Leica Builder
User Manual

Version 4.1
English

- when it has to be **right**

Leica Geosystems

Introduction

Purchase

Congratulations on the purchase of a Builder series instrument.

This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "16 Safety Directions" for further information.
Read carefully through the User Manual before you switch on the product.

Product identification

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

Type: _____

Serial No.: _____

Symbols

The symbols used in this manual have the following meanings:

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 and/or appreciable material, financial and environmental damage.
	Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

Trademarks

- Windows is a registered trademark of Microsoft Corporation

All other trademarks are the property of their respective owners.

Table of Contents

In this manual

1 How to Use this Manual

It is recommended to set-up the instrument while reading through this manual.

Index

The index is at the back of the manual.

Keys, fields and options on the screens which are considered as self-explanatory are not explained.

Validity of this manual

This manual applies to all Builder instruments. Differences between the various models are marked and described.

Available documentation

Name of documentation	Description
Builder User Manual	All instructions required in order to operate the instrument to a basic level are contained in this User Manual. Provides an overview of the instrument together with technical data and safety directions.

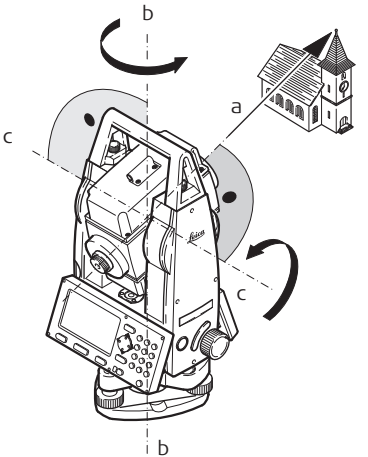
Name of documentation	Description
Builder Construction made faster	Describes the basic principle of construction measurement in combination with Builder functionality.
Builder Quickguide	Describes the onboard application programs step-by-step. Intended as a quick reference field guide.

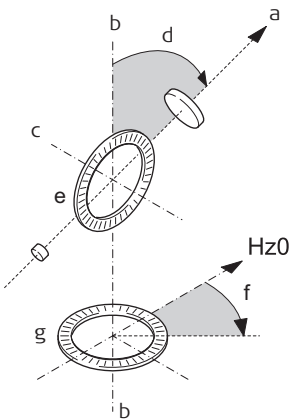
Format of the documentation

The Builder CD contains the entire documentation in electronic format. It is also available in printed form.

2 Technical Terms and Abbreviations

Terminology



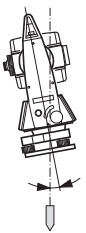


	Term	Description
a)	Line of sight / collimation axis	Telescope axis = line from the reticle to the centre of the objective.
b)	Standing axis	Vertical rotation axis of the instrument.
c)	Tilting axis	Horizontal rotation axis of the telescope.
d)	Vertical angle / zenith angle	
e)	Vertical circle	With coded circular division for reading the vertical angle.
f)	Horizontal angle	
g)	Horizontal circle	With coded circular division for reading the horizontal angle.

Plumb line / Compensator

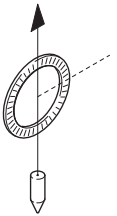
Direction of gravity. The compensator defines the plumb line within the instrument

Standing axis inclination



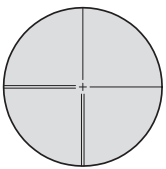
Angle between plumb line and standing axis.
Standing axis tilt is not an instrument error and is not eliminated by measuring in both faces. Any possible influence it may have on the horizontal direction resp. vertical angle is eliminated by the dual axis compensator.

Zenith



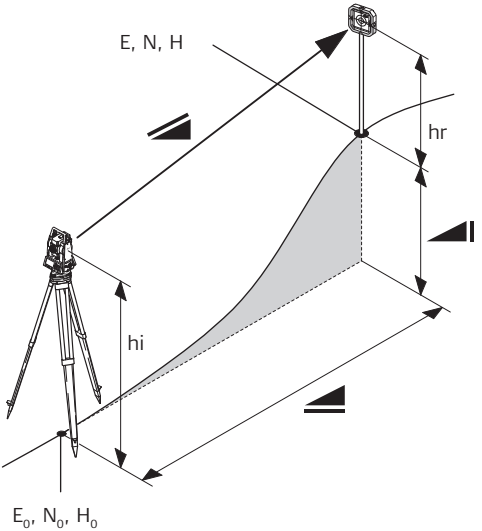
Point on the plumb line above the observer.

Reticle



Glass plate within the telescope with reticle.

Explanation of displayed data



Abbreviation	Description
	Indicated meteorological corrected slope distance between instrument tilting axis and centre of prism/laser dot.
	Indicated meteorological corrected horizontal distance.
	Height difference between station and target point.
hr	Reflector height above ground
hi	Instrument height above ground
E_0	Easting of Station
N_0	Northing of Station
H_0	Height of Station
E	Easting of target point
N	Northing of target point
H	Height of target point

3 Description of the System

3.1 Instrument Models

Instrument models

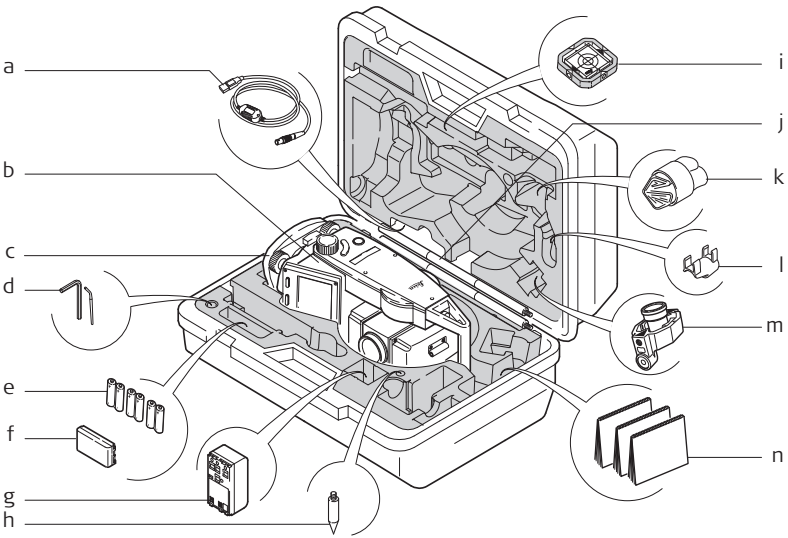
Model	Description
Builder T	Electronic theodolite.
Builder R	Electronic theodolite with distance measurement capability and construction software.
Builder RM	Same as Builder R, additionally with RS232 interface and internal memory to store and manage data and an extended application menu.
Builder RM power*	Same as Builder RM, additionally with 10-digits keypad, distance measurement with reflectors (fine/fast mode), LED that shows used EDM mode and an extended application menu.
Builder M power*	Same as Builder RM power but only distance measurements with reflectors (fine/fast mode).

Builder T, R and RM are available as Builder 100 and 200.
Builder RM power is available as Builder 100, 200 and 300.
Builder M power is available as Builder 100 and 200.

*) The term "power" can be abbreviated as "p", for example Builder R300Mp.

3.2 Set Contents

Set contents

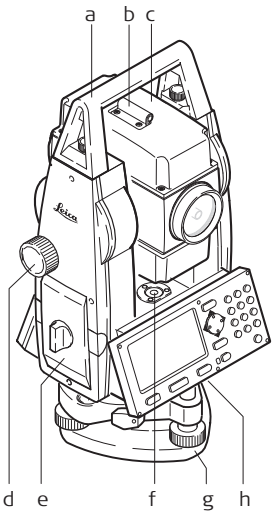


a) GEV189 USB Data transfer cable (for Builder RM)
b) Builder instrument with keyboard
c) CTB101 Tribrach w/o optical plummet, black
d) One Allen key, one Adjusting pin
e) Alkaline batteries, 3x Twinpack, Size AA
f) GEB111 Battery
g) GAD39 battery adapter for Alkaline batteries, Size AA
h) Tip for GLS115
i) CPR105 Double-sided flat prism
j) GLS115 Mini reflector pole set
k) Protective cover / Lens hood
l) GLI115 Clip-on bubble for GLS115
m) CPR111 BUILDER Prism, True-Zero Offset
n) User Manual, CD Rom, Booklet "Construction made faster"

The content depends on the chosen Builder model.

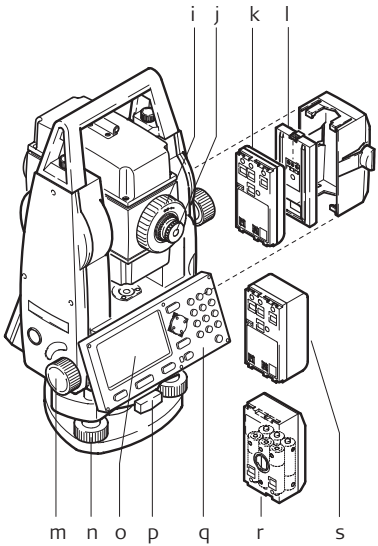
3.3 Instrument Components

Instrument components, part 1 of 2



a) Detachable carrying handle with mounting screws
b) Alignment sight
c) Telescope (with integrated Distance Meter for R, RM, M power and RM power)
d) Vertical drive
e) Battery holder for GAD39/GEB111/GEB121
f) Circular level
g) Tribrach
h) Serial interface RS232 (for Builder RM, M power and RM power)

Instrument components, part 2 of 2



i) Telescope focusing ring
j) Eyepiece
k) Battery GEB111 (optional)
l) Battery stand for GEB111
m) Horizontal drive
n) Foot screw
o) Display
p) Tribrach securing screw
q) Keypad (Keypad depends on model. Refer to chapter "4.1 Keyboard".)
r) Battery adapter GAD39 for 6 single cells, Size AA
s) Battery GEB121 (optional)

3.4 Power Supply

Instrument

Power for the instrument can be supplied either internally or externally.

Internal battery

- Six single cells, Size AA in the battery adapter GAD39,
- or one GEB111 battery,
- or one GEB121 battery

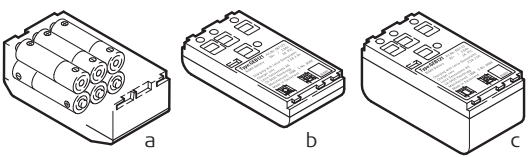
fitted into the battery compartment.

External battery

- One GEB171 battery,
- or one GEB70 battery

connected via cable.

Batteries



a) Single cells, Size AA in the battery adapter GAD39
b) GEB111
c) GEB121

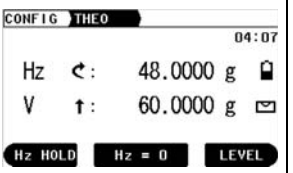
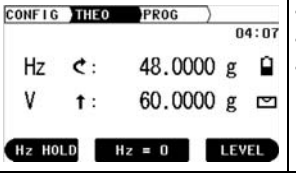
Use the Leica Geosystems batteries, chargers and accessories or accessories recommended by Leica Geosystems to ensure the correct functionality of the instrument.

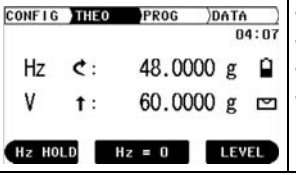
3.5 Software Concept

Description

All instrument types use the same software concept. The software has different modes depending on the instrument type.

Software Concept

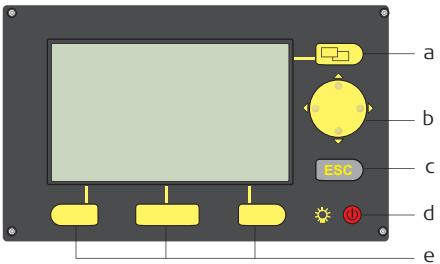
Model	Screen	Available Modes
Builder T		• Configuration Mode • Theodolite Mode
Builder R		• Configuration Mode • Theodolite Mode • Programs Mode

Model	Screen	Available Modes
Builder RM, M power and RM power		• Configuration Mode • Theodolite Mode • Programs Mode • Data Management Mode

4 User Interface

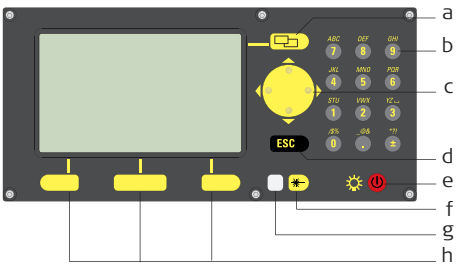
4.1 Keyboard

Keyboard
Builder T, R and RM



a) Page key
b) Navigation keys
c) ESC
d) On/Off, Light
e) Function keys

Keyboard Builder M power and RM power



a) Page key
b) 10-digits keypad
c) Navigation keys
d) ESC
e) On/Off, Light
f) EDM key
g) LED
h) Function keys

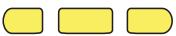
Keys

All Builder models:

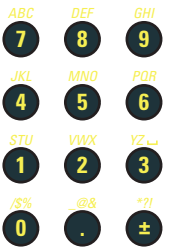
Key	Description
	Changes tab in the tab bar.
	• Move the focus on the screen • Start the edit mode for edit fields • Control the input bar in edit and input mode

Key	Description
	• Leaves the current menu or dialog without storing changes made. • If **THEO** mode is active: press approx. 5 seconds to access **System Info**.

	• If the instrument is off: to turn instrument on
	• If the instrument is on:
	  • press at any time to turn on and off the display light incl. reticle illumination
	  • and press approx. 5 seconds to turn off the instrument

	Correspond to the three softkeys that appear on the bottom of the screen when the screen is activated.

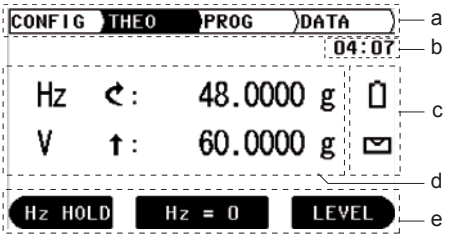
Only Builder M power and RM power:

Key/LED	Description
	• Press button short: to access the EDM settings • Press button long: to toggle between red dot and fine/fast (Builder RM power), or between fine and fast (M power)
	Alphanumeric keys
	• LED white: EDM type is fine/fast • LED red : EDM type is red dot (only Builder RM power) • LED flashes once if the EDM setting has changed by toggling or when a measurement is taken • LED blinks if EDM measures in tracking-mode

4.2 Screen

All shown screens are examples. It is possible that local software versions are different to the basic version.

Screen



a) Tab bar
b) Time
c) Icons
d) Screen area
e) Softkeys

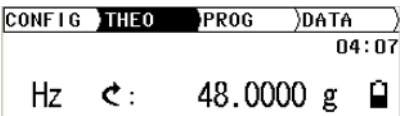
Description

Element	Description
Tab bar	The current active tab is shown black.
Time	Shows the current time provided that the setting is made in the configurations.
Icons	Shows the current status information of the instrument. Refer to "4.4 Icons".
Screen area	The working area of the screen.
Softkeys	Commands can be executed using the function keys. The commands assigned to the softkeys are screen dependent.

4.3 Tab Bar

Tab bar

In the tab bar the current active software mode is shown black.



<- Tab bar

Tab	Mode
CONFIG	Configuration Mode
THEO	Theodolite Mode
PROG	Program Mode (for Builder R, RM, M power and RM power)
MODE	Data Management Mode (for Builder RM, M power and RM power)

☞ The availability of the tabs depend on the instrument model.

4.4 Icons

Description

The icons provide information related to basic instrument functions.

Battery

The status and source of the battery is displayed.

Icon	Description
	**Battery capacity** The battery symbol indicates the level of the remaining battery capacity, 75% full shown in the example.  The battery symbol is only shown if **<Battery Type: NiMH>** is set in Configuration Mode.  If **<Battery Type: NiMH>** is set but alcaline batteries used then the battery charge is not displayed correctly.

Compensator

Compensator on or off is displayed.

Icon	Description
	Compensator is turned on.
	Compensator is turned off.

4.5 Symbols

Horizontal angle

The direction of the horizontal angle is displayed.

Symbol	Description
	Indicates that horizontal angle is set to right side angle measurement (clockwise).
	Indicates that horizontal angle is set to left side angle measurement (anticlockwise).

Vertical angle

The "0"-Orientation of the vertical angle is displayed.

Symbol	Description
	Indicates that the "0"-orientation of the vertical angle is selected to the zenith.
	Indicates that the "0"-orientation of the vertical angle is selected to the horizon.
%	Indicates that the vertical angle is shown in percentage.

Distance

Symbol	Description
	This symbol indicates the **horizontal distance**.
	This symbol indicates the **height difference**.
	This symbol indicates the **slope distance**.

Triangles

Symbol	Description
	Double triangles on the right indicate a **choice field**.
	A single triangle on the right indicates a **choice list**.

5 Operation

5.1 Selection of Language

Description

After switching on the instrument the user is able to choose his preferred language.

The dialog to choose the language is only shown if two languages are loaded onto the instrument and **<Lang.Dialog: On>** is set in Configuration mode or on System Info dialog.

Loading/Changing languages

Instrument model	**To load an additional language or to change the existing language(s),**
Builder RM, M power and RM power	connect the instrument to LGO Tools Version 4.0 (M power and RM power to LGO Tools Version 6.0) or higher via the serial interface and load using "LGO Tools - Software Upload".
Builder R	contact your Leica Geosystems authorized service workshop.
Builder T	contact your Leica Geosystems authorized service workshop.

5.2 Instrument Setup

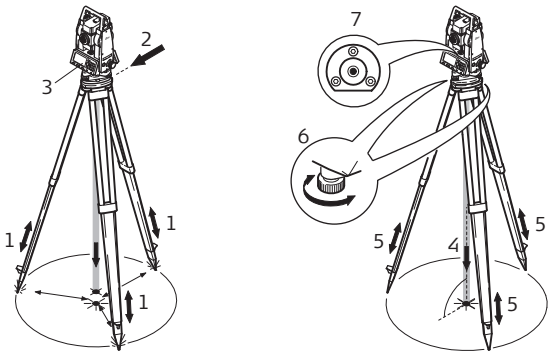
Description

This topic describes an instrument setup over a marked ground point using the laser plummet. It is always possible to set up the instrument without the need for a marked ground point.

Important features:

- It is always recommended to shield the instrument from direct sunlight and avoid uneven temperatures around the instrument.
- The laser plummet described in this topic is built into the vertical axis of the instrument. It projects a red spot onto the ground, making it appreciably easier to centre the instrument.
- The laser plummet cannot be used in conjunction with a tribrach equipped with an optical plummet.

Setup step-by-step



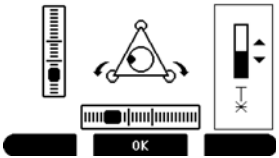
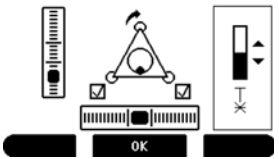
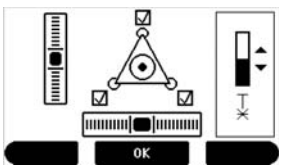
Step	Description
1.	Extend the tripod legs to allow for a comfortable working posture. Position the tripod over the marked ground point, centring it as well as possible.
2.	Fasten the tribrach and instrument onto the tripod.
3.	Turn on the instrument by pressing the ⏻ key.
☞	The electronic level and laser plummet are activated automatically after switching on the instrument, if compensator is set to on.

Step	Description
4.	Move the tripod legs (1) and use the tribrach footscrews (6) to centre the plummet (4) over the ground point.
5.	Adjust the tripod legs to level the circular level (7).
6.	By using the electronic level turn the tribrach footscrews (6) to precisely level the instrument. ☞ Refer to "Levelling up with the electronic level step-by-step" for more information.
7.	Centre the instrument precisely over the ground point (4) by shifting the tribrach on the tripod plate (2).
8.	Repeat steps 6. and 7. until the required accuracy is achieved.

Levelling up with the electronic level step-by-step

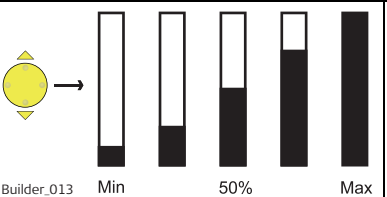
The electronic level can be used to precisely level up the instrument using the footscrews of the tribrach.

Step	Key/Screen	Description
1.		Turn on the instrument by pressing the ⏻ key.
☞		The electronic level and laser plummet are activated automatically after switching on the instrument, if compensator is set to on.
2.		Centre the circular level approximately by turning the footscrews of the tribrach.
☞		The bubble of the electronic level and the arrows for the rotating direction of the footscrews only appear if the instrument tilt is inside a certain levelling range.
3.		Turn the instrument until it is parallel to two footscrews.

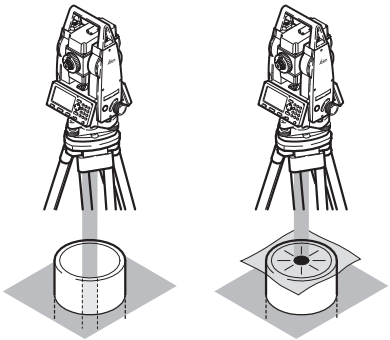
Step	Key/Screen	Description
4.		Centre the electronic level of this axis by turning the two footscrews. Arrows show the direction for rotating the footscrews. When the electronic level is centred the arrows are replaced by checkmarks.
5.		Centre the electronic level for the second axis by turning the last footscrew. An arrow shows the direction for rotating the footscrew. When the electronic level is centred the arrow is replaced by a checkmark.
☞		When the electronic level is centred and three checkmarks are shown, the instrument has been perfectly leveled up.
6.		Accept with **OK**.

Changing the intensity of the laser plummet

External influences and the surface conditions may require the adjustment of the intensity of the laser.

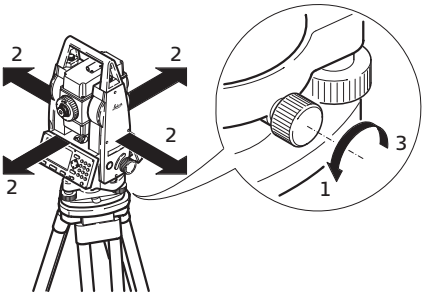
Step	Key/Screen	Description
1.		Turn on the instrument by pressing the ⏻ key.
☞		The electronic level and laser plummet are activated automatically after switching on the instrument, if compensator is set to on.
2.		Adjust the intensity of the laser plummet by pressing ◇. The laser can be adjusted in 25% steps as required.

Positioning over pipes or holes



Under some circumstances the laser dot is not visible, for example over pipes. In this case, the laser dot can be made visible by using a transparent plate so that the laser dot can be easily aligned to the center of the pipe.

Centring with the optional shifting tribrach step-by-step

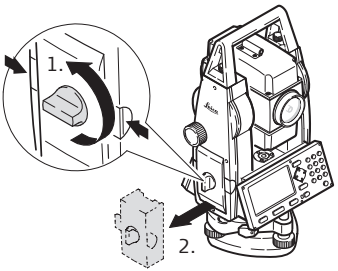


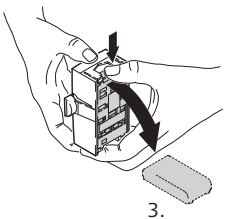
If the instrument is equipped with the optional shifting tribrach it can be aligned to the ground point by slight shifting.

Step	Description
1.	Loosen screw.
2.	Shift instrument.
3.	Fix instrument by turning screw.

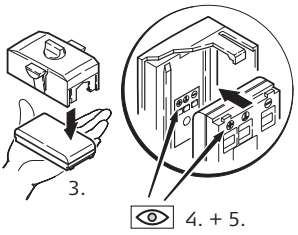
5.3 Instrument Battery

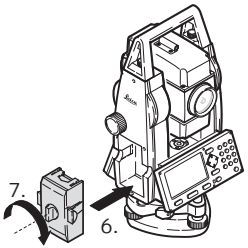
Change instrument battery step-by-step





Step	Description
1.	Face the instrument so that the vertical drive screw is on the left. The battery compartment is now on the left side of the instrument. Turn the knob to the vertical position, opening the lid of the battery compartment.
2.	Pull out the battery housing.
3.	Pull the battery or the GAD39 battery adapter from the battery housing.





Step	Description
4.	The polarity of the battery is displayed inside the battery housing. This is a visual aid to assist in placing the battery correctly.
5.	Place the battery/adapter into the battery housing, ensuring that the contacts are facing outward. Click the battery/adapter into position.
6.	Place the battery housing into the battery compartment. Push the battery housing in until it fits completely into the battery compartment.
7.	Turn the knob to lock the battery compartment. Ensure that the knob is returned to its original horizontal position.

For NiMH batteries:

Charging / first-time use

- The battery must be charged prior to using it for the first time because it is delivered with an energy content as low as possible.
- For new batteries or batteries that have been stored for a long time (> three months), it is effectual to make 3 - 5 charge/discharge cycles.
- The permissible temperature range for charging is between 0°C to +35°C/+32°F to +95°F. For optimal charging we recommend charging the batteries at a low ambient temperature of +10°C to +20°C/+50°F to +68°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 -20°C to +55°C/-4°F to +131°F.
- Low operating temperatures reduce the capacity that can be drawn; very high operating temperatures reduce the service life of the battery.

5.4 Distance Measurement

5.4.1 General

Description

A laser distancer (EDM) is incorporated into the instruments (Builder R, RM, M power and RM power) of the Builder series. In all these versions, the distance can be determined by using a visible red laser beam which emerges coaxially from the telescope objective.

There are multiple EDM types:

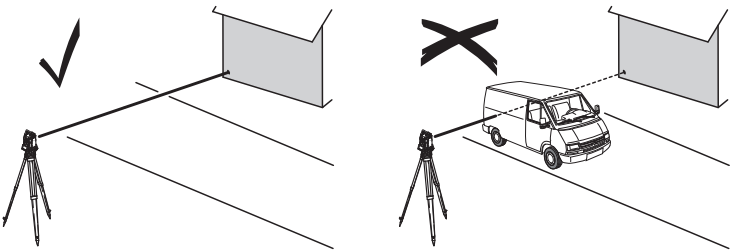
- Measurements with red dot (any surface or CPR105 flat-prism)
- Measurements with fine or fast (CPR111 BUILDER prism, true-zero offset)

Available EDM types depend on the model.

In the standard version of the Builder M power and RM power, the maximum distance measurement range is 1000 m. Please refer to "12.1 EDM" on how to upgrade the measurement range.

5.4.2 Measurement with Red Dot

Description



- When measurements are being made using the red laser EDM, the results may be influenced by objects passing between the EDM and the intended target surface. This occurs because red dot measurements are made to the first surface returning sufficient energy to allow the measurement to take place. For example, if the intended target surface is the surface of a road, but a vehicle passes between the EDM and the target surface as MEASURE or M&R is pressed, the measurement may be made to the side of the vehicle. The result is the distance to the vehicle, not to the road surface.
- When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment. If a temporary obstruction, for

example a passing vehicle, heavy rain, fog or snow is between the instrument and the point to be measured, the EDM may measure to the obstruction.

- Be sure that the laser beam is not reflected by anything close to the line of sight, for example highly reflective objects.
- When measuring longer distances, any divergence of the red laser beam from the line of sight might lead to less accurate measurements. This is because the laser beam might not be reflected from the point at which the crosshairs are pointing. Therefore, it is recommended that the visible laser beam is aligned with the center of the target. Refer to "14 Check & Adjust" for more information on how to check the alignment.
- Do not measure with two instruments to the same target simultaneously.

Guidelines for correct results:

- Do not measure to glass prisms as this may lead to incorrect distance values.

5.4.3 Measurement with Fine or Fast

Description

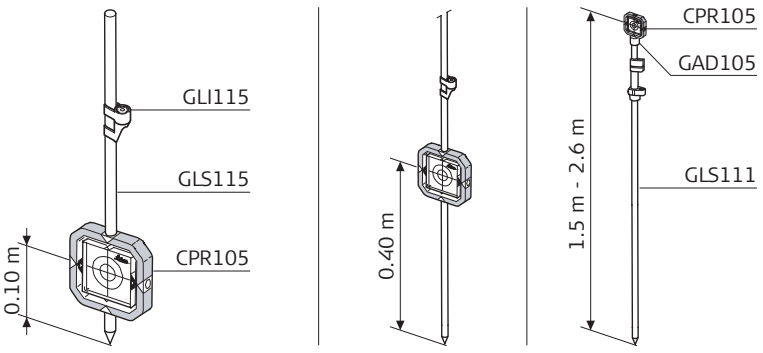
- Accurate measurements to prisms should be made with the standard program (EDM type: fine/fast)
- Measurements to strongly reflecting targets such as to traffic lights in reflector EDM mode without prism should be avoided. The measured distances may be wrong or inaccurate.
- Very short distances may be measured reflectorless in EDM type fine/fast to well reflecting targets.

5.5 CPR105 Flat Prism

Descprition

The standard supplied Flat Prism (delivered with Builder R, RM) has two different reflective surfaces. The highly reflective cat-eye surface can be used for measurements up to 250 m. The reflective tape has printed crosshairs for precise aiming at close range. The closer the flat prism is mounted to the ground, the more accurate it can be positioned over the measured point. For more precise positioning at higher prism positions, the GLS111 reflector pole with GAD105 adapter is recommended.

Prism mounting



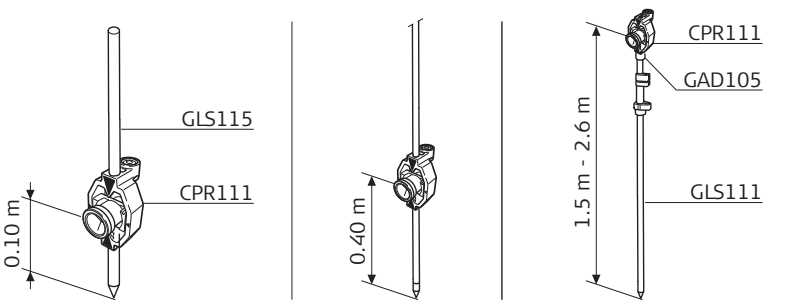
5.6 CPR111 BUILDER Prism, True-Zero Offset

Description

This prism with true-zero offset is only delivered with the Builder M power and RM power. The closer the prism is mounted to the ground, the more accurate it can be positioned over the measured point. For more precise positioning at higher prism positions, the GLS111 reflector pole with GAD105 adapter is recommended.

To guarantee the accuracy the prism must be aligned well. If it is not or the line of sight is very steep it is recommended to aim the middle of the yellow arrows on the prism frame.

Prism mounting



6 Configuration Mode

6.1 Overview

Description

The **CONFIG** mode is used for:

- creating user specific settings in order to adapt the instrument to your own requirements
- setting date and time
- setting units

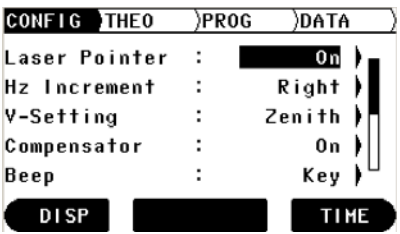
Descriptions apply in general to Builder R, RM, M power and RM power. Available options depend on the model.

6.2 Accessing

Access step-by-step

Step	Description
1.	Turn on the instrument by pressing the ⏻ key.
2.	Level up the instrument. Refer to "5.2 Instrument Setup" for more information.
3.	Press ⇆ until **CONFIG** mode is active.

Example of a configuration screen

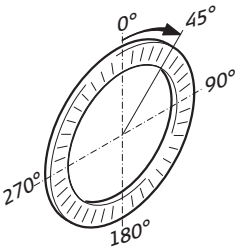
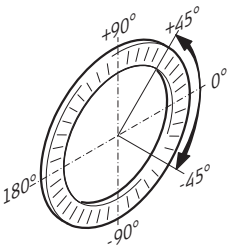


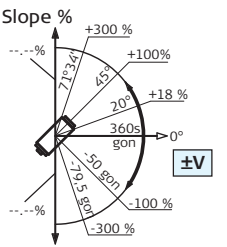
DISP To set configurations regarding display.

TIME To set date and time.

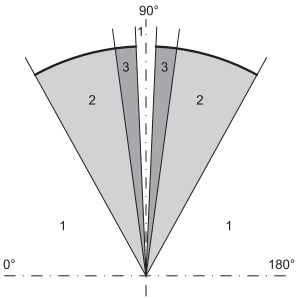
Description of fields for main configuration screen

Field	Option	Description
<Laser Pointer:> (only Builder R, RM and RM power)	**Off**	Turns off the visible laser beam.
	On	Turns on the visible laser beam.
	Off&Trk	Turns on continuous distance measure mode.
	On&Trk	Turns on continuous distance measure mode and visible laser beam.
<Tracking:> (only Builder M power)	**Off**	Turns off continuous distance measure mode.
	On	Turns on continuous distance measure mode.
<Hz Increment:>	**Right**	Sets horizontal angle to clockwise direction measurement.
	Left	Sets horizontal angle to counter-clockwise direction measurement.

Field	Option	Description
<V Setting:>		Sets the vertical angle.
	Zenith	Zenith=0°; Horizon=90° 
	Horizon	Zenith=90°; Horizon=0° Vertical angles are positive above the horizon and negative below it. 

Field	Option	Description
	V(%)	Vertical angles are expressed in % with positive above the horizon and negative below it. 100% corresponds to an vertical angle of 45° (50 gon, 800 mil).  The % value increases rapidly. --.--% appears on the display above 300%.
‹Compensator:›	**On**	Turns on the compensator. Vertical angles are relative to the plumb line. The horizontal angle is corrected for the transversal tilt errors, if ‹ Hz Correction: On ›. Refer to "14 Check & Adjust" for more information.

Field	Option	Description
	Off	Turns off the compensator. Vertical angles are relative to vertical/standing axis. If the instrument is used on an unstable base e.g.shaking platform, ship, etc. the compensator should be switched off. This avoids the compensator drifting out of its measuring range and interrupting the measuring process by indicating an error. ☞ The compensator setting remains active even after the instrument is switched off.
<Beep:>	**Off**	Turns key beep and sector beep off.
	Key	Turns only key beep on.
	Key&Sect	Turns key beep and sector beep on. Turns layout beep in Layout application on.
	Sector	Turns sector beep on. Turns layout beep in Layout application on.

Field	Option	Description
		The key beep is an acoustic signal after each keystroke. The sector beep is an acoustic signal which sounds if horizontal angle is 0°, 90°, 180°, 270° or 0, 100, 200, 300 gon. The sector beep is useful for staking out right angles. Example for sector beep: 

Field	Option	Description
		1 No beep 2 Fast beep, interrupted; from 95.0 to 99.5 gon and 105.0 to 100.5 gon 3 Permanent beep; from 99.5 to 99.995 gon and from 100.5 to 100.005 gon
<Battery Type:>	**Alcaline** **NiMH**	Battery symbol is not displayed in THEO mode. Battery symbol is displayed in THEO mode.
<Auto Off:>		Sets the behaviour of power down and instrument.
	Enable	The instrument is turned off after 20 minutes without any action, for example no key pressed; Vertical and horizontal angle deviation is ≤ ±3'.
	Disable	The instrument is turned on permanently. ☞ Battery discharges quicker.
	Sleep	The instrument is off until any key is pressed.
<Measure& Record:>		Assigns seperated or combined measurement functionality to middle softkey button in all measure screens.

Field	Option	Description
	MEAS/REC	Starts distance and angle measurements without saving measured values. After measurement displayed values can be saved with RECORD.
	ALL-in-1	Starts distance and angle measurements and saves measured values in one step.

Description of fields for display configuration screen

Field	Option	Description
<Contrast:>	**From 10% to 100%**	Adjusts the contrast level for the display immediately.
<Display Heater:>	**On or Off**	Turns the display heater immediately on and off. ☞ The display heater is automatically activated when the display illumination is on and the instrument temperature is ≤ 5°C.
<Angle Unit:>		The units shown for all angular and coordinate related fields.

Field	Option	Description
	° ' "	Degree sexagesimal: possible angle values: 0° to 359°59'59''
	Dec.deg	Degree decimal: possible angle values: 0° to 359.999°
	Gon	Gon: possible angle values: 0 gon to 399.999 gon
	Mil	Mil: possible angle values: 0 to 6399.99mil
		☞ The setting of the angle units can be changed at any time. The actual displayed values are converted according to the selected unit.
<Minimum Reading:>		The number of decimal places shown for all angular fields. This is for data display and does not apply to data export or storage.
	Precise (only 200M power, R200M power, R300M power)	0° 00' 01" for <Angle Unit: ° ' ''>. 0.0001 for <Angle Unit: Gon> and <Angle Unit: Dec.deg>. 0.01 for <Angle Unit: Mil>.

Field	Option	Description
	Precise or **Standard** (only 200M power, R200M power, R300M power)	0° 00' 01" for <Angle Unit: ° ' ''>. 0.001 for <Angle Unit: Gon> and <Angle Unit: Dec.deg>. 0.01 for <Angle Unit: Mil>.
	Standard or **Simple** (only 200M power, R200M power, R300M power)	0° 00' 05" for <Angle Unit: ° ' ''>. 0.005 for <Angle Unit: Gon> and <Angle Unit: Dec.deg> 0.05 for <Angle Unit: Mil>.
	Simple	0° 00' 10" for <Angle Unit: ° ' ''>. 0.010 for <Angle Unit: Gon> and <Angle Unit: Dec.deg>. 0.10 for <Angle Unit: Mil>.
<Distance Unit:>		The units shown for all distance and coordinate related fields.
	Meter	Metres [m]
	ft-in1/16	US feet, inches and 1/16 inches (0' 00 0/16 fi) [ft]
	Us-ft	US feet [ft]

Field	Option	Description
	INT-ft	International feet [fi]
<Language:>		The current loaded language(s) are shown.
<Lang. Dialog:>		If two languages are loaded onto the instrument a dialog to choose the language can be shown directly after switching on the instrument.
	On	The language dialog is shown as startup dialog.
	Off	The language dialog is not shown as startup dialog.

Description of fields for time configuration screen

Field	Option	Description
<Time Format:>	**24 hours or 12 hours (am/pm)**	Shown time format in all time related fields.
<Date Format:>	**dd.mm.yyyy,mm.dd.yyyy, or yyyy.mm.dd**	Shown date format in all date related fields.

6.3 How to Make a Setting

How to make a setting with a choicelist step-by-step

Step	Description
☞	Make sure that **CONFIG** Mode is active.
1.	Press  to set focus on desired field.
2.	Press  to access the choicelist.
3.	Press  to toggle through the list and set focus on desired field.
4.	Accept with **OK**.

How to make a setting with a choicefield step-by-step

Step	Description
☞	Make sure that **CONFIG** Mode is active.
1.	Press  to set focus on desired field.
2.	Press  to toggle through the settings and select desired field.
3.	Accept with **OK**.

7 Theodolite Mode

7.1 Overview

Description

The **THEO** mode is used for:

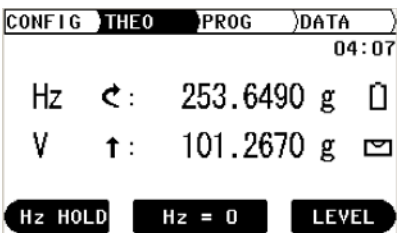
- levelling up the instrument with the electronic level and adjusting the intensity of the laser plummet
- reading off the current horizontal and vertical angle
- setting horizontal angle to zero
- setting any horizontal angle
- quick setting of horizontal and vertical angle direction

7.2 Accessing

Access step-by-step

Step	Description
1.	Turn on the instrument by pressing the ⏻ key.
2.	Level up the instrument. Refer to "5.2 Instrument Setup" for more information.
3.	Press ⇆ until **THEO** mode is active.

Example of a theodolite screen



Hz HOLD To set any horizontal angle.
Hz = 0 To set horizontal angle to 0.000.
LEVEL To switch on electronic level and laser plummet.

Description of fields

Field	Description
Hz 	The current horizontal angle in "clockwise direction measurement".
Hz 	The current horizontal angle in "anticlockwise direction measurement".  Thanks to dual axis compensation, Builder is able to adjust the horizontal angle reading accordingly. Therefore, turning the telescope vertically might cause the horizontal angle to change. The change in **<Hz:>** is the compensation of the standing axis tilt. The more precise the instrument is leveled, the less the horizontal angle needs to be compensated.
V	The current vertical angle with Zenith=0° and Horizon=90°.
V	The current vertical angle with Zenith=90° and Horizon=0°.
V %	The current vertical angle in percentage.

7.3 How to Set Horizontal Angle to 0.000

Set horizontal angle to 0.000 step-by-step

Step	Description
	Make sure that **THEO** Mode is active.
1.	Turn telescope and aim at desired target point.
2.	Press **Hz = 0**.
3.	Accept with **OK**.
	The horizontal angle is set to 0.000.

7.4 How to Set Any Horizontal Angle

Set any horizontal angle step-by-step

Step	Description
	Make sure that **THEO** Mode is active.
1.	Turn telescope to desired horizontal angle.
2.	Press **Hz hold**.
3.	Turn telescope and aim at a target point.
4.	Accept with **OK**.
	The indicated horizontal angle is set.

7.5 Quick Setting of Horizontal Angle and Vertical Angle Direction Measurement

Quick setting of horizontal angle direction measurement step-by-step

Step	Description
	Make sure that **THEO** Mode is active.
	Press  to set horizontal angle to "clockwise direction measurement" or press  to set horizontal angle to "counter-clockwise direction measurement".
	The horizontal angle is set to clockwise direction or counter-clockwise direction measurement.

Quick setting of vertical angle direction measurement step-by-step

Step	Description
☞	Make sure that **THEO** Mode is active.
	Press  to set vertical angle to the zenith, the horizon or in percentage.
☞	The vertical angle is set.

8 Program Mode, for Builder R, RM, M power and RM power

8.1 Overview

Description

The **PROG** mode is used for:
- distance measurements
- Station Setup
- working with application programs

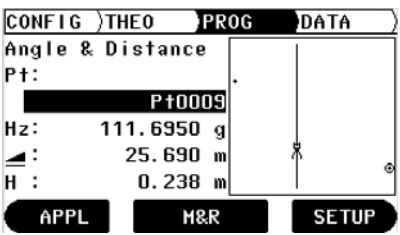
Descriptions apply to Builder R, RM, M power and RM power. Available options depend on the model.

8.2 Accessing

Access step-by-step

Step	Description
1.	Turn on the instrument by pressing the ⏻ key.
2.	Level up the instrument. Refer to "5.2 Instrument Setup" for more information.
3.	Press ⇆ until **PROG** mode is active.

Example of an application program screen



APPL To start application programs menu.

M&R To measure and display distances and record data.
To turn on/off Laserpointer by pressing approx. 5 seconds in all measure screens (except Builder M power).
To turn on/off Tracking mode by pressing approx. 5 seconds in Layout application.

SETUP To start station setup menu.

8.3 Pointsearch

Description

Pointsearch is a global function used by applications and setups, for example to find internally saved measured or fixed points.

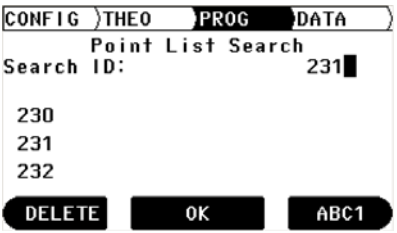
Descriptions apply to Builder RM, M power and RM power. Available options depend on the model.

Pointsearch step-by-step

Step	Description
1.	Turn on the instrument by pressing the key.
	Make sure that **PROG** mode is active.
2.	Choose an application, for example Layout.
3.	Press **APPL** to go back to application menu. (Only in application Layout)
4.	Press **P-List**.
5.	Enter in **<Search ID:>** the point identifier for that should be searched.
6.	Press **OK**.
7.	Press to select the point.
8.	Press **SELECT**.

Step	Description
☞	Now the point appears in the application that was active before.

Example of a Pointsearch screen



DELETE To remove the last character.
OK To access the point list.
ABC1 To switch between numeric and alphanumeric input.

Description of fields

Field	Description
<Search ID:>	Enter the point to be searched for.
231	The middle data point matches the entered information best.

8.4 Measure and Record

Possibilities

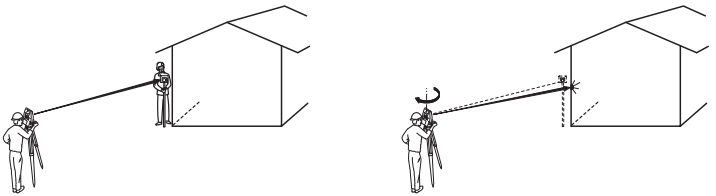
Two possibilities to measure and record points are offered:
- Measure and record in one step (ALL-in-1)
- Combining MEASURE and RECORD

Measure and record (ALL-in-1) step-by-step

Step	Description
☞	Make sure that **PROG** Mode is active.
☞	Make sure that **<Measure&Record: ALL-in-1>** is set. Refer to "6 Configuration Mode" for information on how to make the setting.
1.	Position the prism at the point to be measured.
2.	Press **M&R** to measure and record the distance and angles to the point.

Combining MEASURE and RECORD step-by-step

The key combination of **MEASURE** and **RECORD** can be used to measure non accessible points with the prism, for example building corners.



Step	Description
☞	Make sure that **PROG** Mode is active.
☞	Make sure that **<Measure&Record: MEAS/REC>** is set. Refer to "6 Configuration Mode" for information on how to make the setting.
1.	Position the prism at the same distance from the instrument as the building corner to be measured.
2.	Press **MEASURE** to measure the distance.
3.	Press **RECORD** to store the measured distance to the prism and the angles to the corner of the house.

9 Station Setup, for Builder R, RM, M power and RM power

9.1 Overview

Description

The Setup programs can be used to set up and orientate the instrument.

Three Setup options with different Setup methods are available:
- Control line
- Coordinates
- Height

Description of Setup menu options

Setup Option	Setup Method	Description
Control line	**Over 1st point**	To set up the instrument on the startpoint of a control line.
	Anywhere	To set up the instrument along a control line.
Coordinates	**Over Known Point**	To set up the instrument over a known point and orientate to a known azimuth or to up to five backsight points.

Setup Option	Setup Method	Description
	Anywhere	To set up the instrument on an unknown point and orientate by measuring angles and distances to up to five known target points.
Height	**Height Transfer**	To determine the height of the position of the instrument from measurements to up to five target points with known height.

For the different Setup methods, different types of data and a different number of control points have to be available.

Descriptions apply in general to Builder R, RM, M power and RM power. Available options depend on the model.

9.2 Setup Option 1: Establish Control Line

9.2.1 General

Description

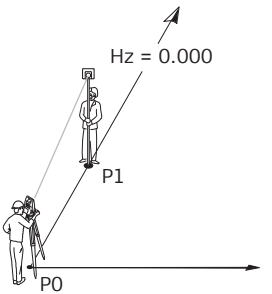
The Setup Option **Control Line** is used to set up the instrument in relation to a control line. All further measuring points and points to be staked are in relation to the control line.

9.2.2 Establish Control Line - Over 1st Point

Description

The Setup method **Control Line - Over 1st Point** is used to set the station coordinates to E_0= 0.000, N_0=0.000, H_0=0.000 and the orientation to 0.000.

Diagram



P0	Station
P1	Target point

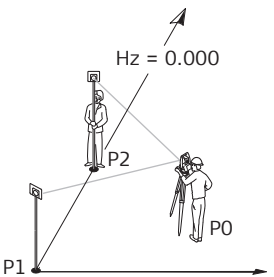
9.2.3 Establish Control Line - Anywhere

Description

The Setup method **Establish Control Line - Anywhere** is used to set up the instrument along a control line. The coordinates of line start point are set to E_0= 0.000, N_0=0.000 and H_0=0.000. The orientation is set to 0.000 in the direction of the second line point. Furthermore line startpoint can be shifted by entering or measuring line and offset values.

The height of line startpoint P1 is used as the reference height for all further measurements.

Diagram

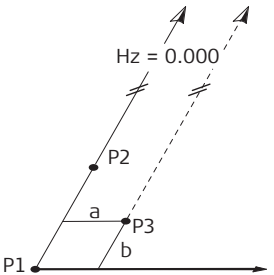


P0	Station
P1	Line start point
P2	Second line point

Shifting Line Startpoint

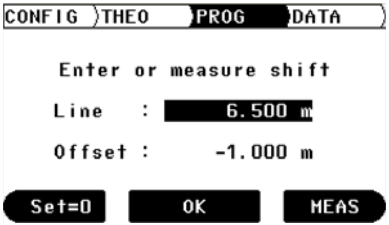
In Setup method **Establish Control line - Anywhere** line startpoint can be shifted to use another origin for the local coordinate system. If the entered line value is positive the start point moves forward otherwise backward. The start point gets a rightward shift if the entered offset value is positive otherwise a leftward shift.

Diagram



P1	Line start point
P2	Second line point
P3	Shifted line start point, new origin of local coordinate system
a	Offset value for shift
b	Line value for shift

Example of a dialog for shifting line startpoint



Set=0 To set line or offset values to zero.

OK To accept entered/measured line or offset values.

MEAS To measure new origin of local coordinate system.

9.3 Setup Option 2: Establish Coordinates

9.3.1 General

Description

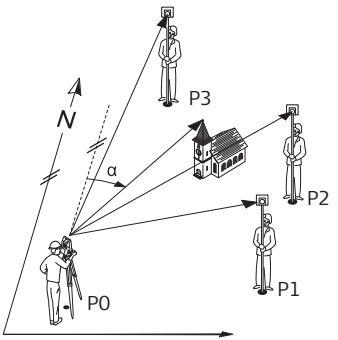
The Setup Option **Coordinates** is used to set up the instrument in relation to a local or global coordinate system. All further measuring points and points to be staked are in relation to the coordinate system.

9.3.2 Establish Coordinates - Over Known Point

Description

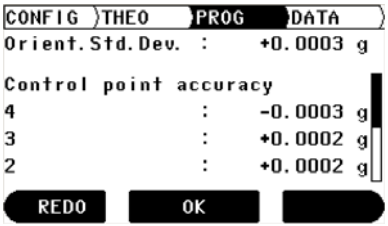
The Setup method **Establish Coordinates - Over Known Point** is used to set up the instrument on a known point and orient to a known azimuth or to up to five known backsight points. If more than one backsight point was used, the quality of the orientation is shown in the result screen.

Diagram



P0	Known Station
P1	Known backsight point
P2	Known backsight point
P3	Known backsight point
α	Azimuth

Example of a result screen



REDO To delete or re-measure an used backsight point.

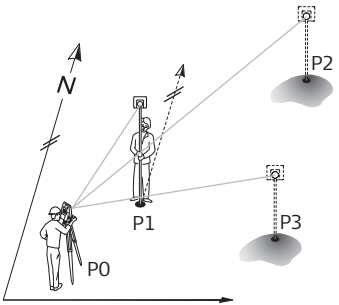
OK To accept computed/measured values.

9.3.3 Establish Coordinates - Anywhere

Description

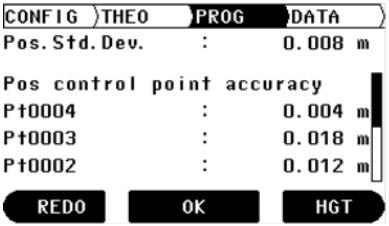
The Setup method **Establish Coordinates - Anywhere** is used to set up the instrument on an unknown point and set the orientation by measuring angles and distances to a minimum of two known target points and a maximum of five target points. Beside the computation of the position, the height is also computed if the measured target point has a known height. If more than two known target points were used, the quality of the new station is shown in the result screen.

Diagram



P0	Station
P1	First known point
P2	Second known point
P3	Third known point

Example of a result screen



REDO To delete or re-measure an used target point.

OK To accept computed/measured values.

HGT To switch to height result screen.

9.4 Setup Option 3: Establish Height

9.4.1 General

Description

The Setup Option **Establish Height** is used to enter the station height, instrument height and reflector height. All further measuring points and points to be staked are in relation to the entered values.

Enter station height, instrument height and reflector height step-by-step

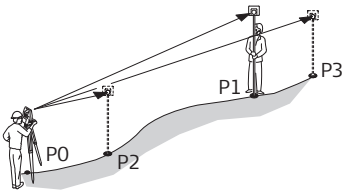
Step	Description
☞	Make sure that **PROG** Mode is active.
1.	Press **SETUP**.
2.	Press  to highlight Setup option **Height**.
3.	If a value for station height is shown, the value is related to the chosen setup method of **Control Line** or **Coordinates**. This value may be changed or in case of **<-----.---->**, a height can be entered.
4.	Enter station height, instrument height and reflector height.
5.	Accept with **OK**.

9.4.2 Height Transfer

Description

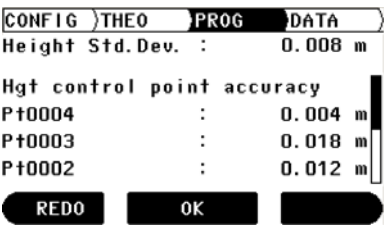
The Setup method **Height Transfer** is used to determine the height of the position of the instrument from measurements to up to five target points with known height.

Diagram



P0	Station
P1	First point with known height
P2	Second point with known height
P3	Third point with known height

Example of a result screen



REDO	To delete or re-measure an used point.
OK	To accept computed/measured values.

10 Application Programs, for Builder R, RM, M power and RM power

10.1 Overview

Description

Application programs are predefined programs, that cover a wide spectrum of construction tasks and facilitate daily work in the field. Up to nine different application programs are available.

Description of application programs

Application program	Description
Layout	To stake out points.
As Built	To measure points with line, offset and height difference or with easting, northing and height.
Angle & Distance	To measure points with horizontal angle, horizontal distance and height difference.
Tie Distance	To determine horizontal distance, height difference and grade between two measured points.
Area (tilt) & Volume	To determine area and perimeter of a plane and tilted surface. Furthermore a volume with constant height can be calculated.

Application program	Description
Hidden Point	To measure points that are not directly visible. Two methods: using a rod with two targets, alternatively enter line of sight shift and/or side shift manually.
COGO	Performs coordinate geometry calculations such as intersections and more.
Layout Line/Arc/Spiral	Layout and as-built check of lines, arcs or spirals. Includes road element and grid layout.
Measure & Descriptor	To measure and encode points.

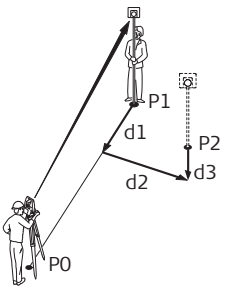
Descriptions apply to Builder RM, M power and RM power. Available options depend on the model.

10.2 Layout

Description

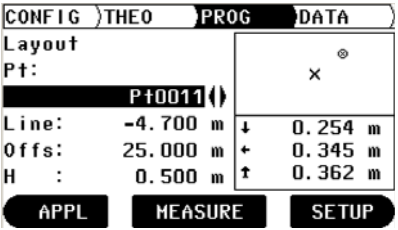
The application program **Layout** is used to place markers in the field at predetermined points. These predetermined points are the points to be staked. The points to be staked are defined by entering line and offset or easting, northing and height depending on the used setup method. For Builder RM, M and RM power the points can also be selected from the memory. The program calculates and displays the difference between the measured point and the point to be staked.

Diagram



P0	Station
P1	Current position
P2	Point to be staked
d1	‹↑:› go forward or ‹↓:› go back
d2	‹→:› go right or ‹←:› left
d3	‹↑:› fill or ‹↓:› cut

Example of a layout application screen



APPL To start application programs menu.

MEASURE To measure and display stake out differences. To turn on/off Tracking mode by pressing approx. 5 seconds.

SETUP To start station setup menu.

Description of fields

Field	Description
<Pt:>	The identifier for the points to be staked. Available for Builder RM, M power and RM power.
<Line:>	Available if a Setup method with **Control Line** was used. Longitudinal offset of the start point of the control line in the direction of the second point of the control line. Line is positive in the direction from line start point to second line point.
<Offs:>	Available if a Setup method with **Control Line** was used. Cross offset to the control line. Offset is positive at the right hand side of the control line.
<E:>	Available if a Setup method with **Coordinates** was used. Easting of point to be staked.
<N:>	Available if a Setup method with **Coordinates** was used. Northing of point to be staked.
<H:>	Height of point to be staked.

Elements of the graphical display

In application program **Layout** a graphical display provides a guide to find the point to be staked out.

Element	Description
⊗	Reflector
X	Point to be staked
<↑:> / <↓:>	go forward / back
<←:> / <→:>	go left / right
<↑:> / <↓:>	fill / cut

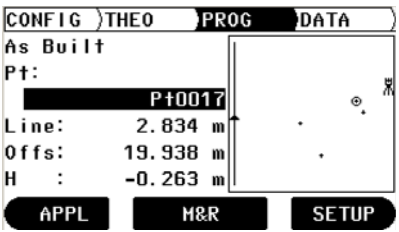
10.3 As Built

Description

The application program **As built** is used for measuring an unlimited number of points. The program shows line and offset values or easting, northing and height depending on the used Setup method.

Example of an As Built application screen

Displayed graphic and available values depend on the used Setup method.



APPL To start application programs menu.

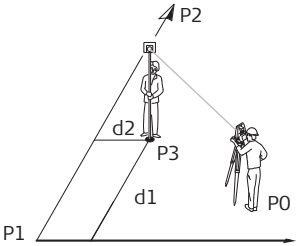
M&R To measure and display distances and record data. To turn on/off Laserpointer by pressing approx. 5 seconds (except Builder M power).

SETUP To start station setup menu.

Description of fields

Field	Description
<Pt:>	The identifier for the measured points. Available for Builder RM, M power and RM power.
<Line:>	Available if a Setup method with **Control Line** was used. Longitudinal offset of the start point of the control line in the direction of the second point of the control line. Line is positive in the direction from line start point to second line point.
<Offs:>	Available if a Setup method with **Control Line** was used. Cross offset to the control line. Offset is positive at the right hand side of the control line.
<E:>	Available if a Setup method with **Coordinates** was used. Easting of measured point.
<N:>	Available if a Setup method with **Coordinates** was used. Northing of measured point.
<H:>	Height of measured point.

Diagram



P0 Station
P1 Line start point
P2 Second line point
P3 Measured point
d1 Line
d2 Offset

Elements of the graphical display

In application program **As Built** a graphical display shows the position of the station, used control points, the reflector and the last 50 measured points.

Element	Description
	Station
	Control point
	Reflector

Element	Description
+	Measured point
	North
	Control Line

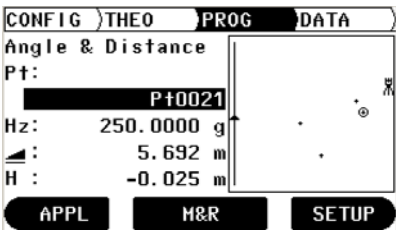
10.4 Angle & Distance

Description

The application program **Angle & Distance** is used for measuring an unlimited number of points. The program shows horizontal angle, horizontal distance and height.

Example of an Angle & Distance application screen

Displayed graphic and available values depend on the used Setup method.



APPL To start application programs menu.

M&R To measure and display distances and record data. To turn on/off Laserpointer by pressing approx. 5 seconds (except Builder M power).

SETUP To start station setup menu.

Description of fields

Field	Description
<Pt:>	The identifier for the measured points. Available for Builder RM, M power and RM power.
<Hz:>	The current horizontal angle.
	The measured horizontal distance to the target point.
<H:>	Height of measured point.

Elements of the graphical display

Refer to "10.3 As Built" for more information.

10.5 Tie Distance

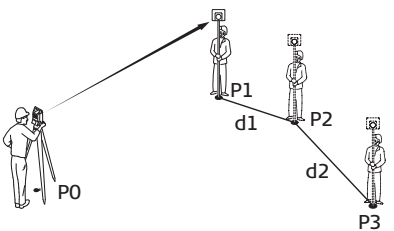
Description

The application program **Tie Distance** is used to compute horizontal distance, height difference and grade between two target points. The target points have to be measured.

The user can choose between two different methods:

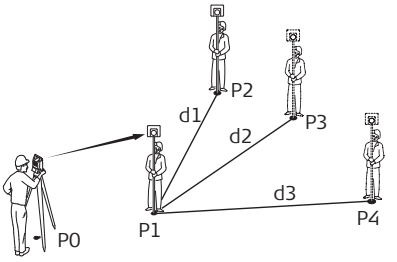
- Polygonal (P1-P2, P2-P3); 
- Radial (P1-P2, P1-P3); 

Diagram Polygonal (P1-P2, P2-P3)



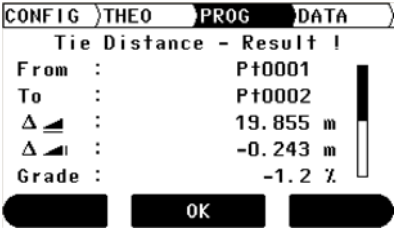
P0	Station
P1	Target point
P2	Target point
P3	Target point
d1	Distance between P1 and P2
d2	Distance between P2 and P3

Diagram Radial (P1-P2, P1-P3)



P0	Station
P1	Target point
P2	Target point
P3	Target point
P4	Target point
d1	Distance between P1 and P2
d2	Distance between P1 and P3
d3	Distance between P1 and P4

Example of a Tie Distance result screen



OK To measure more points.

Description of fields

Field	Description
<From:>	The identifier for the first measured point. Available for Builder RM, M power and RM power.
<To:>	The identifier for the second measured point. Available for Builder RM, M power and RM power.
Δ	Calculated horizontal distance between the measured points.
Δ 	Calculated height difference between the measured points.
<Grade:>	Calculated grade [%] between the measured points.
Δ 	Calculated slope distance between the measured points.

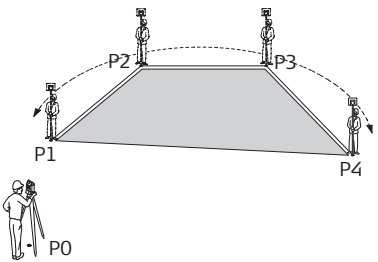
10.6 Area plane (tilt) & Volume

Description

The application program **Area** with methods 'plane' and 'tilt' is used to compute area size of areas with max. 50 boundary points connected by straights. Furthermore a volume with constant height can be calculated.
The calculated area is projected onto the horizontal plane or projected onto the tilted reference plane depending on the chosen method. The tilted reference plane is computed and updated automatically after each measurement. It is determined out of all current boundary points by those three points that stretch the largest area.

Diagram

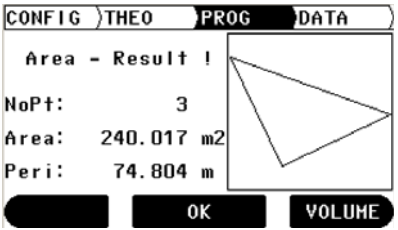
The boundary points have to be measured ordered, either in clockwise or anticlockwise direction.



P0	Station
P1	Start point
P2	Target point
P3	Target point
P4	Target point

The area is calculated and displayed once three points have been measured.

Example of an Area Result screen

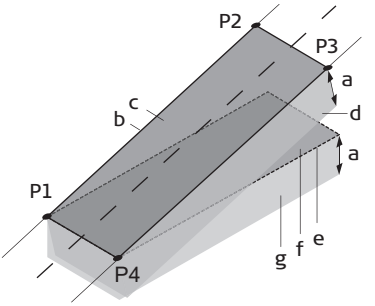


OK To measure more points.
VOLUME To calculate a volume with constant height.

Description of fields

Field	Description
<NoPt:>	Number of measured points.
<Area:>	Calculated area.
<Peri:>	Calculated perimeter.

Diagram



P0	Station
P1	Start Point
P2	Target Point
P3	Target Point
P4	Target Point
a	Constant height
b	Perimeter (tilt) of the tilted area stretched by all current measured points
c	Area (tilt), always closed to the start point P1 projected, onto the tilted reference plane
d	Volume (tilt) = c x a
e	Perimeter (plane) of the plane area stretched by all current measured points
f	Area (plane), always closed to the start point P1, projected onto the horizontal plane
g	Volume (plane) = f x a

10.7 Hidden Point (optional)

Description

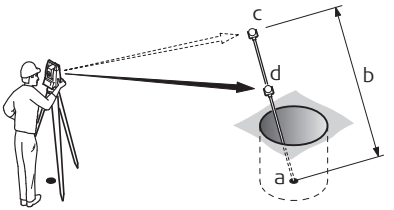
The application program **Hidden Point** allows measurements to a point that is not directly visible. The point can be determined by a rod or by entering the shift in the line of sight and the side shift.

The user can choose between two different methods:

- Rod 
- Shift 

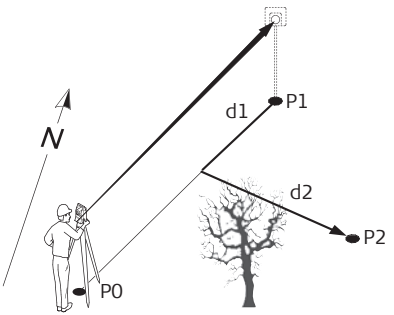
The application program Hidden Point is only available for the Builder RM, M power and RM power. The program can be started in total 40 times for trial. Afterwards you have to enter the license code.

Diagram Rod



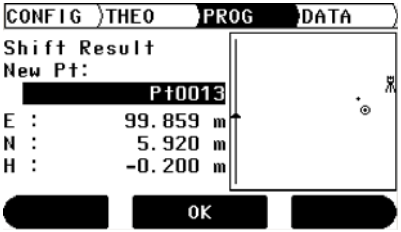
a) Hidden Point
b) Rod length
c) First reflector
d) Second reflector

Diagram Shift (Example)



P0 Station
P1 Reflector
P2 Hidden point
d1 Line of sight
d2 Side shift

Example of Hidden Point result screen



OK To measure next hidden point.

Description of fields

Field	Description
<RL=Rod Length:>	Length of used rod.
<Line of sight:>	Longitudinal offset from reflector in direction to the instrument.
<Side shift:>	Cross offset of hidden point to the line instrument-reflector.
<E:>	Easting of hidden point.
<N:>	Northing of hidden point.
<H:>	Height of hidden point.

Elements of the graphical display

In application program Hidden Point a graphical display shows the position of the station, the reflector and the hidden point.

Element	Description
	Station
	Line instrument-reflector
	Reflector/first measured target of the rod
+	Hidden point
	North
	Control Line

10.8 COGO (optional)

Description

The application program **COGO** is an application program to perform **co**ordinate **g**e-**o**metry calculations such as:

- Coordinates of points
- Directions between points
- Distances between points

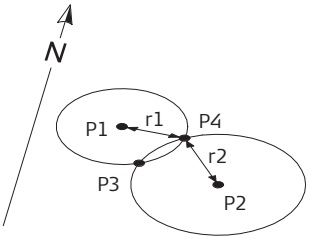
The COGO calculation methods are:

- Intersections
- Line Extension
- Offset Line&Plane
- Traverse and Inverse

The application program COGO is only available for the Builder RM, M power and RM power. The program can be started in total 40 times for trial. Afterwards you have to enter the license code.

Diagram Intersections

Two Distances



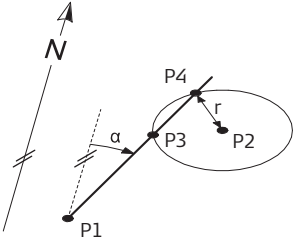
Known

P1 First known point
P2 Second known point
r1 Radius, as defined by the distance from P1 to P3 or P4
r2 Radius, as defined by the distance from P2 to P3 or P4

Unknown

P3 First COGO point
P4 Second COGO point

Direction&Distance



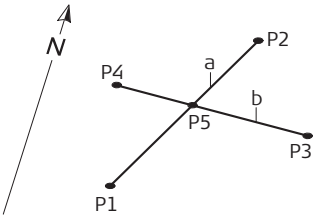
Known

P1 First known point
P2 Second known point
α Direction from P1 to P3 and P4
r Radius, as defined by distance from P2 to P3 and P4

Unknown

P3 First COGO point
P4 Second COGO point

Two Lines



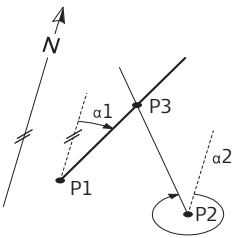
Known

P1 First known point of line 1
P2 Second known point of line 1
P3 First known point of line 2
P4 Second known point of line 2
a Line 1
b Line 2

Unknown

P5 COGO point

Two Directions



Known

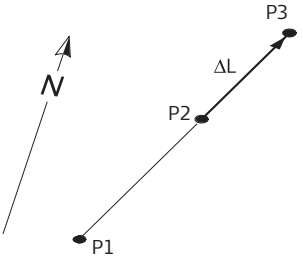
P1 First known point
P2 Second known point
α1 Direction from P1 to P3
α2 Direction from P2 to P3

Unknown

P3 COGO point

Diagram Line Extension

The **Extension** routine computes extended point from base line.



Known

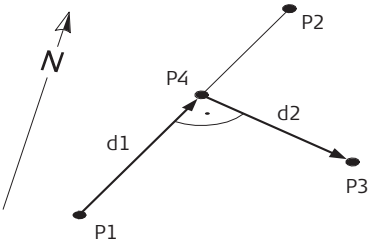
P1 Baseline start point
P2 Baseline end point
ΔL Distance from end point

Unknown

P3 Extended point

Diagram Offset Line & Plane

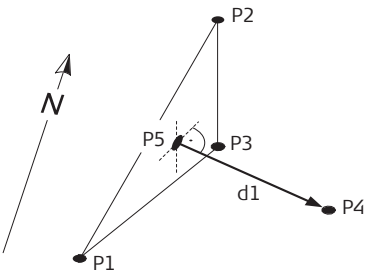
Line Offset



Known
- P1 Baseline start point
- P2 Baseline end point
- P3 Offset point

Unknown
- P4 Base point
- d1 Line
- d2 Offset

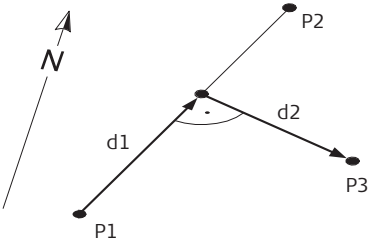
Plane Offset



Known
- P1 Point 1 which defines plane
- P2 Point 2 which defines plane
- P3 Point 3 which defines plane
- P4 Offset point

Unknown
- P5 COGO point
- d1 Offset

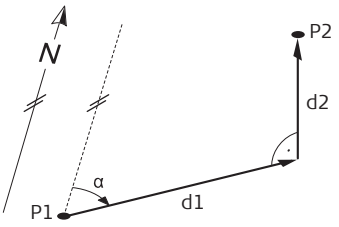
Set Point by Offset



Known
P1 Baseline start point
P2 Baseline end point
d1 Line
d2 Offset
Unknown
P3 Offset point

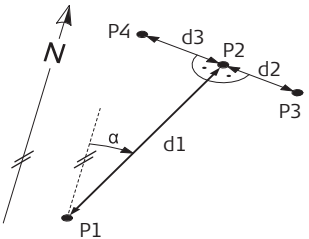
Diagram Inverse & Traverse

Inverse



Known
P1 First known point
P2 Second known point
Unknown
d1 Horizontal distance between P1 and P2
d2 Height difference between P1 and P2
α Direction from P1 to P2

Traverse



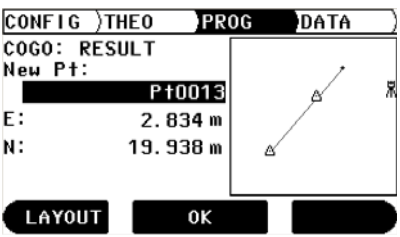
Known

P1 Known point
α Direction from P1 to P2
d1 Horizontal distance between P1 and P2
d2 Positive offset to the right
d3 Negative offset to the left

Unknown

P2 COGO point without offset
P3 COGO point with positive offset
P4 COGO point with negative offset

Example of a COGO Result screen



LAYOUT To stake out new COGO point.

OK To calculate next point.

Description of fields

Refer also to the applications before.

Field	Description
<Direction:>	Direction between two points.
<Dist.:>	Distance between two points.
<Line:>	Longitudinal offset from the start point of the baseline.
<Offset:>	Cross offset to the baseline.
	Calculated horizontal distance between two points.
	Calculated height difference between two points.
<New Point:>	The identifier for the new COGO points.
<E:>	Easting of new COGO point.
<N:>	Northing of new COGO point.
<H:>	Height of new COGO point.

Elements of the graphical display

In application program COGO a graphical display shows the position of the station, used known points, directions, distances and the new calculated point.

Element	Description
	Station
— — — — — —	Direction between two points
————————	Distance between two points
————————	Distance and direction between two points
	Known point
+	New calculated COGO point

Refer to "10.2 Layout" for more information.

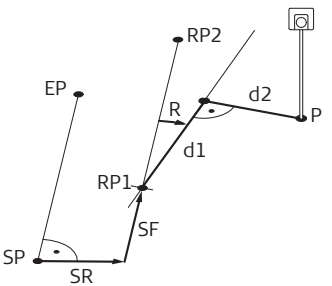
10.9 Layout Line/Arc/Spiral (optional)

Description

The application program **Layout Line/Arc/Spiral** facilitates the easy stake out or checking of lines, grids, arcs, segments and spirals. Besides the usual layout of these elements, this application allows the user to stake out and check points relative to a road alignment.

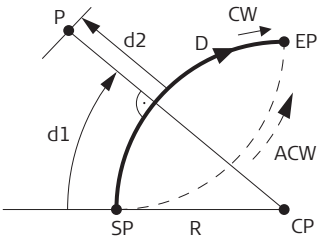
The application program Layout Line/Arc/Spiral is only available for the Builder RM, M power and RM power. The program can be started in total 40 times for trial. Afterwards you have to enter the license code.

Diagram Line



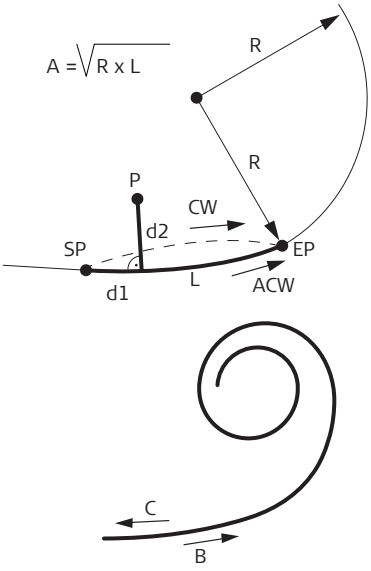
SP	Start point
EP	End point
RP1	Reference line start point
RP2	Reference line end point
SF	Shift forward
SR	Shift right
R	Rotate
d1	Line
d2	Offset
P	Point to stake or check

Diagram Arc



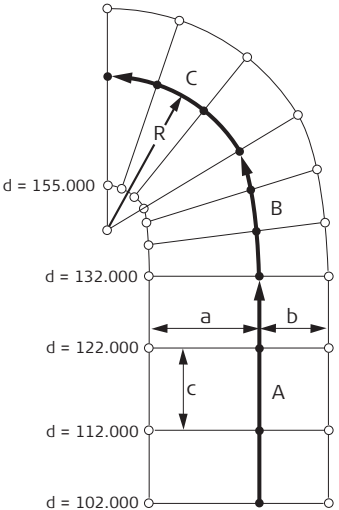
SP	Start point of arc
EP	End point of arc
CP	Center point of circle
R	Radius of arc
D	Direction
d1	Line
d2	Offset
P	Point to stake or check
CW	Arc-turn clockwise
ACW	Arc-turn anticlockwise

Diagram Spiral



SP	Start point of spiral
EP	End point of spiral
R	Radius
L	Length
A	Spiral parameter
CW	Spiral-turn clockwise
ACW	Spiral-turn anticlockwise
P	Point to stake or check
d1	Line
d2	Offset
B,C	Spiral direction (in, out)

Diagram Road



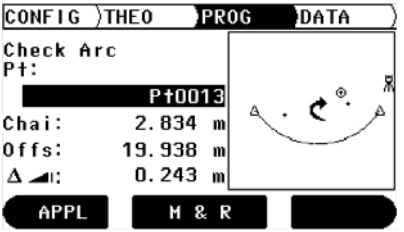
A Line
B Spiral
C Arc

R Radius

a Offset left
b Offset right
c Interval
d Defined chainage

It's only possible to work with one element (Line or Arc or Spiral).

Example of Layout Line/Arc/Spiral result screen



APPL To start application programs menu.

M & R To measure and display distances and record data. To turn on /off Laser pointer by pressing approx. 5 seconds (except Builder M power).

Description of fields

Field	Description
<Chai:>	Chainage.
<Line:>	Longitudinal offset of measured point from start point of reference line.
<Arc:>	Longitudinal offset of measured point from start point of arc.
<Spir:>	Longitudinal offset of measured point from start point of spiral.
<Offs:>	Cross offset of measured point to reference element.
Δ	Calculated height difference between start point of the element and measured point.

Elements of the graphical display

In application program Layout Line/Arc/Spiral a graphical display shows the position of the station, reference element with its definitions, the reflector and the last 50 measured points.

Element	Description
	Station
	Control point
	Reflector

Element	Description
+	Measured point
	Turn of element

Refer to "10.2 Layout" for more information.

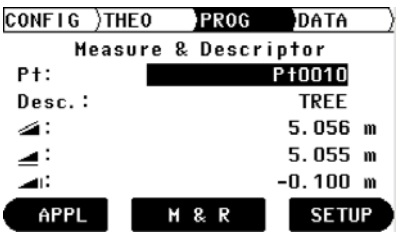
10.10 Measure & Descriptor

Description

In the program **Measure & Descriptor** it is possible to give each measured point a descriptor. Further it shows slope and horizontal distances and height differences.

The application program Measure & Descriptor is only available for the Builder M power and RM power.

Example of Measure & Descriptor application screen



APPL To start application programs menu.

M & R To measure and display distances and record data. To turn on /off Laser pointer by pressing approx. 5 seconds (except Builder M power).

SETUP To start station setup menu.

Description of fields

Field	Description
<Pt:>	The identifier for the measured points.

Field	Description
<Desc.:>	Entry of the description.
	The measured slope distance to the target point.
	The horizontal distance to the target point.
	The height difference to the target point.

11 Data Management Mode, for Builder RM, M power and RM power

11.1 Overview

Description

The **DATA** mode is used for:

- creating, viewing and deleting data in the field
- setting the communication parameters

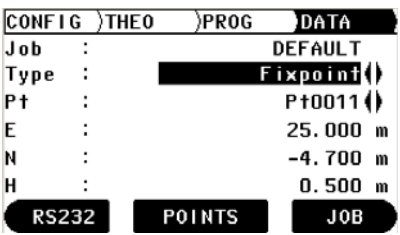
Descriptions apply to Builder RM, M power and RM power.

11.2 Accessing

Access step-by-step

Step	Description
1.	Turn on the instrument by pressing the ⏻ key.
2.	Level up the instrument. Refer to "5.2 Instrument Setup" for more information.
3.	Press ⇆ until **DATA** mode is active.

Example of a data management screen



RS232 To set the communication parameters.

POINTS To access the point management.

JOB To access the job management.

Description of fields

Field	Description
<Job:>	The current active job name.
<Type:>	Fixpoint, Measurement and Result
<Pt:>	The active identifier for points.
<E:>	Easting coordinate
<N:>	Northing coordinate
<H:>	Height

11.3 Jobs

Description

Jobs are a summary of different types of data e.g. fixpoints, measurements, result, etc. The job definition consists of the input of job name, operator and remark. Additionally, the system generates time and date at the time of creation.

Active job

The active job is the one in which data is stored to. One job is always considered the active job.

Default job

A job called **Default** is always available on the instrument. The job **Default** is active until a user defined job is created and selected.

Create a new job step-by-step

Step	Description
☞	Make sure that **DATA** Mode is active.
1.	Press **JOB** to access job management.
2.	Press **NEW** to create a new job.
3.	Enter new job name.
4.	Accept with **OK**.
☞	The new job is set as active job.

View and select a job step-by-step

Step	Description
☞	Make sure that **DATA** Mode is active.
1.	Press **JOB** to access job management.
2.	Press ◀● to toggle through the jobs and select job.
3.	Accept with **OK**.
☞	The selected job is set as active job.

Delete a job step-by-step

Step	Description
☞	Make sure that **DATA** Mode is active.
1.	Press **JOB** to access job management.
2.	Press ◀● to toggle through the jobs and select job.
3.	Press **DELETE**.
4.	Accept with **YES**.
☞	The selected job is deleted. Data is not recoverable.

11.4 Fixpoints

Description

Fixpoints contain at least a point identifier, easting and northing or height.

Fixpoints can be
- created, viewed and deleted in the field
- downloaded for data transfer to a further program
- uploaded, for example for stakeout operations

Create a new fixpoint step-by-step

Step	Description
☞	Make sure that **DATA** Mode is active.
1.	Press ◀● to set **<Type:> Fixpoint**.
2.	Press **POINTS** to access point management.
3.	Press **NEW PT** to create a new fixpoint.
4.	Enter point identifier, easting, northing and/or height.
5.	Accept with **OK**.
☞	The new point is created.

View a fixpoint step-by-step

Step	Description
☞	Make sure that **DATA** Mode is active.
1.	Press ◀▶ to set **<Type:> Fixpoint**.
2.	Press ▼ to set focus on **<Pt:>**.
3.	Press ◀▶ to toggle through the points.
☞	The coordinates are displayed on same screen.

Delete a fixpoint step-by-step

Step	Description
☞	Make sure that **DATA** Mode is active.
1.	Press ◀▶ to set **<Type:> Fixpoint**.
2.	Press ▼ to set focus on **<Pt:>**.
3.	Press ◀▶ to toggle through the points and select point.
4.	Press **POINTS** to access point management.
5.	Press **DELETE** to delete point.
6.	Accept with **YES**.

Step	Description
☞	The selected point is deleted. Data is not recoverable.

11.5 Measurements

Description

Measurement data contains at least horizontal angle, vertical angle, horizontal distance, slope distance, height difference, data, time and if applicable, line, offset, easting, northing and height coordinates.

Measurement data can be:
- viewed
- deleted
- downloaded for data transfer to a further program

View a measurement step-by-step

Step	Description
☞	Make sure that **DATA** Mode is active.
1.	Press ◁▷ to set **<Type:> Measurement**.
2.	Press ▽ to set focus on **<Pt:>**.
3.	Press ◁▷ to toggle through the points.
☞	The coordinates are displayed on same screen.
4.	Press **POINTS** to access point management.
☞	Measurement values are displayed.

Delete a measurement step-by-step

Step	Description
	Make sure that **DATA** Mode is active.
1.	Press  to set **<Type:> Measurement**.
2.	Press  to set focus on **<Pt:>**.
3.	Press  to toggle through the points and select point.
4.	Press **POINTS** to access point management.
5.	Press **DELETE** to delete point.
6.	Accept with **YES**.
	The selected point is deleted. Data is not recoverable.
	Deleting measurements is not available for application programs Tie Distance and Area because of the result calculation.

11.6 Result

Description

Result data contains a result identifier and the different values depending on the application. The applications from which these result data can be displayed are **Area** and **Tie Distance**.
Result data can be:

- viewed
- downloaded for data transfer to a further program

View a result step-by-step

Step	Description
	Make sure that **DATA** Mode is active.
1.	Press  to set **<Type:> Result**.
2.	Press  to set focus on **<Res.>**.
3.	Press  to toggle through the results.
	The first three rows of the result are displayed on the same screen.
4.	Press **VIEW** to access result management.
	Result values are displayed.

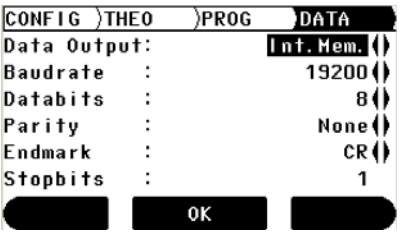
11.7 Communication Parameters

Description

Data can be stored in internal memory or to an external device such as PDA, Data Collector or PC through the RS232 interface.

For data transfer between instrument and external device the communication parameters of the serial interface RS232 must be set.

Example of a communication parameter screen



Description of fields

Field	Option	Description
Data Output	**RS232**	Data is recorded via the serial interface. For this purpose, a data storage device must be connected.
	Int. Mem.	All data is recorded in the internal memory.
Baudrate	**2400, 4800, 9600, or 19200**	Frequency of data transfer from receiver to device in bits per second.
Databits		Number of bits in a block of digital data.
	7	Set automatically if **<Parity:> Even** or **Odd**.
	8	Set automatically if **<Parity:> None**.
Parity	**None, Even or Odd**	Error checksum at the end of a block of digital data.
Endmark	**CR/LF**	The terminator is a carriage return followed by a linefeed.
	CR	The terminator is a carriage return.
Stopbits	**1**	Number of bits at the end of a block of digital data.

Standard RS232

Standard RS232 is supported by default.

Field	Option
Baudrate	19200
Databits	8
Parity	None
Endmark	CR/LF
Stopbits	1

Set communication parameters step-by-step

Step	Description
☞	Make sure that **DATA** Mode is active.
1.	Press **RS232** to access communication parameter setting.
2.	Press  to set focus on desired field.
3.	Press  to toggle through the settings and select desired field.
4.	Accept with **OK**.
☞	The setting is overtaken.

11.8 Data Transfer

Description

For data transfer use:

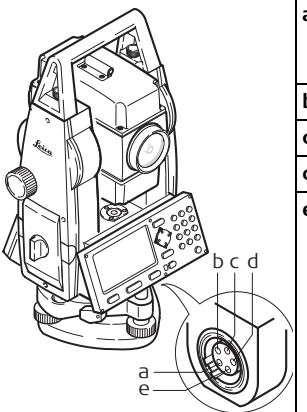
- Construction Data Manager
  Simple office software which supports the exchange of Leica TPS data with the PC, using a Windows® application.

OR

- **L**eica **G**eo **O**ffice Tools
  Office software including a series of programs which supports working with the Builder RM, M power and RM power.

11.9 Pin Assignment

Port at the instrument

Diagram	Pin	Name	Description	Direction
	**a**	**PWR_IN**	Power input: + 12 V nominal (11 - 16 V)	In
	b	**-**	Not used	-
	c	**GND**	Single ground	-
	d	**Rx**	RS232, receive	In
	e	**Tx**	RS232, transmit	Out

12 EDM Settings

12.1 EDM

Description

With the instrument different settings are available for measurements with red dot (without reflectors) and fine/fast (with reflectors). The LED on the keyboard indicates the selected type. Depending on the selected type the selection of prism types is different. Red dot contains the flat prism as the only one and isn't displayed. Beside the settings of the EDM it is possible to set the reflector height.

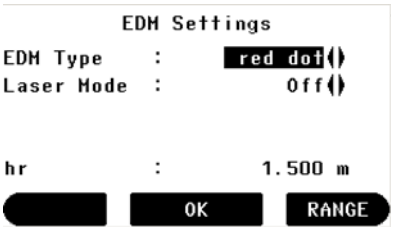
Descriptions apply only to Builder M power and RM power.

Access step-by-step

Step	Description
1.	Turn on the instrument by pressing the key.
2.	Press the key.
	EDM settings are not accessible during the following: • **CONFIG Mode**: Choice list is opened. • **THEO Mode**: Level or orientation procedure is running. • **PROG Mode**: „YES or NO“ decision, for example „Station and Orientation will be changed and set“ or Point List Search is running. • **DATA Mode**: One of the procedures RS232, POINTS or JOB is running.

Step	Description
3.	Make desired settings.
4.	Accept with **OK**.

Example of EDM settings screen



OK To accept settings.
RANGE To disable limited distance measurement. Button disappears when entered once.

Description of fields

Field	Option	Description
<EDM type:>	**fine**	Fine measuring type for high precision measurements with prisms.
	fast	Quick measuring type with higher measuring speed and reduced accuracy.

Field	Option	Description
	red dot	For distance measurements without prisms (only Builder RM power).
<Laser Mode:> (only Builder RM power)	**Off**	Turns off the visible laser beam.
	On	Turns on the visible laser beam.
	Off&Track	Turns on continuous distance measure mode.
	On&Track	Turns on continuous distance measure mode and visible laser beam.
<Tracking:> (only Builder M power)	**Off**	Turns off continuous distance measure mode.
	On	Turns on continuous distance measure mode.
<Prism Type:>	**TrueZero**	CPR111 BUILDER Prism, True-Zero Offset
	JpMini	Sliding Mini Prism
	Mini	Leica Mini Prism
	Round	Standard Leica Prism
	Flat Prism	CPR105 Flat Prism
	Tape	Reflective Tape
	User	User can define his own prism.

Field	Option	Description
<Prism Const.:>		Entry of a user specific prism constant in [mm].
<hr:>		Entry of reflector height.

12.2 PPM

Description

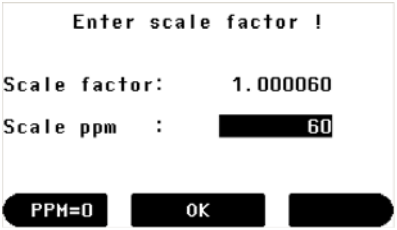
This option enables the entry of a scale factor. Measured values and coordinates are corrected with the PPM parameter.

Descriptions apply only to Builder M power and RM power.

Access step-by-step

Step	Description
1.	Make sure that **EDM Settings** is active.
2.	Press ✱ for approximately 5 seconds.
3.	Enter the PPM parameter.
4.	Accept with **OK**.

Example of PPM screen



PPM=0 To set PPM parameter to zero.

OK To accept parameter

Description of fields

Field	Description
<Scale factor:>	Calculated scale factor.
<Scale ppm:>	Entry of PPM value to calculate scale factor.

13 System Info and Instrument Protection

13.1 System Info

Description

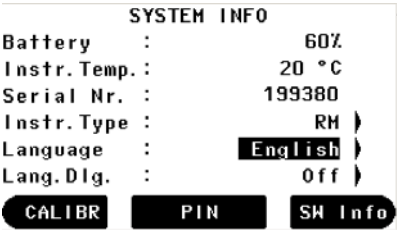
The System Info is used for:
- checking system and software information
- performing the calibrations of the instrument errors

Descriptions apply in general to all Builder models. Available options depend on the model.

Access step-by-step

Step	Description
1.	Turn on the instrument by pressing the ⏻ key.
☞	Make sure that **THEO** mode is active.
2.	Press ESC for approximately 5 seconds.

Example of a system info screen



CALIBR To access the calibration routine. Refer to chapter "14 Check & Adjust".

PIN To access PIN-code settings.

SW Info To access software information.

Description of fields

Field	Description
<Battery:>	Remaining battery power (e.g. 60%).
<Instr.Temp.:>	Measured instrument temperature in ° C.
<Serial Nr.:>	Serial number of the instrument.

Field	Description
<Instr.Type:>	An alternative instrument type can be selected to reduce the software functionality, e.g. for demonstration purpose. For Builder RM power the instrument type M power, RM, R and T may be chosen as an alternative. For Builder M power the instrument type T may be chosen as an alternative. For Builder RM the instrument type R and T may be chosen as an alternative. For Builder R the instrument type T may be chosen as an alternative. For Builder T this choice is not available. ☞ The setting can be reversed.
<Language:>	The current loaded language(s) are shown.
<Lang.Dialog:>	If two languages are loaded onto the instrument a dialog to choose the language can be shown directly after switching on the instrument. **<On>** The language dialog is shown as startup dialog. **<Off>** The language dialog is not shown as startup dialog.

13.2 Instrument Protection (PIN)

Description

The instrument can be protected by a **P**ersonal **I**dentification **N**umber. If the PIN protection is activated, the instrument will always prompt for a PIN code entry after starting up. As soon as the PIN was activated the access to the PIN code settings requires the PIN. If a wrong PIN has been typed in five times, a **P**ersonal **U**nbloc**K**ing code is required which can be found on the instrument delivery papers. If the PUK code was entered correctly, the PIN code is set to default value "0" and the PIN protection is deactivated.

Activate PIN code step-by-step

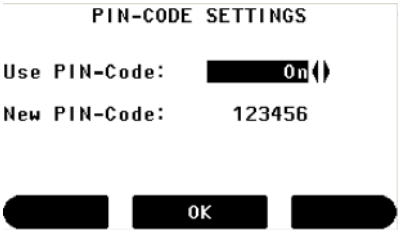
Step	Description
1.	Turn on the instrument by pressing the ⏻ key.
☞	Make sure that **THEO** mode is active.
2.	Press ESC for approximately 5 seconds.
3.	Press **PIN** to access PIN code settings.
4.	Activate PIN by setting **<Use PIN-Code>: On**.
5.	Enter your desired personal PIN Code (max. 6 character numeric) in **<New PIN-Code>:**.
6.	Accept with **OK**.

Step	Description
	Now the instrument is protected against unauthorized use. After switching on the instrument or re-enter in the PIN settings the PIN code entry is necessary.

Deactivate PIN code step-by-step

Step	Description
1.	Turn on the instrument by pressing the ⏻ key.
	Make sure that **THEO** mode is active.
2.	Press ESC for approximately 5 seconds.
3.	Enter your personal PIN in **<PIN-CODE>:**.
4.	Accept with **OK**.
5.	Deactivate PIN by setting **<Use PIN-Code>: Off**.
6.	Accept with **OK**.
	Now the instrument isn't protected anymore against unauthorized use.

Example of a PIN code settings screen



OK To accept settings.

Description of fields

Field	Option	Description
<Use PIN-Code:>	**On** **Off**	To activate PIN-code. To deactivate PIN-code.
<New PIN-Code:>		To enter your personal PIN-code (max. 6 character numeric).

14 Check & Adjust

14.1 Overview

Description

Leica 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 can be done in the field by running through specific measurement procedures. The procedures are guided and have to be followed carefully and precisely as described in the following chapters. Some other instrument errors and mechanical parts can be adjusted mechanically.

Electronic adjustment

The following instrument errors can be checked and adjusted electronically:

l, t	Compensator longitudinal and transversal index errors
i	Vertical index error, related to the standing axis
c	Hz collimation error, also called line of sight error

Every angle measured in the daily work is corrected automatically if the compensator and the Hz-correction are activated.

Mechanical adjustment

The following instrument parts can be adjusted mechanically:

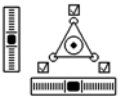
- Circular level on instrument and tribrach
- Laser plummet

- Screws on tripod
- Visible red laser beam for Builder R, RM and RM power. Only Leica Geosystems authorized service workshops are entitled to adjust these products.
- Vertical line of the reticule for Builder T

During the manufacturing process, the instrument errors are carefully determined and set to zero. As mentioned above, these errors can change and it is highly recommended to redetermine them in the following situations:

- Before the first use
- Before every high precision survey
- After rough or long transportations
- After long working periods
- After long storage periods
- If the temperature difference between current environment and the temperature at the last calibration is more than 20°C

14.2 Preparation



Before determining the instrument errors, the instrument has to be levelled-up using the electronic level.
The tribrach, the tripod and the underground should be very stable and secure from vibrations or other disturbances.

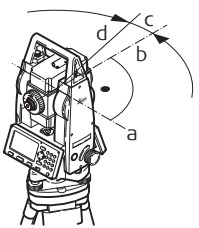
The instrument should be protected from direct sunlight in order to avoid thermal warming.
It is also recommended to avoid strong heat shimmer and air turbulence. The best conditions are usually early in the morning or with overcast sky.

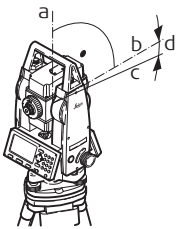
Before starting to work, the instrument has to become acclimatised to the ambient temperature. Approximately two minutes per °C of temperature difference from storage to working environment but at least 15 min should be taken into account.

14.3 Combined Adjustment of Hz Collimation (c), Vertical Index (i) and Compensator Index (l, t) Errors

Description

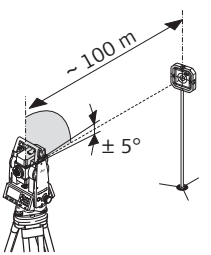
The combined adjustment procedure determines the following instrument errors in one process:

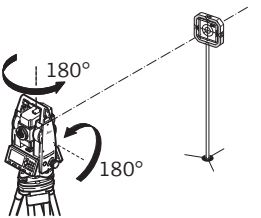
Type	Description	Diagram
c	The Hz collimation error (c) is also called line of sight error. It is caused by the deviation between the optical line of sight, which means the direction in which the crosshairs points and the line perpendicular to the tilting axis. This error affects all Hz readings and increases with steep sightings.	 a) Tilting axis b) Line perpendicular to tilting axis c) Hz collimation error (c), also called line of sight error d) Line of sight

Type	Description	Diagram
i	A vertical index error (i) exists, if the 0° mark of the vertical circle reading doesn't coincide with the mechanical vertical axis of the instrument, also called standing axis. The vertical index error (i) is a constant error that affects all vertical angle readings.	 a) Mechanical vertical axis of the instrument, also called standing axis b) Axis perpendicular to the vertical axis c) V = 90° reading d) Vertical index error
l, t	Compensator longitudinal (l) and transversal (t) index errors	

Combined adjustment procedure step-by-step

The following table explains the most common settings. Refer to the stated chapter for more information on screens.

Step	Description
1.	Turn on the instrument by pressing the ⏻ key.
2.	Level up the instrument. Refer to "5.2 Instrument Setup" for more information.
☞	Make sure that **THEO** mode is active.
3.	Press ESC for approximately 5 seconds until **SYSTEM INFO** is active.
4.	Press **CALIBR**.
5.	Press **NEW**.
6.	 Aim with the telescope accurately at a target at a distance of about 100 m. The target must be positioned within ± 5° of the horizontal plane.

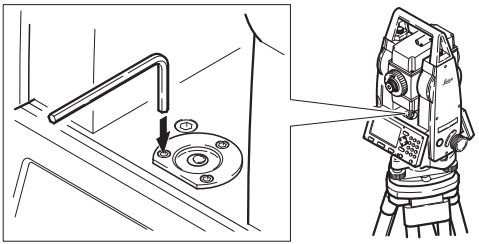
Step	Description
7.	Press **MEASURE** to measure the target.
8.	 Change telescope position and aim with the telescope again to the target.
9.	Press **MEASURE** to measure the same target again and to calculate the instrument errors.
☞	The old and new adjustment results are shown.
10.	Press **SET** to set new adjustment data. OR Press ESC to quit without setting the new adjustment data.

Set Hz correction (c)

Field	Option	Field Description
‹Hz-Correction:›	On	The horizontal angles are corrected for the line of sight and if ‹ Compensator: On › transversal tilt errors.
	Off	Horizontal angles are not corrected. ☞ After switching on the instrument, the setting is automatically reset to ‹ Hz-Correction: On ›.

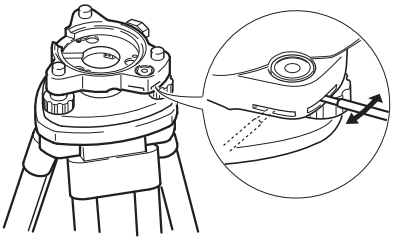
14.4 Adjustment of the Circular Level

On the instrument step-by-step



Step	Description
1.	Level up the instrument in advance with the electronic level, assuming that the electronic level is correctly adjusted.
2.	The bubble must be centered. If it extends beyond the circle, use the allen keys supplied to centre it with the adjustment screws. Turn the instrument slowly 200 gon (180°). Repeat the adjustment procedure if the bubble does not stay centered.
☞	After the adjustment, no screw shall be loose.

On the tribrach step-by-step

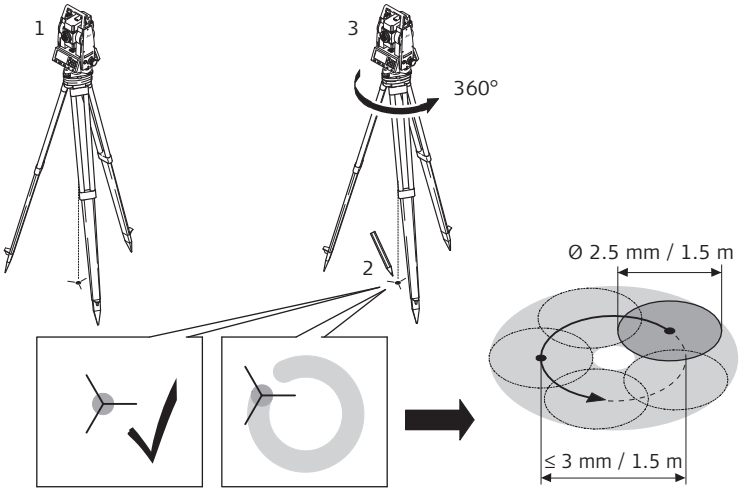


Step	Description
1.	Level up the instrument with the electronic level, assuming that the electronic level is correctly adjusted. Refer to "5.2 Instrument Setup" for more information. Then remove it from the tribrach.
2.	The bubble of the tribrach must be centered. If it extends beyond the circle, use the adjusting pin in conjunction with the two cross headed adjustment screws to centre it.
☞	After the adjustment, no screw shall be loose.

14.5 Adjustment of the Laser Plummet

The laser plummet is located in the vertical axis of the instrument. Under normal conditions of use, the laser plummet does not need adjusting. If an adjustment is necessary due to external influences, the instrument has to be returned to any Leica Geosystems authorized service workshop.

Inspecting laser plummet step-by-step



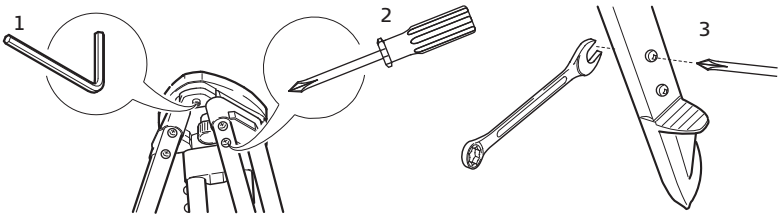
Step	Description
1.	Setup the instrument on a tripod (1) approximately 1.5 m above ground.

Step	Description
2.	Turn on the instrument by pressing the ⏻ key.
3.	Level up the instrument with the electronic level. Refer to "5.2 Instrument Setup" for more information.
☞	Inspection of the laser plummet should be carried out on a bright, smooth and horizontal surface, such like a sheet of paper.
4.	Mark the centre of the red dot on the ground (2).
5.	Slowly turn the instrument through 360°, carefully observing the movement of the red laser dot (3).
☞	The maximum diameter of the circular movement described by the centre of the laser point should not exceed 3 mm at a distance of 1.5 m.
6.	If the centre of the laser dot describes a perceptible circular movement or moves more than 3 mm away from the point which was first marked, an adjustment may be required. Inform your nearest Leica Geosystems authorized service workshop.

Depending on brightness and surface, the diameter of the laser dot can vary. At a distance of 1.5 m it is about 2.5 mm.

14.6 Service of the Tripod

Service tripod step-by-step



Step	Description
☞	The connections must be firm and tight.
1.	Moderately tighten the allen screws with the allen key supplied with the tripod.
2.	Tighten articulated joints just enough to keep the tripod legs open when lifting the tripod of the ground.
3.	Tighten the screws of the tripod legs.

14.7 Inspection of the Red Laser Beam, for Builder R-, RM- and RM power

General

The red laser beam used for measuring is arranged coaxially with the line of sight of the telescope, and emerges from the objective port. If the instrument is well adjusted, the red measuring beam coincides with the visual line of sight. External influences such as shock, stress or large temperature fluctuations can displace the red measuring beam relative to the line of sight.

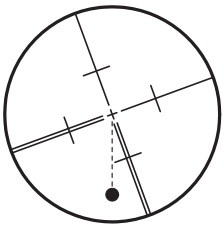
The direction of the beam should be inspected from time to time, because an excessive deviation of the laser beam from the line of sight can result in imprecise distance measurements.

Inspecting of the red laser beam step-by-step

Step	Description
1.	Set up the provided CPR105 flatprism between 5 m and 20 m with the reflective tape side facing the instrument.
2.	Align the instrument crosshairs to the centre of the flatprism.
3.	Switch on the red laser beam by activating the laser pointer function in Configuration Mode.
4.	Without using the telescope inspect the position of the red laser dot on the flatprism. ☞ Look at the flatprism from just above the telescope or from just to the side of it.
5.	If the dot is within the inner printed circle the laser beam is within tolerance. If it is outside it is recommended to have the laser beam realigned by a Leica Geosystems authorized service workshop.

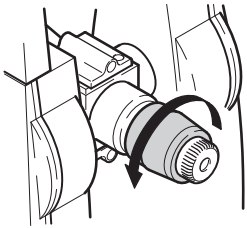
14.8 Adjustment of the Vertical Line of the Reticule, for Builder T

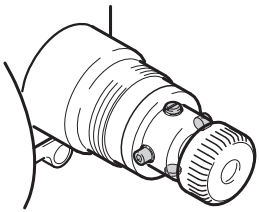
Inspection



Step	Description
1.	Aim on any point in the centre of the reticule.
2.	With the vertical drive move the instrument upwards to the edge of the range of vision.
☞	If the point moves along the vertical line no adjustment is necessary.

Adjusting





Step	Description
1.	If the point does not move along the vertical line remove cover of adjusting screws on the eyepiece.
2.	With the help of the supplied tool loosen all four adjusting screws by the same amount.
3.	Turn the reticule until the vertical line is aligned with the point.
4.	Subsequently, tighten the adjusting screws and repeat the checking procedure until adustment is correct.

15 Care and Transport

15.1 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 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 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.

Field adjustment

After transport inspect the field adjustment parameters given in this user manual before using the product.
If the equipment is to be stored for a long time, remove the alkaline batteries from the product in order to avoid the danger of leakage.

15.2 Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "17 Technical Data" for information about temperature limits.

Field adjustment

After long periods of storage inspect the field adjustment parameters given in this user manual before using the product.

NiMH and Alkaline batteries

- Refer to "17.3 General Technical Data of the Instrument" for information about storage temperature range.
- A storage temperature range of 0°C to +20°C / +32°F to +68°F in dry environment is recommended to minimize self-discharging of the battery.
- At the recommended storage temperature range, batteries containing a 10% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged.
- Remove batteries from the product and the charger before storing.
- After storage recharge batteries (NiMH) before using.
- Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use.

15.3 Cleaning and Drying

Objective, eyepiece and prisms

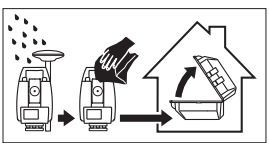
- Blow dust off lenses and prisms.
- Never touch the glass with your fingers.
- Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol. Do not use other liquids; these may attack the polymer components. For cleaning the flat prism pure alcohol is not allowed.

Fogging of prisms

Reflector prisms that are cooler than the ambient temperature tend to fog. It is not enough simply to wipe them. Keep them for some time inside your jacket or in the vehicle to allow them to adjust to the ambient temperature.

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. Do not repack until everything is completely dry.



Cables and plugs

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

16 Safety Directions

16.1 General

Description

The following directions should 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.

16.2 Intended Use

Permitted use

- Measuring horizontal and vertical angles.
- Measuring distances.
- Recording measurements.
- Computing by means of software.
- Visualizing the aiming direction and vertical axis.

Adverse use

- Use of the product without instruction.
- Use outside of the intended limits.
- Disabling safety systems.
- Removal of hazard notices.
- Opening the product using tools, for example screwdriver, unless this is specifically permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.
- Use of products with obviously recognizable 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, for example when measuring on roads.

- Deliberate dazzling of third parties.
- Controlling of machines, moving objects or similar monitoring application without additional control- and safety installations.

⚠ Warning

Adverse use can lead to injury, malfunction and damage.
It is the task of the person responsible for the equipment to inform the user about hazards and how to counteract them. The product is not to be operated until the user has been instructed on how to work with it.

16.3 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 in close proximity to electrical installations or similar situations by the person in charge of the product.

16.4 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 completely safe condition.

Manufacturers of non Leica Geosystems accessories

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

Person in charge of the product

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

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

Warning

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

16.5 Hazards of Use

Warning

The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or adverse use, and can give rise to accidents with far-reaching human, material, financial and environmental consequences.
Precautions:
All users must follow the safety directions given by the manufacturer and the directions of the person responsible for the product.

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 and before and after important measurements.

Danger

Because of the risk of electrocution, it is very dangerous to use poles and extensions in the vicinity of electrical installations such as power cables or electrical railways.
Precautions:
Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their instructions.

Warning

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 and accident prevention and road traffic.

Warning

If computers intended for use indoors are used in the field there is a danger of electric shock.
Precautions:
Adhere to the instructions given by the computer manufacturer with regard to field use in conjunction with Leica Geosystems products.

Caution

If the accessories used with the product are not properly secured and the product is subjected to mechanical shock, for example blows or falling, the product may be damaged or people may sustain injury.
Precautions:
When setting-up the product, make sure that the accessories 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

Using a battery charger not recommended by Leica Geosystems can destroy the batteries. This can cause fire or explosions.
Precautions:
Only use chargers recommended by Leica Geosystems to charge the batteries.

Warning

High mechanical stress, high ambient temperatures or immersion into fluids can cause leackage, 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

Short circuited battery terminals can overheat and cause injury or fire, for example by storing or transporting in pockets if battery terminals come in contact with jewellery, keys, metallized paper or other metals.
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 unauthorized persons to use it in contravention of the regulations, exposing themselves and third parties to the risk of severe injury and rendering the environment liable to contamination.

- Improper disposal of silicone oil may cause environmental contamination.

Precautions:

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

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

Warning

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

16.6 Laser Classification

General

The following directions (in accordance with the state of the art - international standard IEC 60825-1 (2007-03) and IEC TR 60825-14 (2004-02)) provide instruction and training information to 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.

Products classified as laser class 1, class 2 and class 3R do not require

- laser safety officer involvement,
- protective clothes and eyewear,
- special warning signs in the laser working area

if used and operated as defined in this user manual due to the low eye hazard level.

Products classified as laser class 2 or class 3R may cause dazzle, flash-blindness and afterimages, particularly under low ambient light conditions.

16.6.1 Integrated Distancer, Measurements with Red Dot (for Builder R, RM and RM power)

General

The EDM incorporated into the product produces a visible red laser beam which emerges from the telescope objective.

The laser product described in this section, is classified as laser class 3R in accordance with:

- IEC 60825-1 (2007-03): "Safety of laser products".
- EN 60825-1 (2007-10): "Safety of laser products".

Class 3R laser products:
Direct intrabeam viewing may be hazardous (low-level eye hazard), in particular for deliberate ocular exposure. The risk of injury for laser class 3R products is limited because of:

a) unintentional exposure would rarely reflect worst case conditions of (e.g.) beam alignment with the pupil, worst case accommodation,
b) inherent safety margin in the maximum permissible exposure to laser radiation (MPE)
c) natural aversion behaviour for exposure to bright light for the case of visible radiation.

Description	Value
Maximum average radiant power	5.00 mW
Pulse duration	800 ps
Pulse repetition frequency	100MHz - 150MHz
Wavelength	650 nm - 690 nm
Beam divergence	0.2 mrad x 0.3 mrad
NOHD (Nominal Ocular Hazard Distance) @ 0.25s	80 m / 263 ft

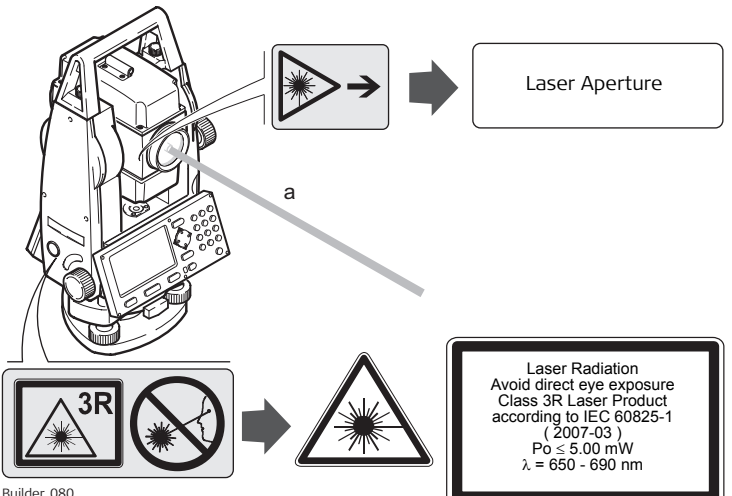
Warning

From a safety perspective class 3R laser products should be treated as potentially hazardous.
Precautions:
Prevent direct eye exposure to the beam. Do not direct the beam at other people.

Warning

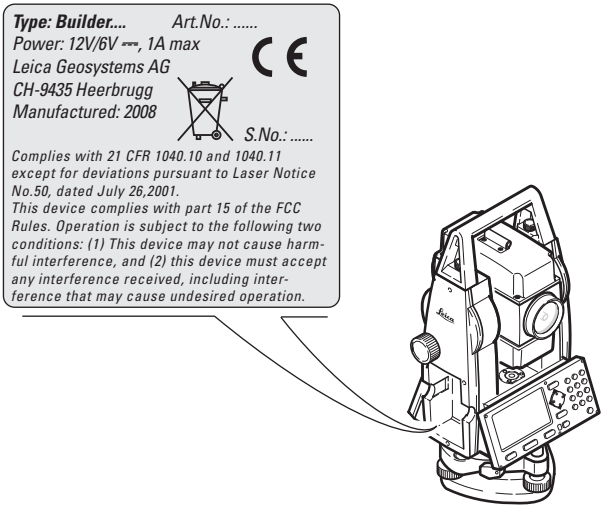
Potential hazards are not only related to direct beams but also to reflected beams aimed at reflecting surfaces such as prisms, windows, mirrors, metallic surfaces etc.
Precautions:
Do not aim at areas that are essentially reflective, such as a mirror, or which could emit unwanted reflections. Do not look through or beside the optical sight at prisms or reflecting objects when the laser is switched on, in laserpointer or distance measurement mode. Aiming at prisms is only permitted when looking through the telescope.

Labelling



Builder_080

a) Laser beam


Type: Builder....
Art.No.: .....
Power: 12V/6V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured: 2008
S.No.: .....
Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated July 26,2001.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

16.6.2 Integrated Distancer, Measurements with Fine/Fast (only Builder M power and RM Power)

General

The EDM module built into the product produces a visible laser beam which emerges from the telescope objective.

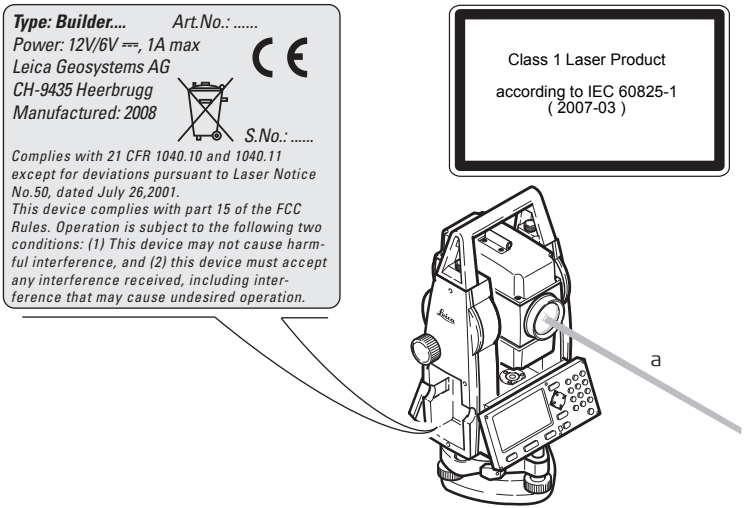
The laser product described in this section is classified as laser class 1 in accordance with:

- IEC 60825-1 (2007-03): "Safety of laser products".
- EN 60825-1 (2007-10): "Safety of laser products".

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

Description	Value
Maximum average radiant power	0.33 mW
Pulse duration	800 ps
Pulse repetition frequency	100 MHz - 150 MHz
Wavelength	650 nm - 690 nm

Labelling



a) Laser beam

16.6.3 Laser Plummet

General

The laser plummet built into the product produces a visible red laser beam which emerges from the bottom of the product.

The laser product described in this section, is classified as laser class 2 in accordance with:

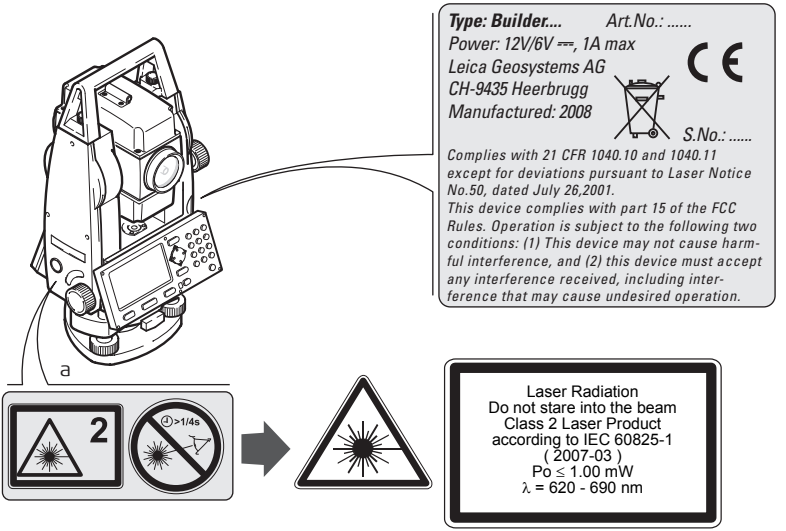
- IEC 60825-1 (2007-03): "Safety of laser products".
- EN 60825-1 (2007-10): "Safety of laser products".

Class 2 laser products:
These products are safe for momentary exposures but can be hazardous for deliberate staring into the beam.

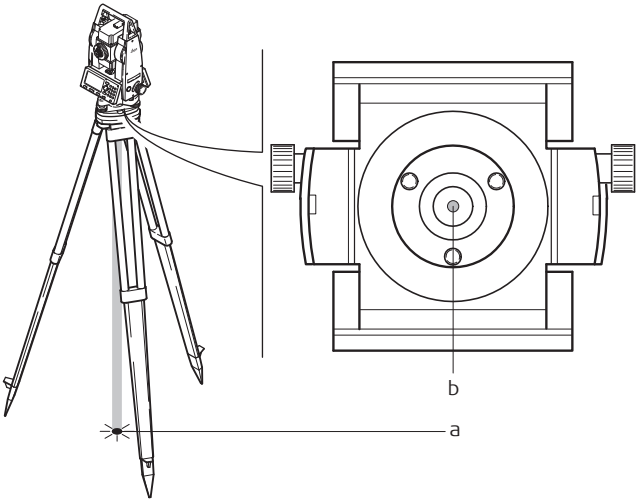
Description	Value
Maximum average radiant power	1.00 mW
Pulse duration	0-100%
Pulse repetition frequency	1 kHz
Wavelength	620 nm - 690nm

Warning From a safety perspective class 2 laser products are not inherently safe for the eyes.
Precautions:
Avoid staring into the beam or pointing the beam at other people.

Labelling



a) Will be replaced by a Class 3R warning label if applicable



a) Laser beam
b) Exit for laser beam

16.7 Electromagnetic Compatibility EMC

Description

The term Electromagnetic Compatability 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 in conjunction with accessories from other manufacturers, for example field computers, personal computers, two-way radios, non-standard cables or external batteries.

Precautions:

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

⚠ Caution

Disturbances caused by electromagnetic radiation can result in erroneous measurements.
Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that the product may be disturbed by very intense electromagnetic radiation, for example, near radio transmitters, two-way radios or diesel generators.
Precautions:
Check the plausibility of results obtained under these conditions.

⚠ Warning

If the product is operated with connecting cables attached at only one of their two ends, for example external supply cables, interface cables, the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other products may be impaired.
Precautions:
While the product is in use, connecting cables, for example product to external battery, product to computer, must be connected at both ends.

16.8 FCC Statement, Applicable in U.S.

Warning

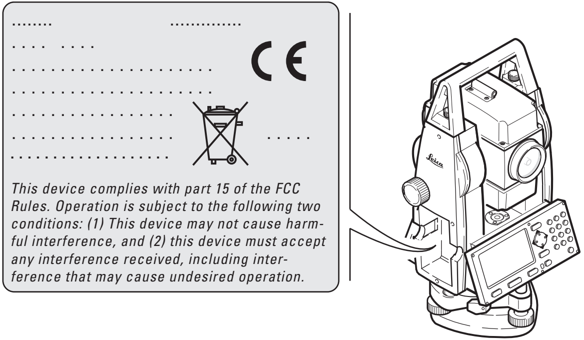
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate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


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

17 Technical Data

17.1 Angle Measurement

Accuracy

Type	Standard deviation Hz, V, ISO 17123-3		Display least count	
	["]	[mgon]	["]	[mgon]
100	9	2.8	1	1
200	6	1.8	1	1
200 (Builder M power and RM power)	5	1.5	1	0.1
300	3	1	1	0.1

Type 300 is only available for the Builder RM power.

Characteristics

Absolute, continuous.

17.2 Distance Measurement

Reflectorless standard range

Type	Kodak Gray Card	Range D		Range E		Range F	
		[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard	White side, 90 % reflective	140	460	170	560	>170	>560
Standard	Grey side, 18 % reflective	70	230	100	330	>100	>330

Reflector range (red dot)

Range of measurement flat prism CPR105: 1.5 m to 250 m
Display unambiguous: Up to 250 m

Type	CPR105	Range D		Range E		Range F	
		[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard	Reflective tape	150	490	170	560	170	560
Standard	Cat-eye	250	820	250	820	250	820

Atmospheric conditions

D: Object in strong sunlight, severe heat shimmer
E: Object in shade, sky overcast
F: Underground, night and twilight

Accuracy

Standard measuring	**Standard deviation, ISO 17123-4**	**Measure time, typical [s]**
Standard Reflectorless	3 mm + 2 ppm	3.0
CPR105 Flat prism (Cat-eye)	5 mm + 2 ppm	< 2
CPR105 Flat prism (Reflective tape)	3 mm + 2ppm	< 2
Tracking	5 mm + 2 ppm	1.0

Object in shade, sky overcast.
Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.
The display resolution is 1 mm.

Reflector range (fine/fast mode)

Range of measurement : 1.5 m to 3500 m

Type	Range 1		Range 2		Range 3	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
CPR111 BUILDER prism, true-zero offset	450	1500	800	2600	1000	3500
Round prism	1800	6000	3000	10000	3500	12000

The range on the round prism is only achievable with the upgraded distance measurement. Otherwise the specifications of the CPR111 are valid (max. 1000 m). Please refer to "5.4 Distance Measurement".

Atmospheric conditions

1: Strong haze, visibility 5km; or strong sunlight, severe heat shimmer
2: Light haze, visibility about 20km; or moderate sunlight, slight heat shimmer
3: Overcast, no haze, visibility about 40km; no heat shimmer

Accuracy

Standard measuring	Standard deviation, ISO 17123-4	Measure time, typical [s]
Fine	2 mm + 2 ppm	< 1
Fast	5 mm + 2 ppm	< 0.5

Standard measuring	**Standard deviation, ISO 17123-4**	**Measure time, typical [s]**
Tracking	5 mm + 2ppm	< 0.3

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

Characteristics

Measuring system:	System analyser basis 100 MHz - 150 MHz
Type:	Coaxial, visible red laser class 1
Carrier wave:	660 nm

Laser dot size

Distance [m]	Laser dot size, approximately [mm]
at 20	10 x 12
at 50	13 x 21
at 250	38 X 85

17.3 General Technical Data of the Instrument

Telescope

Type	Builder T	Builder R, RM, M power and RM power
Magnification	30 x	30 x
Clear objective diameter	40 mm	40 mm
Focusing	1.6 m/5.2 ft to infinity	1.7 m/5.6 ft to infinity
Field of view	1°21′/1.50 gon 2.4 m at 100 m	1°30′/1.66 gon 2.6 m at 100 m

Compensator

Type	Setting accuracy		Setting range	
	["]	[mgon]	[′]	[gon]
100	2	0.7	4	0.07
200	2	0.7	4	0.07
300	2	0.7	4	0.07

Level

Circular level sensitivity: 6′/2 mm
Electronic level resolution: 6" (=20^{cc})

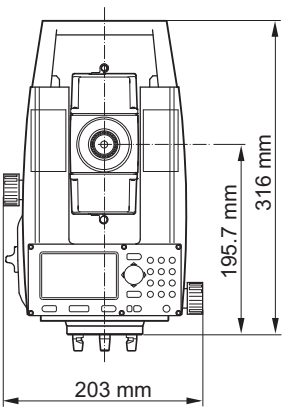
Control unit

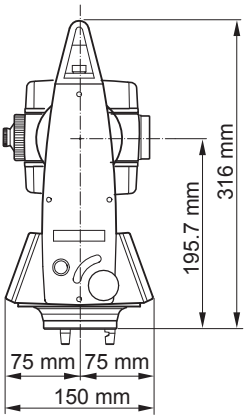
Display:	280 x 160 pixels, monochrome, graphics capable LCD, illumination
Keyboard:	7 keys / 20 keys (only Builder M power and RM power)
Angle Display:	360°'", 360° decimal, 400 gon, 6400 mil, V %
Distance Display:	m, ft int, ft us, ft inch 1/16
Position:	In both faces, face two is optional

Instrument Ports, Builder RM, M power and RM power only

Port	Name	Description
Port 1	Port 1	• 5 pin LEMO-0 for power and/or communication. • This port is located at the base of the instrument.

Instrument Dimensions





Weight

Instrument:	3.3 - 4.1 kg
Tribrach:	0.8 kg
Battery adapter GAD39: incl. 6 alkaline batteries	0.2 kg

Recording, Builder RM, M power and RM power only

Data can be recorded into internal memory.

Type	Capacity [kB]	Number of datablocks
Internal memory	576	10000

Laser plummet

Type:	Visible red laser class 2
Location:	In vertical axis of instrument
Accuracy:	Deviation from plumbline: 1.5 mm at 1.5 m instrument height
Diameter of laser point:	2.5 mm at 1.5 m instrument height

Drives

Type:	Endless horizontal and vertical drives

Power, Builder RM, M power and RM power only

External supply voltage:	Nominal voltage 12.8 V DC, Range 11.5 V-13.5 V

Battery adapter

Type:	Alkaline
Voltage:	GAD39 Adapter: 6 x AA (1.5 V) LR6
Typical operating time:	6 - 8 h (> 400 angle and distance measurements) > 12 h (angle measurement)

Battery GEB121

Type:	NiMh
Voltage:	6V
Typical operating time:	6 - 8h (approx. 9000 angle and distance measurements)

External battery, Builder RM, M power and RM power only

Type:	NiMH
Voltage:	12 V
Capacity:	GEB171: 8.0 Ah
Typical operating time:	20 - 24 h

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
Builder	-20 to +50	-40 to +70

Protection against dust, sand and water

Type	Protection
Builder	IP54 (IEC 60529)

Humidity

Type	Protection
Builder	Max 95 % non condensing The effects of condensation are to be effectively counteracted by periodically drying out the instrument.

Reflectors

Type	Additive Constant [mm]
CPR105 Flat prism (Cat-eye)	0.0
CPR105 Flat prism (reflective tape)	0.0
Reflectorless	0.0
GZM28 reflective tape 60x60 mm	0.0
CPR111 BUILDER prism, true-zero offset	0.0

Automatic corrections

The following automatic corrections are made:

- Line of sight error
- Tilting axis error
- Earth curvature
- Compensator index error
- Vertical index error
- Refraction

18 International Limited Warranty, Software License Agreement

International Limited Warranty

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

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