User Manual

Elta® R 45, Elta® R 55, Elta® R 50
Routine Total Stations

ZEISS

Contents

1 Introduction

Dear Customer

By purchasing an Elta® R Routine Total Station from Carl Zeiss you have opted for a leading-edge product in the field of surveying instruments. We congratulate you on your choice and would like to thank you for the trust placed in our company.

For quite some time, surveying has no longer been limited to the measurement of bearings and distances. Complex measurement systems have been in demand that do not only satisfy ever increasing needs for automatization, but also those involving digital data processing as well as the effectiveness of daily measuring practice. New standards have thus been set regarding technology and operating convenience.

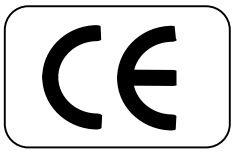
The Elta® R Routine Total Stations are part of a complete range of surveying instruments from Carl Zeiss. Data interchange between all the instruments is ensured by a common data format.

The operating convenience offered by the Elta® R hardware is very high within this group of total stations. The clear graphic display and only 7 keys give the user a wide variety of information for the processing in the field and provide him with valuable aids for achieving high productivity in solving his surveying tasks.

The software meets high standards.

☝ **Attention !**

Please read the safety notes in chapter 2 carefully before starting up the instrument.



The instrument was manufactured by tested methods and using environmentally compatible quality materials.

The mechanical, optical and electronic functions of the instrument were carefully checked prior to delivery. Should any defects attributable to faulty material or workmanship occur within the warranty period, they will be repaired as a warranty service.

This warranty does not cover defects caused by operator errors, inexpert handling or inappropriate application.

Any further liabilities, for example for indirect damages, cannot be accepted.

User manual:	**Edition**
Cat. No.:	**1003.532**
Date:	**June 1998**
Software release:	**V 3.xx**

Subject to alterations by the manufacturer for the purposes of further technical development.

☞ **Tip**

The type label and serial number are provided on the left-hand side and under-side of the instrument, respectively. Please note these data and the following infor-mation in your user manual. Always indicate this reference in any inquiries addressed to our dealer, agency or service department:

Instrument:

☐ Elta® R 45 ☐ Elta® R 50

☐ Elta® R 55

Serial number: Software version

We would like to wish you every success in completing your work with your Elta® R. If you need any help, we will be glad to be of assistance.

Yours

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2 Elta® R - The Routine Total Stations

This chapter gives you an overview of the operation and controls of the instrument as well as the programs which are a special feature of the Elta® R Routine Total Stations.

Hardware Overview

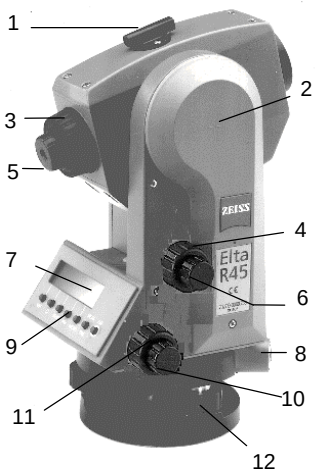


Fig. 1-1: Elta® R 45, Control side

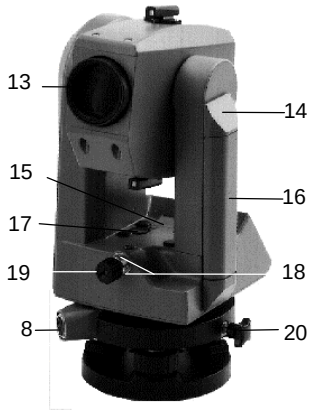


Fig. 1-2: Elta® R, Objective side

1	Sighting collimator
2	Mark for trunnion axis height
3	Telescope focusing control
4	Vertical tangent screw
5	Eyepiece
6	Vertical clamp
7	Display (graphic capabilities 128 x 32 pixels)
8	Interface
9	Keyboard
10	Horizontal clamp
11	Horizontal tangent screw
12	Tribrach screw
13	Telescope objective with integrated sun shield
14	Battery cassette lock
15	Vertical axis level
16	Battery
17	Circular level
18	Adjustment screws for optical plummet
19	Optical plummet
20	Tribrach clamping screw

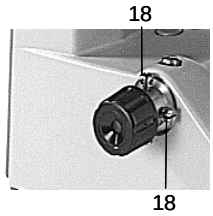


Fig. 1-3: Elta® R, Optical plummet

The Routine Total Stations Elta® R 45, Elta® R 55 and Elta® R 50

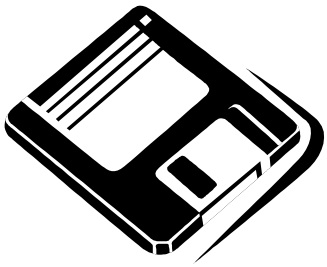
The electronic Routine Total Stations as instruments of mean accuracy are not only appropriate for land-measuring by geodesists, but also users on building sites appreciate their uncomplicated handling as well as rapidity, reliability and clearness in measuring.
Measurements are made easy thanks to menu guidance supported by graphics, instrument software with flexible point identification and universal data record formats.

The principal features:

Distance measurement	by phase comparison method
Measuring range	Elta® R 45 up to 1500 m with 1 prism, Elta® R 55 / R 50 up to 1300 m with 1 prism
Angle measurement	Hz and V electronically by increments, quick initialising, all common units and angle reference systems
Error compensation	Automatic compensation of sighting axis and index errors
The advantages in operating	Display screen with graphic capabilities (128 x 32 pixels), user-friendly surface, easy familiarisation, simple handling, reliable control of all measuring and computing processes with clear references, integrated, practical application programs, ergonomic arrangement of controls, light, compact construction
Quick charging, longer times of measuring	Eco-friendly power supply for about 1000 angle and distance measurements, charging time 1 hour
Data management	RS 232 C (V 24) interface as data input and output
	In the internal data memory of Elta® R 45 and Elta® R 55, 1900 data lines can be saved.

Software - Overview

Menu (ON + MENU)



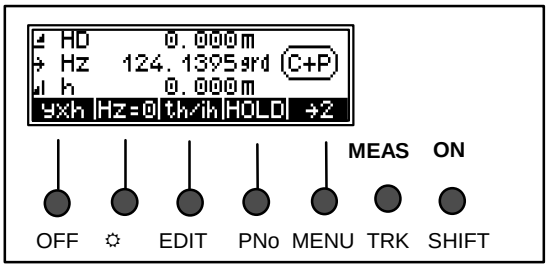
- Input
  - 1 Addco (addition constant)
  - 2 Scale
  - 3 Temp (temperature)
  - 4 Pressure
- Applications
  - 1 Connecting distance
  - 2 Object height
  - 3 Point-to-line distance
  - 4 Vertical plane
  - 5 Orthogonal lines
  - 6 Parallel lines
  - 7 Alignment
- Coordinates
  - 1 Unknown station
  - 2 Known station
  - 3 Stationing in elevation
  - 4 Polar points
  - 5 Setting out
- Instrument setting
  - 1 Angles
  - 2 Distances
  - 3 V reference
  - 4 Coo system
  - 5 Coo display
  - 6 Temperature
  - 7 Pressure
  - 8 Switch off
  - 9 Acoustic signal
  - 0 Contrast
- Interface
  - 0 Record.
  - 1 Format
  - 2 Parity
  - 3 Baud rate
  - 4 Protocol
  - 5 Position C
  - 6 Position P
  - 7 Position I
  - 8 T-O Rec.
  - 9 PC Demo

The Keyboard

Two types of keys:

- Hardkeys
  - direct function [ON] and [MEAS]
  - Key in connection with [ON] (SHIFT)
- Softkey
  function depending on program, significance explained in display line at the bottom

For operating the Elta® R, only 7 keys are needed.



Functions (Hardkeys)

[ON]	Switching the instrument on and changing over to hardkey function
[MEAS]	Starting a measurement
[ON] [OFF]	Switching the instrument off
[ON] [✳]	Illumination ON/OFF
[ON] [EDIT]	Calling up the memory and the Elta® R 45, 55 battery capacity
[ON] [PNo]	Calling up the input of point number and code and the Elta® R 50 battery capacity
[ON] [MENU]	Going to the main menu
[ON] [TRK]	Starting the tracking function

Softkeys

🕮 Overview softkeys Annex	Function keys defined by the display in dependence on the program.

The Basic Concept of the Menu

The total station is able to realise a great variety of functions.

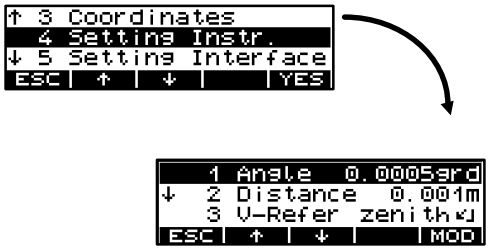
Functions needed directly during the measuring process are accessible through the key functions.

ON *MENU*

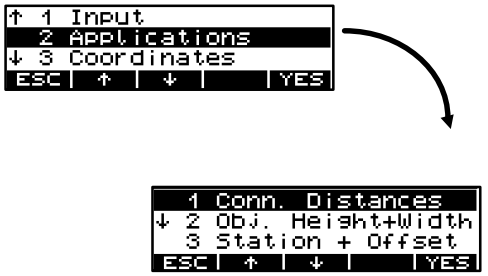
The menu facilitates the access to many other functions.

Having selected the menu, you can go to submenus and you are offered available functions, respectively:

e.g. settings



e.g. measurement programs



Use of this Manual

The manual is divided into 8 main chapters.

The subchapters have not been numbered. Clarity and convenience are provided by a maximum of 3 structural levels, for example:

Chapter

4 Coordinates

Section

2 Coordinates Unknown Station

Subsection

Recording

The pages are divided into two columns:

Functional text for

calling up programs:

4 Coordinates

3 Stationing in elevation

Principal text including

- Description of measuring processes and methods
  - instrument operation and keys
  - Elta® R display / graphics
  - drawings and large graphics
  - tips, warnings and technical information

Mode Softkeys and their functions

📖 Cross references to other chapters

Small graphics

☞ **Tip**

for hints, special aspects and tricks

Attention !

for risks or potential problems

Technical Information

for technical background information

Measuring tasks are defined as follows:

given: **:** given values
meas.: **:** measured values
requ.: **:** required/computed values

You will find a list of terms in the annex (Geodetic Glossary).

Risks in Use

Instruments and original accessories from Carl Zeiss have to be used only for the intended purpose. Read the manual carefully before the first use and keep it with the instrument so that it will be ready to hand at any time. Be sure to comply with the safety notes.

☝ Attention !

- Don´t make any changes or repairs on the instrument and accessories. This is allowed only to the manufacturer or to specialist staff authorised by the same.
- Only the service team or authorised specialist staff are allowed to open the instrument and accessories.
- Do not point the telescope directly at the sun.
- Do not use the instrument and accessories in rooms with danger of explosion.
- Use the instrument only within the operative ranges and conditions defined in the chapter of technical data.
- Do not operate the battery charger in humid or wet conditions (risk of electrical shock). Make sure the voltage setting is identical on the battery charger and voltage source. Do not use instruments while they are wet.

☝ Attention !

- Take the necessary precautions at your measuring site in the field, note the relevant traffic rules.
- Check that the instrument has been correctly set up and the accessories are properly secured.
- Limit the time of working when it is raining, cover the instrument with the protective hood during breaks.
- After taking the instrument out of the case, fix it immediately to the tripod with the retaining screw. Do never leave it unfastened on the tripod plate. After loosening the retaining screw again, put the instrument immediately back into the case.
- Prior to starting operation, allow sufficient time for the instrument to adjust to the ambient temperature.
- Tread the tripod legs sufficiently down in the ground in order to keep the instrument in stable position and to avoid its turning over in case of wind pressure.
- Check your instrument at regular intervals in order to avoid faulty measurements, especially after it has been subjected to shock or heavy punishment.
- Remove the battery in case of being discharged or for a longer stop period of the instrument. Recharge the batteries with the LG 20.
- Properly dispose of the batteries and equipment taking into account the applicable national regulations.

Attention

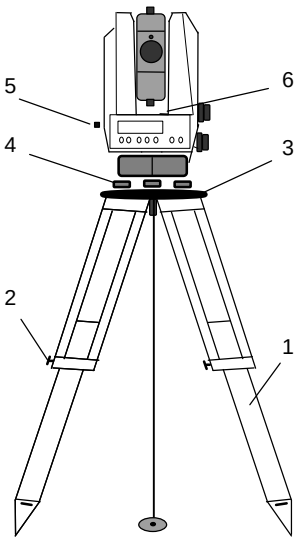
☝ Attention !

- The mains cable and plugs of accessories have to be in perfect condition.
- When working with the tachymeter rod near to electrical installations (for example electric railways, aerial lines, transmitting stations and others), there is acute danger to life, independent of the rod material. Inform in these cases the relevant and authorised security offices and follow their instructions. Keep sufficient distance to the electrical installations.
- Avoid surveying during thunderstorms because of lightning danger.

3 First Steps

The first steps cover up the set-up of the instrument, including the explanation of basic inputs and the necessary presettings.
After having set the parameters for saving and entered the point information, you can measure in the start-up menu.

Set-Up and Coarse Centring



In order to guarantee the stability of measurement we recommend the use of a **Zeiss S27** Tripod.

Set-up:
Extend the tripod legs (1) to a comfortable height of observation and fix them using the tripod locking screws (2). Screw the instrument centrally to the tripod head plate (3). The tribrach screws (4) should be in mid-position.

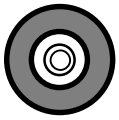
Coarse Centring:
Set up the tripod roughly above the station point (ground mark), the tripod head plate (3) should be approximately horizontal.

Centre the circular mark of the optical plummet (5) above the ground mark using the tribrach screws (4).

To focus the circle: Turn the eyepiece.

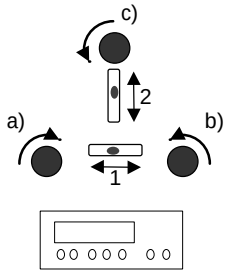
To focus the ground mark: Draw out or push in the eyepiece of the optical plummet.

Levelling and Fine Centring



Coarse Levelling:

Level the circular bubble (6) by adjusting the length of the tripod legs (1).



Precision Levelling:

Align the control unit parallel with the imaginary connecting line between two tribrach screws. Level the instrument by turning the tribrach screws a) and b) in opposite directions. Turn the instrument by 100 gon in Hz and level instrument with tribrach screw c).For checking, turn the instrument round the vertical axis. After that, check the residual inclination by turning the instrument in both diametral positions of (1) and (2). Take the mean of deviation from center point of level and adjust, if necessary.

Precision Centring:
Shift the tribrach on the tripod head plate until the image of the ground mark is in the centre of the circular mark of the optical plummet; repeat the levelling various times if necessary.

Telescope Focusing

Focusing the Crosslines:
Sight a bright, evenly coloured surface and turn the telescope eyepiece until the line pattern is sharply defined.

> ☝ **Attention !**
>
> Sighting of the sun or strong light sources must by all means be avoided. This may cause irreparable damage to your eyes.

Focusing the target point:
Turn the telescope focusing control until the target point is sharply defined.

> ☞ **Tip**
>
> Check the telescope parallax: If you move your head slightly whilst looking through the eyepiece, there must be no relative movement between the crosslines and the target; otherwise, refocus the crosslines as above.

Switching the Instrument on

ON Press key

Additionally to the company logo, the number of the software version (important for future updates) and the values last set for:
- addition constant
- scale
- temperature
- air pressure

are displayed briefly.

Tilting the telescope on the trunnion axis and rotating the instrument on the vertical axis.

The capturing of the zero point is acknowledged with an acoustic signal.

☞ **Tip**

The compensator is automatically activated when the instrument is switched on.

If levelling of the instrument is insufficient, the digits after the decimal point in the displayed angle readings are replaced by dashes.

Switching the instrument off by pressing the keys

ON + ***OFF***

simultaneously.

Principles of Display

The information
- point ***c***ode,
- ***p***oint number and
- measured / computed values

is displayed on two pages.

Toggling between the pages:

→1 to page 1

→2 to page 2

Display page 2:

Display page 1:

☞ **Tip**

The fields at the bottom of the display are related to the functions of the keys situated below the display.

They indicate the next possible settings - do not mix it up with the current setting.

Principles of Input

Additionally to the setting of predefinitions - as described further down in this chapter - you will have to enter data continually during the measuring process.

These entries are

- the constantly changing instrument, station and reflector heights and
- coordinates of stations or other known backsight points.

📖 Editor
Data Management

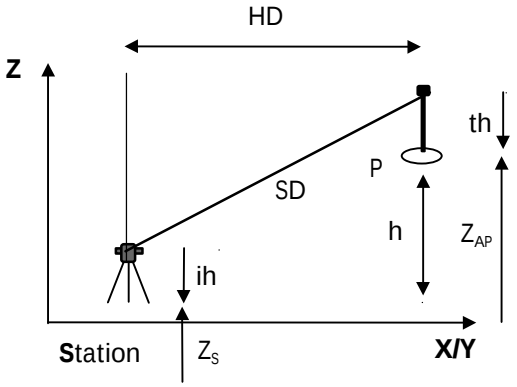
The manual input of coordinates is described in **Chapter *6 Data Management***.

📖 Data Transfer
Data Management

If available, it is useful to transfer the values directly from a PC instead of entering them manually.

Input of Reflector, Trunnion Axis and Station Heights

The input of the values of reflector height (th), instrument height (ih) and station height (Zs) allows you to measure with absolute heights already in the initial menu. If these values have not been entered, only relative height differences will appear in the display (memory).



☞ **Tip**

At this point, it would be convenient to use the program of chapter 4.4 **Coordinates** ***Stationing in Elevation***. The station height is determined by measuring to another visible backsight point.

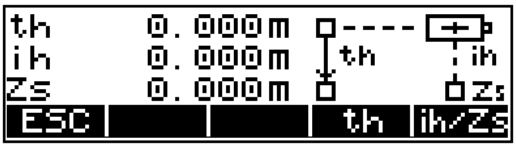
on display page 1 only:

th/ih in measuring modes **HD** and **yxh** only

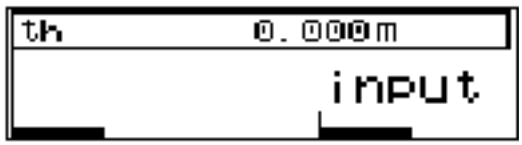
📖 Presettings **First Steps**

th Reflector height

ih/Zs Instrument and station heights



Input of the reflector height:



└ th 0.000 m
to confirm the old reflector height (in this case 0)

└ to enter a value

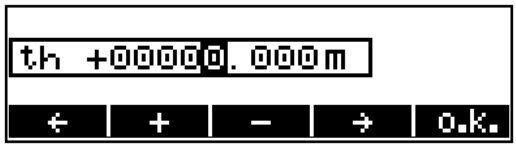
← and

→ to go to the desired position in the display

\+

\- to browse through digits

o.k. to confirm



Presentation of the current position for input in negative type.

Input of the instrument height / station height

└ 🕮 Editor
Data Management

└ to enter values (compare input of th)

ESC to quit the input routine

Input of Point Number and Code

(C+P) signalises the possibility to enter point number and code.

ON + PNo

← and → to go to the desired digit of point number and code

+ and - to browse through the existing character set

The entered values will be used in the next measurement.

C 5-digit point code, alphanumeric notation

P 12-digit point number with the special characters #, -, . , .numeric notation

☞ **Tip**

The toggling between point number and code is realised continuously.

For fast browsing, keep the respective key depressed.

After the measurement, the point number is incremented by one unit, the code remains invariable until being modified by the user.

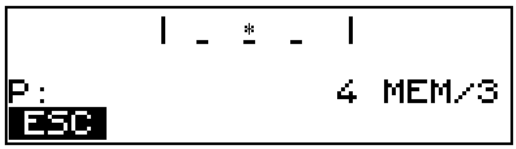
In the application and coordinate programs, the code is provided with non-varying characters (A,B,..). In this case, it is not possible to enter the code.

Principles of Distance Measurements

Single measurement

MEAS

The intensity of the receiving signal can be assessed with the bar graph. The more to the right the stars are presented, the better is the returning signal.



The distance measurement can be cancelled with the softkey ESC.

📖 Presettings
First Steps

The slope distances and derived values are corrected with regard to the influences of earth curvature / refraction. Additionally, a correction of atmospheric influences (temperature and pressure) is applied.

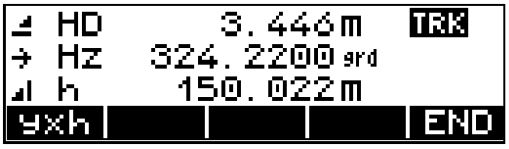
The correction is zero with T = 20°C and P = 944 hPa.

Distance tracking (continuous measurement of the distance)

ON TRK

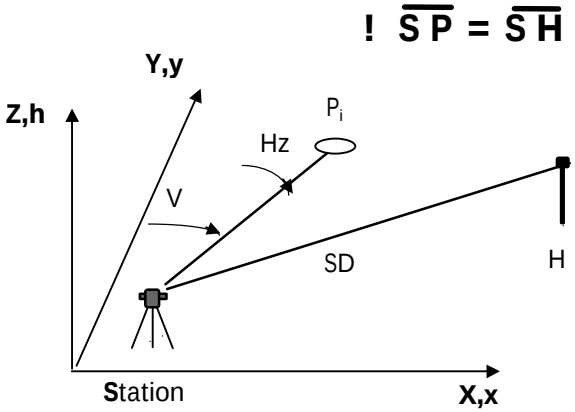
END to finish the measurement

The measuring mode can also be changed during the tracking measurement. For recording data during the tracking measurement use key MEAS.



Measurements to inaccessible Points

The prism used for the distance measurement cannot be stationed on the desired point P.



Sight towards the point P and trigger the measurement. Then, sight the prism stationed on the auxiliary point H.
Pay attention to the condition of equidistance S-P = S-H.

If data recording is activated, only a data line indicating the angle to P and the distance to H is saved.
Naturally, the angle and distance to H are displayed after the measurement, being the angle value continuously updated in the Elta® R display.

Introduction

The required presettings are to be subdivided into three groups:

Settings in the Start-up Menu

- Specify measuring units for angle and distance Short-time setting of V angle in percent
- Activating and deactivating the compensator
- Orientation of Hz circle

Frequently used Settings

- Input of pressure and temperature
- Input of scale and addition constant

Rarely used Set Instructions

- Display mode for angle and distance
- Vertical reference system
- System of coordinates
- Display of coordinates
- Measuring units of temperature, pressure
- Switching the instrument automatically off
- Switching the acoustic signal on and off
- Regulation of display contrast and brightness of crossline illumination

Settings in the Set-Up Menu

Setting the measuring units of angle and distance

to set with

F1 the distance

F2 the angle:

Display page 2:

m meters

ft feet

gon grades

deg degrees, decimal division or

DMS degrees, sexagesimal division

mil mils

Attention !

If the mode is changed after the measurement, the values will be converted and displayed in the new mode, but saved in this form only after the next measurement.

Display page 1

V%

V to toggle quickly between angle in percent / defined measuring unit

Activating and deactivating the compensator

Display page 2:

CHCK to go to the menu

c/i and

Comp 🕮 **Adjusting and checking**

C-on to deactivate the compensator function

C-off to activate the compensator function

If recording is activated, an information line will be saved indicating compensator function on or off.

☝ **Attention !**

If the compensator is out of its working range and the function is activated, the digits after the decimal point in the angle readings are replaced by dashes. In this case, the instrument is not sufficiently levelled and a remote release from a PC is not admitted.

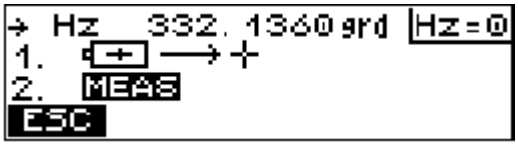
Orientation of Hz circle

Aim: Hz = 0

Hz=0

Sight target

MEAS



Aim: Hz = xxx,xxx

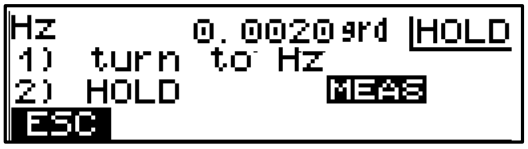
HOLD

Turn the instrument to the desired Hz circle value

MEAS

Sight target

MEAS



Display page 2:

Aim: Change counting direction

→Hz Measurement clockwise

←Hz Measurement anticlockwise

Attention !

The set counting direction is only valid in the start-up menu.

After the connection and in all programs, the Hz counting direction is always set clockwise.

Frequently used Settings

Alteration of pressure, temperature, scale and addition constant

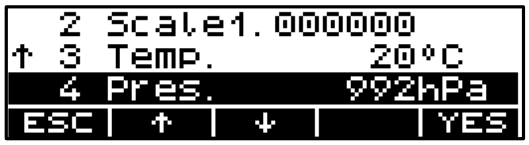
ON MENU

1 Input

and

to go to the desired menu point

o.k. to confirm



+ and

- to alter the addition constant (scale, temperature and pressure) step by step

o.k. to confirm

☞ **Tip**

For the first starting, only temperature and pressure are entered.
If a prism with another prism constant than -35 mm should be used permanently, also this setting should be realised immediately.
(For calculating the constant see annex.)

📖 Formulae and constants
Annex

Range of values

-30 °C	< Temp.	< 70 °C	with Δ 1 °C
-0,127mm	< Addco	< 0,127mm	with Δ 1 mm
0,995000	< Scale	< 1,005000	with Δ 1 ppm
440hPa	< Press.	< 1460 hPa	with Δ 4 hPa

Instructions for Settings

ON *MENU*

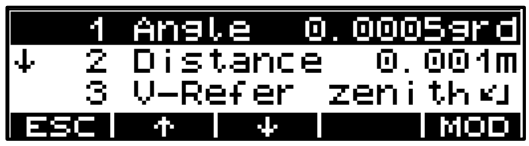
4 Setting the instrument

YES to go to

and

to select the menu point

Angle and distance display



MOD to change setting

ESC to quit menus

and

to quit setting / confirm change

Possibilities:

Angle

grad	0,005-0,001-0,0005 (Elta® R 50 and Elta® R 55)
grad	0,005-0,001-0,0002 (Elta® R 45)
DMS	10 “ - 5 “ - 1 “
deg	$0{,}005^0$ - $0{,}001^0$ - $0{,}0005^0$
mil	

Distance

m	0,01-0,005-0,001
ft	0,02-0,01-0,001

☝ **Attention !**

The defined presentations of angle and distance are related to the display.
Saving is realised with the highest possible precision.

Vertical reference system

MOD to change setting

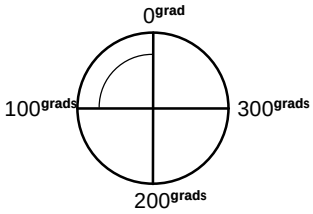
ESC to quit menus

and

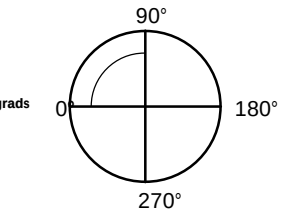
to quit setting / confirm change

V reference systems:

V Zenith angle



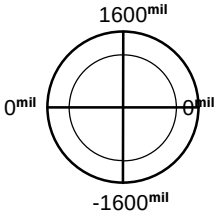
V Vertical angle



Examples 1: Zenith angle unit 400 grads

2: Vertical angle unit 360°

V Height angle



Examples 3: Height angle unit 6400 mil

☞ **Tip**

The setting of the measuring unit % is done in the set-up menu!

System of coordinates / display of coordinates:

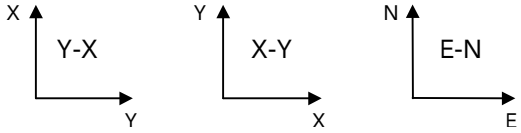
MOD to change setting

ESC to quit menus

and

to quit setting / confirm change

Assignment of coordinates:



Indication sequence: Y-X / X-Y E-N / N-E

Attention !

When the assignment of coordinates is changed, the question for further use of the internal station coordinates appears in the display, calling the user´s attention to a possible source of errors.

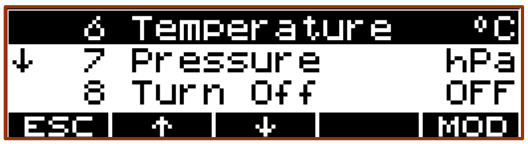
Measuring units for pressure / temperature:

MOD to change setting

ESC to quit menus

and

to quit setting / confirm change



Possibilities:

Temperature	°C	degrees centigrade
	°F	degrees Fahrenheit
Pressure	hPa	hectopascal (or millibar)
	Torr	
	inHg	

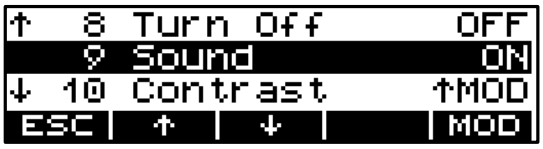
Switching the instrument off / acoustic signal

MOD to change setting

ESC to quit menus

and

to quit setting / confirm change



Possibilities:

Switching off	10 min - 30 min - OFF
Acoustic signal	On - OFF

☞ **Tip**

Before the instrument will be switched off automatically, a warning appears indicating that the instrument will be switched off within one minute. This process can be interrupted by pressing any key.

Regulation
Display contrast / illumination of crosslines:

MOD to change setting

ESC to quit menus

and

to quit setting / confirm change

Possibilities:

Contrast (illumination is not switched on)
With MOD you can regulate the display contrast stepwise

Illumination of crosslines (illumination on)	change brightness stepwise

☞ **Tip**

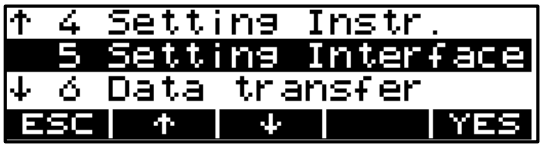
The blinking symbol * on the top right of the display signalises that the illumination is switched on.
For regulating the illumination, cover the objective opening with the hand.

Saving the Measured Values

ON + *MENU*

5 Setting Interface

YES to go to the menu



MOD to toggle between MEM/1, MEM/2, MEM/3 V24/1, V24/2, V24/3 OFF

ESC to return to the higher-order menu

MEM/x - internal saving (only Elta® R 45, 55)

V24/x - external saving through RS232 interface

Off - no saving

1 - saving of measured values

2 - saving of computed values

3 - 1 and 2

📖 Record data lines **Data Management**

☞ **Tip**

The detailed depiction concerning the question of which values are saved with which type identifiers and with which recording selection you can find in the chapter Data Management.

📖 Presettings
First Steps

☝ **Attention !**

In connection with the selection of saving, the selection of the measuring mode is decisive for:

Which results are to be displayed?
Which values are to be saved?

Selecting the Measuring Mode (presentation of the results at the display)

F1 to set the following measuring modes

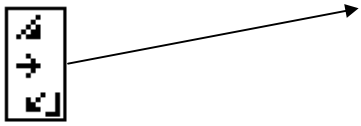
Display page 1:

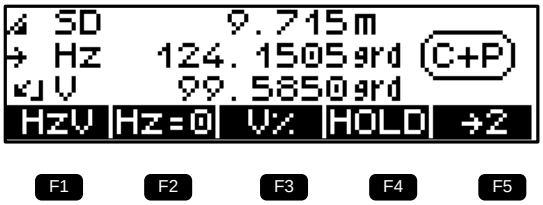
☞ **Tip**

In the display of softkey 1, always the next selectable measuring mode appears.

SD: Display of the real measured values

Status display:





HzV: Display in the theodolite mode

Only for alignments and for setting out right angles, not for distance measurements

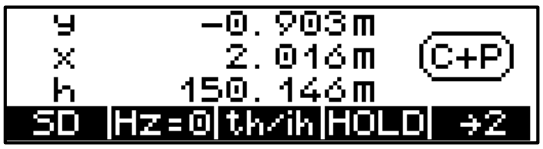
HD: Display of the reduced distance and the height difference

Display of the calculated values

yxh: Display of the local rectangular coordinates

Measurement in the local system with station y=x=0

The input of Zs,ih and th allows measurements with absolute heights.



☞ **Tip**

The measuring modes can be changed at any time and the results will be displayed immediately in the selected measuring mode, but not, though, another recording. All following measurements are displayed and recorded in the newly selected mode.

☞ **Tip**

In all measuring modes, the angle reading is updated continually.

The distance or coordinates are updated only after the next measurement.

Measurement

After entering and defining all parameters required you can carry out the measurement.

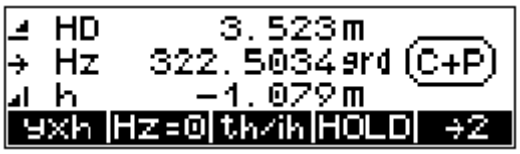
MEAS

etc. Measurement to further points

ON + *PNo*

Input point number and code

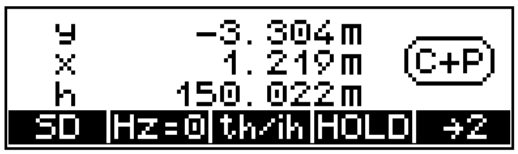
MEAS



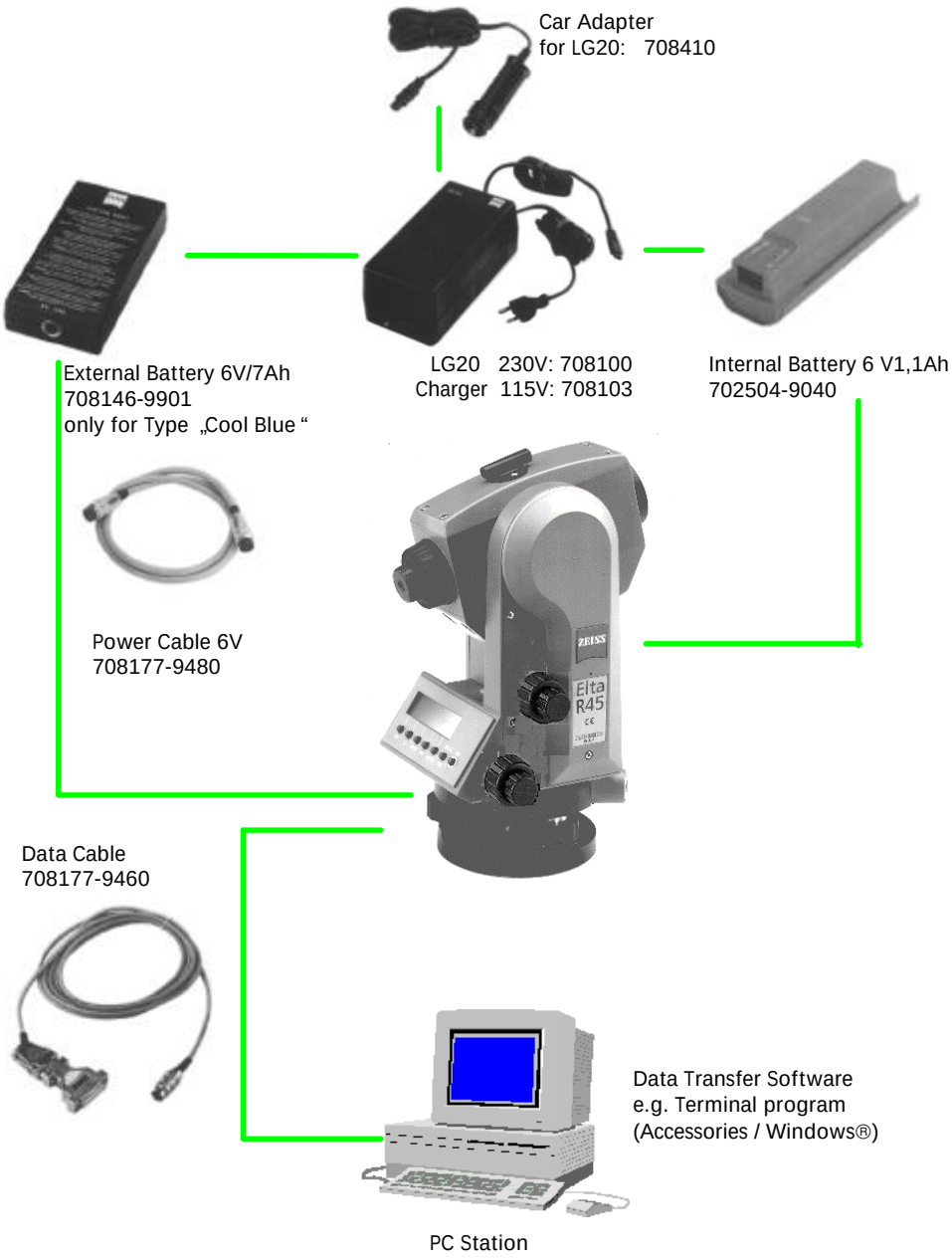
☞ **Tip**

After the measurement, the flush right point number is incremented by one unit within the number of digits displayed up to the special character (no figure) to the left of it. (According to this picture, counting goes only up to 9, then it will begin again with "0".)

Measurements in the modes **HzV** and **SD** are realised without entering and recording local or global heights



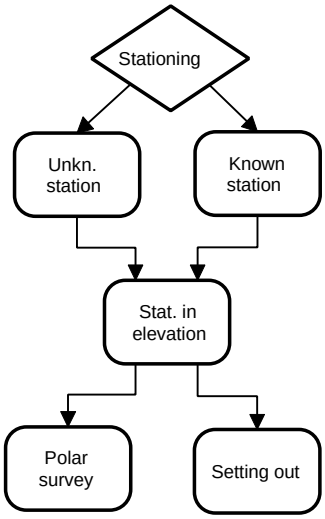
Display with absolute heights, with the heights Zs, ih and th entered


Car Adapter
for LG20: 708410
External Battery 6V/7Ah
708146-9901
only for Type „Cool Blue “
LG20 230V: 708100
Charger 115V: 708103
Internal Battery 6 V1,1Ah
702504-9040
Power Cable 6V
708177-9480
ZEISS
Elta
R45
Data Cable
708177-9460
Data Transfer Software
e.g. Terminal program
(Accessories / Windows®)
PC Station

4 Coordinates

The basic requirement for a measurement in a system of coordinates is a stationing within this system. That means, that the position and height of the instrument are determined by measuring to known backsight points.
In the case of an unknown station, the scale and the orientation of the Hz circle in azimuth direction are computed additionally to the station coordinates. In the case of a known station, only the scale and the orientation of the Hz circle in azimuth direction are computed.

After the stationing, the actual measurements - that means setting out and polar points - are possible within this system of coordinates.



The guidance through the menu is very easy to understand and based on a unique schema for all programs.

Principle

3 Coordinates

2 Unknown station

After calling the respective program, a graphics appears with a detailed explanation of the program.

A and B are backsight points with known coordinates and S is the station the coordinates of which are to be calculated.

CHCK 🕮 **Adjusting and Checking**

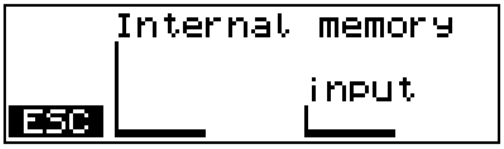
A to call point A

> ☞ **Tip**
>
> The function of adjusting and checking is required for measurements to be carried out without/with compensator or for checking the adjustment of the instrument.

└ 🕮 Principles **First steps**

🕮 Editor **Data management**

Coordinates are to be entered



B to continue by calling point B

ESC to return to the higher-order menu

A to repeat point A if required

If A has been calculated, measured, defined as station, the symbol for A is filled.

Attention !

If errors or confusions should occur whilst measuring to the points, the measurement to single points can be repeated immediately.

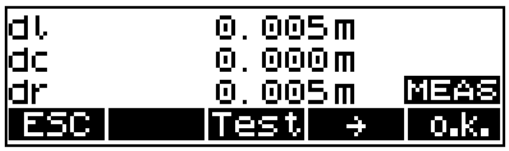
ON + ***PNo*** to enter point number and code

MEAS to trigger measurement

Tip

Prior to each measurement with **MEAS** it is possible to enter a point number and a code for the point to be measured.
In the stationing programs, the codes (A, B, S) have been invariably set. Point numbers can be entered.
The point number is incremented automatically by 1.
The code that has been set is saved with every measurement until being modified by the user.

In the setting-out program, the possibility to measure is indicated additionally by the MEAS symbol in the display



Station Point Memory Elta® R

In a non-volatile instrument memory, the following data are retained after switching the instrument off and overwritten with every new determination:

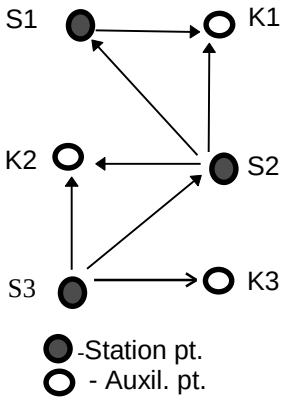
Station coordinates	Y,X,Z
Instrument height	ich
Reflector height	th
Scale	m
Orientation	Om

The coordinates of the station point are calculated or entered by means of the coordination programs.
During the following operations (setting-out / polar points), the user can access this memory at the respective parts of the program and does not have to enter the values again.
After having changed the station, these values have to be calculated or again entered in the course of the program.

Special Features of Elta® R 50

The Elta® R 50 (the instrument is not fitted out with a data memory) has a memory location for another single point (coor-memory) containing the coordinates of this point (Y;X;Z) in a non-volatile form.
This memory location permits a simple transmission of coordinates (stationing with "unknown station") with the Elta® R 50 and spares the user the trouble to take the coordinates down or to enter them twice.

Elta® R Principle of transmission of coordinates „unknown station"



Window of the Elta® R 50 when calling coordinates

Method:

The station coordinates S1 are known or have been calculated by means of a coordinate program. The coordinates of point K1 will be calculated with the program „polar points" and saved in the „coor-memory" with CMem.

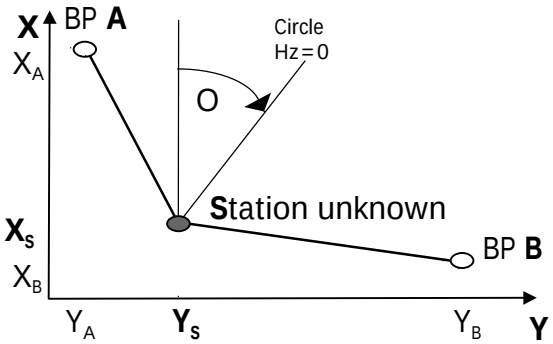
After placing the instrument on S2, the coordinates of the points S1 (last station) and K1 (coor-memory) are called with the stationing program "unknown station" and used for determining the coordinates of S2.

Now, the coordinates of the point K2 can be calculated with the program "polar points" and stored in the "coor-memory". After changing the position of the instrument to S3, the coordinates of this point will be calculated in analogy to station S2.

3 Coordinates

1 Unknown Station

If it is not possible to occupy a point with a known position in order to sight the points to be surveyed or set out, a free stationing can be carried out.



given: : $(Y,X)_{A,B}$

meas.: : $(SD,Hz,V)_{S\text{-}A,\ S\text{-}B}$

requ.: : $(Y,X)_s$, Om , m

By measuring to 2 known **B**acksight **P**oints (**A**, **B**), the instrument will calculate the station coordinates $\mathbf{X_S}$,$\mathbf{Y_S}$, the circle orientation **Om** and the scale **m**.

Measurement „Unknown Station“

A to select BP A

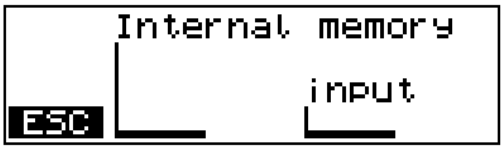
CHCK 🕮 **Adjusting and checking**

ESC to quit the program

Selecting the coordinates of BP A

└ 🕮 Principles **First steps**

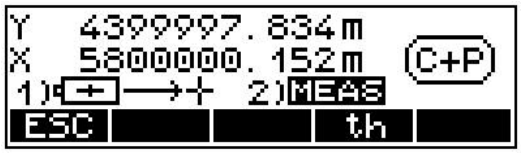
🕮 Editor **Data management**



th to enter data for BP A

ON + ***PNo*** Point number of BP A to be changed?

MEAS to measure to BP A



- Sight reflector

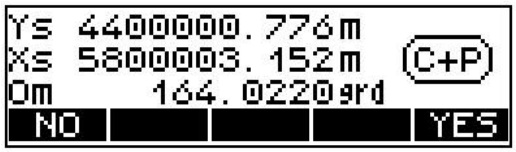
B to select BP B

A Measurement to BP A to be repeated?

The operational steps for BP B are now carried out in analogy to BP A.

After completing the measurement to A and B:

ON + ***PNo*** to enter the point number of the station



Display of results

YES to accept the result. Continuation with stationing in elevation, polar points or setting out

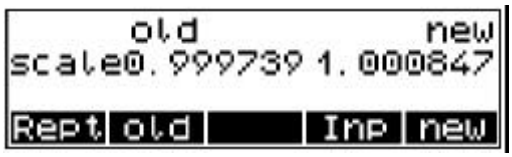
NO to quit the measurement

new to accept all results

old to transfer coordinates accepting an old scale

Inpt to transfer coordinates entering any scale

Rept to repeat the entire calculation



Recording

📖 Presettings
First steps

If recording is activated, the following lines are saved in dependence on the settings:

Designation of the mode

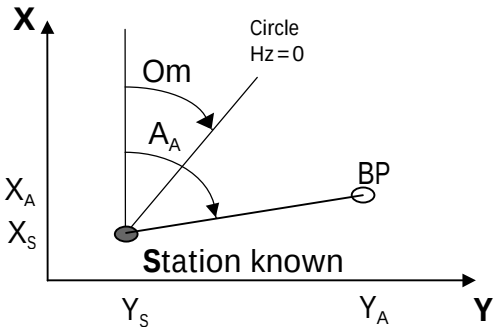
Point numbers and code

Y,X	Coordinates of backsight point A
SD,Hz,V	Readings for backsight point A
Y,X	Coordinates of backsight point B
SD,Hz,V	Readings for backsight point B
Y,X	Coordinates of station point
m,Om	Scale and circle orientation

3 Coordinates

2 Known Station

If it is possible to occupy a point with a known position in order to sight the points to be surveyed or set out, a stationing on a known point can be carried out.



given: : $(Y,X)_{S,A}$

meas.: : $(SD,Hz)_{S\text{-}A,}$ or $(Hz,V)_{S\text{-}A}$

requ.: : Om , m or Om

By measuring to a known **B**acksight **P**oint **A**, the instrument will calculate the circle orientation **Om** and the scale **m**.

Measurement „Known Station“

S to call station S

CHCK 🕮 **Adjusting and checking**

ESC to quit the program

Selecting the coordinates of station S

🕮 Principles
First steps

🕮 Editor
Data management

After defining S:

There are two ways to calculate the orientation.

Hz see below

XY page 4-11

S to repeat station S

Orientation using a known Azimuth

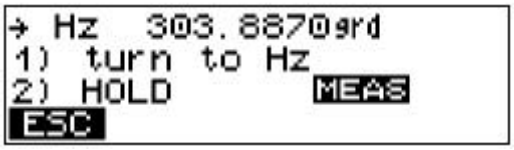
The orientation using a known azimuth will be selected if the bearing angle between the station and the backsight point is known (for example calculated from coordinates) and a distance measurement to the backsight point is impossible.

↘ to set the required direction by turning the instrument

MEAS to clamp the set direction

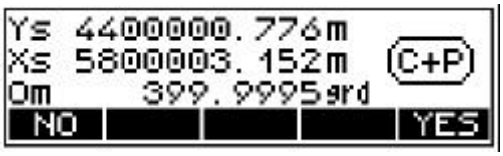
® to sight the known point

MEAS allocation is completed



YES to confirm, record, quit the program

NO to reject, new start

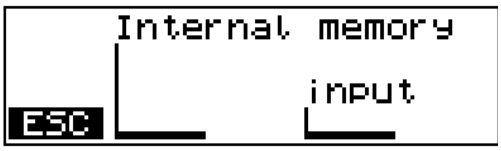


Display of results and recording

Orientation using known Coordinates

This orientation method will be used if the coordinates of the backsight point are known.

Selecting the coordinates of BP A



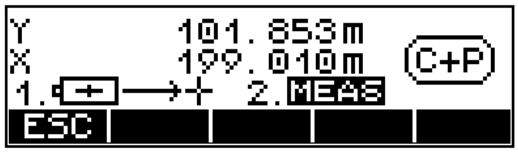
└ 🕮 Principles
First steps

🕮 Editor
Data management

└ SD/Hz/V
Distance and bearing measurement
Hz/V
Bearing measurement

ON + *PNo*
Point number of BP A to be changed?

MEAS to BP A



YES to confirm the orientation, continuation

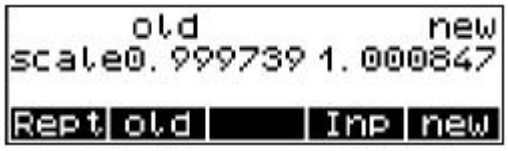
NO to reject the orientation, new start

new to accept the new scale

old to transfer the orientation accepting an old scale

Inpt to transfer the orientation entering any scale

Rept to repeat the calculation



Display of results and recording

Recording

📖 Presettings
First steps

If recording is activated, the following lines are saved in dependence on the settings:

Designation of the mode

Point numbers and code

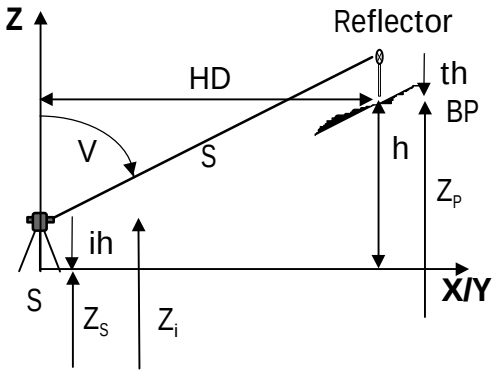
Y,X	Coordinates of station point
Y,X	Coordinates of backsight point A
SD,Hz,V	Readings for backsight point A according to selection
m,Om	Scale and circle orientation according to selection

3 Stationing

3 Stationing in elevation

Stationing in elevation permits the determination of the height above **M**ean **S**ea **L**evel independently of planimetric stationing. In programs involving local coordinates, in particular, the absolute height can be included in the measurement.

The stationing in elevation is possible before or after a planimetric stationing.



given.: : Z_P

meas.: : $(SD,V)_{S\rightarrow P,}$ ih, th

requ.: : Z_s

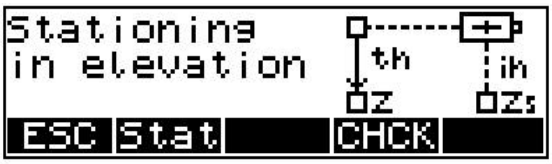
The station height is determined by measurement to a **B**acksight **P**oint with a known height.

Measurement „Stationing in Elevation“

Stat to go to the input menus

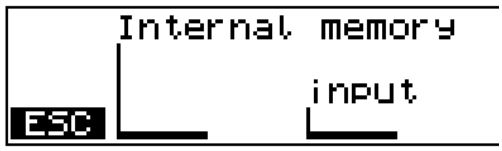
CHCK 🕮 **Adjusting and checking**

ESC to quit the program



Enter one after another:

Z, ih, th:



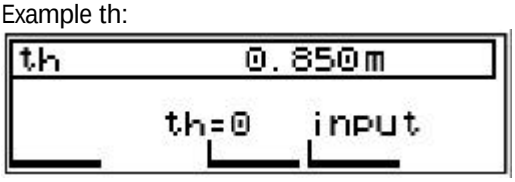
└ 🕮 Principles
First steps

🕮 Editor
Data management

└ th 0.850 m
Confirmation of the old value

└ th=0
Set to zero

Example th:



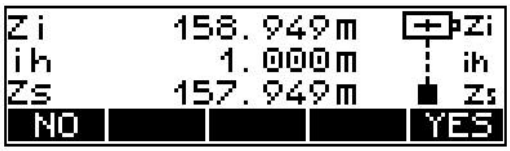
® Sight backsight point

ON + *PNo*
Point number to be changed?

MEAS

YES to confirm, record, quit the program

NO to reject, new start



Display of results and recording

Recording

📖 Presettings
First steps

If recording is activated, the following lines are saved in dependence on the settings:

Designation of the mode

Point numbers and code

th	Reflector height at backsight point (only if changed)
ih	Instrument height (only if changed)
Z	Height of backsight point
SD, Hz, V	Readings for backsight point
Zs	New station height

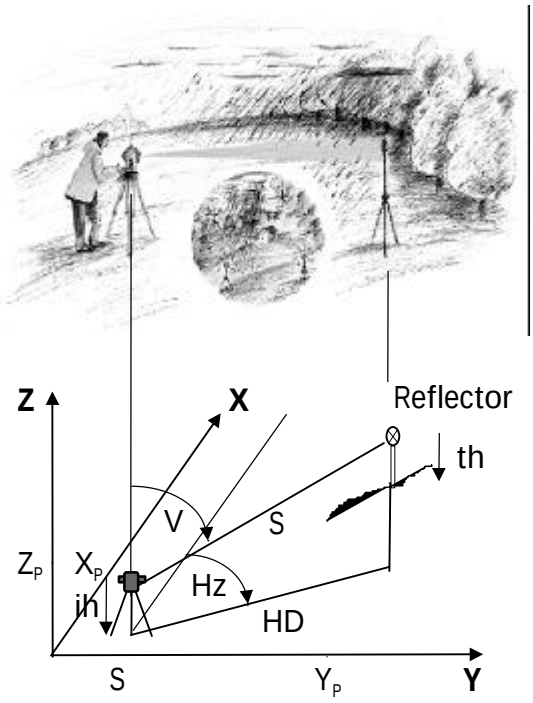
3 Coordinates

4 Polar Points

Determination of the coordinates and heights of new points by distance and direction measurements.

The coordinates can be computed in a higher-order system of coordinates.

Local coordinates can be determined in the standard measurement menu.



given.: : $(Y,X,Z)_S$, Om, m

meas.: : $(SD,Hz,V)_{S-P}$

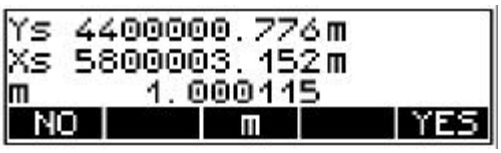
requ.: : $(Y,X,Z)_P$

Confirmation of Stationing

YES to confirm the station coordinates and to continue in the program

NO to reject, new start - stationing

m to change the scale



Scale:

+ , **-** to change m

o.k. to confirm

Reference direction:

YES to confirm and continue in the program

NO to reject, new start - stationing

Instrument and station heights:

YES to confirm and continue in the program

NO to reject, new start - height stationing

ih/Zs to enter instrument and reflector heights

☝ **Attention !**

If neither a stationing in elevation has been realised beforehand nor Zs is entered now, all heights Z will be related to the station height Zs=0.
If ih is not entered either, all heights Z will be related to the trunnion axis height Zi=0.

Measurement „Polar Points“

→1, **→2**
to change pages over

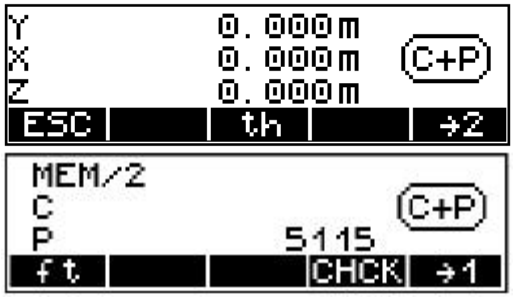
th
to enter the reflector height of the new point

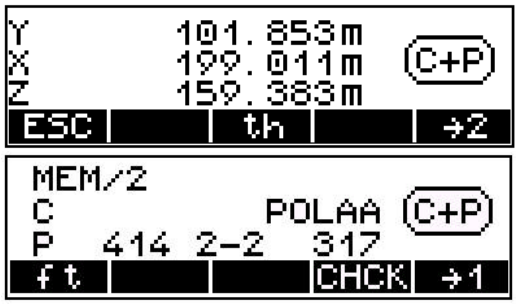
ON + ***PNo***
to enter point number and code of the new point

ft
to change measuring unit

CHCK
📖 **Adjusting and checking**

MEAS
to start the measurement





Display of results and saving

☞ **Tip**

The measurement can be triggered both on display pages 1 and 2.
After the measurement, the program returns to the page where the measurement has been triggered.

Recording

📖 Presettings
First steps

If recording is activated, the following lines are saved in dependence on the settings:

Designation of the mode

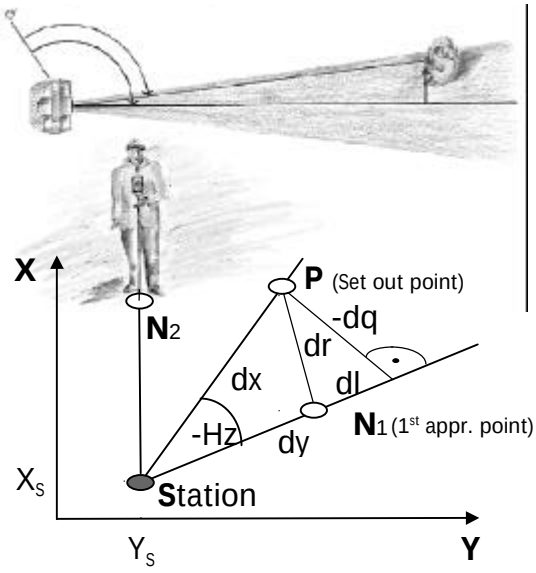
Point numbers and code

m	Scale (only if changed)
ih	Instrument height (only if changed)
Zs	Station height (only if changed)
th	Reflector height at backsight point (only if changed)
SD, Hz, V	Polar coordinates
Y, X, Z	Rectangular coordinates

3 Coordinates

5 Setting Out

Search for or setting out points in a given system of coordinates. A stationing is the prerequisite for setting out points on the basis of coordinates.



After having entered the coordinates of the point to be set out and measured the approximate point, the Elta® R displays the result in the form of the longitudinal deviation dl, the transverse deviation dq, the angle Hz between the approximate point and the nominal point, the radial deviation dr and the deviations of the coordinates dx, dy and dz.

given.: : $(Y,X)_{S,P}$

comp.: :$(HD,Hz)_{S-P}$

meas.: : $(HD,Hz,V)_{S-N}$

comp.: : $(dl,dq,dr)_{P-N}$

Confirmation of Stationing

YES to confirm the station coordinates and continue in the program

NO to reject, new start - stationing

m to change scale

Scale:

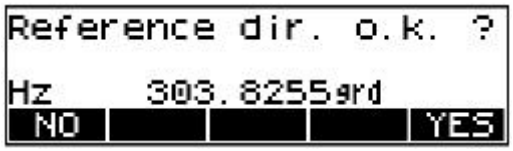
+ , **-** to change scale

o.k. to confirm

Reference direction:

YES to confirm and continue in the program

NO to reject, new start - stationing



Instrument and station heights:

YES to confirm and continue in the program

NO to reject, new start - height stationing

ih/Zs to enter instrument and reflector heights

Measurement „Setting Out“

The following options for the setting-out method are available:

or

CHCK 📖 **Adjusting and checking**

Z-n, **Z-j** Change with / without height — Setting out with or without height

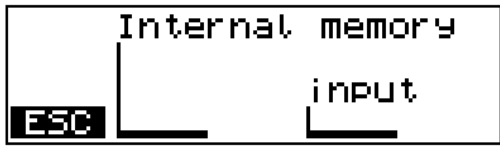
YXZ, **YX** see below — Setting out using given coordinates or

HDh, **HD** page 4-23 — using known setting out parameters

Setting Out using known nominal Coordinates

└ 📖 Principles **First steps**

📖 Editor **Data management**



After defining the coordinates:

to turn the instrument up to Hz=0

th to enter the reflector height

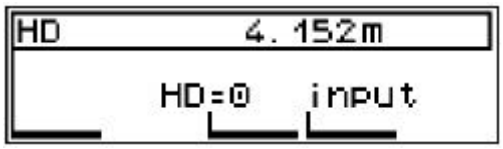
ON + ***PNo*** Point number and code to be corrected?

MEAS to measure the approximate point

to continue see measurement results page 4-24

Setting Out using known Setting Out Parameters

Entering HD:

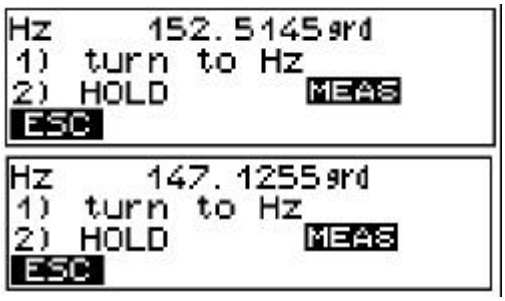


HD 4.152 m
Confirmation of the old value

HD=0
Set to zero

📖 Principles
First steps

Defining the Hz value:

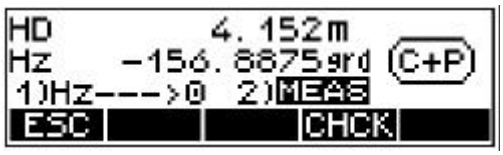


to set the desired Hz value

MEAS 1st measurement to the approximate point

ON + PNo
Point number and code to be corrected?

th
to enter reflector height



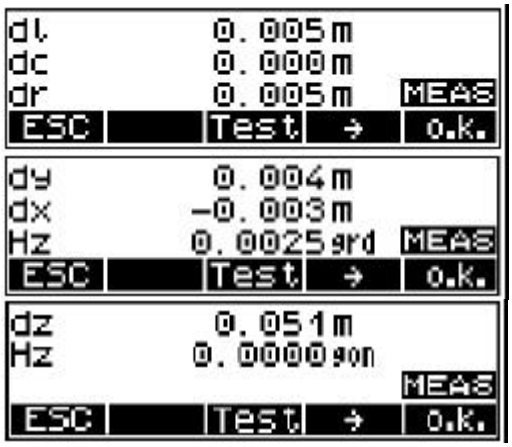
Measurement results see below

Measurement Results

→
to change over the different displays of results

Test
see below

o.k.
to confirm the setting out and to record;
to set out other points



Display of results / recording

MEAS
to repeat until the approximate point is close enough to the set out point!

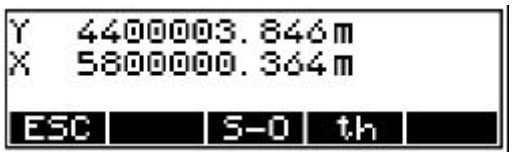
Additional measurement of the set out point:

th
to enter the reflector height

MEAS
to measure

Display of results / recording

S-O Setting out, calling up next point



Display of results and recording

Recording

📖 Presettings
First steps

If recording is activated, the following lines are saved in dependence on the settings:

Designation of the mode

Point numbers and code

HD,Hz, Z or	Nominal values
Y,X,Z	

SD,Hz,V Readings for the point

dl, dq, dr	Setting-out differences
dy, dx	Setting-out differences (only if nominal coordinates are used)
dz	Setting-out differences (only if the height is set out)
	or
th	Reflector height (only if changed)

SD,Hz,V Readings and

Y,X,Z	Actual coordinates of check measurement

5 Applications

The chapter *Applications* describes typical configurations and computations for various measuring methods that are frequently used in practice.

The guidance through the menu is very easy to understand and based on a unique schema for all programs.

Principle

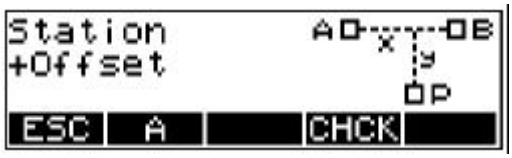
2 Applications

4 Point-to-Line Distance

After calling the respective program, a graphics appears with a detailed explanation of the program.

CHCK 🕮 **Adjusting and checking**

A to start the program by calling point A



☞ **Tip**

The function of adjusting and checking is required for measurements to be carried out without/with compensator or for checking the adjustment of the instrument.

The display of **A** in negative type indicates the possibility to measure to point **A**.

ON + ***PNo***
to enter the point number and code

MEAS to trigger measurement

> ☞ **Tip**
>
> Prior to each measurement triggered with **MEAS** it is possible to enter a point number and a code for the point to be measured. The point number is incremented automatically by 1 without any need to lift a finger.
>
> In the programs, the codes for defined points are invariably set (A, B, C, S) and cannot be changed.

B to continue in the program by calling point B

ESC to return to the higher-order menu

A to repeat point A if required

If A has been calculated, measured or defined as station, the symbol for A (square) is filled. Now, the point B or P can be treated exactly the same way.

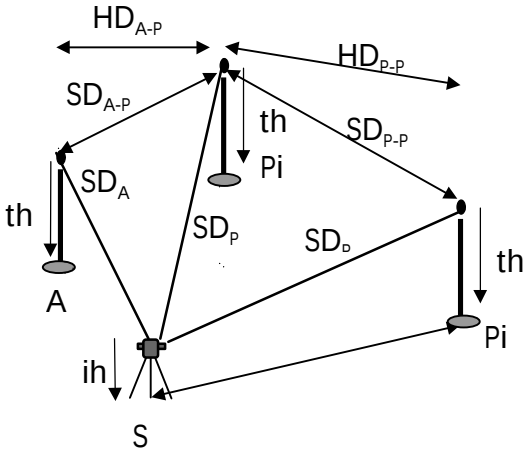
> ☞ **Tip**
>
> If errors or confusions should occur whilst measuring to the points, the measurement to single points can be repeated immediately.

2 Applications

1 Connecting Distance

If it is not possible to measure a distance between two points directly, the measurement to these points has to be started at a station point S. Then, the program calculates the distances SD,HD and the height difference h between the points.

Examples for application:
Measurement of cross sections, checking the distances between points, boundaries and buildings



meas.: : $(SD,Hz,V)_{A,Pi}$

requ.: : $(SD,HD,h)_{A-P}$, $(SD,HD,h)_{P-P}$

Measurement „Connecting Distance“

CHCK 🕮 **Adjusting and checking**

A to start by calling point A

th to enter the reflector height of A

ON + ***PNo***

MEAS to measure to point A

A=S page 5-8

A Measurement to point A to be repeated?

P to call point P

th to enter the reflector height of P

ON + ***PNo***

MEAS to measure to point P

P=S page 5-8

☞ **Tip**

After completing the determination of the first connecting distance, there are two different methods for continuing the measurement:
polygonal measurement P-P or
radial measurement A-P.

The method can be changed at any time after returning to the higher-order menu and selecting again.

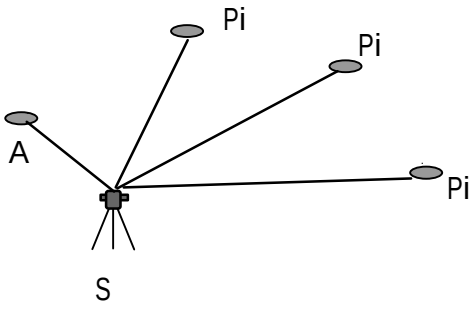
P-P page 5-6

A-P page 5-7

A to repeat measurement to point A

Display of results and saving

Polygonal Connecting Distance P - P



The results are always related to the last two points measured.

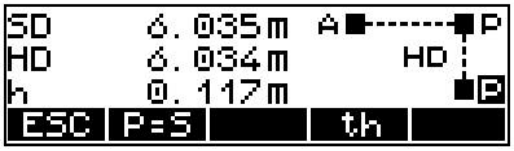
th to enter the reflector height of the next point P

ON + ***PNo***

MEAS to measure to point P

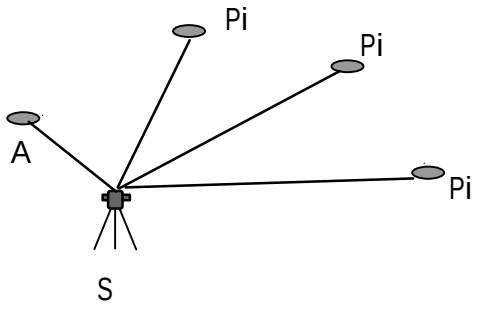
Further points P:

th, **ON** + ***PNo***, **MEAS**



Display of results and saving

Radial Connecting Distance A - P



The results are always related to point A.

th to enter the reflector height of the next point P

ON + ***PNo***

MEAS to measure to point P

Further points P:

th, **ON** + ***PNo***, **MEAS**

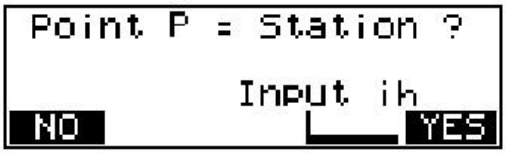
Display of results and saving

The Station equals Point P P = S

📖 Principles
First steps

YES to confirm

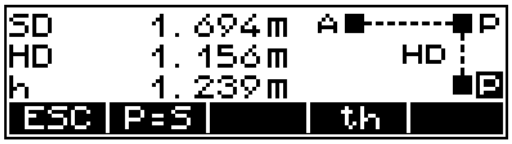
NO to reject



Saving

ON + ***PNo***

MEAS to measure to point P



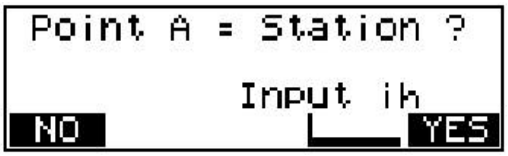
Display of results and saving

The Station equals Point A A = S

📖 Principles
First steps

YES to confirm

NO to reject



Saving

A Measurement to point A to be repeated?

P to call point P and continue in the main program

Recording

📖 Presettings
First steps

If recording is activated, the following lines are saved in dependence on the settings:

Designation of the mode

Point numbers and code

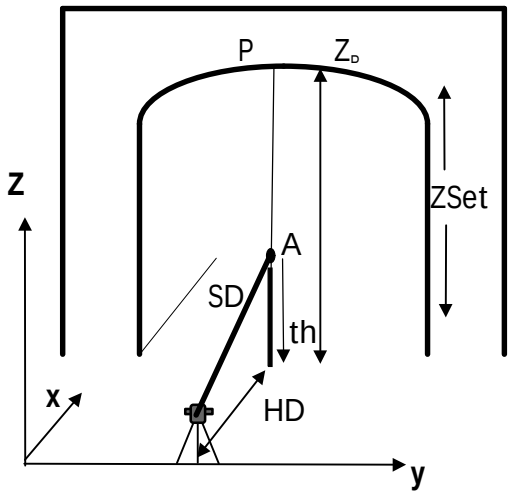
SD, Hz, V	Polar coordinates A,P
th, ih	Reflector height, instrument height (only if changed)
SD, HD, h	Connecting distance A-P
SD, HD, h	Connecting distance P-P

2 Applications

2 Object Height

Heights of inaccessible points are determined by measuring SD,V to an accessible point in the plumb line. Only the angle V is measured to the inaccessible point.

Examples for application:
Determination of tree heights, widths of tree tops and trunk diameters,
power lines,
passageways and bridge profiles,
setting out of heights on vertical objects



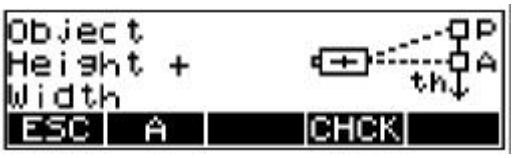
meas.: : $(SD,V,th)_A$, V_P

requ.: : Z, HD, (O)

Measurement „Object Height“

CHCK 🕮 **Adjusting and checking**

A to start by calling point A



th to enter the reflector height of A

ON + ***PNo***

MEAS to measure to point A

Measurement to point P

P to call point P

ON + *PNo*,

→ to sight point P

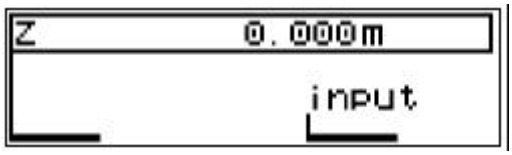
MEAS to measure to point P

Display of results and saving

further points P

Definition of a Reference Height ZSet

With **ZSet**, a horizon with a given height can be defined.



Z 0.000 m
Confirming the old reference height (in this case 0)

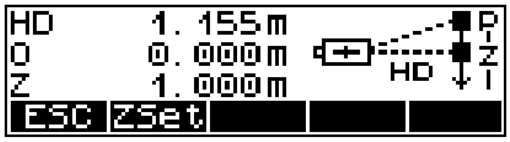
📖 Principles
First steps

ON + *PNo*

MEAS to measure to the reference height

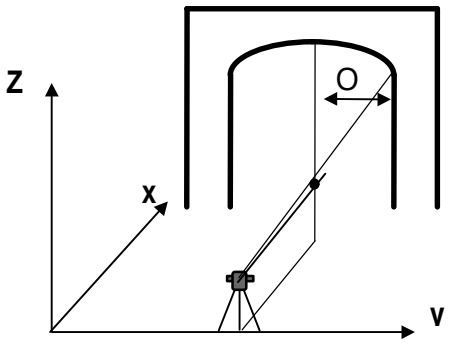
Further points:

ON + *PNo*, MEAS



Display of results and saving

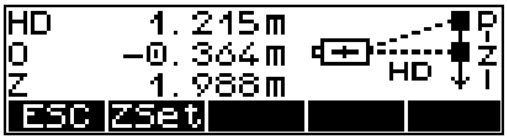
Measurement beside the Plumb Line



Further points:

[ON] + [*PNo*], [MEAS]

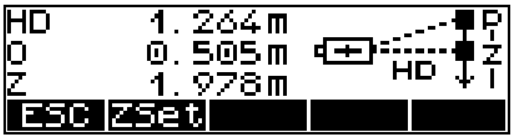
to the left of the plumb line



Further points:

[ON] + [*PNo*], [MEAS]

to the right of the plumb line



Recording

📖 Presettings
First steps

If recording is activated, the following lines are saved in dependence on the settings:

Designation of the mode

Point numbers and code

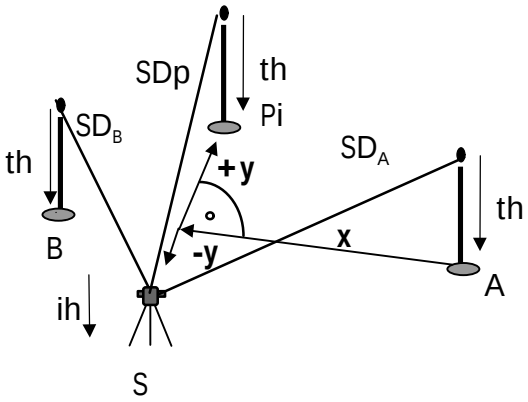
SD, Hz, V	Polar coordinates A
Hz, V	Measuring point P
HD,O,Z	Measuring point P
Z	Set value Z

2 Applications

3 Point-to-Line Distance

Determination of the rectangular coordinates of any point in relation to a reference line defined by the points A and B.

Examples for application:
Checking of point distances from a reference line,
checking of boundaries,
intersection of sight rails,
determination of the distances of buildings from boundaries, footpaths or streets,
alignment of long straight lines in the event of visual obstacles on the line,
surveying of supply lines and channel routes referred to roads and buildings,
free stationing in a local system



meas.: : $(SD,Hz,V)_{A,B,P}$, th

requ.: : $(x,y)_P$, referred to the line A-B

h_{A-B}, h_{A-P}

Measurement „Point-to-Line Distance“

CHCK 🕮 **Adjusting and checking**

A to start by calling point A

th to enter the reflector height of A

ON + ***PNo***

MEAS to measure to point A

A=S page 5-16

B to call point B

A Measurement to point A to be repeated?

th to enter the reflector height of B

ON + ***PNo***

MEAS to measure to point B

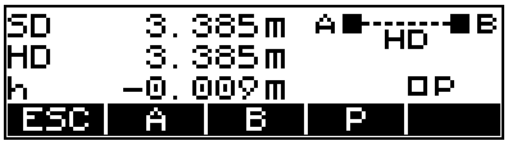
B=S page 5-17

The results refer to points A and B

P to call point P

B B to be repeated?

A A to be repeated?



Display of results and saving

th to enter the reflector height of P

ON + ***PNo***

MEAS to measure to point P

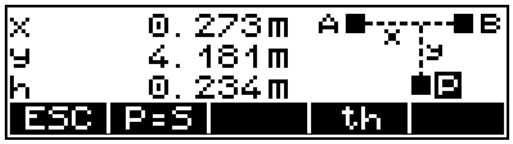
P=S page 5-17

further points P

th to enter the reflector height of P

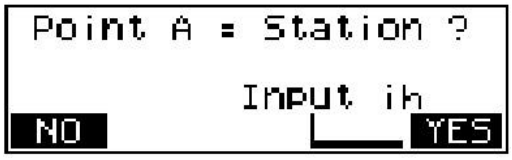
ON + ***PNo***

MEAS



Display of results and saving

The Station equals Point A A = S



📖 Principles
First steps

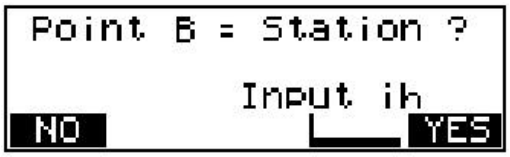
YES to confirm

NO to reject

B to continue in the main program

Saving

The Station equals Point B B =S



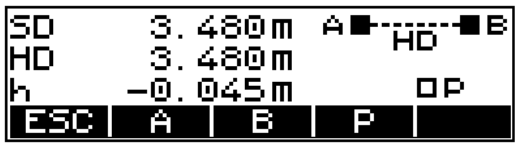
└ 🕮 Principles
First steps

YES to confirm

NO to reject

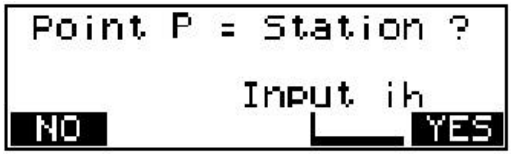
The results refer to points A and B(S)

P to continue in the main program



Display of results and saving

The Station equals Point P P = S (checking)



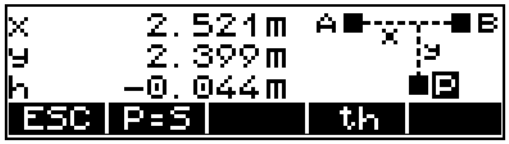
└ 🕮 Principles
First steps

YES to confirm

NO to reject

To continue in the main program:

th, ON + *PNo*, MEAS



Display of results and saving

Recording

📖 Presettings
First steps

If recording is activated, the following lines are saved in dependence on the settings:

Designation of the mode

Point numbers and code

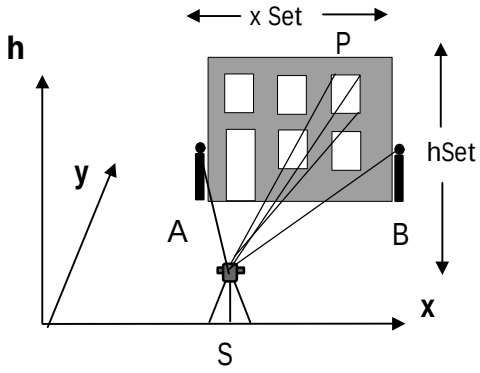
SD, Hz, V	Polar coordinates A,B
th,ih	Reflector height, instrument height (only if changed)
SD, HD, h	Basis A-B
SD, Hz, V	Polar coordinates P
y,x,h	Coordinates P
A=S, B=S and P=S	Information lines
Y,X,h	P=S

2 Applications

4 Vertical Plane

A vertical plane is defined by angle and distance measurements to two points. The coordinates of further points in this plane are determined only by an angle measurement.

Examples for application:
Surveying of building façades, heights of passageways, bridges or motorway signs,
determination of coordinates in a vertical plane for the determination of heights and volume computations,
setting out of sectional planes (planimetry and height) for façade construction



meas.: : $(SD,Hz,V)_{A,B}$, th,
$(Hz,V)_P$

requ.: : $(y,x,h)_P$

Measurement „Vertical Plane“

CHCK 🕮
Adjusting and checking

A to start by calling point A

th to enter the reflector height of A

ON + ***PNo***

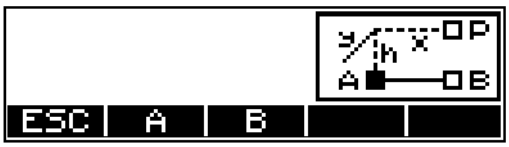
MEAS to measure to point A

B to call point B

th to enter the reflector height of B

ON + ***PNo***

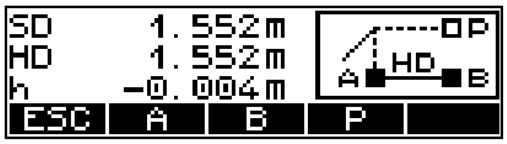
MEAS to measure to point B



P to call point P

ON + ***PNo***

MEAS to measure Hz and V to point P



Display of results and saving

To measure to further points

hSet see below

xSet page 5-21

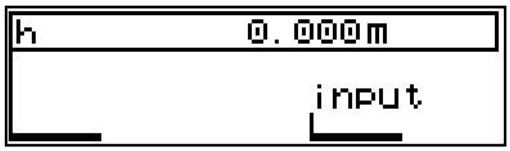
y page 5-22

P=S page 5-23

Display of results and saving

hSet - Determination of the Height Coordinate

Definition of the horizon:



h 0.000 m
Confirm the old reference height (in this case 0)

📖 Principles
First steps

Input (1,00)

ON + *PNo*

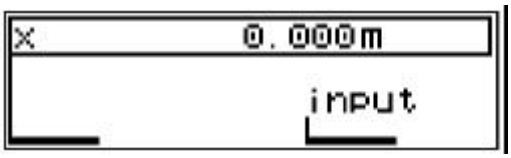
MEAS to measure Hz and V to point P

The results refer to the new height

To measure further points

Display of results and saving

xSet - Definition of the x - Axis



x 0.000 m
Confirm the old reference height (in this case 0)

📖 Principles
First steps

Input (1,00)

ON + *PNo*

MEAS to measure Hz and V to the desired point P

The results refer to the new height
(in this case, the desired and set zero point of coordinates has been measured)

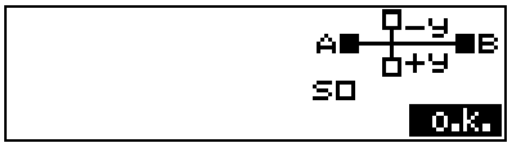
To measure further points

Display of results and saving

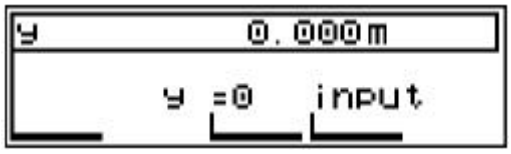
ySet - Points before or behind the Plane

Definition of preceding sign

o.k. to confirm



└ y 0.000 m
Confirm the old value (in this case 0)



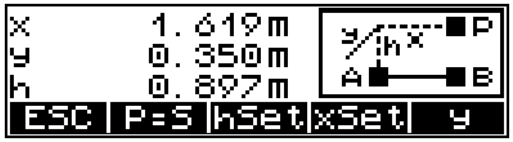
└ y = 0
Set to zero

└ 🕮 Principles
First steps

After entering y=0,350m:

ON + ***PNo***

MEAS to measure Hz and V to point P



Display of results and recording

The Station equals Point P P=S

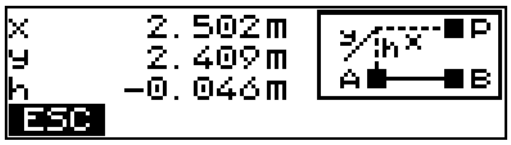
Principles
First steps

YES to confirm

NO to reject

Coordinates of S with reference to plane A-B

ESC further points



Display of results and recording

Recording

Presettings
First steps

If recording is activated, the following lines are saved in dependence on the settings:

Designation of the mode

Point numbers and code

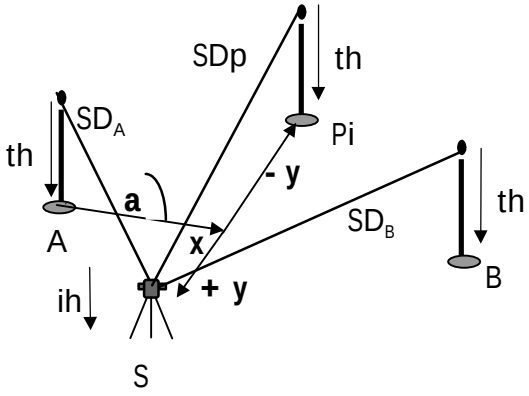
SD, Hz, V	Polar coordinates A,B
th,ih	Reflector height, instrument height (only if changed)
SD, HD, h	Basis
Hz,V	P
y, x, h	P
P=S	Information lines
Y,X,h	P=S

2 Applications

5 Orthogonal Lines

Determination of the angle a and the distances x,y for points, referred to a reference line A-B.

Examples for application:
Checking of lines for orthogonality, setting out of right angles, measurements in the case of visual obstacles



meas.: : $(SD,Hz,V)_{A,B,P}$, th,

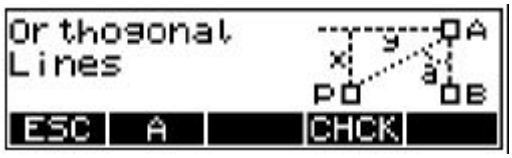
requ.: : a_P, $(y,x)_P$, with ref. to line A-B

h_{A-P}

Measurement „Orthogonal Lines“

CHCK 🕮 **Adjusting and checking**

A to start by calling point A



th to enter the reflector height of A

ON + ***PNo***

MEAS to measure to point A

A=S page 5-26

B to call point B

A Measurement to point A to be repeated?

th to enter the reflector height of B

ON + ***PNo***

MEAS to measure to point B

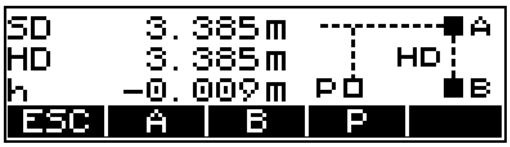
B=S page 5-27

The results refer to points A and B

P to call point P

B B to be repeated?

A A to be repeated?



Display of results and saving

th to enter the reflector height of P

ON + ***PNo***

MEAS to measure to point P

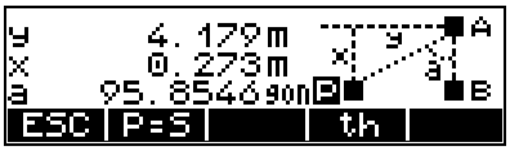
P=S page 5-27

Further points P

th to enter the reflector height

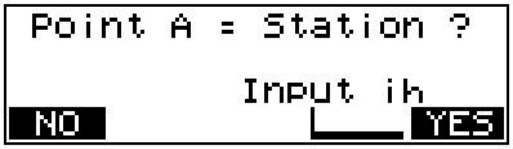
ON + ***PNo***

MEAS



Display of results and saving

The Station equals Point A A = S



📖 Principles
First steps

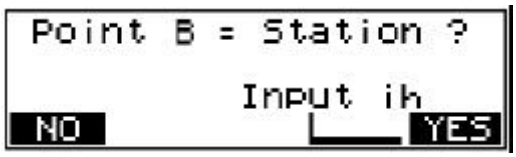
YES to confirm

NO to reject

B to continue in the main program

Saving

The Station equals Point B B =S



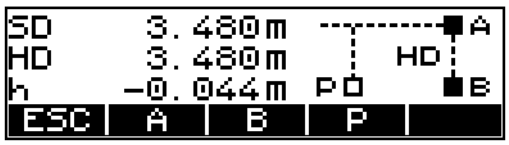
📖 Principles
First steps

YES to confirm

NO to reject

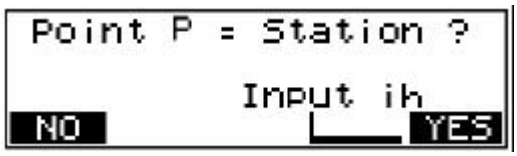
P to continue in the main program

The results refer to points A and B(S)



Display of results and saving

The Station equals Point P P = S (checking)



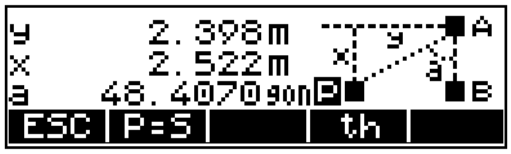
📖 Principles
First steps

YES to confirm

NO to reject

To continue in the main program:

th, ON + *PNo*, MEAS



Display of results without saving

Recording

📖 Presettings
First steps

If recording is activated, the following lines are saved in dependence on the settings:

Designation of the mode

Point numbers and code

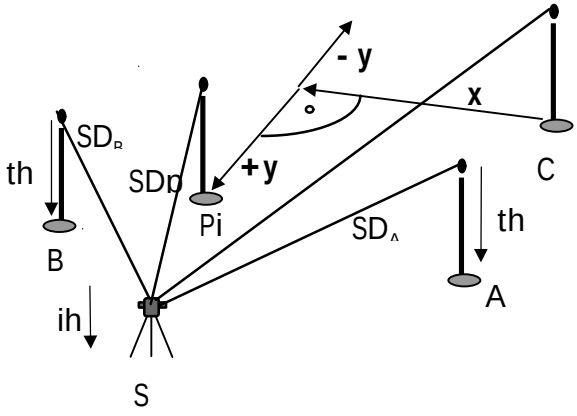
SD, Hz, V	Polar coordinates A,B
th,ih	Reflector height, instrument height (only if changed)
SD, HD, h	Basis A-B
SD, Hz, V	Polar coordinates P
y,x,a	Coordinates, angle P
A=S, B=S	
P=S	Information lines
Y,X,a	P=S

2 Applications

6 Parallel Lines

Creation of a parallel line through C to a reference line A-B. The point distances x,y are determined with reference to this parallel through C.

Examples for application:
Checking of lines for parallelism, setting out of parallel lines if only one point is given



meas.: : $(SD,Hz,V)_{A,B,C,P}$, th,

requ.: : $(y,x)_P$, with reference to line through C (parallel to A-B),

h_{A-P}

Measurement „Parallel Lines“

CHCK 🕮 **Adjusting and checking**

A to start by calling point A

th to enter the reflector height of A

ON + ***PNo***

MEAS to measure to point A

A=S page 5-32

B to call point B

A Measurement to point A to be repeated?

th to enter the reflector height of B

ON + ***PNo***

MEAS to measure to point B

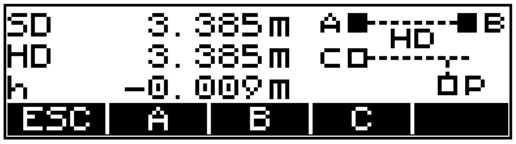
B=S page 5-32

The results refer to points A and B

C to call point C

B B to be repeated?

A A to be repeated?



Display of results and saving

th to enter the reflector height of C

ON + ***PNo***

MEAS to measure to point C

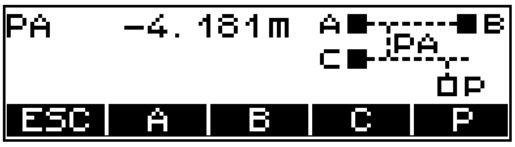
C=S page 5-33

P to call point P

A A to be repeated?

B B to be repeated?

C C to be repeated?

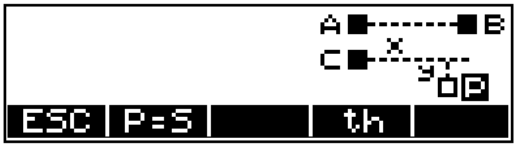


th to enter the reflector height of P

ON + ***PNo***

MEAS to measure to point P

P=S page 5-33

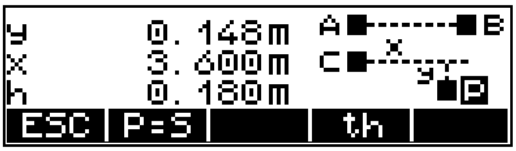


Further points P

th to enter the reflector height

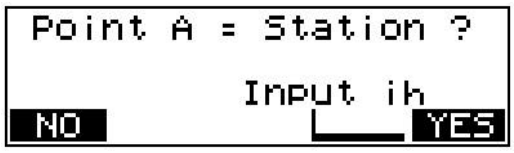
ON + ***PNo***

MEAS



Display of results and saving

The station point is point A A = S



📖 Principles
First steps

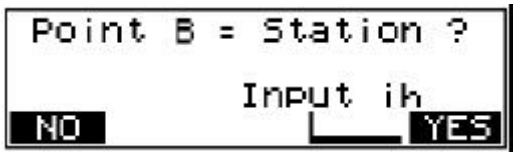
YES to confirm

NO to reject

B further in the main program

Saving

The station point is point B B =S



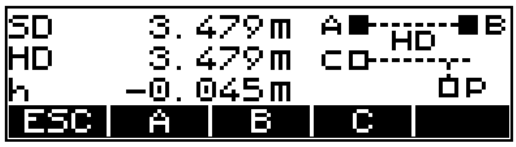
📖 Principles
First steps

YES to confirm

NO to reject

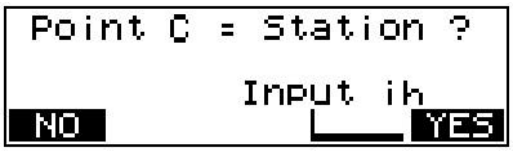
The results refer to points A and B(S)

C further in the main program



Display of results and saving

The Station equals Point C C = S



└ 🕮 Principles
First steps

YES to confirm

NO to reject

P to continue in the main program

Display of results and saving

The Station equals Point P P = S (checking)

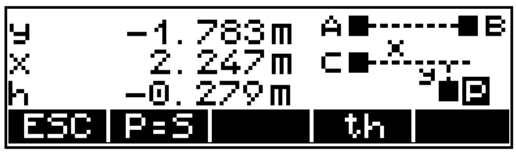
└ 🕮 Principles
First steps

YES to confirm

NO to reject

To continue in the main program:

th, ON + *PNo*, MEAS



Display of results and saving

Recording

📖 Presettings
First steps

If recording is activated, the following lines are saved in dependence on the settings:

Designation of the mode

Point numbers and code

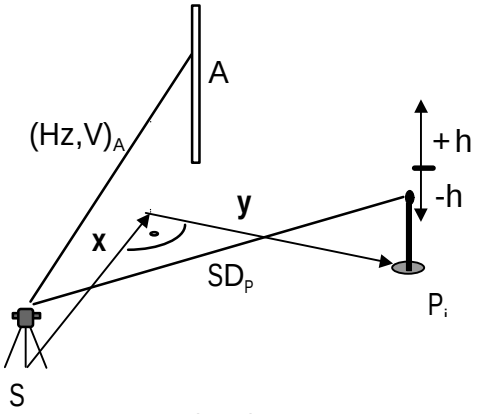
SD, Hz, V	Polar coordinates A,B,C
th,ih	Reflector height, instrument height (only if changed)
SD, HD, h	Basis A-B
SD, Hz, V	Polar coordinates P
y,x,h	Coordinates P
A=S, B=S	
C=S, P=S	Information lines
Y,X,h	P=S

2 Applications

7 Alignment

Determination of point distances x,y on the straight line from S to A.

Examples for application:
Checking of point deviations from a given straight line
Setting out of straight lines in the case of direct visual contact



meas.: : $(Hz,V)_A$

requ.: : $(y,x)_P$, in relation to S-A,
h in relation to the alignment height in point P_i

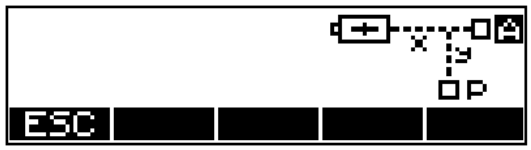
Measurement „Alignment“

CHCK 🕮 **Adjusting and checking**

A to start by calling point A

ON + *PNo*

MEAS to measure to point A



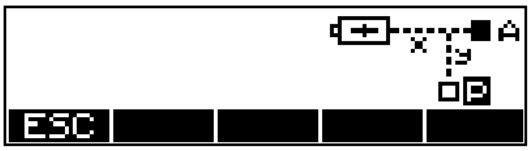
There is only an angle measurement carried out to point A !

P to call P

A Measurement to point A to be repeated?

ON + ***PNo***

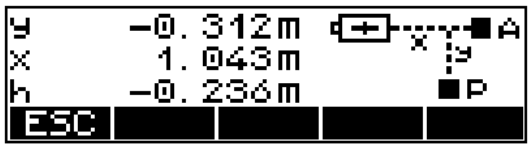
MEAS to measure to point P



Further points P

ON + ***PNo***

MEAS



Display of results and saving

Recording

📖 Presettings
First steps

If recording is activated, the following lines are saved in dependence on the settings:

Designation of the mode

Point numbers and code

Hz, V	Point A
SD, Hz, V	Polar coordinates P
y,x,h	Coordinates P

6 Data Management

Decisive features of an efficient work routine are the saving of the measured and computed values as well as the transfer of measured data to a PC and the transfer of coordinates from the PC to the surveying instrument. This chapter describes all processes necessary to meet these requirements. The section *Editor* only applies to Elta® R 45 and Elta® R 55.

Calling the EDIT Menu

ON *EDIT*

Compensator activated

Indication of battery level

Display of the free data lines and address of the last data line written

Display of Data Lines

Disp to go to memory display

? to call search function

to change page

to display preceding data line

to display following data line

ON *PNo*
allows to change point number and code

☝ **Attention !**

In the coordinate and application programs, fixed codes are assigned to certain data lines. Such codes cannot be modified by the operator.

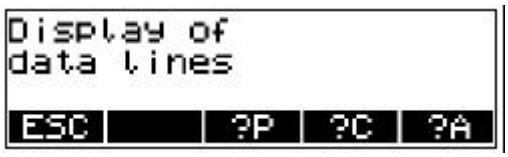
Searching for Data Lines

? to call search function

?P to search for point number

?C to search for code

?A to search for address



Input of the point number, code or address to be searched for

? ↓ to continue search using the same criterion

↵ to change page

↑ to display preceding data line

↓ to display following data line

ESC to quit search routine

☞ **Tip**

If no data line is found to which the search criterion applies, search is followed by an error message.

Deleting Data Lines

Del to call the function "Delete"

Technical Information

This function deletes all data lines or the data lines from a selected line number (address) to the last data line saved.

Attention !

The deletion is definite and irrevocable. To avoid any unintentional loss of data, utmost care has to be taken over this action!

all to select all lines

?P or from the line with point number xx

?C or from the line with code xx

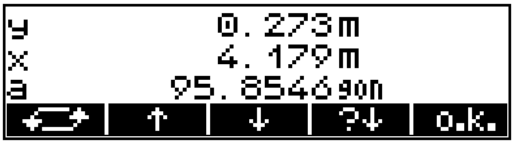
?A or from the line with address xx

Example: search for point number 2

? ↓ to continue search using the same criterion

⇄ to switch over to the page of readings

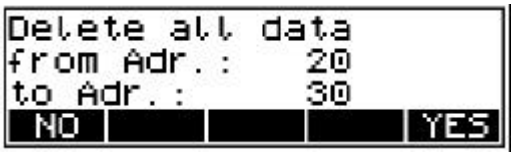
o.k. to confirm the line



For another check, the selected data lines are displayed again and have to be confirmed.

YES to confirm the selection

NO to reject the selection / quit the routine



Entering Data Lines

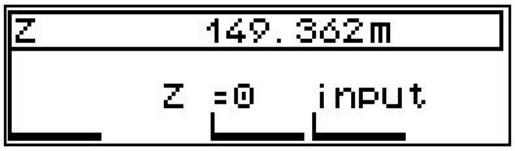
Inpt to call the function "Input"

XY to enter the planimetric coordinates

XYZ to enter planimetric coordinates and heights

Z to enter heights

Example of a height input:



└ Z 149,362 m
Confirmation of the old value (in this case 149,362 m)

└ Z = 0
Set the height to zero

└ 🕮 Principles
First steps

← and
to go to the desired position

\+ and -
to browse through digits

o.k. to confirm

to switch over to the page for readings

ON PNo
to enter point number and code

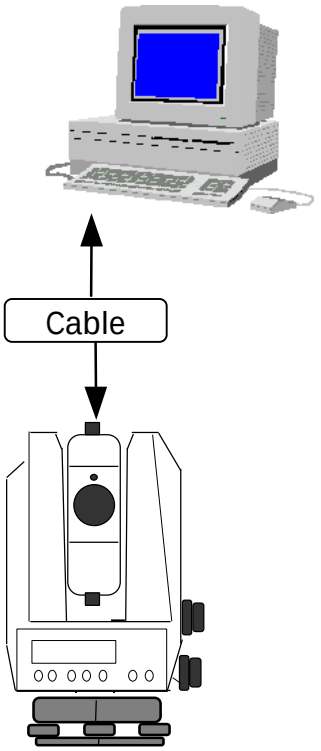
o.k. to confirm and save

Input of further coordinates and heights with point number and code

📖 Presettings
First steps

☝ **Attention !**

The sequence and designation of the coordinate axes depend on the selected system of coordinates and the setting of the display of coordinates. The softkey YX and YXZ, respectively, is labelled according to this selection.



Data transfer can be performed between and by

Elta R « PC Cable

This allows an easy data exchange between instrument and computer.

Preparing the Instrument for Data Transfer

ON *MENU*

5 Interface

YES to go to the menu

MOD to change settings

Menu Interface Elta® R

Elta® S « PC

Connect both devices by the serial interface cable and start the necessary programs for data transfer.

Cable for data transfer Elta® R « PC cable with protocol Xon/Xoff:

Order number 708177-9470.000

Interface parameters for transmitting and receiving project files:

Baud rate:	9600
Protocol:	Xon/Xoff
Parity:	even
Stop bits:	1 (not variable)
Data bits:	8

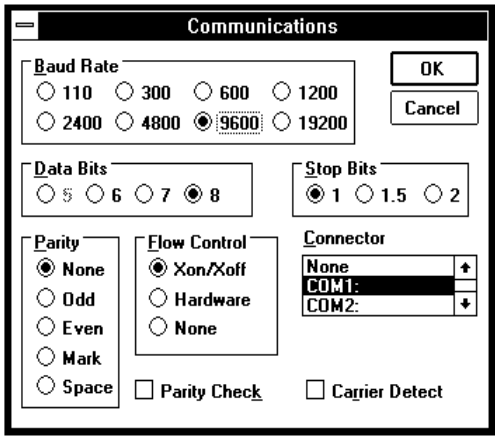
☞ **Tip**

For data transfer to and from the PC, you can use for example the MS-Windows™ Terminal program.

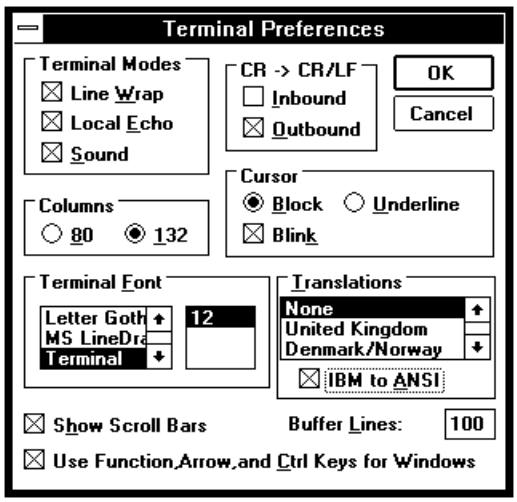
PC Terminal Settings

Example for Windows™ 3.xx Terminal program:

Set the PC for data transfer as follows:



For sending or receiving a project file, set the terminal preferences as shown in the follows:



To transmit a project file, select "Send text file " or "Receive text file ".

Data Transmission

Instrument Settings:

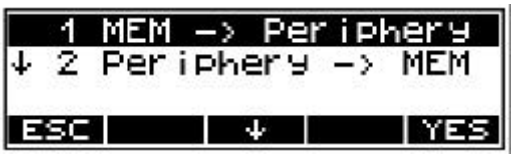
5 Interface

YES to go to the menu

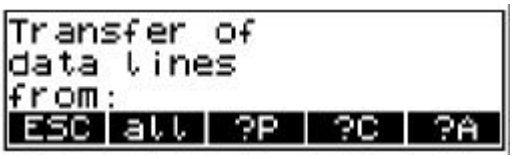
Data transfer menu between Elta® R and PC

1 MEM -----> Peripheral

YES to confirm



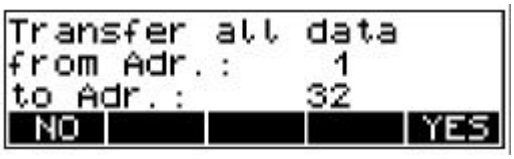
Selection of the required data lines



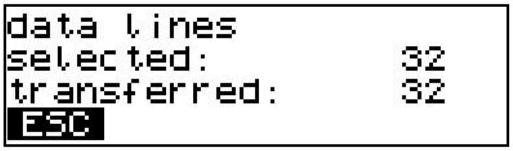
📖 Editor
Data Management

☞ Tip
Now, set the PC to „Receive text file ". The instrument or program at the receiving end must be set to the receive mode before you can transmit the project file.

YES to start



The data lines are transferred to the PC.



ESC to end data transfer

Data Reception

On the instrument:

5 Interface

YES to go to the menu

Data transfer menu between PC and Elta® R

2 Peripheral -----> MEM

YES to confirm

Enter the name of the source file into the PC

Start the transfer from the PC

The data lines are transferred to the Elta® R.

☝ **Attention !**

The instrument only accepts coordinates.

ESC to end data reception

☞ **Tip**

Time Out occurs after 30 seconds without data communication.

The message „Time Out " indicates a data error. After that, the program returns to the data transfer menu.

Introduction

Zeiss Geodetic Systems are used for measurement functions with different data processing requirements.

Elta ® instruments allow densely packed internal measurement and result data lines to be output in various formats.

M5, R4, R5, Rec500 record format

Four data formats which have grown historically are subject to on-site revision service for compatibility with customer instruments. Currently, M5 is the format

to provide most comprehensiveness in definitions. It should be used preferentially for any other tasks.

This chapter describes the structure of data format and the type identifier of measured and calculated values.

📖 Data transfer
Data management

📖 User interface
Data management

Technical

All instruments have a serial interface which ensures the data exchange.

Attention!

Instead of the usual marks within the 27 digit point identification, the M5 data format of Elta * R is limited to a 12 digit point number and a 5 digit code.

Description of M5 data format

„M5 " -> **5 Measuring data blocks** per data line:

1 Address block
1 Information block
3 numerical data blocks

The Zeiss M5 data format is the common standard for all current Carl Zeiss surveying systems.

All 5 data blocks are preceded by a type identifier. The 3 numerical data blocks have a standard layout comprising 14 digits. In addition to the decimal point and sign, they accept numeric values with the specified number of decimal places.
The information block is defined by 27 characters. It is used for point identification (PI) and text information (TI e.g.).
The address block is comprised of 5 digits (from address 1 to 99999).

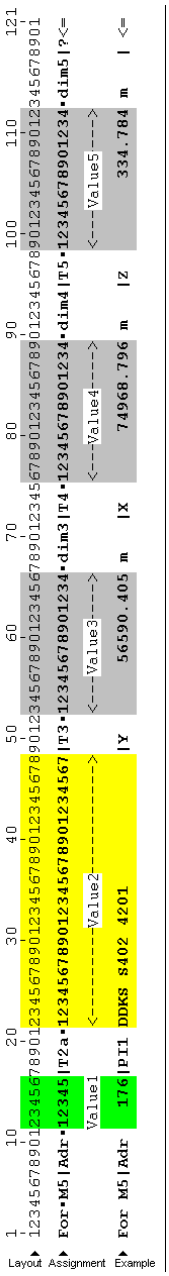
The M5 data line

The data line of the M5 format consists of 121 characters (bytes). The multiplication of this figure by the number of addresses (lines) stored shows the size of the project file in bytes.

Blanks are significant characters in the M5 file and must not be deleted.

The example describes an M5 data line at address 176 with coordinates (YXZ) recorded in unit **m.** The point identification of marking 1 is **DDKS S402 4201**. Column 119 includes a blank (no error code).

The end of the line has CR, LF (columns 120 and 121, shown here as **<=**).



Col. 120-121: Carriage Return <, Line Feed
Column 119: Blank field, in case of error „ę “
Col. 114-117: Unit for block5

Column 99-112: Block5 value block

Column 96-97: Type identifier5 for block5

Column 91-94: Unit for block4

Column 76-89: Block4 value block

Column 73-74: Type identifier4 for Block4

Column 68-71: Unit for block3

Column 53-66: Block3 value block

Column 50-51: Type identifier3 for block3

Column 22-48: Information block PI or TI (point identification PI or text information TI, TO etc.)

Column 18-20: Type identification2 PIa (a=1-0, for 10 Markings) or TI

Column 12-16: Memory address of data line

Column 8-10: Type identifier1 *Adr* for address

Column 1-6: Defines M5 format

blank | separator

Explanations to the data line

Abbr.	Description	Digits	Characters	Meaning
For	Format identifier M5	3	alpha	Elta® Format
	Format type	2	alpha	5 meas. data blocks
Adr	Address identifier	3	alpha	Value1
	Value1	5	numeric	Memory address
T2	Type identifier	2	alpha	Value2 (Pla ,TI, TO...)
a	Marking Value2	1	numeric	a=1, 2, 3 ,..., 9, 0
		27	alpha	PI or TI
T3	Type identifier	2	alpha	Value3
	Value3	14	numeric	14-digit value
dim3	Unit	4	alpha	4-digit unit
T4	Type identifier	2	alpha	Value4
	Value4	14	numeric	14-digit value
dim4	Unit	4	alpha	4-digit unit
T5	Type identifier	2	alpha	Value5
	Value5	14	numeric	14-digit value
dim5	Unit	4	alpha	4-digit unit
?	Identifier	1	alpha	Error message, or
Special characters			ASCII code	Hex code
|	Separator	1	ASCII 124	Hex 7C
	Blank	1	ASCII 32	Hex 20
<	CR (Carriage Return)	1	ASCII 13	Hex 0D
=	LF (Line Feed)	1	ASCII 10	Hex 0A

For your information only!
Elta® R - Page 6-23

The point identification PI in M5 Format

The PI is comprised of 27 characters. It starts in column 22 and terminates in column 48 in the M5 data line. The data structure within the PI is defined by markings. A maximum of 10 markings, marked in the preceding type identifier with PI1 to PI0 (columns 18, 19, 20), can be designated to the PI (depending on the instrument).

For your information only!
Elta® R - page 6-26

The type identifier in the M5 Format

In the course of the time, requirements on the data format have increased. Therefore, the M5 Format carries most of the type identifiers of all available formats, always based on the preceding format (Rec500).

Type identifiers are defined by two characters (except for Adr). If only one character is necessary, the second character is a blank.

In the M5 Format there are 5 Type identifiers (TK) defined:

TK1:	Adr	Identifier address (Value1)
TK2:	T2	Identifier information (Value2)
TK3:	T3	Identifier 3. Value field (Value3)
TK4:	T4	Identifier 4. Value field (Value4)
TK5:	T5	Identifier 5. Value field (Value5)

Example:

„PI" for point identification or „TI" for text information can be used for T2. For T3, T4, T5, „D", „Hz", „V" or „Y", „X", „Z" can be used.

Description of Rec 500 data format

„Rec500 " stands for the description of the electronic field book Rec500.

With the electronic field book Rec500 a data format was developed which was created for CZ instruments years ago and is today the base for the M5 format..

1 Address block
1 Block Information
3 Numeric data blocks

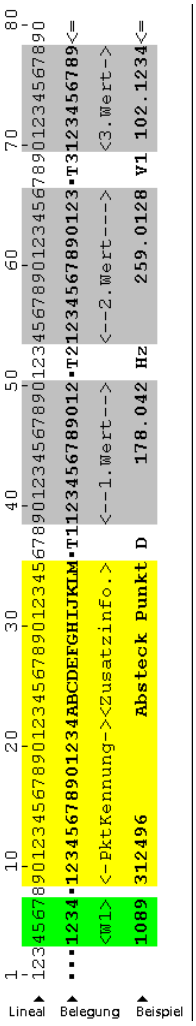
The Rec500 format is divided in 5 marking blocks (analogous the M5 format). These blocks differ in their block length from the M5 format, 80 characters (Bytes) are available on a data line.

The Rec500 Data line

The data line in the Rec500 format is comprised of 80 characters (Bytes).

Abbr.	Description	Digits	Characters	Meaning (w. example)
W1	Address	4	numeric	Memory address
PI	Point identification	27	num / alpha	Point identification (14-digits) and additional information (13 digits)
T1	Type identifier 1. Value	2 12	num / alpha numeric	D = slope distance E = horizontal distance Y = coordinate, etc.
T2	Type identifier 2. Value	2 13	num / alpha numeric	Hz = horizontal direction X = coordinate, etc.
T3	Type identifier 3. Value	2 9	num / alpha numeric	V1 = zenith angle Z = coordinate, etc.

Special characters			ASCII code	Hex code
	Blank	1	ASCII 32	Hex 20
<	CR (Carriage Return)	1	ASCII 13	Hex 0D
=	LF (Line Feed)	1	ASCII 10	Hex 0A



Column 79-80: Carriage Return <, Line Feed =

Column 70-78: 3. Value block

Column 68-69: Type identifier for 3. Value

Column 54-66: 2. Value block

Column 52-53: Type identifier for 2. Value

Column 39-50: 1. Value block

Column 37-38: Type identifier for 1. Value

Column 23-35: additional information of PI (alpha numeric)

Column 9-35: Point identification PI

Column 9-22: Point Number of PI (numeric)

Column 4-7: memory address of data line

Column 1-3: 3 Blanks

Blank

The point identification in Rec500 Format

For information only!
Elta® R –page 6-24

The PI is divided into two areas:
Area 1: numeric area for point marking (point number)
Area 2: alpha numeric area for additional point information

Description of R4 and R5 (M5, Rec 500) format of Elta® R

„R4 “stands for the data recording format of the Elta® R instruments containing 4 measuring data blocks:

1 Information block
3 numeric Data blocks

„R5 “stands for the data recording format of the Elta® R instruments containing 5 measuring data blocks:

1 Address block
1 Information block
3 numeric Data blocks

Two data recording formats - R4 and R5 - are available in the Elta® R total station (tachymeter). Both formats can be chosen in the instruments. Depending on the setting with or without address, either data record format R5 (with address) or R4 (without address) can be used.

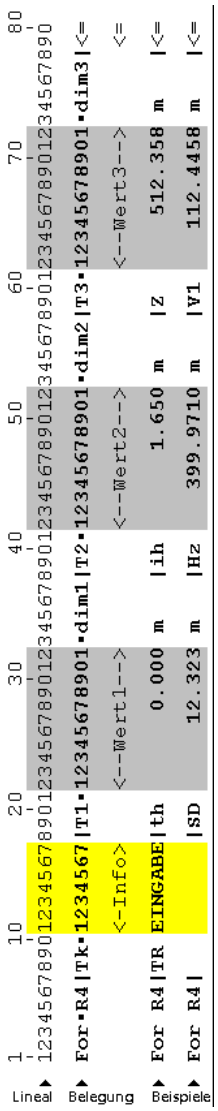
R4 and R5 format data lines

The data line in the R4 format contains 80 characters (Bytes). It is comprised of an information block and 3 numeric value blocks.
The data line in the R5 format contains 89 characters (Bytes). It is comprised of one address block, one information block, 3 numeric value blocks.
Both formats contain the same type identifiers for each block..

Abbr.	Description	Digits	Characters	Meaning
For	Marking format	3	alpha	Elta® R Format
R4,R5	format type R4, R5	2	alpha	4 or. 5 Data blocks
Adr	Address marking	3	alpha	3 digits for marking
<aa>	Value1	4	numeric	Address in R5 Format
Tk	Type identifier Info	2	alpha	Type identifier TR or KR
<Info>	Info	7	num / alpha	Info for data line
Ti	Type identifier Value i	2	num / alpha	Type ID Value block
<Wi>	Value i (i = 1,2,3)	11	numeric	Value block Value i
dimi	dim i (i = 1,2,3)	4	alpha	Unit block Value i

📖 Special characters M5 Data format

The special characters , | , < and = are analogous the M5 format.



The R4 Data line

Column 79-80: Carriage Return <, Line Feed =

Column 74-77: Unit for 3. Value block

Column 62-72: 3. Value block

Column 59-60: Type identifier for 3. Value block

Column 54-57: Unit for 2. Value block

Column 42-52: 2. Value block

Column 39-40: Type identifier for 2. Value block

Column 34-37: Unit for 1. Value block

Column 22-32: 1. Value block

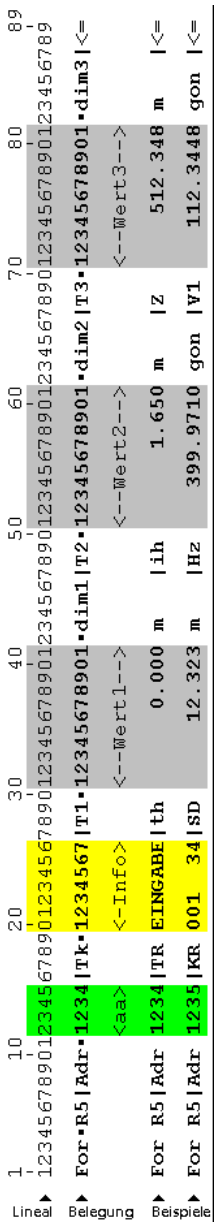
Column 19-20: Type identifier for 1. Value block

Column 11-17: Data line information (alpha numeric)

Column 8-9: Type identifier information

Column 1-6: Defines R4 format

Blank | Separator



The R5 Data line

Column 88-89: Carriage Return <, Line Feed =

Column 83-86: Unit for 3. Value block

Column 71-81: 3. Value block

Column 68-69: Type identifier for 3. Value block

Column 63-66: Unit for 2. Value block

Column 51-61: 2. Value block

Column 48-49: Type identifier for 2. Value block

Column 42-46: Unit for 1. Value block

Column 31-41: 1. Value block

Column 28-29: Type identifier for 1. Value block

Column 20-26: Data line information (alpha numeric)

Column 17-18: Type identifier information

Column 12-15: Memory address of Data line

Column 8-10: Type identifier *Adr* for address

Column 1-6: Defines R5 Format

Blank | Separator

The point identification in the R4/R5 Format

For a point identification in the R4 and R5 format are max. 7 digits available.

The PI is controlled by two Type identifiers, TR and KR, which describe the kind of PI.

TR Type identifier for a text information block

KR Type identifier for a PI with code and point number.

Point number: 0...9, right-aligned, 4-digit

Point code: 0...9, Blank, # 3-digit

The 3 digit code can be combined with additional characters. It is suggested to use the character # for marking incorrect measurements.

Eltaâ R - Marking in the M5/Rec 500 Format

The Elta® R uses a mark which is saved internal in the instrument. This mark consists of 3 blocks with clearly defined block lengths. The user is able to manipulate the order of the 3 blocks.

Examples:

Layout gage:
```
1         10         20     27
12345678901234567890123456 7
```

Sample Marking: **PPPPPPPPPPPP CCCCC IIIIIII**

Sample Marking: **IIIIIII CCCCCPPPPPPPPPPPP**

Meaning:

PPPPPPPPPPPP 12-digit point number

CCCCC 5-digit point code

IIIIIII 7-digit information block

☞ **Tip**

The information block (**I**) is left-aligned, the code (**C**) and point number (**P**) are right-aligned.

Upon data conversion to the R4 / R5 format, the point number and point code will be shortened to 5 and 3 digits, respectively. The right-aligned digits remain.

Change settings of Elta$^{\hat{a}}$ R – Markings in the M5 / Rec 500 format

ON ***MENU***

5 User interface

YES go to the menu

MOD to change setting

Tip

In case of overlapping information in the blocs, the instrument returns into its initial state (Default).

Elta® R –Markings in R4/ R5 format

In instruments of the Elta® R Serie one marking can be used.

In both the R4 and R5 format 7 characters are available for point identification and marking.

The PI is controlled by two type identifiers TR and KR, which mark the kind of the PI.

TR Type identifier for one text information block

KR Type identifier for a PI with code and point number.

Point number: 0...9, right-aligned, 4-digit

Point code: 0...9, Blank, # 3-digit

The 3 digits in the code can be combined with any applicable character. It is sug gested, to use the character # to mark incorrect measurements.

Examples:

Layout gage: `TI 1234567`

Text information: **`TR IIIIIII`**

Point number and code: **`KR CCCPPPP`**

Meaning:

IIIIIII 7-digit Text information block

CCC 3-digit Code block

PPPP 4-digit Point number block

In the M5 / Rec500 Format a 5-digit code and a 12-digit point number are used. In the R4 / R5 Format the established digits (3 and 4, respectively) remain right-aligned.

Definition of type identification

Definition	Type identifiers are assigned to the 5 measuring data blocks of pre-set codes, which show the number or character value of the block.
Type ID´s are defined with two characters.	Type identifiers are (except for **Adr**) defined with two characters. If only one character is necessary, the second character is blank. The code is case sensitive. The following table lists all Type identifiers in alphabetical order according to the CZ Data Formats and the possible position of characters after the comma (,????) as well as signs (±):

Type identifiers - CZ Formats M5, R4, R5 and Rec500 (Elta R)

Type identifier	**,????**	**±**	**Meaning**
A	2,3,4		Distance addition constant
a	6		Horizontal angle of orthogonal line
Adr	-		Address (the only TK with 3 characters)
B			V-angle of control point
c	3,4,5		Collimation correction
c_			Sighting axis error
dl	2,3,4		Longitudinal deviation
dq	2,3,4,5		Transverse deviation
dr	2,3,4		Radial deviation in setting out
dx	2,3,4		Coordinate Difference /Deviation in X direction
dy	2,3,4		Coordinate Difference /Deviation in Y direction
dz	2,3,4		Coordinate Difference /Deviation in Z direction
HD	2,3		Horizontal distance
HV	3,4,5		Hz rotation
Hz	3,4,5	±	Horizontal direction

Type identifier	,????	±	Meaning
h	2,3,4	±	Height difference of a station
i	3,4,5		Index correction
ih	2,3,4		Instrument height
KR			Information Elta® R with code and point number
m	6		Scale
NZ	3,4,5		Compensator reading, sighting direction
O	2,3,4		Transverse distance (indirect height determination)
Om	3,4,5		Orientation (stationing) Omega
P	0,0,1		Air pressure (in hPa, Torr or InMerc)
PI			Point Identification (general)
pa	2,3,4		Parallel distance in 3-D plane
SD	2,3		Slope distance
SZ	3,4,5		Compensator run center: component in line of sight direction
T			Text ID in Rec500 Format
TI	-		Text information line
TR			Information Elta® R as text information
T_	-		Temperature (in °C or °F)
th	2,3,4		Reflector height
V1	3,4,5		Vertical angle: zenith angle
V2	3,4,5		Vertical angle: vertical angle
V3	3,4,5		Vertical angle: height angle
V4	3,4,5		Vertical angle: slope in [%]
X	2,3,4		X - Coordinate
x	2,3,4		x - Coordinate (lokal)
Y	2,3,4		Y - Coordinate
y	2,3,4		y - Koordinate (lokal)
Z	2,3,4		Z - Koordinate (Height above N.N.)

Description Value blocks

3 Value blocks

In each of the Carl Zeiss Formats three value blocks are available whose number of digits depends on the format:

Format	Value1	Value2	Value3	dim
M5	14	14	14	4
R4/R5	11	11	11	4
Rec500	12	13	9	-

📖 Type identifiers

All value blocks are preceded by a type identifier which specifies the function of the succeeding value.

In the M5 and R4 / R5 Format for the value block exists a unit (dim), which follows , 4-digit (divided by a Blank), the value block.

The values are typed right-aligned in the blocks. Decimal point, digits after the comma and definitions of preceding characters correspond to the internal instrument specifications.

☝ **Caution!**

If the files of the CZ Formats are entered manually, it is important to remember that upon using the data in the instrument the digits after the comma and the units need to be adjusted correspondingly.

The following units are defined:

Angle measurement	gon, DEG, DMS, mil, grad, %
Distances, Coordinates	m, ft
Pressure	TORR, hPa, inHg
Temperature	C, F
Standard, PR etc.	no unit

CZ Format ID and address block

CZ Format ID in Columns 1-6

In the formats M5, R4 and R5 a marking which corresponds to the format precedes the data line.

For M5 Format marking for M5 Format

For R4 Format marking for R4 Format

For R5 Format marking for R5 Format

„For " and the marking M5, R4 or R5 are divided by a Blank (ASCII 32).
An exception is the M5 Format for the GePoS® receiver:

For_M5 Format marking M5 Format GePoS® receiver of software versions less than V3.7:

In this case, „For " and the marking M5 is divided by a „_ "(ASCII 95).

From V3.7 on, the Format marking is **For M5**.

Address blocks

The Formats M5, Rec500 and R5 have an address block which marks the data line with the current memory address. In the M5 and R5 format, a type identifier Adr is activated:

Format	TK	Column	Digit
M5	Adr	12 - 16	5
R5	Adr	12 - 15	4
Rec500	none	4 - 7	4

Adr 00001 or
Adr 1 is allowed.

The address entry is right-aligned. Zeros can be used but are usually omitted. The first data line starts with the memory address 1.

Data output on a printer

Direct data output from the instrument to the printer or form the PC:

The R4 data recording format ensures problem-free printout on A4 printers, with each print line comprising one data line. To achieve the same with the R5 data recording format, the following should be noted:

- Direct data transmission to a printer
  Select condensed font in the printer
  or use A 3 printer

- Printing data from a DOS editor
  Select condensed font in the printer
  or use A 3 printer

- Printing from a WINDOWS task
  Do not use true type font or proportionally spaced font, but e.g. Courier
  Select a small type size
  Use landscape print format

Attention!

For printing of data lines from the instrument at a printer is a serial type of printer interface necessary.

Introduction

This charpter decribes the conditions of data transfer, the pin assignment of the interface and key codes and function requests for controlling the instrument by a computer.

What is an Interface?

An interface is the point of contact between two systems or system areas, i.e. the point where information is interchanged. To ensure that it is understood by both the transmitting and receiving unit, specific rules must be defined for the transmission of signals and data.

Hardware interface

a physical connection between functional units such as measuring instruments, computers or printers.
Of significance for the user are:

- shape and pin assignment of the connectors on the functional units and connecting cables
- The data transmission method. The parameters and protocols for transmission control

Software interface

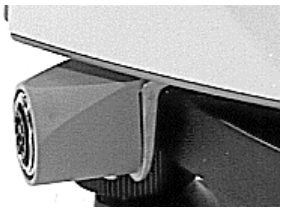
Software interfaces establish the link between programs or program modules. The data to be transmitted must conform to a defined structure: the record format..

User interface

also called user guidance, important for handling of a system.

Interfaces between the user and the system are the monitor, the keyboard and the options for user guidance provided by the software. In the Elta® R concept, special emphasis has been placed on the design of the user interface.

Hardware interface



The interface for the peripheral equipment is of the asynchronous, serial type and conforms to DIN 66020 standard (V 24 / RS 232 C).

The interface is provided on the slip ring connection.

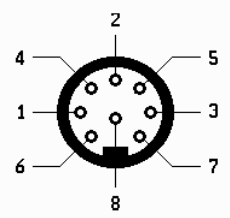
Interface functions:

(1) Data transfer:
Direct transmission of measured data between Elta® R and the connected peripheral instrument (computer, printer,...).
A series of transmission parameters are available for the control of this process.

(2) Software updates for the Elta® R can be loaded via this interface .

Pin assignment of the interface /connecting cable

Pin	Signal	Direction	Designation
1	-	-	
2	Ground	-	Ground ($-U_{batt}$)
3	-	-	
4	SD	Output	Transmitted data
5	ED	Input	Received data
6	Vcc	In	External power supply ($+U_{batt}$)
7	Vcc	In	External power supply ($+U_{batt}$)
8	Ground	-	Ground ($-U_{batt}$)



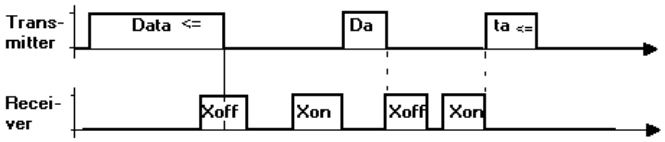
Pin assignment (exterior view of connector),
8-pin female stereo connector

Connecting cable:
Cable 708177 - 9460 is used for external data recording and for data transfer to a PC. You can also use cable 708177 - 9470 (with angled plug) if the Elta® R is installed on a tripod during data transfer.

Introduction

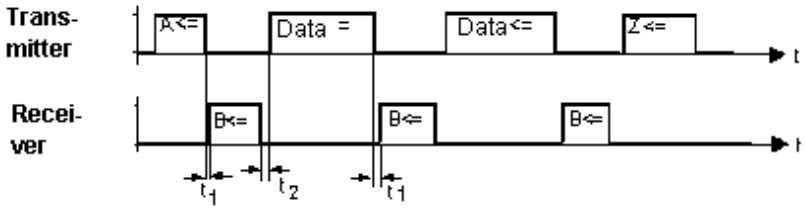
This charpter decribes the conditions of data transfer, data transmission protocols, overviewe about key codes and answers of the PC for the instrument control.

XON/XOFF Control



The XON/XOFF protocol is a very simple, but efficient data transmission protocol. It is preferably employed for so-called terminal programs (e.g. terminal under Windows or Xtalk) and can be used in data recording from the Elta® R to a computer.

Rec 500 Software Dialog (Rec 500 Protocol)



Control diagram of the `Rec 500 software dialog´

The following definitions apply to the time values entered in the control diagram:

t_1: Interval between signal A from Elta® R and the response from the recording unit with signal B, and interval between the end of data transfer and the acknowledgement with signal B.

$0 > t_1 < t_{(Time\text{-}Out)}$ $t_1 = 20$ s

The recording unit may respond without delay to the recording request from the Elta® R. However, the selected time-out $t_{(Time\text{-}out)}$ must not be exceeded; otherwise an error message is displayed and external recording is deactivated. The Elta® R assumes that no external recording unit has been connected.

t_2: Interval between the acknowledgement of the reception of a data line by the connected recording unit with signal B and the transmission of a further data line. Depending on the type of recording line involved, this amounts to

$10 \text{ ms} > t_2 < 100 \text{ ms}$

Rec 500 software dialog is also suited for data transmission to the Elta® R The control diagram is identical to the one shown above, with the designations of the transmitted data line and received data line being interchanged, as data is now transmitted by the peripheral unit.

Key Codes and Function Requests

If the Elta® R is controlled by a computer, the keys can be emulated with the following codes:

Key	Code	Key	Code
F1	T31↵	ON+F1	TB1↵
F2	T32↵	ON+F2	TB2↵
F3	T33↵	ON+F3	TB3↵
F4	T34↵	ON+F4	TB4↵
F5	T35↵	ON+F5	TB5↵
MEAS	T4D↵	ON+MEAS	TCD↵

↵ symbol for CR/LF

The Elta® R can be controlled either by key pressure or, equally, from a connected computer. Each recognized key code is acknowledged by the Elta® R with 'Q↵'; in the event of errors such as incorrect syntax of the call or data transmission errors, the response is 'E↵'.

Function requests:

Code	Meaning
FKO↵	Compensator reading in sighting direction
FMD↵	Slope distance SD
FMW↵	Angle readings Hz, V
FMS↵	SD, Hz, V
FMR↵	HD, Hz, h reduction
FMK↵	y, x, h local coordinates

Each function request is answered with a data line in the selected format. The with/without address setting is effective. Only the XON/XOFF protocol is used

Attention!

The values entered for scale, addition constant, index and collimation correction are taken into account in all function requests.

Parameters:

Reading:	?KTTT↵
Response:	!KTTT |1234567890123456 unit↵
Setting:	!KTTT |12345678901234 unit↵
Response:	Q↵

The response to a reading command is identical with the setting command.
In the event of errors such as incorrect syntax of the call or data transmission errors, the response is 'E↵'.

Designations:

?K	fixed character string for reading
!K	fixed character string for setting
TTT	type identifier (see examples)
↵	carriage return/line feed
|	separator, ASCII dec. 124
1-6	numerical value, 16 characters blank, ASCII dec. 32
unit	unit of the associated numerical value, 4 characters or blanks
Q	acknowledgement

Examples for the parameter calls:

```
?K00A↵ Instrument Identification                          RO
!K00A  | 702718-0000.730     ↵

?K00a↵ Serial Number                                      RO
!K00a  |          209187     ↵

?KSND↵ Acoustic Signal                                    RW
!KSND  |               a Bit ↵                    (a=0:aus, a=1:an)

?KAPO↵ Automatic Shutoff                                  RW
!KAPO  |               a Byte↵                    (a=0:aus, a=1:10
min,
                                        a=2:30 min)
?KP20↵ Compensator                                        RW
!KP20  |               a Bit ↵                    (a=0:aus, a=1:an)

?KSPR↵ Vertical Angle Display                             RW
!KSPR  |               a Bit ↵                    (a=0:Grad, a=1:%)

?KSVR↵ Vertical Reference System                          RW
!KSVR  |                 ZZZZ↵                    (ZZZZ=ZEN : ze-
nith angle,
                                        ZZZZ=VERT:  vertical angle,
                                        ZZZZ=HGHT:  height angle)
?KSKO↵ Coordinate System and Display Sequence             RW
!KSKO  |              ab     ↵                    (a=1:xy, a=2:yx,
a=3:ne
                                        b=1:RW-HW, b=2:HW-RW)

?KSMW↵ Angle Resolution and Unit                          RW
!KSMW  |          0.0005 gon ↵
       (0.0005/0.001/0.005 gon
                                        0.0001/0.0005/0.0010 DMS
                                        0.0005/0.001/0.005 deg
                                        0.01/0.1/0.5 mil)
?KSMS↵ Distance Resolution and Unit                       RW
!KSMS  |           0.001 m   ↵                    (0.001/0.005/0.01
m
                                        0.001/0.01/0.02 ft)
```

```
?KSMT↵ Temperature Resolution and Unit                    RW
!KSMT  |              1 C   ↵       (1 C/1 F)

?KSMD↵ Pressure Resolution and Unit                       RW
!KSMD  |              1 hPA ↵       (1 hPa/1 Torr/0.1 inHg)

?KSZ ↵ Compensator Run Center in Sighting Direction       RW
!KSZ   |         0.00000 gon ↵

?KBz ↵ Compensator Reading in Sighting Direction          RO
!KBz   |         0.00000 gon ↵

?Ki  ↵ Index Correction                                   RW
!Ki    |         0.00000 gon ↵

?Kc  ↵ Collimation Correction                             RW
!Kc    |         0.00000 gon ↵

?KHV ↵ Hz Rotational Angle                                RW
!KHV   |         0.00000 gon ↵

?KA  ↵ Addition Constant                                  RW
!KA    |           0.000 m   ↵

?Km  ↵ Scale                                              RW
!Km    |        1.000000     ↵

?KP  ↵ Air Pressure                                       RW
!KP    |             944 hPa ↵

?KT  ↵ Temperature                                        RW
!KT    |              20 C   ↵

?Kih ↵ Instrument Height                                  RW
!Kih   |          0.0000 m   ↵

?Kth ↵ Reflector Height                                   RW
!Kth   |          0.0000 m   ↵

?KY S↵ Y Coordinate of the Station                        RW
!KY S  |          0.0000 m   ↵
```

```
?KX S↵ X Coordinate of the Station                    RW
!KX S  |          0.0000 m   ↵

?KN_S↵ N Coordinate of the Station                    RW
!KN_S  |          0.0000 m   ↵

?KE_S↵ E Coordinate of the Station                    RW
!KE_S  |          0.0000 m   ↵

?KZ S↵
?KZ S↵      Station Height                            RW
!KZ S  |          0.0000 m   ↵

?KLN1↵ Request for  Language                          R0
!KLN1  |                D-- ↵
```

The following parameter Hz takes up a special position:

`?KHz ↵`	the displayed Hz direction is output in the selected format
`!KHz  |  0.00000 gon ↵`	sets the Hz direction to the preset value (here 0.00000 grad)

Designations:

`RO`	parameter can only be read
`RW`	parameter can be read and set

All parameters are output in the selected units, resolutions etc. Parameters can be entered irrespective of the parameters currently set. If call or setting commands include errors of syntax or content, the Elta® R answers with 'E↵'.

Recording data lines
See Data Formats

Mode	Rec. Mode		Content of Record				Comments
	1	2	P,C,I	T1	T2	T3	
Single meas.	x		CCCCC PPPPPPPPPPP		Hz	Vk	HzV mode,k=1,2,3,4 dep. on V syst.
	x		CCCCC PPPPPPPPPPP	HD	Hz	h	horizontal distance mode
	x		CCCCC PPPPPPPPPPP	SD	Hz	Vk	slope distance mode
	x		CCCCC PPPPPPPPPPP	y	x	h	coordinates mode, sequence y,x
	x		CCCCC PPPPPPPPPPP	x	y	h	coordinates mode, sequence x,y
	x		CCCCC PPPPPPPPPPP	n	e	h	coordinates mode, sequence n,e
	x		CCCCC PPPPPPPPPPP	e	n	h	coordinates mode, sequence e e,n
Adjustment c/i	x	x	ADJUST	Vk	Vk	i	k=1,2,3,4 depending on V system
	x	x	ADJUST	Hz	Hz	c	
	x	x	ADJUST			SZ	
Adjust. comp.	x	x	ADJUST			SZ	
Input values	x	x	INPUT	th	ih		
	x	x	INPUT	T_	P	A	
	x	x	INPUT	m			
	x	x	S PPPPPPPPPPP			Z	Z...station height
Compensator	x	x	COM-ON				compensator activated
	x	x	COM-OFF				compensator deactivated

Rec. mode: 1: MEM/1, V24/1
2: MEM/2, V24/2
3: 1+2

Mode	Rec. mode		Content of Record					Comments
	1	2	P.C.I		T1	T2	T3	
Point to line	x	x	PT.-LINE					point to line
	x		A	PPPPPPPPPPPP	SD	Hz	Vk	reference point A
	x		B	PPPPPPPPPPPP	SD	Hz	Vk	reference point B
	x		A=S					if station is defined as A
	x		B=S					if station is defined as P
		x	A-B		SD	HD	h	base length
	x		CCCCC	PPPPPPPPPPPP	SD	Hz	Vk	meas. pt. P
		x	CCCCC	PPPPPPPPPPPP	y	x	h	meas.pt. P:v.x.e.n dep.on coor.sys.
	x		P=S					if station is defined as P
		x			Y	X	h	
Connect.distance	x		CH.-DIS.					
	x		A	PPPPPPPPPPPP	SD	Hz	Vk	reference point A
	x		CCCCC	PPPPPPPPPPPP	SD	Hz	Vk	meas. pt. P
		x	A-P		SD	HD	h	connecting distance A-P
	x		P-P		SD	HD	h	connecting distance P-P
	x		A=S					if station is defined as A
			P=S					if station is defined as P
Object height	x	x	OBJECTH					
	x		A	PPPPPPPPPPPP	SD	Hz	Vk	reference point A
	x		CCCCC	PPPPPPPPPPPP		Hz	Vk	meas. pt. P, k=1..4 dep. on V syst.
		x	CCCCC	PPPPPPPPPPPP	HD	O	Z	meas. pt. P
	x		!	PPPPPPPPPPPP			Z	Set Z value
	x			PPPPPPPPPPPP		Hz	Vk	k=1,2,3,4 depending on V system

Mode	Rec. mode		Content of Record				Comments
	1	2	P,C,I	T1	T2	T3	
Vertical plane	x	x	VERT-PL				
	x		A PPPPPPPPPPPP	SD	Hz	Vk	reference point A
	x		B PPPPPPPPPPPP	SD	Hz	Vk	reference point B
		x	A-B	SD	HD	h	base length
	x		CCCCC PPPPPPPPPPPP		Hz	Vk	meas. pt. P, k=1..4 dep. on V sys.
		x	CCCCC PPPPPPPPPPPP	y	x	h	meas. pt. P, y,x,e,n dep. on coord.sys.
	x		P=S				if station is defined as P
	x	x	! PPPPPPPPPPPP			x	set value for (y,n)
	x		PPPPPPPPPPPP		Hz	Vk	y, x or n dep. on coord.sys.
	x	x	! PPPPPPPPPPPP			h	Set value for h
	x		PPPPPPPPPPPP		Hz	Vk	
		x		Y	X	h	
Orthogonal lines	x	x	ORT-LINE				
	x		A PPPPPPPPPPPP	SD	Hz	Vk	reference pt. A
	x		B PPPPPPPPPPPP	SD	Hz	Vk	reference pt. B
	x		A=S				if station is defined as A
	x		B=S				if station is defined as B
		x	A-B	SD	HD	h	base length
	x		CCCCC PPPPPPPPPPPP	SD	Hz	Vk	meas. pt. P
		x	CCCCC PPPPPPPPPPPP	y	x	h	meas. pt. P, y,x,e,n dep. on coord.sys.
	x		P=S				if the station is defined as P
		x		Y	X	h	

Mode	Rec. mode 1	Rec. mode 2	Content of Record P,C,I	T1	T2	T3	Comments
Parallel lines	x	x	PAR-LINE				
	x		A PPPPPPPPPPPP	SD	Hz	Vk	Reference point A
	x		B PPPPPPPPPPPP	SD	Hz	Vk	Reference point B
	x		C PPPPPPPPPPPP	SD	Hz	Vk	Reference point C
	x		A=S				if station is defined as A
	x		B=S				if station is defined as B
	x		C=S				if station is defined as C
		x	A-B	SD	HD	h	Base length
		x	PA	y			y, x or e depend. on coord.system
	x		CCCCC PPPPPPPPPPPP	SD	Hz	Vk	meas.pt. P
		x	CCCCC PPPPPPPPPPPP	y	x	h	meas.pt. P, y,x,e,n dep. on coord. syst.
	x		P=S				if station is defined as P
		x		Y	X	h	
Alignment	x	x	ALIGN				
	x		A PPPPPPPPPPPP		Hz	Vk	reference direction
	x		P PPPPPPPPPPPP	SD	Hz	Vk	reference distance to P
	x		CCCCC PPPPPPPPPPPP		Hz	Vk	meas.pt. P,k=1,2,3,4 dep. on V syst.
		x	CCCCC PPPPPPPPPPPP	y	x	h	meas.pt.P, y,x,e,n dep. on coor. syst.
Unknown station	x	x	L-STAT 1				
		x	A PPPPPPPPPPPP	Y	X		reference point A
	x		A PPPPPPPPPPPP	SD	Hz	Vk	measurement to A
		x	B PPPPPPPPPPPP	Y	X		measurement to B
	x		B PPPPPPPPPPPP	SD	Hz	Vk	measurement to B
		x	S PPPPPPPPPPPP	Y	X		station coordinates
		x		m	Om		scale, orientation

Mode	Rec. mode		Content of Record					Comments
	1	2	P,C,I		T1	T2	T3	
Known station	x	x	L-STAT 2					
		x	S	PPPPPPPPPPPP	Y	X		station coordinates
		x	A	PPPPPPPPPPPP	Y	X		reference point A
	x		A	PPPPPPPPPPPP		Hz	Vk	measurement to A (Hz,V mode)
	x		A	PPPPPPPPPPPP	SD	Hz	Vk	measurement to A (SD,Hz,V mode)
		x				Om		orientation (Hz,V)
		x			m	Om		scale, orientation (SD,Hz,V)
Height stationing	x	x	TRZ-STAT					
	x	x	!	PPPPPPPPPPPP			Z	Height of A
	x		A	PPPPPPPPPPPP	SD	Hz	Vk	Measurement to A
		x	S	PPPPPPPPPPPP			Z	computed station height
Polar points	x	x	POLARP					
	x		CCCCCPPPPPPPPPPPP		SD	Hz	Vk	original readings
		x	CCCCCPPPPPPPPPPPP		Y	X	Z	coordinates

Mode	Rec. mode		Content of Record					Comments
	1	2	P,C,I		T1	T2	T3	
Stake out	x	x	S-O					
		x	!	PPPPPPPPPPPP	Y	X	Z	depending on stake-out-method
		x	!	PPPPPPPPPPPP	Y	X		depending on stake-out-method
		x	!	PPPPPPPPPPPP	HD	Hz	Z	depending on stake-out-method
		x	!	PPPPPPPPPPPP	HD	Hz		depending on stake-out-method
	x			PPPPPPPPPPPP	SD	Hz	Vk	reading for backsight point
		x		PPPPPPPPPPPP	dy	dx	dz	stake-out diff. dep. on meas. method
		x		PPPPPPPPPPPP	dy	dx		stake-out diff. dep. on meas. method
		x		PPPPPPPPPPPP	dl	dq	dr	stake-out diff. dep. on meas. method
		x		PPPPPPPPPPPP			dz	stake-out diff. dep. on meas. method
		x		PPPPPPPPPPPP	Y	X	Z	verification measurement
		x		PPPPPPPPPPPP	Y	X		verification measurement

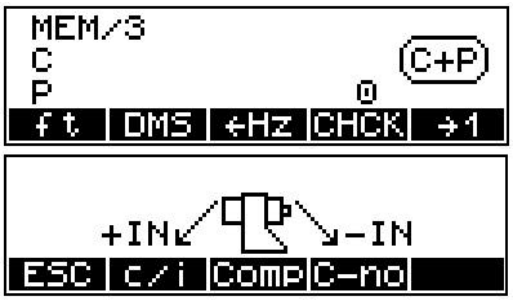
7 Adjusting and Checking

The instrument adjustment defines all corrections and correction values for the Elta® R that are required to ensure optimum measuring accuracy.

Increased strain placed on the instrument by extreme measuring conditions, transportation, prolonged storage and major changes in temperature may lead to misalignment of the instrument and faulty measuring results. Such errors can be eliminated by instrument adjustment or by specific measuring methods.

Display page 2:

CHCK to go to menu "Checking"



📖 Presettings
First steps

Additionally to activating and deactivating the compensator, this menu offers the following functions of checking and adjusting:

c/i Determination of the vertical index correction (V index) and sighting axis correction (Hz collimation).

Comp Determination of the compensator run centre.

☝ **Attention !**

Before starting any adjustment, allow the instrument to adapt to the ambient temperature and make sure it is protected against heating up on one side (sun radiation).

i Vertical Index Correction

The vertical index error is the zero point error of the vertical circle with respect to the vertical shaft.

c Sighting axis correction

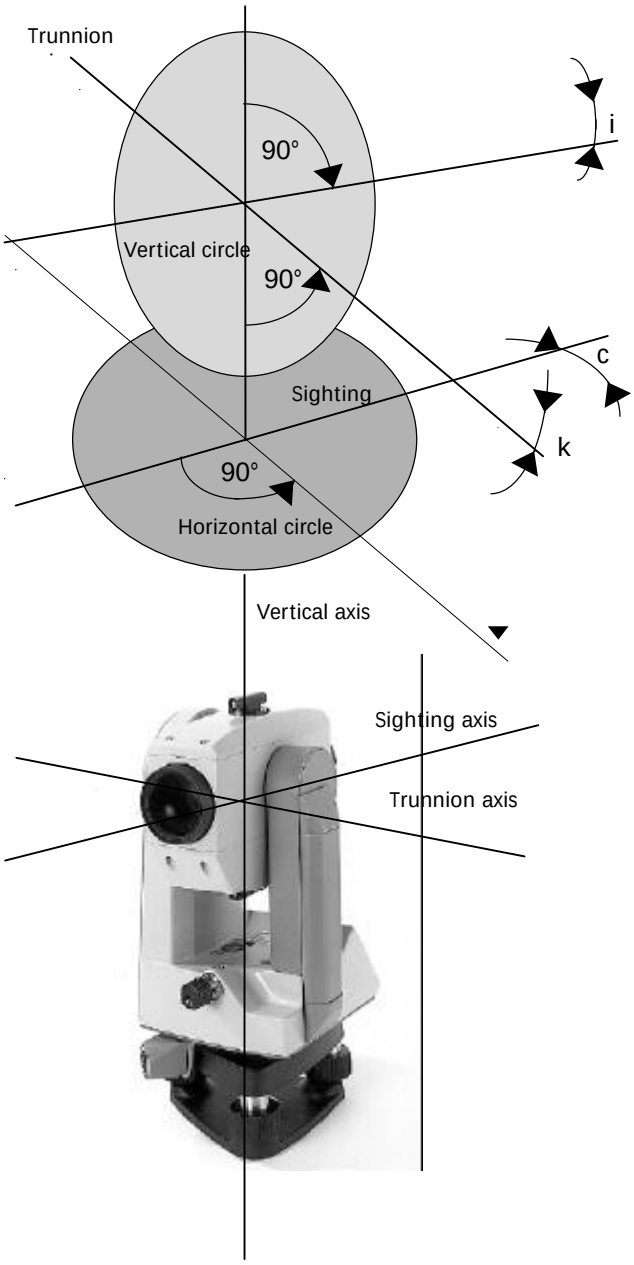
The sighting axis error is the deviation from the right angle between the trunnion axis and sighting axis.

k Trunnion axis correction

The trunnion axis error is the deviation from the right angle between the trunnion axis and vertical shaft (adjusted by the manufacturer).

Another instrument error considered is:

the compensator run centre error



The vertical index and sighting axis corrections should be recomputed after prolonged storage or transportation of the instrument, after major temperature changes and prior to precise height measurements.
These determinations are especially important due to the fact that the measurement is carried out only in the 1st telescope position in order to save time.

☞ **Tip**

Before starting this procedure, precisely level the instrument using the level.

To determine the corrections, sight a clearly visible target in **Hz** and **V** from a distance of approx. 100 m. The sighting point should be close to the horizontal plane (in the range V = $100^{grads} \pm 10^{grads}$).

MEAS to trigger measurement in the 2nd telescope position

c=0, [ ]
Setting of values c = i = 0.

The current **c** and **i** values are displayed in the readings window.

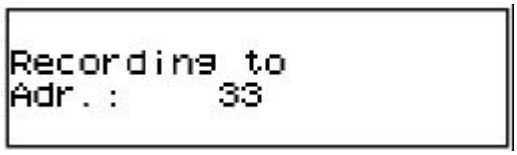
c sighting axis correction
i vertical index correction

MEAS to trigger measurement in the 1st telescope position

new to confirm the new values / to record

old to confirm the old values

Display of results and recording



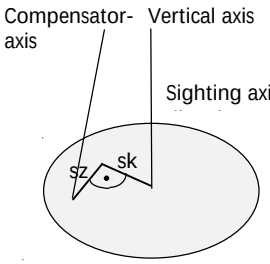
Attention !

During the computation of the vertical index and sighting axis correction, the program also determines the compensator run centre.

If either the **c** or **i** value exceeds the admissible range of ± 50 mgrads, the error message appears. The values are not saved, and the menu for new calculation is displayed again.

Attention !

If the values remain outside the tolerance range, despite accurate sighting and repeated measurement, you should have the instrument checked by the service team.



The Elta® R features a compensator that compensates any vertical shaft inclinations remaining after instrument levelling in the sighting axis direction.
To check the compensator, its run centre should be determined at regular intervals and in particular prior to precise height measurements.

MEAS to start measurement in the 2nd telescope position

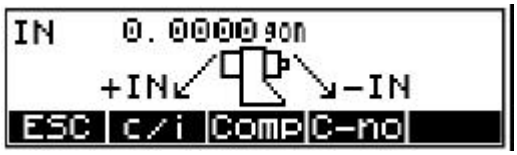
sz component in sighting axis direction

→ to turn Hz = 0

MEAS to trigger measurement in the 1st telescope position

Display of results and recording:

ESC to quit the adjusting menu



Attention !

For the accurate determination of the run centre, it is essential that the liquid in the compensator is allowed to settle, i.e. any vibration of the compensator must be avoided.

8 Annex

The annex contains a compilation of symbols, keys, formulae, constants and error messages as well as explanations of concepts used for the Elta® R Routine Total Stations.

Furthermore, it gives an overview of the technical data and instructions for maintenance and care of the instrument.

		Setting the measuring mode:
HD		Measurement of reduced distances
xyh	yxh	Coordinate measurement, sequence X,Y, h Coordinate measurement, sequence Y,X
neh	enh	Coordinate measurement, sequence N,E Coordinate measurement, sequence E,N
SD	HzV	Measurement of slope distances Measurement of Hz direction and V angle
Hz=0		Setting the Hz direction to Hz=0
HOLD		Clamping the Hz direction for electronic circle orientation
END		Ending a function
th/ih		Input of reflector, instrument and station heights
th		Input of reflector height
ih/Zs		Input of instrument and station heights
→1	→2	Calling page 1 of the measurement menu Calling page 2 of the measurement menu
m	ft	Changing the distance unit: to meters/entry of scale to feet
gon	DMS	Changing the angle unit: to grads to DMS (degrees, minutes, seconds)
deg	mil	to decimal degrees to mils
V %		Display of the height angle in %
V		Display of the zenith angle (V=0 at the zenith)
V		Display of the vertical angle (V=0 at the horizon, 0 < V < 400 grads)

V↗^↖	Display of the height angle (V = 0 at the horizon, -100 < V < 100 grads)
→Hz ←Hz	Setting the Hz counting direction to clockwise Setting the Hz counting direction to anticlockwise
CHCK	Calling the checking and adjustment menu
ESC	Terminating a function, quitting a submenu
↑ ↓	Selecting the next upper line in the bar menu / in the internal memory Selecting the next lower line in the bar menu / in the internal memory
← →	Setting the cursor one character backward Setting the cursor one character forward
+ -	Incrementing a value Decrementing a value
MOD	Modification of the displayed value
o.k.	Confirmation of an entry
YES NO	Acceptance of an option Rejection of an option
c/i	Calling the function for the determination of the collimation and vertical index correction
Comp	Calling the function for the determination of the compensator run centre correction
C-on C-off	Deactivating the compensator Activating the compensator
old new	Retaining the old value Entering the new value
Rept	Repeating the process
i=0	Setting the vertical index correction to i = 0
c=0	Setting the collimation correction to c = 0

A **B** **C**	Activating the reference point A, B, C
P	Activating the new point P
A=S **B=S** **C=S**	Using the station coordinates as reference point coordinates
P=S	Using the station coordinates as the coordinates of the new point
A=P	Using P as the new reference point A (connecting distance)
y **x** **e**	Input of a distance (in the Vertical Plane program)
hSet	Setting the reference height (in the Vertical Plane program)
ZSet	Setting the reference height Z (in the Object Height program)
xSet **ySet** **nSet**	Setting the reference direction: (in the Vertical Plane program) (in the Vertical Plane program) (in the Vertical Plane program)
A-P **P-P**	Referring the connecting distance to: the reference point A the last point used
Inp	Input of a value
m	Calling the scale entry (in the Coordinates programs)
YX **XY**	Setting out according to nominal coordinates without height or entry in MEM
EN **NE**	
YXZ **XYZ**	Setting out according to nominal coordinates with height or entry in MEM
ENZ **NEZ**	

HD **HDh**	Setting out using known setting out elements without with height
Z	Input of a height in the internal MEM memory
Z-j **Z-n**	Changing to setting out: with height without height
Test	Calling the measurement of the setting out points
S-O	Calling the setting out of the next point
Stat	Starting stationing in elevation
S	Input of station coordinates for Unknown Station
Inp	Input of scale for planimetric stationing
Hz	Input of Hz for Known Station
Disp **Del** **Edt**	Display of data lines of the memory Deletion of data lines of the memory Changing the point number and point code of a data line
? **?P** **?C**	Search for: data lines in the memory a point number in the memory a point code in the memory
?A	Search for an address in the memory
? ↓	Continue search according to the same criterion
all	Selecting all data lines of the memory

MEAS	First function Starting a measurement
ON	First function Switching the instrument on
ON OFF	Second function Switching the instrument off
ON *	Second function Illumination ON/OFF
ON EDIT	Second function Calling the memory and the Elta® R 45, 55 battery capacity
ON PNo	Second function Calling the input of point number and code and the Elta® R 50 battery capacity
ON MENU	Second function Going to the main menu
ON TRK	Second function Starting the tracking function

A

Addition constant	Addition value for distance measurement, default 0.
Addition correction	Correction of the addition value (‘addition constant ’) of the distance measuring instrument, e.g. if using prisms of other manufacturers.
Alignment	Application program for the determination of any number of points on the straight line AB.

B

Backsight point BP	A point with known coordinates used for the station point determination and/or for *orientation.*
Bearing angle	Hz bearing orientated to a reference bearing (generally to grid north).
Bearing (Hz)	Value read in the horizontal circle of the instrument, whose accidental orientation is determined by the zero position of the graduated circle.

C

Calibration scale	Influences systematically the distance measurement. Best possible adjustment to 1.0 by the manufacturer. Without influence on all other scale specifications.
Code, code number	Reference number for the point description, characterises certain point types.
Compensation	Automatic mathematical consideration of the *vertical axis inclinations* measured with the *compensator* in the sighting direction, in V angle measurements.
Compensator	Used to determine the current vertical axis inclination in the sighting axis direction, can be deactivated and activated again, as required; a graphical symbol in the information menu di splays the activated compensator.

Compensator run centre	Electronic centre of the clinometer in sighting axis direction.
Connecting distance	Spatial distance, plane distance and height difference between 2 target points.
Control point	Point for checking the *orientation* of the instrument. It is defined at the beginning of a measurement and can be measured at any time for checking.
Coordinates	Measuring program for the determination of points in a higher-order coordinate system.
	D
Default	Standard value for an instrument setting.
Distance measuring mode	Depending on the purpose of application, the distance measurement is to be selected by pressing the MEAS key in the normal mode or the continuous distance measurement (tracking) is to be selected by pressing the ON + TRK keys simultaneously.
	E
Error limits	Limit values which can be set by the user for certain readings or results.
	F
	G
	H
Hardkeys	See key functions.
Height stationing	The height of the station point is derived from measurements to known height points.
Hz circle orientation	A predefined horizontal bearing value is allocated to the sighting direction to a measurement point.
Hz collimation correction	(also called collimation or sighting axis corre ction) Correction of the deviation of the sighting axis from its required position right-angled to the

	trunnion axis. Determination by measurement in two positions, automatic correction in the case of measurements in one position. **I**
Incrementing	(increment = interval) Automatic counting of the point number (increase by 1) after the measurement.
Instrument height	Height of the telescope trunnion axis above the station height (ground point).
Interface	Contact point between 2 systems or system areas, in which information is interchanged according to defined rules.
	K
Key functions	First and second functions; for switching the instrument on, starting the measurement, switching off, illuminating the display, calling the memory, entering PI and going to the main menu, starting of tracking.
	L
Levelling	Vertical adjustment of the vertical axis of the instrument; the levels of the instrument are centred by turning the tribrach screws. The levelling can be checked by means of the digital display of inclinations after pressing the softkey **CHCK**.
	M
Measuring mode	In the measurement menu, the following measuring modes can be selected: HzV display in the theodolite mode HD display of reduced distance and height difference yxh local rectangular coordinates SD display of the original readings

O

Object height	Determination of the height of points to which a direct distance measurement is impossible, by means of an angle measurement.
Orientation	When orientating the instrument, the *bearing angle* of the zero of the graduated circle Omega (Om) is calculated. For this purpose, measur e-ments to a *backsight point* can be made or the *bearing angle* of a known point can be e ntered.
Orthogonal lines	Application program to check lines for orthogonality, setting out right angles and especially for measurements in the case of visual obstacles.

P

Parallel lines	Application program to check the parallelism of straight lines or for setting out parallels with only one point given.
Point identification	Identification of the measured point by a maximum of 12 characters for the point number and up to 5 for the point code.
Point number/Point code	Part of the point identificacion.
Point-to-line distance	Application program for the determination of rectangular coordinates of any point in relation to a straight line defined by the points A and B.
Polar point determination	Determination of the coordinates and height of new points by distance and bearing measur ement.

Q

R

Recording mode	Selectable in the menu Interface/Recording : Off no recording MEM/1 Recording of measured data sets in MEM (not for Elta® R 50) MEM/2 Recording of computed data sets in MEM (not for Elta® R 50) MEM/3 Recording of all data sets in MEM (not for Elta® R 50) V24/1 Recording of measured data sets through V24 V24/2 Recording of computed data sets through V24 V24/3 Recording of all data sets through V24
Reference point	Used here as reflector station for the indirect height determination.
Reflector height	Height of the reflector (prism centre) above its station (ground point).
Refraction coefficient	Measure for the light-beam refraction in the atmosphere; can be set by the user.
Run centre	See *Compensator run centre.*

S

Scale	With a *scale,* the measured distance is varied proportionally to the length and can thus be adapted to certain marginal conditions. There exist a series of direct and indirect scale effects: *calibration scale*, *projection reduction*, *height reduction, reticle scale.*
Softkey	Function key which has several functions in dependence on the program.
Standard measurement menu	The determination of points takes place within the local measuring system . The station of the instrument with the coordinates (0,0,0) represents the zero point of this system of coordinates. The *orientation* is determined by the zero direction of the Hz circle.The data are fitted in a given system

	of coordinates (Elta® R 50) only during the further processing (possibly in the office) or a stationing is carried out in order to measure in a given system of coordinates.
Standard settings	Values set by the manufacturer for all configuration parameters.
Stationing	Precedes any determination of points in a defined system of coordinates. Consists in the station point determination and/or calculation of the orientation of the graduated circle: Stationing on a known or unknown point (free stationing), height stationing (height only).
Stationing on a known point	Given: Station point coordinates / backsight bearing. The *scale* and the *orientation* of the graduated circle are derived from the measurements to known *backsight points.*
	T
Tracking	Continuous measurement of angles and distances. Hz and V values are constantly measured and displayed. Set permanent measurement for distance measurements.
	V
Vertical axis inclination	The inclinations of the vertical axis of the instrument in sighting axis direction are measured with the *compensator*, indicated digitally and can be requested on the display.
Vertical plane	Application program for the determination of points in a vertical plane by means of an angle measurement.
	W Z

	Elta® R 45	Elta® R 55 Elta® R 50
Accuracy as per DIN 18723		
Angle measurement	1.0 mgrad (3 “)	1.5 mgrads (5 “)
Distance measurement	3 mm+3 ppm	5 mm +5 ppm
Telescope		
Magnification	26 x	
Aperture	40 mm	
Length	193 mm	
Field of view at 100 m	2.9 m	
Shortest sighting	1.75 m	
Special features	variable reticle illumination, integrated sun shield	
Angle measurement		
Hz and V circles	electronic, incremental, quasi-absolute with zero encoder	
Measuring units	360° (DMS, DEG), 400 grads, 6400 mils	
Vertical reference systems	zenith, height and vertical angle, slope in percent	
Least display unit (selectable)	1´´/2´´/10´´, 0.0005°/0.002°0.005° 0.2 mgrad/1 mgrad/5 mgrads 0.01-/0.1-/0.5-	1´´/5´´/10´´, 0.0005°/0.001°0.005° 0.5 mgrad/1 mgrad/5 mgrads 0.01-/0.1-/0.5-
Distance measurement		
Method	electro-optical, modulated infrared light	
Transmitter/Receiver optics	coaxial, in telescope	
Measuring units	alternate display of results in m/ft	
Measuring time		
Standard	< 3.0 s	
Tracking	0.5 s	

	Elta® R 45, Elta® R 55, Elta® R 50	
Measuring range		
with 1 prism	1500 m	1300 m
with 3 prisms	2000 m	1600 m
Levelling		
Circular level	10 /2 mm	
Tubular level	30 "/2 mm	
Compensator		
Type	uniaxial compensator	
Working range	2 '40 "/48 mgrads	
Accuracy	1,5 "	
Clamps and tangent screws	coaxial, parallel axes	
Optical plummet		
Magnification	2 x	
Shortest sighting distance	0.5 m	
Display screen		
	4 lines with 21 characters each, graphic capabilities (128 x 32 p ixels) display illumination	
Keyboard		
	7 keys, display-oriented	
Measuring menu		
	Hz-V/SD-Hz-V/HD-Hz-h/y-x-h setting, input, adjustment	
Application programs (supported by graphics)	connecting distances, object height measurement, vertical plane, point-to-line distance, orthogonal lines, parallel lines, alignment	

	Elta® R 45 Elta® R 55	Elta® R 50
Coordinates programs (supported by graphics)	unknown station, known station, stationing in elevation, polar points, setting out	
Recording		
	internal data memory (approx. 1900 data lines)	-
	externally via RS 232 C/V24 interface switchover in the menu interface/recording, slip ring on stationary base	
Power supply		
	NiMH battery pack 6 V/1.1 Ah; sufficient for approx. 1000 angle and distance measurements	
Operating temperatures		
	-20°C to +50°C	
Dimensions		
Instrument (WxHxD)	173 x 268 x 193 mm	
Trunnion axis height with DIN centring spigot/ Wild centring	175 mm/196 mm	
Weights		
Instrument incl. battery and tribrach	3.5 kg	
Case	2.5 kg	

Electromagnetic Compatibility (EMV)

Die EU Conformity Declaration confirms the perfect function of the instrument in an electromagnetic environment.

☝ **Attention !**

Computers connected to the Elta® R which are not part of the Carl Zeiss System delivery, have to meet the same EMV requirements in order to ensure that the overall configuration complies with the applicable interference suppression standards.

Interference suppression as per:
EN 55011 class B

Noise immunity:
EN 50082-2

☞ **Tip**

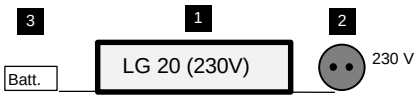
Strong magnetic fields generated by mid and low voltage transformer stations possibly exceed the check criteria. Make a plausibility check of the results when measuring on such conditions.

Battery Charger LG 20

Battery Management	Electrical and thermo-mechanical fuses protect instrument and battery during the oper ation and the battery during the charging pro cess. Change of battery after warning: connect a charged external battery and remove the empty internal battery from the instrument (or vice versa for empty external battery). Switch the instrument off for as long as the power supply is interrupted for the ba ttery change.
Technical Data	Universal charger for NiCd/NiMH cells of safety class II with nominal capacity: 0.5 Ah to 7 Ah. input: 230 V ± 10 % 50 Hz or DC 12 V output: 9.00 V; 800 mA or 2000 mA DC, resp.
Safety Notes	☝ **Attention!** Please, read and observe these operating instructions before using the LG 20! Protect the LG 20 against humidity, use it in dry rooms only. Only the service or authorised specialists are allowed to open the LG 20. Charge temperature range: 5° to 45°C; optimum: 10° to 30°C. Charge parameters (nominal charging time, charging current) set automatically by a coding resistor (in battery pack) ⇒ no overcharging, protection of instrument and battery. For operating the LG 20/1 with a 12 V battery, the cable (70 84 10 - 000.000) with integrated fuse link delivered by the manufacturer is to be used unconditionally!

Charging the Battery

Connect the power source with the battery as demonstrated in the following picture. Note, that the voltage of the charging unit is identical with the power source.



Start charging

LED flashing 3x yellow
Starting

Charging procedure

LED flashing green (max. 1.5 h)

Charging of a fully charged battery: the charging process is stopped after approx. 5 minutes. If the temperature is too high or too low the charging process is stopped automatically

LED permanently red

the charging process is stopped;
if the charging temperature range is reached again the charging process is resumed

End of charging process

LED permanently green
Trickle charge

> ☞ **Tip**
> The batteries cannot be overcharged.

LED permanently yellow
Stand-by mode (no battery connected)

Computational Formulae for Angle Measurements

V angle measurement

$$V_k = V_o + i + SZ_a$$

V_O = uncorrected V circle reading
i = index correction

SZ_a = current vertical axis inclination in the sighting direction

Hz bearing measurement

$$Hz_k = Hz_o + Hz_1 + A$$

Hz_O = uncorrected Hz circle reading
Hz_1 = collimation correction

$Hz_2 = c/\sin V_k$

$c = -\sin(V_{II}) \cdot \frac{dHz}{2}$

A = circle adjustment for orientation

Computational Formulae for Distance Measurements

$$D_k = D_0 \cdot M_i + A$$

D_k = corrected distance
D_0 = uncorrected distance
A = addition constant
M_i = influence of meteorological data

Influence of meteorological data:

$$M_i = (1 + (n_0 - n)\,10^{-6}) \cdot (1 + (a \cdot T \cdot T)\,10^{-6})$$

n = current refractive index
$= (79.146 \cdot P) / (272.479 + T)$
n_0 = reference refractive index = 255
P = air pressure in hPa or torr or in Hg
T = temperature in degrees C or degrees F
a = coefficient of vapour pressure correction
$= 0.001$

carrier wavelength	0.86 microns
modulation wavelength	20 m
precision scale	10 m

Reduction Formulae

Slope distance SD

Distance between the instrument´s trunnion axis and the prism. It is computed from the measured slope distance and the entered scale:

$$\mathbf{SD = D_k \cdot M}$$

SD = displayed slope distance
D_k = basic distance
M = scale

Horizontal distance HD

$$\mathbf{HD = (E_1 + E_2) \cdot M}$$

HD = displayed horizontal distance

$E_1 = D_k \cdot \sin(Z + R)$

R = influence of refraction

$= 6.5 \cdot 10^{-7} \cdot D_k \cdot \sin(Z)$

E_2 = influence of earth curvature

$= -1.57\,10^{-7} \cdot dh \cdot D_k \cdot \sin(Z)$

D_k = corrected slope distance

Z = measured zenith angle [grads]

M = scale

Difference in elevation h

$$\mathbf{h = dh_1 + dh_2}$$

h = displayed difference in elevation

$dh_1 = Dk \cdot \cos(Z)$

$dh_2 = (Dk \cdot \sin(Z)) \cdot (Dk \cdot \sin(Z))\, 6.8 \cdot 10^{-8}$

= influence of earth curvature and r efraction (k = 0.13)

Distance reduction to MSL

Distances measured at elevation Z can be red uced to MSL by computing the following scale outside the instrument (computation formula applies to all earth radii):

$$m = R / R+Z$$

$$S_2 = S_1 \cdot m$$

R = earth radius (6370 Km)
Z = elevation above MSL (Km)
S_1 = measured distance at elevation Z
S_2 = reduced distance at MS L

If this scale is entered into the Elta® R, the computed distances are reduced directly in the instrument.

Verifying on Calibration Distances

Basically, all measured distances are corrected with reference to:
the entered scale,
the entered addition constant,
the influence of pressure and temperature,
internal influencing variables.

Attention!

Prior to the practical realisation of the calibration measurement, the current values of the parameters scale, addition constant, pressure and temperature are to be entered. The scale is to be set to default: 1.000000. This is to secure that all corrections are made completely and perfectly. Furthermore, this allows a direct comparison of nominal and actual values in the case of given distances.

If a weather correction is to be carried out externally, the temperature must be set to 20°C and the air pressure to 944 hPa. Then, the internal correction goes to zero.

Prism and Addition Constants

All total stations manufactured by Carl Zeiss, in combination with their reflectors are adjusted with the **addition constant 0.000**.

In case of measurements to reflectors of other manufacturers, a possibly existing addition constant can be determined by measurement and entered.

Another possibility consists in calculating an addition constant by means of the known prism constant of the reflector used and entering it. This prism constant is calculated as function of the geometric value of the prism, the type of glass and the place of the mechanical reference point. The prism constant for Carl Zeiss reflectors determined that way is -**35 mm**.

Relation between the addition constant Acz for Zeiss instruments, the prism constant Pcz for Zeiss reflectors and the prism constant P_f for other manufacturers:

$$A_{CZ} = P_F - P_{CZ}$$

Example:

Zeiss reflector P_{CZ}	prism constant = -35 mm
Foreign reflector P_F	prism constant = -30 mm

Addition constant for Zeiss instruments in connection with this

foreign reflector A_{CZ} = + 5 mm

In this case, in the Elta® R the addition constant + 0.005 m is set.

Error Message	What to do
001 ROM error **002** RAM error **003/004** Data EEPROM was initialised **005/006** Data EEPROM error	If errors 001...006 occur, call the service. It is not advisable to continue the measurement as all basic settings of the instrument may have been changed.
40 - 59 Error in dist. measuring unit	If this error occurs repeatedly, please inform the service.
202 Compensator oper. range exceeded	Relevel the instrument. If the instrument is in the angle tracking mode or any measuring program based on it, error me ssage 202 is not displayed. Instead, the digits after the decimal point in the displayed angle readings are replaced by dashes.
410 MEM not initialised!	Initialisation can only be performed by service staff
411/412 Defect in system area	Work with the data memory is not possible, call the service
413 Defect in system area, reading is possible **415** MEM reading error **416** MEM writing error	In the event of error messages 413...416, try to save the content of the data memory by transmission to the PC. If the error occurs again when recording is repeated, call the service.

Error Message	What to do
417 MEM is full	Read out the memory content, delete the memory.
418 Point code not found **419** Point number not found	Correct the entry.
581 Transmission error (in data transmission) **584** Transmission time out (in XON/XOFF protocol) **584** Transmission time out (in XON/XOFF Rec 500 protocol) **587** I/O time out, Rec 500 protocol **588** REC 500 protocol error	If the general recording errors 518...588 occur, first try to repeat recording. If the error occurs again, check the interface parameters, the cable and the recording program at the other end.

☞Tip

If the warning "inadequate geometrical conditions" is ignored in the application programs, the last digit of the displayed values is replaced by 3 dots.
If a recording error occurs, the last data line has usually not been transmitted.

Instructions for Maintenance and Care

Instrument	Allow sufficient time for the instrument to adjust to the ambient temper ature.
	Use a soft cloth to remove dirt and dust from the instrument.
	When working in wet weather or rain, cover the instrument during longer breaks with the protective hood.
Object lens and eyepiece	Clean the optics with special care using a clean and soft cloth, cotton wool or a soft brush, do not use any liquid except pure alc ohol.
	Do not touch the optical surface with the fi ngers.
Prisms	Steamed prisms must have sufficient time to adjust to the ambient temperature. Remove a fterwards the moisture using a clean and soft cloth.
Transportation	For transportation over long distances, the instrument should be stored in its case.
	When working in wet weather, wipe the instrument and case dry in the field and let it dry completely indoors, with the case open.
	If, for the purpose of changing the station, the instrument with the tripod is transported on the shoulder, please make sure that instrument and person will not be damaged or i njured.
Storage	Let wet instruments and accessories dry before packing them up.
	After a long storage, check the adjustment of the instrument prior to use.
	Observe the boundary values for the temper ature of storing, especially in the summer (interior of the vehicle).

Keeping the Measurement System in the Case

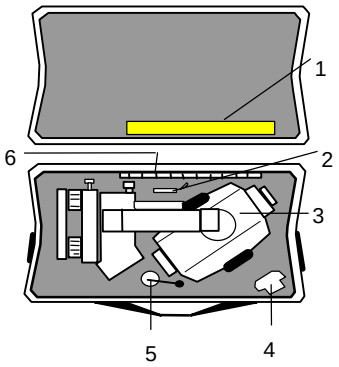


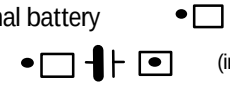
Fig. 1: Instrument case
Elta® R 45,
Elta® R 55,
Elta® R 50

1	Protective hood
2	Adjusting tools: Pin for adjusting t he optical plummet, Pin for adjusting the clamping power of the tripod legs
3	Instrument
4	Battery
5	Plumb line
6	Operating instructions

Using the Instrument in the Low Temperature Range to -35°C

For surveying in extreme climatic conditions, a version of the instrument suitable for an e xtended temperature range to -35° is available, broadening the operative range of the Routine Total Stations considerably as far as seasons and geographical features are concerned.

Due to the heated display, the instrument works just as in the normal temperature range. The required heating energy is provided by the exte rnal battery.

For operations in low temperatures change switch 1 over to external battery 

(external battery) (internal battery)

The heating switches on automatically at about -10°C.if the instrument is connected with the external battery.

The external battery provides energy for about 8 hours at -35°C.

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Order No.: 702718-7044-002 e