



# Leica DNA03/DNA10 User Manual

Version 2.0  
English

- when it has to be **right**

*Leica*  
Geosystems

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## Digital Level

**Congratulations on your purchase of the new Leica Geosystems digital level.**



This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "Safety directions" for further information.

Please read these instructions carefully before putting the instrument into operation.

### Trademarks

- Windows and Windows CE are a registered trademark of Microsoft Corporation
- CompactFlash and CF are trademarks of SanDisk Corporation

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## Product ID

The type and the serial-no. of your instrument are written on the label located on the underside of the instrument. Enter the type and serial number in your manual and always refer to this information when you need to contact your agency or Leica Geosystems authorized service workshop.

Type: \_\_\_\_\_ Serial-no.: \_\_\_\_\_

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## ***Symbols used***



### **DANGER**

Immediate hazards of use that lead to personal injuries or even death.



### **WARNING**

Hazards of use or inappropriate application that lead to personal injuries or even death.



### **CAUTION**

Hazards of use or inappropriate application that lead to minor personal injuries but appreciatble material, financial or enviromental damage.



Useful information for the operator to use the instrument properly and efficiently.

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## ***Introduction***

With the acquisition of this Leica digital level you have chosen a product of excellence, with state of the art ergonomics and outstanding measuring accuracy. Both types of the instrument feature electronic reading of the measuring staff height. The bull's eye bubble only has to be roughly set for every stationing. The fine adjustment of the target beam is done automatically by the high-precision compensator. A key press triggers the electronic measurement. Should it not be possible for once, to make an electronic measurement, then the height can be optically read from a conventional, metered staff and manually entered with the keypad.

Leica digital levels come with a wide range of software functions. Single height measurements are easy to make and also just as easy is measuring all the elements in a line levelling job. With the program "Line Adjustment", measured heights can be compared directly with the height of fixed points and adjusted to them if desired. Staking out absolute heights or height differences or point-to-point measurements are all easily possible.

The unique concept of format files enables the output of store data in almost any format. The format files can be created individually and modified as desired. The logfile e.g., can be completed in the field and transferred to an internal memory card.



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## ***Principal of measurement***

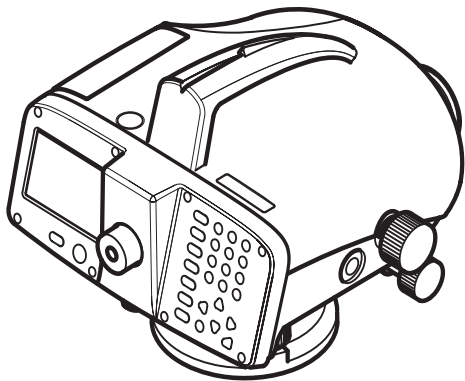
The bar code of the staff is stored in the instrument as a reference signal. When measuring, the visible section of the staff within the field of view is captured by the line decoder as a measuring signal. Then the measuring signal is compared to the reference signal. This results in the height reading and horizontal distance. The staff must be perpendicular during measurement, as for optical levelling. With artificial lighting of the staff, measurements can be made in the dark (The sensitivity of the sensor ranges from the highest frequencies of visible light down to the frequency of infra red light).

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## ***Validity***

This manual is valid for both instruments of the DNA series. Sections only valid for the DNA03 are marked accordingly.

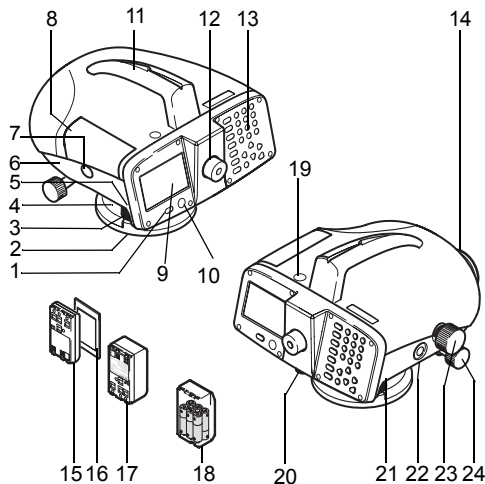
## ***Special features***



- Large display, alphanumeric keyboard
- Bi-directional horizontal drive
- Camcorder batteries
- Magnetically damped compensator
- Onboard programs
- Data storage to internal memory
- Data backup to PCMCIA-card or to CF-card with adapter

DNA03\_01

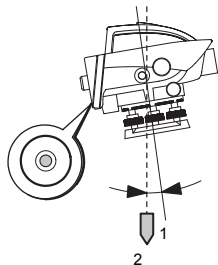
## Most important elements



DNA03\_02

- 1 On/ off button
- 2 Base plate
- 3 Foot screws
- 4 Horizontal circle
- 5 Lever to unlatch battery
- 6 Battery compartment
- 7 Button to unlatch card compartment cover
- 8 Card compartment cover
- 9 Display
- 10 Circular level
- 11 Hand grip with aiming sight
- 12 Ocular
- 13 Keyboard
- 14 Objective
- 15 Battery GEB111 (optional)
- 16 PCMCIA or CF-card with adapter (optional)
- 17 Battery GEB121 (optional)
- 18 Battery adapter GAD39; 6 single cells (optional)
- 19 Light duct for circular level
- 20 Plug stopper for crosshair adjustment knob
- 21 RS232 serial interface with external power supply
- 22 Measuring button
- 23 Focussing drive
- 24 Endless horizontal drive (bi-directional)

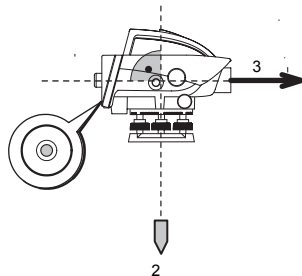
## Vertical axis tilt



DNA03\_05

After centering the circular level the instrument is almost horizontal. A minimal instrument tilt remains, this is the vertical axis tilt.

## Compensator

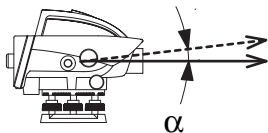


DNA03\_06

The compensator corrects for the vertical axis tilt on the line-of-sight so that the instruments aim is exactly horizontal.

- 1 Vertical axis
- 2 Plumb line
- 3 Line-of-sight

## Collimation error



DNA03\_07

The Collimation error ( $\alpha$ ) is the vertical angle between the actual line-of-sight and the ideal horizontal line. It is determined by a level test.



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## ***Applications***

### **DNA10**

Mainly for technical levelling tasks.

### **DNA03**

Technical levelling and precision levelling.

### **Staff selection**

Measuring accuracy depends on the staff used in combination with the instrument. Use standard staffs for low to medium range accuracy and invar levelling staffs for the highest precision.

### **Range of application**

- Simple measurements using staff and distance readings
- Line levelling
- Sureying and set out intermediate points.
- Online operations with a computer.

## ***Line levelling***

Dependent on the required accuracy the same rules for levelling and regulations within the given countries apply as for optical levelling.

### **Adhere to the following general rules:**

- Maintain same target distance for back and foresight.
- Measure a fore and back run and check it by the error after the closing point.

### **Exclusively for precision levelling:**

- Limit target distance, < 30m.
- Minimum ground clearance of >0.5m required to minimize refractionary influences of ground proximity.
- Double observance (BFFB, aBFFB) to increase the reliability of the measurement and to reduce possible errors caused by the staff sinking.
- Applying alternating observations procedures (aBFFB = BFFB FBBF) to eliminate horizontal tilt (residual error of the automatic compensator).
- Use an umbrella in strong sunlight.

- Precision Mode: "Precise" is activated in the tolerance-settings for line levelling, the instrument monitors the distance of the height reading (Ziellinie) to both ends of staff, top and bottom. The reduced number of staff code elements may slightly lower the measuring accuracy of measurements taken on the edge of the staff. If the distance is less than 50cm a warning is displayed. When this mode is activated, the top and bottom limits of the staff are automatically converted to a 3m Invar staff. In order to use different staff sizes, the limit values can be manually adjusted. The precision mode also monitors measuring distances critical to the staff. These distances depend on the physical properties of the instrument and of the staff. The measuring accuracy of height measurements within these distance ranges may also be slightly lower. A warning is displayed if the measuring distance is within the following ranges: 13.250m - 13.500m and 26.650m - 26.900m. The Precision Mode is meant as a helpful tool to

increase measuring accuracy. Activating Precision Mode for line levelling with typical accuracy is possible but not necessary.



## ***Area levelling***

Unlike line levelling, the individual target distances in area levelling may be very different. Depending on the required accuracy, a possible line-of-sight error or the influence of the earth's curvature may have to be taken into consideration.



In strong sunlight and when working for long periods, cover instrument and stand with an umbrella.

## **Computer software package**

### **Leica Geo Office (LGO)**

The Leica Geo Office (LGO) software package includes a number of programs and tools that support working with the instrument. LGO-Tools is a part of the complete LGO package and can be installed from the supplied CD.

After the tools have been successfully installed, the following program modules are available:

- **Data Exchange Manager**  
Data exchange of fixed points, measurements, code lists and data output formats between the instrument (internal memory) and the computer. Data exchange between PCMCIA-card (in the instrument) and the computer.
- **Coordinate Editor**  
Import/ export/ create/ edit coordinate data.
- **Codelist Manager**  
Creates and edits code lists.
- **Software Upload**  
Uploads system software and measuring programs.

- **Format Manager**  
Creates and edits user defined output formats.
- **Configuration Manager**  
Creates and edits user defined instrument settings.
- **DNA GSI Converter**  
Converts DNA03/ DNA10-data in the new GSI-format into data in the old GSI-format of the NA3003/ NA2002.



For more information on the Leica Geo Office refer to the detailed Online-help.

LEICA Geo Office (LGO) is available as a separate software package and includes the basic module as well as the LGO Tools package. The base module and the corresponding options offered support visualization, calculation, quality testing and recording of measurement data of various Leica instruments.


The following options are available for the evaluation of levelling data:

- Display, editing and evaluation of single line levelling
- Creating and adjusting 1D height grids.

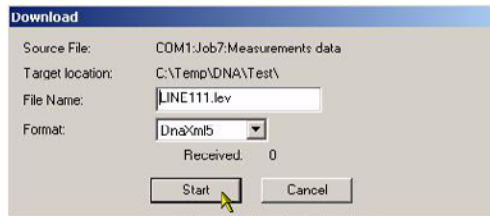
Further information on the LGO will gladly be given by your local Leica representative.

#### Data flow:

We recommend using the XML-format to transfer measurement data from the DNA to the LGO and its modules. The required Format file (DnaXml.frt) is located on the supplied CD and can be installed on the instrument with the "Data Exchange Manager".

 The transfer of job data from the instrument to the computer is then also done through the "Data Exchange Manager".

As LGO / LevelPak-Pro read in \*.lev files by default, we recommend giving the file to be transferred to the computer a \*.lev name. The following input mask is displayed in the LGO Data Exchange Manager when transferring data to the computer. As an example, the format file DNAXml5 was selected.



We advise against transferring measured data in GSI format from the level to the LGO software package. As the GSI format does not include all information, errors may occur during height calculations and lead to wrong results.

Transferring measurement data from the level test from the DNA to LGO is also not recommended in XML format.

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## ***PCMCIA or CF card***

Measured data is stored in the internal memory of the DNA03/ DNA10 and remains there. In addition, data can be backed up to a PCMCIA or CF card from the internal memory.

The system supports the PCMCIA standard for ATA-Flash, SRAM or CF memory cards. Data exchange with the computer is done via an internal PCMCIA- drive or with the external OMNI-drive offered by Leica Geosystems.

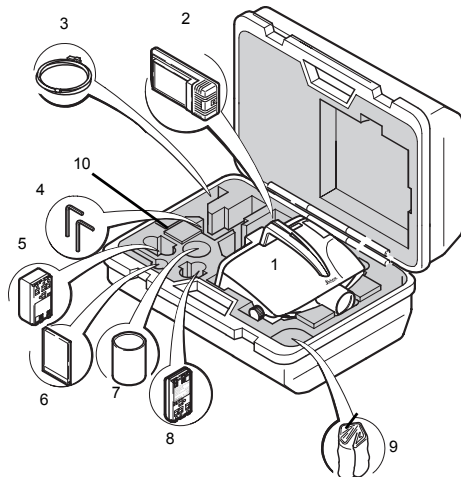
Files can also be exchanged between the memory card in the instrument and the computer via the RS 232 serial interface using the Leica Survey Office software.



Due to possible incompatibility with internal drives, data exchange with SRAM-cards is best done with the external OMNI-drive.

## Equipment

Unpack the levelling instrument from the case and check for completeness.

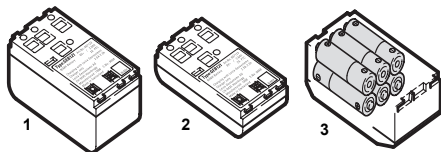


DNA03\_03

## Unpack

- 1 Instrument
- 2 Charger with accessories (optional)
- 3 Lemo-0/ RS232 data cable (optional)
- 4 Allen key (2x)
- 5 Battery GEB121 (optional)
- 6 Memory card
- 7 Lense hood (optional)
- 8 Battery GEB111 (optional)
- 9 Rain cover
- 10 User Manual, CD-ROM

## Batteries



DNA\_GEB

1 GEB121

2 GEB111

3 Single cells in the battery adapter GAD39

Your Leica Geosystems instrument is powered by rechargeable plug-in batteries. For DNA instruments, we recommend the basic battery (GEB111) or the Pro battery (GEB121). Optionally six single cells can be used with the GAD39 battery adapter.

Six single cell batteries (1.5 V each) supply 9 Volts. The voltmeter on the instrument is designed for a voltage of 6 Volts (GEB111/ GEB121).

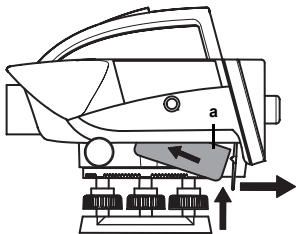
The battery charge is not displayed correctly when using single cells. Use the single cells with the battery adapter as emergency power supply. The advantage of the single cells is in a lower rate of discharge even over long periods.



Use the Leica Geosystems batteries, chargers and accessories or accessories recommended by Leica Geosystems to ensure the correct functionality of the instrument.

## Batteries

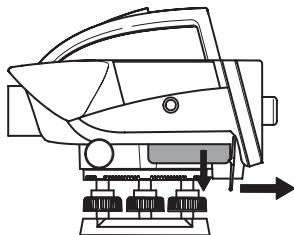
### Inserting the batteries



DNA\_BTTR\_1

First insert battery towards the objective (contact in a). Then pull the lever towards the display, press battery upwards until it locks in place.

### Removing the batteries



DNA\_BTTR\_2


Place one of your hands below the open battery compartment to catch the battery and with the other hand, pull the lever towards the display. The battery will fall out into your waiting hand.

## Memory card

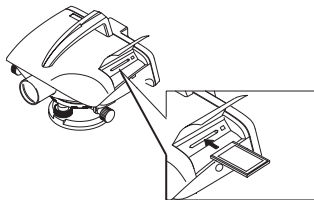
### Card compartment cover

Open: Press latch.

Close: Press cover downwards until it locks in place.

 Keep card compartment cover closed while using the instrument to protect it from water and dirt.

### Inserting the card

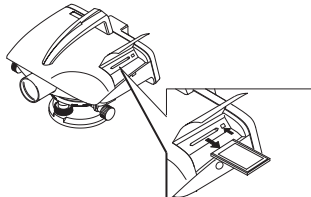


DNA03\_PCMCIA\_1

Insert card with the Leica logo facing up until it locks in at the end position.


**Check:** the card's eject button is flush with the card.

### Removing the card



DNA03\_PCMCIA\_2

Firmly press down on the card eject button; the card is ejected.

 Only use clean and dry cards. Only insert or eject the card with the instrument off.

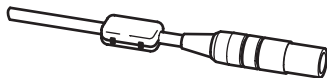


## ***External power supply***

The cable used must have a ferrite core (electromagnetic compatibility, EMV).

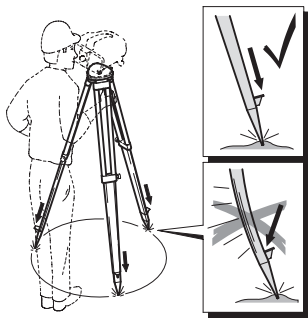


Always plug the Lemo-plug with the ferrite core into the instrument. Only plug in or remove the plug when the instrument is switched off. Cables delivered by Leica Geosystems come standard with a ferrite core.

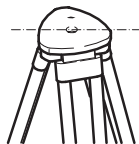


Ferrit\_01

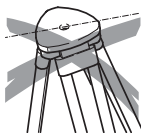
## Measurement preparations



DNA03\_Stativ1



DNA03\_Stativ2



DNA03\_Stativ3



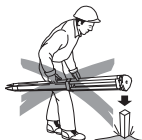
Level the tripod plate as much as possible.  
The remaining tilt of the tripod plate will be compensated with the foot screws on the instrument.

- 1 Loosen screws of tripod legs and pull them out to the required length and tighten screws.
- 2 To guarantee a firm foothold, press the tripod legs firmly into the ground.
- 3 While pressing, apply the force along the legs of the tripod.

## Levelling up



DNA03\_Stativ4



NA03\_Stativ5

Handle the tripod with care:

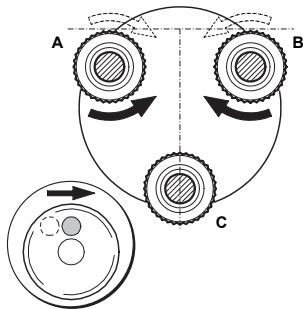
- Check the fit of all screws and bolts.
- During transport always use the cover supplied.
- Only use the tripod for surveying.



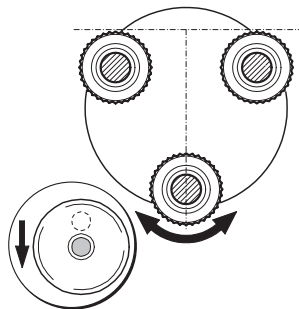
DNA03\_Horiz\_1

- 1 Place level on the tripod. Tighten tripod's central fixing screw.
- 2 Turn foot screws of tribach to their middle positions.
- 3 Center circular level by turning the foot screws.

## Centering the circular level



DDNA03\_Horiz\_2

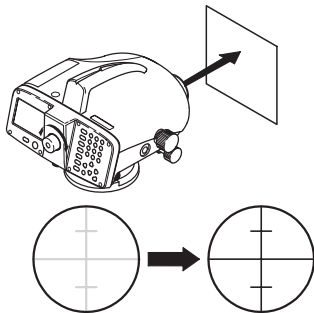


NA03\_Horiz\_3

- 1 Position ocular above foot screw C.
- 2 Turn foot screws A and B simultaneously in opposite directions until the bubble is in the center (of the imaginary "T").

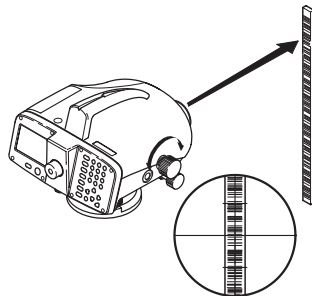
- 3 Turn foot screw C until the bubble is centered.

## *Focussing the telescope*



NDNA03\_Monok\_fok\_I

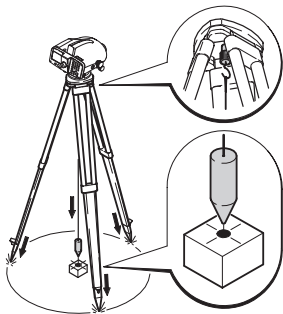
- 1 Point telescope towards bright background (e.g. white paper).
- 2 Turn ocular until reticle is focussed and appears sharp and black.



NDNA03\_Monok\_fok\_I

- 3 Aim telescope on staff using the coarse aiming device.
- 4 Turn focussing knob until image of staff is sharp. Moving the eye up and down behind the ocular should not show the staff and reticle be displaced against one another.

## Centering



Zentrier

For possible centering over a ground point:

- 1 Attach plummet.
- 2 Loosen central fixing screw slightly and shift instrument parallel on the tripod until the plummet is exactly over the point.
- 3 Tighten central fixing screw.

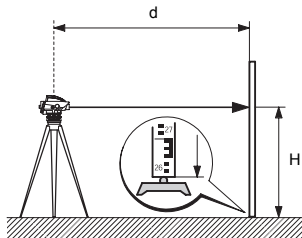
# Measuring

## General notices

- First check and adjust the line-of-sight errors, then the circular level on the instrument and then the staff.
- Before starting work in the field
- After long storage periods
- After long transportation
- Keep the optics clean. Dirt or condensation on the optics can limit measurements.
- Before starting work, let the instrument adjust to the ambient temperature (approx. 2 minutes per °C of temperature difference).

## Height reading

Example of an optical measurement:

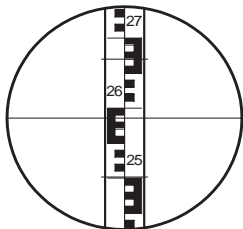


DNA\_03\_Höh\_ables

- 1 Set up instrument, level it and focus the reticle.
- 2 Set up staff vertically.
- 3 Coarsely aim at staff.

## Distance measurement

Example of an optical measurement:

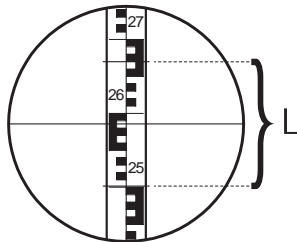


DDNA\_03\_LatteF-Kreuz

- 4 Focus with focussing knob.
- 5 Fine aim with horizontal drive.
- 6 Check if bubble is centered .
- 7 Read height H at the middle line of the reticle.

Example shown:  $H = 2.586 \text{ m}$

Perform electronic measurement according to steps 1...6 and trigger measurement.



NDNADNA\_Dist-Mess

Perform points 1 to 6 according to height readings.

### Reading

Distance line above: 2.670 m

Distance line below: 2.502 m

Difference L: 0.168 m

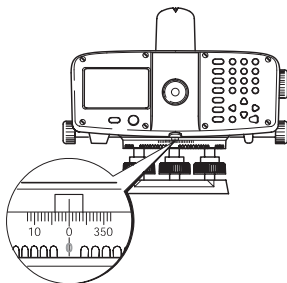
Distance d: 16.8 m

### Result:

**Distance  $d = 100 \times L$**



## Angle measurement



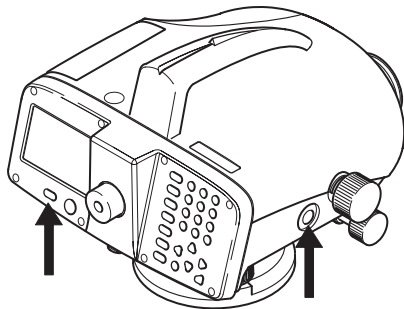
DNA\_Winkel-Mess

The instrument is equipped with a rotatable horizontal circle. The angle unit is  $360^\circ$  subdivided into  $1^\circ$  intervals. The gon division is printed in steps of 50 gon below the  $360^\circ$  division. Angle conversion from degree to gon has to be done by the user.

## Operating the instrument



The shown displays are examples and local software versions may deviate from the base version.



DNA03\_03



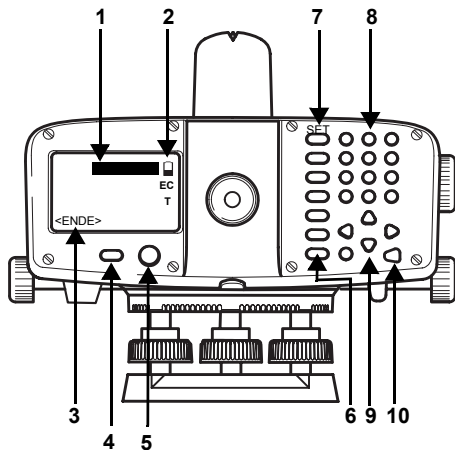
On switch: Press briefly

Off switch: Press for 1 second

### Measure button

Press lightly to trigger measurement.


## Keyboard and display



- 1 **Focus**  
Black bar shows active field.
- 2 **Symbols**
- 3 **Display key**
- 4 **On/ off key**
- 5 **Circular level**
- 6 **Fixed keys (left row of keys)**  
Keys with fixed functions.
- 7 **Fixed keys 2nd level**  
Function is triggered with [SHIFT] plus fixed key.
- 8 **Entry keys**  
To enter number, letters and special characters.
- 9 **Navigation keys**  
Functions vary depending on application.
- 10 **Enter-key**

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## Fixed keys

- INT** Switching to point-to-point measurement.
- MODE** Set measurement mode.
- USER** Key with any function from the FNC-menu.
- PROG** Measurement programs, main menu.
- DATA** Data manager.
- ESC** Quit measurement program, function or edit mode step-by-step, retrieving the old parameters. Cancel /stop measurement.
- SHIFT** Switching to the 2<sup>nd</sup> key level (SET OUT, INV, FNC, MENU, Lighting, PgUp, PgDn, <<Back, INS) and toggling numeric/ alphanumeric.
- CE** Delete character/ field, Cancel/ stop measurement.
-  Confirm entry, continue to next field.

## Key combinations

### SET OUT

**SHIFT** **INT**

Switch to setout.

### INV

**SHIFT** **MODE**

Invert staff (0-mark at the top) for measurement. The "T" symbol appears as long as INV is active. Revert with a renewed press on INV.

Measured values with inverted staffs are negative.

### FNC

**SHIFT** **USER**

Functions that support the measurements.

### MENU

**SHIFT** **PROG**

Instrument settings, system-Information, line-of-sight check with collimator (DNA03 only).



**SHIFT** **DATA**

Display and circular level lighting.

## PgUp



"Page Up"= scroll up to previous "page" if display contains multiple pages.

## PgDn



"Page Down" = scroll down to next "page" if display contains multiple pages.

## <<Back



Return to last sight, e.g. return to backsight and repeat.




## *Navigation keys*



The navigation keys take on different functions, depending on the mode in which they are used:

- Focus control
- Cursor control
- Navigate through the selection
- Select resp. confirming parameters

## Entry keys

-  Enter numbers, letters and special characters.
-  Enter decimal point and special characters.
-  Toggle positive/ negative signs; enter special characters.

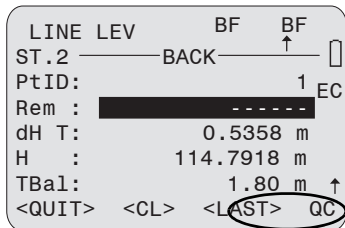
### In alphanumeric mode:

- Quick consecutive presses call up the next sign (letter/ special character, number).
- After a pause of approx. 0,5 seconds, the presently displayed sign is accepted and the cursor jumps to the next position.



The exact function is explained in detail in the appropriate sections of the manual.

## Display keys



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Display keys are additional "software keys" for a given situation. They can be marked with the navigation keys. When the cursor is over a button, the corresponding function can be called up with **[ENTER]**.

### General display keys:

**<CONT>** Accept values or conditions and move to the next screen.

**<OK>** Confirm and continue.

**<SET>** Set displayed parameter and continue.

**<QUIT>** Ends measuring program/ function. Parameters entered are ignored. In MENU, PROG and DATA returns to selection menu.

**<QUIT>** Leaves a sub program or an auxiliary function; returns to initial display.

**<PREV>** Reverts to last display.

**<REC>** Stores data to internal memory.



All displays depicted in the manual contain only text without the following explanation of the symbols.

## Symbols

Symbols with the following meaning are displayed on the right side of the screen:

- 1/3** Page number of the total pages or for search results the count of the counter from the total sum. Navigate with **[PgUp]** resp. **[PgDn]**.
- ◀ ▶** Signal the selection from a list.
- ◀ ▶** Navigate the list.
- 🔍** Quit.
- ▲ ▼** Quit.
- 🔋** The battery symbol shows the level of battery capacity remaining. (Example: 50% full).
- EC** Earth curvature correction switched on. Electronically measured or manually entered staff heights are automatically corrected for earth's curvature.
- T** Inverse staff switched on. It is only possible to take measurement with the staff inverted.
- ⬆** **[SHIFT]** was pressed.

**N**

Numeric digits activated.

**α**

Alphanumeric characters activated.

**QC**

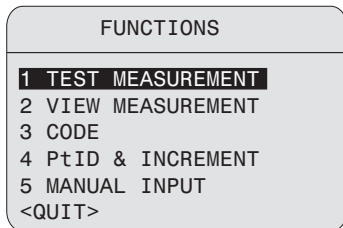
QuickCode. QuickCode is activated when a codelist is loaded into the instrument and when the cursor is over a button.

Enter the corresponding two digit Quick-Code to trigger the measurement and to save it together with the assigned code. QuickCode is not activated when the cursor is over an input field or when no codelist is loaded into the instrument. In this case entering a two digit code produces an error message.



## Navigating the menus

### Example: Function menu [FNC]



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### Starting a function

- ①...⑤ Call it up by directly entering a number 1 to 5, or

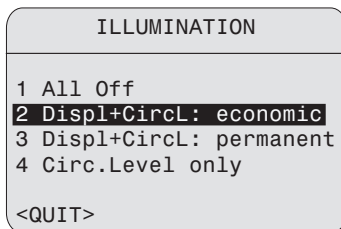
▲▼ highlight it with the navigation keys.

⏏ Starts the function.

☞ Sequence, layout and texts of the menu may vary depending on local configuration.

## Illumination menu

☞ Switch on illumination, displays setting options.



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- ① Switch off all illumination.
- ② Display illumination in economic mode. The circular level remains on permanently. The display switches off after a few seconds and comes back on at the press of a key.
- ③ Display and circular level illuminations remain on permanently.
- ④ Switches on the circular level illumination.

☞ The illumination cannot be switched on when messages are being displayed.

## User input


### Entering numeric values


Numeric fields can only contain numeric values, negative signs and decimal points. Numeric fields are e.g.: starting heights, staff readings and distances.

Enter numeric values in two ways:


#### 1. Enter a new value

Replace displayed value with a new value:

 Use navigation keys to highlight the desired entry field. Type numeric value and decimal point using the keyboard.


 Sign can be changed while making the entry.


Positive to negative or vice-versa.


 Acknowledge entry and the next entry field is highlighted.


#### 2. Edit displayed value


Edit a few digits of displayed value:


 Highlight the desired entry field with the navigation keys.

 Starts edit mode and places the cursor at the far right of the field.

 Starts edit mode and places the cursor at the far left of the field.

 Place cursor on digit to be edited. Type in desired digit.

 Acknowledge entry and the next entry field is highlighted.

 Discards entry and restores old value.

## Entering alphanumeric values

Alphanumeric fields can contain numeric as well as alphanumeric values e.g.: PtID, Code, Attribute.

### Procedure:

**SHIFT** Switch into - entry mode. In - entry mode a key is used for 3 letters and one digit.

Example:

- 1 Entering the letters S, T and U.
- 1 Press S: once, T: twice, U: three times, 1: four times. If the desired letter or number is missed just continue pressing until it comes around again.

## Inserting letters and numbers

**SHIFT** ◀ Inserting a digit into an existing number in edit mode.

A missing digit (e.g. -15 is entered instead of -125) can be inserted afterwards.

◀ ▶ Place cursor on the "1"  
(example.: **1**5)

**SHIFT** ◀ Inserts a digit (0 in numeric, space in alphanumeric fields) to the right of "1"  
(example: **1**05).

2 key inserts the desired digit  
(example: **1**25)

◀ Confirm entry/ change.

## Deleting letters and numbers

### Deleting single characters:

**CE** Deleting single characters in edit mode.

Example:

1AB**C**32 → **CE** → AB**B**32

### Deleting all characters:

**CE** Press several times until entry field is empty. A final press restores the previous value.



Numeric values are always displayed with decimal points. Decimal points are not deleted but set to zero.



**[CE]** deletes the entire highlighted value when not in edit mode. A second press restores the old value.

## Set of charaters

	Numeric digits	Alphanumeric characters			
Key	Numeric	Alpha 1	Alpha 2	Alpha 3	Alpha 4
	0	/	\$	%	0
<b>.</b>	.	#	@	&	.
<b>±</b>	+/-	(*)	?	!	+   -
<b>1</b>	1	S	T	U	1
<b>2</b>	2	V	W	X	2
<b>3</b>	3	Y	Z	Space	3
<b>4</b>	4	J	K	L	4
<b>5</b>	5	M	N	O	5
<b>6</b>	6	P	Q	R	6
<b>7</b>	7	A	B	C	7
<b>8</b>	8	D	E	F	8
<b>9</b>	9	G	H	I	9

In data entry fields the character "\*\*\*" can be entered for point ID and code searches.

## Signs



In the alphanumeric set of characters, the "+" and "-" signs are treated like normal alphanumeric characters. They have no mathematical function.

## Special characters

- \* WILDCARD for point searches only (see "Wildcard-Search").



In edit mode the position of the decimal point cannot be changed.

## Find point

Find point is a global function to find internally stored measured points or coordinates. A point search may refer to a special job or to the entire memory.

After entering the first point number of a line leveling, a search is automatically started in the memory for a height. If no fixed or measured point with the specified point number is found, 0.000m is displayed.

Should one or more points be found, then the result of the search is displayed in the following dialog.

FIND POINT - RESULT	
( 1/3 )	
Job :	HEERBRUGG
PtID:	P13 ◀▶
H :	412.2259 m
Type:	Fixpoints
<QUIT> <PtSearch+> <OK>	

**Direct search:**

It is possible to search for a specific point number (e.g. "P13"). The search result contains all the points with the relevant point number.

Example:

Entry: **P13**

Two fixed points and three measurements are displayed.

◀▶ Scroll through the found selection.

**Search results:**

FIND POINT	
( 2 / 5 )	
JOB :	HEERBRUGG
PtID:	<b>P13</b> ◀▶
H :	425.00000 m
Type:	Fixpoint
<EXIT>	<FINDPT> <OK>

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**Explanations****2/5**

The displayed point P13 is the second of 5 in the relevant job.

**Type**

The displayed point is a fixed point.

**<PtSearch+>**

Calling up the extended point search. Enter new search criteria.



If no points are found a message is displayed with that information.

The Search function always finds fixed point (in Fixed Points-jobs) before measured point (in Meas. Jobs) that fulfill the search criterion. If several points are found that fulfill the search criterion, they are listed chronologically. The instrument lists the oldest fixed point first

### Extended point search:

The search for a specific point number (e.g. "P13") is possible with **<PtSearch+>**. The dialog permits searching the point a random job or in all jobs.

EXTENDED POINT SEARCH	
JOB :	ALL JOBS ◀▶
PtID. :	<input type="text" value="P13"/>
<QUIT>	

The entered point number is searched for in the memory after confirming it with ENTER. The search result is displayed in the dialog "Point Search - Search Results" and includes all points with corresponding point numbers.

Example:

Enter : **P13** --> 2 fixed points and 2 measurements are displayed.

<-- --> Scroll through the selection found

### Manual height entry

If no point is found in the memory, the height of the point can be entered manually.

NEW POINT	
JOB :	HEERBRUGG
PtID. :	<input type="text" value="P113"/>
H0 :	0.0000 m
<QUIT> <PtSearch+> <OK>	

## Wildcard-search

Wildcard-searches are characterized by the "\*". The "\*" serves as a wild-card for any given sequence of characters.

Wildcards are used when the exact point ID is not known or when a series of points are to be found.

EXTENDED POINT SEARCH

JOB : HEERBRUGG ◀▶

PtID. : 13\*

α

<QUIT>

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Examples:

- \* finds all points of any given length.
- A** finds all points with the exact point ID "A".
- A\*** finds all points of any given length that start with "A" (e.g.: A, A9, A15, ABCD).
- \*1** finds all points of any given length that have a "1" as a second digit (e.g. A1, B12, A1C).
- A\*1** finds all points of any given length with an "A" as the first character and a "1" as the third digit (e.g.: AB1, AA100, AS15).



Starts search procedure.



## Technical hints for measurements

### Special measuring situations

#### Vibrations

Vibrations at the instrument, e.g. due to wind can be damped by touching the upper third of the tripod.

#### Back light

Use the lense hood (optional accessory) to cover the objective when back light disturbs your work. As a last resort, use your hands to shield the objective from disturbing backlight.

#### Darkness

Evenly illuminate the measuring area of the staff with a flashlight or spotlight in darkness.

#### Measuring at the beginning of the staff

Measurements slightly below the zero point are possible (negative measured values).

#### Measuring at the upper end of the staff

With the following staffs, measurements can be made up to the end of the staff: 4.05m; 2.95m; 2.70m; 1.95m und 1.82m.

With other staff lengths, measurements up to the upper ends are not possible.

#### Code length required in the field of view



For exact measurements, the centering area in the field of view should be free of any interfering cover.

The following code lengths are required in the field of view, depending on the distance, from which the permitted amount of interfering cover on the edges of the field of view can be determined:

Distance	Code length	Cover
0m - 10m	100%	0%
10m - 50m	80%	20%
50m - 90m	70%	30%
90m - 110m	60%	40%

## Shade

Shade patterns on the staff normally do not affect the measured results. Extremely dark shade can have the same effects as an interfering cover has on the field-of-view.

## Focus

A slightly unfocussed image does not influence the measuring time and the accuracy. When large focus errors occur, measurement is stopped.

## Measuring through window panes

Avoid measuring through window panes.

## Precision Mode for line levelling

The Precision Mode is meant as a helpful tool to increase measuring accuracy. The Precision Mode should be activated for line levelling jobs that require high accuracy. Further details are on page 15.

## *Important instrument settings*

Before starting any measurement, use the list to check how the measurement is to proceed and what corrections have to be made. Set or change the relevant instrument parameters.

- Current line-of-sight error ok?
- Earth curvature correction on or off?
- Which measurement mode to use?

The collimation error entered into the instrument is automatically applied as a correction to every reading of the staff.

There are two ways of determining the line-of-sight error:

- 1 Using the integrated field level test procedure or the laboratory test with the collimator (DNA03 only). See Check & Adjust, resp. check with collimator.
- 2 Determine the values through your own measurements and procedures and enter them manually ([MENU]/ All settings/ System).

The earth curvature correction can be switched on or off. [MENU]/ Quick settings.

## Measurement modes (MODE)

Set single or multiple measurements. With multiple measurements the instrument automatically carries out several measurement in sequence until the defined amount of measurements are done, a terminating criteria is reached or the observer terminates the procedure themselves.

**MODE** The measure mode display:

MEASURE MODE	
Meas-Mode:	Single
n Meas. :	1
n min :	
n max :	
sDevM/20m:	
<QUIT>	<SET>

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### Mode settings:

- **Single** (measure).  $n = 1$
- **Mean (average)** and amount of measurements to be made, e.g.  $n = 3$  (2... 99).

The instrument calculates the average of all measurements made.

- **Median** and amount of measurements to be made, e.g.  $n = 3$  (2... 99).

Uneven number of measurements: central value

Even number of measurements: by the two central values

Example:

Sorted measurements: 2, 5, 6 Median = 5

Sorted measurements: 2, 5, 6, 7 Median = 5.5

- **Mean s** = Average value with a set maximum standard deviation (S) of the average value and with outlier test. From a certain minimum amount of measurements (n min), the instrument checks if the measured standard deviation of the average value (sDevM) is less or larger than that of the set deviation (S). If smaller or equal the measurements are stopped. The measurements are continued step-by-step until the maximum amount of measurements has been reached.

A check is made at each step, whether the maximum standard deviation (S) can be

reached by eliminating outliers (measurement value with the greatest improvement).

Entries:

n min	Minimum amount of measurements (2..99)
n max	Maximum amount of measurements (2..99)
sDev/20m	Standard deviation of the average value at 20m

For the measurement, this value is converted to the specific distance measured and compared to the current standard deviation of the average (sDevM).

Example:

Measured distance= 60m

sDevM/20m= 0,0007 m

$$S = sDevM/60m = \frac{0,0007m \cdot 60}{20} = 0.0021m$$

The maximum allowable standard deviation at 60m is 0,0021m.



At "n min" = "n max" no measurements are discarded by the wild shot test.

#### • Repeat single

"Repeat single measurement". The instrument continuously makes single measurements (maximum 99), until the observer stops the process as follows:

**DATA**

The last valid single measurement is stored immediately.

If any other key is pressed [not the DATA key]:  
The last valid single measurement is displayed.



Repeated measurements (of median) increase the integrity and quality of the measured data, especially during heat shimmer or ground vibrations due to road traffic.

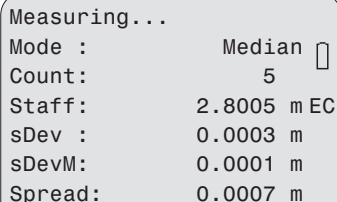
## Measuring progress


Different screens are displayed while the measurements are in progress, depending on the measurement mode selected.

### Single measurement

Measurement time is very short. An hour glass is displayed to indicate that measurement is in progress.

### Multiple measurements



Measuring...  
Mode :                      Median   
Count:                      5  
Staff:                      2.8005 m EC  
sDev :                      0.0003 m  
sDevM:                      0.0001 m  
Spread:                      0.0007 m

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All the important information required to evaluate multiple measurements is placed in a single display.

### Count

Amount of measurements made (n).

### Staff

Current staff height according to mode (mean, median or single measurement) after "n" measurements.

### sDev

Current standard deviation of a single measurement after "n" measurements.

### sDevM

Current standard deviation of the mean after "n" measurements.

### Spread

Spread of the single measurements after "n" measurements.


Spread =

largest measured value - smallest measured value



After the last measurement the display remains static for approx. 3 seconds.



or  Shortens the display time.

### Manual cancellation of multiple measurements



The last valid measured value is accepted and stored.

If any other key is pressed [not the DATA key]:  
the last valid single measurement is displayed:

Measuring...

Mode :	Median	
Count:	7	
Staff:	2.8004 m	EC
sDev :	0.0003 m	
sDevM:	0.0001 m	
Spread:	0.0009 m	

<CANCEL>   <CONT>   **<OK>**

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**<OK>**

Accept measured value and continue.

**<CANCEL>**

Reject measured value and cancel measurement.

**<CONT>**

Continue measurement.

## ***Repeating a measured sight***

A sight just carried out can be repeated by pressing the **<<Back** key. In line levelling, several sights, but the entire station at most (B and F, resp. B1, F1, F2, B2), can be repeated. When a sight is repeated the calculations are updated. The original measurement is deleted from the internal memory.

Example: repeating the foresight measurement with point ID = 2.

**<<Back** opens the display:

Remeasure Fore?

PtID: 2

<NO>   **<YES>**

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## ***Managing point IDs***

Point IDs are handled differently if they are for line points (foresight), intermediate or setout sights.

### **Line points (foresight)**

The instrument will suggest a **running** automatically incremented **number** as a foresight point ID. The starting point ID and the increment are defined in the function [FNC]/ "PtID & Increment". Switching the instrument on, set PtID value to A1.

Manually entered foresight point IDs are taken as **individual numbers** and are only valid for single measurements. The next foresight number will automatically be a running point ID.

### **Intermediate points** (intermediate/ setout sight)

A special range of numbers are reserved for intermediate and setout sights. When switching on the instrument they begin at point ID 1001. A manually entered point ID is always a **running number** and is automatically incremented. Set increment in [FNC].

## ***Data and memory management***

The data is stored in jobs, comparable to directories. They can be copied, edited or deleted individually.

Within a job data is stored in two memory areas:

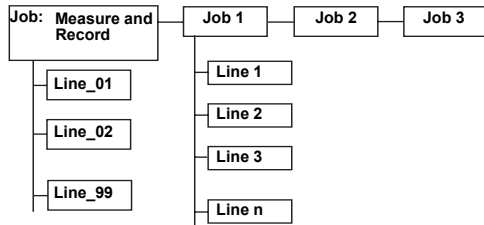
- 1 Measurement memory:  
Measurements and codes
- 2 Fixed point memory:  
Fixed and setout points.

Internal memory is divided into 16 sectors of equal sizes that are individually assigned to store measurements or fixed points.

When starting a job, sectors are reserved for measurements or fixed points. When a memory sector is full, another free sector is used. A maximum of 16 jobs can be stored to internal memory. Each sector stores approximately 350 measurements or 700 fixed points (PtID, X, Y, Z).

### **The hierarchy of jobs and lines**

The measured data of a measuring program selected in [PROG] is stored in a line within a job.



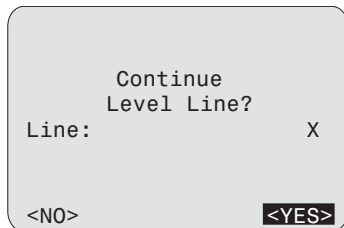
The job "Measure & Record" and its line designations are fixed and preset in the system.

In a job, only the most recent (last) line can be selected as the current line. It can also be supplemented.



## Measure & Record

After start up, either the basic measuring program "MEAS & REC" is called up or message is displayed. The message is displayed if the instrument had been shut down during a line levelling job. The last measured line can be continued from by confirming the message.



The procedure of MEAS & REC corresponds mostly to line levelling with the BF method. The first backsight is the starting point of the line. The height of the starting point is either searched for in the memory or it can be entered manually. All basic functions of levelling can then be easily carried out.

- **Single point measurements, staff readings and distances to different points:**

If height difference are not required and only saving staff readings and distances are desired, then directly in the first dialog of Meas & Rec any amount of single points can be measured.



Note that the "Save" settings in the Start menu is set to "Every Meas". Thus every measurement triggered by the red measuring button is saved.



The point numbers are not automatically incremented in this dialog. If required, the numbers must be incremented manually.

- **BF line levelling :**

Press<REC> to save the backsight and to switch to foresight. Now measure the foresight and save it with <REC>. This sequence corresponds tot the BE line levelling procedure.

- **Point-to-point and staking out of heights, height differences and distances:**

Before measuring a foresight, it is possible to measure point-to-point or stakeout points.

The measurements are saved in the internal memory in current job. If not job was created, then a "DEFAULT" job is automatically created.

In the Start dialog of "Meas & Rec" set whether every measurement (every measurement triggered with the red measuring button) should be saved or only the last measurement made before pressing <REC>.

If the data back up settings in the menu is set to "RS232" , then the data are transferred to the imterface in GSI-format and not saved internally. Backing up to the RS232 interface triggers a warning to the user.



In the back and foresight displays a single point can be measured as often as desired (PtID is **not** incremented). The observer has to switch to the next sight, like e.g. between back and foresights.



Before measuring the next sight make sure you have moved to the next **empty** data field.

## Starting display (1<sup>st</sup> backsight)

First enter all required values and then trigger the measurement with the measurement key.

MEAS & REC		BF
PtBS:	A1	↑
Rem :	-----	□
H0 :	251.6670 m	
HCol:	253.5223 m	EC
Staf:	1.8553 m	
Dist:	9.65 m	
<JOB/LINE>		<REC>QC

Entries:

### PtBS

Starting point ID.

Default is "A1".

### Rem

Remarks to the measurements.

### H0

Height of starting point (standard value = 0.00000).  
If the point is recorded in the list of fixed points of the job "Measure & Record", its height is automatically entered.

After the measurement:

**HCol**, **Staf**, and **Dist** are displayed with their respective values. The measurement can be repeated as often as desired. PtID is not incremented in the display for the same sight.

### <JOB/LINE>

Call up the Start dialog to enter names of the job and line.



The job and line names can not be changed afterwards.

### <REC>

Save measurement and continue to foresight.

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## ***Foresight display***

First enter all required values and then trigger the measurement.

MEAS & REC		BF
PtFS:	1	↑
Rem :	-----	□
H FS:	251.0257 m	
dH :	-0.6413 m	EC
Staf:	2.4966 m	
Dist:	12.67 m	
<END>	<LAST>	<REC>QC

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Entries:

### **PtFS**

Retain running point IDs or replace with individual PtIDs.

### **Rem**

Remarks to the measurements.

After the measurement:

**H FS (Height Foresight), dH, Staf and Dist** are displayed with corresponding vales.

### **<REC>**

Save measurement and continue to backsight.

### **<LAST>**

Data and measured values of the last backsight are displayed.

### **<END>**

Quits the "Meas & Rec" program. As long as no new line is started, the current line can always be continued.

## Backsight display

First enter all required values and then trigger the measurement.

MEAS & REC		BF
PtBS:		1↑
Rem :	-----	□
H BS:	251.0257 m	
HCol:	254.1417 m	EC
Staf:	3.1160 m	
Dist:	16.56 m	
<END>	<LAST>	<REC>QC

Entries:

### PtBS

Point number for the starting point.

The standard value is "1".

### Rem

Remarks to the measurements.

After the measurement:

H BS (height backsight), dH, Staf and Dist are displayed with corresponding values.

### <REC>

Save measurement and continue to foresight.

### <LAST>

Data and measured values of the last foresight are displayed.

### <END>

Quits the "Meas & Rec" program. As long as no new line is started, the current line can always be continued.

## Switching to intermediate sight or set out sight

Switching is only possible from the foresight to calculate the intermediate and setout sights. Requires a valid backsight for the station.



Note that this is a significant difference to line levelling-programs: Point-to-point and stakeout points can only be called up after completing all measurements of a station i.e after measuring the foresight.

## Surveying intermediate points

There are two displays for the intermediate sight:

- Height difference as related to the backsight (Pt to BS)
- Height difference as related to the previous intermediate point (point to point).



Point ID is incremented after each measurement.

**INT** Starts measurement display for intermediate points.

First enter all required values and then trigger the measurement.

INTERMEDIATE (BS to Pt)	
Next:	1001
Pt2 :	----- □
Staf:	----- m EC
Dist:	----- m
dH :	----- m
Pt2H:	----- m
<QUIT>	<Pt to Pt>QC

Entries:

**Next:**

Enter the point number to be measured next. Point numbers are sequential and are incremented with every measurement.

After the measurement

**Pt2:**

The point number of the current measured point

**Staff:**

The staff reading of the current measured point

**dH:**

The height difference from point-to-point to back-sight point

**Pt2H**

The height of the current measured intermediate point.

**<Pt to Pt>**

Switches to display "point to point"

**<QUIT>**

Exit intermediate sight, return to foresight.

### Point-to-point

First enter all required values and then trigger the measurement with the trigger key.

INTERMEDIATE (BS to Pt)	
Next:	1003
RemN:	-----
Last:	A1
Pt2 :	1002 EC
dH2 :	-1.0000 m
Pt2H:	110.0000 m
<QUIT>	<BS to Pt>QC

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Entries:

#### Next

Enter the point number to be measured next. Point numbers are sequential and are incremented with every measurement.

#### RemN:

Remarks on measurements

After the measurement

#### Last:

The point number of the last measured point

#### Pt2:

The point number of the current measured point

#### dH2:

The height difference from the current measured intermediate point to the last measured point.

#### Pt2H

The height of the current measured intermediate point.

#### <Pt to BS>

Returns to the "intermediate point to backsight point" screen

#### <QUIT>

Exit from intermediate sight display and return to foresight display.

## Set out

Normally, height values are staked out. These stake out heights can be loaded as fixed points into the corresponding job, in order for the heights to be calculated up for the stake out, simply by the point number. These set out values have to be entered manually. Of the three possible set out parameters only one can be used.

**[SET OUT]** Starts set out point display:

STAKE	
StkP:	1004
Rem :	----- <input type="checkbox"/>
SO H:	414.0000 m
SOdH:	---.--- m
SO D:	---.--- m
<QUIT>	<b>&lt;CONT&gt;</b>

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Entries:

### StkP:

Enter the running point number. The height of the entered point is searched for in the current job as soon as the entry is confirmed with ENTER. Should a suitable point number be found, the dialog "Find Point - Result" is displayed. From here it is also possible to search in other jobs or to search with the wildcard "\*" for random point numbers.

### Rem

Remarks to the measurements.

### SO H

If any set out point heights are stored in the fixed point memory they are displayed, else new heights have to be entered.

### SOdH

Set out height differences with respect to backsight.

### SO D

Set out distance.

### <CONT>

Continue to set out display.

### <QUIT>

Exit set out, return to foresight.



### Set out display

Trigger measurement. The calculated values and cut are displayed.

Set out according to **height** or **height difference**:

STAKE HEIGHT — 1/2	
PtBS:	A1
StkP:	1002
Rem :	-----
SO H:	414.0000 m EC
H :	412.3750 m
Fill:	1.6250 m
<QUIT>	<REC> <NEXT> QC

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### H/ dH

Measured height/ measured height difference.

### fill/ cut

Amount to displace:

fill (+) = raise staff

cut (-) = lower staff

### Page 2

Measured values (staff height and distance).

Set out according to **distance**:

STAKE DISTANCE — 1/2	
PtBS:	A1
PtID:	1001
Rem :	-----
SO D:	25.00 m EC
Dist:	24.85 m
Out :	0.15 m
<EXIT>	<REC> <NEXT> QC

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### Dist

Measured distance:

### in/ out

Amount to displace:

out (+) = move staff further away

in (-) = move staff closer

### Page 2

Measured values (staff height and distance).

**Procedure within the set out display**

Move staff and repeat measurement until the difference (fill/ cut, in/ out) meets the cut. Then select one of the three functions:

**<REC>**

Store measurements and results, with the possibility of subsequent measurements.

**<NEXT>**

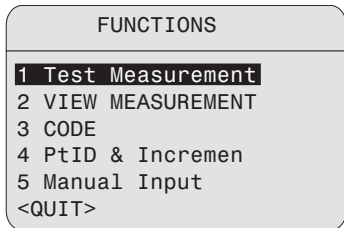
Set out next point.

**<QUIT>**

Exit from set out, return to foresight.

## Functions (FNC)

**[FNC]** opens the main menu for functions that support measurements:



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The most used functions can be called up directly from the measuring program. Should there be no reaction to the call up, then the function is not appropriate for the current application and is therefore blocked.

Each of these functions can be assigned to the [USER]-key in ([MENU] / Quick settings).

Example:

Place the function " View measurement " in the [USER]-key if you want to frequently inspect the results of measurements.

## Test measurement

"Test measurement" provides a measurement display, in which as many measurements as desired can be made without storing the data. This mode is intended for test measurements or to optimize target distances. Test measurements are always single measurements disregarding the currently set measuring mode.

- 1 Calling up "Test measurement":

TEST MEASUREMENT	
Staff:	----- m EC
Dist.:	----- m
<QUIT>	

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## View measurement

This function displays the result of the last measurement made again.

- 2 Calling up the "View measurement" display  
Example for the mean measuring mode:

VIEW MEASUREMENT	
Mode :	Mean s
Staff :	1.68859 m
n :	5
sDev :	0.00036 m EC
sDevM :	0.00016 m
Spread:	0.00075 m
<QUIT>	

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## Code

This function permits a code to be entered  
Two entry modes are available:

- 1 Select a code from the code list. A code would have to be stored in the instrument. If no code list is stored then the second mode is automatically suggested.
- 2 Enter a code manually.
- 3 Call up the "Code" function. A check is made to see if a code list is stored in the instrument.

Example:

Code entered manually (no code list available):

CODE & ATTR ENTRY 1 / 2	
Code :	-----
Info1:	-----
Info2:	-----
Info3:	-----
Info4:	-----
<QUIT>	<REC>

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**Entries on page 1:**

Code and info 1-4

**Entries on page 2:**

Info 5-8



**<REC>** The code is stored but not placed in the code list.

For more information see section *Coding*.

### ***Point ID and increment***

Enter starting value for the running point ID and enter the increment.

- ④ Call up the function  
PtID & Increment:

**PtID & INCREMENT**

Running PtID

PtID:           1

Incr: 1

<QUIT>
<SET>

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#### **<SET>**

The PtID is set ready for the current or next foresight.

### ***Manual entry of measured values***

Electronic measurements to staff less than 1.8 m away are not possible. These measurements must be done optically and the data entered into the instrument manually.

The following applies:

- Earth curvature correction is taken into consideration according to instrument settings.
- With inverted staffs the read values are negative.
- If distance value is missing a zero is stored.
- Available decimal positions correspond to the decimal position settings.

5 Calling up the "Manual input" function:

MANUAL INPUT

Staff: 0.00000 m

Dist : 0.00 m

<QUIT> <CONT>

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This function is blocked in the level test measuring program.

## Start programs

The following start programs are available as measuring programs in [PROG]:

Meas & Rec	Line levelling (BF, aBF, BFFB, aBFFB)	Level test
Set job	Set job	Set job
Set line	Set line	Set method
Setting the Memory Mode	Set tolerances	
Start	Start	Start

### Start display

Example:

Start display of the measuring program line levelling ([PROG]/ line levelling).

LINE LEVELLING

1 Job :           DEFAULT

2 Line :       LINE00002

3 Set :       Tolerances

4 Start/ CONT

<END>

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### 4 Start/continue

If the desired job and line are displayed and all tolerances are set, then the measuring program can be started at any time.



## Set job

If no job was created, then the "DEFAULT" job is automatically suggested. If several jobs are available, the desired one can be selected.

SELECT JOB	
( 1 / 1 )	
Job :	DEFAULT ◀▶
Oper:	-----
Cmt1:	-----
Cmt2:	-----
20.06.2006	09:20:33
<QUIT>	<NEW>      <SET>

### <SET>

Sets the selected job to active.

### <NEW>

Enter and open a new job

NEW JOB	
Job :	-----
Oper:	-----
Cmt1:	-----
Cmt2:	-----
20.06.2006	10:00:03
<QUIT>	<BACK>      <SET>

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Entries:

### Job

One time job name (using same job names is not possible).

### Oper

Operator's name (optional), or the most recent entry remains active.

### Cmt1/ Cmt2

Comments on the job (optional).

### Date/ Time

Stored in the system.

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## Set line

In the selected job, a new line name is automatically created and displayed. Should a different line name be desired, then it has to be changed before starting with the measurement. If the job is empty, then a new line is switched to.

Example:

- Display of **Actual line** line levelling:

ACTUAL LINE	
Name:	LINE00001
Meth:	BF
PtID:	A1
HO :	426.00000 m
Stf1:	INVAR1
Stf2:	-----
<QUIT>	<NEW> <b>&lt;SET&gt;</b>

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### <SET>

Accept current line.

### <NEW>

Branches off to enable the entry of a new line.

- Display **New line** line levelling:

NEW LINE	
Name:	LINE00003
Meth:	BF ◀▶
PtID:	P1 <b>3</b>
HO :	0.0000 m
Stf1:	-----
Stf2:	-----
<QUIT>	<PtSearch+> <SET>

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Entries:

### Name

One time line name (no same line names possible in same job).

### Meth

Observation method: BF/ aBF/ BFFB/ aBFFB.

### PtID

Start PtID.

### Stf1/ Stf2

Designation for staffs 1 and 2.(optional).

After entering the start PtID the job checks if it is already stored as a fixed point, measured point or as a previous start PtID (manual input/ standard value). If it is stored, it is selected from the list.

FIND POINT - RESULT	
( 1/3 )	
Job :	HEERBRUGG
PtID:	P13
H :	412.2259 m
Type:	Fixpoint
<QUIT> <PtSearch+> <OK>	

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## H

Point height.

## Type

Type of point: fixed point/ measured point/ manually input point/ standard value (0.000).

## <PtSearch+>

Extended point search, including other jobs.

If the point is not found in the memory, even with the extended search, then the manual entry box opens automatically:

NEW POINT	
Job :	123
PtID:	P50045
H0 :	0:00000 m
<QUIT> <SEARCH> <OK>	

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Entries:

## PtID

Start PtID.

## H0

Height of start PtID. (standard value: 0.0000).

## Set tolerances

Set tolerances must be adhered to during line levelling, depending on the application. Tolerance checks are activated and deactivated here. With tolerance check activated a message is displayed as soon as the set tolerance is exceeded. This permits corrective measures to be taken immediately.

BF, aBF method:

SET TOLERANCES

Precise :

Off

↕

TDistBal:

Off

↕

MaxDist :

Off

↕

StafEnds:

Off

↕

<QUIT>

<VALUE>

<SET>

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Activate or deactivate relevant tolerance check:

### Precise:

Precision Mode: "Precise" is activated in the tolerance-settings for line levelling, the instrument monitors the distance of the height reading (collima-

tion) to both ends of staff, top and bottom. The reduced number of staff code elements may slightly lower the measuring accuracy of measurements taken on the edge of the staff. If the distance is less than 50cm a warning is displayed. When this mode is activated, the top and bottom limits of the staff are automatically converted to a 3m Invar staff. In order to use different staff sizes, the limit values can be manually adjusted.

The precision mode also monitors measuring distances critical to the staff. These distances depend on the physical properties of the instrument and of the staff. The measuring accuracy of height measurements within these distance ranges may also be slightly lower. A warning is displayed if the measuring distance is within the following ranges: 13.250m - 13.500m and 26.650m - 26.900m.

The Precision Mode is meant as a helpful tool to increase measuring accuracy. Activating Precision Mode for line levelling with typical accuracy is possible but not necessary.

### DistBal

"Distance-balance" = Distance balance between foresight and backsight distances.

**MaxDist**

Maximum target distance.

**StaEnds:**

Enables lowest or highest approach to the ends of the staff.

- BFFB, aBFFB method:

SET TOLERANCES		
Precise :	Off	↕
DistBal :	Off	↕
MaxDist :	Off	↕
StaEnds:	Off	↕
StatDif :	Off	↕
B-B/F-F :	Off	↕
<QUIT>	<VALUE>	<SET>

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In addition to checks in BF:

**StatDif**

Permitted station difference.

**B-B/F-F**

Permitted maximum difference for double observations.

**Change tolerances**

To check or change tolerance values open the display as follows:

**<VALUE>**

Branches to the entry of tolerance values:

ENTER TOLERANCES		
TDistBal:	3.00 m	
MaxDist :	50.00 m	
StaHigh:	2.5000 m	
StaLow :	0.5000 m	
StatDiff:	0.0003 m	
B-B/F-F :	0.0002 m	
<PREV>	<DEFLT>	<SET>

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## Select method

Select level test procedure.

SELECT METHOD	
Method:	A x Bx ◀▶
Stf1:	-----
Stf2:	-----
<QUIT>	<SET>

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Entries:

### Method

"A x x B" or "A x Bx".

### Stf1/ Stf2

Designation for staff 1. and 2. (optional).

## Check list

With the measuring programs **Meas & Rec** and **Line Levelling**, after starting a new line, the first thing displayed before starting the measurement is a check list with important settings. To change the settings, call up the corresponding function.

CHECK LIST	
Meas-Mode:	Single
n Meas :	6 <input type="text"/>
sDevM/20m:	- . - - - - m <input type="text"/>
USER-Key :	TestMeas EC
Pt-Incr. :	1
Methode :	BF
	<OK>

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### Meas-Mode, n Meas, sDevM/20m

Change values in [MODE].

### USER-Key

Change assigned keys in [MENU]/ Quick settings.

### PtID, Incr

Change values in [FNC]/ PtID & increment (PtID = PtID of foresight).

### ***Start programs error messages***

The error messages are self explanatory. The countermeasures can usually be derived.

<b>Message</b>	<b>Explanation / Counter measure</b>
Memory is full!	Create space - delete an existing job.
Job exists in memory Invalid job name! Name is empty or reserved for the system!	Enter a different job name.
Line exists in the job! Invalid Line Name! Name is empty!	Enter a different line name.

## Measurement programs

The contents displayed, especially the rows, may differ in local software versions. The functions however, are always the same.

### PROG, MENU and DATA

These functions can be called up from the basic measurement program "Meas & Rec" and also from other parts of the program. Therefore the data saved in the instrument can be displayed with the [DATA] key at almost any time.

### Online-mode

In all measuring programs the instrument receives and processes commands sent via a serial interface from a computer. Transferring measured data via the RS232 interface by triggering a measurement is only possible in GSI-format and only from the basic measurement program "Meas & Rec".

---

### Introduction

As opposed to the simple measuring program **Meas & Rec**, the display switched automatically to the next screen in the measuring programs **Line-levelling** and **Level Test**. This simplifies and accelerates measurement procedures.

**PROG** Calling up the program-Menu. The program-Menu is the highest level menu in the hierarchy of the Level-operating interface. From here, all measuring programs can be called up.



## PROGRAMS

- 1 MEAS & REC
- 2 LINE LEVELLING
- 3 LINE ADJUSTMENT
- 4 CHECK & ADJUST

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With the start of a measuring program, the start screen is displayed with Job, Line and other settings of the corresponding measuring program (refer to section *Start Up programm*).

## Line levelling

The line levelling measuring program supports the BF, aBF, BFFB and aBFFB method that are selectable in the "Set line" start program.

Meaning of the methods:

Method	Uneven station	Even station
BF	BF	BF
aBF (alternating BF)	BF	FB
BFFB	BFFB	BFFB
aBFFB (alternating BFFB)	BFFB	FBBF

## Typical measurement display of Line points (B/F)

LINE	LEV	BF	BF
ST.4			↑
PtID:			3
Rem :		-----	
dH T:		1.0179 m	EC
H :		427.1299 m	
TBal:		4.20 m	
<END>	<CL>	<LAST>	QC

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### PtID

PtID of next aiming (can only be edited in foresight).

### Rem

Remarks to the next measurement (optional).

### dH T

Total height difference between current backsight and starting point.

### H

Height of the current backsight point.

### TBal

Total current distance compensation between all back and foresights.

### Heading

Displays the method (here BF) with even and uneven station.

### 2. row

The arrow marks the station (here the even station) and within the station the next measurement that will be made (here B).

### St.4

Displays the current station number, starting with 1.



With the help of the current station number and the indicator arrow, it can be determined if you are on an even or uneven numbered station. This information is helpful, if you have to close line levelling with a even station (levelling with two staffs).

#### <END>

Quits the Line Levelling program. The line can be continued at any time as long as no new line is opened, no data from other programs were saved in the current job and the current job was not changed.

#### <CUT>

Complete the line at a known point. Display all information on the line.

Refer to section "Line Cut".

#### <LAST>

Last measurement with calculated values.

### ***Last measurement backsight***

#### <LAST>

Example for BF method:

Displaying measured values with the instruments height of collimation:

View Last BACK		
PtBS :		3
Rem :		-----
HCol :	428.7973	m
H :	427.1299	m
Staff:	1.6674	m
Dist :	16.80	m
TBal :	21.00	m
		OK

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## Last measurement foresight

### <LAST>

Example for BF method:

Measured values displayed with height difference and height of the foresight point:

View Last FORE			
PtFS :			
Rem :		-----	
dH :	-0.7200	m	
H :	427.1299	m	
Staff:	2.6000	m	
Dist :	9.60	m	
TBal :	4.20	m	OK

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## Intermediate sight and set out

Calculations of the intermediate sight and set out always reference the last **backsight**. With the BF method switching between intermediate and set out sight is permitted in any sight (B/F). With most methods, the station must be completely measured before intermediate or stakeout points are possible.

The displays and the procedures are analogous to "Meas & Rec".

**INT** Opens the display to record intermediate sights.

**[SETOUT]** Opens the display for set outs.



After a station change, always complete the measurement of the backsight or the entire station, before measuring intermediate or stake out sights. The results would otherwise relate to the backsight of the previous station and would therefore be wrong. The display switches automatically to the next station when all measurements of a station are completed. Even though the display already shows the next station to

be measured, the intermediate and stakeout sights for the current station must be measured at this time before the first measurement of the next station is made.

### **Station results**

'When using the double sight procedure (BFFB, aBFFB) at the end, after completing the 4th measurement each the station results are displayed.

Example with the BFFB method:

The 4<sup>th</sup> measurement to an uneven station is completed.

LINE	LEV	BFFB	BFFB	
ST4.			↑	□
PtID:			7	
Rem :			-----	EC
dH T:		-1.1310	m	
H :		282.5023	m	
TBal:		-3.40	m	
<END><STAT><CL><LAST>QC				

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## &lt;STATION&gt;

Switches to station results, page 1.

STATION RESULTS		1 / 2
Stat.No :		3
StatDif :	-0.0200 m	
$\Sigma$ StatDif:	0.0080 m	
dH :	-0.7900 m	
H	282.5023 m	
		<PREV>

**Stat.No**

Station number (running numbers, begins with 1).

**StatDif**

Station difference.

 **$\Sigma$  StatDif**

Accumulated station differences.

**dH**

Height difference (B-F).

**H**

Height of foresight point.

## Page 2:

STATION RESULTS		2 / 2
Stat.No :		3
StatDist:	30.55 m	
B1-B2 :	-0.0200 m	
F1-F2 :	0.0000 m	
		<CONT>

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**Stat.No**

Station number.

**B1-B2**

Difference of the two backsight measurements.

**F1-F2**

Difference of the two foresight measurements.

***Exceeding tolerances***

If the tolerance is exceeded during measurement with the activated tolerance check (see Section *Set tolerances*), a message is displayed showing the current parameters.

Example:

Distance balance tolerance was exceeded:

DISTANCE BALANCE CHECK	
TBal :	6.75 m
Limit:	3.00 m
Distance Bal. too big!	
<IGNORE>	<b>&lt;REMEAS&gt;</b>

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### TBal

The current distance compensation of the entire line is displayed.

### <IGNORE>

Accept value and continue normally.

### <REPEAT>

The whole station is measured again (the previous measurement is lost).

## Line cut

With all methods of the program line-levelling, there is the possibility of comparing the height of the last point of a line with a known fixed point and to calculate the misclosure.

After completing the measurement of a station, the **<CUT>** key is displayed. It starts the calculation of the line misclosure.

LINE	LEV	BF	BF	
ST4.	———	PREV	———	↑
PtID:			225	
Rem :		-----		
dH T:		0.5100 m	EC	
H :		412.7359 m		
TBal:		-0.70 m		
<END>	<b>&lt;CL&gt;</b>	<LAST>	QC	

### <CUT>

Displays the current line information

## LINE INFO

Line: LINE225  
 #Stations: 3  
 dH T: 0.5100 m  
 DTot: 96.90 m  
 TBal: -0.70 m  
 <QUIT> **<CONT>**

**#Station.:**total number of stations

**dH T**

Total height difference between the last point of the line and the starting point

**DTot**

Total length of the line

**TBal**

Total distance compensation of the line

**<CONT>**

When the dialog is called up, the height of the fixed point or if it is not available, the measured height of the last point of the line is searched for in the memory and displayed

## QUICK CLOSURE

LstId: 225  
 Hline: 412.7359 m  
 PtId : **225**  
 H fix: 412.0000 m  
 Diff : -0.7359 m  
 <END> <PtSearch> <REC>

**<PtSearch>**

Search for other fixed point heights in memory.

**<REC>**

Save the end result and return to the program-Menu



## Line Adjustment

The line adjustment program allows adjusting single level lines. Any two points of the line can be defined as control points. The fixed heights of the control points can be entered. The program calculates the misclosure and adjusts and records all points of the line.

**PROG** ③ to start the line adjustment program.

```
-----ADJUSTMENT-----  
Job   :      Switzerland  ⬆  
Line  :              LINE2  ⬆  
Meth.:      by Distance  ⬆  
a     :              0.0020 m  
b     :              0.0050 m  
Adj.  :Line+Interm+Set0⬆  
<QUIT>  <DEFLT.>  <CONT>
```

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**<DEFLT.>** to reset the default parameters for **Meth.**, **a**, **b** and **Adj.**

### Job:

to select a job containing level lines.

### Line:

to select a level line in the current job. Lines recorded with the line leveling program can be adjusted. The symbol "\*" is displayed if no line to adjust is available.

### Meth.:

Two methods are available to adjust the level line. The selected method is also used to calculate the closing tolerance:

- **by Distance:**

Closing tolerance =  $a + b \cdot \sqrt{L}$  with L = total line length or

- **by Station:**

Closing tolerance =  $a \cdot \sqrt{n}$ , with n = total number of stations

### a and b:

General used parameters to calculate the closure tolerance according to the formulas above.

**Adj.:**

Three different point types and some combinations of them can be selected: **Line-**, **Intermediate-** and **StakeOut-**points. All points belonging to the selected point-types are adjusted.

**<CONT>**

```
--ENTER FIXED HEIGHTS--
FixPoint 1:
PtID :          1  ⬅➡
H   :      259.2947 m
FixPoint 2:
PtID :          15  ⬅➡
H   :      281.0045 m
<QUIT>  <RESET>  <CONT>
```

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**<RESET>** to reset the **FixPoints** and heights **H** to their default values.

**Fixpoint 1:**

Default for **FixPoint 1** is the first point of the selected line. Any point of the line can be selected.

**Fixpoint 2:**

Default for **FixPoint 2** is the last point of the selected line. Any point of the line can be selected as long as it is different from FixPoint 1.

**H:**

Defaults for **H** are the measured heights. Enter the fixed heights here after selecting the FixPoint ID's. Changing the PixPoint ID will reset H.

**<CONT>** to calculate the misclosure and to view the results. A message appears if the misclosure exceeds the closure tolerance.

```
---ADJUSTMENT RESULT---
Job   :      Switzerland
Line  :      Line 25
Close:      0.0035 m
Tol.  :      0.0050 m
/Sta.:      0.0002 m
Meth.:      by Distance
<QUIT>      <RUN>
```

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**Close:**

Calculated misclosure of the line at the second Fix-Point.

**Tol.:**

Calculated closing tolerance according to the selected method.

**/Sta.:**

Calculated misclosure per station.

**Meth.:**

Method used for the adjustment, in this example "by Distance".

**<RUN>**

to adjust and record all points of the selected point-types.

```
----ADJUSTED HEIGHTS----  
Line-Point:           1 / 15  
PtID :                 1 ◀▶  
H new:                260.0000 m  
H ori:                259.2947 m  
Resid:                0.7053 m
```

<OK>

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to step through all adjusted points.

**<OK>** to exit the line adjustment program.

**PtID:**

The current point ID and the point type e.g. **Line-Point** are displayed. The adjusted points can also be viewed in the data-manager.

**H:**

- new: the adjusted height
- ori: the original measured height

**Resid:**

Residual or difference between **H new** and **H ori**.

Using a suitable format mask, the adjustment results and the heights of all adjusted points can be read out and stored in a file on the PC-card or transferred to the PC.

***Data-Management***

The original measurements are kept in the job. With every adjustment, a new data-block with all new point-heights is recorded in the current job.

The calculated heights can be viewed using the on-board data manager.

**DATA****1****1**

to view the adjusted heights.

---

## Check & Adjust

With the Leica DNA03/10 the optical as well as an electronic collimation error can occur.

Electronic staff readings are automatically corrected by the collimation error stored in the instrument. Optical collimation errors have to be eliminated by adjusting the reticle.

### Procedure and general notices

The instrument offers two integrated field procedures for electronic measurements.

"A x Bx" and "A x x B" (A and B are the staffs positions, x is the instrument position). Both procedures cover two procedures each.

#### A x Bx

Procedure "from the center" (classic) and by Kukkamäki.

#### A x x B

Procedure by Förstner and Näbauer.

The line-of-sight error is displayed in arc seconds. With the following approximation arc seconds are converted to circular measure.

1" = 0.1mm/ 20m resp. 2" = 0.001ft/ 100ft

The sequence of the staff to be measured (A1, B1, B2, A2) must be adhered to in all four procedures:

Station 1    A1, B1

Station 2    B2, A2



The shorter of two aimings must always be done first (not valid for measurements from the center).

Where possible the distance ranges are checked. A wrong instrument position is reported at once with the correction factor.

After the fourth measurement the electronic line-of-sight error is compared with the stored line-of-sight error and displayed. The new line-of-sight error is now set as corrective factor. The value for the optical reading for the reticle adjustment is displayed at the same time.

**Data storage:**

Level test measurements are stored in a special line of the selected job. The line name is predetermined and is called "Check & Adjust" .



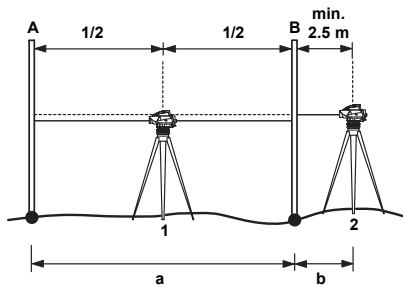
Should the level test result in a line-of-sight error  $>100''$ , an error message is displayed.

With the "A x Bx" procedure make sure that for the first station B1 is not erroneously measured. This can lead to a wrong, large line-of-sight error ( $<100''$ ) that the system does not recognize as faulty.

## "A x Bx" method

From the center procedure:

Instrument positioned in the center of the staffs and close to staff B (inside or outside).  $a$  = approx. 30m.



DNA03\_Nivellierprobe\_1

- 1 1<sup>st</sup> Position
- 2 2<sup>nd</sup> Position
- A Staff A
- B Staff B

Conditions on the distances:

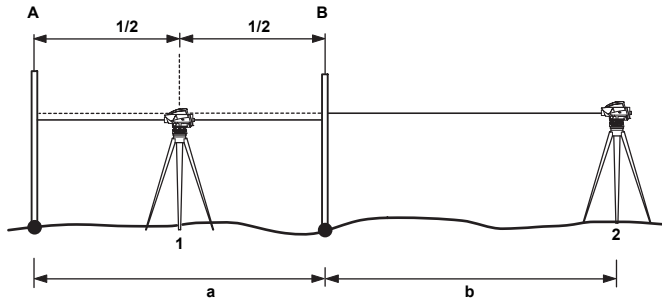
- 1. Station The center has to be within an accuracy of  $\pm 1$  m
- 2. Station  $b \geq 2.5$  m

**Kukkamäki procedure:**

Instrument positioned in the center of the staffs and on the outside of staff B at a distance  $b$  ( $b = a$ ).

$a$  = approx. 20 m.

Distance conditions as before.



DNA03\_Nivellierprobe\_2

- 1      1<sup>st</sup> Position
- 2      2<sup>nd</sup> Position
- A      Staff A
- B      Staff B



## "A x x B" method

Features of this method: The distances have a 1:2 ratio in every position.

**Förstner** procedure:

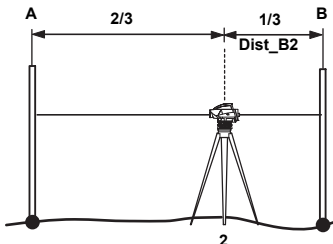
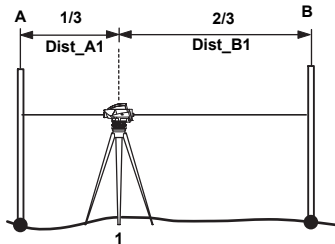
Instrument positioned at each third between the staffs. Staff distance D approx. 45 m - 60 m.

Distance conditions:

1. Station:  $0.2 \times D < \text{Dist\_A1} < 0.4 \times D$

2. Station:  $0.2 \times D < \text{Dist\_B2} < 0.4 \times D$

$D = \text{Dist\_A1} + \text{Dist\_B1}$



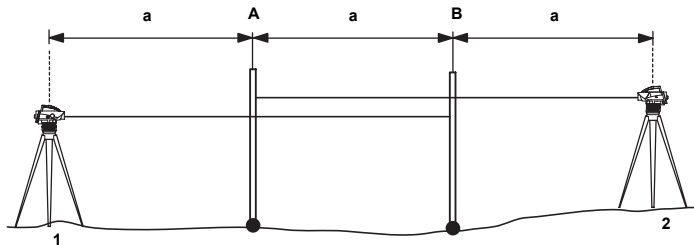
- 1 1<sup>st</sup> Position
- 2 2<sup>nd</sup> Position
- A Staff A
- B Staff B

DNA03\_Nivellierprobe\_3/4

**Näbauer** procedure:

Instrument position outside of the staffs.  $a$  = approx. 15 m - 20 m.

Distance condition: same as above.



- 1 1<sup>st</sup> Position
- 2 2<sup>nd</sup> Position
- A Staff A
- B Staff B

## Measuring procedure

The program shows which station is to be placed where using self explanatory displays:

### Procedure:

- Trigger measurement. Repeated measurements can be made.
- <CONT> switches to next aiming.

Example of a measurement display:

CHECK & ADJUST		A	x	B
Station 1				
A1 :	1.56495	m	EC	
Dist:	15.780	m		
B1 :	-----	m		
Dist:	-----	m		
<QUIT>		<CONT>		

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### Heading

Procedure is displayed and where station (x) is placed.

### Station 1

Position number

### A1, Dist

Displays the measurement A1

### B1, Dist

Displays the measurement B1 (in this display not taken yet)

### <CONT>

Continue to the next Set Up and Measurement B2 and A2 proceed in the same manner.

Display of the final result:

CHECK & ADJUST	
Coll.err.old:	4.0 "
Coll.err.new:	5.4 "
Difference :	1.4 "
Reticle:	1.56411 m
<QUIT>	
<SET>	

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### Coll.err.old

Old collimation error.

### Coll.err.new

New collimation error.

**Difference**

Difference of the two collimation errors.

**Reticle**

Final value for staff A. For adjusting the reticle see section *Check & Adjust*.

**<SET>**

The new collimation error is stored in the system as corrective value.

**<QUIT>**

The old collimation error remains set.



The <<**Back**-function is blocked. No sight is repeatable. The measurement is repeated if a disturbance occurs during a measurement.

## Coding

Codes are supplementary information and are stored as code blocks with the measurements. The Leica DNA03/ DNA10 differentiates between coding with and without a code list.

Remarks to the codes can be written in the field "Desc" of each measuring display.

### Coding with the code list

A code list can be created in the Leica Geo Office program with the Code List Manager and then loaded into the instrument. It also contains the following elements:

Designation	Input
Code	Code value
Desc	Description
Attr1 *)	Attribute value 1
...	...
Attr8 *)	Attribute value 8

\*) User definable attribute name, given while creating the code list.

## Coding without code list

Coding without code list is the same as the form of coding in GSI-format known from the old generation of instruments.

The elements are:

Designation	Input
Code	Code value
Info1	Information value 1
...	...
Info8	Informations value 8

## Entering a code

- Codes are entered in FNC (see section *Code*).
- Should no code list exist then the prompt for a manual input appears automatically. (see section *Code*).

Calling up CODE with an existing code lists:

CODE (Find/Select)

Find: \*

Code: K1

Rem : CHANNEL 1

<QUIT> <NEW> <ATTR> <REC>

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## Procedure:

### Find

Enter a search criteria ("\*" = all values ).

### Code

Make selection from the list of codes found.

## Desc

The description of the found code is displayed.

## <REC>

Store code as data block.

## <ATTR>

Attribute display; attribute values can be changed as desired.

## Except with fixed assigned status in the code list manager:

### Status

- "fix" Value is write protected.
- "mandatory" Input or confirmation required.
- "normal" Value is editable as desired.

## <MAN>

Manual code entry, as if no codelist was loaded.

---

## Quick Code

Quick Code enables entering two 2 digit to trigger a measurement und to directly save the assigned code. Quick-Code is available in most measurement displays and is usually shown in the lower right with QC. The cursor can be placed on the soft key QC. Press ENTER to determine if a codelist with Quick-Code numbers is loaded in the instrument or if the codelist is empty. The corresponding message is then displayed for a brief period.

The entry of Quick-Code digits in a measurement display activates QC, as soon as the cursor is placed on a soft key of the current display. After the two desired Quick-Code digits are entered, a measurement is triggered, saved and the assigned code is saved. The code is saved before or after the measurement, depending on the settings.

The codelist consists of a maximum of 200 codes and can be created in Leica Geo Office with the Codelist manager or entered directly into the instrument in reduced form. Whether using the Codelist manager or entering the Codelist directly into the

instrument requires assigning a two digit number (the Quick-Code number) to the codes. Codes without a Quick-Code number are automatically assigned the next highest free Quick-Code number 01, 02, 03, ... 99, 00.

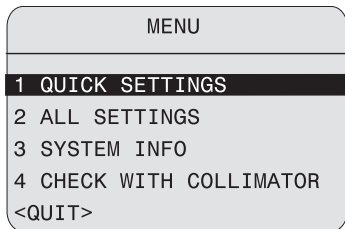


# Menu settings

The contents of the following display, especially the rows, may differ with local software versions. The respective functions remain the same.

In MENU instrument settings are made.

[MENU] opens the main menu.



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## MENU over view:

### 1 QUICK SETTINGS

- Contrast
- Earth curvature correction
- USER-key
- Decimal position

### 2 ALL SETTINGS

#### 1 System

- Beep
- Initial data
- Auto-OFF
- Contrast
- USER-Key
- Display heater
- Collimation error

#### 2 Measuring

- Code setting
- Decimal position
- GSI-format
- Earth curvature correction

#### 3 Communication

- Baudrate
- Data bit
- Parity

- End mark
- Stop bit

#### 4 Units

- Distance
- Temperature

#### 5 Date and time

### 3 SYSTEM INFO

Free jobs  
 USER-key  
 Battery  
 Instrument temperatue  
 Display heater  
 Collimation error  
 Software version

### 4 CHECK WITH COLLIMATOR

Measuring program (DNA03)

Example:

[MENU]/ Quick settings:

QUICK SETTINGS	
Contrast :	50% ▬▬
EarthCurv:	Yes ▬▬
USER-Key :	TestMeas ▬▬
Decimals :	0.00001m ▬▬
<QUIT> <SET>	

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Select appropriate setting from the list.

**<SET>**

Accept and store new settings.

**<QUIT>**

Quit display, possible setting changes are ignored.

---

## All settings

### System

Contains the system settings.

#### Beep

Acoustic signal trigger key:

Off, loud, normal.

#### Data output

- **RS232**

Data output is through the (RS232) serial interface. Only possible in the "Measure & Record" program.

- **Internal**

Data is stored to internal memory.

#### Auto-OFF

- **Inactive**

Does not switch off. The instrument is permanently on.

- **Active**

The instrument switches off about 15 minutes after the last keypress.

- **Standby (Sleep)**

The instrument switches into energy saving mode about 15 minutes after the last key press. At the next key press it reverts to normal mode.

#### Contrast

Sets contrasts in steps of 10%.

#### USER-key

Has a function assigned in FNC.

- **TestMeas**

Performs a test measurement without storing.

- **ViewMeas**

Displays the last measurements with standard deviation and spread for repeated measurements (measurement progress display).

- **Code**

Code-input and code-selection.

- **PtID&Inc**

Enter running PtID and increment.

- **ManInput**

Manual input of staff reading and distance.

**Display heater**

When the instrument is switched on the display heater is set to Off.

- **On**

Display heater starts when the inner temperature of the instrument falls below -5°C.

- **Off**

Display heater is off.

**Collimation error**

Displays the current collimation error. The value can be edited to a new collimation value if e.g. it was determined by other means than with the integrated level test.

***Measuring***

Important settings for measuring.

**Set code**

Refers to Quick code.

- **Before**

Stores code before making a measurement.

- **After**

Stores code after making a measurement.

**Decimals**

Number of decimals displayed and for manual input (three steps).

## **GSI-format**

Data via interface and data export in GSI-format.

- **GSI-8**

8-data characters output format  
(83..00+12345678).

These data words can hold alpha as well as numeric data.

- **GSI-16**

16-data characters output format  
(\*83..00+1234567890123456 ).

These data words can hold alpha as well as numeric data.

## **Earth curvature correction**

For electronically measured or manually entered staff heights.

- **Yes**

With correction.

- **No**

Without correction.

## **Communication**

Communication parameters of the RS232 interface for data transfer between computer and instrument.

### **Leica standard settings**

19200 baud, 8 data bits, no parity, CR/LF, 1 stop bit.

### **Baudrate**

Data transfer rates: 1200, 2400, 4800, 9600, 19200 (bits/second).

### **Data bits**

- **7**

7 data bits are set automatically for data transfer when parity is set to "Even" or "Odd".

- **8**

8 data bits are automatically set when for parity "No" is set.

### **Parity**

- **Even**

Even parity.

- **Odd**

Odd parity.

- **No**

No parity (when data bits = 8).

**Endmark**

- **CR/ LF**  
New line and line feed.
- **CR**  
New line.

**Stop bit**

Set to 1.

***Unit selection*****Distance**

Meter   Meter

US foot   US foot

INT foot   International foot

US foot/ inch   US-foot-inch (DNA03 only)

**Temperature**

°C   Degree Centigrade

°F   Degree Fahrenheit

## ***Date and time***

Display and setting of system date/ time. After date and time have been entered, they are stored in the system.

### **Date**

Format: dd/mm/yy (day, month, year)

### **Time**

Format: hh:mm:ss (hour, min., sec.)

---

## ***System information***

Display important and useful information.

### **Free jobs**

Amount of free jobs (maximum 16).

### **USER-key**

Current assignment of the USER-key.

### **Battery**

remaining battery capacity.

### **Instr.-Temp**

Inner temperature of the instrument.

### **Display heater**

Settings (on/ off).

### **Collimation error**

Currently set collimation error.

### ***Check with collimator***

The measuring program, only available with the DNA03, contains electronic collimation error determination using a collimator. Reticle adjustment (optical collimation error) is not supported.

The special collimator contains a graticule with a reticle with the scale of the digital level and is used to make the adjustments. The collimator is not listed in the scope of delivery of the measuring instrument. For more information please contact Leica Geosystem's technical services.

### **Procedure:**

[MENU]/ Testing with the collimator:

CHECK WITH COLLIMATOR

Input collimator values:  
Co-Staff:       0.00000 m  
Co-Dist :        0.00 m

<QUIT> **<CONT>**

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Entries:

### **Co-Staff**

Collimator calibration value for the staff height.

### **Co-Dist**

Collimator calibration value for the distance.



### <CONT>

Confirm and continue to measurement display.

CHECK WITH COLLIMATOR		
Staff	:	2.74905 m
Distance	:	20.04 m
Coll.err.old	:	1.0 "
Coll.err.new	:	2.1 "
Difference	:	1.1 "
<QUIT>		<SET>

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### Procedure:

#### [MODE]

All the measuring modes that are also available with the staff.

Aim at and focus on the bar code of the staff.

Trigger measurement with the measurement key or with the external command (GET/M/WI32/WI330).

#### Staff

Staff height.

### Distance

Distance.

### Coll.err.old

Old collimation error.

### Coll.err.new

New collimation error.

### <SET>

Store new collimation error.

## Data manager

Use the data manager to enter, edit, view or copy data to other data mediums. It manages the internal memory, where all measured data is stored and the PCMCIA-card.

**DATA** Call up the data manager- selection display:

DATA MANAGER	
1	VIEW / EDIT DATA
2	DELETE JOBS
3	MEMORY INFORMATION
4	DATA EXPORT
5	DATA IMPORT
<QUIT>	<CARD>

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Points 1-3 refer to the internal memory. The corresponding functions referencing the storage card can be found under **<CARD>**.

- **VIEW/ EDIT DATA**

Change, create, view and delete job data, measurements, fixed points and code lists.

- **INITIALIZE JOB**

Delete the entire memory, single jobs or single storage areas (fix points, measurements).

- **MEMORY INFORMATION**

Information on jobs and of memory status.

- **DATA EXPORT**

Export measured data/ fix points of a job from internal memory to a card or via the interface.

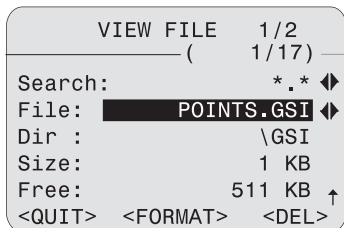
- **DATA IMPORT**

Load fix points/ code lists from the card to the internal memory.

## Card functions

Insert or delete data on the PCMCIA-card or format the card:

**DATA** / <CARD> calls up the card display:



A screenshot of a handheld device's card display menu. The menu is titled 'VIEW FILE' with a progress indicator '1/2' and a sub-indicator '( 1/17)'. The menu options are: 'Search:' with a search pattern '\*.\*' and a double arrow icon; 'File:' with the filename 'POINTS.GSI' highlighted and a double arrow icon; 'Dir : \GSI'; 'Size: 1 KB'; 'Free: 511 KB' with an upward arrow icon; and three bottom options: '<QUIT>', '<FORMAT>', and '<DEL>'.

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### Procedure:

#### Search

Select file extension from the list as search criteria.

#### File

Select file from the list.

### 1. Page:

#### Dir.

Directory of the card.

#### Size

File size in KB.

#### Free

Free memory space on the card in KB.

### 2. Page:

#### File

File name.

#### Dir.

Directory of the card.

#### Date

Date the file was created.

#### File, first line:

Displays the first 23 characters (as identification aid).

#### <FORMAT>

Format card.

#### <DELETE>

Delete selected files from the card.

## View/edit data

**DATA/1** Call up "View / Edit data":

VIEW / EDIT DATA	
<b>1</b>	<b>MEASUREMENTS</b>
2	IMPORT FIXPOINTS
3	JOBS
4	CODELIST
<QUIT>	

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## Measurements

Measured data in memory can be searched, displayed and partially deleted. First, enter search criteria of the job, line and point.

VIEW MEASUREMENT	
(Set search option)	
Job :	HEERBRUGG ◀▶
Line :	* ◀▶
PtID :	A*
<QUIT>	<b>&lt;VIEW&gt;</b>

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### Procedure:

#### Job

Select job from the list.

#### Line

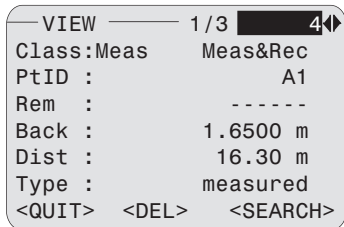
Select line from the list.

#### PtID

Set criteria for point search.

### <VIEW>

Point search starts and result is displayed:



The screenshot shows a terminal window titled "VIEW". At the top right, it displays "1 / 3" and a black box with the number "4" and a right-pointing arrow. The main content area shows the following text:

Class:Meas	Meas&Rec
PtID :	A1
Rem :	-----
Back :	1.6500 m
Dist :	16.30 m
Type :	measured

At the bottom, there are three options: "<QUIT>", "<DEL>", and "<SEARCH>".

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A data block is displayed. Large amounts of data are displayed over several pages.

### Header

Block number and page number are on the right.  
Scroll block by block through the data.

### Class

Displays block type (measurement) and measuring program (line levelling).

### <DEL>

Deletes record (necessary records for line calculation can not be deleted).

### <SEARCH>

Returns to data search display ready for the entry of new search criteria.

More information on the structure of data block is in section *Data storage*.

## Fix points

A fix point must contain either all coordinates (E, N, H) or only height (H).

```

— VIEW FIXPOINTS — 1 / 2
Job :           All Jobs ◀▶
Find:           *
PtID: 100 ◀▶
E   :          655874.210 m
N   :          221653.860 m
H   :          445.22900 m
<QUIT>    <DEL>    <NEW>
  
```

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## Display:

### PtID

Lists the found points.

### E/N/H

Point coordinates. With height points only enter the height.

### <DEL>

Delete single points.

### <NEW>

Enter new point (PtID and height with or without position coordinates).

## Jobs

### Contents:

- Displays jobs with relevant supplementary information.
- **<DEL>** Delete single jobs.
- **<NEW>** Create new job.

## Procedure:

### Job

Select job from the list.

### Find

Enter search criteria for the PtID ("\*" = all).

## Code list

Find, display and supplement data in the code list. It is possible to scroll through the code list from the main display. The code has a maximum of eight attributes. The information 1-8 on a code extend over two pages.

VIEW CODELIST — 1 / 2

Find : \*

Code : [REDACTED] ⇄

Rem : -----

QCNo : --

-----

-----

<QUIT>      <DEL>      <NEW>

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### Procedure:

#### Find

Enter search criteria.

#### Code

Select code from the list.

#### <DEL>

Delete selected code.

#### <NEW>

Enter a new code:

INPUT CODELIST 1 / 2

Code : [REDACTED] -----

Rem : -----

QCNo : --

Info1: -----

Info2: -----

<QUIT>      <PREV>      <SAVE>

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After entering the desired value:

#### <SAVE>

Code is stored in code list.

#### <PREV>

Return to code search without storing.

## Delete memory

Deletes all measurements or fix points of a job, deletes an entire job or the entire memory:

DELETE DATA / JOBS

Job : DEFAULT ◀▶

Data: Measurements ◀▶

<QUIT>   <ALLMEM>   <DEL>

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## <DEL-ALL>

Deletes entire memory. After confirming the question whether to delete, all records are deleted.

### Procedure:

#### Job

Select relevant job.

#### Data

Select data area (fix point/ measurements/ fix points & measurements).

#### <DEL>

Deletes selected data area.



---

## Memory information

Provides information on contents (sectors for measurements or fix points) of individual jobs and the number of free jobs available:

MEMORY INFORMATION		
Job:	HEERBRUGG	◀▶
Lines	:	6
MeasRecds:		150
FixPoints:		5
Free Jobs:		12
<QUIT>		

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### Job

Select job.

### Lines

Amount of stored lines in the job.

### MeasRecds

Amount of stored data blocks in the job (measurements, codes, etc.).

### FixPoints

Amount of stored fix points in the job.

### Free Jobs

Displays the amount of free jobs available if only measurements were stored. Jobs containing measurements and fix points display twice the amount of space for free jobs than is actually available.

## Data export

The data export function backs up the data in internal memory to the storage card or sends it to the serial interface. Data transfer via the serial interface is done without protocol. As standard output format the GSI-format is available in both options, GSI-8 and GSI-16. The description is on the CD-ROM as a PDF-file in the directory GSI\_Online. To collect data in your own format the instrument can load four additional user formats. Create and load the user formats with the Leica Survey Office program.

### Target directory on card:

GSI-Formats:     \GSI

User-Formats:    \DATA

— DATA EXPORT —

Target :	Card	↕
Job :	HEERBRUGG	↕
Data :	Measurements	↕
Form :	GSI - 16	↕
File :	HEERBRUG-GSI	↕
Dir. :	\GSI	

<QUIT>                      <EXPORT>

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### Target

Select memory target (card or serial interface).

### Job

Select job.

### Data

Select data type (measurements or fix points).

### Format

Select output format (GSI-8, GSI-16 or user format).

## **<EXPORT>**

Start data export.



If the device receiving the data is too slow, data loss may occur as transfer is done without protocol.



Further information on data flow can be found in the section "Computer software package Leica Geo Office (LGO)".

## Data import

Loading fix points or code list from the memory card into the internal memory of the instrument. Existing data is completely replaced by the new data. Fixed points and code lists must be in GSI-format.

```

DATA IMPORT      1/2
----- ( 2/10 ) -----
(Select Data)
Type:  Fixpoints  ⬅➡
Find:   GSI      ⬅➡
File:   HEERBRUG.GSI ⬅➡
Dir.:   \GSI
<QUIT>                                <OK>
  
```

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### Type

Select data type (fix points or code list).

### Find

Select data extension (GSI or all).

### File

Select file

### Dir.

Card directory.

### Data

Data file was created.

### <OK>

Confirm and continue.



Data are searched and viewed in all directories of the card.

For fix points a job has to be selected as the target.

```

IMPORT FIXPOINTS
-----
(Select target)
Job  :  MEAS&REC  ⬅➡
File:   HEERBRUG.GSI
<PREV> <NEWJOB> <IMPORT>
  
```

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### Job

Select target job.

**File**

Displays the file for checking.

**<IMPORT>**

Start data import.

**<NEWJOB>**

Create new job.

## ***Data storage***

The internal memory stores data by jobs. However, fix points and measurements are stored separately. Data blocks of different sizes are created, depending on the measuring program. The data is stored right after the completion of an action.

Example:

The "Line" type data block is stored immediately after the line definition in the start program "Set line" is done. The data blocks of the measurements are displayed in the data manager in the sequence they were measured and stored.

The following list shows the data blocks in the sequence of their creation with the most important variables as displayed in the data manager.

### ***Start programs***

#### **Job**

Job	= Job name
Oper	= Operator name
Cmt1	= Comment 1
Cmt2	= Comment 2
Date	= Date
Time	= Time

#### **Line**

Name	= Line name
Method	= Method
Staff1	= Designation of 1 <sup>st</sup> staff
Staff2	= Designation of 2 <sup>nd</sup> staff

## ***Measurement program***

### **Start PtID**

PtID	= Point number
E	= Coordinate (Easting)
N	= Coordinate (Northings)
H	= Height
Type	= Type of point (fix point/ entered measurement/ standard).
Rem	= Remarks
Date	= Date
Time	= Time

### **Measurement**

PtID	= Point number
Rem	= Remarks
Back/...	= Staff height (Back/B1/B2/Fore/F1/F2/ Intm/ SOut/ Meas)
Dist	= Horizontal distance
Type	= Measurement/ manual input
dH	= Height difference referring to backsight
dH_seq	= Height difference of two successive measured points
H	= Height
Date	= Date
Time	= Time
n	= Number of measurements made
sDev	= Standard deviation (single measurement)
sDevM	= Standard deviation (mean)
Spread	= Spread (max. - min.)

**Target point**

PtID	= Point number
E	= Coordinate (Eastings)
N	= Coordinate (Northings)
H	= Height
Rem	= Remarks
Date	= Date
Time	= Time

**Station**

No	= Running station number
dH	= Height difference
H	= Foresight point height
DBal	= Distance balance
DTot	= Total distance
DSta	= Station distance
Date	= Date
Time	= Time
StatDif	= Station difference
$\Sigma$ StatDif	= Accumulated station difference
B1 - B2	= Difference double sighting (backsight)
F1 - F2	= Difference double sighting (foresight)

**Set out results**

Diff (dH, H, D) = Set out result

**Measurement mode and corrective parameter**

These data blocks are stored at the beginning of a new line, even when a setting is changed during a measurement.

**Measurement mode**

Mode	= Measurement mode
n	= Preset amount of measurements (2-99) for mean and median modes
n min	= Minimum preset amount of measurements for "Mean s" mode.
n max	= Maximum preset amount of measurements for "Mean s" mode.
sDevM/20m	= Preset standard deviation of "Mean s" mode.

**Corrective parameter**

Earth curv	= Earth curvature correction yes/ no
Collim.Err	= Collimation error



## ***Coding***

Coding with code list

Code = Code name

Desc = Description

Attr1 \*) = Attribute name 1

...

Attr8 \*) = Attribute name 8

\*) Instead of attr1... attr8 a user defined attribute name can be used.

### **Coding without code list**

Code = Code name

Info1 = Information 1

...

Info8 = Information 8

## ***Fix points coordinates***

PtID = Point number

E = Coordinate (Easting)

N = Coordinate (Northings)

H = Height

### ***RS232 interface***

Measuring via serial interface RS232 is only possible in the basic measuring program "Meas & Rec" and only in the GSI-format. Set data output to RS232 ([MENU]/ All settings/ System) and select GSI-8 or GSI-16 format ([MENU]/ All settings/ Measuring).

## ***Safety Directions***

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

---

### ***Intended use of instrument***

#### **Permitted uses**

- Electronic and optical height and distance measurements to a staff.
- Angle measurement with the horizontal circle.
- Recording of measurement data.
- Calculations using measuring programs.

## **Adverse uses**

- Use of the level without previous instruction
- Use outside of the intended limits
- Disabling safety systems.
- Removal of hazard notices.
- Opening the product using tools (screwdriver, etc.), unless this is specifically permitted for certain functions.
- Modification or conversion of the instrument
- Use after misappropriation
- Use of products with obviously recognizable damages or defects
- Use with accessories from other manufacturers without the prior express approval of Leica Geosystems
- Aiming directly into the sun
- Inadequate safeguards at the surveying site (e.g. when measuring on roads, etc.)



## **WARNING**

Adverse use can lead to injury, malfunction, and material damage.

It is the task of the person responsible for the product to inform the user about hazards and how to counteract them. The product is not to be operated until the user has been instructed on how to work with it.

---

## **Limits of use**

### **Environment**

Suitable for use in an atmosphere appropriate for permanent human habitation. Not suitable for use in aggressive or explosive environments. Use in rain is permissible for limited periods (splash-water-proof).

---

## ***Responsibilities***

### **Manufacturer of the product**

Leica Geosystems AG, CH-9435 Heerbrugg, hereinafter referred to as Leica Geosystems, is responsible for supplying the product, including the user manual and original accessories, in a completely safe condition.

### **Manufacturers of non Leica Geosystems accessories**

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

### **Person in charge of the product**

The person in charge of the product has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual.
- To be familiar with local regulations relating to safety and accident prevention.
- To inform Leica Geosystems immediately if the product and the application becomes unsafe.



### **WARNING**

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

## **Hazards of use**



### **WARNING**

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

#### **Precautions:**

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



### **WARNING**

Using a battery charger not recommended by Leica Geosystems can destroy the batteries. This can cause fire or explosions.

#### **Precautions:**

Only use chargers recommended by Leica Geosystems to charge the batteries.



### **CAUTION**

Watch out for erroneous measurement results if the product has been dropped or has been misused, modified, stored for long periods or transported.

#### **Precautions:**

Periodically carry out test measurements and perform the field adjustments indicated in the User Manual particularly after the instrument has been subjected to abnormal use and before and after important measurements.



### **CAUTION**

Strong magnetic fields in the immediate vicinity (e.g. transformers, melting furnaces...) may influence the compensator and lead to measuring errors.

#### **Counter measures:**

When measuring near strong magnetic fields, check results for plausibility.

**DANGER**

Because of the risk of electrocution, it is very dangerous to use poles and extensions in the vicinity of electrical installations such as power cables or electrical railways

**Precautions:**

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

**WARNING**

By surveying during a thunderstorm you are at risk from lightning.

**Precautions:**

Do not carry out field surveys during thunderstorms.

**CAUTION**

Be careful when pointing the product towards the sun, because the telescope functions as a magnifying glass and can injure your eyes and/or cause damage inside the product..

**Precautions:**

Do not point the product directly at the sun.

**WARNING**

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

**Precautions:**

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

**CAUTION**

If the accessories used with the product are not properly secured and the product is subjected to mechanical shock, for example blows or falling, the product may be damaged or people may sustain injury.

**Precautions:**

When setting-up the product, make sure that the accessories, for example tripod, tribrach, connecting cables, are correctly adapted, fitted, secured, and locked in position.

Avoid subjecting the product to mechanical stress.

**CAUTION**

When using a vertical staff supported by one brace there is always the danger of falling (e.g. by wind gusts) and therefore danger of damage to equipment and danger of personal injuries.

**Precautions:**

Never leave a vertical staff supported by a brace unsupervised (person at the staff).

**WARNING**

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

**Precautions:**

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

**CAUTION**

During the transport, shipping or disposal of batteries it is possible for inappropriate mechanical influences to constitute a fire hazard.

**Precautions:**

Before shipping the product or disposing of it, discharge the batteries by running the product until they are flat.

When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping contact your local passenger or freight transport company.





## WARNING

If the product is improperly disposed of, the following can happen:

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

## Precautions:



The product must not be disposed with household waste. Dispose of the product appropriately in accordance with the national regulations in force in your country. Always prevent access to the product by unauthorized personnel.

Product specific treatment and waste management information can be downloaded from the Leica Geosystems home page at <http://www.leica-geosystems.com/treatment> or received from your Leica Geosystems dealer.



## CAUTION

Only Leica Geosystems authorized workshops are entitled to repair these products.

## *Electromagnetic Compatibility (EMC)*

### Description

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



## WARNING

Electromagnetic radiation can cause disturbances in other equipment.

Although this product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment may be disturbed.

**CAUTION**

There is a risk that disturbances may be caused in other equipment if the product is used in conjunction with accessories from other manufacturers, for example field computers, personal computers, two-way radios, non-standard cables or external batteries.

**Precautions:**

Use only the equipment and accessories recommended by Leica Geosystems. When combined with this product, they meet the strict requirements stipulated by the guidelines and standards. When using computers and radios, pay attention to the information about electromagnetic compatibility provided by the manufacturer.

**CAUTION**

Disturbances caused by electromagnetic radiation can result in erroneous measurements.

Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that the product may be disturbed by very intense electromagnetic radiation, for example, near radio transmitters, two-way radios or diesel generators.

**Precautions:**

Check the plausibility of results obtained under these conditions.

**WARNING**

If the product is operated with connecting cables attached at only one of their two ends, for example external supply cables, interface cables, the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other products may be impaired.

**Precautions:**

While the product is in use, connecting cables, for example product to external battery, product to computer, must be connected at both ends.

## ***FCC Statement, applicable in U.S.***



### **WARNING**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

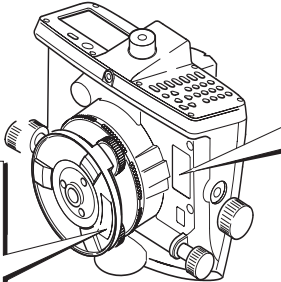
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help



### **WARNING**

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

## Product labelling



The device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Type: **DNA 03** Art. No. 723289

S. No. ....

Power: 12/6V -, 0,1Amax

Leica Geosystems AG

CH-9435 Heerbrugg

Manufactured 2002

Made in Switzerland



## Care and storage

### Transport

Always use Leica Geosystems original case to transport the instrument.

(Transport case and shipping container).



Check the field adjustment parameters specified in this manual after long storage or transport periods.

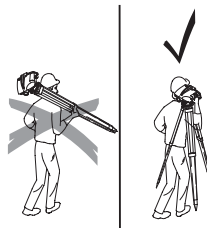
### In the field



Im Feld\_1

Always make sure that

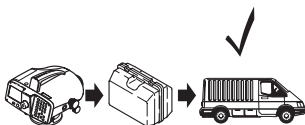
- the instrument is transported in its transport case



ImFeld\_2

- or that the tripod is carried on your shoulders with the instrument held upright.

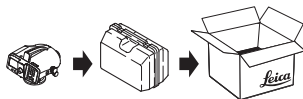
## In a vehicle



ImAuto

Never transport the instrument **loose** in a vehicle. Shocks and vibrations may damage the instrument. Always transport the instrument **secured** in the **casing**.

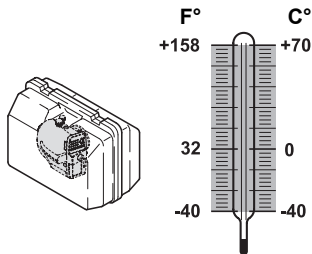
## Shipping




PerFracht

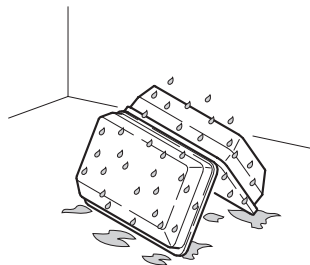
For shipping by **train**, **plane** or **ship** always use the Leica Geosystems original packaging (transport case and shipping container) or other suitable packaging. The packaging protects the instrument from shock and vibrations.

## Storage




Lagerung

 Keep an eye on **temperature limits** when storing your equipment, especially in summer inside a vehicle.  
(-40°C to +70°C; -40°F to +158°F)



Koffer\_gedreht

 If the **instrument gets wet** remove it from the case, clean and dry it. Do the same with the container, foam insert and accessories (at most at +40°C/ +104°F). Only place the instrument back into the case after everything has dried.  
Keep the transport case closed as often as possible.

## Cleaning



**Do not use aggressive liquids**, as they may damage the plastics parts.



### **Casing, keypad and display:**

Only clean them with a clean, soft cloth and if necessary dampened with a small amount of suds.



### **Objective and Ocular:**

- Blow dust off the lense.
- Do not touch the glass with your fingers.
- Use only a clean, soft and lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol.



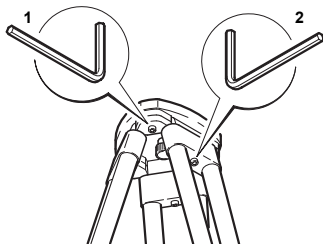
### **Cables and plugs**

Protect plug from humidity and dirt. Blow out dirty plugs of connecting cables.



# Check and adjust

## Stand

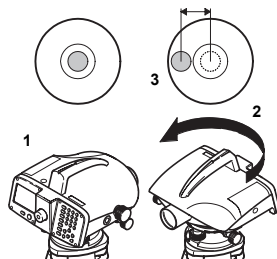


Stativ\_just

The individual elements must be firmly connected together.

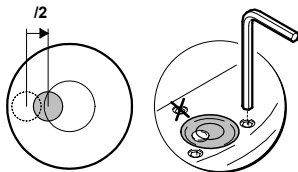
- 1 Firmly tighten Allen screw (2) (if one is used).
- 2 Tighten the joint on the stand head (1) just enough so that with the legs extended, the stand can be lifted off the ground and the legs remain in the same position.

## Circular level



Dosenlibelle\_1

- 1 Level instrument
- 2 Turn instrument by 180°.
- 3 Center bubble if it extends beyond the centering circle.

**Reticle**

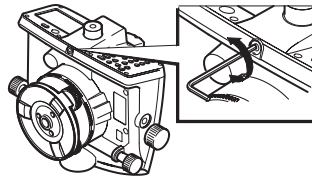
Dosenlibelle\_2

#### 4 Correct half of the error with the Allen key.

Repeat steps 1 to 4 until the circular level bubble is centered at any random telescope pointing.



Marked screw **may not be used** to adjust the bubble.



Fadenkreuz

If the collimation error exceeds 3mm per 30m, the collimation needs to be adjusted.

- 1 Turn Allen key until design value is reached.
- 2 Check collimation.

See "Check & Adjust" on page 93.

## Technical data

### Height measurements

Standard deviation per km double run  
(ISO 17123-2):

Electronic measurement	<b>DNA03</b>	<b>DNA10</b>
with invar staff	0.3mm	0.9mm
with standard staff	1.0mm	1.5mm
Optical measurement	2.0mm	2.0mm

### Distance measurement

Standard deviation 5mm/10m

### Distance measuring range for electronic measurements

Staff lengths $\geq 3m$	1.8m - 110m
Recommendation for 3m invar staffs	1.8m - 60m
Staff lengths = 2.7m	1.8m - 100m
Staff lengths = 1.82m/ 2m	1.8m - 60m

**Measuring time single measure** typically 3 sec.

### Telescope

Magnification	24x
Free objective diameter	36mm

Opening angle 2°

Field of view 3.5m at 100m

Min. target distance 0.6m

Multiplication constant 100

Addition constant 0

### Level sensitivity

Circular level 8'/2mm

### Compensator

Magnet damped pendulum compensator with electronic range control.

Slope angle  $\sim \pm 10'$

Centering accuracy **DNA03** **DNA10**

Standard deviation 0.3" 0.8"

### Display

LC display 8 lines of 24 characters, 144 x 64 pixels

Lighting economic/ permanent/ circular level only

Heating on/off switch, sets in below -5°C

## Dimensions

### Instrument

Height (incl. hand grip)	168mm +/-5mm
Width	
on the side drives	240mm
instrument body	206mm
Length	210mm
Container	468 x 254 x 355mm (L x B x H)

## Weight

incl. battery GEB111 2.85kg

## Measured values corrections

Collimation error correction	automatically
Earth curvature correction	on/off switch; level probe with correction

## Record

Internal storage	approx. 6000 measurements or about 1650 stations (BF)
Serial interface RS232	from "Measure & Record" in GSI-8/16-format

Data backup

PCMCIA-card (flash, SRAM), up to 32MB capacity

## Temperature range

Storage: -40°C - +70°C

Operation -20°C - +50°C

## Environmental conditions

Water and dust-proof IP53 (acc. IEC60529)

Humidity up to 95% humidity no condensation

## Magnetic field sensitivity

Line-of-sight difference in horizontal constant magnetic field at a field strength of 0μT up to ±400μT [4 Gauss]. ≤ 1"

## Battery powered

Batteries (NiMh)	GEB111	GEB121
Voltage	6V	6V
Capacity	1800mAh	3600mAh
Operating life DNA	12h	24h
Battery adapter GAD39	only for Alkaline batteries, 6 x LR6/AA/AM3, 1.5V	

### **Powered via serial interface**

Voltage range using  
an external cable

11.5V - 14V (DC)

Current consumption at 12V

- maximum 500mA
- Instrument on and  
without lighting, typically: 70mA

## ***Corrections/ formulas***

### **Height differences**

dH = height difference of all sights in relation to back sight.

dh = height difference of two successive measured points from the first measurement after the back sight.

Example for a measure set of a station BF with intermediate sightings Int1 and Int2: B - Int1 - Int2 - F.

$$dh1 = B - \text{Int1}$$

$$dh2 = \text{Int1} - \text{Int2}$$

$$dh3 = \text{Int2} - F$$

### **Earth curvature correction**

$$E = x^2 / (2R)$$

x = measured distance

R = 6'378'000m (earth radius)

### **Line-of-sight error**

$$\alpha = \arctan [(A1 - B1 + B2 - A2) / (d1 - d2 + d3 - d4)]$$

A1, B1, B2, A2 = staff height

d1, d2, d3, d4 = distances of the respective staff heights.

### **Distance balances**

$$D_{\text{Bal}} = \sum D_B - \sum D_F$$

$D_B$  = back sight distance

$D_F$  = fore sight distance

### **Total distance**

$$D_{\text{Tot}} = \sum D_B + \sum D_F$$

### **Station distances**

$$D_{\text{Stat}} = D_B + D_F$$

### **Station differences**

$$\text{StatDiff} = (B1 - F1) - (B2 - F2)$$

B1, F1, B2, F2, = staff heights

# ***Accessories***

## **Tripod**

### **Staffs**

- ground plate of staff
- struts

### **Power supply**

- batteries
- charger

### **Recording**

- PCMCIA-card
- Computer cable - serial interface

### **Computer software**

- Leica Geo Office
- LevelPak-Pro

### **Documentation**

- User Manual
- Field Manual
- GSI Online

## ***Sensor-error messages***

### **List of the "Measurement not possible" messages:**

<b>Error message</b>	<b>Counter measure</b>
Image too dark.	Light up staff.
Image too bright.	Darken staff or reduce lighting to staff.
No staff or staff covered or insuff. code length.	Check targeting.
Distance out of measuring range.	Move staff or instrument closer together.
Staff inverted or wrong INV setting.	Check staff position and INV-setting.
Bad focussing.	Check focus.
Compensator out of range.	Level instrument.



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**Total Quality Management: Our commitment to total customer satisfaction.**



Leica Geosystems AG, Heerbrugg, Switzerland, has been certified as being equipped with a quality system which meets the International Standards of Quality Management and Quality Systems (ISO standard 9001) and Environmental Management Systems (ISO standard 14001).

**Ask your local Leica dealer for more information about our TQM program.**

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