Leica LS10/LS15
User Manual

Version 2.0
English

- when it has to be **right**

Leica Geosystems

Introduction

Purchase

Congratulations on the purchase of a Leica LS10/LS15 Digital Level.

Product identification

The type and serial number of your product are indicated on the type plate. Always refer to this information when you need to contact your agency or Leica Geosystems authorised service workshop.

This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "1 Safety Directions" for further information. Read carefully through the User Manual before you switch on the product.

Keep for future reference!

Trademarks

- Windows is a registered trademark of Microsoft Corporation.
- Bluetooth® is a registered trademark of Bluetooth SIG, Inc.

All other trademarks are the property of their respective owners.

Validity of this manual

This manual applies to the LS10/LS15 Digital Levels. Where there are differences between the instruments they are clearly described.

Available documentation

Name	Description/Format		
LS10/LS15 Quick Guide	Provides an overview of the product together with technical data and safety directions. Intended as a quick reference guide.	✓	✓
LS10/LS15 User Manual	All instructions required in order to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions.	-	✓

Refer to the following resources for all LS10/LS15 documentation/software:

- the Digital Levels USB documentation card
- https://myworld.leica-geosystems.com

Leica Geosystems Address Book

On the last page of this manual, you can find the address of Leica Geosystems headquarters. For a list of regional contacts, please visit **http://leica-geosystems.com/contact-us/sales_support**.

myWorld@Leica Geosystems (**https://myworld.leica-geosystems.com**) offers a wide range of services, information and training material.
With direct access to myWorld, you are able to access all relevant services whenever it is convenient for you, 24 hours a day, 7 days per week. This increases your efficiency and keeps you and your equipment instantly updated with the latest information from Leica Geosystems.

Service	Description
myProducts	Add all products that you and your company own and explore your world of Leica Geosystems: View detailed information on your products and update your products with the latest software and keep up-to-date with the latest documentation.
myService	View the current service status and full service history of your products in Leica Geosystems service centres. Access detailed information on the services performed and download your latest calibration certificates and service reports.
mySupport	View the current service status and full service history of your products in Leica Geosystems service centres. Access detailed information on the services performed and download your latest calibration certificates and service reports.
myTraining	Enhance your product knowledge with Leica Geosystems Campus - Information, Knowledge, Training. Study the latest online training material on your products and register for seminars or courses in your country.
myTrustedServices	Add your subscriptions and manage users for Leica Geosystems Trusted Services, the secure software services, that assist you to optimise your workflow and increase your efficiency.

Table of Contents

In this manual

1 Safety Directions

1.1 General

Description

The following directions enable the person responsible for the product, and the person who actually uses the equipment, to anticipate and avoid operational hazards.

The person responsible for the product must ensure that all users understand these directions and adhere to them.

About Warning Messages

Warning messages are an essential part of the safety concept of the instrument. They appear wherever hazards or hazardous situations can occur.

Warning messages...

- make the user alert about direct and indirect hazards concerning the use of the product.
- contain general rules of behaviour.

For the users' safety, all safety instructions and safety messages shall be strictly observed and followed! Therefore, the manual must always be available to all persons performing any tasks described here.

DANGER, **WARNING**, **CAUTION** and **NOTICE** are standardised signal words for identifying levels of hazards and risks related to personal injury and property damage. For your safety, it is important to read and fully understand the following table with the different signal words and their definitions! Supplementary safety information symbols may be placed within a warning message as well as supplementary text.

Type	Description
DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in appreciable material, financial and environmental damage.
☞	Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

1.2 Definition of Use

Intended Use

- Electronic and optical height and distance measurements to a staff.
- Angle measurement with the integrated compass (LS15 only) or the horizontal circle.
- Recording measurements.
- Calculations using measuring programs.
- Capturing and recording screenshots.
- Visualising the aiming direction and vertical axis.
- Data communication with external appliances.

Reasonably Foreseeable Misuse

- Use of the product without instruction.
- Use outside of the intended use and limits.
- Disabling safety systems.
- Removal of hazard notices.
- Opening the product using tools, for example screwdriver, unless this is permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.
- Use of products with obvious damages or defects.
- Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.
- Aiming directly into the sun.
- Inadequate safeguards at the working site.

1.3 Limits of Use

Environment

Suitable for use in an atmosphere appropriate for permanent human habitation: not suitable for use in aggressive or explosive environments.

DANGER

Local safety authorities and safety experts must be contacted before working in hazardous areas, or close to electrical installations or similar situations by the person in charge of the product.

Environmental conditions for indoor chargers

Suitable for use in dry environments only and not under adverse conditions.

1.4 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 safe condition.

Person responsible for the product

The person responsible for the product has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual.
- To ensure that it is used in accordance with the instructions.
- 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.
- To ensure that the national laws, regulations and conditions for the operation of e.g. radio transmitters or lasers are respected.

1.5 Hazards of Use

DANGER

Because of the risk of electrocution, it is dangerous to use poles, levelling staffs 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

If the product is used with accessories, for example masts, staffs, poles, you may increase the risk of being struck by lightning.

Precautions:

Do not use the product in a thunderstorm.

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

During dynamic applications, for example stakeout procedures there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around, for example obstacles, excavations or traffic.

Precautions:

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

WARNING

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

Precautions:

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

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 product has been subjected to abnormal use as well as before and after important measurements.

NOTICE

Strong magnetic fields in the immediate vicinity (e.g. transformers, melting furnaces...) may influence the compensator and compass (only LS15) of the instrument and lead to measuring errors.

Precautions:

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

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 can sustain injury.

Precautions:

When setting up the product, make sure that the accessories are correctly adapted, fitted, secured, and locked in position.

Avoid subjecting the product to mechanical stress.

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

High mechanical stress, high ambient temperatures or immersion into fluids can cause leakage, fire or explosions of the batteries.

Precautions:

Protect the batteries from mechanical influences and high ambient temperatures. Do not drop or immerse batteries into fluids.

WARNING

If battery terminals are short circuited e.g. by coming in contact with jewellery, keys, metallised paper or other metals, the battery can overheat and cause injury or fire, for example by storing or transporting in pockets.

Precautions:

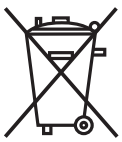
Make sure that the battery terminals do not come into contact with metallic objects.

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 unauthorised 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 unauthorised 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.

WARNING

Only Leica Geosystems authorised service centres are entitled to repair these products.

1.6 Electromagnetic Compatibility EMC

Description

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

WARNING

Electromagnetic radiation can cause disturbances in other equipment.

Although the 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 with accessories from other manufacturers, for example field computers, personal computers or other electronic equipment, non-standard cables or external batteries.

Precautions:

Use only the equipment and accessories recommended by Leica Geosystems. When combined with the product, they meet the strict requirements stipulated by the guidelines and standards. When using computers or other electronic equipment, 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 intense electromagnetic radiation, for example, near radio transmitters, two-way radios or diesel generators.

Precautions:

Check the plausibility of results obtained under these conditions.

CAUTION

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.

Bluetooth

Use of product with Bluetooth:

WARNING

Electromagnetic radiation can cause disturbances in other equipment, in installations, in medical devices, for example pacemakers or hearing aids and in aircraft. It can also affect humans and animals.

Precautions:

Although the product meets in combination with radio or digital cellular phone devices recommended by Leica Geosystems 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 or that humans or animals may be affected.

- Do not operate the product with radio or digital cellular phone devices in the vicinity of filling stations or chemical installations, or in other areas where an explosion hazard exists.

- Do not operate the product with radio or digital cellular phone devices near to medical equipment.
- Do not operate the product with radio or digital cellular phone devices in aircraft.

1.7 FCC Statement, Applicable in U.S.

The greyed paragraph below is only applicable for products without radio.

WARNING

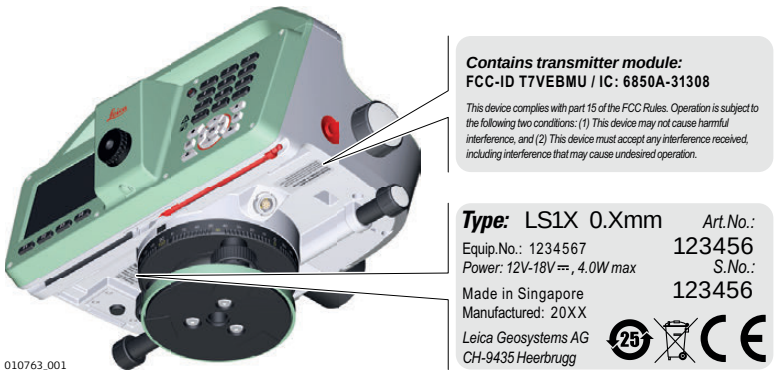
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

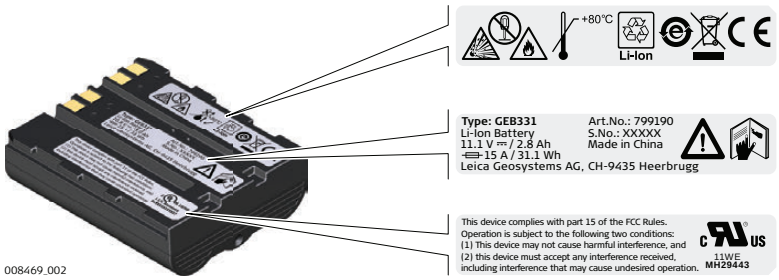
WARNING

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

Labelling LS10/LS15



Labelling Internal Battery GEB331



2 Description of the System

2.1 System Components

Main Components

Component	Description
LS10/LS15 instrument	An instrument for measuring, calculating and capturing data. Ideally suited for measurement tasks such as single height measurements, line levelling jobs, adjustment of point heights or staking out heights. Equipped with a package of standard applications to complete these tasks.
Standard applications	All standard applications are already installed on the instrument. Standard applications include Q-Level, Line Levelling, Line Adjustment, Intermediate, Set Out and additional Tools features.
Infinity software	An office software consisting of a suite of standard and extended programs for the viewing, exchanging, managing and post processing of data.
Data transfer	Data can be transferred between the instrument and a computer via a data transfer cable, a USB memory stick, a USB cable or Bluetooth.

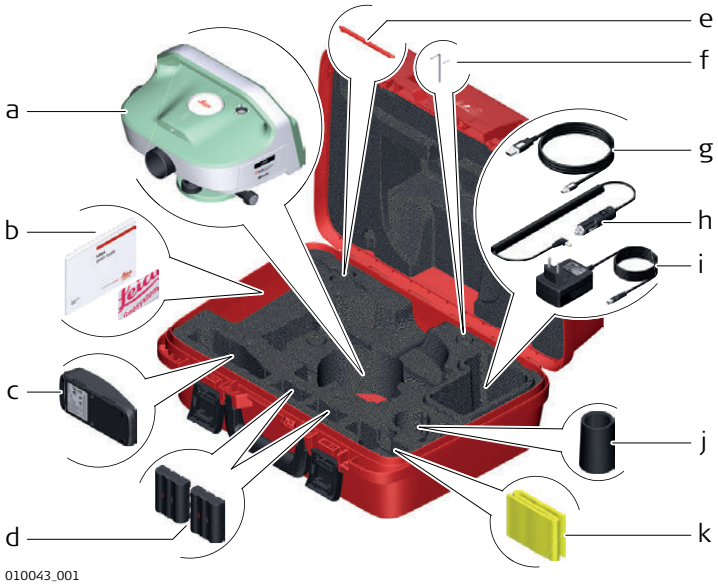
Features of LS10/LS15

Feature	LS10	LS15
Height measurement	●	●
Distance measurement	●	●
Magnetically damped compensator	●	●
32x Magnification telescope	●	●
Manual focus	●	●
Autofocus	-	●
Overview camera	-	●
Compass	-	●
MapView / Coordinates for office export	-	●
Mechanical bubble	●	●
Electronic bubble / Tilt check	-	●
Communication (USB host, USB device)	●	●
Bluetooth	●	●
RS232/USB Lemo connector interface	-	●
Internal flash memory for 30.000 measurements	●	●

● Available - Not available

2.2 Container Contents

Container Contents



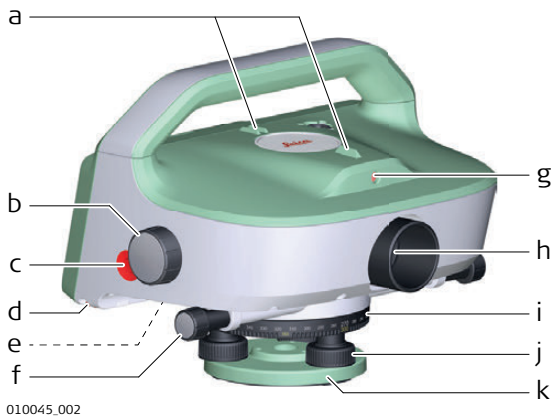
a) Instrument
b) Quick Guide/USB documentation card
c) GKL311 battery charger (optional)
d) GEB331 batteries (optional)
e) Spare stylus (optional)
f) Allen keys (1.5 mm/2 mm)
g) GEV223 USB data transfer cable (optional)
h) Car adapter cable for GKL311 (optional)
i) GEV192 AC power adapter for GKL311 (optional)
j) Sunshade
k) Rain Cover

2.3 Instrument Components

Instrument Components (Part 1)

a) Optical sight
b) Handle with integrated prism for viewing the circular level
c) Circular level
d) Touchscreen
e) Battery compartment, also containing interface for USB stick and Mini USB
f) Horizontal drive
g) Push button to open battery compartment
h) Function keys
i) ON/OFF key
j) Keyboard
k) Eyepiece
l) Protective cap for crosshair adjustment screw
m) Horizontal circle

Instrument Components (Part 2)

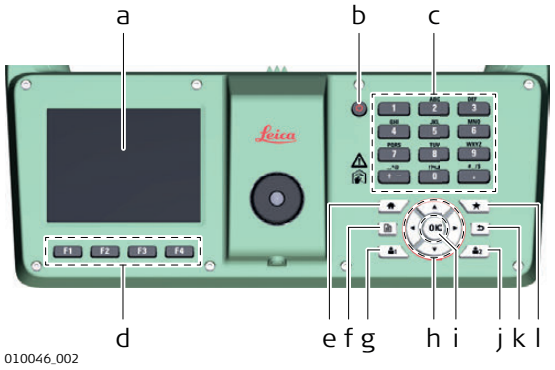


a) Optical sight
b) Focussing drive
c) Trigger key
d) Stylus for touchscreen
e) RS232 serial/USB interface with external power supply (**only** LS15)
f) Horizontal drive
g) Overview camera (**only** LS15)
h) Objective
i) Horizontal circle
j) Footscrews
k) Base plate

3 User Interface

3.1 Keyboard

Keyboard



a) Touchscreen
b) ON/OFF key
c) Alphanumeric keypad
d) Function keys **F1** to **F4**
e) Home key
f) Page key
g) User key 1
h) Navigation keys
i) Enter key
j) User key 2
k) ESC key
l) Favourites key

Keys

Key	Description
	ON/OFF key to switch the instrument on or off or to set it into standby mode.
JKL 5	Alphanumeric keypad for entering text and numerical values.
	Home key. Returns to the **Main Menu**.
	Page key. Displays the next screen when several screens are available.
	Favourites key. Quick-access to measurement supporting functions.
	ESC key (in general): Quits a screen or edit mode without saving changes. Returns to next higher level. ESC key (in all levelling applications): After confirming the action, the ESC key deletes the last observation and allows to repeat it.
1	User key 1. Programmable with a function from the **Favourites** menu.
2	User key 2. Programmable with a function from the **Favourites** menu.
	Navigation keys. Control the focus bar within the screen and the entry bar within a field.
OK	ENTER key. Confirms an entry and continues to the next field.
	Trigger key. Triggers a measurement. Programmable with functions which allow the auto-focussing of the telescope (only LS15), the height and distance reading and the storing of the measurement data. For details on how to define the functions of trigger key, refer to "6.1 Work Settings".
F1 F2 F3 F4	Function keys that are assigned to the variable functions displayed at the bottom of the screen.

Edit Fields with Alphanumeric Keypad

Use the alphanumeric keypad to enter characters directly into editable fields.

- **Numeric fields**: Can only contain numerical values. Press a key of the keypad to enter a number.
- **Alphanumeric fields**: Can contain numbers and letters. Press a key of the keypad to enter one of the characters written above that key. To toggle through the characters, press the key several times until the required character is displayed. For example: A›B›C›2›A›B›...

Select a Menu Option with Alphanumeric Keypad

Within the menu screens, you can select a menu option by pressing a key on the alphanumeric keyboard. To select a menu option, press the respective number that is displayed at the upper left corner of the menu icon  .

Example:

☞ Press 2 on the alphanumeric keyboard to open the menu **Programs**.

Keys for Editing Input Fields

Key	Description
ESC key	Deletes any change and restores the previous value.
Left navigation key	Moves the cursor to the left.
Right navigation key	Moves the cursor to the right.
Softkey **Insert**	If alphanumeric mode is activated: Inserts a whitespace at the cursor position. If numeric mode is activated: Inserts zero at the cursor position.
Softkey **Delete**	Deletes the character at the cursor position.
Softkey **Clear**	Deletes all characters entered into the input field.
Softkey **➡ ABC/➡ 123**	Switches between alphanumeric and numeric mode.

☞ In edit mode the position of the decimal place cannot be changed. The decimal place is skipped.

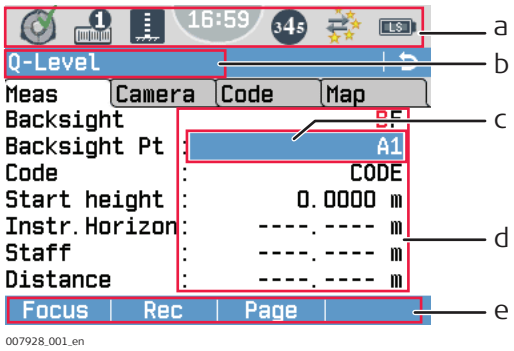
Special Characters

Character	Description
*	Used as wildcard in search fields for point IDs or codes. Refer to "7.1.2 Pointsearch".
+/-	In the alphanumeric character set "+" and "-" are treated as normal alphanumeric characters with no mathematical function. ☞ "+" / "-" only appear in front of an entry.

3.3 Screen

Colour and Touch Screen

All screens shown in this manual are examples. It is possible that firmware versions in local languages are different to the English version.



a) Status icons
b) Title of screen
c) Focus in screen (active field)
d) Input and output fields
e) Softkeys

The screen is touch-sensitive and optimised for operation with the supplied stylus. Tap on an icon, field or tab to run a function.

3.4 Status Icons

Description

The icons provide status information related to basic instrument functions.

Icons

Icon	Description
Tilt Check on LS15	
	Tilt Check is off. Tap the icon to open the **Level & Tilt Check** screen.
	The instrument is levelled and Tilt Check is on. Tap the icon to open the **Level & Tilt Check** screen.
	Instrument needs to be levelled before a measurement can be performed. Tap the icon to open the **Level & Tilt Check** screen.
Tilt Check on LS10	
	Instrument is levelled. Tap the icon to open the **Level** screen.
	Instrument needs to be levelled. Tap the icon to open the **Level** screen.
Measurement Mode	
	Measurement mode is set to **Single**. Tap the icon to open the **Mode Settings** screen.
	Measurement mode is set to **Mean**. Tap the icon to open the **Mode Settings** screen.
	Measurement mode is set to **Mean S**. Tap the icon to open the **Mode Settings** screen.
	Measurement mode is set to **Median**. Tap the icon to open the **Mode Settings** screen.
	Measurement mode is set to **Tracking**. Tap the icon to open the **Mode Settings** screen.
Orientation of Staff and Status of Earth Curvature Correction	
	Within the **Check & Adjust** application, the earth curvature correction is automatically set to **On**.

Icon	Description
	The orientation of the staff is set to **upright**. It is only possible to take measurements with the 0-mark at the bottom of the staff. Tap the icon to change the orientation to **inverse**. The earth curvature correction is set to **Off**. Refer to "6.2 Regional Settings" for details on how to set the earth curvature correction to **On**.
	The orientation of the staff is set to **inverse**. It is only possible to take measurements with the 0-mark at the top of the staff. The measured values are negative. Tap the icon to change the orientation to **upright**. The earth curvature correction is set to **Off**. Refer to "6.2 Regional Settings" for details on how to set the earth curvature correction to **On**.
	The orientation of the staff is set to **upright**. It is only possible to take measurements with the 0-mark at the bottom of the staff. Tap the icon to change the orientation to **inverse**. The earth curvature correction is set to **On**. Refer to "6.2 Regional Settings" for details on how to set the earth curvature correction to **Off**.
	The orientation of the staff is set to **inverse**. It is only possible to take measurements with the 0-mark at the top of the staff. The measured values are negative. Tap the icon to change the orientation to **upright**. The earth curvature correction is set to **On**. Refer to "6.2 Regional Settings" for details on how to set the earth curvature correction to **Off**.
Keypad Mode	
	Keypad is set to numeric mode. Tap the icon to switch to alphanumeric mode or use the softkey **ABC**.
	Keypad is set to alphanumeric mode. Tap the icon to switch to numeric mode or use the softkey **123**.
Interface Setting	
	Only available on LS15 instrument: RS232 communication port is selected. Tap the icon to open the **Interface Settings** screen.
	Bluetooth communication port is selected, but inactive. Tap the icon to open the **Interface Settings** screen.
	Bluetooth communication port is selected and active. Tap the icon to open the **Interface Settings** screen.
	Either Mini USB or Lemo USB (only LS15) communication port is configured and connected. Tap the icon to open the **Interface Settings** screen.
	Either Mini USB or Lemo USB (only LS15) communication port is configured but disconnected. Tap the icon to open the **Interface Settings** screen.
System Status	
	The battery symbol indicates the level of the remaining battery capacity, 100% full shown in the example. Tap the icon to open the **Info** screen.
	The instrument is connected to an external power supply.

3.5 Softkeys

Description

Softkeys are selected using the relevant **F1** to **F4** function key. This chapter describes the functionality of the common softkeys used by the system. The more specialised softkeys are described where they appear in the program chapters.

Common Softkey Functions

Key	Description
Cont	If entry screen: Confirms measured or entered values and continues the process. If message screen: Confirms message and continues with selected action or returns to the previous screen to reselect an option.
Back	To return to the last active screen.
Page	To change to the next page within a menu, program or settings screen.
Yes/**No**	To confirm or reject a warning or information message on a message screen.
⬇	To display the lower softkey level.
⬆	To return to the upper softkey level.
Default/**Reset**	To reset all editable fields to their default values.
New	To create a job, fixpoint or code.
Edit	To edit existing values or data.
Insert	To insert zero within an entry field.
Delete	To delete a single character within an entry field.
Clear	To delete all characters within an entry field.
➡ **ABC**	To change the keypad operation to alphanumerical.
➡ **345**	To change the keypad operation to numerical.
Focus	To focus to the staff with auto-focus mode (only available on LS15).
Dist	To take a height and distance reading. Note: The values measured by pressing **Dist** (softkey **F2**) are not stored to the job. To measure and store use the trigger key.
Rec	To store the measured data and continue the process.
SetOut	To switch to the screen for setting out heights, height differences or distances.
INT	To switch to the screen for surveying intermediate points.
ENH	To open the manual coordinate entry screen.
Find	To search for fixed points or measurements.
List	To display the list of available points.
View	To display the coordinate and job details of the selected point.

4 Operation

4.1 Power Supply

4.1.1 Working with the Battery

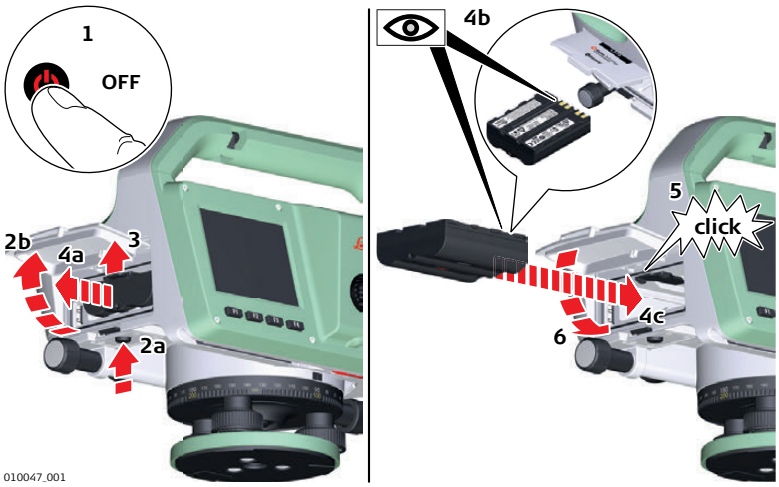
Charging / first-time use

- The battery is delivered in a sleep mode and needs to be activated before using it for the first time. To activate, charge the battery. For more information, refer to the documentation supplied with the battery.
- The permissible temperature range for charging is between 0°C to +45°C/+32°F to +113°F. For optimal charging we recommend charging the batteries at a low ambient temperature of +10°C to +30°C/+50°F to +86°F if possible.
- It is normal for the battery to become warm during charging. Using the chargers recommended by Leica Geosystems, it is not possible to charge the battery if the temperature is too high.

Operation / discharging

- The batteries can be operated from -30°C to +60°C/-22°F to +140°F.
- Low operating temperatures reduce the capacity that can be drawn; very high operating temperatures reduce the service life of the battery.
- For Li-Ion batteries, we recommend carrying out a single discharging and charging cycle when the battery capacity indicated on the charger or on a Leica Geosystems product deviates significantly from the actual battery capacity available.

Change the Battery Step-by-Step



Step	Description
1.	Turn off the instrument.
2.	To open the battery compartment, press the push button that is underneath the battery compartment.
3.	To release the battery from the compartment, push the latch securing the battery upwards.
4.	Take the battery out of the compartment and insert a charged battery. Insert the battery with the contacts facing upwards and towards the instrument.
5.	Push the battery into the compartment until the latch snaps back to its position.
6.	Close the battery compartment.

4.2 Data Storage

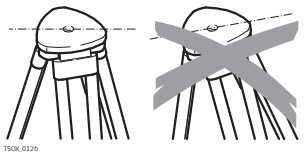
Description

The instrument is equipped with an internal memory. In the internal memory, all data is stored within jobs in the database. From the database, you can transfer or export the data and convert it into a readable format (e.g. ASCII, HexML, GSI) by using the transfer functionality.
For further information on data management and data transfer refer to "12 Data Management".

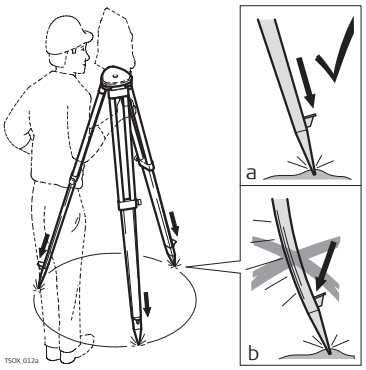
4.3 Instrument Setup

For highest accuracy levelling tasks, use a tripod with fixed legs, for example 328422 GST40.

Tripod

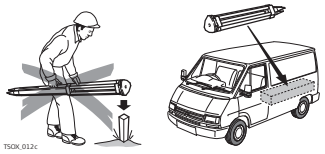


When setting up the tripod pay attention to ensuring a horizontal position of the tripod plate. Slight corrections of inclination can be made with the foot screws of the tribrach. Larger corrections must be done with the tripod legs.



Loosen the clamping screws on the tripod legs, pull out to the required length and tighten the clamps.

a) In order to guarantee a firm foothold sufficiently press the tripod legs into the ground.
b) When pressing the legs into the ground note that the force must be applied along the legs.



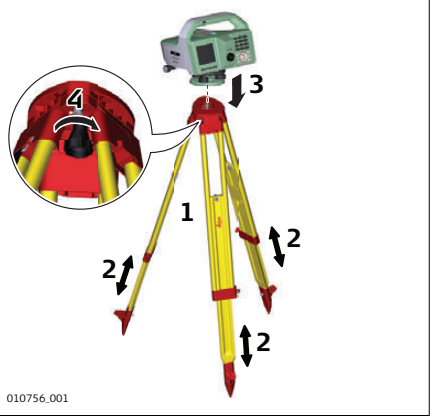
Careful handling of tripod.

- Check all screws and bolts for correct fit.
- During transport, always use the cover supplied.
- Use the tripod only for surveying tasks.

Setup Step-by-Step

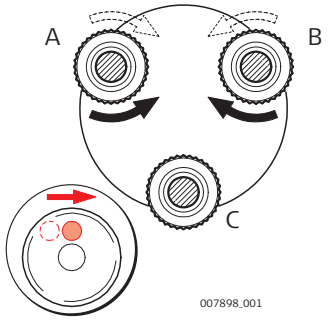
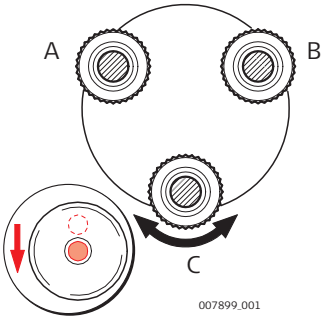
Setting up the Instrument on the Tripod

Step	Description
1.	Set up the tripod.
2.	Extend the tripod legs to allow for a comfortable working posture.
3.	Fasten the instrument onto the tripod.
4.	Tighten the central fixing screw.



Centring the Circular Level Manually

The circular level helps you to level up the instrument manually. To level up the instrument precisely, you can also use the electronic level. Refer to 4.4" For LS15: Level Up with the Electronic Level Step-by-Step".

Step	Description	
1.	Turn the instrument, so that the ocular is positioned above footscrew C.	
2.	Turn the footscrews A and B simultaneously in opposite directions until the bubble is on the middle axis of the circular level.	
3.	Turn the footscrew C until the bubble is centred.	

Adjusting the Reticle to the Eyesight of the User

Step	Description
☞	To ensure a parallax free sight for optical readings of a staff, you need to adjust the reticle to the eyesight of the user.
1.	Point the telescope towards a bright background.
2.	Turn the ocular until the reticle is focussed and appears sharp and black.

4.4 Startup

Turn Instrument On/Off or Enable Standby Mode

To turn the instrument on, press the ON/OFF key for 2 seconds.
To turn off the instrument or set it into standby mode, press the ON/OFF key and select the appropriate option from the information screen.

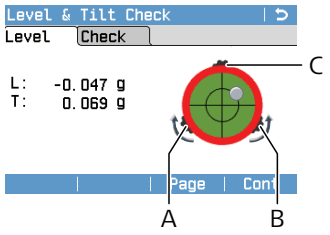
Select a Language

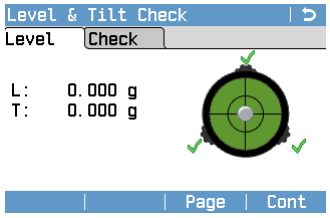
After turning on the instrument, you can choose the preferred language. The language choice screen is only shown if multiple languages are loaded onto the instrument and **Lang.Choice**: **On** is set in the instrument settings. Refer to "6.2 Regional Settings".

For LS15: Level Up with the Electronic Level Step-by-Step

The electronic level allows you to precisely level up the instrument.

Step	Description
1.	Turn on the instrument. Tap on the **Level & Tilt Check** icon. OR Press the Favourites key ★ from within any program and select **Level**.
	☞ The bubble of the electronic level and the arrows for the rotating direction of the footscrews only appear if the instrument tilt is within the sensors working range. To roughly level the instrument, centre the bubble of the circular level first. Refer to "4.3 Instrument Setup".
2.	Turn the instrument, so that the ocular is positioned above footscrew C.
3.	Turn the footscrews A and B simultaneously in opposite directions until the bubble of the electronic level is approximately on the middle axis.
	☞ When levelled correctly, check marks are displayed. If the tilt of the instrument exceeds 0.0700gon/0.0630°, the electronic level is out of its working range and therefore, the frame becomes red. Once the level is within the working range, the frame becomes black.
4.	Centre the bubble of the electronic level for the second axis by turning the footscrew C. An arrow shows the direction of rotation required.
	☞ When the bubble is centred and the check marks are displayed, the instrument has been perfectly levelled up.
5.	Accept with **Cont**.





Activating Tilt Check (only LS15)

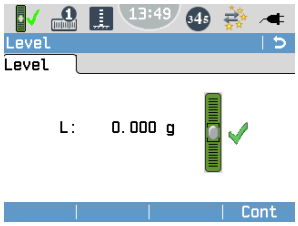
☞ If you activate the **Tilt Check** functionality, the instrument checks the longitudinal and transversal tilt before taking a measurement. If the instrument needs to be levelled again, a warning message is displayed.

To activate or deactivate the **Tilt Check** functionality, tap on the **Level & Tilt Check** icon and press the softkey **Page** (**F3**). On the **Check** page, select **On** or **Off** and press the softkey **Cont**.

For LS10: Level Up with the Electronic Level Step-by-Step

The electronic level allows you to precisely level up the instrument.

Step	Description
1.	Turn on the instrument. Tap on the **Level & Tilt Check** icon. OR Press the Favourites key ★ from within any program and select **Level**.
2.	Centre the bubble of the circular level as described in "4.3 Instrument Setup".
3.	To centre the bubble of the electronic tubular level, turn the footscrew C. ☞ When a checkmark is displayed, the instrument has been correctly levelled up.
4.	Accept with **Cont**.



4.5 Main Menu

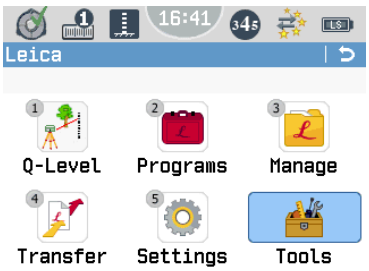
Description

The **Main Menu** is the starting place for accessing all functionality of the instrument.

☞ If desired, you can configure the instrument to start with a user-defined screen instead of the **Main Menu**. Refer to "6.1 Work Settings".

☞ For the LS15, it is recommended to define the **Compass Calib** application as starting screen. To allow the visualisation of levelling lines within the office software, the compass should be calibrated on each instrument startup.

Main Menu



Description of the Main Menu functions

Function	Description
Q-Level	**Q-Level** (Quick Level): a line levelling program to start right away. Each time you access **Q-Level**, a new Line is started and ended when you exit the application. ☞ You cannot adjust lines that are measured with the **Q-Level** application. For details refer to "7.2 Q-Level Program".
Programs	To select and start the programs **BasicLevel**, **LineLevel** and **LineAdjust**. For details refer to "7 Programs".
Manage	To manage jobs, data, codelists and formats in the internal memory as well as files stored on the USB memory stick. Refer to "12 Data Management".
Transfer	To export and import data. Refer to "12.2 Exporting Data"or "12.3 Importing Data".

Function	Description
 **Settings**	To change **Work** or **Regional** settings and to select communication parameters. To change general instrument settings such as measurement modes and interface settings. Refer to "6 Settings".
 **Tools**	To access instrument-related tools such as check and adjust, personal startup settings, PIN code settings, licence keys, system information and firmware upload. Refer to "11 Tools".

5 Measurement Guidelines

5.1 General Measurement Guidelines

General Guidelines

Selecting a Staff

The measuring accuracy depends on the staff that is used in combination with the instrument. Use standard staffs for medium range of accuracy and (calibrated) Invar levelling staffs (for example GPCL3) for highest precision.

Preparing a Measurement

- Allow the instrument to acclimatise to the ambient temperature. Wait approximately 2 minutes per °C of temperature difference.
- When working under strong sunlight with the instrument remaining on one station for a long time, for example when measuring or setting out a grid, use an umbrella to shield the instrument and the tripod.
- Keep the optics clean. Dirt or condensation on the optics can affect measurements.
- Check and adjust the instrument regularly; especially after long storage periods, after transportation or before an upcoming high precision levelling task. Refer to "13 Check & Adjust"
- Depending on the planned measurement task, set or change relevant instrument parameters, such as earth curvature correction or measurement mode.

Taking a Measurement

- Maintain approximately the same target distance for back- and foresight. At the end of a line, check if the sum of all foresights equals the sum of all backsights.
- Measure foresights and backsights. When closing a line at a known end point, check the misclosure between the measured total delta height and the delta height calculated from the difference between start and end-point height.

Taking a Precision Measurement

- Limit the target distance to ≤ 30 m.
- Ensure a minimum ground clearance of 0.5 m to minimise the influence of refractions due to ground proximity.
- Apply double observation methods, such as BFFB or aBFFB, to increase the reliability of the measurement and to reduce possible errors caused by the staff sinking.
- Apply alternating observation methods (aBFFB = BFFB FBBF) to eliminate the horizontal tilt. The horizontal tilt is the residual error of the automatic compensator.
- When taking measurements near the edge of the staff, the reduced number of staff code elements may slightly lower the measuring accuracy. To maintain highest accuracy, activate the **precision mode** in the tolerance settings of the **LineLevel** program. When activated, the instrument monitors whether the height reading is within 0.50 m to either end of the staff (top and bottom). The top and bottom limits of the staff are automatically converted to a 3 m Invar staff. In order to use different staff sizes, you can manually adjust the limit values.
  The precision mode also monitors critical distances between the instrument and the staff. These distances depend on the physical properties of the staff code. 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: 13.250 m - 13.500 m and 26.650 m - 26.900 m. If the instrument detects a staff distance within these ranges, slightly move the staff out of the mentioned measurement range in order to maintain highest measurement accuracy expectations.

Visual Control of the Staff

When looking through the telescope, e.g. for visual control while taking a measurement, a low intensity red blinking LED light may be visible, especially when measuring in low light surrounding. This LED light is used in the illumination of the compensator and has no impact on the eye safety of the user.

5.2 Guidelines for Special Measurement Situations

Special Measurement Situations

Vibrations

Touch the upper third of the tripod to reduce the vibrations at the instrument, for example caused by wind.

Back light

Low sunlight may influence the ability of the instrument to read the staff. Use the sunshade delivered with the instrument to shield the objective.

Darkness

When working in darkness (for example tunnelling), evenly illuminate the measuring area of the staff with a flashlight or a spotlight or use a special self-illuminated staff (for example Nedo Lumiscale).

Measuring at the lower end of the staff

Measurements slightly below the zero point of a staff are possible and will result in negative measurement values.

Measuring at the upper end of the staff

When measuring at the upper end of the staff, use staffs with the following lengths:

- 4.05 m
- 2.95 m
- 2.70 m
- 1.95 m
- 1.82 m

With other staff lengths, measurements at the upper end of the staff are not possible.

Code length required in the field of view

☞ For exact measurements, the centre 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 to the staff.

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

Shade

Normally, shade patterns on the staff do not affect the measurement results. However, avoid dark shade, as it can have the same effect as an interfering cover on the field of view.

Focus

A slightly unfocused image does not influence the measuring time and the accuracy. When large focus errors occur, the instrument stops the measurement. On LS15 instruments, the **Autofocus** routine is based on the maximum contrast of code on the instruments sensor. If the reticle is not adjusted to the eyesight of the user, this may lead to the impression of an incomplete auto focussing. For details on how to adjust the reticle to the eyesight, refer to "4.3 Instrument Setup".

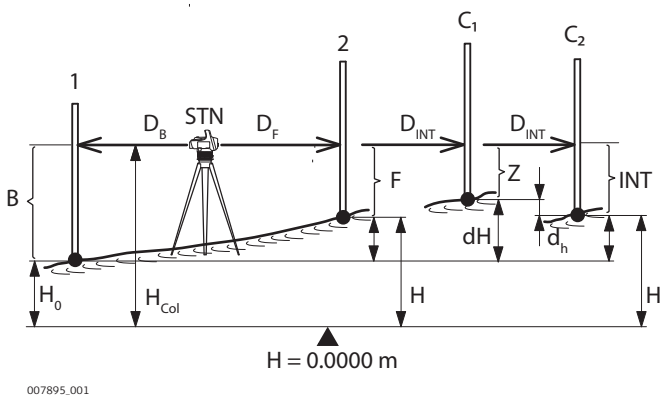
Measuring through window panes

Avoid measuring through window panes.

Precision mode for line levelling
If a line levelling job requires high accuracy, activate the precision mode. Refer to "7.4.3 Setting Tolerances".

5.3 Guidelines for Taking a Measurement

Measurement Values

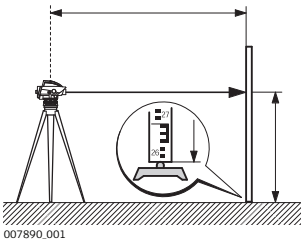


STN	Station
1	Staff 1 (backsight staff)
2	Staff 2 (foresight staff)
C_1/C_2	Staff C_1 and C_2 for intermediate or set-out sight
B	Staff height backsight. For double observations: B1, B2
F	Staff height foresight. For double observations: F1, F2
INT	Staff height intermediate sight or set-out sight
D_B	Backsight distance
D_F	Foresight distance
D_{Int}	Intermediate sight distance / Set-out distance
H_0	Height of starting point, for example, as height above sea level
H	Height of foresight point / intermediate point
dH	Height difference between backsight and foresight / intermediate sight / set-out sight
d_h	Sequential height difference between two measurements taken in sequence (foresight / intermediate sight / set-out sight)
H_{Col}	Instrument horizon (height of line of sight)

Principle of Electronic Height Readings

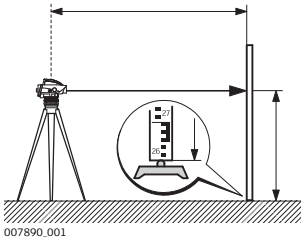
The bar code of the staff is stored in the instrument as a reference signal. When measuring, the line decoder captures the visible section of the staff within the field of view as a measuring signal. The instrument compares the measuring signal to the reference signal and as a result displays the height of the staff and the horizontal distance.
The sensitivity of the sensor ranges from the highest frequencies of visible light down to the frequency of infrared light.

Electronic Height Reading with LS10 Instrument

Step	Description
	
1.	Set up the instrument, level it and focus the reticle.
2.	Set up staff vertically with the bar code turned toward the instrument.
3.	Coarsely aim at staff.
4.	Focus with focussing drive.
5.	Fine aim with horizontal drive.
6.	Check if the bubble of the circular level is centred.
7.	Open a levelling application and press the trigger key to take a measurement.

☞ In some cases you may not be able to perform an electronic height reading, e.g. there are obstacles in the line of sight or there is no overhead clearance for the staff. In such cases, you can take an optical height reading and add it to the levelling line. For more details, refer to "5.4 Manual Input Screen for Optical Height Reading".

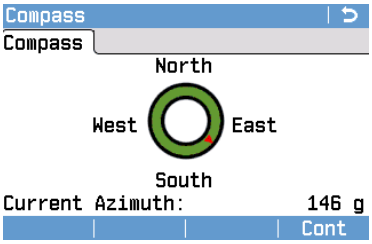
Electronic Height Reading with LS15 Instrument

Step	Description
	
1.	Set up the instrument, level it and focus the reticle.
2.	Set up staff vertically with the bar code turned toward the instrument.
3.	Access **Q-Level** and level the instrument using the electronic level.
4.	Switch to the **Camera** tab. To align the camera crosshair (vertically arranged cursors) in the camera view to the staff, turn the horizontal drive of the instrument.
5.	To focus the staff automatically, either press the softkey **Focus** or ensure that the function **AF+Dist+Rec** or **AF+Dist** is assigned to the trigger key (for more details refer to "6.1 Work Settings").
6.	Press the trigger key to take a measurement.

☞ In case you cannot perform an electronic height reading, you can take an optical height reading and add it to the levelling line. For more details, refer to "5.4 Manual Input Screen for Optical Height Reading".

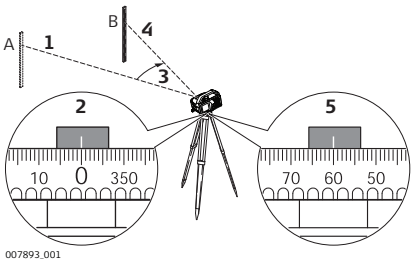
Angle Measurement with Digital Compass (only LS15)

☞ It is recommended to perform a compass calibration before taking an angle measurement. Refer to "13.6 Calibrating the Digital Compass".

Step	Description
1.	To access the digital compass, select **Tools** from the main menu, then **Compass**.
2.	Within the **Compass** screen, the red arrow of the digital compass shows the current viewing direction of the instrument. In the output field **Current Azimuth**, the exact angle in reference to north is displayed.  The LS15 instrument uses the digital compass to calculate the coordinates of a measured point. Together with the office software Leica Infinity, these coordinates can be used to visualise the position of a levelling line.

Angle Measurement with Horizontal Circle

Both the LS10 and LS15 are equipped with a rotatable horizontal circle. The angle unit is 360° subdivided into 1° intervals. The gon division is printed in steps of 50 gon below the 360° division.



Step	Description
1.	Align instrument to point A.
2.	Turn Hz-circle to “0”.
3.	Align instrument to point B.
4.	Aim on the centre of the staff.
5.	Read off Hz-angle from Hz circle. In this example the Hz-angle is 60°.

Access

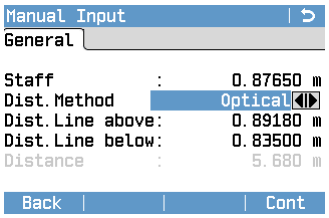
☞ The **Manual Input** screen can only be accessed from within a levelling application.

1. Press the Favourites key. ★
2. Change to the **Apps** tab.
3. Select **Man.Input**.

Description

If electronic height readings are not possible, you can perform an optical height reading and use the **Manual Input** screen to enter the measured data manually. With the left and right navigation keys select one of the desired distance methods:

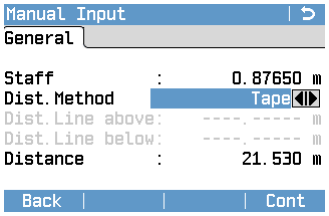
Distance Method Optical



Perform an optical height reading and enter the values for the staff height and for the heights of the distance line above and below. The instrument automatically calculates the distance based on the entered staff section and the multiplication constant 100.

Press **Cont** to add the entered data to the current levelling line.

Distance Method Tape



Perform an optical height reading and measure the distance with a tape.

Enter the values for the staff height and for the distance.

Press **Cont** to add the entered data to the current levelling line.

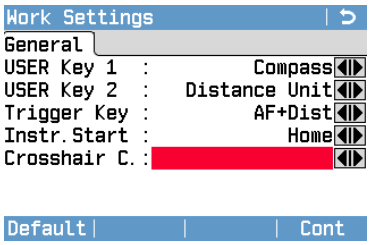
6 Settings

6.1 Work Settings

Access

1. Select **Settings** from the **Main Menu**.
2. Select **Work** from the **Settings Menu**.

Work Settings

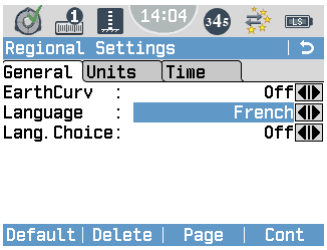


Field	Description
USER Key 1, **USER Key 2**	You can assign one of the following functions to both keys: • **Level** • **Distance Unit** • **Home** • **PIN** • **Touch** • **Manual Input** • **PtID Incr** • **Screenshot** • **Compass** (only LS15)
Trigger Key	You can assign one of the following functions to the trigger key: • **Dist**: The staff reading and distance are measured. • **Dist+Rec**: The staff reading and distance are measured and stored. • **AF+Dist** (only LS15): Focussing is done automatically and the staff reading and distance are measured. • **AF+Dist+Rec** (only LS15): Focussing is done automatically, the staff reading and distance are measured and stored.
Instr.Start	The start screen is displayed after turning on the instrument. You can define one of the following screens as start screen: • **Home** (Main Menu) • **Compass Calib** (only LS15) • **Level Bubble** • **Q-Level** • **BasicLevel** • **LineLevel**
Crosshair C. (only LS15)	You can define one of the following colours for the camera crosshair (vertically arranged indicators): • Purple • Blue • Yellow • Green • Black • Red

Access

1. Select **Settings** from the **Main Menu**.
2. Select **Regional** from the **Settings Menu**.
3. Press **Page** (F3) or the Page key to scroll through the screens of available settings or click directly on the desired tab.

Regional Settings

Field	Description
Tab **General**	
EarthCurv	You can activate or deactivate the earth curvature correction. If the earth curvature correction is on, electronically measured or manually entered staff heights are automatically corrected regarding the curvature of the earth. ☞ If you start the **Check & Adjust** application, the earth curvature correction is automatically set to **On**. As soon as you exit the application, the earth curvature correction is set back to the previous setting.
Language	You can select your preferred language. Several languages can be uploaded onto the instrument. The current loaded languages are displayed. **Deleting a language:** If more than one language is installed, you can delete a language, as long as it is not the chosen operating language. To delete an inactive language, select the language and press **Delete**. 
Lang.Choice	The language screen allows you to choose the language of the user interface. If you activate the language screen it is displayed directly after switching on the instrument. **On** The language screen is displayed as the startup screen. **Off** The language screen is not displayed as the startup screen.
Tab **Units**	
Dist. Unit	Sets the units shown for all distance and coordinate related fields. **Meter** Meter [m]. **US-ft** US Survey feet [ft]. **INT-ft** International feet [fi].
Azimuth Unit	Sets the units displayed for all angular fields. You can choose between **gon** and **dec. deg**.

Field	Description	
E,N Decimal	Sets the number of decimal places displayed for all East and North coordinates and for all input/output fields.	
	0	Displays East and North with no decimals.
	1	Displays East and North with one decimal.
	2	Displays East and North with two decimals.
H Decimal	Sets the number of decimal places displayed for all height coordinates and for all input/output fields.	
	3	Displays height with three decimals.
	4	Displays height with four decimals.
	5	Displays height with five decimals.
D Decimal	Sets the number of decimal places displayed for all distance input/output fields.	
	1	Displays distance with one decimal.
	2	Displays distance with two decimals.
	3	Displays distance with three decimals.
Temp. Unit	Sets the units shown for all temperature fields.	
	°C	Degree Celsius.
	°F	Degree Fahrenheit.
Tab **Time**		
Time (24h)	The current time.	
Date	Shows an example of the selected date format.	
Format	**dd.mm.yyyy**, **mm.dd.yyyy** or **yyyy.mm.dd**	You can choose between three display formats for all date-related fields: day-month-year, month-day-year or year-month-day.

6.3 Data Settings

Description

In the **Data Settings** screen, you can define different options for measurement data, such as sort order of points within point search or location for data storage.

Access

1. Select **Settings** from the **Main Menu**.
2. Select **Data** from the **Settings Menu**.
3. Press the page key to scroll through the screens of available settings.

Data Settings

Field	Description	
Record		
Sort Type	**Time**	Lists are sorted by time of entry.
	PtID	Lists are sorted by Point IDs.
Sort Order	**Descending**	Lists are ordered in descending order of sort type.
	Ascending	Lists are ordered in ascending order of sort type.
Code Record	Defines whether the code block is saved before or after the measurement. Refer to "9 Coding".	

Field	Description	
Code	Defines whether the code is used for one or for many measurements.	
	Reset after Rec	The set code is cleared from the measurement screen after the measurement has been recorded. The code is only applied to this single measurement.
	Permanent	The set code remains in the measurement screen until you delete it manually. The code is applied to all further measurements.
Output		
Data Output	Sets the location for data storage.	
	Internal Memory	All data is recorded in the internal memory.
	Interface	All recorded data is sent to a connected computer, either through Bluetooth or serial interface. Select the respective interface in the **Interface Settings** screen
GSI-Format	Sets the GSI output format.	
	GSI 8	81..00+12345678
	GSI 16	81..00+1234567890123456

6.4 Screen & Audio Settings

Access

1. Select **Settings** from the **Main Menu**.
2. Select **Screen...** from the **Settings Menu**.
3. Press the page key to scroll through the screens of available settings.

Screen & Audio Settings

Field	Description	
Display Ill.	**20%** to **100%**	Sets the display illumination in steps of 20%.
Touch Screen	**On**	The touchscreen is activated.
	Off	The touchscreen is deactivated.
	☞	To calibrate the touchscreen, press **Calib.**. Follow the instructions on the screen. To abort the calibration routine, press the **ESC** key.
Auto-Off	**Enable**	The instrument switches off after 20 minutes without any activity.
	Disable	The automatic switch-off function is deactivated. ☞ Battery discharges quicker.
	Standby	The instrument switches to standby mode after 5 minutes without any activity.

Field	Description	
Beep	The beep is an acoustic signal and is used in the following three variations: **Single beep:** sounds as input confirmation after a key stroke or a touchscreen event. **Triple beep:** sounds when an error message is displayed or when a function is not allowed. **Long beep:** sounds after a measurement has been stored. You can set the volume of the beep.	
	Normal	Normal volume.
	Loud	Increased volume.
	Off	Beep is deactivated.
Screensaver	**after 1 min**, **after 2 min**, **after 5 min**, **after 10 min**	The screensaver is activated and starts after the selected time.
	Off	The screensaver is deactivated.

6.5 Mode Settings

Description

In the **Mode Settings** screen you can select different measurement modes for single or multiple measurements.
Multiple measurements: The instrument automatically carries out several measurements in sequence until one of the following criteria is met:

- The defined number of measurements is reached.
- A terminating criterion is met.
- The procedure is terminated.

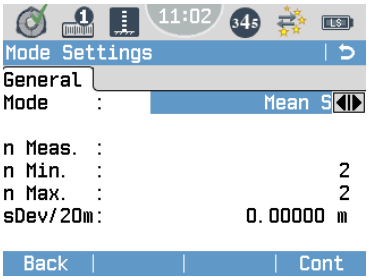
For all multiple measurement modes, the instrument stores the average measurement values according to the mean or median selection and all individual measurements contributing to this average.

Access

1. Select **Settings** from the **Main Menu**.
2. Select **Mode** from the **Settings Menu**.

To quickly access the **Mode Settings** screen from within a program, tap on the status icon.

Mode Settings



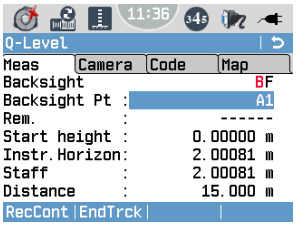
Mode
To select a mode setting.

n Meas.
Only available for **Mean** or **Median**.
To set a number of measurements.

n Min.
Only available for **Mean S**.
To set a minimum number of measurements.

n Max.
Only available for **Mean S**.
To set a maximum number of measurements.

sDev/20m
Only available for **Mean S**.
To set a maximum standard deviation of the average value at 20 m.

Field	Description
Single	The instrument carries out a single measurement (n = 1).
Mean	Enter the number of measurements to be made (n = 2...99). The instrument calculates the average of all measurements.
Mean S	Enter a minimum and a maximum number of measurements (n = 2...99) and a maximum standard deviation. Starting with the minimum number of measurements, the instrument checks if the measured standard deviation is less or larger than the entered maximum standard deviation. • If the deviation is less or equal, the instrument stops measuring. • If the deviation is larger, the instrument continues measuring until the maximum number of measurements is reached. At each step, the instrument checks whether the maximum standard deviation can be reached by eliminating outliers. **Example:** Measured distance = 60 m, sDevM/20 m = 0.0007 m, S = sDevM/60 m = 0.0021 m The maximum allowable standard deviation at 60 m is 0.0021 m. ☞ For **n Min.** = **n Max.**, no measurements are discarded by the outlier test.
Median	Enter the number of measurements to be made (n = 2...99). • Uneven number of measurements: The instrument calculates the Median of all measurements by using the central value. • Even number of measurements: The instrument calculates the Median of all measurements by using the two central values.
Tracking	The instrument continuously takes single measurements until you end the procedure.  Press **RecCont** to save the last valid measurement data. Press **EndTrck** to stop the measurements without saving data.

6.6 Interface Settings

Description

For data transfer, you need to set the communication parameters of the instrument:

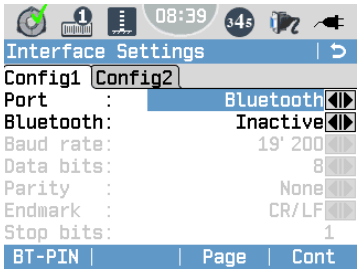
- For serial data communication (e.g. Data import/export, GSI/Geocom commanding), select either **RS232** (only LS15) or **Bluetooth**.
- For file transfer communication (Active Sync/Mobile Device Centre), select **Mini USB** or **Lemo USB** (only LS15).

☞ For USB connections, serial communication is not supported.

Access

1. Select **Settings** from the **Main Menu**.
2. Select **Interface** from the **Settings Menu**.

Interface Settings



BT-PIN

To set a PIN code for the Bluetooth connection.

☞ The default Bluetooth PIN is '0000'.

Default

To reset the fields to the default interface settings. Available, if **RS232** is selected as instrument port.

For LS10:

Field	Description	
Port :	Instrument port.	
	Mini USB	Communication is via the Mini-USB port.
	Bluetooth	Communication is via Bluetooth.
Bluetooth:	**Active**	Bluetooth sensor is activated.
	Inactive	Bluetooth sensor is deactivated.

For LS15:

Field	Description	
Port :	Instrument port.	
	Mini USB	Communication is via the Mini-USB port.
	Bluetooth	Communication is via Bluetooth.
	RS232	Communication is via the serial interface.
	Lemo USB	Communication is via the Lemo-USB port.
Bluetooth:	**Active**	Bluetooth sensor is activated.
	Inactive	Bluetooth sensor is deactivated.
The following fields are active only when **Port : RS232** is set.		
Baud rate:	Speed of data transfer from receiver to device in bits per second.	
	1'200, **2'400**, **4'800**, **9'600**, **14'400**, **19'200**, **38'400**, **57'600**, **115'200**	
Data bits:	Number of bits in a block of digital data.	
	7	Data transfer is realised with seven data bits.
	8	Data transfer is realised with eight data bits.
Parity :	**Even**	Even parity. Available if data bit is set to 7.
	Odd	Odd parity. Available if data bit is set to 7.

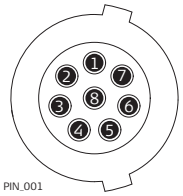
Field	Description	
	None	No parity. Available if data bit is set to 8.
Endmark :	**CR/LF**	The terminator is a carriage return followed by a line feed.
	CR	The terminator is a carriage return.
Stop bits: 1		Number of bits at the end of a block of digital data.
Acknowlge:	**On**	Acknowledgement expected from other device after data transfer received. If no acknowledgement is returned, an error message displays.
	Off	No acknowledgement expected after data transfer.
	☞	For **Mean**, **Mean S** and **Median**, you only have to send the acknowledgement character "?" after the mean/median value is received, not for the individual measurement generating this mean/median value.

Leica RS232 Default Settings

When you select **Default**, the communication parameters are reset to the Leica RS232 default settings:

- 115200 Baud, 8 Databit, No Parity, CR/LF Endmark, 1 Stopbit.

Pin Assignments (only LS15)



Pin	Signal Name	Function	Direction
1	USB_D+	USB data line	In or out
2	USB_D-	USB data line	In or out
3	GND	Signal ground	-
4	RxD	RS232, receive data	In
5	TxD	RS232, transmit data	Out
6	ID	Identification pin	In or out
7	PWR	Power input, nominal +12 V (11 V - 16 V)	In
8	NC	Not connected	-

7 Programs

7.1 General

7.1.1 Common Fields

Description of Fields

The following table describes common fields that are found within the programs.

Field	Description
PtID	Point ID of the point.
Backsight Pt / **PtBS**	Point ID of backsight point.
Foresight Pt	Point ID of foresight point.
Start height / **Start H**	Height of starting point.
Height BS	Height of backsight point.
Height FS	Height of foresight point.
Total dH	Sum of the height differences determined between the first backsight and the current foresight/backsight observation of this line.
Instr.Horizon	Instrument horizon: Height of line of sight.
Staff	Height reading on staff.
Distance	Distance between instrument and staff
Total Dist	Sum of the distances measured between the first backsight and the current foresight/backsight observation of this line.
Dist.Balance	Difference between the sum of all foresight distances and the sum of all backsight distances. For high precision line levelling, the distance balance at the end of the line should be close to zero.
Stat.ID	ID of current instrument station.
Rem. / **Remark** / **Code**	Remark (Rem.) or Code name depending on the selected method. • Remark: This text is an additional information stored to the corresponding measurement. • Code: Within the **Code** tab, highlight a code from the code list. The highlighted code is added to the measurement that is stored next. For details on adding or editing a code refer to "9 Coding".
East	Easting coordinate of the point.
North	Northing coordinate of the point.
Height	Height coordinate of the point.

7.1.2 Pointsearch

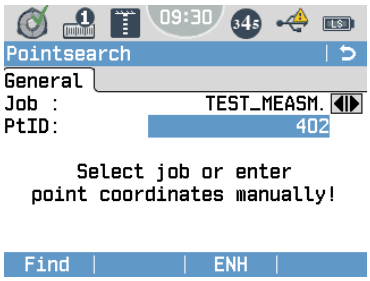
Description

Pointsearch is a function used by programs to find measured points or fixpoints in the memory storage.
It is possible to limit the point search to a particular job or to search the whole storage. The search procedure always finds fixpoints before measured points that fulfil the same search criteria. If several points meet the search criteria, then the results are ordered according to the entry date. The instrument finds the most recent fixpoint first.

Direct Search

You can search directly for fixpoints by entering a specific point ID:
1) Select a specific job or the option **All Jobs**.
2) Enter a specific point ID and press the **ENTER** key.
3) Press **Find** to start the point search.

All points within the selected job and with the corresponding point ID are found. Use the Navigation keys to toggle through the found point IDs.



Find
To search for matching points within the selected job.

ENH
To create a point and enter its coordinates.

Wildcard search

The wildcard search is indicated by a "*". The asterisk is a place holder for any following sequence of characters. Wildcards should be used if the point number is not fully known, or to search for a batch of points.

Examples of point searches

*	All points are found.
A	All points with exactly the point number "A" are found.
A*	All points starting with "A" are found, for example, A9, A15, ABCD, A2A.
*1	All points containing only one "1" are found, for example, 1, A1, AB1.
A*1	All points starting with "A" and containing only one "1" are found, for example, A1, AB1, A51.

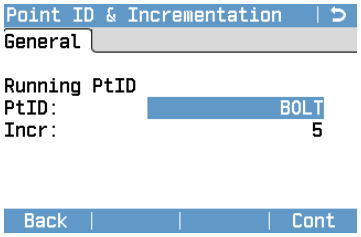
7.1.3 Point ID & Incrementation

Access

1. Press the Favourites key. ★
2. Within the page **Setting**, tab **PtID Incr**.

Define a Default Point ID and Incrementation

Within the **Point ID & Incrementation** screen, you can define a default point ID for the points measured with the levelling applications. You can also define the increment by which the point IDs are automatically incremented.



PtID:: Enter a point ID with 16 characters maximum. The point ID can consist of numeric and alphanumeric characters. If the point ID ends with an alphanumeric character, the suffix "01" is added automatically after returning to one of the levelling applications.

Incr:: Enter an increment of maximum 9999. This input field is limited to four numeric characters.

7.2 Q-Level Program

7.2.1 General

Description

The **Q-Level** program allows you to carry out a basic line levelling task using the BF method. Each time you access **Q-Level**, a new Line is started and ended when you exit the application. Use this program, if you immediately want to start measuring after switching on and setting up the instrument.

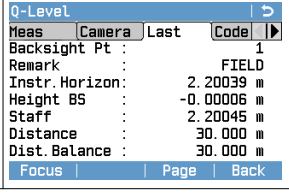
☞ You cannot adjust lines that are measured with the **Q-Level** application.

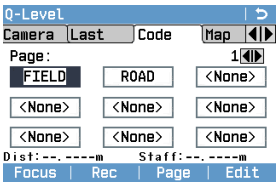
Access

Select **Q-Level** from the **Main Menu**.

Available Pages within the Q-Level Program

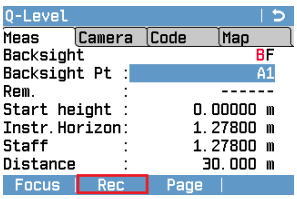
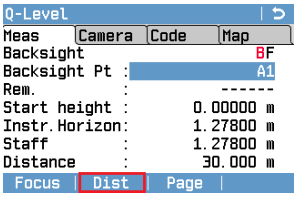
☞ Use the Page key or the softkey **Page** (**F3**) to toggle between the different pages.

Page	Description
Meas	This page displays the input/output fields for the current measurement. For more details refer to "7.2.2 Measurement Procedure for Q-Level".
Camera (only LS15)	This page displays the image of the overview camera. Use the **Camera** page to quickly aim at the staff.
Last	 This page is only available after the first measurement has been stored. The values of the last measurement are displayed.

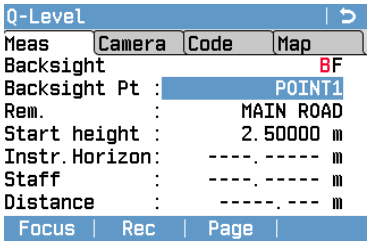
Page	Description
Code	 This page contains a list of codes. Highlight a code to add it to the next measurement. Press **Edit** to edit the selected code in the **Manage Codes** screen. For more details on managing codes, refer to "9 Coding".
Map (only LS15)	This page displays a graphical overview over the last five instrument stations and the related measurements. For more details refer to "10 MapView".

7.2.2 Measurement Procedure for Q-Level

Measurement Procedure

Step	Description
☞	The first screen allows you to measure the first backsight, which is the starting point of the line.
1.	Enter the height of the starting point manually or search for an already stored fixpoint or adjusted point in the current job.
2.	Measure the first backsight: Aim at the staff and press the trigger key. Depending on the setting of the trigger key, the measurement is executed with or without storing the measured values.  **Backsight/Foresight**: The current viewing direction is highlighted in red. If the trigger key is set to **Dist** or **AF+Dist** (only LS15), press **Rec** (**F2** softkey) to store the measurement.  If the trigger key is set to **Dist+Rec** or **AF+Dist+Rec** (only LS15), press **Dist** (**F2** softkey) to take a measurement without storing it; e.g. in order to verify the correct distance of a foresight staff before the actual measurement.
3.	After storing the measurement of the first backsight, the foresight screen is displayed. Before measuring a foresight, you can measure intermediate points or set out heights, height differences and distances.
4.	Measure the foresight. The procedure for aiming and measuring is the same as described for the first backsight.
5.	After storing the measurement of the foresight, the next backsight screen is displayed. You can continue to measure backsight and foresight points.

Starting Screen (First Backsight)



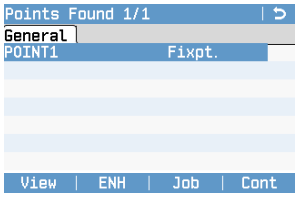
Focus

To automatically focus the telescope (only LS15).

Rec

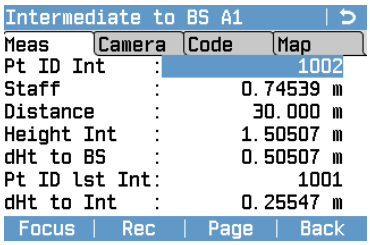
To save the measured values and switch to the foresight screen.

Before measuring the first backsight point, you can edit the following fields:

Backsight Pt	ID of the starting point (first backsight). Default value is “A1”. To search for fixpoints, enter a start point ID and confirm with the ENTER key. For more details on pointsearch refer to "7.1.2 Pointsearch".  If one or more fixpoints with this ID are already stored in the current job, all available fixpoints are displayed in the **Points Found** screen. Select the desired fixpoint and press **Cont** to return to the first backsight screen.
Rem.	Additional Remarks concerning the measurement (optional).
Start height	Height of the starting point. Default value is 0.00000 m. If you select an already stored fixpoint as starting point, the field **Start height** is automatically set to the height of the fixpoint.

Survey Intermediate Points

To switch to the **INT to BS** display, press ⬇ and the **INT** softkey.



Back

To exit INT to BS and return to the foresight/backsight display.

Before taking a measurement:

Pt ID Int — You can enter the point ID of the intermediate point. Default value is 1001. The point ID is incremented after each measurement.

After taking a measurement:

Staff — The staff reading of the currently measured point.

Distance — The distance between the instrument and the intermediate point.

Height Int — The height of the currently measured intermediate point.

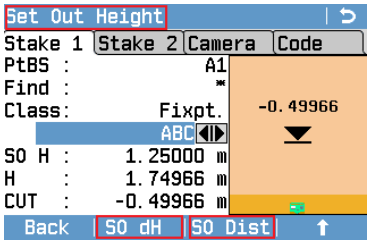
dHt to BS — The height difference between the currently measured point and the last backsight point.

Pt ID lst Int — The point ID of the last intermediate point. When measuring the first intermediate point, this field remains empty.

dHt to Int — The height difference between the last intermediate point and the currently measured intermediate point. When measuring the first intermediate point, this field remains empty.

SetOut Application

With the **SetOut** application, you can set out heights, height differences or distances.
To access the application, press ⬇ and the **SetOut** softkey.
The **Set Out Height** screen is displayed first. From this screen, you can access the screens for setting out height differences or distances.



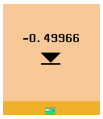
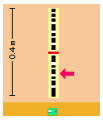
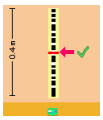
⬇Softkey
To display further softkeys.

SO dH
To display the **Set Out dH** screen.

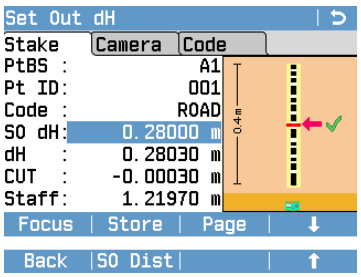
SO Dist
To display the **Set Out Distance** screen.

Back
To exit SetOut and return to the fore-sight/backsight display.

Set Out Heights Step-by-Step

Step	Description
☞	Before you set out height values, ensure that these heights are stored as fixpoints in the current job.
1.	To load a fixpoint, enter the ID of the point in the field **Find** and press the **ENTER** key. Select the desired fixpoint from the list and press **Cont**. You can also use the left and right navigation keys to toggle through the list of available points. **Class**: Displays the type of the selected point (**AdjPt.**, Fixpt., **Meas.**). **SO H**: Height value of the selected fixpoint. This value is used as the set-out height.
2.	Press the trigger key to take a measurement.
3.	Display field **H**: Measured height value. Depending on the difference between set-out height and measured height, the following fields and graphical elements are displayed:
	FILL :: Difference between measured height and set-out height (positive value). The staff is too low. **CUT :**: Difference between measured height and set-out height (negative value). The staff is too high.  When the difference is greater than 0.2 m, a black arrow indicates whether the measured height is above or below the set-out height.
	 When the difference is less than 0.2 m, a red arrow indicates whether the measured height is above or below the set-out height.
	 When the difference is less than 0.01 m, a green checkmark is displayed.
4.	Raise or lower the staff according to the displayed value and take a new measurement. Repeat this step until the measured height corresponds to the set-out height.

Set Out Height Differences Step-by-Step

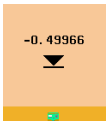
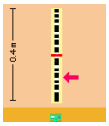
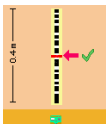


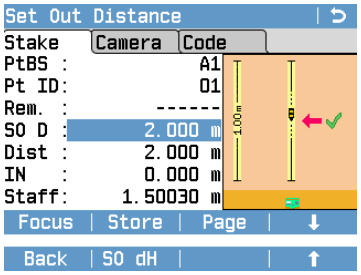
Back

To exit **Set Out dH** and return to the **Set Out Height** screen.

SO Dist

To display the **Set Out Distance** screen.

Step	Description
1.	Enter the necessary data. **Pt ID**: If desired, you can change the point ID. Default value is 1001. The point ID is incremented after each measurement. **Rem.**: If desired, enter a remark. When you enter a code, the field name changes to **Code**. **SO dH**: Enter the height difference that needs to be set out.
2.	Press the trigger key to take a measurement.
3.	Display field **dH**: Measured height difference. Depending on the difference between entered and measured height difference, the following fields and graphical elements are displayed:
	FILL :: Difference from entered height difference (positive value). The staff is too low. **CUT :**: Difference from entered height difference (negative value). The staff is too high.  When the difference is greater than 0.2 m, a black arrow indicates whether the measured height difference is above or below the entered value.
	 When the difference is less than 0.2 m, a red arrow indicates whether the measured height difference is above or below the entered value.
	 When the difference is less than 0.01 m, a green checkmark is displayed.
4.	Raise or lower the staff according to the displayed value and take a new measurement. Repeat this step until the measured height difference corresponds to the entered height difference.

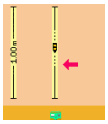
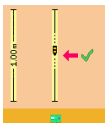


Back

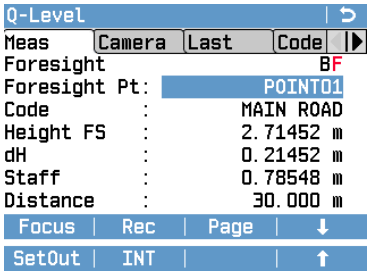
To exit **Set Out dH** and return to the **Set Out Height** screen.

SO dH

To display the **Set Out dH** screen.

Step	Description
1.	Enter the necessary data. **Pt ID**: If desired, you can change the point ID. Default value is 1001. The point ID is incremented after each measurement. **Rem.**: If desired, enter a remark. When you enter a code, the field name changes to **Code**. **SO D**: Enter the distance that needs to be set out.
2.	Press the trigger key to take a measurement.
3.	Display field **Dist**: Measured distance. Depending on the difference between entered and measured distance, the following fields and graphical elements are displayed:
	OUT :: Difference from entered distance (positive value). The distance between instrument and staff is too small. **IN :**: Difference from entered distance (negative value). The distance between instrument and staff is too big.  When the difference is greater than 0.5 m, a black arrow indicates whether the measured distance is too small or too big.
	 When the difference is less than 0.5 m, a red arrow indicates whether the measured distance is smaller or greater than the entered value.
	 When the difference is less than 0.03 m, a green checkmark is displayed.
4.	Move the staff according to the displayed value and take a new measurement. Repeat this step until the measured distance corresponds to the entered distance.

Foresight Display



Focus
To automatically focus the telescope (only LS15).

Rec
To save the measured values and switch to the backsight screen.

SetOut
To switch to the **Set Out Height** screen.

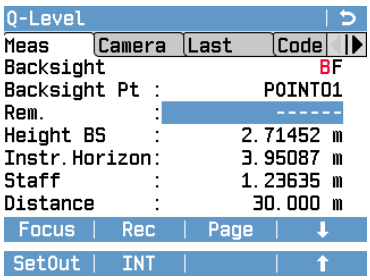
INT
To survey intermediate points.

Before measuring the foresight point, you can edit the following fields:

Foresight Pt	The default value is 1. You can enter a point ID or change the default value in the **Point ID & Incrementation** screen. The ID of the foresight point is incremented automatically according to the definitions of the **Point ID & Incrementation** screen (refer to " Define a Default Point ID and Incrementation").
Rem.	Additional Remarks concerning the measurement (optional).

Press the trigger key to measure the foresight point. The measured values are displayed in the fields **Height FS**, **dH**, **Staff** and **Distance**.

Backsight Display



Focus
To automatically focus the telescope (only LS15).

Rec
To save the measured values and switch to the foresight screen.

SetOut
To switch to the **Set Out Height** screen.

INT
To survey intermediate points.

Before measuring the backsight point, you can edit the field **Rem.** to enter a remark concerning the measurement.

Press the trigger key to measure the backsight point. The measured values are displayed in the fields **Instr.Horizon**, **Staff** and **Distance**.

7.3 BasicLevel Program

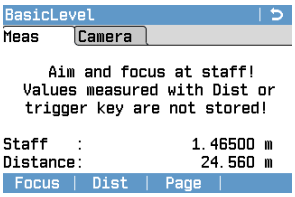
Description

The **BasicLevel** program allows you to take an unlimited number of single or multiple measurements without storing the data. The program is intended for general levelling purposes.

Access

1. Select **Programs** from the **Main Menu**.
2. Select **BasicLevel** from the **Programs Menu**.

Available Pages within the BasicLevel Program

Page	Description
Meas	 This page displays the output fields for the current measurement. To take a measurement, tap **Dist** or press the trigger key.
Camera (only LS15)	This page displays the image of the overview camera. Use the **Camera** page to quickly aim at the staff.

7.4 LineLevel Program

7.4.1 General

Description

The **LineLevel** program allows you to make detailed preferences before carrying out a line levelling task:

- Setting a job
- Setting tolerances
- Setting a line and a measurement method

Lines measured within the **LineLevel** program can be adjusted later on with the integrated **LineAdjust** program.

Access

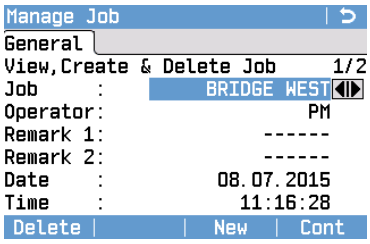
1. Select **Programs** from the **Main Menu**.
2. Select **LineLevel** from the **Programs Menu**.
3. - To set a job, press **F1**.
   - To set tolerances, press **F2**.
   - To set a line and a method and start the levelling, press **F4**.

7.4.2 Setting a Job

Description

All data is saved in Jobs, like file directories. Jobs contain measurement data of different types, for example measurements, codes, fixpoints or stations. Jobs are individually manageable and can be exported, edited or deleted separately.

Select Job



Delete
To delete an existing job.

New
To create a job.

Field	Description
Job	Name of an existing job.
Operator	Name of operator (optional).
Remark 1, **Remark 2**	Additional remarks (optional).
Date	Date on which the selected job was created.
Time	Time at which the selected job was created.

How to Set an Existing Job

- Use the navigation keys to select an existing job.
- To continue with the selected job, press **Cont**.

How to Create and Set a New Job

- Press **New** to open the **Enter Job Data** screen.
- Enter the required job data.
- To return without saving the entered data, press **Back**.
- To save the entered job data and return to the previous screen, press **Cont**.
- To continue with the created job, press **Cont**.

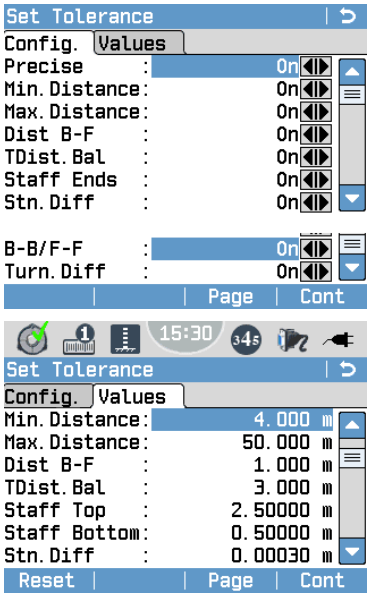
☞ Once you saved the entered job data, you cannot change it anymore.

Recorded Data

Once a job is set up, all subsequent recorded data will be stored in this job.

☞ If no job is defined and you start a program, or if you record a measurement within **Q-Level**, the system automatically creates a new job and names it "Default".

Set Tolerance



☞ To select an item of the list and to activate or deactivate the selected item, use the **navigation keys**.

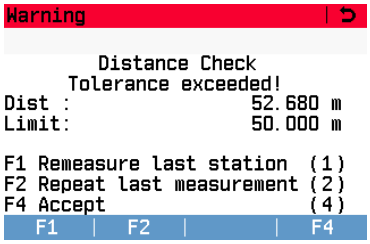
Reset

To reset tolerances to default values.

Field	Description
Precise :	When taking measurements near the edge of the staff, the reduced number of staff code elements may slightly lower the measuring accuracy. If **Precise :** is activated, the instrument monitors whether the height reading is within 0.50 m to either end of the staff (top and bottom). The top and bottom limits of the staff are automatically converted to a 3 m Invar staff. In order to use different staff lengths, you can manually adjust the limit values. The precision mode also monitors critical distances between the instrument and the staff. These distances depend on the physical properties of the staff code. 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: 13.250 m - 13.500 m and 26.650 m - 26.900 m. If the instrument detects a staff distance within these ranges, slightly move the staff out of the mentioned measurement range in order to maintain highest measurement accuracy expectations.
Min.Distance:	If activated, the instrument monitors the minimum target distance. If the tolerance is exceeded, a warning message is displayed. For a detailed description of the warning message, refer to the next paragraph " Warning Message “Tolerance exceeded!”". Change to the **Values** screen, to enter a value for the minimum target distance.
Max.Distance:	If activated, the instrument monitors the maximum target distance. If the tolerance is exceeded, a warning message is displayed. For a detailed description of the warning message, refer to the next paragraph " Warning Message “Tolerance exceeded!”". Change to the **Values** screen, to enter a value for the maximum target distance.

Field	Description
Dist B-F :	Only available for double observation levelling methods such as **BFFB**. If activated, the instrument monitors the distance balance between foresight and backsight distance on the current station. If the tolerance is exceeded, a warning message is displayed. For a detailed description of the warning message, refer to the next paragraph " Warning Message “Tolerance exceeded!”". Change to the **Values** screen, to enter a value for the distance balance.
TDist.Bal :	If activated, the instrument monitors the total distance balance between foresight and backsight distances. If the tolerance is exceeded, a warning message is displayed. For a detailed description of the warning message, refer to the next paragraph " Warning Message “Tolerance exceeded!”". Change to the **Values** screen, to enter a value for the distance balance.
Staff Ends :	If activated, the instrument monitors whether a measurement is within the staff end zones. If the tolerance is exceeded, a warning message is displayed. For a detailed description of the warning message, refer to the next paragraph " Warning Message “Tolerance exceeded!”". Change to the **Values** screen, to enter values for **Staff Top** and **Staff Bottom**.
Stn.Diff :	If activated, the instrument monitors the permitted station difference. If the tolerance is exceeded, a warning message is displayed. For a detailed description of the warning message, refer to the next paragraph " Warning Message “Tolerance exceeded!”". Change to the **Values** screen, to enter a value for the station difference.
B-B/F-F :	If activated, the instrument monitors the permitted maximum difference of double observations. If the tolerance is exceeded, a warning message is displayed. For a detailed description of the warning message, refer to the next paragraph " Warning Message “Tolerance exceeded!”". Change to the **Values** screen, to enter a value for the maximum difference.
Turn.Diff :	Only available for the levelling methods **SimBF** and **SimBFFB**. If activated, the instrument monitors whether the height difference of the two ground points of the staffs is identical for station n in the foresight measurement and for station n+1 in the backsight measurements. If the tolerance is exceeded, a warning message is displayed. For a detailed description of the warning message, refer to the next paragraph " Warning Message “Tolerance exceeded!”".

Warning Message "Tolerance exceeded!"

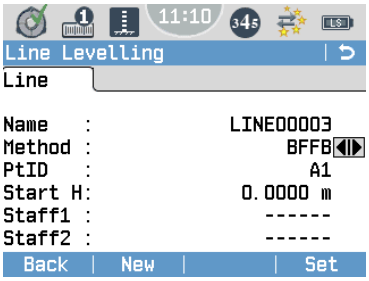


Example of warning message screen. The title of the screen describes which type of tolerance has been exceeded, e.g. the distance tolerance.

Option	Description
F1	If you select **F1 Remeasure last station (1)**, the instrument assumes that all staff ground points are clearly identified and unchanged. All prior measurements for this station are deleted and have to be remeasured.
F2	If you select **F2 Repeat last measurement (2)**, only the last measurement for this station is deleted and has to be remeasured.
F4	If you select **F4 Accept (4)**, the instrument ignores the warning message and stores the measurement.

7.4.4 Setting a Line and a Method

Line



New or **List**

New: To create a line. Only available if the job already contains one or more lines.

List: To view a list of available points within the job. Only available if you create a line or if the job contains no line at all.

Set

To set the selected line and method and continue with the program.

Field	Description
Name	Name of the current line. If the job is empty, a new line name is automatically created and displayed.
Method	Select a levelling method: • **BF**: Backsight and foresight are measured according to the pattern BF BF. • **BFFB**: Backsight and foresight are measured according to the pattern BFFB BFFB. • **BBFF**: Backsight and foresight are measured according to the pattern BBFF BBFF. • **BFBF**: Backsight and foresight are measured according to the pattern BFBF BFBF. • **aBF**: Backsight and foresight are measured alternatingly according to the pattern BF FB BF FB. • **aBFFB**: Backsight and foresight are measured alternatingly according to the pattern BFFB FBBF BFFB. • **aFBBF**: Backsight and foresight are measured alternatingly according to the pattern FBBF BFFB FBBF.

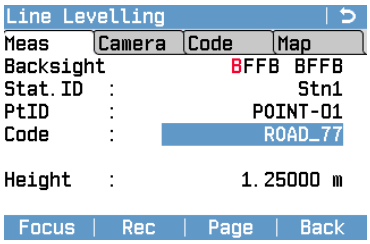
Field	Description
	• **SimBF**: This levelling method allows to simultaneously measure two lines that have the same start and end point. Backsight and foresight are measured according to the pattern BF(Line1) BF(Line2) BF(Line1) BF(Line2). • **SimBFFB**: This levelling method allows to simultaneously measure two lines that have the same start and end point. Backsight and foresight are measured according to the pattern BFFB(Line1) BFFB(Line2) BFFB(Line1) BFFB(Line2).
PtID	ID of the starting point.
Start H	Height of the starting point.
Staff 1, **Staff 2**	Designations for first and second staff (optional).

7.4.5 Measurement Procedure for LineLevel

Measurement Procedure

If a new line is started, the first measurement screen is either the backsight or the foresight measurement, depending on the selected levelling method. On each screen, the current measurement (**Backsight**/**Foresight**) is indicated by the viewing direction which is highlighted in red.In the following example, the levelling method **BFFB** is used to described the measurement procedure of the **LineLevel** application. For other levelling methods, the sequence of screens may differ.

First Backsight Screen (Station1)



Backsight/**Foresight**: The selected levelling method. The current viewing direction is highlighted in red.

Stat.ID: ID of the current station.

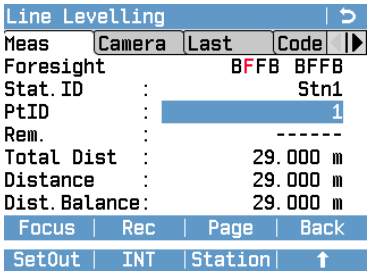
PtID: ID of the start point.

Rem/**Code**: If desired, you can enter an additional remark to be stored with the measurement.

Height: Height of the start point.

☞ To take a measurement, aim at the staff and press the trigger key. If the trigger key is set to **Dist** or **AF+Dist** (only LS15), press **Rec** (**F2** softkey) to store the measurement and switch to the next measurement screen.

First Foresight Screen (Station1)

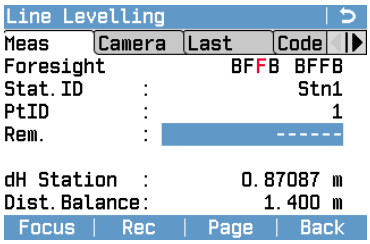


Total Dist: Total length of the line.

Distance: Measured distance between station and staff.

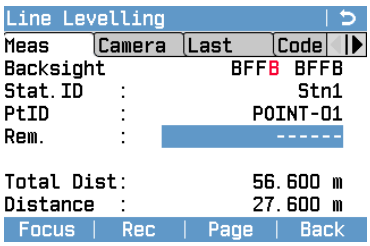
Dist.Balance: Distance difference (Σsum B - Σsum F) at the current station of the line.

Second Foresight Screen (Station1)



dH Station: Height difference on the current instrument station.

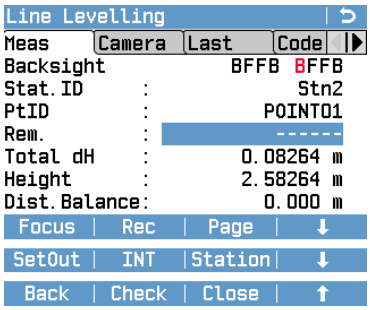
Second Backsight Screen (Station1)



Total Dist: Total length of the line.
Distance: Measured distance between station and staff.

First Backsight Screen (Station2)

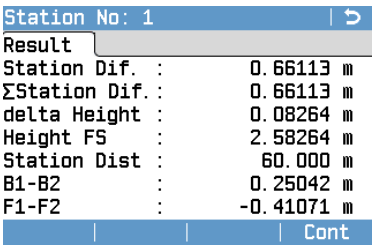
The field **Stat.ID** displays the ID of the next station. In the **Backsight**/**Foresight** field, the first viewing direction of the next station is highlighted in red.



Total dH: Height difference between start and current backsight.
Height: Height of current backsight.

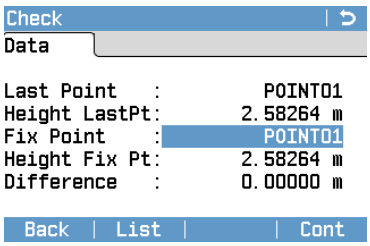
As soon as all measurements of a station are completed you can access the functions **SetOut** or **INT**. For a detailed overview about when these functions are available, refer to " Availability of the Softkeys SetOut and INT". For a detailed description of the **SetOut** and **INT** functions, refer to "7.2.2 Measurement Procedure for Q-Level".
After finishing all backsight and foresight measurements of a station, the following three softkeys are available on the screen of the next station:
Station: To show the result screen of the previous station.
Check: To check the height of the last measured point with the height of a known point (fixpoint).
Close: To start the calculation of the line end.

Station Result Screen



Station Dif.: Station difference.
ΣStation Dif.: Accumulated station difference.
delta Height: Height difference between backsight and foresight.
Height FS: Height of the foresight point.
Station Dist: Distance measured on this station (backsight + foresight).
B1-B2: Difference between the two backsight height measurements.
F1-F2: Difference between the two foresight height measurements.

Check Screen



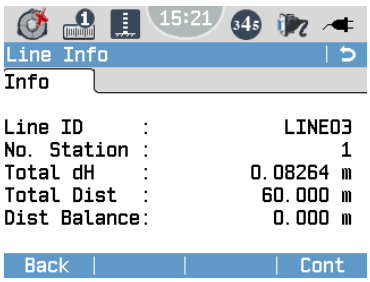
Last Point: Point ID of the last measured point.
Height LastPt: Height of the last measured point.
Fix Point: Point ID of the selected fixpoint.
Height Fix Pt: Height of the selected fixpoint.
Difference: Height difference between measured point and fixpoint.

To select a fixpoint from the available list of fixpoints, press the softkey **List**.

Closing a Line

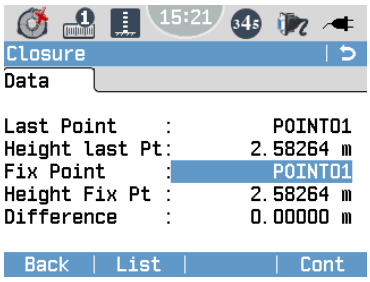
After completing all measurement of a station you can compare the height of the last point of a line with a known fixpoint and calculate the misclosure. Press the softkey **Close** to start the caculation of the line end.

Line Info Screen



Line ID: Line ID.
No. Station: Number of stations.
Total dH: Total height difference.
Total Dist: Accumulated distances.
Dist Balance: Distance difference (Σsum B - Σsum F) at the current station of the line.

Closure Screen



Last Point: Point ID of the last measured point.
Height LastPt: Height of the last measured point.
Fix Point: Point ID of the selected fixpoint.
Height Fix Pt: Height of the selected fixpoint.
Difference: Height difference between measured point and fixpoint.

To select a fixpoint from the available list of fixpoints, press the softkey **List**.

To store the date and return to the Main Menu, press the softkey **Cont**.

☞ If the misclosure is out of tolerance, an information message is displayed. To return to the **Closure** Screen, press the softkey **Abort**. To ignore the message and continue storing the data, press the softkey **Cont**.

Availability of the Softkeys SetOut and INT

The following table describes the availability of the softkeys **SetOut** and **INT** within the **LineLevel** application, depending on the selected levelling method. Both functions are only available after the first sequence of backsight and foresight measurements has been completed (except for the **BF** method).

SetOut and **INT** are available

x: **SetOut** and **INT** are not available
●: **SetOut** and **INT** are available

Levelling Method	Availability
BF	B F B F x ● ● ●
BFFB	B F F B B F F B B F F B x x x x ● x x x ● x x x
BBFF	B B F F B B F F B B F F B B F F x x x x ● x x x ● x x x ● x x x
BFBF	B F B F B F B F B F B F B F B F x x x x ● x x x ● x x x ● x x x
aBF	B F F B B F F B x x ● x ● x ● x
aBFFB	B F F B F B B F B F F B F B B F x x x x ● x x x ● x x x ● x x x
aFBBF	F B B F B F F B F B B F B F F B x x x x ● x x x ● x x x ● x x x

7.5 LineAdjust Program

7.5.1 General

Description

The program **LineAdjust** allows you to adjust single level lines which have been measured with the **LineLevel** application.

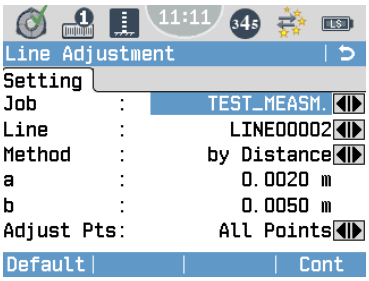
- Define the general parameters for the adjustment procedure.
- Select any two points of the line as control points. Enter their heights or take over the heights from the fixpoints.

The program calculates the misclosure between the measured total height difference and the height difference calculated from the two control points. Based on the misclosure and the selected distribution method, the program calculates and stores adjusted heights for all points in the line.

Access

1. Select **Programs** from the **Main Menu**.
2. Select **LineAdjust** from the **Programs Menu**.

Define Parameters for Adjustment Procedure



To reset the default parameters for **Method**, **a**, **b**, and **Adjust Pts**, press **Default**.

To continue with the adjustment procedure, press **Cont**.

Job Select a job that contains level lines.

Line Select a level line in the current job. You can only adjust lines that are recorded with the **LineLevel** program.
If no line to adjust is available, the symbol * is displayed.

Method Select one of the following methods for the line adjustment procedure. The selected method is used to calculate the closing tolerance:

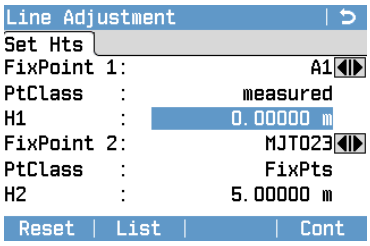
- **by Distance**:
  Closing tolerance = a + b *√L (L = total line length)
- **by Station**:
  Closing tolerance = a * √n (n = total number of stations)

a and **b** These parameters are used to calculate the closure tolerance according to the described formulas.

Adjust Pts Select the type of points that you want to adjust:

- **All Points**
- **Line+Interm.**
- **Line+SetOut**
- **Line only**

Define Two Control Points



To reset the selected points and their heights to the default value, press **Reset**.
To calculate the misclosure and to view the adjustment results, press **Cont**.

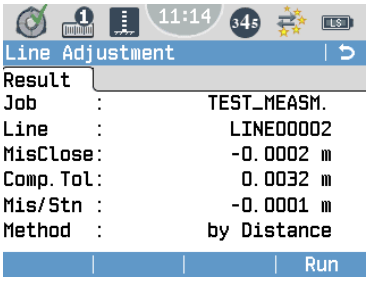
FixPoint 1/**FixPoint 2** Select any two points of the line as first and second control point. The default point ID is the start point of the selected line.

PtClass Displays the type of the selected point (measured point, fixpoint, adjusted point).

H1, **H2** Displays the height of the selected point. If you change the point ID, the height stored for this point ID is displayed.
For points of the type "**measured**", you can change the height. Either enter the height directly or press **List** to select a point with the desired height from the list of available points.

☞ If the misclosure exceeds the closure tolerance, a warning message appears. Press **Cont** to ignore the message and continue the procedure. Press **Abort** to cancel the procedure and change the settings on the previous screen.

Adjustment Results



MisClose Calculated misclosure of the line at the second control point.

Comp.Tol Calculated closing tolerance according to the selected method.

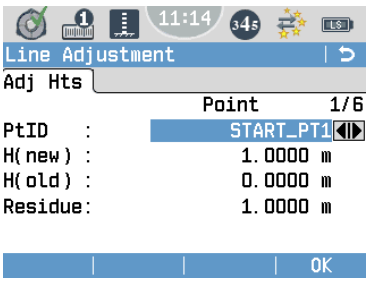
Mis/Stn Calculated misclosure per station.

Method Method that was used for the adjustment.

- **by Distance**: the misclosure is distributed to the points of the level line according to the distances between the staffs.
- **by Station**: the misclosure is distributed according to the number of stations of the level line and is thus independent of the distances between the staffs.

To adjust and record all points of the selected type of points, press **Run**.

Adjusted Heights



Point: Displays the number of points that were adjusted.

PtID Displays the current point ID. Use the navigation keys to scroll through the point IDs.

H(new) Displays the adjusted height of the selected point.

H(old) Displays the originally measured height of the selected point.

Residue Displays the height difference (residual) between the original and the adjusted height of the selected point.

To exit the screen and end the program, press **OK**.

☞ The original measurements are kept in the job and are stored as measured triplets. For each adjusted point, an adjusted triplet is created additionally and stored to the current job.

8 Favourites

Description

Favourites can be accessed by pressing the Favourites key ★ from any measurement screen.
The Favourites key opens the **Favourites Menu** and a function can be selected and activated.

Favourites

	Favourite	Description
Work	**Home**	Returns to the **Main Menu**.
	Level	Opens the **Level & Tilt Check** screen. Refer to "For LS15: Level Up with the Electronic Level Step-by-Step".
	PIN	Allows you to lock the screen with a PIN. Refer to "11.4 Instrument Protection with PIN".
	Code	Opens screen to view, create or delete codes. Refer to "9 Coding".
	INV	Changes the orientation of the staff (upright or inverse). Note that the selected earth curvature correction setting remains unchanged. To change the earth curvature correction refer to "6.2 Regional Settings".
	View Meas	To view measurement data for a selected job. Refer to "12 Data Management".
Apps	**Adjust**	Opens the **LineAdjust** program. Refer to "13 Check & Adjust".
	Man.Input	To manually enter staff readings and distances between staff and instrument. Refer to "5.4 Manual Input Screen for Optical Height Reading".
	Setout	Opens the **Setout** screen. Refer to " SetOut Application" within "7.2.2 Measurement Procedure for Q-Level".
	Interm	To activate the Intermediate point measuring function. Refer to " Survey Intermediate Points" within "7.2.2 Measurement Procedure for Q-Level".
Setting	**Mode**	Opens the screen to change the mode settings. Refer to "6.5 Mode Settings".
	Touch	To activate/deactivate the touch screen.
	Work	Opens the **Work Settings** screen. Refer to "6.1 Work Settings".
	PtID Incr	Opens the **Point ID & Incrementation** screen. Refer to "6.1 Work Settings".

☞ In addition to the Favourites key, you can use the User Key 1 and User Key 2 to quickly access functions from any measurement screen. For details on how to assign functions to the User keys, refer to "7.1.3 Point ID & Incrementation".

9 Coding

Description

Codes contain supplementary information about recorded points and are stored as code blocks together with the measurements. Both, coding with and without a codelist is supported.
With the help of coding, points can be assigned to a particular group of information to simplify later processing.

Creating a Codelist

A codelist can be created:

- on the instrument.
- in Infinity.

Codelists can be imported and exported via USB memory stick. Refer to "12.2 Exporting Data" and "12.3 Importing Data".
Number of codes supported in codelists:

- Up to 500, when created in Infinity.
- Up to 200, when created on the instrument.

GSI coding

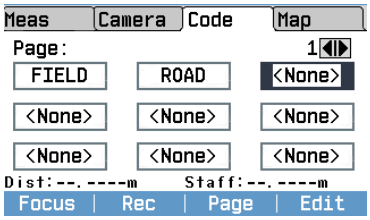
Codes are always stored as free codes (WI41-49), that means that codes are not directly linked to a point. They are stored before or after the measurement depending on the setting made.
A code is always recorded for each measurement as long as a code is highlighted within the page **Code**. To stop recording a code, ensure that no code field is highlighted within the page **Code**.
For permanent recordings of points or a reset of the code recording after storing a point, refer to "6.3 Data Settings".

Access

Direct Access to Codelists

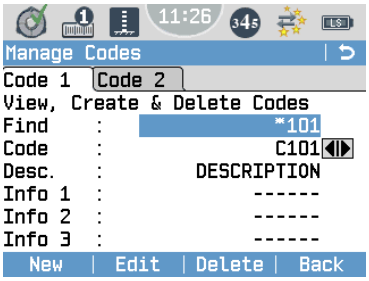
- Select **Manage** from the **Main Menu**.
- Select **Codes** from the **Manage Menu**.

Access from within a program



- Open the **Q-Level** or the **LineLevel** program.
- Within the program, press **Page** to change to the page **Code**.
- Press **Edit** to open the **Manage Codes** screen.

Manage Codes



New
To create a code.

Edit
To edit the selected code.

Delete
To delete the selected code.

Field	Description
Find	Enter a code name to search for existing codes. If the entry does not match any existing code name, a warning message is displayed and a wildcard is automatically inserted into the field.
Code	List of existing code names. Use the navigation keys to toggle through the list.
Desc.	Additional remarks.
Info 1 to **Info 8**	More information lines, freely editable. Used to describe attributes of the code.

10 MapView

10.1 Overview

Availability

The MapView functionality is only available on the LS15 instrument.

Description

MapView is an interactive display feature embedded in the firmware. MapView provides a graphical display of the current and the last four instrument stations. In the MapView, all line measurements and intermediate sights are drawn according to their orientation to give a better understanding of how the different measurement data are related to each other.
The displayed data in all modes of MapView can be shifted by using both the arrow keys and the touchscreen.

Access

The MapView functionality is provided as a page within applications.
Within **Q-Level** or **LineLevel**, change to page **Map**.

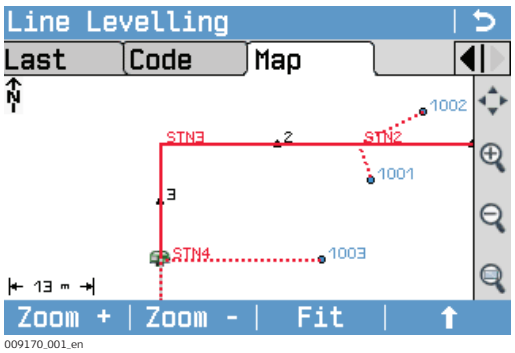
10.2 MapView Components

10.2.1 Screen Area

Description

Standard functionality is provided by softkeys, keys and a toolbar within MapView. The softkeys are available regardless of the mode in which MapView was accessed and always perform the same functions.
On the right side of the screen, a toolbar with icons is available. Some functions of the toolbar can also be performed by using a softkey or key instead. Refer to the following table for a description of the toolbar functions and their respective softkey/key equivalents, if available.

Elements of the Map Page



Symbol	Description
N	North arrow. North is always orientated towards the top of the screen.
120	Scale of the current screen. The minimum is 0.04 m. There is no maximum for the zoom but the scale cannot display values greater than 99999 m. In this case the value displayed will be >99999 m.
	Position of the instrument station. The ID of a station is displayed in red.
	Position of the foresight or backsight staff. The ID of the measured points is displayed in black.
	Intermediate point / Set-out point. The ID of such a point is displayed in blue.
	Measured line to the staff.

Symbol	Description
	Measured line to an intermediate or a set-out point.
	Current viewing direction of the instrument.
	The fit icon fits all displayable data, according to filters and the map configuration, into the screen area, using the largest possible scale. Tap on the icon or press the softkey **Fit** (**F3**).
	To zoom into the map. Tap on the icon or press the softkey **Zoom +** (**F1**).
	To zoom out of the map. Tap on the icon or press the softkey **Zoom -** (**F2**).
	The windowing icon zooms to a specified area window. An area window can be drawn by dragging the stylus on the screen in a diagonal line to make a rectangular area or by tapping twice on the screen to define diagonally opposite corners of a rectangular area. This action causes the screen to zoom to the selected area.

☞ To move the view of the map up and down as well as left and right, tap on the screen with the stylus, hold and move. You can also use the navigation keys. Moving the map is useful when you have zoomed in on a view, and want to move the view around to see other areas of interest.

11 Tools

11.1 Adjust

Description

The **Check & Adjust Menu** contains tools to be used for the electronic adjustment of the line of sight, for the alignment of the camera crosshair and for the compass calibration of the instrument. Using these tools helps to maintain the measuring accuracy of the instrument.

Access

1. Select **Tools** from the **Main Menu**.
2. Select **Adjust** from the **Tools Menu**.
3. Select an Adjustment option from the **Check & Adjust** screen.

Adjustment Options

In the **Check & Adjust** screen, there are several adjustment options.

Menu selection	Description
F1 Line Of Sight	To check and adjust the line-of-sight error. Refer to "13.3 Adjusting Line-of-Sight Error".
F2 Camera Crosshair	Only for LS15: To align the camera crosshair (vertically arranged indicators) to the staff. Refer to "13.5 Aligning the Camera Crosshair".
F3 Digital Compass	Only for LS15: To calibrate the digital compass. Refer to "13.6 Calibrating the Digital Compass".
F4 Level Bubble	To adjust the electronic level of the instrument. Refer to "13.8 Adjusting the Electronic Level".

11.2 System Information

Description

The **Info** screen displays instrument, system and firmware information.

Please provide the instrument-related information, such as instrument type, serial number and equipment number, as well as the firmware version and build number when contacting support.

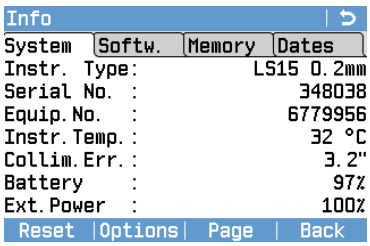
Access

1. Select **Tools** from the **Main Menu**.
2. Select **Info** from the **Tools Menu**.

Info

Page 1/4 (System)

This screen displays information about the instrument and operating system.



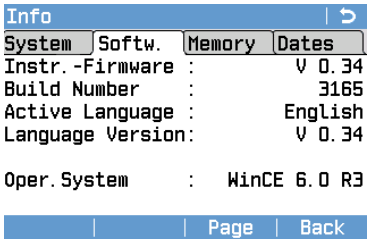
Reset
To reset all settings to the system default.

Options
To display hardware related options which this particular instrument provides.

Field	Description
Instr. Type	Displays the instrument type.
Serial No.	Displays the serial number of the instrument.

Field	Description
Equip.No.	Displays the equipment number.
Instr.Temp.	Displays the current temperature of the instrument.
Collim.Err.	Displays the current collimation error (line-of-sight error).
Battery	Displays the current capacity of the internal battery.
Ext.Power	Displays the current capacity of the external power supply.

Page 2/4 (Softw.)



Field	Description
Instr.-Firmware	Firmware version
Build Number	Build number of the current firmware version
Active Language	Currently activated user interface language
Language Version	Version of the currently used language file. ☞ Firmware version and language version should always be identical.
Oper.System	Operating System installed on the instrument

Page 3/4 (Memory)

Displays job-specific memory information such as the number of stored stations and fixpoints within a job, the number of recorded data blocks, for example measured points, or codes within a job, and the memory space occupied.

☞ Before pressing **Format**, to format the internal memory, ensure that all important data is first transferred to a computer. Jobs, formats, codelists, configuration files, uploaded languages and firmware are deleted by formatting.

☞ Despite an automatic defragmentation, the memory gets fragmented after a while. Please format the internal memory periodically to maintain the instrument performance.

Page 4/4 (Dates)

Field	Description
Maint.-End Date	Displays the end date of the maintenance agreement for the instrument firmware.
mySec.Renewal Date	The date when the instrument must be connected to mySecurity in order to renew the security functionality.
Next Service Date	Displays the date of the next required service check. The field can be invisible if turned off by the service reminder.

11.3 Licence Keys

Description

To fully activate firmware contracts, it may be necessary to load a valid licence key on the instrument. To load a licence key, carry out the procedure described in the following paragraph.

Loading a Licence Key

Step	Description
1.	Copy the licence key into the system directory (e.g. D:\system\) of the USB memory stick.
2.	Insert the USB memory stick into the USB interface within the battery compartment.
3.	Select **Tools** from the **Main Menu**.
4.	Select **Licence** from the **Tools Menu**.
5.	An information message is displayed. To confirm, press **Cont**. The licence key is loaded automatically on the instrument.

11.4 Instrument Protection with PIN

Description

The instrument can be protected by a Personal Identification Number. If PIN protection is activated,the instrument will always prompt for a PIN code entry before starting up. If a wrong PIN has been entered five times, a Personal UnblocKing (PUK) code is required.

Activate PIN code Step-by-Step

Step	Description
1.	Select **Tools** from the **Main Menu**.
2.	Select **PIN** from the **Tools Menu**.
3.	Activate PIN protection by setting **Use PIN-Code**: **On**.
4.	Enter a personal PIN Code in the **New PIN-Code** field. The PIN code must have exactly five numerics.
5.	Accept with **Cont**.

☞ Now the instrument is protected against unauthorised use. After switching on the instrument, a PIN code entry is necessary.

Lock Instrument Step-by-Step

If PIN protection is activated, it is possible to lock the instrument from within any program without switching off the instrument.

Step	Description
1.	Press the Favourites key when within any program. ★
2.	Select **PIN** from the **Favourites Menu**.

Resetting the PIN with the PUK Code

If a wrong PIN is entered five times, the system prompts for a personal unblocking (PUK) code. The PUK code is a licence key.
When you load the licence key file with the correct PUK code, the instrument starts up and resets the PIN code to default value **0** and **Use PIN-Code**: **Off**.
Refer to "11.3 Licence Keys" for instructions on how to load a licence key.

Deactivate PIN Code Step-by-Step

Step	Description
1.	Select **Tools** from the **Main Menu**.
2.	Select **PIN** from the **Tools Menu**.
3.	Enter the current PIN in **PIN-Code:**.
4.	Press **Cont**.
5.	Deactivate PIN protection by setting **Use PIN-Code**: **Off**.
6.	Accept with **Cont**.

The instrument is now no longer protected against unauthorised use.

11.5 Loading Software

Description

You can load a firmware file or additional languages on the instrument. To load a firmware or language file, carry out the procedure described in the following paragraph.

- Never disconnect the power supply during the system upload process. The battery must be at least 75% capacity before commencing the upload.

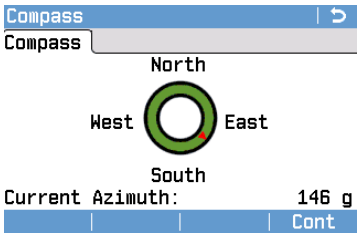
Loading Firmware and Language Files

Step	Description
1.	Copy the firmware and language file into the system directory (e.g. D:\system\) of the USB memory stick.
	Loading a firmware file always requires to load a language file simultaneously. Before you start the process, ensure that the system directory of the USB contains the firmware file and at least one language file.
2.	Insert the USB memory stick into the USB interface within the battery compartment.
3.	Select **Tools** from the **Main Menu**.
4.	Select **Load FW** from the **Tools Menu**.
5.	• To load firmware and language files together, select **F1 Firmware**. The **Select File!** screen is displayed. Select the firmware file from the system directory of the USB memory stick. Press **Cont** to display the **Upload Languages!** screen. • To load only one or several language files, select **F2 Language(s) only**. The **Upload Languages!** screen is displayed. To define which languages you want to load, select **Yes** or **No** for each language file. At least one language must be set to **Yes**.
6.	To start loading the files, press **Cont**. Once the files are successfully loaded, the system shuts down and restarts again automatically.

11.6 Compass

Description

The digital compass is only available on the LS15 instrument.
The **Compass** screen displays the current compass reading.



You can use the digital compass to turn the instrument to a specific direction. For each measurement taken with a LS15 instrument, the coordinates of a measured point are stored. The estimated coordinates can be imported into Infinity to visualise the direction of a levelling line.

☞ The digital compass is sensitive and can be interfered by magnetic fields. Avoid using the compass in areas or environments that may interfere with the quality of the compass measurements. The interference can affect the accuracy and quality of the coordinates/positions determined.

☞ For correct measurement results, it is recommended to perform a compass calibration every time you set up the instrument. For this purpose, you can define the compass calibration screen as start screen. Refer to "6.1 Work Settings".

Access

1. Select **Tools** from the **Main Menu**.
2. Select **Compass** from the **Tools Menu**.

12 Data Management

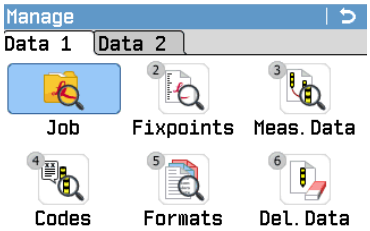
12.1 Manage

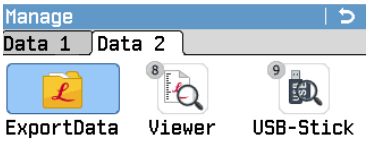
Access

Select **Manage** from the **Main Menu**.

Manage

The **Manage Menu** contains all functions for entering, editing, checking and deleting data in the field.





Menu item	Description
Job	To select, view, create and delete jobs. Jobs are a summary of different types of data, for example, fixpoints, measurements or codes. The job definition consists of the job name and user. The system generates time and date at the time of creation.
Fixpoints	To view, create, edit and delete fixpoints. Valid fixpoints contain at least the point ID and the coordinates E, N or H.
Meas.Data	To view, edit and delete measurement data. Measurement data available in the internal memory can be searched for via a specific point search, or by viewing all points within a job. ☞ If the details of a point have been edited or updated, any new calculations will use the new point details. However, any previously stored calculation results based on the original coordinates of the point will not be updated. The same applies to updates of delta height calculations and averages.
Codes	To view, create, edit and delete codes. To each code a description and a maximum of 8 attributes with up to 16 characters each can be assigned.
Formats	To view and delete data format files.
Del.Data	To delete individual jobs, fixpoints and measurements of a specific job or all jobs in the memory. ☞ Deleting the memory cannot be undone. After confirming the message all data is permanently deleted.
Int.Mem.	To view, delete, or rename exported data files.
Viewer	To view the contents of a data files stored in the internal memory or on the USB memory stick.
USB-Stick	To view, delete, rename and create folders and files stored on the USB memory stick.

Description

Job data, format files, configuration sets and codelists can be exported from the internal memory of the instrument. Data can be exported to:

1) Internal memory

The selected database content is translated into a readable ASCII, GSI or XML file and stored in the internal memory of the instrument. If you connect the instrument to a PC through Active Sync/Mobile Device Centre, you can copy these files to the PC by drag and drop.

2) USB Memory Stick:

The selected database content is translated into a readable ASCII, GSI or XML file and stored on the USB memory stick that is inserted into the USB interface.

3) RS232 or Bluetooth Interface:

The selected database content is translated into a readable ASCII, GSI or XML file and send to an external receiver (e.g. a PC) using the RS232 or bluetooth interface.

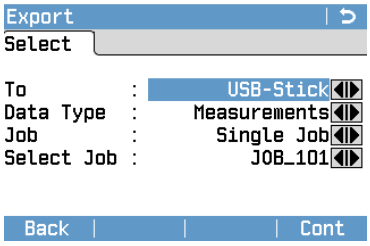
To receive the data, the receiver needs to be equipped with a third party receiving program.

If the receiver cannot process the data fast enough or if the connection to the receiver is unstable, the exported data could be lost. Note, that for this type of data transfer no protocol check exists.

Access

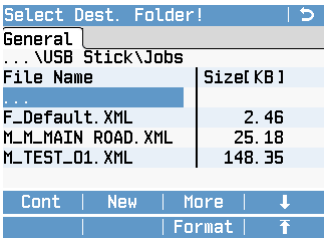
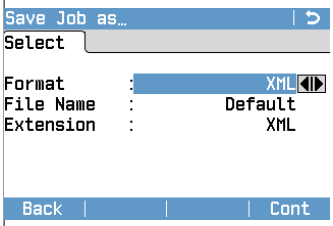
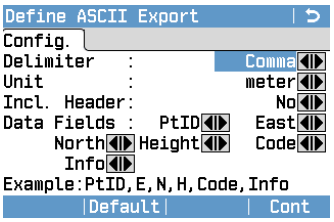
1) Select **Transfer** from the **Main Menu**.
2) Select **Export**.

Select Export Details



Field	Description
To	Destination of the exported data: • **Internal Memory** • **USB Stick** • **Interface** (RS232, Bluetooth)
Data Type	Data type to be transferred: To **Internal Memory**, **USB Stick** or **Interface**: **Measurements**, **Fixpoints**, **Meas.& Fixpoints** Only to **USB Stick**: **Code**, **Format**, **Backup**
Job	Select whether to export all job-related data or a single job data file.
Select Job	Displays the selected job.

Export Data Step-by-Step

Step	Description
1.	Select the export details in the **Export** screen and press **Cont**.
2.	If the export destination is a USB memory stick or the internal memory, select the desired file location.  **Cont** To display the **Save ... as** screen. **New** To create a folder. **More** To display additional information: creation date, creation time and file size. **Format** Only available if you select USB Stick as export destination. To delete all data on the USB stick.
3.	Within the **Save ... as** screen, select the data format and enter the file name.  **Data Formats:** XML: E**x**tensible **M**arkup **L**anguage. XML is a recommendation of the World Wide Web Consortium. Fixed format. ASCII: **A**merican **S**tandard **C**ode for **I**nformation **I**nterchange. Free format. Usage and order of variables and delimiter can be defined during import.  Define the delimiter value, the units and the data fields of the file and press **Cont**. GSI: LeicaGeo **S**erial **I**nterface. Fixed format. Select between **GSI 8** and **GSI 16**. Refer to " Exportable Job Data Formats" for an explanation of the formats. User defined: Any uploaded user defined format. To create a user defined format, use the Format Manager. For details on how to upload a format file, refer to **Importing Data**.
4.	To start the data export, press **Cont** or **Send**. After the data has been successfully exported, a message is displayed.

☞ Measurement data are stored in chronological order – line by line - on the instrument.The XML data format and other format files do not output data chronologically but sort the data in separate blocks. During the data export in XML data format or other format files, the instrument has to search the whole memory until the required data is found. Therefore, the data transfer time varies between formats. The GSI data format has the best transfer speed-performance.

☞ A '+', '-', '.' or alphanumerical characters should not be used as delimiter values in ASCII files. These characters can also be part of the point ID or coordinate values and if so, will generate errors where they occur in the ASCII file.

☞ All jobs, formats, codelists and configurations will be stored in the backup folder created on the USB memory stick. The job data will be stored as individual database files for each job, which can then be imported again. Refer to "12.3 Importing Data".

Exportable Job Data Formats

Job data can be exported from a job in GSI, ASCII and XML file types, or any other user-defined ASCII format. A format can be defined in the Format Manager tool delivered with the instrument. Refer to the online help of the Format Manager tool for information on creating format files.

Example job data output

PtID	East	North	Height	Code	Info1-8
POINT01	-2.0940	-59.9634	0.3003	MAIN_ROAD	
POINT02	-4.1879	-119.9269	-0.0934	MAIN_ROAD	
POINT023	-6.2819	-179.8903	-0.3782	MAIN_ROAD	

12.3 Importing Data

Description

Data can be imported to the internal memory of the instrument via a USB memory stick.

Importable Data Formats

When importing data, the instrument automatically stores the file in a directory folder based on the file extension. The following data formats can be imported:

Data Type	File extension	Recognised as
GSI	.gsi	Fixpoints
HexXML	.xml	Fixpoints
ASCII	any ASCII file extension e.g. .txt	Fixpoints
Format	.frt	Format file
Codelist	.cls	Codelist file
Backup	.db	Backup of fixpoints, measurements and configuration

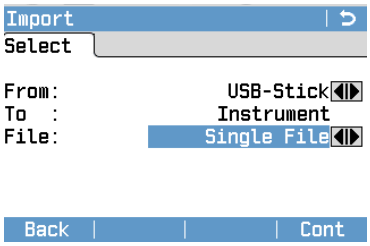
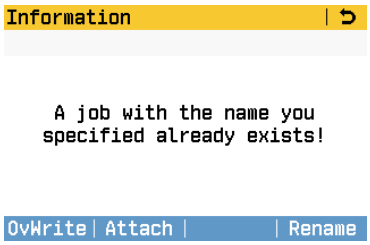
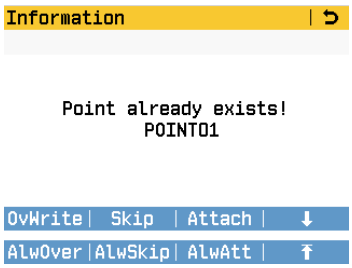
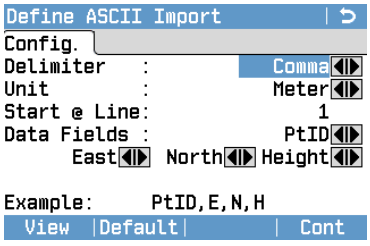
Access

1) Select **Transfer** from the **Main Menu**.
2) Select **Import**.

☞
- Importing a backup folder will overwrite the existing configuration file and code lists on the instrument, and all existing formats and jobs will be deleted.
- A backup can only be imported if the instrument database structure was not changed by a firmware update. If the instrument firmware was updated, it can happen that a backup created before the update cannot be imported. In this case, downgrade the firmware to the previous used version, save the data in the way required and then reload the new firmware.

☞ A '+', '-', '.' or alphanumerical characters should not be used as delimiter values in ASCII files. These characters can also be part of the point ID or coordinate values and if so, will generate errors where they occur in the ASCII file.

Import Data Step-by-Step

Step	Description
1.	Choose the desired settings in the **Import** screen:  **From**: USB-Stick or Internal Memory **File**: Import a single file or a backup folder.
2.	Press **Cont** in the **Import** screen to proceed to the USB memory stick file directory.
3.	Select the file or backup folder on the USB memory stick to be imported and press **Cont**.
4.	**For a file:** Define the Job name for the imported file. Press **Cont** to import.
	If a Job with the same name already exists in the internal memory, an information message is displayed:  **OvWrite** To overwrite the existing job. **Attach** To attach the new points to the current job. **Rename** To rename the job.
5.	If you attach new points to the current job and a point with the same point ID already exists, the following information message is displayed:  **OvWrite** To overwrite the point with the currently displayed point ID. Press ↓ (F4) and AlwOver to overwrite all duplicate point IDs with the new points. **Skip** To skip the point with the currently displayed point ID. The new point is ignored and the existing point is kept. Press ↓ (F4) and AlwSkip to skip all duplicate points. **Attach** To attach the new point to the current job and keep the existing point. The existing point ID is renamed with a numerical suffix. For example, Point23 is renamed to Point23_1. The maximum renamed suffix is 10, e.g. Point23_10. Press ↓ (F4) and AlwAtt to attach all duplicate points to the current job.
	For a backup folder: Take note of the warning message displayed and press **Cont** to proceed and import the folder.
6.	 If the file is an ASCII file, the **Define ASCII Import** screen is displayed. Define the delimiter value, the units and the data fields of the file and press **Cont** to continue.

Step	Description
7.	Once the file or backup folder has been successfully imported, a message is displayed.

12.4 Working with a USB Memory Stick

Insert a USB Memory Stick Step-by-Step

010758_001

Step	Description
1.	Open the battery compartment by pressing the push button underneath the battery compartment. ☞ The USB host port is located at the left side of the battery compartment.
2.	Insert the USB memory stick into the USB host port.

☞ Always return to the **Main Menu** before removing the USB memory stick. If you remove the stick without returning to the **Main Menu**, a warning message is displayed.

☞ Whilst other USB memory sticks may be used, Leica Geosystems recommends Leica industrial grade USB memory sticks and cannot be held responsible for data loss or any other error that may occur when using a non-Leica USB memory stick.

☞
- Keep the USB memory stick dry.
- Use it only within the specified temperature range, -40°C to +85°C (-40°F to +185°F).
- Protect the USB memory stick from direct impacts.

Failure to follow these instructions could result in data loss and/or permanent damage to the USB memory stick.

Format a USB Memory Stick Step-by-Step

If you use a completely new USB memory stick or if you want to delete all existing data, format the USB memory stick before starting to store data.
If the instrument detects a non-recommended File Allocation Table (FAT) on the USB stick, you are automatically prompted to format the USB stick upon insert. The recommended FAT is FAT32. Follow the on-screen instructions to format with FAT32.

Step	Description
☞	Despite an automatic defragmentation, the USB memory stick gets fragmented after a while. Please format the USB memory stick periodically to maintain the instrument performance.
1.	Select **Manage** from the **Main Menu**.
2.	Select **USB-Stick** from the **Manage Menu**.
3.	Press ⬇ **Format** in the **USB-File Manager** screen.
4.	A warning message will appear. ☞ By activating the format command all data will be lost. Make sure that all important data on the USB memory stick has been backed up before formatting the USB memory stick.
5.	Press **Yes** to format the USB memory stick.
6.	A message will display once the formatting of the USB memory stick is completed. Press **Cont** to return to the **USB-File Manager** screen.

12.5 Working with Bluetooth

Description

The LS10/LS15 can communicate with external devices via a Bluetooth connection. The Bluetooth of the instrument is a slave module only. The Bluetooth of the external device is the master module, and therefore controls the connection and any data transfer.

Establishing a Connection Step-by-Step

Step	Description
1.	On the instrument ensure that the communication parameters are set to **Bluetooth:** and **Active**. Refer to "6.6 Interface Settings".
2.	Activate Bluetooth on the external device. The steps required depend on the Bluetooth driver and other device specific configurations. Refer to the device user manual for information on how to configure and search for a Bluetooth connection. The instrument will appear on the external device as “LS_zzzzzz”, with zzzzzz being the serial number of the instrument, for example LS_348005.
3.	Some devices ask for the identification number of the Bluetooth. The default number for a LS10/LS15 Bluetooth is 0000. This can be changed by: • Select **Settings** from the **Main Menu**. • Select **Interface** from the **Settings Menu**. • Press **BT-PIN** from the **Interface Settings** screen. • Enter a new Bluetooth PIN number in **PIN-Code**. • Press **Cont** to confirm the new Bluetooth PIN.
4.	When the external Bluetooth device has located the instrument for the first time, a message will display on the instrument stating the name of the external device and requesting confirmation that connection to this device should be allowed. • Press **Yes** to allow, or • Press **No** to disallow this connection

Step	Description
5.	The instrument Bluetooth sends out the instrument name and serial number to the external Bluetooth device.
6.	All further steps must be made in accordance to the user manual of the external device.

12.6 Working with Leica Infinity

Description

With the office software Leica Infinity, you can seamlessly import, manage and post process level data from the LS10/LS15. The supported file types are HeXML, GSI and LEV. To transfer the level data to Infinity, use a USB cable connection or export the files to a USB memory stick. In Leica Infinity, level data can be combined and adjusted together with total station- and GPS data sets.

13 Check & Adjust

13.1 Overview

Description

Leica Geosystems instruments are manufactured, assembled and adjusted to the best possible quality. Quick temperature changes, shock or stress can cause deviations and decrease the instrument accuracy. It is therefore recommended to check and adjust the instrument from time to time. This check and adjust can be done in the field by running through specific measurement procedures. The procedures are guided and must be followed carefully and precisely as described in the following chapters. Some other instrument errors and mechanical parts can be adjusted mechanically.

☞

During the manufacturing process, the instrument errors are carefully determined and set to zero. These errors can change and it is highly recommended to determine them again for any of the following situations:

- Before the instrument is used for the first time.
- Before every high precision levelling task.
- After rough or long periods of transport.
- After long periods of work or storage.
- If the temperature difference between current environment and the temperature during the last calibration is more than 10°C (18°F).

Electronic Adjustment

You can carry out the following electronic adjustment tasks:

- Correcting the collimation error, also called line-of-sight error (refer to "13.3 Adjusting Line-of-Sight Error").
- Aligning the camera crosshair (refer to "13.5 Aligning the Camera Crosshair").
- Calibrating the digital compass (refer to "13.6 Calibrating the Digital Compass").
- Adjusting the electronic level (refer to "13.8 Adjusting the Electronic Level").

Mechanical Adjustment

You can adjust the following instrument parts mechanically:

- Circular level of the instrument (refer to "13.7 Adjusting the Circular Level of the Instrument").
- Optical crosshair (refer to "13.4 Adjusting the Optical Crosshair").
- Screws on the tripod (refer to"13.9 Servicing the Tripod").

13.2 Preparation

☞

Before determining the instrument errors, level-up the instrument using the circular level and if available, the electronic level. Ensure, that the circular level is adjusted (refer to "13.7 Adjusting the Circular Level of the Instrument").
The tribrach, the tripod and the ground should be very stable and secure from vibrations or other disturbances.

☞

During the calibration, protect the instrument and if possible also the staffs from direct sunlight in order to avoid uneven thermal expansion on one side only.

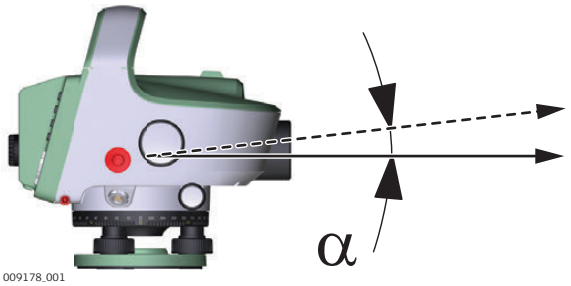
☞

Before starting to work, the instrument has to become acclimatised to the ambient temperature. Approximately two minutes per °C of temperature difference from storage to working environment, but at least 15 min, should be taken into account.

13.3 Adjusting Line-of-Sight Error

Line-of-Sight Error

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

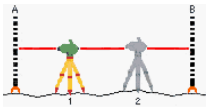
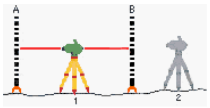


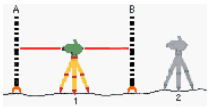
Access

1. Select **Tools** from the **Main Menu**.
2. Select **Adjust** from the **Tools Menu**.

   An information page is displayed. Select **Cont** to display the **Check & Adjust-Menu**.
3. Select **F1 Line Of Sight**.

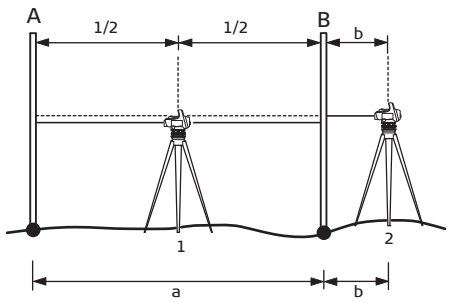
Check and Adjust Step-by-Step

Step	Description
1.	Press **F1** or tap on **F1 Line Of Sight** to start the adjustment of the collimation error.
2.	On the page *General*, the current collimation error is displayed in arc seconds. Select one of the available adjustment methods. A and B are the staffs positions, x is the instrument position. Each method covers two procedures. • **A x Bx** method covers "From the Centre" procedure (classic) and Kukkamäki procedure (refer to " Adjustment Method "A x Bx""). • **A x x B** method covers Förstner and Näbauer procedure (refer to " Adjustment Method "A x x B""). Press **F4** or **Cont**.
3.	An information page displays the correct setup of the station according to the selected adjustment method.  **A x x B** method  **A x Bx** method Set up the instrument at the first position (station 1) and level the instrument with the electronic level.
4.	Press **F4** or **Cont**.
5.	To aim at the staff, you can use the overview camera within the tab **Camera**. Aim first at staff A and carry out a measurement (A1). Aim next to staff B and carry out a measurement (B1). Store the measurements for station 1.

Step	Description
6.	An information page displays the correct setup of the station according to the selected adjustment method.  **A x x B** method  **A x Bx** method Set up the instrument at the second position (station 2) and level the instrument with the electronic level.
7.	Press **F4** or **Cont**.
8.	Aim first at staff B and carry out a measurement (B2). Aim next to staff A and carry out a measurement (A2). Store the measurements for station 2.
	On the page *Result*, the results of the adjustment procedure are displayed. Collimation Error Result Collim error old: 0.0 " Collim error new: 4.4 " Difference : 4.4 " Reticle : 2.0003 m Back | | Mve Er | Set To set the determined collimation error and apply it to all subsequent measurements, press **Set**.
9.	For some markets, it may be necessary to add the determined user collimation error to the factory collimation error. By adding the user collimation error, the correct collimation error is applied to all measurements and the reported user collimation error is within the market-specific tolerance. To add the determined user collimation error to the factory collimation error, press **Mve Er**. You need to confirm this action by pressing **Cont**. After confirming, the new user collimation error is reported as 0.0″.

Adjustment Method "A x Bx"

"From the Centre" Procedure



009364_001

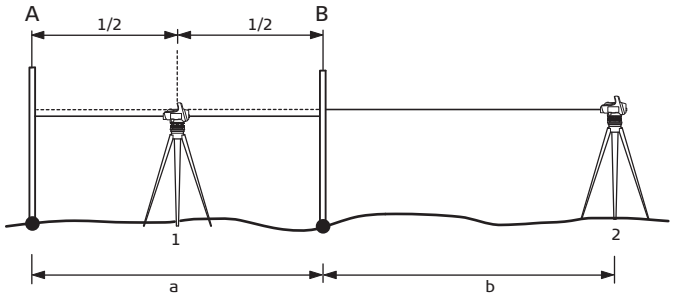
First position (station 1):

- Position the instrument centrally between staff A and B.
- The centre has to be within an accuracy of ±1 m.
- The distance a between the staffs should be approximately 30 m.

Second position (station 2):

- Position the instrument close to staff B (inside or outside).
- The distance b has to be at least 2.5 m.

Kukkamäki Procedure



009365_001

First position (station 1):

- Position the instrument centrally between staff A and B.
- The centre has to be within an accuracy of ±1 m.
- The distance a between the staffs should be approximately 20 m.

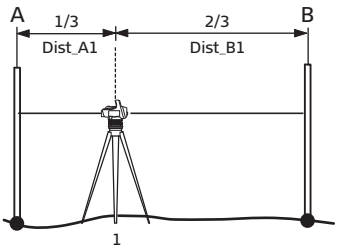
Second position (station 2):

- Position the instrument on the outside of staff B at the distance b (b = a).

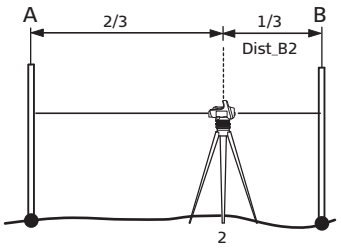
Adjustment Method "A x x B"

For this adjustment method, the distances to the staffs have a 1:2 ratio for each position of the instrument.

Förstner Procedure



009362_001



009363_001

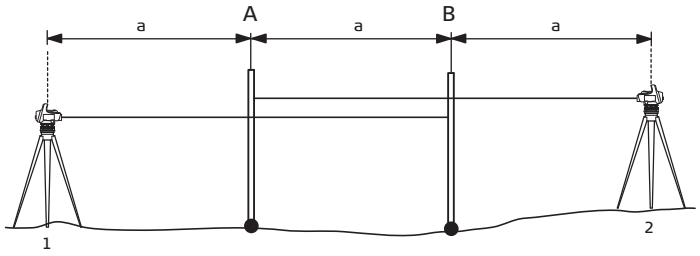
First position (station 1):

- Position the instrument at 1/3 of the distance D between staff A and B.
- The distance D should be approximately 45 m - 60 m.
- The following requirement must be fulfilled: 0.2 x D < Dist_A1 < 0.4 x D and D = Dist_A1 + Dist_B1.

Second position (station 2):

- Position the instrument at 2/3 of the distance D between staff A and B.
- The following requirement must be fulfilled: 0.2 x D < Dist_B2 < 0.4 x D and D = Dist_A1 + Dist_B1.

Näbauer Procedure



009366_001

First position (station 1):

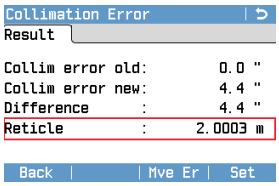
- Position the instrument on the outside of staff A at the distance a.
- The distance a should be approximately 15 m - 20 m and be equal to the distance between staff A and B.
- The following requirement must be fulfilled: 0.2 x D < Dist_A1 < 0.4 x D and D = Dist_A1 + Dist_B1.

Second position (station 2):

- Position the instrument on the outside of staff B at the distance a.
- The following requirement must be fulfilled: 0.2 x D < Dist_B2 < 0.4 x D and D = Dist_A1 + Dist_B1.

13.4 Adjusting the Optical Crosshair

Adjust the Optical Crosshair Step-by-Step

Step	Description
☞	To check if the optical crosshair needs adjustment, first adjust the line-of-sight error. Pay attention to the **Reticle** value which is displayed in the **Result** screen:  Take an optical height reading and check if this value corresponds with the **Reticle** value of the **Result** screen. If not, you need to adjust the optical crosshair.
1.	The crosshair adjustment screw is underneath the eyepiece and is covered by a protective cap. Pull out the cap about 1 cm and slightly press it to the side.
2.	Using an allen key, turn the adjustment screw to move the optical crosshair until the optical height reading corresponds with the **Reticle** value on the screen.
3.	Gently remove the allen key and put the protective cap back in place.

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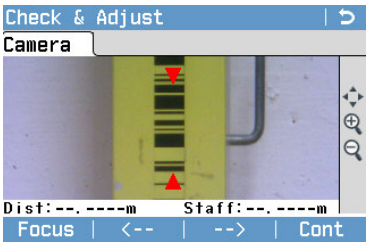
13.5 Aligning the Camera Crosshair

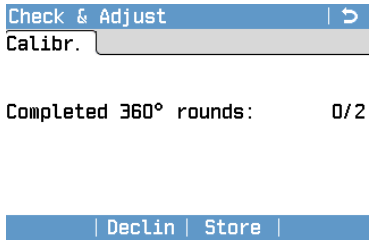
Only for LS15 - Step-by-Step

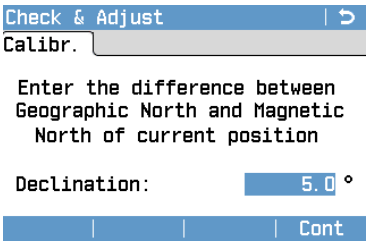
Step	Description
1.	Select **Tools** from the **Main Menu**.
2.	Select **Adjust** from the **Tools Menu**.
3.	Select **F2 Camera Crosshair** from the **Check & Adjust** screen.
4.	An information message is displayed. Aim accurately at a vertical target by using the optical crosshair. Press the softkey **Cont** (**F3**).
5.	 **Focus** To focus the optics onto the staff distance. **<--** To move the camera crosshair (vertical indicators) to the left. **-->** To move the camera crosshair (vertical indicators) to the right. ☞ The camera crosshair moves with an increment of one pixel.
6.	To save the changes and display the next screen, press **Cont**.
	An information message is displayed. Press **Cont** to accept the new position of the camera crosshair and to close the **Check & Adjust** screen. Press **Reset** to reset the crosshair to the factory default and to return to the **Check & Adjust** screen.

13.6 Calibrating the Digital Compass

Only for LS15 - Step-by-Step

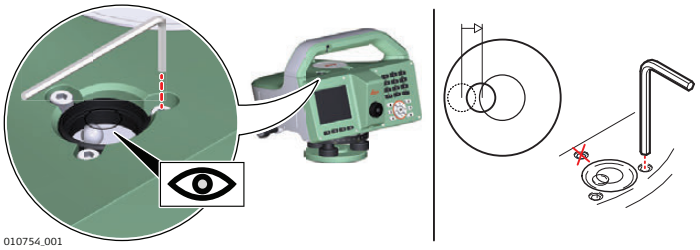
☞ For correct measurement results, it is recommended to perform a compass calibration every time you set up the instrument. For this purpose, you can define the compass calibration screen as start screen. Refer to "6.1 Work Settings".

Step	Description
1.	Select **Tools** from the **Main Menu**.
2.	Select **Adjust** from the **Tools Menu**.
3.	Select **F3 Digital Compass** from the **Check & Adjust** screen.
4.	Read the instruction in the displayed information message. Press the softkey **Cont** (**F4**) to start with the compass calibration.
5.	The following screen is displayed: 

Step	Description
6.	 If it is required to enter a magnetic declination correction for the current work location, press the softkey **Declin** (**F3**). Enter the declination value. To store the entered value, press **Cont** (**F4**).
☞	Magnetic declination is the difference between geographic north and magnetic north and changes with the location on earth and also over time. The magnetic declination is given in degrees. A positive value indicates a declination east of north, a negative value a declination west of north. To get a correct calibration result, you need to enter the current magnetic declination at your position.
7.	Rotate the instrument 360° at least two times. While rotating, the field **Completed 360° rounds** displays the number of already completed rounds.
8.	To complete the compass calibration, press **Cont** (**F4**). An information message is displayed to inform you whether the compass calibration has been successful. To confirm the information message, press **Cont** (**F4**).

13.7 Adjusting the Circular Level of the Instrument

Adjust the Circular Level Step-by-Step

Step	Description
1.	Place and secure the instrument onto the tribrach.
2.	Using the tribrach footscrews, level the instrument with the circular level.
3.	Turn the instrument by 180°/200 gon and observe the bubble of the circular level. If after turning, the bubble is still centred no adjustment is needed.
4.	If the bubble is not centred, correct half of the deviation by moving the adjustment screws with the supplied allen key. 
5.	Turn the instrument again by 180°/200 gon and observe the bubble.
6.	If necessary, repeat the two previous steps until the bubble is centred correctly.

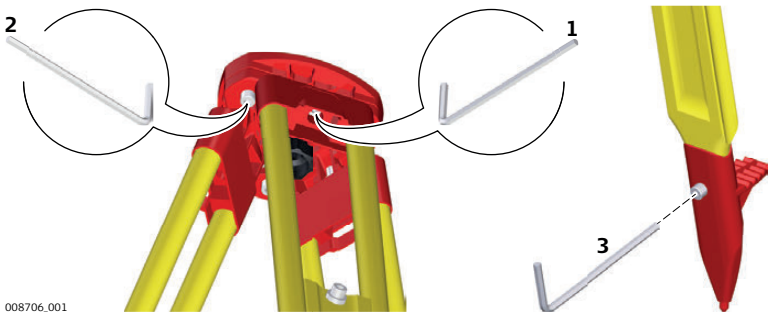
13.8 Adjusting the Electronic Level

Step-by-Step

Step	Description
1.	Select **Tools** from the **Main Menu**.
2.	Select **Adjust** from the **Tools Menu**.
3.	Select **F4 Level Bubble** from the **Check & Adjust** screen.
4.	Use the mechanical circular level to precisely level the instrument. Press the softkey **Cont** (**F4**).
5.	Turn the horizontal circle of the instrument to 0 gon/0 deg. ☞ Avoid any vibrations while turning the instrument.
6.	Press the trigger key and wait until the next screen is displayed.
7.	Turn the horizontal circle of the instrument to 200 gon/180 deg. ☞ Avoid any vibrations while turning the instrument.
8.	Press the trigger key and wait until the message "**Level Bubble calibrated!**" is displayed.
	Press the softkey **Cont** (**F4**) to return to the **Main Menu**.

13.9 Servicing the Tripod

Servicing the Tripod Step-by-Step



The following table explains the most common settings.

Step	Description
☞	The connections between metal and timber components must always be firm and tight.
1.	Tighten the leg cap screws moderately, with the supplied allen key.
2.	Tighten the articulated joints on the tripod head enough to keep the tripod legs open when lifting the tripod off the ground.
3.	Tighten the allen screws of the tripod legs.

14 mySecurity

Description

mySecurity is a cloud-based theft protection. A locking mechanism ensures that the instrument is disabled and can no longer be used. A Leica Geosystems service centre will inform local authorities if such an instrument turns up.

mySecurity is activated in myWorld.

Adding/removing instruments to/from mySecurity

Step	Description
1.	Go to myWorld@Leica Geosystems (**https://myworld.leica-geosystems.com**).
☞	You must add your instruments to **myProducts** first, before the instruments can be added to mySecurity.
2.	Select **myTrustedServices**/**mySecurity**. Available information for listed instruments: • Activation date of the mySecurity service • Renewal date of the mySecurity service • Stolen status, in case of the instrument has been flagged as stolen
3.	Click **Add** to add an instrument to mySecurity. Select the instrument from the selectable list. Click **OK**.
4.	Select an instrument. Click **Remove** to delete the instrument from mySecurity.

Activating the theft protection

For an active theft protection, the instrument must be connected to myWorld within a defined time interval.
If the instrument is not connected within the defined interval, then the instrument is blocked and cannot be used. In this case, the instrument must be connected to myWorld again and the theft protection must be reactivated.

Step	Description
1.	Click the check box to select an instrument.
2.	Click **Details**.
3.	For **New mySecurity Renewal**, set the start date of the theft protection. Click **In 3 months**, **In 6 months** or **In 12 months** to define the connection interval.
4.	Click **Set**.
5.	Download and install the mySecurity Online Update program.
6.	The program scans for the instrument connection port automatically. In case automatic scanning fails, click **Scan** for a search of the port. Select the connection settings.
7.	Click **Connect**. After the activation, the end date of the theft protection is displayed in the mySecurity Online Update program and on the instrument.
8.	Press **Close**.
9.	Click the Refresh button to update the screen information.
10.	Check the status, the activation date and the renewal date of the theft protection.

Status information on the instrument

Step	Description
1.	Select **Tools** from the **Main Menu**.
2.	Select **Info** from the **Tools Menu**.
3.	Go to page *4/4* or **Dates**.
4.	**mySec.Renewal Date**: Displays the date when the instrument must be connected to mySecurity. The date is transferred from myWorld to the instrument.
☞	Ten days before the **mySec.Renewal Date**, a reminder message is displayed each time the instrument is turned on.
☞	When the **mySec.Renewal Date** has been exceeded, a message informs about the instrument lock. Go to myWorld to renew the theft protection.

Report stolen instrument

Step	Description
1.	Go to myWorld@Leica Geosystems (**https://myworld.leica-geosystems.com**).
2.	Select **myTrustedServices**/**mySecurity**.
3.	Click the check box to select an instrument.
4.	Click **Details**.
5.	In the **General** section, click **Report as Stolen**.
6.	A warning comes up to confirm device as stolen. Click **OK**.
7.	The **Status** of the instrument changes to **Stolen!**. A Leica Geosystems service centre informs local authorities if such an instrument turns up.

Locate stolen instrument

If a reported, stolen instrument is registered to myWorld, then the IP address of the computer is logged. The IP address is used to locate the instrument.
In myWorld/**myTrustedServices**/**mySecurity**, the **Status** of the instrument changes to **Located**.
Clicking **Show Location** shows:

- The date and time when the instrument was located
- The IP address of the computer
- A link to show the location on a map

15 Care and Transport

15.1 Care

☞	Despite an automatic defragmentation, the memory gets fragmented after a while. Please format the internal memory periodically to maintain the instrument performance.
Field adjustment	Periodically carry out test measurements and perform the field adjustments indicated in the User Manual, particularly after the product has been dropped, stored for long periods or transported.

15.2 Transport

Transport in the field	When transporting the equipment in the field, always make sure that you • either carry the product in its original transport container, • or carry the tripod with its legs splayed across your shoulder, keeping the attached product upright.
Transport in a road vehicle	Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container, original packaging or equivalent and secure it.
Shipping	When transporting the product by rail, air or sea, always use the complete original Leica Geosystems packaging, transport container and cardboard box, or its equivalent, to protect against shock and vibration.
Shipping, transport of batteries	When transporting or shipping batteries, the person responsible for 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.

15.3 Storage

Product	Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "16 Technical Data" for information about temperature limits.
Li-Ion batteries	• Refer to "Technical Data" for information about storage temperature range. • Remove batteries from the product and the charger before storing. • After storage recharge batteries before using. • Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use. • A storage temperature range of 0 °C to +30 °C / +32 °F to +86 °F in a dry environment is recommended to minimize self-discharging of the battery. • At the recommended storage temperature range, batteries containing a 40% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged.
Charger and docking station	• Keep chargers and docking stations away from excessive dirt, dust and contaminants. • After unpacking the product visually inspect the charger for possible damage. • Unplug the product from the outlet before attempting any maintenance or cleaning.

15.4 Cleaning and Drying

NOTICE

Cleaning of all optical parts requires great care. Improper cleaning can destroy optical surfaces which may lead to a malfunction.

Precautions:

Only use appropriate cleaning material and follow the cleaning procedure described in this User Manual.

Product and Accessories

- Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or soapy water. Do not use other liquids; these may attack the product surface.

For power supplies and chargers:

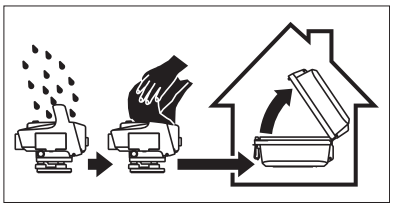
- Use only a clean, soft, lint-free cloth for cleaning.

Cables and plugs

Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.

Damp Products

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40°C /104°F and clean them. Open and dry the battery compartment. Do not repack until everything is completely dry. Always close the transport container when using in the field.



16 Technical Data

16.1 General Technical Data of the Instrument

Control Unit

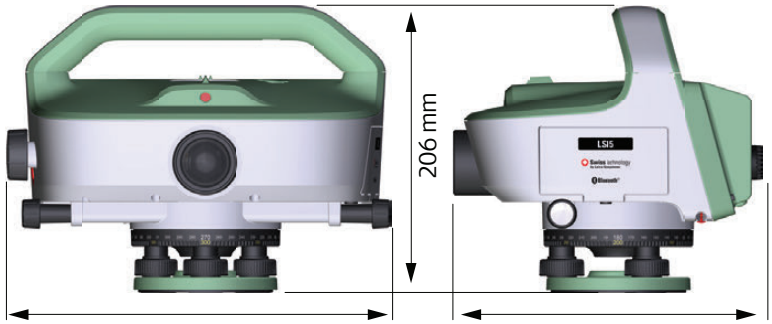
Display

LCD display:	QVGA (320 x 240 pixels) colour touch screen; brightness of backlight LED is adjustable.

Keyboard

28 Keys:	including 4 Function keys and 12 alphanumeric keys

Instrument Dimensions



Weight

Instrument type	Weight (including GEB331 battery)
LS10	3.7 kg/8.2 lbs
LS15	3.9 kg/8.6 lbs

Power Supply

External Power Supply using the Serial Interface

Voltage:	Nominal voltage 12.8 V DC Range 10.5 V-18 V
Standby power consumption:	Typically 1.4 W
Operating power consumption:	Typically 2 W (3 W when motor for Autofocus is in use)

Internal Battery GEB331

Type:	Li-Ion
Voltage	11.1 V
Capacity:	2.8 Ah
Operating time:	10-12 h

Data Storage

Type	Capacity / Number of measurements	Format
Internal memory	30’000 measurements	Database
USB Stick	1 GB, up to 32 GB supported	ASCII

Environmental Specifications

Temperature

	LS10	LS15	GEB331
Operating temperature [C°]	-20 to +50	-20 to +50	-30 to +60
Storage temperature [C°]	-40 to +70	-40 to +70	-40 to +70

Protection against Water, Dust and Sand

	LS10, LS15
Protection	IP55 (IEC60529)

Humidity

	LS10, LS15
Protection	Up to 95% To avoid the effects of condensation, periodically dry out the instrument.

Magnetic Field Sensitivity

	LS10, LS15
Line-of-sight difference in horizontal constant magnetic field at a field strength of 0 µT up to ±400 µT [4 Gauss].	≤ 1″

Telescope

Magnification:	32x
Free objective diameter	36 mm
Opening angle	2°
Field of view	3.5 m at 100 m
Minimum target distance	0.6 m

Distance measurement with Stadia lines

Multiplication constant	100

Compensator

Magnetically damped pendulum compensator with electronic range control.

	LS10, LS15
Slope angle	±9′
Standard deviation	0.3″

Circular Level

Sensitivity:	8′/2 mm

Electronic Level

Working range:	Longitudinal	0.110 gon/0.099° 0.166 gon/0.150°, if **Tilt Check** is Off.
	Transversal (only LS15)	0.110 gon/0.099° 0.166 gon/0.150°, if **Tilt Check** is Off.
Accuracy:		0.015 gon/0.013°

Autofocus (only LS15)

Working range:	1.8 m to infinity
Time to focus:	typically 4 s

Digital Compass (only LS15)

Working range:	360°/400 gon
Accuracy:	2.7°/3 gon
Correction of Declination:	✓

Overview Camera (only LS15)

Sensor:	5 Megapixel CMOS sensor
Focal length:	34 mm
Field of view:	6° x 4.8° (7.7° diagonal)
Frame rate:	up to 20 frames per second
Focus:	3 m (10 ft) to infinity at zoom level 1x
Image storage:	QVGA screenshot in *.bmp format
Zoom:	4-step (1x, 2x, 4x, 8x)
White balance:	Automatic
Brightness:	Automatic

Interfaces

- RS232 Serial (only LS15)
- Bluetooth Serial
- Lemo USB for Active Sync/Mobile Device Centre connection (only LS15)
- Mini USB for Active Sync/Mobile Device Centre connection
- USB Host (for USB Stick)

16.2 Measurements

Height Measurements

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

	LS10/LS15 0.3 mm	LS15 0.2 mm
Electronic measurement with invar staff	0.3 mm	0.2 mm
Electronic measurement with standard staff	1.0 mm	1.0 mm
Optical measurement	2.0 mm	2.0 mm

Distance Measurements

Standard Deviation:

	LS10	LS15
For distances up to 50 m	500 ppm	500 ppm
For distances up to the maximal possible measurement distance	1000 ppm	1000 ppm

☞ 500 ppm is 1 cm standard deviation at 20 m distance.

Measuring Range for Electronic Measurements:

Staff lengths	Measuring Range
3 m to 4 m	1.8 m - 110.0 m
3 m invar staff	1.8 m - 60.0 m
2.7 m	1.8 m - 100.0 m
1.82 m / 2 m	1.8 m - 60.0 m

Measurement Time

Typically 2.5 seconds.

Correction of Measured Values	Collimation error correction: Earth curvature correction:	Applied automatically. For the **Check & Adjust** application, earth curvature correction is enabled automatically. For all other applications, earth curvature correction can be enabled/disabled in the **Regional Settings**.

16.3 Conformity to National Regulations

16.3.1 General

Conformity to national regulations

- FCC Part 15, 22 and 24 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product LS10/LS15 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.

  CE Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15, 22 and 24 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

16.3.2 Dangerous Goods Regulations

Dangerous Goods Regulations

The products of Leica Geosystems are powered by Lithium batteries.

Lithium batteries can be dangerous under certain conditions and can pose a safety hazard. In certain conditions, Lithium batteries can overheat and ignite.

☞ When carrying or shipping your Leica product with Lithium batteries onboard a commercial aircraft, you must do so in accordance with the **IATA Dangerous Goods Regulations**.

☞ Leica Geosystems has developed **Guidelines** on "How to carry Leica products" and "How to ship Leica products" with Lithium batteries. Before any transportation of a Leica product, we ask you to consult these guidelines on our web page (http://www.leica-geosystems.com/dgr) to ensure that you are in accordance with the IATA Dangerous Goods Regulations and that the Leica products can be transported correctly.

☞ Damaged or defective batteries are prohibited from being carried or transported onboard any aircraft. Therefore, ensure that the condition of any battery is safe for transportation.

17 Software Licence Agreement

Software Licence Agreement

This product contains software that is preinstalled on the product, or that is supplied to you on a data carrier medium, or that can be downloaded by you online according to prior authorisation from Leica Geosystems. Such software is protected by copyright and other laws and its use is defined and regulated by the Leica Geosystems Software Licence Agreement, which covers aspects such as, but not limited to, Scope of the Licence, Warranty, Intellectual Property Rights, Limitation of Liability, Exclusion of other Assurances, Governing Law and Place of Jurisdiction. Please make sure, that at any time you fully comply with the terms and conditions of the Leica Geosystems Software Licence Agreement.

Such agreement is provided together with all products and can also be referred to and downloaded at the Leica Geosystems home page at http://leica-geosystems.com/about-us/compliance-standards/legal-documents or collected from your Leica Geosystems distributor.

You must not install or use the software unless you have read and accepted the terms and conditions of the Leica Geosystems Software Licence Agreement. Installation or use of the software or any part thereof, is deemed to be an acceptance of all the terms and conditions of such Licence Agreement. If you do not agree to all or some of the terms of such Licence Agreement, you must not download, install or use the software and you must return the unused software together with its accompanying documentation and the purchase receipt to the distributor from whom you purchased the product within ten (10) days of purchase to obtain a full refund of the purchase price.

Appendix A Menu Tree

☞ Depending on local firmware versions the menu items may differ.

Menu Tree

- **Q-Level**
- **Programs**
  - BasicLevel
  - LineLevel
  - LineAdjust
- **Manage**
  - Job
  - Fixpoints
  - Meas.Data
  - Codes
  - Formats
  - Del.Data
  - Int.Mem.
  - Viewer
  - USB-Stick
- **Transfer**
  - Export
  - Import
  - Copy Lines
- **Settings**
  - **Work**
    USER Key 1, USER Key 2, Trigger key, Instr.Start, Crosshair C.
  - **Regional**
    General: Earth Curv, Language, Lang.Choice,
    Units: Dist. Unit, H Decimal, D Decimal, Temp. Unit, Azimuth Unit, E,N Decimal,
    Time: Time (24h), Date, Format
  - **Data**
    Record: Sort Type, Sort Order, Code Record, Code
    Output: Data Output, GSI-Format
  - **Screen...**
    Display Ill., Touch Screen, Auto-Off, Beep, Sleep Mode, Screensaver, Touch screen calibration
  - **Mode**
    Mode, n Meas., n Min., n Max., sDev/20m
  - **Interface**
    Config1: Port :, Bluetooth:, Baud rate:, Data bits:, Parity :, Endmark :, Stop bits: 1
- **Tools**
  - **Adjust**
    Line Of Sight, Camera Crosshair, Digital Compass, Level Bubble
  - **Info**
    System: Instr. Type, Serial No., Equip.No.,Instr.Temp., Collim.Err., Battery, Ext.Power
    Softw.: Instr.-Firmware, Build Number, Active Language, Language Version, Oper.System
    Memory: Job, Stations, Fixpoints, Meas.Records, Occ.Job Mem., Occ.Sys.Mem.
    Dates: Maint.-End Date, mySec.Renewal Date, Next Service Date
  - **Licence**
  - **PIN**
    Use PIN-Code, New PIN-Code
  - **Load FW**

F1 Firmware, F2 Language(s) only
| |—— **Compass**

Appendix B Directory Structure

Description

On the USB memory stick, files are stored in certain directories. The following diagram is the default directory structure.

Directory Structure

|—— BACKUP	• Backup files (A backup folder is only created once a backup has been exported).
|—— CODES	• Codelists (*.cls)
|—— FORMATS	• Format files (*.frt)
|—— JOBS	• GSI, ASCII and LandXML files (*.*) • Logfiles created from programs
|—— SYSTEM	• Firmware files (LS_Levels.fw) • Language files (LS_Levels_Language_xx.fw) • Licence file (*.key)

Appendix C Corrections and Formulas

Formulas

Earth Curvature Correction

$$E = \frac{x^2}{(2R)}$$

x: Measured Distance
R: 6'378'000 m (earth radius)

Line-of-Sight Error

$$\alpha = \arctan\left[\frac{(A_1-B_1)+(B_2-A_2)}{(d_1-d_2)+(d_3-d_4)}\right]$$

α: Difference between new and current line-of-sight error.
A_1, B_1, A_2, B_2: Staff heights.
d_1, d_2, d_3, d_4: Distances of the respective staff heights.

Mean S Outlier Test

Maximum residual observation is discarded.

Distance Balances

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

Total Distance

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

Station Differences

$$D_{stat} = D_B + D_F$$

D_B: backsight distance
D_F: foresight distance

Appendix D GeoCom Commands

Introduction

LS10/LS15 support the GeoCOM protocol known from various Leica TotalStation hardware. The protocol consists of a command and reply structure as listed in the following table.
All replies are in Meter for lengths, Radians for angles, and °C for temperatures.
If a command is successfully executed, the reply is 0:0 (%R1P,0,0:0). If an error occurs, this is marked by error code, e.g. 0:12035 (%R1P,0,0:12035).
The following table contains LS specific commands and general TPS commands of importance for the LS digital level, as well as typical return codes for these commands.
For further details on GeoCOM refer to the GeoCOM manual available for Leica TotalStations.

Name	ASCII command	Reply
COM_NullProc	%R1Q,0:0	%R1P,0,0:0
COM_SwitchOnTPS	%R1Q,111:	%R1P,0,0:0
	Instrument confirms %R1P,0,0:0 when ready to process further commands (Instrument boot-up completed)	
COM_SwitchOffTPS	%R1Q,112:	%R1P,0,0:0
	Parameter 0 for Off, Parameter 5 for Standby	
CSV_GetInstrumentNo	%R1Q,5003:	%R1P,0,0:0,348005
CSV_GetInstrumentName	%R1Q,5004:	%R1P,0,0:0, "LS15"
CSV_GetIntTemp	%R1Q,5011:	%R1P,0,0:0,27
CSV_GetSWVersion2	%R1Q,5034:	%R1P,0,0:0,1,0,2687
CSV_GetSWCreationDate	%R1Q,5038:	%R1P,0,0:0, "2015-04-28"
CSV_CheckPower	%R1Q,5039:	%R1P,0,0:0,0,1,1
	0 for Internal battery, 1 for external power device	
CSV_SetDateTime2	%R1Q,5050:2015,4,29,15,33,47	%R1P,0:0
	year,month,day,hour,min,sec	
CSV_GetDateTime2	%R1Q,5051:	%R1P,0,0:0,2015,4,29,15,33,47
	year,month,day,hour,min,sec	
CSV_SetupList	%R1Q,5072:	%R1P,0,0:0
CSV_List	%R1Q,5073:	%R1P,0,0:0, "setout", "job-setout-02", 0,0, "260713161438"
CSV_GetMaintenanceEnd	%R1Q,5114:	%R1P,0,0:0,2016,'03','1a'
	Date is in hexadecimal format	
BMM_BeepAlarm	%R1Q,11004:	%R1P,0,0:0

Name	ASCII command	Reply
DNA_GetMeasResult	%R1Q,29005:7000	%R1P,0,0:0,0.654936429207282,2.877974290086675,91,53,5312137,0.013920634920635,20,1
	7000 is waittime in ms to make the measurement, in reply the first argument is the height reading, the second argument is the distance	
DNA_SetRodPos	%R1Q,29010:1	%R1P,0,0:0
	Parameter for normal staff is 0, parameter for inverted staff is 1	
DNA_GetRodPos	%R1Q,29011:	%R1P,0,0:0,1
DNA_StartMeasurement	%R1Q,29036:	%R1P,0,0:0
DNA_StartAutofocus	%R1Q,29068:	%R1P,0,0:0
DNA_GetTiltX	%R1Q,29070:	%R1P,0,0:0,0.00075146
DNA_GetCompassData	%R1Q,29072:	%R1P,0,0:0,1.705186679198458
DNA_GetTiltL	%R1Q,29104:	%R1P,0,0:0,0.00068843
DNA_SwitchEarthCurvature	%R1Q,29107:	
	Parameter 0 for Off, Parameter 1 for On	
DNA_GetEarthCurvatureStatus	%R1Q,29108:	
DNA_GetJobNumber	%R1Q,29109:	%R1P,0,0:0,22
	Number of stored jobs and codelists	
DNA_WakeUpInstrument	%R1Q,29110:	
	To switch from stand-by mode to normal operation.	

Return Codes

Code	Description
0	OK
12032	Too dark or poor light.
12033	Too bright.
12034	Instrument not horizontal. Level up the instrument.
12035	Coarse correlation error. Too much coverage or insufficient code length.
12036	Fine correlation error. Too much coverage or insufficient code length.
12037	Distance outside the permitted range.
12038	Staff inverted or inverse mode activated.
12039	Bad focusing.

Appendix E GSI Online Commands

E.1 Introduction

Return Codes

LS10/LS15 support the GSI Online protocol known from Leica DNA and TotalStations hardware. The protocol consists of a command and reply structure as listed in the following table. All replies are in the currently configured instrument unit.

E.2 General Commands and Descriptions

General Commands

Syntax	Response
<command><CR/LF>	

Commands	Description
a	Switch on the instrument
b	Switch off the instrument
c	Clear
BEEP/0	Short beep
BEEP/1	Long beep
BEEP/2	Alarm beep (short beep, 3 times)

E.3 Operating Commands

Overview

Command	Description
SET	Setting instrument parameters
CONF	Reading instrument parameter settings
PUT	Writing/changing values in the instrument
GET/I	Getting instant values from the instrument (last valid value)
GET/M	Executing a measurement to obtain the value from the instrument
GET/C	Executing continuous measurements to obtain values from the instrument. Measurements can be halted by sending command “c”.

SET Commands

Syntax	Response
SET/<set spec>/<parameter><CR/LF>	

Function	Spec.	Setting	Example
Beep	30	0 = OFF 1 = Medium 2 = Loud	**SET/30/2** Setting Beep to LOUD
Display Illumination	32	Range from 0%-100% 0 = 0% contrast 50 = 50% contrast 100= 100% contrast	**SET/32/50** Setting display illumination to 50% brightness
Unit (Length)	41	0 = Meter 1 = US ft, decimal 2 = International ft, decimal	**SET/41/1** Setting Distance(length) Unit to US ft, decimal

Function	Spec.	Setting	Example
Unit (Temperature)	42	0 = °C (Degree Celsius) 1 = °F (Degree Fahrenheit)	**SET/42/0** Setting Temperature Unit to °C (Degree Celsius)
Staff Reading Decimals	51	3 = 3 decimals 4 = 4 decimals 5 = 5 decimals	**SET/51/5** Setting Staff reading decimal on display to 5
Baudrate	70	2 = 1,200 Baud 3 = 2,400 Baud 4 = 4,800 Baud 5 = 9,600 Baud 6 = 19,200 Baud 7 = 14,400 Baud 8 = 38,400 Baud 9 = 57,600 Baud 10 = 115,200 Baud	**SET/70/6** Setting Interfacing Baud rate to 19,200 Baud
Parity	71	0 = None 1 = Odd 2 = Even	**SET/71/1** Setting Interfacing Parity to Odd
Terminator	73	0 = CR 1 = CR/LF	**SET/73/1** Setting Terminator to CR/LF
Protocol	75	0 = OFF 1 = ON	**SET/75/1** Setting Acknowledgement protocol to ON
Data Recording	76	0 = Internal Memory 1 = RS232	**SET/76/1** Setting data recording to external via RS232
Delay (between 2 strings sent)	78	Range from 0 to 50: 0 = No delay 25 = 25 ms delay 50 = 50 ms delay	**SET/78/25** Setting delay to 25ms between subsequent strings
AutoOff	95	0 = Disable 1 = Enable 2 = Standby	**SET/95/1** Setting AutoOFF to ON
Earth Curvature Correction	125	0 = Off 1 = On	**SET/125/1** Setting Earth Curvature Correction to ON
Staff Mode	127	0 = Upright 1 = Inverted	**SET/127/1** Setting Staff to inverted mode
Output GSI Format Length	137	0 = GSI-8 1 = GSI-16	**SET/137/1** Setting format output to GSI-16
Code Recording	138	0 = Before measurement 1 = After measurement	**SET/138/1** Setting Code recording after the measurement

Syntax	Response	Example
CONF/‹conf spec› ‹CR/LF›	**00**‹conf spec›/00 ‹parameter›	READING BEEP SETTING ON LS10/15: Command: **CONF/30** Response: **0030/0002**

Function	Spec.	Command	Response	Parameters
Beep	30	**CONF/30**	0030/0000 0030/0001 0030/0002	0 = OFF 1 = Medium 2 = Loud
Display Illumination	32	**CONF/32**	0032/0nnn	Range from 0%-100% 0 = 0% contrast 50 = 50% contrast 100= 100% contrast
Unit (Length)	41	**CONF/41**	0041/0000 0041/0001 0041/0002	0 = Meter 1 = US ft, decimal 2 = International ft, decimal
Unit (Temperature)	42	**CONF/42**	0042/0000 0042/0001	0 = °C 1 = °F
Staff Reading Decimals	51	**CONF/51**	0051/0003 0051/0004 0051/0005	3 = 3 decimals 4 = 4 decimals 5 = 5 decimals
Baudrate	70	**CONF/70**	0070/0002 0070/0003 0070/0004 0070/0005 0070/0006 0070/0007 0070/0008 0070/0009 0070/0010	2 = 1,200 Baud 3 = 2,400 Baud 4 = 4,800 Baud 5 = 9,600 Baud 6 = 19,200 Baud 7 = 14,400 Baud 8 = 38,400 Baud 9 = 57,600 Baud 10 = 115,200 Baud
Parity	71	**CONF/71**	0071/0000 0071/0001 0071/0002	0 = None 1 = Odd 2 = Even
Terminator	73	**CONF/73**	0073/0000 0073/0001	0 = CR 1 = CR/LF
Protocol	75	**CONF/75**	0075/0000 0075/0001	0 = OFF 1 = ON
Data Recording	76	**CONF/76**	0076/0000 0076/0001	0 = Internal Memory 1 = RS232
Delay (between 2 strings sent)	78	**CONF/78**	(0...50) Increment of 10ms/unit	Range from 0 to 50: 0 = No delay 25 = 25 ms delay 50 = 50 ms delay
Battery Level	90	**CONF/90**	0090/00nn	n: (0...10) 0: Empty 10: Full
Instrument Temperature	91	**CONF/91**	0090/0nnn	n: (0...±100)°C

Function	Spec.	Command	Response	Parameters
AutoOff	95	**CONF/95**	0095/0000 0095/0001 0095/0002	0 = Off 1 = On 2 = Standby
Earth Curvature Correction	125	**CONF/125**	0125/0000 0125/0001	0 = Off 1 = On
Staff Mode	127	**CONF/127**	0127/0000 0127/0001	0 = Upright 1 = Inverted
Output GSI Format Length	137	**CONF/137**	0137/0000 0137/0001	0 = GSI-8 1 = GSI-16

PUT Commands

Syntax	Response	Example
PUT/‹put spec›‹Value› ‹space›‹CR/LF›		INPUTING/WRITING PtID of BM2002: Command: **PUT/11....+00BM2002** Response: Confirmation: **CR/LF**

Function	Spec.	Command	Example
PtID	11	**PUT/11**	**PUT/11....+00BM2002**‹space›‹CR/LF›
Remark	71	**PUT/71**	**PUT/71....+00PTKERB**‹space›‹CR/LF›
Time (hh.mm.ss)	560	**PUT/560**	**PUT/560..6+00115120**‹space›‹CR/LF›
Date (mm.dd)	561	**PUT/561**	**PUT/561..6+00042700**‹space›‹CR/LF›
Year (yyyy)	562	**PUT/562**	**PUT/562...+00002015**‹space›‹CR/LF›

GET Commands

Syntax	Example
GET/n/WI/‹get spec› ‹CR/LF› where n = M / I / C	Single command Read Distance value: Command: **GET/M/WI32** Response: **32...0+00040663** Combined commands Read PtID, Distance & Height reading: Command: **GET/M/WI11/WI32/WI330** Response: 11....+00BM2002 32..00+00015256 330.26+00014875

Function	Spec.	Command	Example
PtID	11	**GET/n/WI11**	Command: GET/M/WI11‹CR/LF› Response: 11....+00BM2002
Remark	71	**GET/n/WI71**	Command: GET/M/WI71‹CR/LF› Response: 71....+00PTKERB
Time (hh.mm.ss)	560	**GET/n/WI560**	Command: GET/M/WI560‹CR/LF› Response: 560...6+00115120
Date (mm.dd)	561	**GET/n/WI561**	Command: GET/M/WI561‹CR/LF› Response: 561..6+00042700
Year (yyyy)	562	**GET/n/WI562**	Command: GET/M/WI562‹CR/LF› Response: 562...+00002015

Function	Spec.	Command	Example
Horizontal Distance	32	**GET/n/WI32**	Command: GET/M/WI32 Response: 32...0+00140663
Staff Height Reading	330	**GET/n/WI330**	Command: GET/M/WI330 Response:330.26+00014876
Instrument Temperature	95	**GET/n/WI95**	Command: GET/M/WI95 Response: 95...6+00260000
Serial Number	12	**GET/n/WI12**	Command: GET/M/WI12 Response: 12....+00348004
Instrument Name	13	**GET/n/WI13**	Command: GET/M/WI13 Response: 13....+0000LS15
Date: d/m/y	17	**GET/n/WI17**	Command: GET/M/WI17 Response: 17....+27042015
Date and time: d/m/y/min	19	**GET/n/WI19**	Command: GET/M/WI19 Response: 19....+04271212
Version	599	**GET/n/WI599**	Command: GET/M/WI599 Response: 599..6+00342673

Warnings and Errors

Message	Description	Possible Cause / Action
@W400	Instrument is busy	**Cause:** Other device may be interfacing with the instrument. **Action:** Check the interfacing priorities.
@W427	Invalid command	**Cause:** The string sent to the instrument could not be decoded properly or command does not exist. **Action:** Check the syntax of the commands. Check if buffer is over flow (maximum 100 characters).
@E458	Tilt sensor is out of range	**Cause:** Instrument out of level. **Action:** Check if the instrument is set up and levelled properly.
@E439	No measurement possible	**Cause:** • Insufficient or uneven lighting on the staff. • Incorrect setup of the staff (inverted/upright). • The staff could be out of the telescope field of view. • The instrument may not be properly focused onto the staff. **Action:** Check and focus onto the staff with optimum lighting. Ensure that the staff is set up in its correct position.

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- when it has to be **right**

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