigned if the first data set is already displayed.

**SHIFT F4** Jumps to the last block in the file. This key is not assigned if the last data set is already displayed.

**SHIFT F5** Deletes the displayed data.

**Number of GSI data found**

```
\  Data View and Edit        ▣    MC
                      ■      17/20
Point Id      :        17
Hz            :286°12'36"
V             :275°45'12"
Slope Dist    :  123.236m
ppm tot/mm    : +0051+000
CONT NEW S  <--   -->  <<REP REP>>
```

```
SHIFT                <<-  ->>   DEL  QUIT
  ●    F1   F2   F3   F4   F5   F6
```
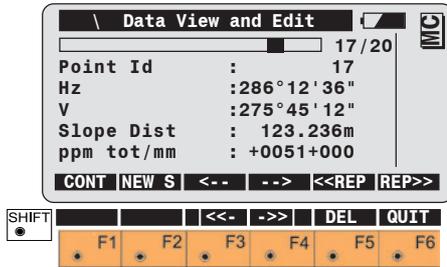
The data is displayed point by point in
accordance with the recording mask
in use at the time of the storage. The
data displayed can therefore change
from one point to another.
The assignations of the keys, and the
subsequent course of the program,
are the same as in the dialog "Data
View and Edit", with the exception of
the following function:

SHIFT F5  Deletes the displayed
          data block from the file.
A message is called to confirm that
you want to delete the block.

This function searches in the current
data job for the coordinates of the
point required. It accepts the first
data set found after the start of the
file, but does not display this data set.

If no point data are found, a message
is displayed along with the note that
no points with this point number were
found.
With "NEW S", the dialog "File & Pt.
Selection" is called. The file for the
data search can be changed and/or a
new point number can be entered.

Or:

The missing data can be entered with
"INPUT".

This function searches in the current data job for the coordinates of the required point. The first data set found after the beginning of the file is the one accepted. The data set found is displayed in every case.

If point data are found, refer to the dialog "Data View and Edit". "CONT" accepts the values displayed, and terminates the function.

Or:

Using "NEW S", call the dialog "File & Pt. Selection". The file for the data search can be changed and/or a new point number can be entered.

If no point data is found, a message appears with the note that no points with this point number were found.

Using "NEW S", call the dialog "File & Pt. Selection". The file for the data search can be changed and/or a new point number can be entered.

Or:

Using "INPUT", enter the missing data.

This function searches in the current measurement file for data relating to the required point. The user has the option of displaying the data stored on the PC-card within a chosen file and to delete data blocks. Individual points, and multiple entries of points with the same point number, can be searched for, displayed and deleted. The last point number in the file is displayed automatically. If editing of the data is permitted, point numbers, code information, attributes, instrument height and reflector height can all be changed. True measurement data such as directions and distances cannot be changed.

To activate the dialog "File & Pt. Selection", refer to the appropriate dialog.

If no point or code is found, a message is displayed along with the note that no point or code was found in the current measurement file.

If a point or code is found, refer to the dialog "Data View and Edit".

The search for stored data can be made easier if a placeholder is used instead of the complete point number. In the TPS1000, a decimal point "." is used instead of the more usual star "*", because it is more easily entered. There is no entry corresponding to "?".

Example of the use of placeholders:

| Input | Results | Remarks |
|---|---|---|
| 11. | 11, 110, 1101, 11ABC5, 111111 | **After** 11 there can be any character and in any amount. |
| .11 | 11, ABC11, 11111 | **Before** 11 there can be any character in any amount. |
| 1.0 | 10, 100, 1ABCD0, 11111110 | **Between** 1 and 0 there can be any character and in any amount. |
| .10. | 10, 3410ABC, 111110, 1000000 | A 10 must be **present at least once** |
| .1.0. | 10, 341ABC0, 1123Z0Y, 1001A000 | A 1 must be present **in frount of** a 0 **at least once**, and any amount of characters can be present between them. |

If a number with placeholder is entered instead of the complete point number, the **controlled data search** is always started and the first matching data set is displayed. The subsequent procedure is the same as that used when entering a complete point number.

This function enables point coordinates to be entered and stored in the current data file.

```
\ Enter coordinate set          ▉   MC
Data Job   : papillon.gsi    ▼
Enter min. :   PointId+E+N
Indiv.PtId :             1
East       :        0.000  m
North      :        0.000  m
Elev.      :        0.000  m
 CONT         REC
                            SHIFT         QUIT
      F1    F2    F3    F4    F5    F6
```
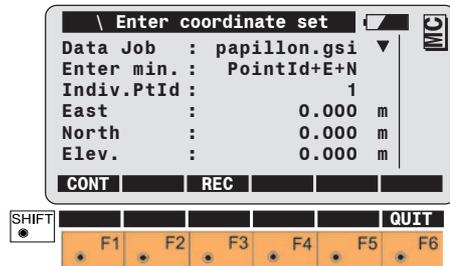
**F1**   Transfers the displayed values to the calling function.

**F3**   Sets the point data and stores them in the data file.
The height is stored only if a value has been entered.

This function permits the conversion of coordinates (P, E, N, (H)).

Three different file formats are supported:
- GSI (Leica Geosystems standard format) = *.GSI
- ASCII (normal ASCII text files) = *.ASC
- TDS (Tripod Data Systems) = *.CR5

After the function has been called, the dialog shown on the next page appears, permitting rapid selection of the original file and its format and also input of the name of the target file (output file) and its format.

## Conversion dialog

```
Main\  File Selection
Source Path:      A:\DATA\    ▼
Source File: PAPILLON.CR5    ▼
Format     : TDS sequent.    ▼
Output Path:       A:\GSI    ▼
Output File: PAPILLON.GSI
Format     :        GSI 16    ▼
  GO   CONF
                         QUIT
SHIFT
   F1    F2    F3    F4    F5    F6
```
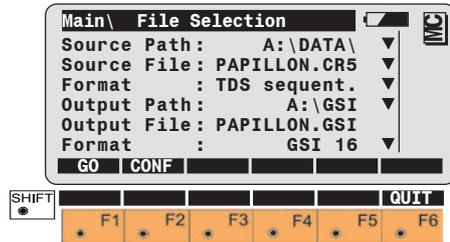
### Source Path
Selects the directory for the source file.

### Source File
Selects the name of the source file.

### Format
Selects the file format.
There is a choice between the following formats:
GS18, GSI16, ASCII, TDS sequential, TDS non-sequential.

## Output Path
Selects the directory for the output file.

## Output File
Enters the name of the output file.

## Format
Selects the file format.

F1  Starts the conversion.

F2  Calls up the configuration.

## Configuration dialog

```
CONV\  Configuration
Source file settings
Search extens. :       ASC
Header lines  :         O

Output file settings
Default extens :       GSI
  OK        ASCII

Decimals    :    As System   ▼
SHIFT
                         QUIT
   F1    F2    F3    F4    F5    F6
```
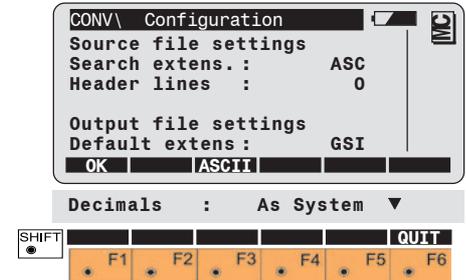
### Source file settings
### Search extens.
Determines the file extension to be searched for.

### Header lines
Determines the number of lines to be jumped at the beginning of a source file, i.e. which should not be converted (range of values 0-999).

### *Configuration dialog (continued)*

**Settings for output file**
**Search extens.**
Determines the extension for the output file.

**Decimals**
Determines the number of decimal places in the output if this is not limited by the format (e.g. by GSI). Choice between "As System" and up to six decimal places.

F1 — Returns to conversion dialog.

F3 — Calls the ASCII - configuration dialog.

### ASCII configuration dialog

The ASCII file format can be defined in the ASCII configuration dialog. The defined format is valid for ASCII source files and ASCII output files.

```
CONV\   ASCII File Format
Separator    :        Space   ▼
Id Pos       :            1   ▼
East Pos     :            2   ▼
North Pos    :            3   ▼
Height Pos   :            4   ▼
Pt. Code Pos:            5   ▼
  OK                 DEFLT

Attrib 1 Pos:            6   ▼
Attrib 2 Pos:            7   ▼
```

```
SHIFT                          QUIT
      F1    F2    F3    F4    F5    F6
```
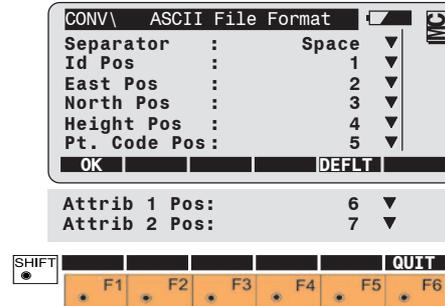
**Separator**
Determines the separator between the data during output. Spacing, commas and tabulator can be set.

**PtId, East, North,... Position**
The position in the ASCII format has to be defined for each component ("None" or 1,..,10 can be set).

F5 — Reset to the default settings (as shown above).

## Closing dialog

The closing dialog indicates the end of the conversion and shows the user how many lines were converted and how many not.

```
CONV\  CONVERSION      ▭▭  MC

Completed!

Points converted   :   135
Lines not converted:    12
 NEW                       QUIT
```
```
SHIFT                      QUIT
 F1   F2   F3   F4   F5   F6
```
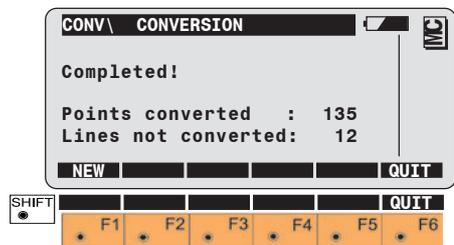
### Points converted
Output of the number of successfully-converted points.

### Lines not converted
Output of the number of lines not converted.

F1  Starts new conversion and calls the conversion dialog.

F6  Quits the function.

```
\Format PC-Card        ▭▭  MC
WARNING: 1151

Formatting deletes all data
on the PC-Card.

                    OK   ABORT
```
```
SHIFT
 F1   F2   F3   F4   F5   F6
```
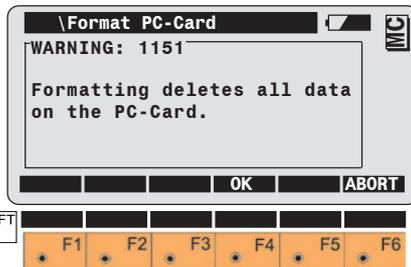
☞ Formatting the PC-card irretrievably deletes all data.

F4  Confirms the formatting is to go ahead. The storage capacity of the PC-card is ascertained and the card is formatted accordingly.

F6  Aborts the function "Format PC-Card".

```
\  Format PC-Card      ▭▭  MC
Formatting finished.

Memory space of PC-card
Card type  :     SRAM
Total      :   523776 Byte
Free       :   509952 Byte
               OK
```
```
SHIFT                      QUIT
 F1   F2   F3   F4   F5   F6
```
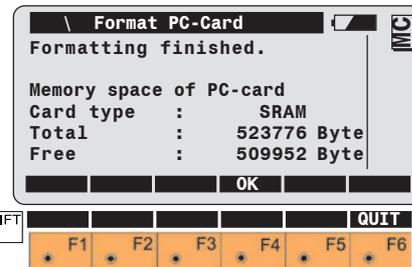
After the formatting is complete, the total memory capacity and the memory available on the card are displayed. The difference between the total memory capacity and the available memory is used for managing the directories.

```
\      Check PC-Card    ⬜▭   MC
Card type  :    ATA-Flash
Card name  :     TPS-1100
Total      :   523776 Byte
Free       :   509952 Byte
Status     : Not protected
Card.Batt  :         Good
 CONT
```

```
SHIFT                        QUIT
⦿
    F1    F2    F3    F4    F5    F6
```
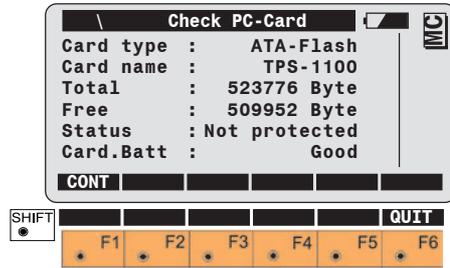
Display of the type of card (SRAM or ATA-Flash).

Display of the total memory capacity and the available memory.

Display of the write-protection function:
NOT PROTECTED or PROTECTED.

Display of the battery status (only for SRAM cards):
GOOD or LOW. (If LOW appears, fit a new internal battery for the PC-card immediately).

Activates the function "**REC-Mask Definition**".

Five REC masks can be defined for recording measurement data, and one REC mask for setting the station data.

The first line (point number) cannot be changed. For the remaining 11 lines, the data to be recorded can be selected from a list.

```
\ REC-Mask Definition  ⬜▭   MC
Define     :    Rec-Mask 1▼
Mask name  :        Polar
REC format : GSI16(16 char)▼
1st  word  : Point Id  (11)
2nd  word  : Hz        (21)▼
3rd  word  : V         (22)▼
 CONT               DEFLT          ⬆
```

```
4th  word  : Slope Dist.(31)▼
5th  word  :         East▼
6th  word  :        North▼
7th  word  : Elev.    (83)▼
8th  word  :ppm tot/mm (51)▼
9th  word  :      (empty)▼
10th word  :      (empty)▼
11th word  :      (empty)▼
12th word  :      (empty)▼
```

```
SHIFT                        QUIT
⦿
    F1    F2    F3    F4    F5    F6
```
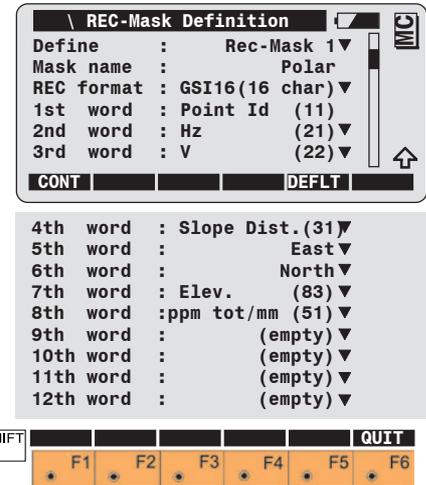
F5  Sets the current REC mask to "Standard", i.e. to the REC masks originally defined.

In contrast to the display mask, the parameters in the recording template can be set only once.

☞ If Point Codes and Attributes need to be stored , it must be defined in the recording mask. If attributes are defined in the display mask, they can directly be entered in the measuring dialog.

☞ The standard REC masks are different from the standard display mask. The REC mask does not include the reflector height, for example. If the heights of targets are to be inspected in the office, the attribute "Refl. Height" must be added to the recording mask.

Activates the function from the "**DISPLAY MASK**" dialog.

Three DSP masks can be defined.

The 12 lines can be set up by using the parameters available from the lists.

```
┌─────────────────────────────┐  ┌──┐
│ \Displ.mask definition  ▭▱   │  │MC│
│ Define    :   Displ.Mask 1▼ ▮│  └──┘
│ Mask name :    Standard 1   ▮│
│ 1st  word :      Point Id▼  ▮│
│ 2nd  word :           Hz▼   ▯│
│ 3rd  word :            V▼   ▯│
│ 4th  word :   Slope Dist.▼  ▯│
│                            ⇧ │
│ CONT │    │    │ DEFLT │      │
└─────────────────────────────┘

  5th  word :     Horiz.Dist▼
  6th  word :     Elev.Diff.▼
  7th  word :           East▼
  8th  word :          North▼
  9th  word :          Elev.▼
  10th word :         ppm/mm▼
  11th word :        (empty)▼
  12th word :        (empty)▼
```

SHIFT
⊙
F1   F2   F3   F4   F5   F6   QUIT

Each line can display any and all of the available display data.

[F5] Sets the current DSP mask to "Standard", i.e. to the DSP masks originally defined.
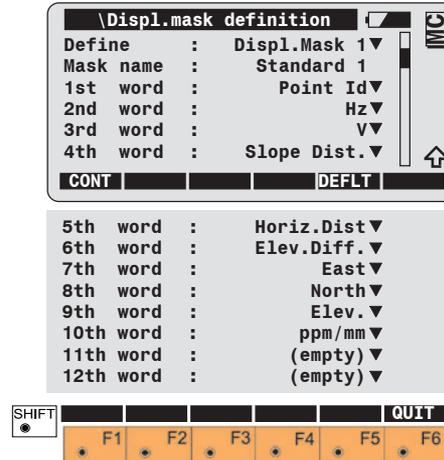
## Complete list of display and recording parameters

☞ (*) = only on the record screen

| WI-No. | Parameters | Description |
|---|---|---|
| -- | \empty | Empty line |
| -- | Displ.Mask | Current display mask |
| (*) 58 | Add.const. | Prism constant |
| -- | Backs. Id | Current backsight Id |
| (*) 72<br>(*) 73<br>(*) 74<br>(*) 75<br>(*) 76<br>(*) 77<br>(*) 78<br>(*) 79 | Attrib. 1<br>Attrib. 2<br>Attrib. 3<br>Attrib. 4<br>Attrib. 5<br>Attrib. 6<br>Attrib. 7<br>Attrib. 8 | Attributes (1-8) can be used to store additional information in the field. Each of the editable parameters can contain up to 8 or 16 alphanumeric characters.<br>Contrary to CODE-words, Point codes and Attributes are stored within the measurement data block, as long as the record mask contains attributes. |
| -- | AVG n max. | Maximum number of distance measurements in the averaging mode |
| 41 | Code | Code blocks serve to record additional information used in further processing of the measurement data. The codes are stored in blocks separate from the measurement data blocks and contain at least one CODE-word and up to 87 more information words (Info 1 to 8). |
| -- | Code Mngmt | Codelist managment: view, select, create, edit |
| -- | Code Descr | Description for the current code |
| -- | Codelist | View and select Codelist |
| -- | Data job | View and select Data-Job |
| -- | Date | Current date |
| -- | DJob Mngmt | Data-Job management: view, select, create, edit |

| WI-No. | Parameters | Description |
|---|---|---|
| -- | Offs. Elev. | Elevation offset of target point |
| -- | Offs. Lngth | Length offset of target point |
| -- | Offs.Cross | Cross offset of target point |
| -- | Offs.Mode | View and select offset mode, reset after REC or keep |
| -- | Half line space | Half empty line |
| (*) 32 | Horiz.dist. | Horizontal distance (reduced slope distance) |
| (*) 21 | Hz | Horizontal direction |
| (*) 83 | Elev. | Target point height (Z) |
| (*) 33 | Elev.Diff. | Height difference between the station point and the target point with allowance made for the instrument and reflector heights |
| (*) (11) | Indiv.PtId | Current individual point number |
| 42<br>43<br>44<br>45<br>46<br>47<br>48<br>49 | Info 1<br>Info 2<br>Info 3<br>Info 4<br>Info 5<br>Info 6<br>Info 7<br>Info 8 | Additional information to the Code. Each of these editable information words can contain up to 8 or 16 alphanumeric characters. |
| -- | Increment | Increment to encrease the running point id |
| (*) 88 | Inst.Ht | Instrument height |
| (*) (11) | Runn.PtId | Current running point id |
| -- | Meas job | View and select Meas-Job |
| -- | EDM Prog. | View and select EDM program |
| -- | MJob Mngmt | Meas-Job management: view, select, create, edit |
| (*) 52 | n / s | Number of averaged distances measured and the standard deviation in millimetre |
| (*) 82 | North | North coordinate of target point |

| WI-Nr. | Parameters | Description |
|--------|-----------|-------------|
| (*) 81 | East | East coordinate of traget point |
| -- | ppm atm. | Atmospheric ppm value |
| -- | ppm geom. | Geometric ppm value |
| (*) 59 | ppm total | Total ppm-correction |
| (*) 51 | ppm/mm | Total ppm-correction and prism constant |
| -- | PtC.Descr. | Description for the current Code |
| (*) 71 | Point Code | Current Point Code |
| (*) 11 | Point Id | Current Point Id (either the running or the individual point id) |
| (*) 87 | Refl. Ht. | Reflector height |
| -- | Refl. list | View and select a reflector |
| -- | Refl.Name | Display the current reflector name |
| -- | Displ.Mask | View and select the recording mask |
| (*) 31 | Slope Dist | Measured slope distance (already corrected using ppm and prism constant) |
| -- | Station Id | Station point number |
| (*) 86 | Stn.Elev. | Station Elevation (Zo) |
| (*) 85 | Stn.North | Station northing coordinate (Xo) |
| (*) 84 | Stn.East | Station easting coordinate (Yo) |
| (*) 22 | V | Vertical angle |
| -- | V-Display | View and select the V angle display |
| -- | Last PtId | Display of the last recorded Point Id |
| -- | Prev.Code | Display of the last recorded Code |
| -- | Prev.PtCod | Display of the last recorded Point Code |
| -- | Time | Current system-time |
| -- | Target Typ | Current target type, reflector or none |

☞ Display and recording parameters can be defined independently. Therefore make sure that the recording mask contains all parameters necessary for evaluation.

☞ If values "East" and then "North" are defined in the display mask and if the coordinate display shows "Easting/Northing" then also the Easting value followed by the Northing value appears in the measurement mode. However, in connection with the display mask and the display in the measurement mode four cases must be considered:

| DMask | Coord. Seq. | Display in measurement mode | Change |
|---|---|---|---|
| Easting/Northing | E/N as in DMask | Easting/Northing | none |
| Easting/Northing | change E/N Seq. | Northing/Easting | yes |
| Northing/Easting | E/N as in DMask | Northing/Easting | none |
| Northing/Easting | change E/N Seq. | Easting/Northing | yes |

# Measurement functions

### Single-point orientation (quick station setup)

This function brings together in a single dialog all of the relevant inputs needed to set up the instrument from scratch.
Activate the function "Quick-station setup (QSET)".

```
\Quick station setup              MC
Station Id :              1
Backs. Id  :              A
Inst. Ht.  :         1.500    m
Refl. Ht.  :         1.000    m
ΔHorizDist :         -----    m
     Measure to Backs.point
        DIST       CONT INPUT
 SHIFT      ALL   REC I<>II VIEW  QUIT
       F1    F2    F3    F4    F5    F6
```
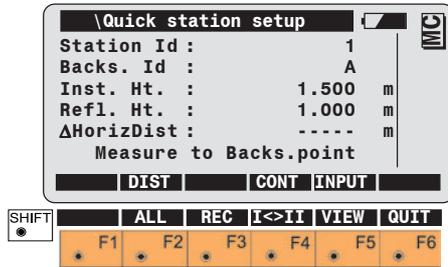
Enter the numbers of the station point and of the backsight point respectively. The appropriate point is immediately searched for in the data file and, if the search is successful, the coordinates will be assigned to the station point and backsight point without this fact being displayed.

After the instrument height and the reflector height have been entered, target the backsight point and measure the distance and/or the direction.

**F2**   Measure the distance. The difference between the calculated distance and the measured distance to the backsight point is displayed.

**F4**   Determine the direction, but do not store the values. The graduated circle is orientated.

**F5**   Using the keyboard, enter the coordinates for the station or for the tie point. *See chapter "Data management"*.

**SHIFT F2**   Measure the distance and determine the direction, and store the measurement block. The graduated circle is orientated. The difference between the calculated distance and the measured distance to the backsight point is displayed.

**SHIFT F3**   Determine the direction and store it, including the previously-measured distance where appropriate. The graduated circle is orientated.

**SHIFT F5**   Activate controlled data search within data file.
*See chapter "Data management"*.

```
MAIN\Quick station setup          MC
Station Id :              1
Inst. Ht.  :         1.600
Stn.East   :    726530.424    m
Stn.North  :    256431.871    m
Stn.Elev.  :       459.173    m
Set Station with REC or CONT
                 REC  CONT
 SHIFT                           QUIT
       F1    F2    F3    F4    F5    F6
```
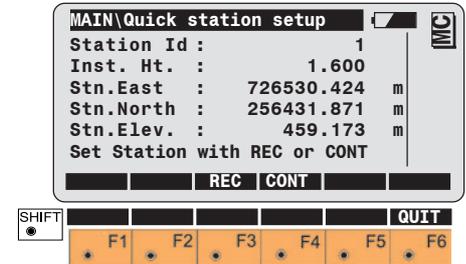
**F3**   Station data are set.

**F4**   Station data are set and are stored in the measurement file.

Activate the function "Set Hz to any angle".
Target the tie point exactly.
The direction must always be set using face I.

Set Hz direction to 0° 00' 00" (0.0000 gon) or enter a known value.

```
\ Set Hz to any angle        MC

Set Hz-direction

Hz             :123°17'56"


 SET         Hz=0 HOLD
```
```
SHIFT                        QUIT
  F1    F2    F3    F4    F5   F6
```
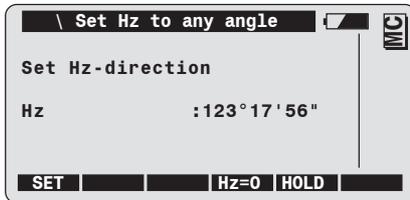
| F4 | Sets Hz to 0° 00' 00" (0.0000 gon). |

Instead of entering a value, this can be set by turning the instrument.

| F5 | Secures the value (clamp the circle) |

Target the tie point exactly.

| F5 | Releases the circle. |

☞ This function is also activated from other dialogs in order to enter the Hz direction.

The following dialog is displayed during the "first" distance measurement:

```
\      Distance Meas.         MC

EDM Prog.  :      Standard IR
Refl.Name  : Leica 360° prism

Add.const. :         23.1 mm
ppm total  :          0.0
->Ref ->TRK      TEST STOP EDM-P
```
```
SHIFT                        QUIT
  F1    F2    F3    F4    F5   F6
```
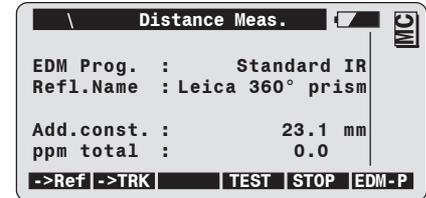
The display shows the current measuring program and reflector, the current additive constant (prism constant) and the total ppm value.

| F1 | Switches between infrared (with reflector, →REF) and red laser (no reflector, RL). |

**F2** Activates the tracking mode if the measuring program "Standard distance measurement" was selected, or the rapid-tracking mode if the measuring program "Fast distance measurement" was selected.

**F4** Calls the EDM test (signal and frequency)

**F5** Stops the current measuring program.

**F6** Calls the function " EDM parameters".

```
 \        EDM parameters           MC
Set EDM Prog for DIST/ALL
Target Typ :      IR=Reflector▼
EDM Prog.  :        Standard IR▼

Refl.Name  : Leica circ.prism▼
Add.const.:            0.0  mm
 CONT                    REFL
```

SHIFT                        QUIT
F1   F2   F3   F4   F5   F6
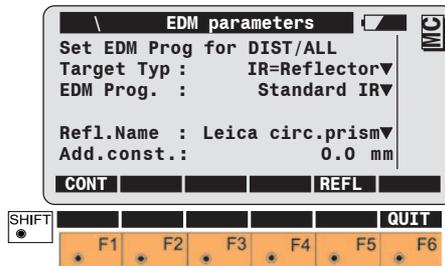
**Infrared:**

Standard IR
Normal distance measurement.
Accuracy 2mm+2ppm.
Measuring time 1.0 seconds.

Standard Fast IR
Rapid distance measurement.
Accuracy 5mm+2ppm.
Measuring time 0.5 seconds.

Tracking IR
Continuous measurement.
Accuracy 5mm+2ppm.
Measuring time 0.3 seconds.

Tracking Fast IR
Continuous measurement.
Accuracy 10mm+2ppm.
Measuring time <0.15 seconds.

Average IR
Repeat measurements in standard measuring mode with display of the number of distance measurements ($2 \leq n \leq 999$), the current average and the standard deviation for the averaged distance.

☞ **Very short distances may be measured reflectorless in Infrared-mode (e.g. to well reflecting targets like traffic signs). In this case the distances are corrected with the addition constant defined for the active reflector.**

**Reflector-free and long range: (red laser)**

Standard Long RL
Normal distance measurement.
Accuracy 3mm+2ppm.

Average Long RL
Repeat measurements in normal measuring mode

⚠ **WARNING:
(only for Extended Range
Instruments)**

Reflector-free:
The visible laser beam may only be
used within a controlled area (*refer to
chapter "Safety Directions"*) and must
hit a non reflecting material at the
end of its intended path.
Long Range to prisms:
This mode is only permissible from a
distance of 1000 m (3300 ft) from the
telescope. No persons may stay
within the beam path up to 1000 m
(=controlled area; *refer to chapter
"Safety Directions"*).

**Selecting the target type**

This line appears only if a
reflectorless instrument is being
used. There is a choice between
"reflectorless" and "reflector".

☞ Wrong target type setting
leads to bad measurements.

**Refl.Name**

The current reflector is indicated and,
on the next line, the additive constant
associated with it.

F5 Calls the function "Reflector
selection".

☞ Wrong prism setting leads to
bad measurements.

**[ >REF ]**   Activates infrared
distance measurement
(with reflector). The last
used ATR/LOCK
settings are
simultaneously
activated.

**[   >RL ]**   Activates reflectorless
distance measurement.

| *Switch between Standard/Tracking* | *Switch between Fast measurement/Rapid* | *Setting / defining prisms* |
|---|---|---|

| | | |
|---|---|---|
| **[ >STD ]** Activates standard distance measurement. | *Tracking* | Activating the function "**Reflector selection**". |
| **[ >TRK ]** Activates distance tracking. | **[>RTRK]** Activates rapid distance tracking. | |
| | **[>FAST]** Activates rapid distance measurement. | |

```
┌────────────────────────────────┐
│ \ Reflector Selection   ▭ ▱  MC│
│                                │
│ Select reflector type          │
│ Refl.Name : Leica circ.prism▼  │
│ Add.const. :           0.0mm   │
│                                │
│ DEF 1,2,3 for new reflector    │
│ CONT      DEF 1 DEF 2 DEF 3    │
├────────────────────────────────┤
│SHIFT                      QUIT │
│  F1   F2   F3   F4   F5   F6   │
└────────────────────────────────┘
```
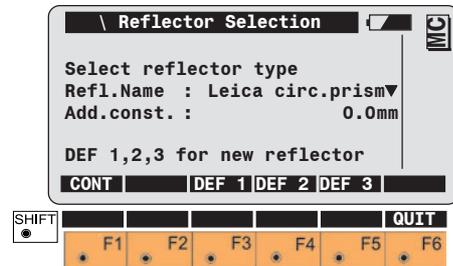
Choosing the appropriate prism. The appropriate additive constant is set automatically at the same time.

☞ Wrong prism setting leads to bad measurements.

F3, F4, F5 Define reflectors from other manufacturers.

```
┌──────────────────────────────────┐
│ \Define new reflector 1  ▢▬   ┌MC │
│                                   │
│ Define type of reflector          │
│ Ref.1 Type  :  Not defined▼       │
│                                   │
│ Ref.1 Name  :        -----        │
│ Ref.1 Cons  :        ----- mm     │
│ CONT                              │
└──────────────────────────────────┘
 SHIFT
   F1   F2   F3   F4   F5  │QUIT│ F6
```
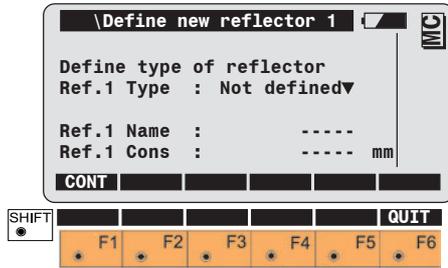
The user can freely define the name and additive constant (additive constant) for three reflectors and can enter the type of reflector (prism or retro tape). The additive constant is always given in millimetres [mm]. It is advisable to determine the additive constant for "non Leica Geosystems prisms" on a baseline by means of an appropriate procedure.
For the reflector to be available for choice, the reflector type may not be "None".

Displays the signal strength or measurement frequency.

```
┌──────────────────────────────────┐
│ \ EDM Return Signal   ▢▬   ┌MC    │
│ Signal strength                   │
│                                   │
│ 0% ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▯▯▯100%          │
│               75%                 │
│ Tone      :    OFF▼               │
│                                   │
│ CONT      │FREQ│    │STOP│        │
└──────────────────────────────────┘
 SHIFT
   F1   F2   F3   F4   F5  │QUIT│ F6
```
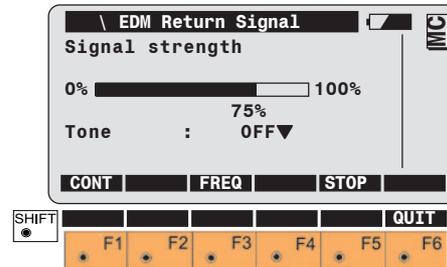
F3    Toggles between the displays of measurement frequency and signal strength. The measurement frequency display is similar to the display shown above.

F5    End and return to the previous dialog.

ON/OFF - key for the acoustic tone. The stronger the signal the more the black intensity bar is extending to the right against 100%. With an already low signal distances can be measured.

A distinction is made between atmospheric (ppm) and geometric (ppm) corrections, the sum of which is used as the final distance correction.

## Atmospheric correction

The atmospheric distance corrections are derived from the dry-air temperature, air pressure or height over mean sea-level, and relative air humidity or wet-air temperature.

```
┌──────────────────────────────────┐
│ \ ATMOSPHERIC CORR.   ▢▬   ┌MC    │
│ Temperature     :       12.0 °C   │
│ Atm. press.     :1013.3 mBar      │
│ Temp.wet-b.     :       60.0 %    │
│ ppm atmospheric :        0.0      │
│ ppm geometric   :        0.0      │
│ ppm total       :        0.0      │
│ CONT│ GEOM│REFRA│P<>E│%<>T'│ATM=O  │
└──────────────────────────────────┘
 SHIFT                        │QUIT│
   F1   F2   F3   F4   F5      F6
```
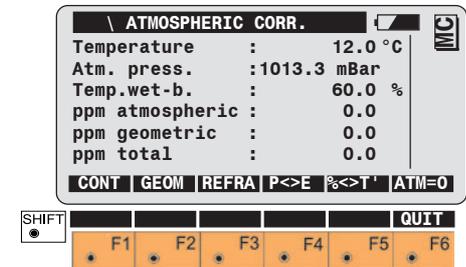
F2    Settings for the geometrical correction.

**F3** Settings for the refraction correction.

**F4** Toggle between air pressure and height above mean sea-level.

**F5** Toggle between relative air humidity and wet-air temperature.

**F6** Set the atmospheric ppm to "0.00". (Individual parameters are set to the standard atmospheric values, corresponding to the atmospheric correction ATM=0)

**Geometrical correction**

The geometrical distance correction is derived from the projection distortion and the height above the reference datum.
The calculation of the geometrical ppm follows the formula for the Transversal Mercator Projection. The individual factors are: the scale factor of the line of projection (central meridian, Gauss-Krüger = 1.0, UTM = 0.9996, etc.); the offset from the line of projection; the height above the reference datum (normally this is the height above mean sea-level); and an additional individual scale correction.

☞ The distance without any projection distortion is used to determine the height difference. The individually-set scale adjustment is always applied to the distance.

The individual scale correction can be used to enter a total geometrical correction.

```
\ GEOMETRIC CORR.
Scale C.M.    : 1.0000000
Offset C.M.   :     51000 m
Height aRef   :       350 m
Indiv. ppm    :       0.0

ppm geometric :      -22.9
CONT                            GEO=O
```

```
ppm ref. level   :   0.0
ppm map projection:  0.0
```

**F6** Sets the geometrical ppm to "0.00".
The scale on the Central Meridian is set to "1.0000000". The other parameters are set to "0.00".

## Refraction correction

The refraction correction is taken into account during the calculation of the height difference.

```
\ REFRACTION CORR.        MC
Set coeff. of refraction

Correction    :    ON   ▼
Refr.coeff. (k) :    0.13


CONT              DEFLT
```
```
SHIFT                     QUIT
  F1   F2   F3   F4   F5   F6
```
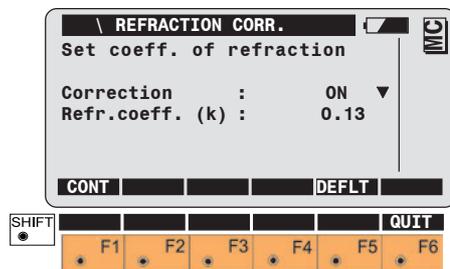
F5    Sets the refraction coefficient to standard values.

For standard applications the distance is corrected only on account of atmospheric influences.
The geometrical correction and the projection distortions are set to "0.00". Heights are reduced with the standard refraction coefficient

Activate the function "**PPM Atmospheric**" from the dialog "**Function Selection**".

```
\  PPM Corrections       MC
Enter your correction values

Atm.pressure :    1013.3 mbar
Temperature  :      12.0   °C

ppm total    :      -0.0
CONT
```
```
SHIFT                     QUIT
  F1   F2   F3   F4   F5   F6
```
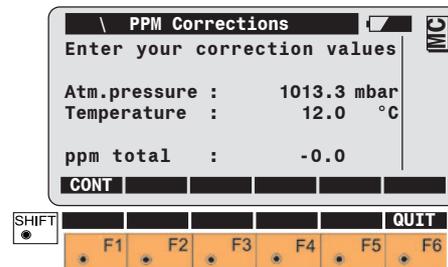
Input of air pressure and temperature
or
Input of ppm value.
The values for pressure and temperature are erased.

```
MEAS\ Measurement & Record    MC
Point Id     :          1
Attrib. 1    :      -----
Refl. Ht.    :      1.500   m
Hz           :286°55'50"
V            : 91°16'20"
Horiz.Dist.  :      -----   m  ⇧
 ALL  DIST  REC        SetHz >DISP

Elev.Diff.   :      -----   m
East         :      -----   m
North        :      -----   m
Elev.        :      -----   m
```
```
SHIFT        INPUT Del B I<>II INDIV QUIT
      F1    F2    F3    F4    F5    F6
```
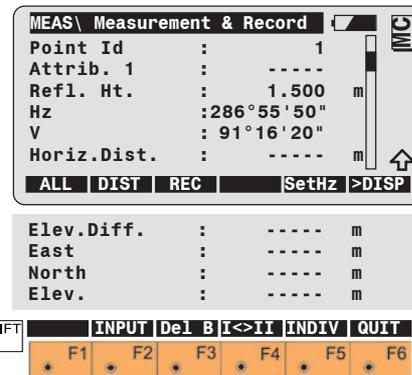
The data shown above represent the standard display mask.

F3    Measurement block recording. The recorded measurement-block corresponds to the active recording template. The last measured distance is also recorded.

This procedure offers the option of realigning the telescope on another point after measuring the distance and before measuring the angle. In this way two points can be used for measurements of angle and distance.

It is therefore possible to record inaccessible points, e.g. house corners, fences surrounded by hedges.



MEASURING DISTANCE

1000QS36

STORING DATA

1000QS37
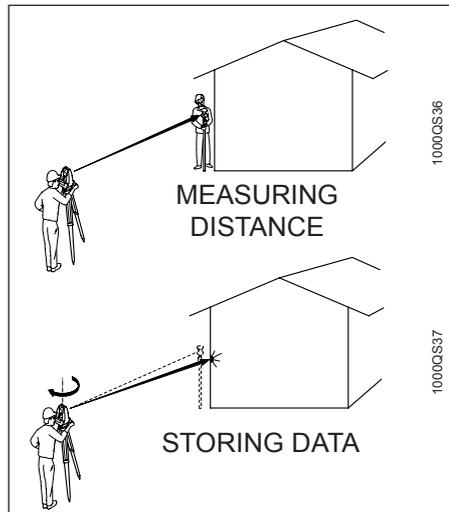
For calculations which depend on distance, the V-angle after completion of the distance measurement is used, along with the current Hz-direction. Consequently, calculated heights and height differences are retained and the coordinates for easting and northing which correspond to the new Hz direction are recalculated using the last-measured distance.

☞ The V-angle displayed corresponds to the position of the telescope on completion of the distance measurement. The V-angle is not altered until the measurement is recorded for a new distance is measured.

When distances, heights, or height differences are displayed as empty fields (i.e. -----), the V-angle is continuously displayed and updated.

If, after the distance has been measured, changes are made to the target-point data which have an influence on the distance measured or on the height and height difference (e.g. ppm, prism constant, reflector height, refraction coefficient), the dependent data will be correspondingly re-computed.

### Measuring distances and angles together with storage (ALL)

Hz-angle measurement is carried out after the distance has been measured. Immediately afterwards all data is stored.
The measurement block stored in the meas.job corresponds with the active recording mask.

☞ Therefore the instrument may only be moved after data storage is complete.
This is signalled acoustically by the third beep after the ALL key has been pressed.

The data is automatically recorded after the distance has been measured. The distance, and all data which depend on it, are then displayed with the tag "-----", which indicates that the data storage is complete.

### Storing station data (REC)

The station data (point number, easting, northing, station height, reflector height and instrument height) are recorded in the measurement job. The coordinates are set as station coordinates.

### Changing face (I< >II)

Positioning in the other face. Display of DHz and DV. If the instrument is turned so that these values are at "0.000", the target becomes visible in the telescope again. This aid is an advantage under conditions of poor visibility.

I**f the instrument is motorized, the instrument automatically travels to the other face.**

| Last point number (L.Pt.) | Deleting the GSI block (Del B) | Manual distance entry |
|---|---|---|
| Enter the last point number to be stored and use it as the current point number. | This function deletes the last GSI block of the current measuring job. With "Del B", a measuring block (starting with WI11) or a code block (starting with WI41) can be deleted. | Enter the horizontal distance, which was measured with a tape for instance.<br>Immediately after confirmation of input, the horizontal distance is shown corrected for the geometrical ppm. After the distance has been entered, the V-angle is set to "horizontal" 90° ( 100 gon ) or 270° ( 300 gon ). The coordinates are calculated using the corrected horizontal distance, the Hz-direction, and the V-angle. Heights are always corrected for earth curvature and are corrected for refraction according to the parameter settings. |

☞ The reflector height is temporarily set to the value for the instrument height and so there is always a height difference of "0.000".
The slope distance is the same as the horizontal distance.

(Applies only to motorized instruments)

The telescope is automatically pointed at the latest point to be stored. This function is available only if a point was stored after switching on the instrument.

**[>FREE]**   This function activates the vertical angle mode "Running" for the following measurements. In this mode, the vertical angle is continuously updated with the telescope movement.

☞   After a distance measurement, vertical angle, slope distance, height difference, and the elevation coordinate are displayed as running values. Slope distance, height difference, and the elevation coordinate of the target point are calculated from the initial horizontal distance and currently displayed vertical angle. The REC-function records the displayed values in the measurement file.

[>FIX]   This function activates the vertical angle mode "Hold after DIST" for the following measurements. In this mode, the vertical angle is fixed after a distance measurement, whereas the horizontal angle is running.

**Function [VRUN]**

This function deletes the last measured distance and so releases the locked vertical angle.

(Available only with special configuration.)

The Offset function allows offset points to be determined, for instance when the reflector cannot be set up directly on a point. Transverse, longitudinal and/or elevation offsets can be defined from the reflector position to the offset point.
All of the displayed and recorded measurement data are calculated in relation to the offset point.

The values for target eccentricity will be retained after storage with the choice of "Permanent" in the Offset Mode. The values will be set to zero with the choice of "No reset after REC".



Offset PT.

Offs.Cross -

Offs.Lngth -

Offs.Lngth +

Offs.Cross +

**Elev. +:**
Offset point is higher than measurement

1100QS07
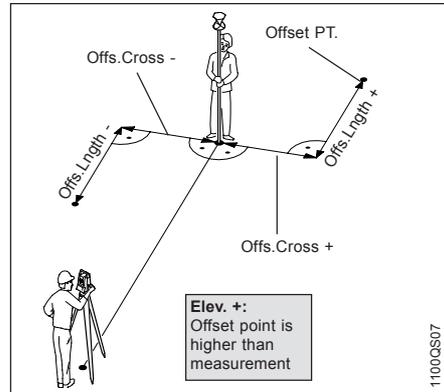
This function is for switching between the display masks. If no mask is defined, or only one, this function key does not appear.

This function is for switching between the individual [INDIV] and running [RUN] point numbers.

**Standard coding (without codelist)**

Code blocks are used to record additional information for subsequent processing of the measurement data. They are recorded in separate blocks and consist of at least the CODE number, along with up to 8 further information blocks (Info 1 to 8). Each of these editable information words contains up to 8 (or 16) alphanumeric characters.
Information words which include "-----" are not stored.
In general, the code function can be called whenever a measurement or another data set in the measurement file can be stored. The code function, together with the measuring mode, is available in most of the loadable applications.

[CODE] calls up the standard coding (Code, Info 1 to 8) if no codelist was selected.

```
\ Coding (standard)               MC
Code            :       -----
Info 1          :       -----
Info 2          :       -----
Info 3          :       -----
Info 4          :       -----
Info 5          :       -----
 REC           L Pt.

Info 6          :       -----
Info 7          :       -----
Info 8          :       -----
SHIFT                                 ENDE
  F1    F2    F3    F4    F5    F6
```
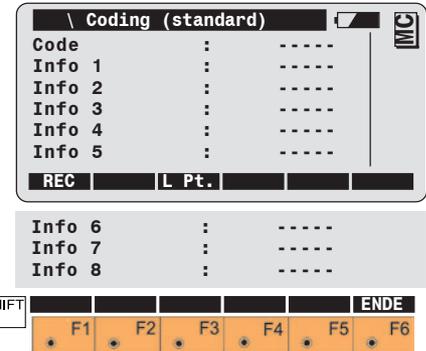
[F1]    When a new code is entered, or after using the - [F3] key, "REC" is assigned to the - [F1] key. Only information-bearing elements are recorded.

Standard codes (Code, info 1 to 8) are recorded in separate blocks in GSI format behind the last measurement stored. These codes are not part of the recorded data block (recording template).

| | |
|---|---|
| **F3** | Calls the latest codes stored, and also the WIs. |

**WIs for storage:**

Code:       WI 41
Info 1 - 8:   WI 42 - 49

**Point coding (without codelist)**

In the TPS1000 instruments, the so-called "Remarks" (REM words) were used for storing additional information in the measurement-data blocks, but in the TPS1100 they have been replaced by "Point code" and "Attrib. 1-8".

**WIs for storing:**

Point code:   WI 71
Attrib. 1-8:   WI 72-79

**Standard coding with codelist**

This function becomes active if a standard codelist has been selected.

The fixed key CODE is used for calling up the codelist.

```
MEAS\   TEST.CRF ◇              MC
Code
101     Tree
102     Bush
103     Latern
104     Hydrant

  REC │ NEW │ LAST │ INFO │     αNUM
SHIFT                          QUIT
  F1   F2   F3   F4   F5   F6
```
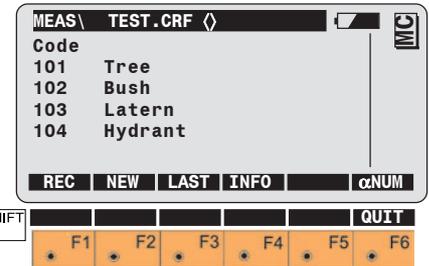
| | |
|---|---|
| **F1** | Stores the code block. |
| **F2** | Creates a new code. |
| **F3** | Calls the latest code stored. |
| **F4** | Enters information. |
| **F6** | Switches between numeric and alphanumeric input for a rapid search of codes. |

## Point coding with codelist

This function becomes active if a point code list has been selected. In the measurement dialog, the codelist is displayed in the line "point code". The list is opened with direct input or with 🔽 .

```
┌─────────────────────────────────┐
│MEAS\ Measurement & Record  ▢▰ │MC│
│MEAS: TEST.CRF <      >           │
│Code                              │
│101    Tree                       │
│102    Bush                       │
│103    Latern                     │
│104    Hydrant                    │
│ CONT │ NEW │ LAST │ATRIB│   │αNUM│
└─────────────────────────────────┘
┌─────┐┌───┐┌───┐┌───┐┌───┐┌──QUIT┐
│SHIFT││   ││   ││   ││   ││      │
│  ◉  ││ F1││ F2││ F3││ F4││ F5 F6│
└─────┘└───┘└───┘└───┘└───┘└──────┘
```
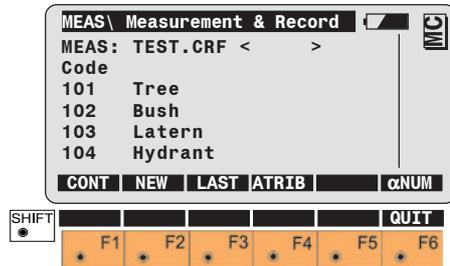
**F1**  Confirms the selection.

**F2**  Creates a new point code.

**F3**  Calls the latest point code.

**F4**  Enters attribute values.

**F6**  Switches between numeric and alphanumeric input for a rapid search for codes.

This function enables a measurement block and a code block for a predefined code to be stored by pressing a key (Quick-Coding). Up to 100 codes defined in the codelist can be called with the numerical keys in this manner (default 10 codes).

The quick coding can be switched on and off with "QCod+ / QCod-". When quick coding is active, the symbol "C" is displayed in the bottom of the graphical status field of the measurement display. When the quick-coding option is switched off, this symbol disappears.

The Check Orientation dialog allows to check the orientation to a known backsight point, and to reset the orientation if necessary.

Activating the function "Check Orientation".

```
....\  Check Orientation  [    ] MC
Station Id     :          1
Backs. Id      :         BS
Refl. Ht.      :      1.650 m
Azimut         :   100.2222 g
Hz             :    95.6650 g
ΔHz            :    -0.0059 g
 CONT  DIST  POSIT  SET   VIEW  LAST

Horiz Dist     :      -----
ΔHorizDist     :      -----
Elevation      :      -----
ΔHeight        :      -----
SHIFT HELP                        QUIT
        F1    F2    F3   F4   F5   F6
```
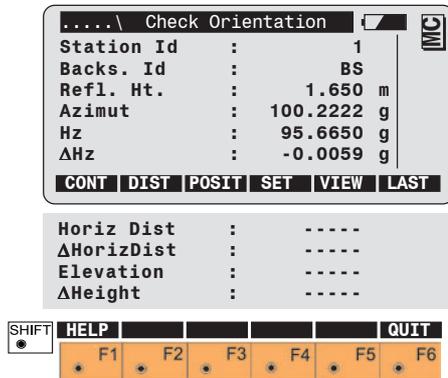
Enter the Backsight Id. With ↵ the appropriate point will immediately be searched for in the data file and, if the search is successful , the coordinates will be assigned to the backsight point.
Additionally the calculated azimuth to the point will be shown.

After the reflector height has been entered, target the backsight point and measure the distance and/or the direction and compare azimuth with HZ.

F1    Leave the dialog and continue work.

F2    Measure distance. Distance and difference between calculated and measured distance to the backsight point will be shown.

F3    Position the telescope to the backsight point. For motorised instruments only!

The instrument positions automatically back to the start position when leaving the "Check Orientation" function. This is particularly suitable for RCS-applications.

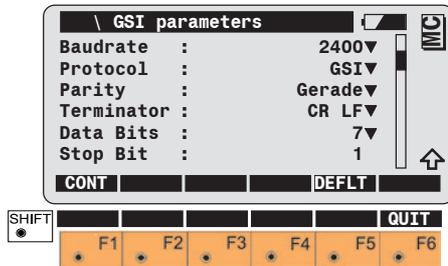F4    Target the backsight point accurately and reset the orientation.

F5    Search and display the coordinates of the point found in the active data job.

F6    If Orientation was set more than once, LAST recalls the last backsight point and azimuth.

# *Communication*

*GSI communication parameters*

The setting for the interface parameters is valid for communication with the GSI command structure. The baud rate can be chosen from the standard values between 2400 and 19200.

```
 \ GSI parameters      ▭    MC
Baudrate   :        2400▼
Protocol   :         GSI▼
Parity     :      Gerade▼
Terminator :       CR LF▼
Data Bits  :           7▼
Stop Bit   :           1       ⇧
 CONT            DEFLT
SHIFT                    QUIT
  F1    F2    F3   F4   F5   F6
```

F5    The standard parameters are shown above.

For more detailed information about command- and data structure, please refer to "WILD Instruments On-Line" (document no. G-366-0en), a copy of which is available (in English only) from your local Leica Geosystems agency.

*Interface parameters (GeoCOM)*

The settings of the interface parameters are valid for communication using the "GeoCOM command structure". The baud rate can be chosen from a list of standard values between 2400 and 19200. All other parameters are fixed and cannot be changed.
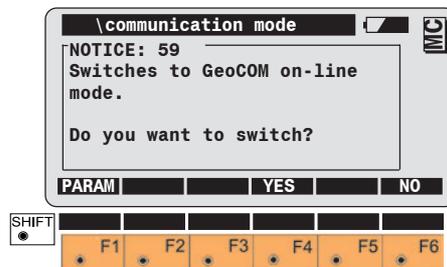
For more detailed information about command- and data-structure, please refer to the handbook "GeoCOM Reference Manual" (document no. G-560-0en), a copy of which is available (in English only) from your local Leica Geosystems agency.

The setting for the interface parameters is valid for communication in remote-control mode. The baud rate can be selected within the range 2400 - 19200. No other values can be altered.
For detailed information, please refer to the separate instructions for use.

With on-line operation (GeoCOM), the instrument is switched to a mode which permits communication with, or control by, a data recorder or PC. This mode operates across the RS232 interface; the GeoCOM command set is used.

```
┌──────────────────────────────────────┐
│ \communication mode          ▭▱   MC  │
│ ┌NOTICE: 59─────────────────────┐     │
│ Switches to GeoCOM on-line            │
│ mode.                                 │
│                                       │
│ Do you want to switch?                │
│                                       │
│ PARAM          YES          NO        │
└──────────────────────────────────────┘
 SHIFT
  ⊙    ┌──┬──┬──┬──┬──┬──┐
       │F1│F2│F3│F4│F5│F6│
       └──┴──┴──┴──┴──┴──┘
```

**F1**   Calls the settings for the GeoCOM communications parameters.

**F4**   Activates the "On-line mode". The operation of the instrument is now totally controlled across the interface. For information about data structures, and for the detailed structure of the control commands, please refer to the "GeoCOM Reference Manual"(G-560-0en), which is available only in English. The on-line mode can be quitted by pressing "OFF" ( **F6** ).

**F6**   Reverts; "On-line" mode is not activated.

TCA and TCRA instruments are motorized and equipped with Automatic Target Recognition (ATR) coaxially in the telescope. The EGL guide light, mounted on the telescope, is optional.

These instruments permit automatic angle and distance measurements to normal prisms and reduce the tedium of precise visual sighting to prisms. The prism is sighted with the optical sight only. Initiating a distance measurement will turn the instrument with the help of the motors to sight the prism-centre automatically. The angles V and Hz are measured to the centre of the prism at the completion of the distance measurement.

☞ As with all other instrument errors, the collimation error of the automatic target recognition (ATR) must be redetermined periodically *(Refer to chapter "Checking and Adjusting").*

☞ Reflections or foreign lights (eg. from car headlights) can affect the ATR-measurement.

The built-in Automatic Target Recognition ATR1 transmits a laser beam. The reflected light is received by the built-in camera (CCD). The position of the received light spot with respect to the centre of the CCD is computed and the offsets are used to correct the horizontal and vertical angles. The offsets are also used to control the motors which turn the instrument so that the crosshairs are centred on the prism.

In order to minimize the times for measuring, the crosshair is not moved to the exact centre of the prism. The offset can be up to 5mm. Then the Automatic Target Recognition ATR1 measures the offsets between the crosshair and prism centre and corrects the Hz and V angles accordingly.

Therefore the Hz and V angles are measured to the prism-centre, regardless of the crosshair pointing precisely to the centre of the prism.

If the offset is more than 5mm when the prism is exactly aligned and in faultless condition, the Automatic Target Recognition ATR1 must be recalibrated. If excessive offsets occur frequently, contact your Leica Geosystems agency.
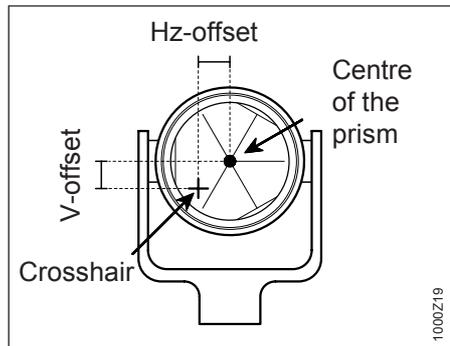


The telescopic field of view is the active field of the ATR. Within this area the prism is identified immediately.

☞ The following functions are valid only for TCA and TCRA instruments.

This mode permits the automatic recognition of stationary targets.

The observer must first use the optical sight to target the prism approximately so that it is located within the telescopic field of view.

When the distance measurement is triggered, the motors move the crosshair close to the centre of the prism to make distance measurement possible.

Lock-mode will enable TCA instruments to follow a moving prism. Distances can be measured whenever the prism stops for a short time (Stop and Go mode).

The icon ⊞ is shown in the lower left area of the status field when the LOCK-mode is activated and before a prism is found.

Switching to LOCK mode requires an initial distance measurement so that ATR1 "learns" the prism.

This measurement is the same as the initial measurement in ATR mode.

If the prism is subsequently moved, the telescope tracks it automatically for as long as the prism is aligned to the instrument.

The displayed angles refer to the crosshair direction during search. Once the prism is static, a distance measurement can be activated using "**DIST**" or "**ALL**". In this case the angles are measured on the centre of the prism after the distance measurement.

After a distance measurement, these corrected angles (for the centre of the prism) are displayed or recorded.

The icon ⊕ is shown in the lower left area of the status field if the **LOCK** mode is active and if the telescope tracks the prism

Any interruption to the tracking of the prism is indicated for about two seconds graphically in the lower left status field by the symbol and also by a continuous acoustic signal (beep).

The LOCK mode is interrupted (LOCK Interrupt), e.g. to measure inbetween to faraway targets without prism (eg. church spires). After the distance has been measured, the ATR immediately returns to its original condition.

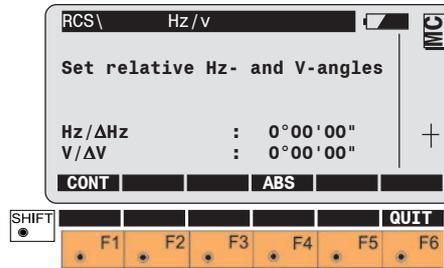This function should be used for measuring to a second prism (Changing the prism).

The icon is shown in the lower left area of the status field, once the L.INT-mode is activated. Measured angles refer to the direction of the crosshair.

At the completion of the distance measurement or after pressing L.GO, the LOCK mode is reactivated and the corresponding icon is shown in the lower left area of the status field.

(Valid only for motorized instruments)

The telescope is automatically pointed at the latest point to be stored. This function is available only if a point was stored after the instrument was switched on.

`PROG` `F2`   Activates the Hz/V mode.

```
RCS\        Hz/v              ▭      MC

Set relative Hz- and V-angles


Hz/ΔHz          :   0°00'00"       +
V/ΔV            :   0°00'00"
 CONT                    ABS
```

`SHIFT`                              `QUIT`
F1    F2    F3    F4    F5    F6

In Hz/V mode, the TPS1100 can be turned by set angle values.

The input options are:

• absolute angle values which relate to the orientation of the TPS1100
• relative angle values which cause the TPS1100 to turn away from its present position by the amount entered.

`F1`   Quits the Hz/V mode and starts the search mode, if ATR is activated.

`F4`   Switches between absolute (ABS) and relative (REL).

# Automatic Reflector Search

If the reflector is in the telescope's field of view, the crosshair is automatically positioned to the reflector when a measurement is triggered. If the target is not within the telescope's field of view, an automatic reflector search is started. Instruments equipped with the option PowerSearch can be switched to PowerSearch mode for a quick detection of prisms.

The shape of the ATR search window is rectangular and the defined area is scanned line by line starting in the center of the searching window.
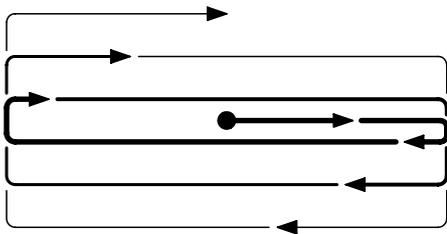


Depending on the working mode of the instrument different sized search windows and different search strategies are used.
The dimension of the search window in RCS mode can be defined in the "RCS Searching Window" function. In RCS mode, a working area can be additionnally defined. This area is automatically scanned if the local search was not successful.

- **ATR and LOCK modes:**

The operator stands at the instrument and can manually position the telescope to the reflector at any time. When a measurement is triggered, a small search window (Hz: 2.5gon / V: 2.5gon) is used to find the reflector as quickly as possible. If the target is lost in LOCK mode the path of the reflector is predicted for a few seconds.

- **RCS mode:**

The operator stands at the reflector and directs the telescope to the target with his preferred positioning mode (e.g. joystick). Because the telescope can only be positioned roughly when standing at the reflector, bigger search windows are used in RCS mode. If a search is triggered manually by pressing ALL or DIST the RCS Searching Window (default size Hz: 30gon / V: 15gon) is scanned starting at the current position of the telescope.

- The dimension of the search window in RCS mode can be defined in the "RCS Searching Window" function.
- A Working Area can be defined in RCS mode. This area is scanned automatically if the local search was not successful.
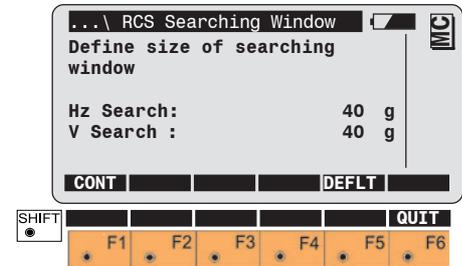
If the target is lost in LOCK mode first the path of the reflector is predicted for a few seconds followed by a search which will by carried out mainly in horizontal direction. The size of the search window depends on the shape of the predicted path. If a Working Area is activated then the entire Working Area is scanned after the respective local searches.

• **PowerSearch**

Instruments equipped with PowerSearch have the quick prism search feature. When PowerSearch is activated, the instrument performs a 360° rotation around its standing axis. If the laser swath of the PowerSearch sensor detects a prism, the rotation is stopped and the ATR performs a fine aiming in vertical direction. If a working area has been defined, PowerSearch is only active within the defined limits.
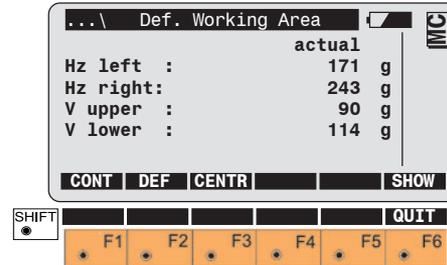
With this function the dimensions of the RCS Searching Window can be defined. If an automatic reflector search is started by pressing ALL or DIST in RCS mode, a search window with the predetermined dimensions is scanned at the current position of the telescope.

```
...\ RCS Searching Window  [    ]  MC
Define size of searching
window

Hz Search:              40  g
V Search :              40  g

CONT              DEFLT
SHIFT                      QUIT
 F1    F2    F3    F4    F5    F6
```

**Hz Search**    extent of search window in Hz-direction

**V Search**    extent of search window in V-direction

F1    To confirm the displayed values and leave the dialog.

F5    Returns all values to default values.

With this function a Working Area can be defined in which the instrument automatically searches for the reflector when working in RCS mode.

```
...\   Def. Working Area         [   ] MC
                           actual
Hz left  :                 171  g
Hz right:                  243  g
V upper  :                  90  g
V lower  :                 114  g

 CONT  DEF  CENTR            SHOW
SHIFT                       QUIT
  F1    F2    F3    F4    F5    F6
```

**Hz left**    left boundary of working area

**Hz right**    right boundary of working area

**V upper**    upper boundary of working area

**V lower**    lower boundary of working area

F1    To confirm the displayed values and return to the previous dialog.

F2    To define a new working area by pointing the telescope to two opposite corners of the working area (left corner - opposite right corner).

F3    To centre the working area to the current telescope position (retains the same size of the WA).

F6    To position the telescope to the upper left / lower right corner of the defined Working Area.

If the instrument is in RCS mode and the determined working area is activated then the entire working area is scanned for the reflector if the target was not found by the standard search method at the current position of the telescope.
If the working area is deactivated only the standard search methods at the current position of the telescope are performed.
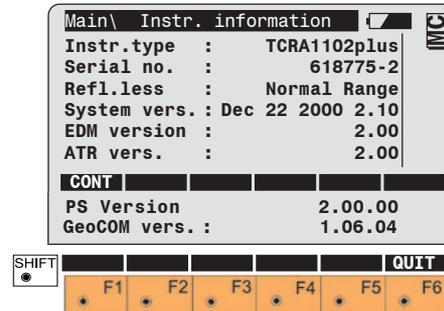
☞ The instrument follows the reflector even if the reflector is outside the Working Area.
If the target is lost outside the Working Area a local search will be started. If the reflector was not found the predefined Working Area is scanned.
On instruments with the optional PowerSearch, the working area can be used to limit PowerSearch to a certain area and when activated, PowerSearch only scans within the defined limits.

### Instrument designation and software version (INFO)

This function displays the most important systems information.

```
Main\  Instr. information
Instr.type  :     TCRA1102plus
Serial no.  :         618775-2
Refl.less   :      Normal Range
System vers.: Dec 22 2000 2.10
EDM version :             2.00
ATR vers.   :             2.00

CONT
PS Version             2.00.00
GeoCOM vers.:          1.06.04

SHIFT                       QUIT
  F1    F2    F3    F4    F5    F6
```

Display of instrument type, serial number, RL EDM type, software version and creation date, EDM version, ATR version, PS (PowerSearch) and GeoCOM version.

### Electronic bubble (LEVEL)

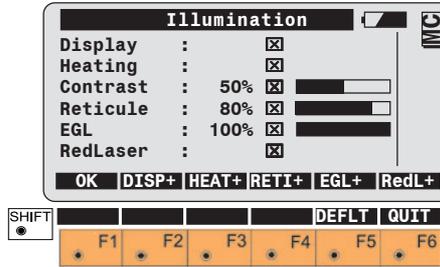Please refer to the description in the section "Levelling-up with the electronic bubble".

Switches on the back lighting and crosshair.

Settings for:
- Back lighting (display) on/off
- Heating of display on/off
- Contrast of display
- Brightness of crosshair illumination
- Brightness of EGL guide light (optional)
- Eyepiece diode laser on/off (optional)
- Red laser on/off (optional)

The current settings are displayed numerically as percentages and graphically as a bar diagram. Optional settings are possible only if the instrument is additionally equipped.

```
┌──────────────────────────────┐
│        Illumination     ▭  MC │
│ Display   :        ⊠          │
│ Heating   :        ⊠          │
│ Contrast  :   50%  ⊠ ▐████▌   │
│ Reticle   :   80%  ⊠ ▐█████▌  │
│ EGL       :  100%  ⊠          │
│ RedLaser  :        ⊠          │
│ OK  DISP+ HEAT+ RETI+ EGL+ RedL+│
└──────────────────────────────┘
SHIFT
        F1    F2    F3    F4  F5  F6
```

F2 — Switches the back lighting on and off.

F3 — Switches the display heating on and off.

F4 — Switches the crosshair illumination on and off.

F5 — The assignment of the function key depends on the equipment installed:
Switches the guide light on and off (EGL); key assignment "EGL+" .
Or:
Switches the eyepiece diode laser on and off; key assignment "DIOD+".

F6 — Switches the visible red laser on and off (only for TCR/TCRM instruments).

⚠ **WARNING:**
**(only for Extended Range Instruments)**

If the visible red laser is switched on do not aim at prisms or reflecting objects through or beside the optical sight. Aiming against prisms is only allowed by looking through the telescope. Using the laser pointer is only permissible within a controlled area (*refer to chapter "Safety Directions"*).
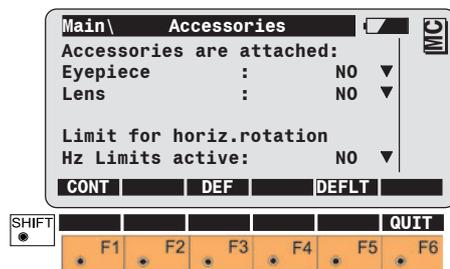
SHIFT F5 — Sets standard values (contrast 50%, crosshair 80%).

☞ At extremely low temperatures or in very bright ambient light conditions the contrast should be set to a higher value than 50%.
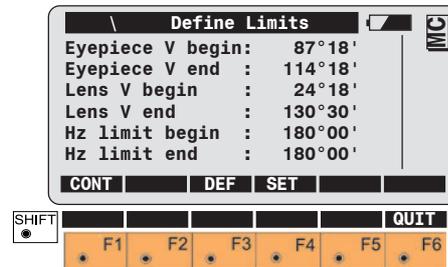
**Eyepiece V begin** Starting value for V-angle of eyepiece.

**Eyepiece V end** Finishing value for V-angle of eyepiece.

**Lens V begin** Starting value for V-angle of objective.

**Lens V end** Finishing value for V-angle of objective.

**Hz limit begin** Starting value for Hz-direction.

**Hz limit end** Finishing value for Hz-direction.

If the Hz direction of the instrument is outside the permitted range but the target is within it, the instrument can still rotate itself towards the target.
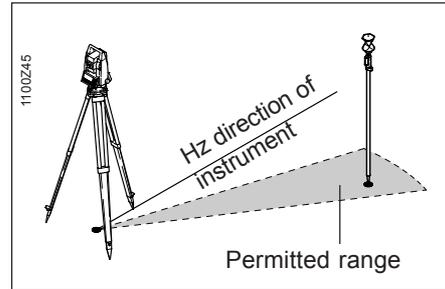


*Rotation towards target possible*

If the Hz direction of the instrument is within the permitted range but the target is outside it, rotation is not possible and an error report appears.

The functions for transferring information between the internal memory and the PC-card are described below. For transfer via RS232 the Leica SurveyOffice PC software is generally used, in which event the instrument is remote-controlled and requires no user interface.
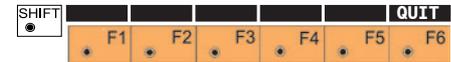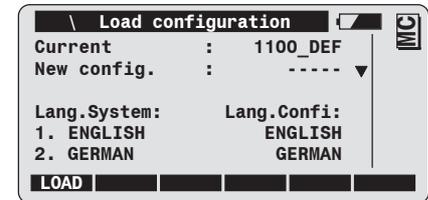


Selects the configuration files from the PC-card in the directory "\tps\conf\".
Displays the languages available in the system or which belong to the configuration file.
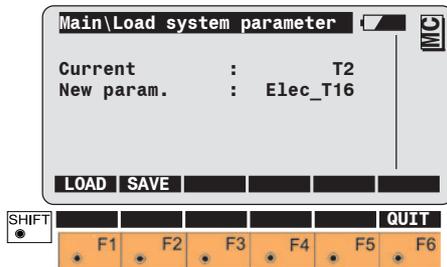
F1   Loads the new configuration.

If no file can be found, the message 659 appears along with the note that no configuration file was found.

A precautionary interrogation (message 658) appears before the actual loading and asks for confirmation of the intention to load a new configuration.

"NO" will then abort the function. "YES" will load the configuration.

```
Main\Load system parameter  ▭▬  [MC]

Current        :        T2
New param.     :   Elec_T16



LOAD  SAVE
SHIFT                                  QUIT
  F1    F2    F3    F4    F5    F6
```

Select the new system-parameter files from the PC-card.

**F1**   Loads the new system-parameters.

**F2**   Stores the current system-parameters.

The following display appears:

```
Main\Save param.to PC-Card  ▭▬  [MC]

Enter filename to save para:
Param. file    :       TEST



SAVE
SHIFT                                  QUIT
  F1    F2    F3    F4    F5    F6
```
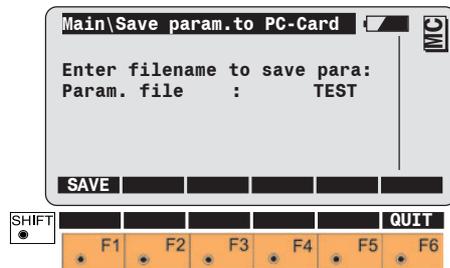
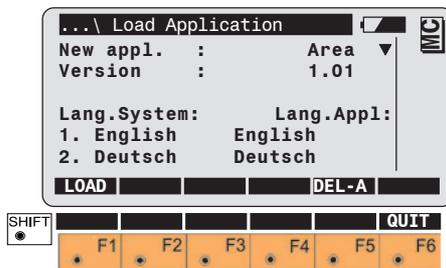Input the name of the system-parameter file to be saved.

**F1**   Stores the file on the PC-card.

# System parameters

## General parameters

This section describes the system-parameters of the TPS1100 instruments.

### Load application

```
...\ Load Application      ▭▱  MC
New appl.   :          Area  ▼
Version     :          1.01

Lang.System:        Lang.Appl:
1. English        English
2. Deutsch        Deutsch
 LOAD              DEL-A
SHIFT                        QUIT
    F1    F2    F3    F4    F5    F6
```
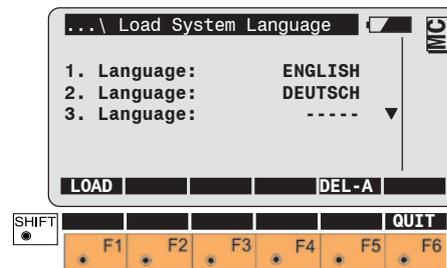
Selects the application from the PC-card in the directory "\tps\appl\".
The column at the right of the diplay shows in which languages the application will be loaded.

**F1** Loads the selected application.
New application versions can be loaded directly; it is not necessary to delete the existing application before.

**F5** Deletes the selected application.

### Load system language

```
...\ Load System Language  ▭▱  MC

1. Language:       ENGLISH
2. Language:       DEUTSCH
3. Language:       -----  ▼

 LOAD              DEL-A
SHIFT                        QUIT
    F1    F2    F3    F4    F5    F6
```

Selects the system languages from the PC-card in the directory "\tps\lang\".
An existing system language can not be overwritten: it must be deleted first.

**F1** Loads a selected system language.

**F5** Deletes a selected system language.

**Date**

Sets the date.
Choice of layout: 09-11-98 or
11.09.98.

**Date form.**

Selects the date format.
Choice of layout:
Day/Month/Year
Month/Day/Year
Year/Month/Day

**Time**

Sets the time.

**Time form.**

Sets the time format.
Choice between 24h clock
and 12h clock with am/pm

**Alpha mode**

The alphanumeric input can be either
through the function keys or through
the numeric keys. If numeric keys are
used, there is a choice between
"Numeric keys" and "Numeric exten-
ded". In "Numeric extended" mode,
more characters are available.

**Key beep**

Sets the volume of the beep emitted
when the keys are pressed. The
beep is always active for messages.
There is a choice between beep off
(None), soft beep (Low) and loud
beep (Loud).

# Configuration parameters

## Autoexec.

Selects the application, which will then be started automatically immediately after switching on.
The list includes the following permanently-available options: "Main menu", "Measurement & Recording" and "Enter Station Data". Also, all of the applications programs loaded are listed.
The function or application selected is automatically started whenever the instrument is switched on.

## Language

Selects the system language (a maximum of three languages can be stored). English is always available and cannot be deleted.

## Dist. Unit

**Units of distance measurement:**

| | |
|---|---|
| Metre | Metres (m) |
| Int.Ft | International feet, storage in US feet [fi] |
| Int.Ft/Inch | Int. feet, inches and 1/8 inches (0' 00 0/8fi), storage in US feet [fi] |
| US Ft | US feet [ft] |
| US Ft/Inch | US feet, inches and 1/8 inches (0' 00 0/8fi) [ft] |

## Dist. Dec.

**Decimal places for distance:**

| | |
|---|---|
| Metre | 0,1,2,3 |
| Int.Ft | 0,1,2,3 |
| Int.Ft/Inch | 0 |
| US Ft | 0,1,2,3 |
| US Ft/Inch | 0 |

## Angle Unit

**Units of angle measurement:**
400gon
360° ' "
360° dec
6400 mil

## Angle Dec.

**Decimal places for angle:**

TCx1101/1102:
- 400 gon, 360°'", 360°dec. => 2, 3, 4
- 6400 mil => 1, 2, 3

TCx1103/1105:
- 400 gon, 360° dec. => 2, 3, 4 (in steps of five units)
- 360°'" => 2, 3, 4
- 6400 mil => 1, 2, 3

# *Configuration parameters, continued*

## *Temp. Unit*

### Units of temperature
° C        Degrees Celsius
° F        Degrees Fahrenheit

## *Press. Unit*

### Units of atmospheric pressure
mbar       millibars
mm Hg     millimetres of mercury
inch Hg    inches of mercury
hPa        hectopascals
psi         pounds per square inch

## *Coord. Seq.*

### Sequence of coordinates in display
North / East (X, Y)
East / North (Y, X)

For further information, please refer to the section "GSI parameters".

## *Hz system*

### Sense of Hz-circle system
North Azimuth(+)  Clockwise angle measurement (+) starting at North
North anticlw (-)  Anticlockwise angle measurement (-) starting at North
South Azimuth  Clockwise angle measurement (+) starting at South

## *Face I*

### Definition of faces:
V-drive left    Vertical drive on the left side
V-drive right   Vertical drive on the right side

*Compensator*

*Hz-Corr.*

**ON** Switches on the compensator, which measures the longitudinal and transverse tilts of the vertical axis. The V-angles are relative to the plumb line.

**OFF** Switches off the compensator. ⬦ appears in the status display. The V-angles are relative to the vertical axis.

☞ The working range of the two-axis compensator is 6' (0.10 gon) for each axis.

**ON** Switches on the Hz correction.
The Hz measurements are corrected for the following errors:
1. Line-of-sight error
2. Tilting-axis error
3. Standing-axis tilt (only for compensator ON).

**OFF** Switches off the Hz correction. The Hz measurements are not corrected.
⬦ appears in the status display.

**Examples of compensator / Hz corrections:**

1. Compensator **ON**, Hz corrections **ON**.
The V-angles are relative to the plumb line. The Hz measurements are corrected for line-of-sight error, tilting-axis error and standing-axis tilt.

2. Compensator **ON**, Hz corrections **OFF**
The V-angles are relative to the plumb line. The Hz measurements are not corrected for line-of-sight error, tilting-axis error or standing-axis tilt.

3. Compensator **OFF**, Hz corrections **ON**
The V-angles are relative to the standing axis. The Hz measurements are corrected for line-of-sight error and for tilting-axis error.

4. Compensator **OFF**, Hz corrections **OFF**
The V-angles are relative to the standing axis. Hz corrections are not applied.

# Configuration parameters, *continued*

*Sect. Beep*

**Hz sector beep**
Sets the beep (ON/OFF) for angle sectors.

*Sect. Angle*

**Hz sector angle**
Enters the angles for which a beep should sound.
When the angle approaches 4°30' (5 gon), the beep becomes regular.
At 27' (0.5 gon) the beep is continuous.
At 16" (0.005 gon) there is no beep.
The angle count always commences at 0°00'00" (0.0000 gon).

*Release V-angle*

**Running**   This parameter activates the vertical angle mode "Running" for the following measurements. In this mode, the vertical angle is continuously updated with the telescope movement.

☞ **Pay attention to the following when using V-angle setting "running" for the determination of remote heights:**
The active reflector height is applied in the calculation of remote point elevations. The reflector height must be manually set to zero to display and record the elevation of the targeted remote point.

☞ After a distance measurement, vertical angle, slope distance, height difference, and the elevation coordinate are displayed as running values. Slope distance, height difference, and the elevation coordinate of the target point are calculated from the initial horizontal distance and currently displayed vertical angle. The REC-function records the displayed values in the measurement file.

**Hold after DIST**   This parameter activates the vertical angle mode "Hold after DIST" for the following measurements. In this mode, the vertical angle is fixed after a distance measurement, whereas the horizontal angle is running.

# Configuration parameters, *continued*

## *V-Display*

**Selects the V-angle display**

- **Zenith angle**
  V = 0 in zenith
- **Elev. angle**
  V = 0 in horizontal (elevation angle)
  V-angles are positive above the horizon and negative below it.
- **Elev. angle %**
  V = 0 in horizontal
  V-angles are expressed in % and are positive above the horizon and negative below it.

## *Power mode*

Sets automatic switchoff criteria. These become effective after the set time has elapsed, provided that the keyboard and interface have not been used meanwhile.

**Selects the switch-off option**
- **Sleep after ...**
  Goes into sleep mode after the number of minutes set. In this energy-saving mode the power consumption is reduced by about 60%. Active functions and applications can be resumed after waking.
- **Auto off after ...**
  The instrument switches off automatically after the number of minutes set.
- **Remains on**
  The instrument remains permanently switched on.

## *Power Time*

**Selects switchoff time in minutes:**
Enters the time after which the instrument is to go into power-saving mode or to switch off.

## *Dist. Delay*

Enters how long the display should appear during the distance measurement (values between 0 and 3 seconds are possible).

# *Configuration parameters, continued*

### *PPM entry*

Choice between display mask for reduced distance corrections (ppm atmospheric) for standard applications and display mask for extended distance corrections (ppm atmospheric + geometrical).

**PPM Atmospheric**
Direct input of the ppm value (ppm total) or input of temperature and pressure for automatic calculation of ppm atmospheric.

**PPM atmospheric + geometrical**
A distinction is made between atmospheric corrections (temperature, relative air humidity and air pressure) and geometrical corrections (projection distortion, scale factor and height above the reference datum), the sum of which is used as the final distance correction.

### *Info / Atrib*

Display of the last attribute entry

**Default value**
The default value defined in the codelist is displayed and can be overwritten.

**Last user value**
Instead of default values or choicelists, the last entered values (Info's/Attributes) are displayed for each code.
Note predefined default values for Infos and attributes are overwritten by the last entered values and can not be anymore recovered!

*Auto Dist*

**ON**      Activates automatic distance measurement after choice of EDM-program with function key.

**OFF**     Deactivates automatic distance measurement after choice of EDM-program with function key.

*Pt. Id. mode*

In the measurement dialog and in the programs, the Point Id is defined as a running point number with corresponding increment.

**Mode "Change to Indiv":**
The user can enter individual Point Ids manually at any time. After recording, the active running Point Id will be displayed again.

**Mode "Remain running":**
The manual entry of a new Point Id defines a new running Point Id.

*Offs. Mode*

Determines whether the values for target eccentricity are to be retained after storage or are to be set to zero (choice between "Permanent" and "No reset after REC").
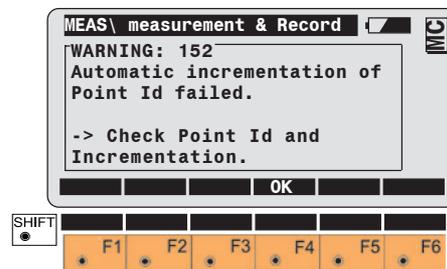
*Increment*

**Incrementation of point numbers**
Numeric and alphanumeric components of the running point number can be incremented individually, enabling the incrementation to be defined as a numerical template.

For example, the running point number 12A2001 is incremented by 102001 after the point number 12B22002 has been stored, and then again for the point number 12C23003, and so on.

Letters can be from A - z (ASCII 065 - 122). In this connection it is not possible to transfer numbers to letters and vice-versa and within the alphanumeric range.

Examples:

| Pt.Id. | 12z001 | 12A999 | 12Az100 |
|---|---|---|---|
| **Increment** | 1000 | 000001 | 1001000 |
| **Explanation** | no transfer of letters to numbers | no transfer of numbers to letters | no transfer of letters |

```
MEAS\ measurement & Record
WARNING: 152
Automatic incrementation of
Point Id failed.

-> Check Point Id and
Incrementation.

            OK
```

SHIFT
F1   F2   F3   F4   F5   F6

F4    Confirms the warning and the change in the point number or in the increment.

# Work settings

### Meas Job

Displays the measuring jobs which are available and selects the appropriate one.

### Codelist

Displays the code lists which are available and selects the appropriate one.

### Quick-Code

Stores the code block before or after the measurement if the quick-code method is used. Choice between "REC before ALL" and "REC after ALL".

### Data Job

Displays the data jobs which are available and selects the appropriate one.

# Data format

## Introduction

This chapter describes the data structure and organization of the Leica Geosystems GSI (Geo Serial Interface). The GSI data structure is used for all data transferred between the Leica Geosystems electronic survey instruments, and also defines the data stored internally. The following information describes the data structure of the TPS1100 instruments and contains some specific features only applicable to these instruments.
Data transferred between a Leica Geosystems instrument and a computer will conform to the GSI data structure (also called GSI data format).

## Format with 8 or 16 characters

There is a choice between storing 8 characters (places) or 16.

From Version 2.20 onwards, there is a choice of two GSI formats, with word lengths of 8 and 16 characters respectively. When 16 characters are stored and supported the following special conditions apply:

- A measurement block is tagged with * at the first position.

- A data word includes the data at positions 7 to 23 instead of at 7 to 15.

**GSI-8 format**

```
84..10+12345123.
 WI  ZS   DA   LE
84..10+0000123456789123.
```
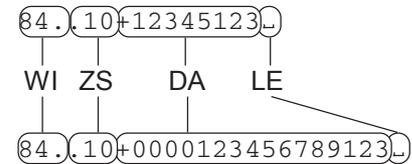
**GSI-16 format**

WI   Word index
AI   Additional information
DA   Data
BL   Blank = separating character

## Block concept

Data transmitted by instruments over the GSI interface is composed of blocks. Each one of these data blocks is treated as a whole, and ends with a terminator (CR, or CR LF). There are two types of data block:

1  Measurement blocks
2  Code blocks

**Measurement blocks** contain a point number and measurement information. They are designed primarily for triangulation, traverse, detail, and tacheometric surveys. Code blocks are designed primarily for recording identification codes, data-processing codes and information. However, they can also be used for recording measurement information such as instrument and target heights, and tie distances.

**Each data block** has a block number. The block numbers start with 1 and are incremented by 1 each time that a new data block is stored.

## Structure of a block

A data block consists of words, each with 16 (24) characters. The maximum number of words in the TPS1100 is 12.

## Measurement block

The words of a measurement block are determined by the format which is set on the survey instrument.

Example:    Measurement block with TPS1000 default values

| Word 1 | Word 2 | ..... | ..... | Word n | |
|---|---|---|---|---|---|
| Point number | Hz direction | V angle | Slope distance | ppm mm | Term |

## Code block

| Word 1 | Word 2 | ..... | ..... | Word n | |
|---|---|---|---|---|---|
| Code number | Info1 | Info2 | | Info n | Term |

The first word of a code block is always the code number. A code block can contain between one and eight words.

## Terminator of a data block

The terminator is sent by the instrument after data blocks, after the response sign (?) and after other messages.
The standard terminator is CR/LF (carriage return/line feed). TPS1100 instruments can be set to transmit and accept only CR.

# *Structure of a word*

Each word has a fixed length of 16 (24) characters.

```
W 1 w 2  .  .  .  .  + 1 2 3  4  5  6  7  8 ↵
 1  2  3 4 5 6 7 8 9 10 11 12 13 14 15 16
```

| Position | Meaning |
|---|---|
| 1 - 2 | Word index |
| 3 - 6 | Information relating to data |
| 7 - 15 (23) | Data |
| 16   (24) | Blank = separating character |

Each word has a two-digit word index to identify it. These two digits occupy the first two positions of the word. Word index numbers lie in the range 01 to 99.

The word indices are listed on the following pages.
In some applications special word indices are used. They are described in the application manuals.

## Word identification table

| Word index | Description |
|---|---|
| **General** | |
| 11 | Point number (includes block number) |
| 12 | Instrument serial number |
| 13 | Instrument type |
| 18 | Time format 1: pos. 8-9 year, 10-11 sec, 12-14 msec |
| 19 | Time format 2: pos. 8-9 month, 10-11 day, 12-13 hour, 14-15 min |
| **Angles** | |
| 21 | Horizontal circle (Hz) |
| 22 | Vertical angle (V) |
| 25 | Horizontal circle difference (Hz0-Hz) |
| **Distances** | |
| 31 | Slope distance |
| 32 | Horizontal distance |
| 33 | Height difference |
| **Codebl.** | |
| 41 | Code number (includes block number) |
| 42 - 49 | Information 1-8 |

| Word index | Description |
|---|---|
| **Distance (additional information)** 51 52 53 58 59 | Constants (ppm,mm) Number of measurements, standard deviation Signal strength Reflector constant  (1/10 mm) ppm |
| **Point coding** 71 72 - 79 | Point code Attrib. 1-8 |
| **Coordinates** 81 82 83 84 85 86 87 88 | Easting  (target) Northing   (target) Elevation  (target) Station easting  (Eo) Station northing  (No) Station elevation  (Ho) Reflector height (above ground) Instrument height (above ground) |

☞ All words can be used in measurement blocks except words 41 - 49, which are reserved.

☞ A code block begins with 41, the word index for a code number.

Positions 3 to 6 contain information which relates to the data in positions 7 to 15 (23).

| Position in word | Explanation | Applicable to |
|---|---|---|
| 3 | Extension for word index | Digital level |
| 4 | Compensator information 0 Automatic height  index and monitoring of levelling up: OFF 3 Automatic height  index and monitoring of levelling up: ON | All words containing angle information |
| 5 | Input mode 0 Value measured  automatically 1 Manual input from keyboard 2 Angle: All Hz-corrections for Line of sight error, tilting axis and tilt of standing axis (only with compensator: on): ON Distance: Correction for measurement to vertical prism 3 Angle: All Hz-corrections: OFF 4 Result calculated from functions | All words containing measured data |

| Position in word | Explanation | Applicable to |
|---|---|---|
| 6 | Units<br>0 Metre (last digit = 1mm)<br>1 US-Feet (last digit = 1/1000ft)<br>2 400gon<br>3 360° decimal<br>4 360° sexagesimal<br>5 6400 mil<br>6 Metre (last digit = 1/10mm)<br>7 US-Feet (last digit = 1/10000ft)<br>8 Metre (last digit = 1/100mm) | All words containing measured data |

| Position in word | Explanation | Applicable to |
|---|---|---|
| 7 | Extension of word identification | All words |
| 8-15(23) | The data comprises 8 (16) numeric or alphanumeric characters<br><br>Note that certain words can contain two data blocks, i.e. pairs. These are transferred automatically, complete with signs, from the survey instrument:<br>e.g.  0123  -035<br>　　　ppm    mm | All words containing data<br><br>Words 51 - 59 |

☞ A point in any of the positions 3 to 6 means that there is no information.

For the data words Point number (WI = 11) and Code number (WI = 41), the block number occupies positions 3 to 6.

## Separating character (position 16/24)

| Position in word | Explanation | Applicable to |
|---|---|---|
| 16 (24) | Blank (separating character) | all words |

☞ The last data word of a block must also contain the separating character and CRLF.

## Block number

Each data block is allocated a block number by the recording device. Block numbers start at 1 and increment automatically.
The block number is contained in the first word of the block. The first word of a measurement block is the point number (WI = 11). The first of a code block is the code number (WI = 41).

The structure of the first word of a data block is as follows:

| Position in word | Explanation |
|---|---|
| 1-2 | Word index 11 or 41 |
| 3-6 | Block number (assigned by recording device) |
| 7 | Sign + or - |
| 8-15(23) | Point number, code number or text |
| 16(24) | Blank = separating character |

The GSI data format does not contain a decimal point.
On transferring data to the computer, the decimal point must be inserted by the computer in accordance with the units indicated in position 6 of the word.

This section describes the types of data measured and transmitted by an electronic theodolite.

| Position 6 in data word | Units | Places before point | Places after point | Example |
|---|---|---|---|---|
| 0 | Metre (last digit = 1mm) | 5 | 3 | 12345.678 |
| 1 | Feet (last digit = 1/1000ft) | 5 | 3 | 12345.678 |
| 2 | 400gon | 3 | 5 | 123.45670 |
| 3 | 360° decimal | 3 | 5 | 123.45670 |
| 4 | 360° sexagesimal | 3 | 5 | 123.45120 |
| 5 | 6400mil | 4 | 4 | 1234.5670 |
| 6 | Metre (last digit = 1/10mm) | 4 | 4 | 1234.5678 |
| 7 | Feet (last digit = 1/10000ft) | 4 | 4 | 1234.5678 |
| 8 | Metre (last digit = 1/100mm) | 3 | 5 | 123.45678 |

| Word 1 | Word 2 | Word 3 | Word 4 | Word 5 |
|--------|--------|--------|--------|--------|
| Point no | Hz circle | V circle | Slope distance | ppm mm |

The following table shows the structure of a measurement block for 8 characters:

| Word | Position | Explanation | Characters |
|------|----------|-------------|------------|
| Point number | 1 - 2 | Word index for point number | 11 |
| | 3 - 6 | Block number (set by recording device) | num |
| | 7 | Sign | +,- |
| | 8 - 15 | Point number | α num |
| | 16 | Blank = separating character | ↵ |
| Hz circle | 17 - 18 | Word index for Hz circle | 21 |
| | 19 | Reserved | . |
| | 20 | Automatic index information | 2, 3 |
| | 21 | Input mode | 0 - 4 |
| | 22 | Units | 2,3,4,5 |
| | 23 | Sign | +,- |
| | 24 - 26 | Degrees | num |
| | 27 - 28 | Minutes (resp. 1/100 grad) | num |
| | 29 - 31 | Seconds (resp. 1/10000 grad) | num |
| | 32 | Blank = separating character | ↵ |

| Word | Position | Explanation | Characters |
|------|----------|-------------|------------|
| V circle | 33 - 34<br>35<br>36<br>37<br>38<br>39<br>40 - 42<br>43 - 44<br>45 - 47<br>48 | Word index for V circle<br>Reserved<br>Automatic index information<br>Input mode<br>Units<br>Sign<br>Degrees<br>Minutes (or 1/100 grad)<br>Seconds (or 1/10000 grad)<br>Blank = separating character | 22<br>.<br>2, 3<br>0 - 4<br>2,3,4,5<br>+,-<br>num<br>num<br>num<br>↵ |
| Slope distance | 49 - 50<br>51 - 52<br>53<br>54<br>55<br>56 - 60<br>61 - 63<br>64 | Word index for slope distance<br>No significance<br>Input mode<br>Units<br>Sign<br>Metres/feet<br>Decimals of metre/feet<br>Blank = separating character | 31<br>..<br>0, 2<br>0,1<br>+,-<br>num<br>num<br>↵ |
| ppm / mm | 65 - 66<br>67 - 70<br>71<br>72 - 75<br>76<br>77 - 79<br>80 | Word index for ppm, mm<br>No significance<br>Sign<br>ppm<br>sign<br>mm<br>Blank = separating character | 51<br>....<br>+,-<br>num<br>+,-<br>num<br>↵ |
| End Character | 81<br>(82) | Carriage Return<br>Line Feed | CR<br>LF |

| Word 1 | Word 2 | | Word 5 |
|--------|--------|--|--------|
| Point No | Hz circle | | ppm / mm |

The table below shows in detail the layout of a code block:

| Word | Position | Explanation | Characters |
|------|----------|-------------|------------|
| Codenumber | 1 - 2<br>3 - 6<br>7<br>8 - 15<br>16 | Word index for code number<br>Block number (set by recording instrument)<br>Sign<br>Code number<br>Blank = separating character | 41<br>num<br>+,-<br>$\alpha$ num<br>↵ |
| Information 1 | 17 - 18<br>19 - 22<br>23<br>24 - 31<br>32 | Word index for Information 1<br>No significance<br>Sign<br>Information 1<br>Blank = separating character | 42<br>....<br>+,-<br>$\alpha$ num<br>↵ |
| Information 2 | 33 - 34<br>35 - 38<br>39<br>40 - 47<br>48 | Word index for Information 2<br>No significance<br>Sign<br>Information 2<br>Blank = separating character | 43<br>....<br>+,-<br>$\alpha$ num<br>↵ |
| Information 3 | 49 - 50<br>51 - 54<br>55<br>56 - 63<br>64 | Word index for Information 3<br>No significance<br>Sign<br>Information 3<br>Blank = separating character | 44<br>....<br>+,-<br>$\alpha$ num<br>↵ |
| Information 4 | 65 - 66<br>67 - 70<br>71<br>72 - 79<br>80 | Word index for Information 4<br>No significance<br>Sign<br>Information 4<br>Blank = separating character | 45<br>....<br>+,-<br>$\alpha$ num<br>↵ |
| End Char | 81<br>(82) | Carriage Return<br>Line Feed | CR<br>LF |

# Care and transport

## Transport

☞ When dispatching the instrument, always use the complete original Leica Geosystems packaging (case and cardboard box).

When transporting the instrument **in the field**, always make sure that you:
• 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.

Never carry the instrument loose in a **road vehicle**. It can be affected by shock and vibration. Always carry it in its case and secure it.

When transporting the instrument by **rail, air or ship**, always use the complete original packaging (case and cardboard box), or its equivalent, to protect it against shock and vibration.

☞ After transport, or after long periods of storage, inspect the field adjustment parameters given in this user manual before using the instrument.

## Maintainance for motorized drives

An inspection of the drives in TCM, TCRM, TCA, or TCRA instruments must be done in a Leica Geosystems service shop:
• After about 4000 hours operation
• Twice a year in case of permanent use of the instrument (e.g. in monitoring applications)

## *Storage*

☞ **Temperature limits**
(-40°C to +70°C / -40°C to +158°F) Respect the temperature limits when storing the instrument, particularly in summer if the instrument is inside a vehicle.

☞ **Damp instruments** must be unpacked. Dry the instrument, the case, the foam inserts and the accessories at not more than 40°C / 108°F and clean them. Do not repack until everything is completely dry.

## *Cleaning and drying*

☞ **Objective, eyepiece and prisms**
• Blow dust off lenses and prisms.
• Never touch the glass with your fingers.
• Use only a clean, soft, lint-free cloth for cleaning.
  If necessary, moisten the cloth with pure alcohol.

Use no other liquids; these may attack the polymer components.

☞ **Cables and plugs**
Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables. Unplugging connecting cables or removing the PCMCIA card during the measurement may cause loss of data. Always switch off the instrument before removing the cables or the PCMCIA card.

☞ **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.

# Safety directions

The following directions should enable the person responsible for the TPS-System 1100, 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 TPS-System 1100 electronic theodolites and total stations are intended for the following applications:

• Measuring horizontal and vertical angles
• Measuring distances (TC-models with integrated EDM, T-models with removable EDM)
• Recording measurements
• Computing by means of application software
• Automatic target recognition (with ATR)
• Visualizing the aiming direction (with EGL guide light)
• Visualizing the vertical axis (with the laser plummet).

## Prohibited uses

• Use of the product without instruction
• Use outside of the intended limits
• Disabling safety systems
• 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
• Use after misappropriation
• Use with accessories from other manufacturers without the prior express approval of Leica Geosystems
• Aiming directly into the sun
• Inadequate safeguards at the measuring station (e.g. when measuring on roads)

- Controlling machines, or controlling moving objects or similar, with the automatic target recognition ATR.

- Deliberate dazzling of third parties

⚠ **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 total station is not to be operated until the user has been instructed how to work with it.

**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.

*See chapter "Technical specifications".*

# Responsibilities

**Area of responsibility for the manufacturer of the original equipment:**
**Leica Geosystems AG, CH-9435 Heerbrugg (hereinafter referred to as Leica Geosystems):**
Leica Geosystems 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 Geosystems accessories:**

☞ The manufacturers of non-Leica Geosystems accessories for the total stations are responsible for developing, implementing and communicating safety concepts for their products, and are also responsible for the effectiveness of those safety concepts in combination with the Leica Geosystems product.

**Responsibilities of the person in charge of the instrument:**

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

**The person in charge of the instrument has the following duties:**
• To understand the safety instructions on the product and the instructions in the user manual;
• To be familiar with local regulations relating to accident prevention;
• To inform Leica Geosystems 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 under damp or inclement conditions. If moisture penetrates these devices, the user may receive an electric shock.

**Precautions:**

Use the charger and the PCMCIA-card reader only indoors, in dry rooms. Protect them from damp. If the devices are damp, do not use them.

⚠️ **WARNING:**
If you open the charger, either of the following actions may cause you to receive an electric shock:

• Touching live components;
• Using the devices after incorrect attempts to carry out repairs.

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

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

**Precautions:**

Periodically carry out test measurements and perform the field adjustments indicated in the user manual, particularly after the instrument has been subjected to ab-normal 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 lightning.

Precautions:

Do not carry out field surveys during thunderstorms.

**CAUTION:**
Be careful when pointing a total station towards the sun, because the telescope functions as a burning glass and can injure your eyes and/or cause damage inside the EDM or the EGL light guide.

**Precautions:**

Do not point the telescope directly at the sun.

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

**Precautions:**

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

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

**Precautions:**

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

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

**Precautions:**

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

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

**Precautions:**

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

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

**Precautions:**

Before dispatching the equipment or disposing of it, discharge the batteries by running the instrument in tracking mode until they are flat.

⚠️ **CAUTION:**
If the accessories used with the instrument are not properly secured and the equipment is subjected to mechanical shock (e.g. blows, falling), 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) 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.

**CAUTION:**
Only Leica Geosystems - authorized workshops are entitled to repair these products.

*Integrated distancer (infrared laser)*

The EDM module built into the total stations produces an invisible infra-red beam which emerges coaxially from the telescope objective.
The product is a Class 1 laser product in accordance with:
• IEC 60825-1:1993 "Radiation safety of laser products"
• EN 60825-1:1994 + A11:1996 "Radiation safety of laser products"

The product is a Class I laser product in accordance with:
• FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations)

Class 1/I 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.

Class 1 Laser Product

according to IEC 60825-1:1993
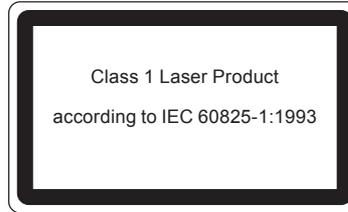
| Beam divergence: | 1.8 mrad |
| Pulse duration: | 800 ps |
| Maximum radiant power: | 0.33 mW |
| Maximum radiant power per pulse: | 4.12 mW |
| Measurement uncertainty: | ± 5% |

Exit for infrared beam (invisible)



Type: TC.....          Art.No.: ......
Power: 12V/6V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured:1998
Made in Switzerland    S.No.: ......

CE

This laser product complies with 21CFR 1040 as applicable.
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.

As an alternative to the infrared beam, the EDM incorporated into the total station produces a visible red laser beam which emerges from the telescope objective.

⚠️ **WARNING:**
Two types of distancers with visible laser are available:

• Total stations with distancers of **laser class 3R resp. IIIa** - identifiable by:
    • the type plate in the battery compartment **with** note to "+Reflectorless Ext. Range",
    • a laser emission indicator lamp on the eyepiece side of the telescope cover,
    • a warning label below the memory card compartment: "Laser class 3R" and "Class IIIa LASER PRODUCT".
• Total stations with distancers of **laser class 2 resp. II** - identifiable by:
    • the type plate in the battery compartment **without** note to "+Reflectorless Ext. Range",
    • a warning label below the memory card compartment: "Laser class 2" and "Class II LASER PRODUCT".

**Products with an integrated distancer of laser class 3R resp. IIIa**

**The product is a Class 3R laser product in accordance with:**
• IEC 60825-1:1993 + A1:1997 + A2:2001 : "Radiation safety of laser products"

**The product is a Class IIIa laser product in accordance with:**
• FDA 21CFR Ch.I §1040 : 1988 (US Department of Health and Human Service, Code of Federal Regulations).

Class 3R / IIIa laser products: Direct intrabeam viewing is always hazardous. Avoid direct eye exposure. The accessible emission limit is within five times the accessible emission limits of Class 2 / II in the wavelength range from 400nm to 700nm.

⚠ **WARNING:**
Direct intrabeam viewing is always hazardous.

**Precautions:**

Do not stare into the beam or direct it towards other people unnecessarily. These measures are also valid for the reflected beam.

⚠ **WARNING:**
Looking directly into the reflected laser beam could be dangerous to the eyes when the laser beam is aimed at areas that reflect like a mirror or emit reflections unexpectedly (e.g. prisms, mirrors, metallic surfaces, windows).

**Precautions:**

Do not aim at areas that are essentially reflective, such as a mirror, or which could emit unwanted reflections. Do not look through or beside the optical sight at prisms or reflecting objects when the laser is switched on (in Laserpointer or distance measurement mode). Aiming at prisms is only permitted when looking through the telescope.

⚠ **WARNING:**
The use of Laser Class 3R / IIIa equipment can be dangerous.

**Precautions:**

To counteract hazards, it is essential for every user to respect the safety precautions and control measures specified in the standard IEC 60825-1: 1993 + A1:1997 + A2:2001, within the hazard distance *). Pay particular attention to Section Three "User's Guide".

There follows here below an interpretation of the main points in the relevant section of the standard quoted.

Class 3R laser products used on construction sites and outdoors (surveying, alignment, levelling):

a) Only qualified and trained persons should be assigned to install, adjust and operate the laser equipment.

b) Areas in which these lasers are used should be posted with an appropriate laser warning sign.

c) Precautions should be taken to ensure that persons do not look directly, with or without an optical instrument, into the beam.

d) The laser beam should be terminated at the end of its useful beam path and should in all cases be terminated if the hazardous beam path extends beyond the limit (hazard distance *)) of the area in which the presence and activities of personnel are monitored for reasons of protection from laser radiation.

e) The laser beam path should be located well above or below eye level wherever practicable.

f)  When not in use the laser product should be stored in a location where unauthorized personnel cannot gain access.

g) Precautions should be taken to ensure that the laser beam is not unintentionally directed at mirror-like (specular) surfaces (e.g. mirrors, metal surfaces, windows). But, more importantly, at flat or concave mirror-like surfaces.

*) The hazard distance is the distance from the laser at which beam irradiance or radiant exposure equals the maximum permissible value to which personnel may be exposed without being exposed to a health risk.

Products with an integrated distancer of laser class 3R resp. IIIa this hazard distance is 1000m (3300ft). At this distance, the laser beam rates as Class 1 (= direct intrabeam viewing is not hazardous).

## Labelling



Laser Radiation
Avoid Direct Eye Exposure

Class 3R Laser Product
according to IEC 60825-1:1993 +
A2:2001

$P_0 \leq 4.75$ mW
$\lambda = 620 - 690$ nm

**3R**

Exit for laser beam (visible)

1100Z54

1100Z33

**AVOID EXPOSURE**
Laser radiation is emitted
from this aperture

**3R**

**DANGER**
LASER RADIATION - AVOID
DIRECT EYE EXPOSURE
620-690nm/4.75mW max.
CLASS IIIa LASER PRODUCT
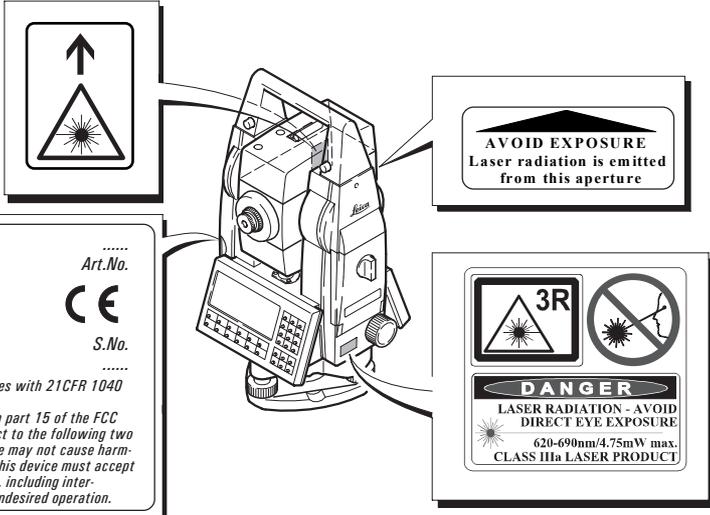
*Type: TCR....*
*+Reflectorless Ext. Range*     ......
Art.No.
*Power: 12V/6V ⎓, 1A*
*Leica Geosystems AG*
*CH-9435 Heerbrugg*    C E
*Manufactured: ......*     S.No.
*Made in Switzerland*     ......
*This laser product complies with 21CFR 1040
as applicable.
This device complies with part 15 of the FCC
Rules. Operation is subject to the following two
conditions: (1) This device may not cause harm-
ful interference, and (2) this device must accept
any interference received, including inter-
ference that may cause undesired operation.*

| Beam divergence: | 0.15 x 0.35 mrad |
|---|---|
| Pulse duration: | 800 ps |
| Maximum radiant power: | 4.75 mW |
| Maximum radiant power per pulse: | 59.4 mW |
| Measurement uncertainty: | ± 5% |

**Products with an integrated distancer of laser class 2 resp. II**

**The product is a Class 2 laser product in accordance with:**
• IEC 60825-1:1993 "Radiation safety of laser products"
• EN 60825-1:1994 + A11:1996 "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)

**Class 2/II laser products:**
Do not stare into the beam or direct it unnecessarily at other persons. Eye protection is normally afforded by aversion responses including the blink reflex.

**WARNING:**
It can be dangerous to look into the beam with optical equipment (e.g. binoculars, telescopes)

**Precautions:**
Do not look directly into the beam with optical equipment.

**Labelling**

Laser Radiation
Do not stare into beam
Class 2 Laser Product
according to IEC 60825-1:1993
$P_0 \leq 0.95$ mW
$\lambda = 620 - 690$ nm

2    >1/4s

AVOID EXPOSURE
Laser radiation is emitted
from this aperture

*Type: TCR....          Art.No.: ......*
*Power: 12V/6V ⎓, 1A max*
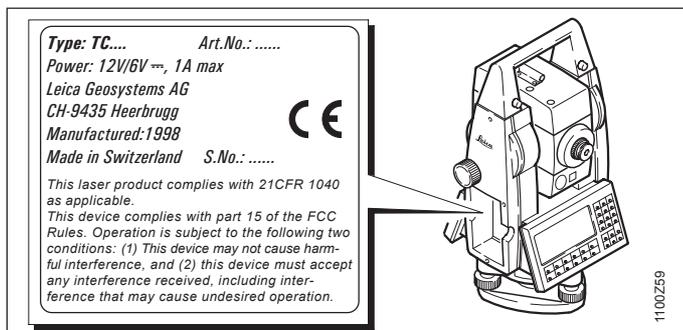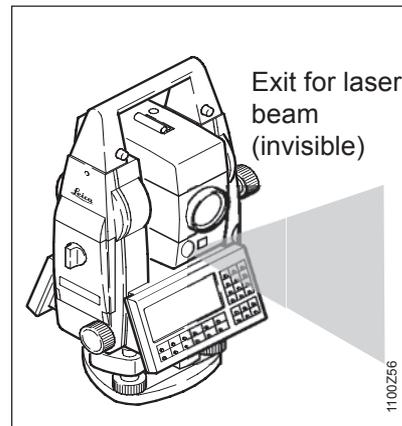*Leica Geosystems AG*
*CH-9435 Heerbrugg*
*Manufactured:1998*
*Made in Switzerland     S.No.: ......*

CE

*This laser product complies with 21CFR 1040*
*as applicable.*
*This device complies with part 15 of the FCC*
*Rules. Operation is subject to the following two*
*conditions: (1) This device may not cause harm-*
*ful interference, and (2) this device must accept*
*any interference received, including inter-*
*ference that may cause undesired operation.*

CAUTION
LASER RADIATION - DO NOT
STARE INTO BEAM
620-690nm/0.95mW max.
CLASS II LASER PRODUCT

2    >1/4s

1100Z39

| Beam divergence: | 0.15 x 0.35 mrad |
|---|---|
| Pulse duration: | 800 ps |
| Maximum radiant power: | 0.95 mW |
| Maximum radiant power per pulse: | 12 mW |
| Measurement uncertainty: | ± 5% |



Exit for laser beam (visible)

1100Z33
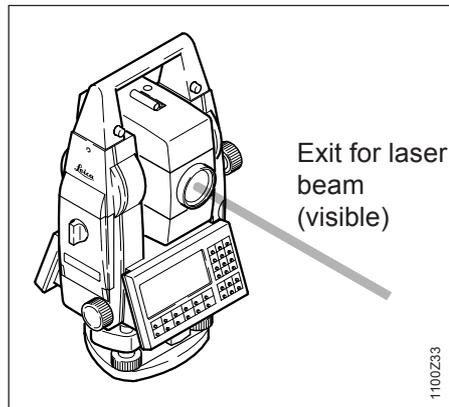
The integrated automatic target recognition produces an invisible laser beam which emerges coaxially from the telescope objective.

The product is a Class 1 laser product in accordance with:
• IEC 60825-1:1993 "Radiation safety of laser products".
• EN 60825-1:1994 + A11:1996 "Radiation safety of laser products"

The product is a Class I laser product in accordance with:
• FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations)

Class 1/I 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.
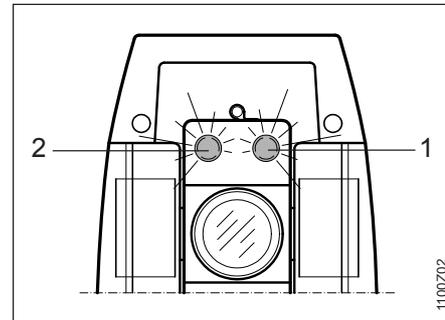
Class 1 Laser Product

according to IEC 60825-1:1993
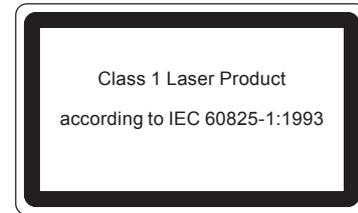
| Beam divergence: | 26.2 mrad |
|---|---|
| Pulse duration: | 9.8 ms |
| Maximum radiant power: | 0.76 mW |
| Maximum radiant power per pulse: | 1.52 mW |
| Measurement uncertainty: | ± 5% |

*Type: TCA....          Art.No.: ......*
*Power: 12V/6V ⎓, 1A max*
*Leica Geosystems AG*
*CH-9435 Heerbrugg*
*Manufactured:1998*
*Made in Switzerland    S.No.: ......*

CE

*This laser product complies with 21CFR 1040 as applicable.*
*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.*
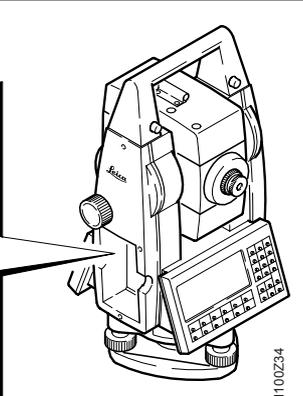
1100Z34
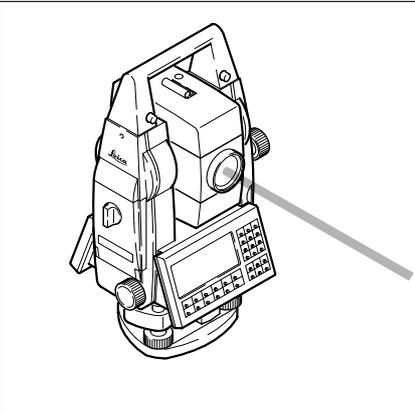
Exit for laser
beam
(invisible)

1100Z33

The integrated PowerSearch generates an invisible laser from the lower front of the telescope.

The product is a Class 1 laser product in accordance with:
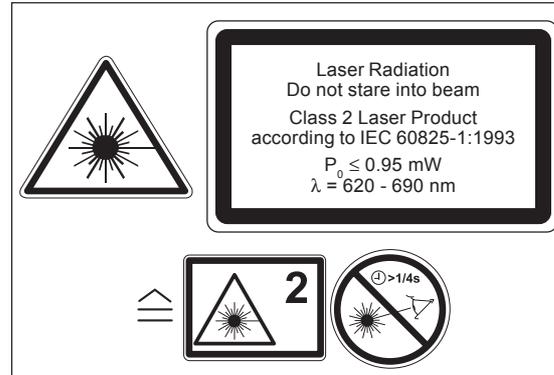• IEC 60825-1:1993 + A1:1997 + A2:2001 "Radiation safety of laser products".
• EN 60825-1:1994 + A11:1996 + A2:2001 "Radiation safety of laser products".

The product is a Class I laser product in accordance with:
• FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations).

Class 1/I 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.



Class 1 Laser Product

according to IEC 60825-1:1993 + A1:1997 + A2:2001
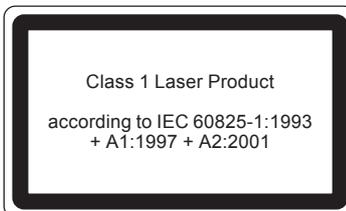
| Beam divergence: | 0.4x700 mrad |
|---|---|
| Pulse duration: | 80 ns |
| Max. radiant power: | 1.1 mW |
| Max. radiant power per pulse: | 5.3 W |
| Measurement uncertainty: | ± 5% |

Exit for laser beam (invisible)



Type: TC....        Art.No.: ......
Power: 12V/6V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured:1998
Made in Switzerland    S.No.: ......

CE

This laser product complies with 21CFR 1040 as applicable.
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.

The integrated guide light produces a visible LED beam from the upper front side of the telescope.
The product is a Class 1 LED product *) in accordance with:
• IEC 60825-1:1993 "Radiation safety of laser products"
• EN 60825-1:1994 + A11:1996 "Radiation safety of laser products"

*) Within the specified working range of > 5 m (> 16 ft).

Class 1 LED 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.

⚠ CAUTION:
Use the guide light only within the specified working range of > 5 m (> 16 ft) from the telescope.
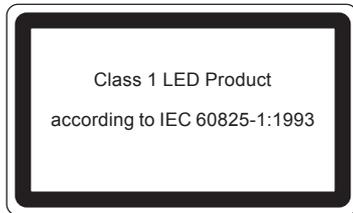
| Class 1 LED Product |
| --- |
| according to IEC 60825-1:1993 |

| Flashing LED | yellow | red |
| --- | --- | --- |
| Beam divergence: | 2.4 ° | 2.4 ° |
| Pulse duration: | 2 x 105 ms | 1 x 105 ms |
| Maximum radiant power: | 0.28 mW | 0.47 mW |
| Maximum radiant power per pulse: | 0.75 mW | 2.5 mW |
| Measurement uncertainty: | ± 5 % | ± 5 % |



1  Exit for flashing red LED
2  Exit for flashing yellow LED

The laser plummet built into the total station produces a visible infrared beam which emerges from the bottom of the instrument.

The product is a Class 2 laser product in accordance with:
• IEC 60825-1:1993 "Radiation safety of laser products"
• EN 60825-1:1994 + A11:1996 "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)

Class 2/II laser products: Do not stare into the beam or direct it unnecessarily at other persons. Eye protection is normally afforded by aversion responses including the blink reflex.

**Labelling**



Laser Radiation
Do not stare into beam

Class 2 Laser Product
according to IEC 60825-1:1993

$P_0 \leq 0.95$ mW
$\lambda = 620 - 690$ nm

**WARNING:**

It can be dangerous to look into the beam with optical equipment (e.g. binoculars, telescopes)

**Precautions:**

Do not look directly into the beam with optical equipment.

Type: TC.....          Art.No.: ......
Power: 12V/6V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured:1998
Made in Switzerland    S.No.: ......     CE

This laser product complies with 21CFR 1040
as applicable.
This device complies with part 15 of the FCC
Rules. Operation is subject to the following two
conditions: (1) This device may not cause harm-
ful interference, and (2) this device must accept
any interference received, including inter-
ference that may cause undesired operation.

**CAUTION**
**LASER RADIATION - DO NOT STARE INTO BEAM**
**620-690nm/0.95mW max.**
**CLASS II LASER PRODUCT**

2

**AVOID EXPOSURE**
**Laser radiation is emitted from this aperture**

| Beam divergence: | 0.16 x 0.6 mrad |
|---|---|
| Pulse duration: | c.w. |
| Maximum radiant power: | 0.95 mW |
| Maximum radiant power per pulse: | n/a |
| Measurement uncertainty: | ± 5% |

Laser beam (visible)

Exit for laser beam (visible)
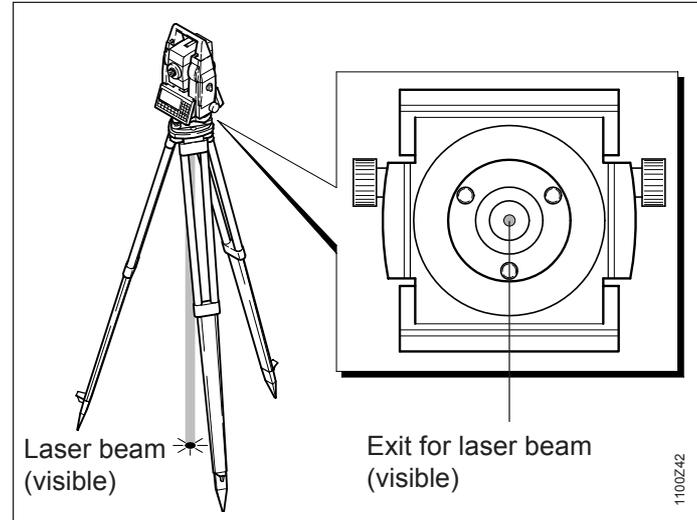
# Electromagnetic Compatibility (EMC)

The term "electromagnetic compatibility" is taken to mean the capability of the total station to function smoothly in an environment where electromagnetic radiation and electrostatic discharges are present, and without causing electromagnetic disturbances to other equipment.

⚠ **WARNING:**
Electromagnetic radiation can cause disturbances in other equipment.

Although the total stations meet the strict regulations and standards which are in force in this respect, Leica Geosystems 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, walkie-talkies, non-standard cables, external batteries.
**Precautions:**
Use only the equipment and accessories recommended by Leica Geosystems. When combined with total stations, they meet the strict requirements stipulated by the guidelines and standards. When using computers and walkie-talkies, pay attention to the information about electromagnetic compatibility provided by the manufacturer.

# Electromagnetic Compatibility, continued

⚠ **CAUTION:**
Disturbances caused by electromagnetic radiation can result in the tolerance limits for measurements being exceeded.

Although the total stations meet the strict regulations and standards which are in force in this connection, Leica Geosystems cannot completely exclude the possibility that the total station may be disturbed by very intense electromagnetic radiation, e.g. near radio transmitters, walkie-talkies, diesel generators, power cables.

Check the plausibility of results obtained under these conditions.

⚠ **WARNING:**
If the total station is operated with connecting cables attached at only one of their two ends (e.g. external supply cables, interface cables), 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, connecting cables (e.g. instrument to external battery, instrument to computer) 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 receiver.
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
• Consult the dealer or an experienced radio/TV technician for help.

⚠️ **WARNING:**
Changes or modifications not expressly approved by Leica Geosystems 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.



*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.*
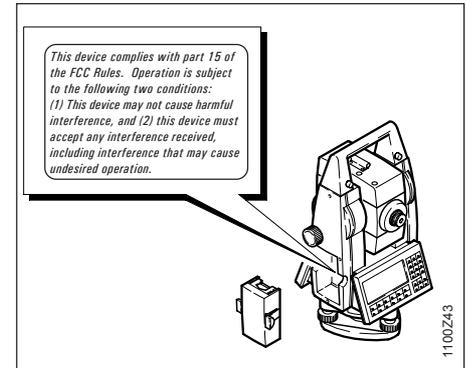
**Distance measurement (infrared)**
- Type      infrared
- Carrier wave      0.780 µm
- Measuring system      special frequency system basis 100 MHz = 1.5 m
- EDM type      coaxial
- Display (least count)      1 mm

| EDM measuring programm | Accuracy ** | Time per measurement |
|---|---|---|
| Standard measurement | 2 mm + 2 ppm | 1.0 sec. |
| Fast measurement | 5 mm + 2 ppm | 0.5 sec. |
| Normal tracking | 5 mm + 2 ppm | 0.3 sec. |
| Rapid tracking | 10 mm + 2 ppm | < 0.15 sec. |
| Averaging | 2 mm + 2 ppm | ----- |

** Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.)

**Prism constants (additive constants)**
- Standard prism      0.0 mm
- Mini prism      +17.5 mm
- 360° Reflector      +23.1 mm
- 360° Mini prism      +30.0 mm
- Reflector tape      +34.4 mm

| Range: (normal and rapid measurement) | | | | |
|---|---|---|---|---|
| Standard prism | 3 prisms (GPH3) | 360° reflector | Reflector tape 60mm x 60mm | Mini prism |
| 1800 m (6000 ft) | 2300 m (7500 ft) | 800 m (2600 ft) | 150 m (500 ft) | 800 m (2600 ft) |
| 3000 m (10000 ft) | 4500 m (14700 ft) | 1500 m (5000 ft) | 250 m (800 ft) | 1200 m (4000 ft) |
| 3500 m (12000 ft) | 5400 m (17700 ft) | 2000 m (7000 ft) | 250 m (800 ft) | 2000 m (7000 ft) |

(Rows numbered 1, 2, 3)

Atmospheric conditions:
1) Strong haze, visibility 5km; or strong sunlight, severe heat shimmer
2) Light haze, visibility about 20km; or moderate sunlight, slight heat shimmer
3) Overcast, no haze, visibility about 40km; no heat shimmer

**Shortest measuring distance**
- Standard prism      0.2 m
- Mini prism      0.2 m
- 360° Reflector      1.5 m
- 360° Mini prism      1.5 m
- Reflector tape      1.5 m

☞ Measurements can be made to reflector tapes over the entire range without external ancillary optics (GDV3).

## Distance measurement (long range, or without reflector)

| | |
|---|---|
| • Type | visible red laser |
| • Carrier wave | 0.670μm |
| • Measuring system | special frequency system basis 100 MHz = 1.5 m |
| • EDM type | coaxial |
| • Display (least count) | 1mm |
| • Laser dot Size: | ~ 7mm x 14mm at 20m |
| | ~ 10mm x 20mm at 50m |

| Standard measuring | Accuracy ** | Meas. time |
|---|---|---|
| Reflector-free up to 30 m | 3 mm + 2 ppm | ≤ 3.0 sec |
| Reflector-free above 30 m | 3 mm + 2 ppm | 3.0 sec +1.0 sec/10m |
| Long Range | 5 mm + 2 pmm | typ. 1.5 sec max. 8 sec |

** Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.)

## Distance measurement (without reflector)

| | |
|---|---|
| • Range of measurement: | 1.5 m to 80 m (to target plate, part.no. 710333) |
| • Display unambiguous: | to 760 m |
| • Prism constant (additive constant): | + 34.4 mm |

| Atmospheric conditions | Range (without reflector) | |
|---|---|---|
| | No reflector (white target)* | No reflector (grey, albedo 0.25) |
| 4 | 60 m (200 ft) | 30 m (100 ft) |
| 5 | 80 m (260 ft) | 50 m (160 ft) |
| 6 | 80 m (260 ft) | 50 m (160 ft) |

\* Kodak Grey Card used with exposure meter for reflected light
4) Object in strong sunlight, severe heat shimmer
5) Object in shade, or sky overcast
6) Underground, night and twilight

## Distance measurement (long range)

| | |
|---|---|
| • Range of measurement: | from 1000m up |
| • Display unambiguous: | to 12 km |

| Atmospheric conditions | Range (long range) | |
|---|---|---|
| | Standard prism | Three prisms (GPH3) |
| 1 | 1500 m (5000 ft) | 2000 m (7000 ft) |
| 2 | 5000 m (16000 ft) | 7000 m (23000 ft) |
| 3 | > 5000 m (16000 ft) | > 9000 m (30000 ft) |

1) Strong haze, visibility 5km; or strong sunlight, severe heat shimmer
2) Light haze, visibility about 20km; or moderate sunlight, slight heat shimmer
3) Overcast, no haze, visibility about 40km; no heat shimmer

# Technical specifications, continued

**Distance measurement Extended Range (long range, or without reflector)**
- Type      visible red laser
- Carrier wave      0.670 µm
- Measuring system      special frequency system basis 100 MHz ≙ 1.5 m
- EDM type      coaxial
- Display (least count)      1 mm
- Laser dot Size:      ~ 7mm x 14mm / 20m
       ~ 15mm x 30mm / 100m
       ~ 30mm x 60mm / 200m

| Standard measuring | Accuracy ** | Meas. time |
|---|---|---|
| Reflector-free | 3 mm + 2 ppm | typ. 3 - 6 sec max. 12 sec |
| Long Range | 5 mm + 2 pmm | typ. 2.5 sec max. 8 sec |

** Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.)

**Distance measurement Extended Range (without reflector)**
- Range of measurement:      1.5 m to 300 m (to target plate, part.no. 710333)
- Display unambiguous:      to 760 m
- Prism constant (additive constant):      + 34.4 mm

| Atmospheric conditions | Range (without reflector) | |
|---|---|---|
| | No reflector (white target)* | No reflector (grey, albedo 0.25) |
| 4 | 140 m (460 ft) | 70 m (230 ft) |
| 5 | 170 m (560 ft) | 100 m (330 ft) |
| 6 | >170 m (560 ft) | > 100 m (330 ft) |

\* Kodak Grey Card used with exposure meter for reflected light
4) Object in strong sunlight, severe heat shimmer
5) Object in shade, or sky overcast
6) Underground, night and twilight

**Distance measurement Extended Range (long range)**
- Range of measurement      from 1000 m
- Display unambiguous:      up to 12 km

| Atmospheric conditions | Range (long range) | |
|---|---|---|
| | Standard prism | Reflector Tape (60 x 60 mm) |
| 1 | 2200 m (7200 ft) | 600 m (2000 ft) |
| 2 | 7500 m (24600 ft) | 1000 m (3300 ft) |
| 3 | > 10000 m (33000 ft) | 1300 m (4200 ft) |

1) Strong haze, visibility 5km; or strong sunlight, severe heat shimmer
2) Light haze, visibility about 20km; or moderate sunlight, slight heat shimmer
3) Overcast, no haze, visibility about 40km; no heat shimmer

# Technical specifications, continued

## Angle measurement

| Types | Accuracy Hz, V (ISO 17123-3) | Display (least count) |
|---|---|---|
| 1101 | 1.5" (0.5 mgon) | 1" (0.1 mgon |
| 1102 | 2" (0.6 mgon) | 1" (0.1 mgon) |
| 1103 | 3" (1.0 mgon) | 1" (0.5 mgon) |
| 1105 | 5" (1.5 mgon) | 1" (0.5 mgon) |

- Options / cimal: 360° ' ", 360dec., 400 gon, V%, 6400 mil
- method: absolute, continuous, diametral

## Telescope
- Magnification: 30x
- Image: upright
- Clear objective diameter: 40 mm
- Shortest sighting distance:
  1.7 m (5.6 ft)
- Focusing: only coarse
- Field of view: 1°30' (1.66gon)
- Telescope field of view at 100m 2.7 m
- Transit: fully

## Compensator
- Type: liquid
- No. of axes: dual (switchable on/off)
- Setting range 4' (0.07 gon)
- Setting accuracy
  Type 1101 0.5" (0.2 mgon)
  Type 1102 0.5" (0.2 mgon)
  Type 1103 1" (0.3 mgon)
  Type 1105 1.5" (0.5 mgon)

## Sensitivity of bubble or of level
- Bull's-eye bubble: 6'/2 mm
- Plate level: none
- Electronic bubble: resolution 2"

## Tilting-axis height
- above tribrach: 196mm

## Optical plummet
- Location: in tribrach
- Magnification: 2x, focusable

## Laser plummet
- Location: in vertical axis of instrument
- Accuracy: Deviation from plumbline 1.5 mm (2 sigma) at 1.5 m instrument height
- Diameter of laser point 2.5 mm / 1.5 m

# Technical specifications, continued

## Battery

- Type        Nickel-metal hydride (NiMH)
- Nominal voltage     6 V
- Capacitance
  GEB121 (Standard)    3.6 Ah
  GEB111 (Optional)    1.8 Ah
- Location        in support
- Power Supply

  If an external cable is used, then for a nominal voltage of 12V (DC) the voltage range must lie between 11.5V and 14V.

| | No. of measurement (angle and distance) |
|---|---|
| TC/TCR | 600 |
| TCM/TCRM/ TCA/TCRA | 400 |

## Keyboard and display

Keyboard with 30 keys, six of them function keys and 12 of them alphanumeric keys.

| Position | in both faces (face 2 as option) |
|---|---|
| Alphanumeric characters | maximum 256 |
| Character sets | Extended ASCII character set as standard. Additional character set optionally loadable |
| Type of display | LCD |
| Size of display | 8 rows x 32 characters |
| Graphics capable | yes, 64 x 256 pixels |

## Weight

| Type | Weight |
|---|---|
| TC/TCR | 4.7 kg (10.4 lbs) |
| TCM/TCRM/ TCA/TCRA | 4.9 kg (10.8 lbs) |
| Tribrach | 0.8 kg (1.7 lbs) |
| Battery module | 0.4 kg (0.8lbs) |

**Durability/ Temperature range**
*   Measuring:          -20° to +50° C
    (-4° to +122° F)
*   Storage:           -40° to +70° C
    (-40° to +158° F)

**Other features**
*   Programmability:      Yes
*   Alignment aid:       as option

**Automatic corrections**
*   Line-of-sight error     Yes
*   Vertical-index error    Yes
    Tilting-axis error      Yes
*   Standing-axis tilt      Yes
*   Earth curvature       Yes
*   Refraction           Yes
*   Circle eccentricity     Yes

**Recording**
*   RS232 interface       Yes
*   Internal memory:      Yes
    Total capacity:     5 Mbytes
    Capacity available for
    programs and texts:  ~ 1.7 Mbytes
*   Plug-in data storage module
    (SRAM):         PC card
    for data:             Yes
    Capacity:    0.5 / 2 / 4 Mbytes
    No. of data blocks     4500
    to 36000
*   Plug-in data storage module
    (ATA Flash):       PC card
    for data:             Yes
    Capacity:      4 / 10 Mbytes
    No. of data blocks    36000
    to 90 000

**Tangent screws**
*   Number Hz/V      1 Hz, 1V
*   Movement         endless

**Other drives**
*   TCM, TCA        motorized

*   Working range:     5m - 150m
    (15 ft - 500 ft)
*   Positioning range
    at 100 m:          50mm
*   Left/right indication:    Yes
*   TCA/TCRA instruments:   EGL2
*   All other instruments:    EGL3

## Positioning accuracy
(TCA1102 / Standard prism, static, ATR single measurement)

| Distance | Accuracy | Measuring time |
|----------|----------|----------------|
| to 300 m | 3 mm | 3sec |
| > 300 m | * | 3 - 4 |

\* in accordance with angle-measuring accuracy

## Prism use
* Standard prisms          Yes
* Mini prism               Yes
* 360° reflector           Yes
* 360° Mini prism          Yes
* Reflector tape           Yes

Special active prisms are not required.

## Recognition method
* Video techniques:        Yes
* EDM techniques:          No

## Range
(under average conditions without interruption of view)

|  | ATR mode | LOCK mode |
|--|----------|-----------|
| Standard prism | 1000 m (3300 ft) | 800 m (2600 ft) |
| Mini prism | 500 m (1600 ft) | 400 m (1300 ft) |
| 360° reflector | 600 m (2000 ft) | 500 m (1600 ft) |
| 360° Mini prism | 350 m (1150 ft) | 300 m (1000 ft) |
| Reflector tape 60x60 | 65 m (200 ft) | not qualified |

## Shortest measuring distance (360°Refl.)
* ATR          1.5 m
* LOCK         5 m

## Rotation and speed
Positioning          to 50 gon/sec

## Follow a moving prism
(LOCK mode)

| Tracking ? | Distance | Max. tang. speed |
|------------|----------|------------------|
| No | at 20 m | 5 m/sec. |
| No | at 100 m | 25 m/sec. |
| Yes | at 20 m | 3.5 m/sec. |
| Yes | at 100 m | 18 m/sec. |
| Tracking ? | Distance | Max. radial speed |
| Yes | 0 to max. distance | 4 m/sec. |

## Searching

| Typical search time in telescopic field of view | Normal measurement = 2.5 sec + 1 sec positioning |
|--------------------------------------------------|--------------------------------------------------|
| Full scope of search | 1°30' (1.66 gon) |
| Scope of search using remote control | 18° (20 gon) |
| Interrupted viewing | Yes, briefly |

## Usable prisms
• Standard prisms                                    yes
• Mini prisms                                        yes
• 360º  Reflector                                    yes
• 360º  Mini prism   not recommended
• Reflector tape                                      no
No special active prisms are required.

## Range*
(under average conditions without
interruption of view)
Standard prism                         200 m
360º prism**                           200 m
Mini prism                             100 m

\*    Measurements at the vertical limits of the
     swath or under unfavorable atmospheric
     conditions may reduce the maximum
     range.

\*\*  optimally aligned to the instrument.

## Target recognition
Shortest measuring distance        5 m
Rotation speed        up to 50 gon/sec
Definable search area               yes
Search area            400 gon x 40 gon
Typical search time              <10 sec.

*See "Reference handbook TPS1100
programs".*

## Integrated programs
Target eccentricity
Manual coordinate input
Single-point orientation
Data converter (ASCII /GSI)

## Standard programs
Free station
Orientation and height transfer
Resection
Stakeout
Tie distance
Remote height

**Survey programs**

| | |
|---|---|
| Area | + |
| COGO | + |
| Hidden point | + |
| Local Resection | + |
| Reference Line | + |
| Road Plus /File editor | + |
| Sets of angles | + |
| Traverse | + |
| Auto Record | + |
| DTM stakeout | + |
| Face scan | + |
| Programmable | + |

*with GeoBasic language. No DOS required in total station.*

**Key:**

+ available as option

**TPS Advanced program package**

All standard programs,
Area,
COGO,
Local Resection,
Reference Line,
Sets of angles,
Traverse,

**TPS Expert program package**
All standard programs,
TPS Advanced program package,
DTM stakeout,
Auto Record,
Hidden point,
Reference line,
Face scan,

By entering a scale correction, reductions proportional to distance (e.g. atmospheric correction, reduction to mean sea level, or projection distortion) can be taken into account.

The distance displayed is correct only if the scale correction in ppm (mm/km) which has been entered corresponds to the atmospheric conditions prevailing at the time of the measurement.

The atmospheric correction includes adjustments for air pressure, air temperature and relative humidity.

If, for highest-precision distance measurements, the atmospheric correction should be determined with an accuracy of 1 ppm, the following parameters must be redetermined: Air temperature to 1°C; air pressure to 3 millibars; relative humidity to 20%.

It is usually sufficient to take the atmospheric correction from the diagram and to enter this value with the keyboard.

The air humidity influences the distance measurement if the climate is extremely hot and damp.

For high-precision measurements, the relative humidity must be measured and entered along with the air pressure and the temperature.
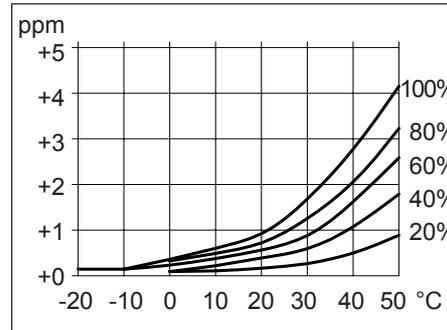


*Air-humidity correction in mm/km (ppm), air temperature in °C, relative humidity in %*

The index n for the infrared EDM (carrier wave 780nm) = 1.0002830. For the visible red laser (carrier wave 670nm), n = 1.0002859.

The index n is calculated from the formula of Barrel and Sears, and is valid for air pressure p = 1013.25 mbar, for air temperature t = 12°C and for relative air humidity h = 60%.

**Formula for infrared EDM:**

$$\Delta D_1 = 283.04 - \left[ \frac{0.29195 \cdot p}{(1 + \alpha \cdot t)} - \frac{4.126 \cdot 10^{-4} \cdot h}{(1 + \alpha \cdot t)} \cdot 10^x \right]$$

**Formula for visible red laser:**

$$\Delta D_1 = 285.92 - \left[ \frac{0.29492 \cdot p}{(1 + \alpha \cdot t)} - \frac{4.126 \cdot 10^{-4} \cdot h}{(1 + \alpha \cdot t)} \cdot 10^x \right]$$

## Atmospheric correction $\Delta D_1$, continued

$\Delta D_1$ = atmospheric correction [ppm]

p = air pressure [mbar]
t = air temperature [°C]
h = relative humidity [%]
$\alpha$ = 1 / 273.16

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

If the basic value of 60% relative humidity as used by the EDM is retained, the maximum possible error in the calculated atmospheric correction will be 2 ppm (2 mm / km).

## Reduction to mean sea level $\Delta D_2$

The values for $\Delta D_2$ are always negative and are derived from the following formula:

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

$\Delta D_2$ = reduction to mean sea level [ppm]
H = height of EDM above sea level [m]
R = 6378 km

## Projection distortion $\Delta D_3$

The magnitude of the projection distortion is in accordance with the projection system used in a particular country, for which official tables are generally available. The following formula is valid for cylindrical projections such as that of Gauss-Krüger:

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

$\Delta D_3$ = projection distortion [ppm]
X = northing, distance from projection zero line with the scale factor 1 [km]
R = 6378 km

In countries where the scale factor is not unity, this formula cannot be directly applied.

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

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

*Height measurement*
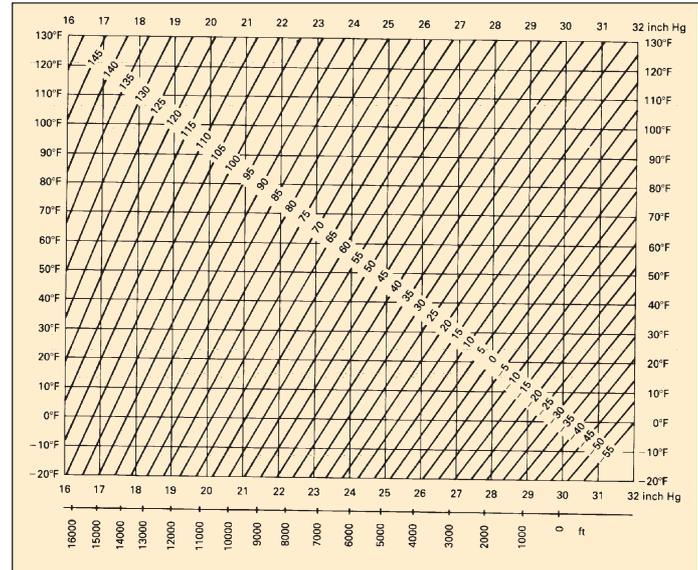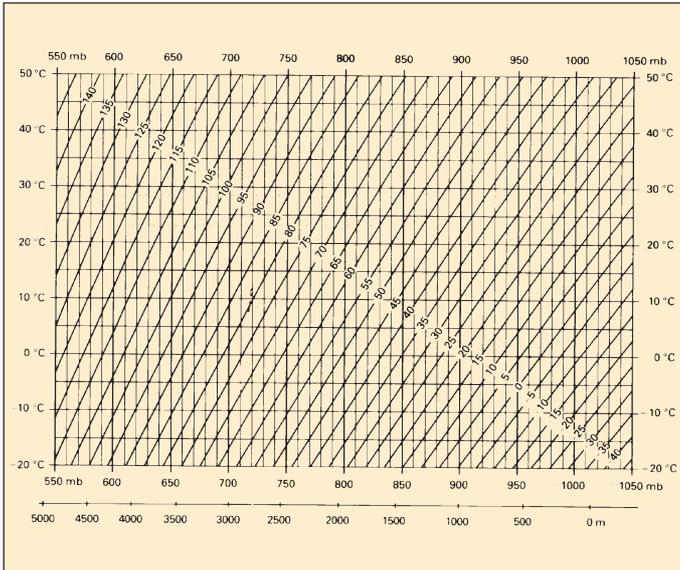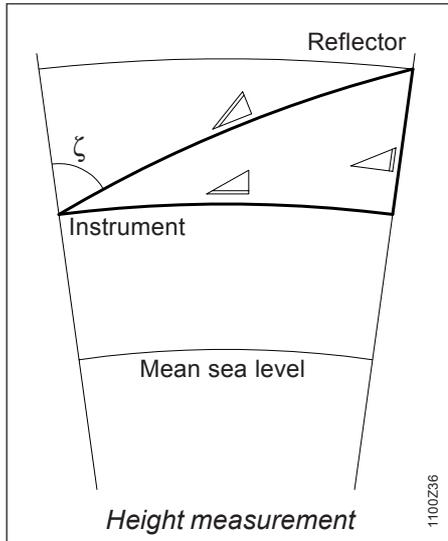
The instrument calculates slope distance, horizontal distance and height difference in accordance with the following formula. Earth curvature and mean refraction coefficient (k = 0.13) are taken into account automatically. The calculated horizontal distance relates to the station height, not to the reflector height.

$$\text{⊿} = D_0 \cdot (1 + \text{ppm} \cdot 10^{-6}) + \text{mm}$$

⊿ = displayed slope distance [m]
$D_0$ = uncorrected distance [m]
ppm = scale correction [mm/km]
mm = prism constant [mm]

$$\text{⊿} = Y - A \cdot X \cdot Y$$

$$\text{⊿} = X + B \cdot Y^2$$

⊿ = horizontal distance [m]
⊿ = height difference [m]
Y = ⊿ · |sin ζ|
X = ⊿ · cos ζ
ζ = vertical-circle reading

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

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

k = 0.13
R = 6.37 · 10$^6$ m

In the distance-measuring program "Averaging", the following values are displayed:
D = slope distance as arithmetic mean of all measurements
s = standard deviation of a single measurement
n = number of measurements

These values are calculated as follows:

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

$\Sigma$ = sum
$D_i$ = single measurement

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

The standard deviation $S_{\bar{D}}$ of the arithmetic mean of the distance can be calculated as follows:

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

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# *Index, contd.*

# *Index, contd.*

# Index, contd.

*Leica Geosystems AG, Heerbrugg, Switzerland has been certified as being equipped with a quality system which meets the International Standards of Quality Management and Quality Systems (ISO standard 9001) and Environmental Management Systems (ISO standard 14001).*

**TQM**
ISO 9001 / ISO 14001

*Total Quality Management - Our commitment to total customer satisfaction*

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

**Leica Geosystems**

*Leica Geosystems AG*
*CH-9435 Heerbrugg*
*(Switzerland)*
*Phone +41 71 727 31 31*
*Fax +41 71 727 46 73*
*www.leica-geosystems.com*