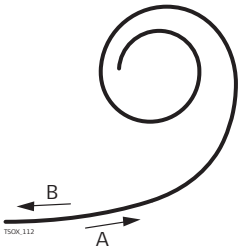
- Enter the radius and parameter, or radius and length, depending on the method chosen.
- Select the type and direction of the spiral.
- Press **Cont**.



Spiral type
A Spiral in
B Spiral out

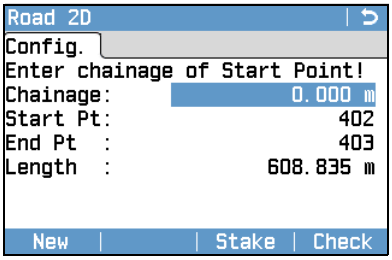
4. When the element has been defined the **Road 2D** - **Config.** appears.

Chainage and method

Enter the chainage values and press:

- **Stake**: to select the point and offset (center, left or right), to stake out and start the measurement. The correction from actual point to stake out point is shown on the display.
- **Check**: to measure, or select points from memory, to calculate the chainage, line and offset from the defined element.

Enter stakeout values



Next step

- If in stakeout mode, press **Cont** to begin staking out.
- Or, if in measurement mode, press **Meas** to measure and record.

6.13 Road 3D

6.13.1 Starting Road 3D

Description

Road 3D is a program used to stake out points or for as-built checks relative to a road alignment, including slopes. It supports the following features:

- Horizontal alignments with the elements straight, curve, and spiral (entry and exit as well as partial).
- Vertical alignments with the elements straight, curve and quadratic parabola.
- Upload of horizontal and vertical alignments which are in gsi data format of FlexOffice Road Line Editor.
- Creation, view and deletion of alignments onboard.
- Use of design height of vertical alignments or manually entered heights.
- Log file via Format manager of FlexOffice.

Road 3D methods

Road 3D has the following subprograms:

- Subprogram Check
- Subprogram Stake
- Subprogram Check Slope
- Subprogram Stake Slope

The program can be trialled 15 times. After 15 trials, it is necessary to enter the licence code.

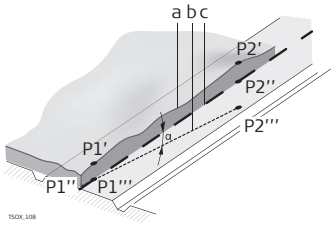
Road 3D step-by-step

1. Create or upload road alignments.
2. Select horizontal and/or vertical alignment files.
3. Define stake/check/slope parameter.
4. Select one of the Road 3D subprograms.

- The alignment file data has to be in the same data structure as FlexOffice Road Line Editor. These gsi files have unique identifiers for each element which are used by the program.
- The alignments must be continuous because geometrical gaps and chainage equations are not supported.
- The file name for the horizontal alignment file must have the prefix ALN, for example, ALN_HZ_Axis_01.gsi. The file name for the vertical alignment files must have the prefix PRF, for example PRF_VT_Axis_01.gsi. File names can be 16 characters long.
- The uploaded or created road alignments are permanent and stored even if the program is closed.
- Road alignments can be deleted onboard or via FlexOffice Data Exchange Manager.
- Road alignments cannot be edited onboard. This needs to be done via FlexOffice Road Line Editor.

Elements of a road project

Road projects consist, in general, of a horizontal and a vertical alignment.



Any project point P1 has E, N and H coordinates in a determined coordinate system and has three positions.

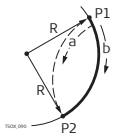
- P1' Position on natural surface
- P1'' Position on vertical alignment
- P1''' Position on horizontal alignment

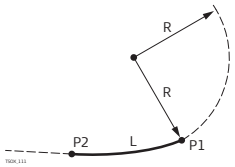
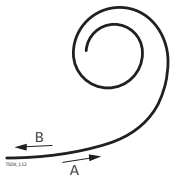
With a second point P2 the alignment is defined.

- P1' P2'
  Projection of the alignment onto the natural surface.
- P1'' P2''
  Vertical alignment
- P1''' P2'''
  Horizontal alignment
- α Grade angle between the vertical and horizontal alignment.
- a Natural surface
- b Horizontal alignment
- c Vertical alignment

Horizontal geometry elements

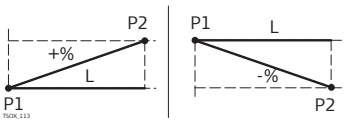
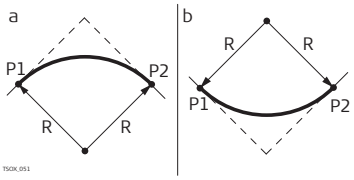
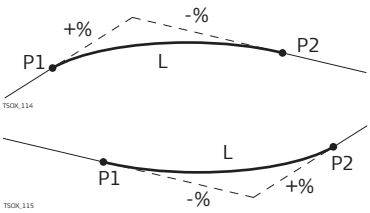
For onboard input Road 3D supports the following elements for horizontal alignments.

Element	Description
Straight	A straight has to be defined by: • Start point (P1) and end point (P2) with known Easting and Northing coordinates.  P1 Start point P2 End point
Curve	A circular curve has to be defined by: • Start point (P1) and end point (P2) with known Easting and Northing coordinates. • Radius (R). • Direction: Clockwise (b) or Anticlockwise (a).  P1 Start point P2 End point R Radius a Anticlockwise direction b Clockwise direction
Spiral / Clothoid	A spiral is a transition curve whose radius changes along its length. A spiral has to be defined by: • Start point (P1) and end point (P2) with known Easting and Northing coordinates. • Radius at the start of the spiral (R). • Spiral parameter ($A = \sqrt{L \cdot R}$) or length (L) of the spiral. • Direction: Clockwise or Anticlockwise. • Spiral type: Spiral in or Spiral out.

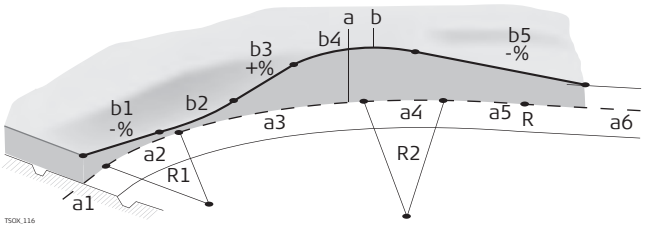
Element	Description
	 P1 Start point P2 End point R Radius L Length
Spiral types	• Entry spiral (Spiral in = A): Spiral with a radius of infinity at the start and a given radius at the end. • Exit spiral (Spiral out = B): Spiral with a given radius at the start and radius of infinity at the end. • Partial/Ovoid spiral: A spiral with a given radius at the start and another given radius at the end.  A Entry spiral B Exit spiral

Vertical geometry elements

For onboard input Road 3D supports the following elements for vertical alignments.

Element	Description
Straight	A straight has to be defined by: • Start chainage and start height of P1. • End chainage and end height of P2, or length (L) and slope (%).  P1 Start point P2 End point L Length % Slope
Transition curve	A circular curve has to be defined by: • Start chainage and start height of P1. • End chainage and end height of P2. • Radius (R). • Type: Convex (crest) or Concave (sag).  a Convex b Concave P1 Start point P2 End point R Radius
Quadratic parabola	A quadratic parabola has the advantage that the rate of change of grade is constant, resulting in a "smoother" curve. A quadratic parabola has to be defined by: • Start chainage and start height of P1. • End chainage and end height of P2. • Parameter, or Length (L), grade of entry straight (Grade In) and grade of exit straight (Grade Out).  P1 Start point P2 End point L Length % Slope

Horizontal and vertical geometry elements combined



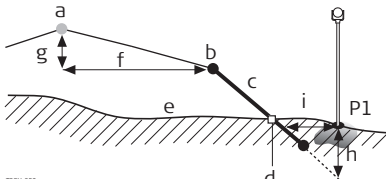
a = Horizontal alignment (top view)
R1 Radius 1
R2 Radius 2
a1 Straight
a2 Curve with R1
a3 Partial spiral with R1 and R2
a4 Curve with R2
a5 Spiral out with R2 and R= ∞
a6 Straight

b = Vertical alignment (front view)
b1 Straight
b2 Curve
b3 Straight
b4 Parabola
b5 Straight

- Tangent point

☞ Start and end chainage and tangent points can be different for the horizontal and vertical alignments.

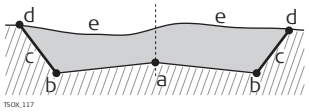
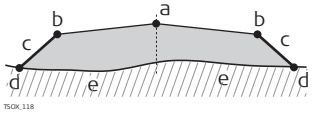
Slope elements



P1 Measured point
a Horizontal alignment
b Hinge point
c Slope
d Catch point
e Natural surface
f Defined offset
g Defined height difference
h Cut situation for defined slope
i Δ Offset to catch point

Explanation of the slope elements:

a) Horizontal alignment at a defined chainage.
b) Hinge point, is defined by entered offset left/right and height difference.
c) Slope = ratio.
d) Catch point, or daylight point, indicates the point of intersection between the slope and the natural surface. Both the hinge point and the catch point lie on the slope.
e) Natural surface, is the undisturbed surface before project construction.

Cut / Fill	Description	
Cut situation		a) Horizontal alignment b) Hinge point c) Slope d) Catch point e) Natural surface
Fill situation		a) Horizontal alignment b) Hinge point c) Slope d) Catch point e) Natural surface

6.13.3 Creating or Uploading Alignment Files

Description

Create horizontal and vertical road alignment files with FlexOffice Road Line Editor and upload them onto the instrument using the Data Exchange Manager.
Alternatively, horizontal and vertical road alignments can be created onboard the instrument.

Access

1. Select **Programs** from the Main Menu.
2. Select **Road 3D** from the **Programs** Menu.
3. Complete program pre-settings. Refer to "5 Programs - Getting Started".

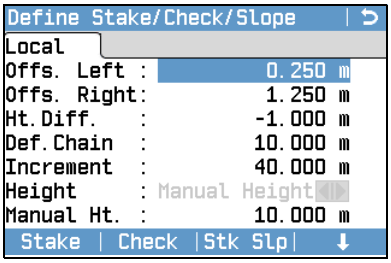
Select Alignment File:

Field	Description
Horiz. Aln.	List of available horizontal alignment files. Using a horizontal alignment file is mandatory.
Verti. Aln.	List of available vertical alignment files. Using a vertical alignment file is not mandatory. A height can be defined manually instead.

Next step

- Either, press **New** to name and define a new alignment file.
- Or, press **Cont** to select an existing alignment file and proceed to the **Define Stake/Check/Slope** values screen.

Define Stake/Check/Slope



Stake
To start the subprogram Stake.

Check
To start the subprogram Check.

Stk Slp
To start the subprogram Stake Slope.

⬇ Ch Slp
To start the subprogram Check Slope.

Field	Description	
Offs. Left	Horizontal offset to the left of the horizontal alignment.	
Offs. Right	Horizontal offset to the right of the horizontal alignment.	
Ht.Diff.	Vertical offset, either up or down, from the horizontal alignment.	
Def.Chain	Defined chainage for stake out.	
Increment	Value by which the defined chainage can be incremented or decremented in subprograms Stake and Stake Slope.	
Height	**Manual Height**	Height reference for height calculations. If enabled this height is used for all subprograms.
	Use Design Hgt.	The height reference for height calculations is the selected vertical alignment file.
Manual Ht.	Height to be used for **Manual Height**.	

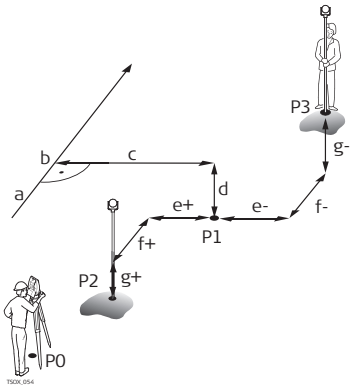
Next step

Select a softkey option, **Stake**, **Check**, **Stk Slp** or **⬇ Ch Slp**, to proceed to a subprogram.

6.13.4 Stake

Description

The subprogram Stake is used to stake out points relative to an existing alignment. The height difference is relative to a vertical alignment or manually entered height.

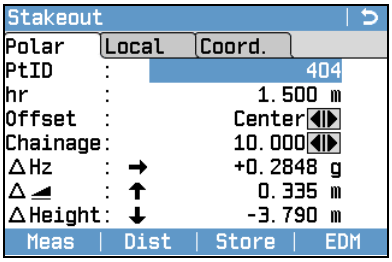


P0	Instrument station
P1	Target point
P2	Measured point
P3	Measured point
a	Horizontal alignment
b	Defined chainage
c	Offset
d	Height difference
e+	Δ Offset, positive
e-	Δ Offset, negative
f+	Δ Chainage, positive
f-	Δ Chainage, negative
g+	Δ Height, positive
g-	Δ Height, negative

Access

Press **Stake** from the **Define Stake/Check/Slope** values screen.

Stakeout



To find/enter codes, press the FNC/Favourites key and select **Coding**.

Field	Description
Chainage	Selected chainage to stake out.
ΔHz	Angle offset: Positive if the stake out point is to the right of the measured point.
Δ	Horizontal offset: Positive if the stake out point is further away than the measured point.
ΔHeight	Height offset: Positive if the stake out point is higher than the measured point.
ΔChain	Longitudinal offset: Positive if the stake out point is further away than the measured point.
ΔOffset	Perpendicular offset: Positive if the stake out point is to the right of the measured point.
Def.East	Calculated East coordinate of the stake out point.
Def.North	Calculated North coordinate of the stake out point.
Def.Hght	Calculated Height of the stake out point.

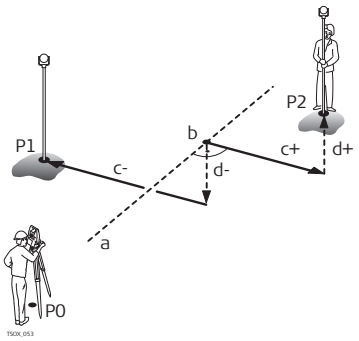
Next step

- Either, press **Meas** to measure and record.
- Or, press ESC to return to the **Define Stake/Check/Slope** values screen.

6.13.5 Check

Description

The subprogram Check is used for as-built checks. The points can be measured or selected from the memory. The chainage and offset values are relative to an existing horizontal alignment, and the height difference is relative to a vertical alignment or manually entered height.



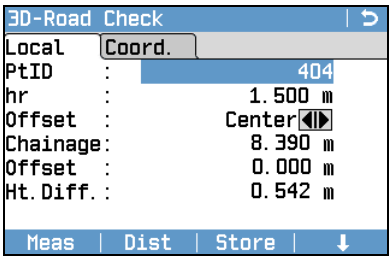
P0 Instrument station
P1 Target point
P2 Target point
a Horizontal alignment
b Chainage
c+ Offset, positive
c- Offset, negative
d+ Height difference, positive
d- Height difference, negative

Defined chainage and increment values will not be considered in the subprogram Check.

Access

Press **Check** from the **Define Stake/Check/Slope** values screen.

3D-Road Check



Field	Description
Offset	Defined horizontal offset. **Left**, **Right** or **Centre**.
Chainage	Current chainage from measured point.
Offset	Perpendicular offset to alignment.
Ht.Diff.	Height difference between the measured point and the defined height.
ΔEast	Calculated difference in Easting coordinate between the measured point and the alignment element.
ΔNorth	Calculated difference in Northing coordinate between the measured point and the alignment element.

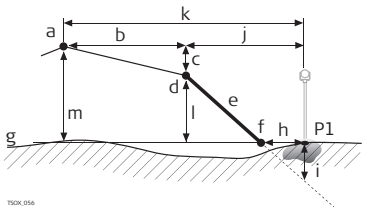
Next step

- Either, press **Meas** to measure and record.
- Or, press ESC to return to the **Define Stake/Check/Slope** values screen.

6.13.6 Stake Slope

Description

The subprogram Stake Slope is used to stake out the catch point, which is the intersection point of a defined slope with the natural surface.
The slope is always defined as starting from a hinge point. If the parameter offset right/left and height difference are not entered, the point at the defined chainage on the horizontal alignment is the hinge point.

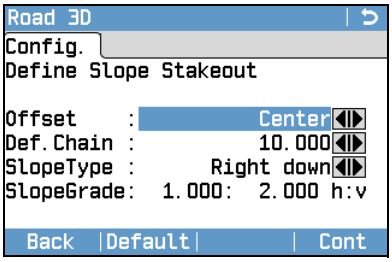


P1 Measured point
a Horizontal alignment
b Defined offset
c Defined height difference
d Hinge point
e Defined slope
f Catch point
g Natural surface
h Δ Offset to catch point
i Cut/fill to catch point
j Offset to hinge point
k Offset to alignment
l Height difference to hinge point
m Height difference to alignment

Access

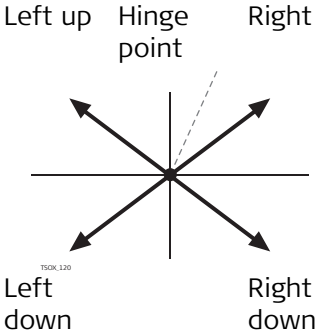
Press **Stk Slp** from the **Define Stake/Check/Slope** values screen.

Define Slope Stakeout



Field	Description
Offset	Horizontal offset from the horizontal alignment to define the hinge point.
Def.Chain	Defined chainage for stakeout.
SlopeType	Type of slope. Refer to "Slope Type".
SlopeGrade	Slope ratio. Refer to " Slope Grade".

Slope Type



Left up
Creates an upward plane extending to the left of the defined hinge point.
Right up
Creates an upward plane extending to the right of the defined hinge point.
Left down
Creates a downward plane extending to the left of the defined hinge point.
Right down
Creates a downward plane extending to the right of the defined hinge point.

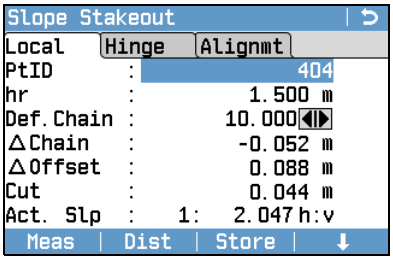
Slope Grade

Ratio of the slope. The unit for slope grade is defined in the **Regional Settings** screen. Refer to "4.2 Regional Settings".

Next step

Press **Slope Stakeout** to proceed to the **Slope Stakeout** screen.

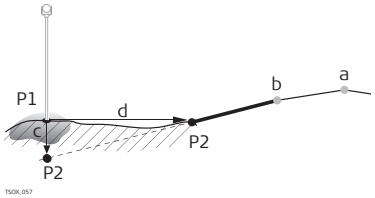
Slope Stakeout



Field	Description
DefChain	Defined chainage for stake out.
ΔChain	Difference between the defined chainage and the measured chainage.
ΔOffset	Horizontal offset between the catch point of defined slope and the measured position.
Cut/Fill	Vertical offset between the catch point of the defined slope and the measured position. A cut is above the slope, a fill is below the slope.
Act.Slope	Measured slope of the reflector position to the hinge point.
Offs.Hng	Measured offset to the horizontal alignment including offset right and offset left.
ΔH Hinge	Height difference to the hinge point. The vertical offset between the defined height at the current chainage, and the measured position, including the defined height difference.
Hinge	Slope distance from the measured point to the hinge point.
Height	Height value of the measured point.
Act. Ch.	The measured chainage.
Offs.Aln	Measured offset to the horizontal alignment excluding offset right and offset left.
ΔH Aln	Height difference to the alignment. The vertical offset between defined height at the current chainage, and the measured position, excluding the defined height difference.
Aln	Slope distance from the measured point to the alignment.

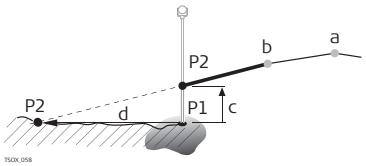
Sign convention

Cut situation



P1 Measured point
P2 Catch point
a Horizontal alignment
b Hinge point
c Cut
d Δ Offset to catch point

Fill situation



P1 Measured point
P2 Catch point
a Horizontal alignment
b Hinge point
c Fill
d Δ Offset to catch point

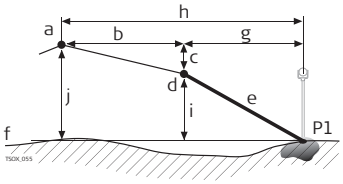
Next step

- Either, press **Meas** to measure and record.
- Or, press ESC to return to the **Define Stake/Check/Slope** values screen.

6.13.7 Check Slope

Description

The subprogram Check Slope is used for as-built checks and to get information about slopes, for example on a natural surface. If the parameter offset left/right and height difference are not entered, the point on the horizontal alignment is the hinge point.



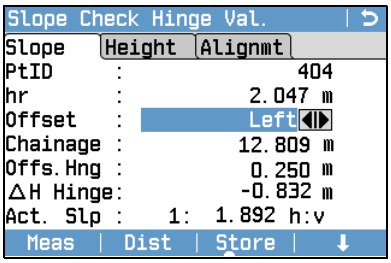
P1 Measured point
a Horizontal alignment
b Defined offset
c Defined height difference
d Hinge point
e Actual slope
f Natural surface
g Offset to hinge point
h Offset to alignment
i Height difference to hinge point
j Height difference to alignment

☞ Defined chainage and increment values will not be considered in the subprogram Check.

Access

Press ⬇ **Ch Slp** from the **Define Stake/Check/Slope** values screen.

Slope Check Hinge Val.



Field	Description
Offset	Defined horizontal offset. Left, Right or Center.
Chainage	Current chainage from measured point.
Offs.Hng	Offset to hinge. Measured offset to the horizontal alignment including offset right and offset left.
ΔH Hinge	Height difference to the hinge point. The vertical offset between the defined height at the current chainage, and the measured position including defined height difference.
Act. Slp	The measured slope ratio of the measured point to the hinge point.
◢ Hinge	Slope distance from the measured point to the hinge point.
Height	Height value of the measured point.
Offs.Aln	Measured offset to the horizontal alignment excluding offset right and offset left.
ΔH Aln	Height difference to the alignment. The vertical offset between defined height at the current chainage, and the measured position, excluding the defined height difference.
◢ Aln	Slope distance from the measured point to the alignment.

Next step

- Either, press **Meas** to measure and record.
- Or, press ESC to return to the **Define Stake/Check/Slope** values screen.
- Or, continue selecting ESC to exit the application.

6.14 Traverse

6.14.1 Overview

☞	The program Traverse can be trialled 15 times. After 15 trials, it is necessary to enter a licence code.
Description	Traverse is a program used to establish control networks whereby other survey operations such as topographic surveys or point stake outs can be completed. The Traverse methods include 2D Helmert transformation, compass rule and transit rule.
2D Helmert transformation	A Helmert transformation is calculated based on two control points. These must be the start point and the end, or closing, station. Shift, rotation and scale factor will be computed and applied to the traverse. Starting a traverse without an initial backsight measurement will automatically result in a Helmert transformation.
Compass rule	The coordinate misclosure will be distributed with respect to the length of the traverse legs. The compass rule assumes that the biggest error comes from the longest traverse observations. This method is suitable when the precision of the angles and distances are approximately equal.
Transit rule	The coordinate misclosure will be distributed with respect to the coordinate changes in Easting and Northing. Use this method if the angles were measured with a higher precision than the distances.
Traverse step-by-step	1. Start and configure Traverse. 2. Enter station data. 3. Select starting method. 4. Measure a backsight point or go directly to step 5.. 5. Measure a foresight point. 6. Repeat for the number of sets. 7. Move to the next station.
Traverse options	• It is also possible to observe sideshots and check points during the traverse, however, check points are not included in the traverse adjustment. • At the end of the traverse, results are displayed and an adjustment may be calculated if desired.

6.14.2 Starting and Configuring Traverse

Access

1. Select **Programs** from the Main Menu.
2. Select **Traverse** from the **Programs** Menu.
3. Complete program pre-settings.
   - **F1 Set Job**:
     Only one traverse per job is allowed. If an adjusted or finished traverse is already part of the selected job, then select another job.
     Refer to "5 Programs - Getting Started".
   - **F2 Set Tolerances**:
     Use Tolerances: **Yes** to activate the use of tolerances.
     Enter limits for horizontal direction (the difference between measured and calculated azimuth to the closing point), distance (the distance between known and measured closing point), and for differences in Easting, Northing and Height. If the adjustment results, or the deviation for a check point, exceed these limits a warning message appears.
     Press **Cont** to save the limits and return to the Pre-settings screen.
4. Select **F4 Start** to begin the program.

☞ It is not recommended to start a traverse if the memory is almost full. Doing so, may mean the traverse measurements and results cannot be saved. Accordingly, a message is displayed if less than 10% of the memory is free.

Traverse configuration

Field	Description
Traverse ID	Name of the new traverse.
Desc.	Description, if desired.
Operator	Name of the user who will be using the new traverse, if desired.
Method	**B'F'F"B"** All points are measured in face I, then all points are measured in face II in reverse sequential order. **B'B"F"F'** The backsight point is measured in face I immediately followed by face II. Other points are measured in alternating face order. **B'F'** All points are measured in face I only.
No. of Sets	Number of sets. Limited to 10.
Use Face-Tol.	Important when measuring with face I and II. This checks if both measurements are within a defined limit. If the limit is exceeded, a warning message is displayed.
Face-Tol.	The limit that will be used for checking the face tolerance.

Next step
Press **Cont** to confirm the traverse configuration and proceed to the **Enter Station Data** screen.

Measure Traverse - Enter Station Data

Field	Description
Stat.ID	Name of the station.
hi	Height of the instrument.
Desc.	Description of the station, if desired.

☞ Every Traverse must start on a known point.

Next step
Press **Cont** to confirm station data and proceed to the **Traverse** - **Select** screen.

Access

From the **Traverse** - **Select** screen select one of the following:

- **F1 ...w/o known Backsight**: Starts the traverse without a known backsight. The measurements begin to a foresight point.
- **F2 ...with known Backsight**: Starts the traverse with a known backsight.
- **F3 ...with known Azimuth**: Starts the traverse with a user-defined azimuth.

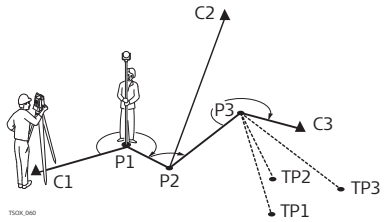
Without known backsight

Start a traverse without a known backsight

- Start on a known point without an initial measurement to a known backsight.
- Stop on a known point, or make a final foresight measurement to a known closing point.

If the coordinates of the start station are unknown, the Station Setup program can be run before the traverse. A Helmert transformation will be performed at the end of the traverse.

If the traverse is left open, then the calculations are based on the system azimuth.

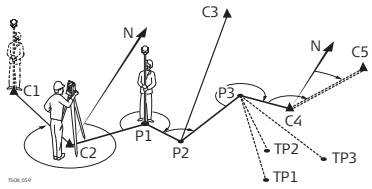


C1, C3 Control points
C2 Check point
P1-P3 Traverse points
TP1-TP3 Topographic points

With known back-sight

Start a traverse with a known backsight

- Start on a known point with an initial measurement to a known backsight.
- Stop on a known point and optionally measure to a known closing point.



C1, C2 Control points
C4, C5 Control points
C3 Check point
P1...P3 Traverse points
TP1...TP3 Topographic points
N North direction

With known azimuth

Start a traverse with a known azimuth

- Start on a known point, aim to any direction (e.g. a tower) and define this direction as the reference. This method is often used to define a 0-direction.
- Stop/end the traverse either on a known point or a traverse point and then measure to a known closing point, or leave the traverse open. Refer to "6.14.5 Closing a Traverse".

If using the current system azimuth, for example from the Stn.Setup program, then simply confirm the suggested Hz-value in the **Set Horizontal Angle** screen.

Measure traverse - Sight Backsight!

Field	Description
BS ID	Point ID of the backsight point.
Remark	Description of the backsight point.
Stat.ID	Name of the station.

Next step

Depending on the traverse method configured, after the measurement either the **Sight Backsight!** screen stays active for measuring the backsight point in a second face, or the **Sight Foresight!** screen appears for measuring the foresight point.

Measure traverse - Sight Foresight!

Next step

Depending on the traverse method configured, after the measurement either the **Sight Foresight!** screen stays active for measuring the foresight point in a second face, or the **Sight Backsight!** screen appears for measuring the backsight point.

Interrupt a set

To interrupt a set, press ESC to exit the backsight or foresight screen. The **Continue with...** screen will appear.

Continue with...

Field	Description
F1 Redo last measurement	Returns to last measured point, can be either a backsight or a foresight point. The last measurement is not stored.
F2 Redo whole station	Returns to first sight point screen. The data from the last station is not stored.
F3 Exit Traverse	Returns to the **Programs** Menu. The traverse stays active and can be continued later. The data from the last station is lost.
F4 Back	Returns to the previous screen where ESC was pressed.

Repetitive loop for the number of sets

Alternating between screens for the backsight and foresight measurements continues according to the configured number of sets.
The number of sets and the face are indicated in the top right corner of the screen. For example 1/I means set 1 in face I.

6.14.4 Moving ahead

Number of defined sets is achieved

When the number of defined sets is achieved, the **Traverse** - **Select** screen is displayed automatically. The accuracy of the set measurements is checked. The set can be accepted or redone.

Moving ahead with the traverse

From the **Traverse** - **Select** screen, select an option to move ahead with the traverse, or press ESC to redo the last station.

Field	Description
F1 Survey Side-shot	Enables the measurement of standard survey and topographic points. Measured points are stored with a Traverse flag. If the traverse is finally adjusted, these points will be updated. **Close** To exit the **Measure Sideshot!** screen and returns to the **Traverse** - **Select** screen.
F2 Move to next Station	Move to the next station. The instrument can either be left on or turned off. If the instrument is turned off and then turned on again later, the message **Last traverse not yet finished or processed! Do you really want to start a new traverse ? All existing data will be overwritten!** will display. Selecting **Yes** will re-open the Traverse to continue at the new station. The start screen for the next station is similar to the **Enter Station Data** screen. The point ID of the foresight point of the last station is suggested as station ID automatically. Run through the loop of backsight and foresight measurements until the number of sets is reached.
F3 Measure Checkpoint	By measuring a check point it is possible to check whether the Traverse is still within certain deviations. A check point is excluded from the traverse calculation and adjustment, however, all measurement data and results observed from a check point are stored. 1) Enter the name of the check point and the height of the reflector. 2) Press **Cont** to go to the next screen. 3) Measure the check point. The differences in Easting, Northing and Height are displayed. A message will appear if the tolerances defined in the Traverse configuration are exceeded.

Next step

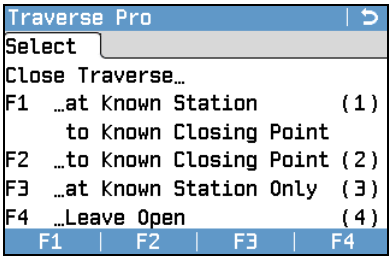
Close the traverse by selecting **Close** in the **Sight Foresight!** screen after a backsight point measurement, but before the foresight point measurement.

6.14.5 Closing a Traverse

Access

Close the traverse by selecting **Close** in the **Sight Foresight!** screen after a backsight point measurement, but before the foresight point measurement.

Close Traverse...



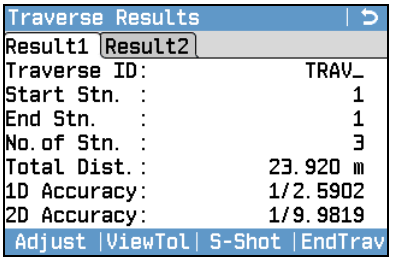
F1 - F4
To select menu item.

Field	Description
F1 ...at Known Station to Known Closing Point	To close a traverse at a known station to a known closing point. Use when setup on the closing station, and the coordinates for the station and the closing point are known. ☞ If this method is chosen a distance measurement is mandatory. 1) Input the data for both points. 2) Measure to the closing point. 3) The results are displayed.
F2 ...to Known Closing Point	To close a traverse to a known closing point. Use when setup on an unknown station and only the coordinates of the closing point are known. 1) Input the data for the point. 2) Measure to the closing point. 3) The results are displayed.
F3 ...at Known Station Only	To close a traverse at a known station only. Use when setup on the closing station and the coordinates for it are known. 1) Input the data for the closing station. 2) The results are displayed.
F4 ...Leave Open	To leave the traverse open. There is no last traverse station. 1) The results are displayed.

Next step

Select an option, from the **Close Traverse...** menu to proceed to the **Traverse Results** screen.

Traverse Results



Adjust
To calculate an adjustment. Unavailable when the traverse is left open.

ViewTol
To view the tolerances for the traverse.

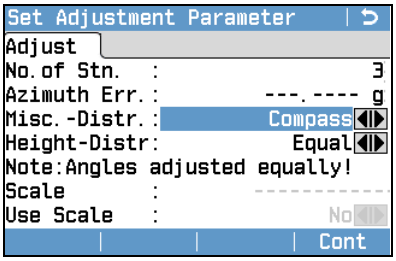
S-Shot
To measure a sideshot.

EndTrav
To record the results and end the traverse.

Field	Description
Traverse ID	Name of the traverse.
Start Stn.	Point ID of the start station.
End Stn.	Point ID of the end station.
No.of Stn.	Number of stations in the traverse.
Total Dist.	Total distance of the traverse.
1D Accuracy	Accuracy in 1D $1/\left(\frac{\text{Length of Traverse}}{\text{Height Misclosure}}\right)$
2D Accuracy	Accuracy in 2D $1/\left(\frac{\text{Length of Traverse}}{\text{Linear Misclosure}}\right)$
L of Error	Length/distance error.
Azimuth Err.	Azimuth closure error.
ΔEast, **ΔNorth**, **ΔHeight**	Calculated coordinates.

Next step
Press **Adjust** from the **Traverse Results** screen to calculate the adjustments.

Set Adjustment Parameter



Field	Description
No.of Stn.	Number of stations in the traverse.
Azimuth Err.	Azimuth closure error.
Misc.-Distr.	For misclosure distribution. ☞ Angle misclosures are distributed equally. **Compass** For surveys where angles and distances were measured with equal precision. **Transit** For surveys where angles were measured with a higher precision than the distances.
Height-Distr	The height error can be distributed equally, by distance or not at all.
Scale	PPM value defined by the calculated distance between start and end point divided by the distance measured.
Use Scale	Whether to use the calculated ppm.

☞

- Depending on the number of measured points the calculation may take some time. A message is displayed during the processing.
- Adjusted points are stored as fixpoints with an additional prefix, for example point BS-154.B is stored as CBS-154.B.
- After the adjustment the Traverse program is exited and the system returns to the Main Menu.

Messages

The following are important messages or warnings that may appear.

Messages	Description
Memory is nearly full! Do you want to continue ?	This message occurs if less than 10% of the memory is free. It is not recommended to start a traverse if the memory is almost full. Doing so, may mean that the traverse measurements and the results cannot be saved.
Current job contains an adjusted Traverse. Select a different job!	Only one traverse per job is allowed. Another job must be selected.
Last traverse not yet finished or processed! Do you want to continue ?	The Traverse program was quit without closing a traverse. The traverse can be continued on a new station, left unfinished, or a new traverse started and the old traverse data overwritten.
Do you really want to start a new traverse ? All existing data will be overwritten!	Confirmation of this message will start a new traverse and the old traverse data will be overwritten.
Redo last station ? Measurements of this station **will be overwritten!**	Confirming returns to the first sight point screen for the previous station measurements. The data from the last station is not stored.
Exit Traverse application ? Current station data will be lost!!!	Quitting the program returns to the Main Menu. The traverse can be continued later, but the current station data will be lost.
Out of Tolerance!	The tolerance limits have been exceeded. If not accepted, the calculations can be redone.
Traverse points are re- calculated and newly stored...	An information message displayed while the adjustment is calculated.

7 Favourites

7.1 Overview

Description

Favourites can be accessed by pressing the FNC/Favourites key, or from any measurement screen.

- The FNC/Favourites key opens the **Favourites** Menu and a function can be selected and activated.
- or , activates the specific function assigned to the key. Any function from the **Favourites** Menu can be assigned to these keys. Refer to "4.1 Work Settings".

Favourites

The symbol of an unavailable favourite is crossed out.

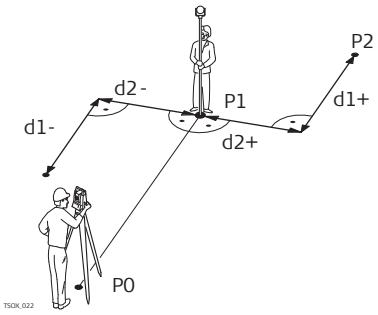
Favourite	Description
Home	Returns to the Main Menu.
Level	Activates the laser plummet and electronic level. Refer to "Level up with the electronic level step-by-step".
Offset	Refer to "7.2 Target Offset".
Del.Rec	Deletes the last recorded data block. This can be either a measurement block or a code block. Deleting the last record is not reversible! Only records recorded in **Survey** and **Quick Survey** can be deleted.
Coding	Starts Coding to select a code from a codelist or enter a new code. Same functionality as the softkey **Code**.
PIN-lock	Refer to "9.5 Instrument Protection with PIN".
NP←→P	Changes between the two EDM modes. Refer to "4.5 EDM Settings". Available for instrument with non-prism mode.
Laserpt.	Activates/deactivates the visible laser beam for illuminating the target point. Available for instrument with non-prism mode.
EDM Track	Refer to "7.5 EDM Tracking".
Sig.Refl.	To view EDM Signal reflection value.
H-Trans	Height Transfer. Refer to "6.2 Station Setup".
Hidden Pt	Refer to "7.3 Hidden Point".
CheckTie	Refer to "7.4 Check Tie".
BS-Check	Refer to "7.6 Backsight Check".
Illumin.	To turn the keyboard illumination on/off. Available for Color&Touch display.
Touch	To deactivate/activate the touch screen. Available for Color&Touch display.
Distance Unit	Sets the distance measurement unit. Available for the user keys.
Angular Unit	Sets the angle measurement unit. Available for the user keys.

7.2 Target Offset

7.2.1 Overview

Description

This favourite calculates the target point coordinates if it is not possible to set up the reflector, or to aim at the target point directly. The offset values (length, trav. and/or height offset) can be entered. The values for the angles and distances are calculated to determine the target point.

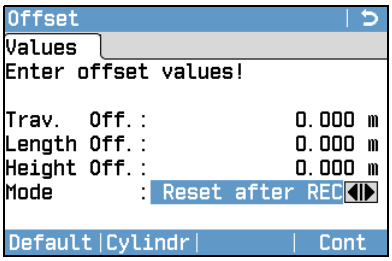


P0 Instrument station
P1 Measured point
P2 Calculated offset point
d1+ Length offset, positive
d1- Length offset, negative
d2+ Trav. offset, positive
d2- Trav. offset, negative

Access

1. Press the FNC/Favourites key when within any program.
2. Select **Offset** from the **Favourites** Menu.

Enter offset values



Default
To reset offset values to 0.

Cylindr
To enter cylindrical offsets.

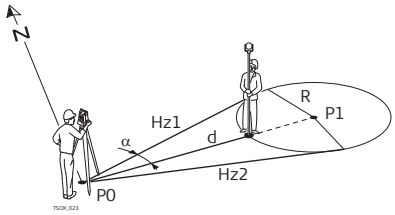
Field	Description
Trav. Off.	Perpendicular offset. Positive if the offset point is to the right of the measured point.
Length Off.	Longitudinal offset. Positive if the offset point is further away than the measured point.
Height Off.	Height offset. Positive if the offset point is higher than the measured point.
Mode	Period for which the offset is to apply. **Reset after REC** The offset values are reset to 0 after the point is saved. **Permanent** The offset values are applied to all further measurements.
☞	The offset values are always reset to 0 when the program is quit.

- Either, press **Cont** to calculate the corrected values and return to the program from which the offset favourite was started. The corrected angle and distances are displayed as soon as a valid distance measurement has been triggered or exists.
- Or, press **Cylindr** to enter cylindrical offsets. Refer to "7.2.2 Cylindrical Offset Subprogram".

7.2.2 Cylindrical Offset Subprogram

Description

Determines the coordinates of the centre point of cylindrical objects and their radius. The horizontal angle to points on both the left and right sides of the object are measured, and the distance to the object as well.

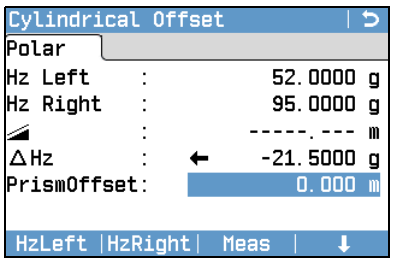


P0 Instrument station
P1 Centre point of cylindrical object
Hz1 Horizontal angle to a point on the left side of the object
Hz2 Horizontal angle to a point on the right side of the object
d Distance to the object in the middle between Hz1 and Hz2
R Radius of cylinder
α Azimuth from Hz1 to Hz2

Access

Press **Cylindr** from the **Offset** screen.

Cylindrical Offset



HzLeft
To trigger measurement for the left side of the object.

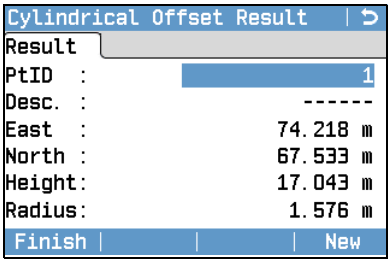
HzRight
To trigger measurement for the right side of the object.

Field	Description
Hz Left	Measured horizontal direction to the left side of the object. Using the verticalhair, aim at the left side of the object, then press **HzLeft**.
Hz Right	Measured horizontal direction to the right side of the object. Using the verticalhair, aim at the right side of the object, then press **HzRight**.
ΔHz	Deviation angle. Rotate the instrument to aim in the direction of the centre point of the cylindrical object, such that ΔHz is zero.
PrismOffset	Prism offset distance between the centre of the prism and the surface of the object to be measured. If the EDM mode is Non-Prism, the value is set to zero automatically.

Next step

Once **ΔHz** is zero, press **Meas** to complete the measurement and display the results.

Cylindrical Offset Result



Finish
To record results and return to the main **Offset** screen.

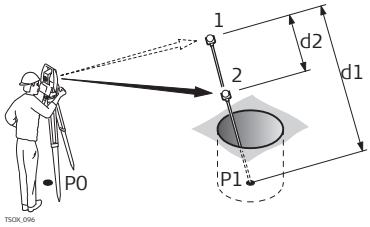
New
To measure a new cylindrical object.

Field	Description
PtID	Defined point ID of the center point.
East	Easting coordinate of the centre point.
North	Northing coordinate of the centre point.
Height	Height of the point measured with the reflector. ☞ This is not the calculated height of the centre point.
Radius	Radius of the cylinder.

7.3 Hidden Point

Description

This favourite is used for measurements to a point that is not directly visible, using a special hidden point rod.



P0 Instrument station
P1 Hidden point
1-2 Prisms 1 and 2
d1 Distance between prism 1 and the hidden point
d2 Distance between prism 1 and 2

Access

1. Press the FNC/Favourites key when within any program.
2. Select **Hidden Pt** from the **Favourites** Menu.
3. If neccesary, press **Rod/EDM** to define the rod or EDM settings.

Hidden Point - Rod Settings

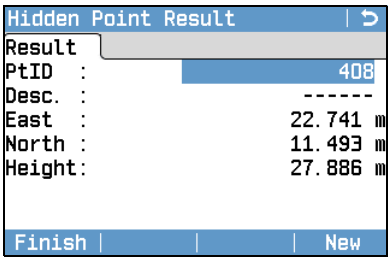
Field	Description
EDM Mode	Changes the EDM Mode.
Prism Type	Changes the prism type.
PrismConst.	Displays the prism constant.
Rod Length	Total length of hidden point rod.
Dist. R1-R2	Spacing between the centres of the prisms R1 and R2.
Meas. Tol.	Limit for the difference between the given and measured spacing of the prisms. If the tolerance value is exceeded, a warning is issued.

Next step

In the **Hidden Point** screen, measure to the first and second prisms using **Meas** and the **Hidden Point Result** screen is displayed.

Hidden Point Result

Displays Easting, Northing and Height coordinates of the hidden point.



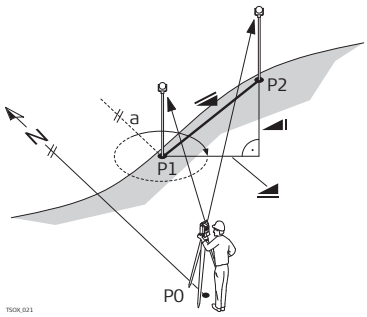
Finish
To record results and return to program where the FNC/Favourites key was selected.

New
To return to the **Hidden Point** screen.

7.4 Check Tie

Description

This favourite calculates and displays the slope and horizontal distance, height difference, azimuth, grade, and coordinate differences between the last two measured points. Valid distance measurements are required for the calculation.



a Azimuth
Slope distance
Height distance
Horizontal distance
P0 Instrument station
P1 First point
P2 Second point

Access

1. Press the FNC/Favourites key when within any program.
2. Select **CheckTie** from the **Favourites** Menu.

Check Tie

Field	Description
Bearing	Difference in bearing between the two points.
Grade	Difference in gradient between the two points.
	Difference in horizontal distance between the two points.
	Difference in slope distance between the two points.
Δ	Difference in height between the two points.

Messages

The following are important messages or warnings that may appear.

Messages	Description
Two measurements required!	The values cannot be calculated as there are less than two valid measurements.

7.5 EDM Tracking

Access

1. Press the FNC/Favourites key when within any program.
2. Select **EDM** from the **Favourites** Menu.

Description

This favourite activates or deactivates the tracking measurement mode. The new setting is displayed for about one second and then set. This favourite can only be activated from within the same EDM mode and prism type. The following options are available.

EDM Mode	Tracking mode OFF! <=> Tracking mode ON!
Prism	**P-Precise+ <=> P-Tracking** / **P-Precise & Fast <=> P-Tracking**
Non-Prism	**NP-Precise <=> NP-Tracking**

☞ The last active measurement mode remains set when the instrument is switched off.

7.6 Backsight Check

Description

This favourite enables the user to remeasure to the point(s) used for Station Setup. This is useful to check if the station position is still correct after measuring some points.

Access

1. Press the FNC/Favourites key when within any program.
2. Select  **BS-Check** from the **Favourites** Menu.

Backsight Check

This screen is exactly the same as the Stakeout screen, except that the available PtIDs are restricted to the points used for the last orientation. Refer to "6.4 Stakeout" for information about the screen.

☞ When setting up a station by local resection, check the coordinate system of the points used from the list.

8 Coding

8.1 Coding

Description

Codes contain information about recorded points. With the help of coding, points can be assigned to a particular group simplifying later processing.
Codes are stored in codelists, with each codelist supporting a maximum of 200 codes.

Creating a codelist

A codelist can be created:

- on the instrument: Select **Manage** from the Main Menu. Select from the **Manage** Menu.
- in FlexOffice.

Codelists can be imported and exported via USB memory stick and via FlexOffice. Refer to "10.3 Importing Data" and "10.2 Exporting Data".

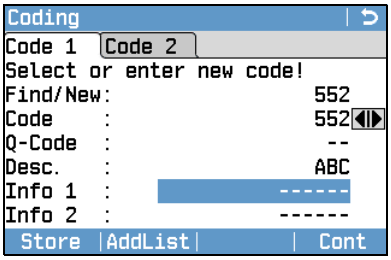
GSI coding

Codes are always stored as free codes (WI41-49), that means that codes are not directly linked to a point. They are stored before or after the measurement depending on the setting made.
A code is always recorded for each measurement as long as the code is displayed in the Code: field. For a code not to be recorded, the Code: field must be cleared. This can be set to occur automatically. Refer to "4.3 Data Settings".

Access

- Either, select **Q-Survey** from the Main Menu and press ⬇ **Code** or change to page 4/4 for Black&White display and to page **Code** for Color&Touch display.
- Or, select **Programs** from the Main Menu, select **Survey** and press ⬇ **Code** or change to page 4/4 for Black&White display and to page **Code** for Color&Touch display.
- Or, press the FNC/Favourites key when within any program and select **Coding**.

Coding



Store
To record the code immediatelly without measurement.

AddList
To add the entered code to the codelist.

Cont
To record the code with the next measurement.

Field	Description
Find/New	Code name. After entry, the firmware searches for a matching code name, and displays these in the code field. If a matching code name does not exist this value becomes the new code name. It can be added by pressing **AddList**.
Code	List of existing code names.
Q-Code	Two digit quick code assigned to the code. Refer to "8.2 Quick Coding".
Desc.	Additional remarks.
Info 1 to **Info 8**	More information lines, freely editable. Used to describe attributes of the code.

Extend / edit codes

To each code a description and a maximum of 8 attributes with up to 16 characters each can be assigned. Existing code attributes, displayed in fields **Info 1** to **Info 8**, can be overwritten freely with the following exceptions:
The codelist editor of FlexOffice can assign a status to the attributes.

- Attributes with status "fixed" are write-protected. They cannot be overwritten or edited.
- For attributes with status "Mandatory" an input or a confirmation is required.
- Attributes with status "Normal" can be edited freely.

8.2 Quick Coding

Description

Using quick coding, a predefined code can be called directly via the keypad on the instrument. The code is selected by entering a two-digit number, the measurement is then triggered and the measured data and code saved.
A total of 99 quick codes can be assigned.
The quick code number can be assigned when the code is created in the **Coding** screen, in the Codelist Manager in FlexOffice, or it is assigned in accordance with the order in which the codes were entered, for example, 01 -› first code in the code list ... 10 -› tenth code in the code list.

Access

1. Select **Programs** from the Main Menu.
2. Select **Survey** from the **Programs** Menu.
3. Press ⬇ **Q-Code**.

Quick coding step-by-step

1. Press ⬇ **Q-Code**.
2. Enter a two-digit number on the keypad.
   A two-digit code must always be entered on the keypad even if only a one-digit code was assigned.
   For example: 4 -› enter 04.
3. The code is selected, the measurement triggered and the measured data and code saved. The name of the selected code is displayed after the measurement.
4. Press ⬇ **Q-Code** again to end quick coding.

Messages

The following are important messages or warnings that may appear.

Messages	Description
Cannot edit attribute!	Attribute with fixed status cannot be changed.
No codelist available !	No codelist in memory. Manual input for code and attributes are called automatically.
Code not found!	No code is assigned to the entered number.

FlexOffice

Codelists can be easily created and uploaded to the instrument using the supplied FlexOffice software.

9 Tools

9.1 Adjust

Description

The **Adjustments** Menu contains tools to be used for the electronic adjustment of the instrument and for setting adjustment reminders. Using these tools helps to maintain the measuring accuracy of the instrument.

Access

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

Adjustment options

In the **Adjustments** screen, there are several adjustment options.

Menu selection	Description
Hz-Collimation	Refer to "11.3 Adjusting Line-of-Sight and Vertical Index Error".
Vertical Index	Refer to "11.3 Adjusting Line-of-Sight and Vertical Index Error".
Compensator Index	Refer to "11.4 Adjusting the Compensator".
Tilting Axis	Refer to "11.5 Adjusting the Tilting Axis Error".
View Current Adj. Data	Displays the current adjustment values that have been set for Hz-Collimation, V-index and Tilt Axis.
Set Adjustment Reminder	Defines the time period from the last adjustment to when a reminder message should display to do another adjustment. Options are: **Never**, **2 weeks**, **1 month**, **3 months**, **6 months**, **12months**. The message will display the next time the instrument is switched on after the time period has been reached.

9.2 Startup Sequence

Description

Through the Startup tool, it is possible to record a user-defined sequence of key presses so that, after switching on the instrument, a particular screen can be displayed after the **Level & Plummet** screen instead of the Main Menu. For example, the general **Settings** screen for configuring the instrument settings.

Access

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

Auto start step-by-step

1. Press **Record** in the **Startup** screen.
2. Press **Cont** to confirm the information message and begin the recording process.
3. The next key presses are stored, up to a maximum of 64. To end the recording press ESC.
4. If the auto start **Status** is set to **Active**, the stored key presses will be executed automatically after switching on the instrument.

☞ The automatic start sequence has the same effect as pressing the keys manually. Certain instrument settings cannot be made in this way. Relative entries such as automatically setting **EDM Mode**: **P-Precise & Fast** upon switching on the instrument, are not possible.

Description

The **Info** screen displays instrument, system and firmware information, as well as settings for the date and time.

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

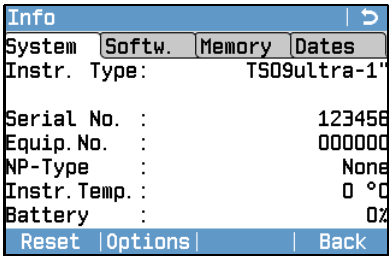
Access

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

Info

Page 1/4 or System

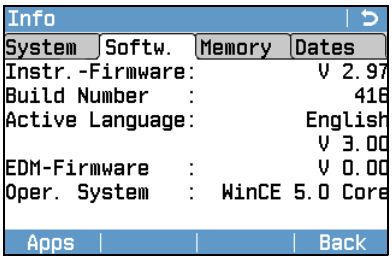
This screen displays information about the instrument and operating system.



Reset
To reset all settings to the system default.

Options
To display hardware related options.

Page 2/4 or Softw.



Apps
To display a list of the programs available on the instrument. A check mark is display in the check box beside each program that is licenced.

Field	Description
Instr.-Firmware	Displays the firmware version number installed on the instrument.
Build Number	Displays the build number of the firmware.
Active Language	Displays the current language and version number selected for the instrument.
EDM-Firmware	Displays the version number of the EDM firmware.
Oper. System	Display the operating system of the instrument.

Page 3/4 or Memory

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

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

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

Page *4*/*4* or Dates

Field	Description
Maint.-End Date	Displays the end date of the maintenance agreement for the instrument firmware.
Next Service Date	Displays the date of the next service check required. The field can be invisible if turned off by the service reminder.

9.4 Licence Keys

Description

To fully activate hardware functionality, firmware applications and firmware contracts, licence keys may be required on the instrument. For all instruments, licence keys can be manually entered or uploaded via FlexOffice. For instruments fitted with a Communication side cover licence keys can also be uploaded via a USB memory stick.

Access

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

Enter Licence Key

Field	Description
Method	Method of licence key entry. Either **Manual Entry** or **Upload Key File**.
Key	Licence key. Available when **Method**: **Manual Entry**.

☞

- Selecting **Delete** from this screen will delete all firmware licence keys on the instrument and the firmware maintenance licence.
  When uploading firmware from a USB memory stick, the license key file must be stored in the System folder on the USB memory stick.

9.5 Instrument Protection with PIN

Description

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

Activate PIN code step-by-step

1. Select **Tools** from the Main Menu.
2. Select **PIN** from the **Tools** Menu.
3. Activate PIN protection by setting **Use PIN-Code**: **On**.
4. Enter a personal PIN Code (max. 6 numerics) in the **New PIN-Code** field.
5. Accept with **Cont**.

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

Lock instrument step-by-step

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

1. Press the FNC/Favourites key when within any program.
2. Select **PIN-lock** from the **Favourites** Menu.

Entering the PUK code

If a wrong PIN has been entered five times, the system will prompt for a Personal UnblocKing code. The PUK code can be found on the instrument delivery papers.
If the PUK code entered is correct then the instrument will start up and reset the PIN code to default value 0 and **Use PIN-Code**: **Off**.

Deactivate PIN code step-by-step

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

☞ The instrument is now no longer protected against unauthorised use.

9.6 Loading Software

Description

To load program software or an additional language, connect the instrument to FlexOffice via the serial interface and load using "FlexOffice - Software Upload". Refer to the FlexOffice online help for further information.

For instruments fitted with a Communication side cover, the software can be loaded via a USB memory stick. This process is described below.

Access

1. Select  **Tools** from the Main Menu.
2. Select  **Load FW** from the **Tools** Menu.

☞

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

Loading firmware and languages step-by-step

☞ All firmware and language files must be stored in the system folder to be transferred to the instrument.

1. To load firmware and languages: Select **F1 Firmware,EDM-FW,Logo**. The **Select File!** screen will appear.
   To load only languages: Select **F2 Language(s) only** and skip to step *4.*.
2. Select the firmware file from the system folder of the USB memory stick.
3. Press **Cont**.
4. The **Upload Languages!** screen will appear displaying all language files in the system folder of the USB memory stick. Select **Yes** or **No** for a language file to be uploaded. At least one language must be set to **Yes**.
5. Press **Cont**.
6. Once successfully loaded, the system will shut down and restart again automatically.

10 Data Management

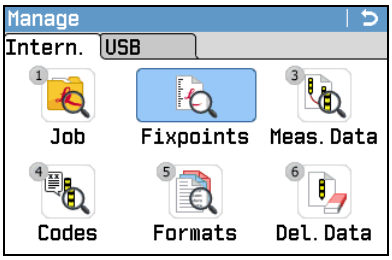
10.1 Manage

Access

Select **Manage** from the Main Menu.

Manage

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



Menu item	Description
Job	To view, create and delete jobs. Jobs are a summary of data of different types, for example, fixed points, measurements or codes. The job definition consists of the job name and user. The system generates time and date at the time of creation.
Fixpoints	To view, create, edit and delete fixpoints. Valid fixed points contain at least the point ID and the coordinates E, N or H.
Meas.Data	To view, edit and delete measurement data. Measurement data available in the internal memory can be searched for via a specific point search, or by viewing all points within a job. The PtID, hr, code and code details can be edited. ☞ If the details of a point have been edited, any new calculations will use the new point details. However, any previously stored calculation results based on the original coordinates of the point will not be updated.
Codes	To view, create, edit and delete codes. To each code a description and a maximum of 8 attributes with up to 16 characters each can be assigned.
Formats	To view and delete data format files.
Del.Data	To delete individual jobs, fixpoints and measurements of a specific job or all jobs in the memory. ☞ Deleting the memory cannot be undone. After confirming the message all data is permanently deleted.
USB-Stick	To view, delete, rename and create folders and files stored on the USB memory stick. Only available if the instrument is fitted with a Communication side cover and a USB memory stick is inserted. Refer to "10.4 Working with a USB Memory Stick"and "Appendix B Directory Structure".

10.2 Exporting Data

Description

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

The RS232 serial interface

A receiver, such as a laptop, is connected to the RS232 port. The receiver requires FlexOffice or another third-party software.

☞ If the receiver is too slow in processing data the data could be lost. With this type of data transfer the instrument is not informed about the performance of the receiver (no protocol). Therefore the success of this type of transfer is not checked.

The USB device port

For instruments fitted with a Communication side cover.

The USB device can be connected to the USB device port housed in the Communication side cover. The USB device requires FlexOffice or another third-party software.

A USB memory stick

For instruments fitted with a Communication side cover. A USB memory stick can be inserted and removed from the USB host port housed in the Communication side cover. No additional software is required for the transfer.

XML Export

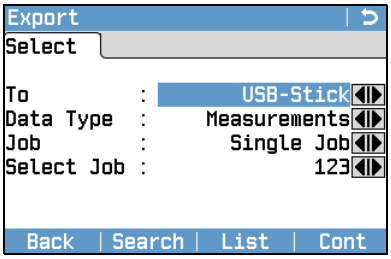
The exporting of XML data has some special requirements.

- XML standards do not allow a mix of imperial and metric measurement systems. When exporting XML data, all measurements will be converted to the same measurement system as set for the distance unit. For example, if the distance unit is set to a metric unit (metre), the pressure and temperature units will be converted to metric units as well, even if they are set to imperial units on the instrument.
- The angle unit MIL is not supported by XML. When exporting XML data, measurements using this unit are converted to dec.deg.
- The distance unit ft-in/16 is not supported by XML. When exporting XML data, measurements using this unit are converted to feet.
- Points with Height coordinates only, are not supported by XML. These points are given the E and N values of 0.

Access

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

Export

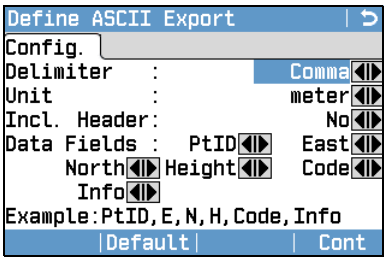


Search
To search for jobs or formats within the internal memory.

List
To list all jobs or formats within the internal memory.

Field	Description
To	USB memory stick or RS232 serial interface.
Data Type	Data type to be transferred. To USB memory stick or RS232 serial interface: **Measurements**, **Fixpoints**, **Meas.& Fixpoints** Only to USB memory stick: **Road Data**, **Code**, **Format**, **Configuration**, **Backup**
Job	Select whether to export all job-related data or a single job data file.
Select Job	Displays the selected job or road alignment file.
Format	If **Data Type**: **Format**. Select whether to export all formats or a single format.
Format Name	If **Format**: **Single Format**. Name of the format to be transferred.

Export data step-by-step

1. Press **Cont** in the **Export** screen after selecting the export details.
2. If export is to a USB memory stick, select the desired file location and press **Cont**
   Data type: Default folder on USB memory stick
   Job data: Jobs
   Format files: Formats
   Codes: Codes
3. Select the data format, enter the file name and press **Cont** or **Send**.
   If the data format is ASCII, the **Define ASCII Export** screen appears. Continue with step 4.. For all other data format types, a message will display confirming the successful export of data.
4. 

   Define the delimiter value, the units and the data fields of the file and press **Cont**. A message will display confirming the successful export of data.

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

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

☞ **Road Data**, **Format** and **Backup** data types, and the ASCII data format, are only available for data exports to a USB memory stick, not via the RS232 serial interface.

☞ All jobs, formats, codelists and configurations will be stored in the backup folder created on the USB memory stick. The job data will be stored as individual database files for each job, which can then be imported again. Refer to "10.3 Importing Data".

Exportable job data formats

Job data can be exported from a job in dxf, gsi, csv and xml file types, or any other user-defined ASCII format. A format can be defined in FlexOffice Format Manager. Refer to the online help of FlexOffice for information on creating format files.

RS232 example job data output

Within the **Data Type** setting **Measurements**, a data set could be shown as follows:

11....+00000D19	21..022+16641826	22..022+09635023
31..00+00006649	58..16+00000344	81..00+00003342
82..00-00005736	83..00+00000091	87..10+00001700

GSI-IDs			GSI-IDs continued		
11	≙	PtID	41-49	≙	Codes and attributes
21	≙	Horizontal direction	51	≙	ppm [mm]
22	≙	Vertical angle	58	≙	Prism constants
25	≙	Orientation	81-83	≙	(E, N, H) Target point
31	≙	Slope distance	84-86	≙	(E, N, H) Station point
32	≙	Horizontal distance	87	≙	Reflector height
33	≙	Height difference	88	≙	Instrument height

10.3 Importing Data

Description

For instruments fitted with a Communication side cover, data can be imported to the internal memory of the instrument via a USB memory stick.

Importable data formats

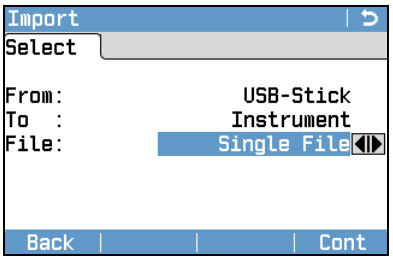
When importing data, the instrument automatically stores the file in a directory folder based on the file extension. The following data formats can be imported:

Data Type	File extension	Recognised as
GSI	.gsi, .gsi (road)	Fixpoints
DXF	.dxf	Fixpoints
LandXML	.xml	Fixpoints
ASCII	any ASCII file extension e.g. .txt	Fixpoints
Format	.frt	Format file
Codelist	.cls	Codelist file
Configuration	.cfg	Configuration file
Backup	.db	Backup of fixpoints, measurements and configuration

Access

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

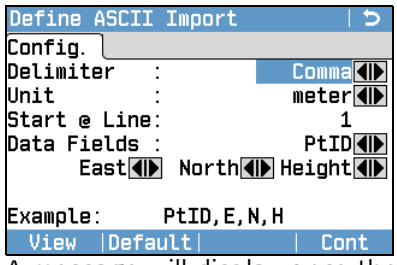
Import



Field	Description
From	USB-Stick
To	Instrument
File	Import a single file or a backup folder.

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

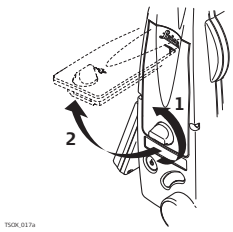
Import data step-by-step

1. Press **Cont** in the **Import** screen to proceed to the USB memory stick file directory.
2. Select the file or backup folder on the USB memory stick to be imported and press **Cont**.
3. For a file: Define the Job name for the imported file, and, if requested, the file definition and layers, and press **Cont** to import. If a Job with the same name already exists in the internal memory, a message will appear with the options to overwrite the existing job, attach the new points to the current job, or rename the job for the file being imported.
   If new points are attached to the current job, and the same point ID already exists, the existing point ID will be renamed with a numerical suffix. For example, PointID23 will be renamed to PointID23_1. The maximum renamed suffix is 10, e.g. PointID23_10.
   For a backup folder: Take note of the warning message displayed and press **Cont** to proceed and import the folder.
4. 

   If the file is an ASCII file, the **Define ASCII Import** screen will appear. Define the delimiter value, the units and the data fields of the file and press **Cont** to continue.
5. A message will display once the file or backup folder has been successfully imported.

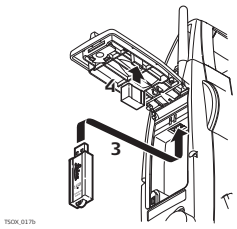
☞ A '+', '-', '.' or alphanumerical characters should not be used as delimiter values in ASCII files. These characters can also be part of the point ID or coordinate values and if so, will generate errors where they occur in the ASCII file.

Insert a USB memory stick step-by-step



Open the compartment lid on the Communication side cover.

The USB host port is located underneath the top edge of the compartment.



Insert the USB memory stick into the USB host port.

The cap of a Leica industrial grade USB memory stick can be stored on the underside of the compartment lid.

Close the compartment lid and turn the knob to lock the compartment closed.

☞ Always return to the Main Menu before removing the USB memory stick.

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

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

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

Format a USB memory stick step-by-step

Formatting the USB memory stick before starting to store data is required if a completely new USB memory stick is used, or if all existing data needs to be deleted.

☞ The formatting function on the instrument only works for Leica USB memory sticks. All other USB memory sticks should be formatted on a computer.

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

1. Select **Manage** from the Main Menu.
2. Select **USB-Stick** from the **Manage** Menu.
3. Press ⬇ **Format** in the **USB-File Manager** screen.
4. A warning message will appear.
   ☞ By activating the format command all data will be lost. Make sure that all important data on the USB memory stick has been backed up before formatting the USB memory stick.
5. Press **Yes** to format the USB memory stick.
6. A message will display once the formatting of the USB memory stick is completed. Press **Cont** to return to the **USB-File Manager** screen.

10.5 Working with Bluetooth

Description

Instruments fitted with a Communication side cover can communicate with external devices via a Bluetooth connection. The instrument Bluetooth is a slave only. The Bluetooth of the external device will be the master, and therefore will control the connection and any data transfer.

Establishing a connection step-by-step

1. On the instrument ensure that the communication parameters are set to **Bluetooth:** and **Active**. Refer to "4.6 Interface Settings".
2. Activate Bluetooth on the external device. The steps required depend on the Bluetooth driver and other device specific configurations. Refer to the device user manual for information on how to configure and search for a Bluetooth connection.
   The instrument will appear on the external device as "TS0x_y_zzzzzzz", where x = the FlexLine plus series (TS06 plus or TS09 plus), y = the angular accuracy in arc seconds, and z = the serial number of the instrument. For example, TS06_3_1234567.
3. Some devices ask for the identification number of the Bluetooth. The default number for a FlexLine plus Bluetooth is 0000. This can be changed by:
   - Select **Settings** from the Main Menu.
   - Select **Interface** from the **Settings** Menu.
   - Press **BT-PIN** from the **Interface Settings** screen.
   - Enter a new Bluetooth PIN number in **PIN-Code**.
   - Press **Cont** to confirm the new Bluetooth PIN.
4. When the external Bluetooth device has located the instrument for the first time, a message will display on the instrument stating the name of the external device and requesting confirmation that connection to this device should be allowed.
   - Press **Yes** to allow, or
   - Press **No** to disallow this connection
5. The instrument Bluetooth sends out the instrument name and serial number to the external Bluetooth device.
6. All further steps must be made in accordance to the user manual of the external device.

Transferring data via Bluetooth

Using FlexOffice Data Exchange Manager, data files can be transferred from the instrument to a local folder via the Bluetooth connection. The transfer is made through the serial port configured on the computer as the Bluetooth Serial Port, however, for faster data transfer speeds we recommend using the USB or RS232 connections.
For more information about FlexOffice Data Exchange Manager refer to the comprehensive online help.
For transferring data using other external devices or software programs, refer to the user manual of the device or software. The FlexLine plus Bluetooth does not establish or manage the data transfer.

10.6 Working with Leica FlexOffice

Description	The program package FlexOffice is used for the data exchange between the instrument and a computer. It contains several auxiliary programs in order to support the instrument.
Installation on a computer	The installation program can be found on the DVD-ROM supplied. Insert the DVD and follow the on-screen instructions. Please note that FlexOffice can only be installed on computers with MS Windows 2000, XP, Vista and Windows 7 operating systems.
☞	FlexLine plus instruments are supported from FlexOffice v2.2 onwards.
☞	For more information about FlexOffice refer to the comprehensive online help.

11 Check & Adjust

11.1 Overview

Description

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

Electronic adjustment

The following instrument errors can be checked and adjusted electronically:
- Horizontal collimation error, also called line-of-sight error.
- Vertical index error, and simultaneously the electronic level.
- Compensator longitudinal and transversal index errors
- Tilting axis error.

☞ For determining these errors, it is necessary to measure in both faces, but the procedure can be started in any face.

Mechanical adjustment

The following instrument parts can be adjusted mechanically:
- Circular level on the instrument and tribrach.
- Laser plummet.
- Screws on the tripod.

☞ During the manufacturing process, the instrument errors are carefully determined and set to zero. As mentioned, these errors can change and it is highly recommended to redetermine them in the following situations:
- Before the instrument is used for the first time.
- Before every high precision survey.
- After rough or long periods of transport.
- After long periods of work or storage.
- If the temperature difference between current environment and the temperature at the last calibration is more than 10°C (18°F).

11.2 Preparation

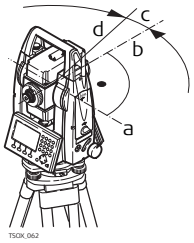
☞  Before determining the instrument errors, level-up the instrument using the electronic level. The **Level & Plummet** is the first screen to appear after turning on the instrument.
The tribrach, the tripod and the ground should be very stable and secure from vibrations or other disturbances.

☞  The instrument should be protected from direct sunlight in order to avoid thermal expansion on one side only.

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

Line-of-sight error

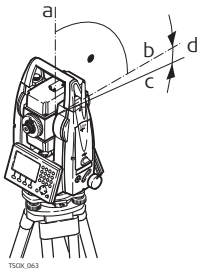
The line-of-sight error, or horizontal collimation error is the deviation from the perpendicular between the tilting axis and the line of sight. The effect of the line-of-sight error to the horizontal direction increases with the vertical angle.



a) Tilting axis
b) Line perpendicular to tilting axis
c) Horizontal collimation, or line-of-sight, error
d) Line-of-sight

Vertical index error

The vertical circle should read exactly 90° (100 gon) when the line of sight is horizontal. Any deviation from this figure is termed vertical index error. This 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. True 90°
c) Vertical angle is reading 90°
d) Vertical index error

☞ By determining the vertical index error the electronic level is adjusted automatically

Access

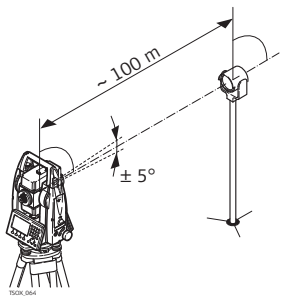
1) Select **Tools** from the Main Menu.
2) Select **Adjust** from the **Tools** Menu.

- Select:
  - **F1 Hz-Collimation**, or
  - **F2 Vertical Index**.

☞ The procedures and conditions required to correct line-of-sight and vertical index errors are the same, therefore the procedure will only be described once.

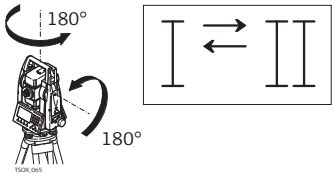
Check and adjust step-by-step

1. Level the instrument with the electronic level. Refer to "3 Operation"- "Level up with the electronic level step-by-step".

2. 

Aim at a point approximately 100 m from the instrument which is within 5° of the horizontal.

3. Press **Store** to measure to the target point.

4. 

Change face and aim at the target point again

☞ For checking the horizontal aim, the difference in Hz and V are displayed.

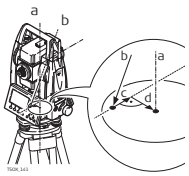
5. Press **Store** to measure to the target point.
   ☞ The old and new calculated values are displayed.
6. Either:
   - Press **More** to measure another set to the same target point. The final adjustment values will be the calculated average from all the measurements.
   - Press **Cont** to save the new adjustment data, or
   - Press ESC to exit without saving the new adjustment data.

Messages

The following are important messages or warnings that may appear.

Messages	Description
V-Angle is not suitablefor adjustment or wrong face!	The vertical angle deviates from the required horizontal / line-of-sight, or in face II the vertical angle deviates by more than 5° from the target point. Aim at the target point with an accuracy of min. 5° or, when adjusting the tilt axis, 27° above or beneath the horizontal plane. Confirmation of the message required.
Out of Tolerance! Previous values retained!	Computed values out of tolerance. The previous values are retained and measurements should be repeated. Confirmation of the message required.
Hz-Angle is not suitable for adjustment!	Horizontal angle in face II deviates by more than 5° from the target point. Aim on the target point with an accuracy of min. 5°. Confirmation of the message required.
Timelimit exceeded!Please repeat Adjustment!	Time difference between measurements for results storage exceeds 15 minutes. Repeat the process. Confirmation of the message required.

Compensator index error



a) Mechanical vertical axis of the instrument, also called standing axis
b) Plumb line
c) Longitudinal component (l) of the compensator index error
d) Transversal component (t) of the compensator index error

The compensator index errors (l, t) occur, if the vertical axis of the instrument and the plumb line are parallel but the zero points of the compensator and the circular level do not coincide. The calibration procedure electronically adjusts the zero point of the compensator.
A longitudinal component in direction of the telescope and a transversal component perpendicular to the telescope define the plane of the dual axis compensator of the instrument.
The longitudinal compensator index error (l) has a similar effect as the vertical index error and effects all vertical angle readings.
The transversal compensator index error (t) is similar to the tilting axis error. The effect of this error to the horizontal angle readings is 0 at the horizon and increases with steep sightings.

Access

1) Select **Tools** from the Main Menu.
2) Select **Adjust** from the **Tools** Menu.
3) Select **F3 Compensator Index**.

Check and adjust step-by-step

Step	Description
1.	Level the instrument with the electronic level. Refer to "3 Operation" - "Level up with the electronic level step-by-step".
2.	Press **Store** to measure the first face. No target has to be aimed at.
3.	**Store** to release the measurement in the other face.
☞	If one or more errors are bigger than the predefined limits, the procedure must be repeated. All measurements of the current run are rejected and are not averaged with the results from previous runs.
4.	Measure the target. The standard deviations of the determined adjustment errors can be calculated from the second run onwards.

11.5 Adjusting the Tilting Axis Error

Description

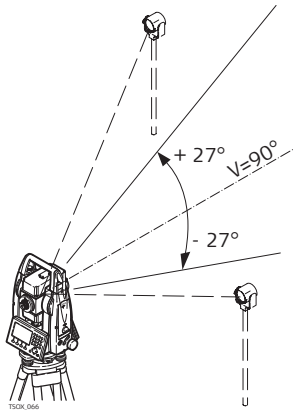
The tilting axis error is caused by the deviation between the mechanical tilting axis and the line perpendicular to the vertical axis. This error affects horizontal angles. To determine this error, it is necessary to point to a target located significantly below or above the horizontal plane.

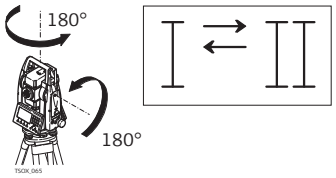
☞ The horizontal collimation error has to be determined before starting this procedure.

Access

1) Select **Tools** from the Main Menu.
2) Select **Adjust** from the **Tools** Menu.
3) Select **F4 Tilt Axis**.

Check and adjust step-by-step

1. Level the instrument with the electronic level. Refer to "3 Operation" - "Level up with the electronic level step-by-step".
2. 

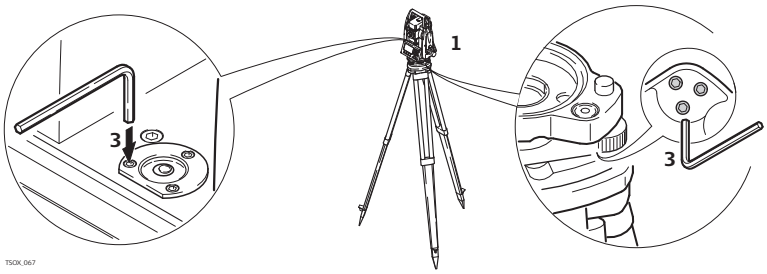
Aim at a point approximately 100 m from the instrument which is at least 27° (30 gon) above or beneath the horizontal plane.
3. Press **Store** to measure to the target point.
4. 

Change face and aim at the target point again
   ☞ For checking the horizontal aim, the difference in Hz and V are displayed.
5. Press **Store** to measure to the target point.
   ☞ The old and new calculated values are displayed.
6. Either:
   - Press **More** to measure another set to the same target point. The final adjustment values will be the calculated average from all the measurements.
   - Press **Cont** to save the new adjustment data, or
   - Press ESC to exit without saving the new adjustment data.

Messages

The same messages or warning as in "11.3 Adjusting Line-of-Sight and Vertical Index Error" may appear.

Adjust the circular level step-by-step



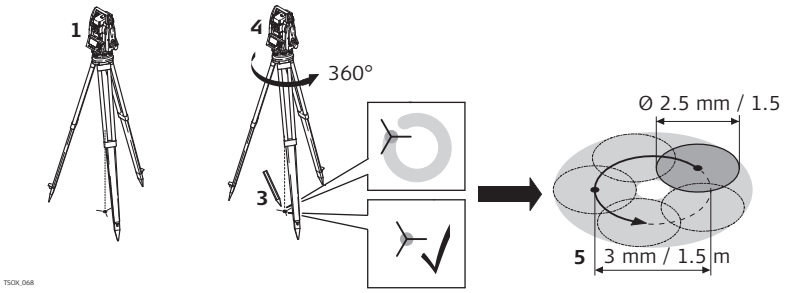
1. Place and secure the tribrach onto the tripod, and then secure the instrument onto the tribrach.
2. Using the tribrach footscrews, level the instrument with the electronic level. To activate the electronic level, turn on the instrument, and, if tilt correction is set to **On**, the **Level & Plummet** screen appears automatically. Alternatively, press the FNC/Favourites key from within any program and select **Level**.
3. The bubbles of the instrument and tribrach levels must be centred. If one or both circular levels are not centred, adjust as follows.
   Instrument: If the bubble extends beyond the circle, use the Allen key supplied to centre it with the adjustment screws.
   Tribrach: If the bubble extends beyond the circle, adjust it using the adjustment pin in conjunction with the adjustment screws. Turn the adjustment screws:
   - To the left: and the bubble approaches the screw.
   - To the right: and the bubble goes away from the screw.
4. Repeat step 3. on the instrument and tribrach until both circular levels are centred and no further adjustments are necessary.

☞ After the adjustment, no adjustment screw should be loose.

11.7 Inspecting the Laser Plummet of the Instrument

The laser plummet is integrated into 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 a Leica service department.

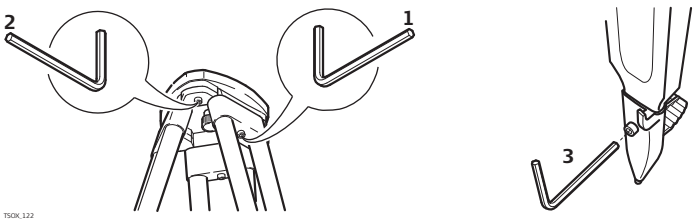
Inspect the laser plummet step-by-step



1. Set up the instrument on the tripod approximately 1.5 m above the ground and level up.
2. To activate the laser plummet, turn on the instrument, and, if tilt correction is set to **On**, the laser plummet will be activated automatically, and the **Level & Plummet** screen appears. Otherwise, press the FNC/Favourites key from within any program and select **Level**.
   Inspection of the laser plummet should be carried out on a bright, smooth and horizontal surface, such as a sheet of paper.
3. Mark the centre of the red laser dot on the ground.
4. Turn the instrument slowly through 360°, carefully observing the movement of the red laser dot.
   The maximum diameter of the circular movement described by the centre of the laser dot should not exceed 3 mm at a height of 1.5 m.
5. If the centre of the laser dot makes a clearly circular movement, or moves more than 3 mm away from the point which was first marked, an adjustment may be required. Call your nearest Leica service department.
   Depending on brightness and surface type, the size of the laser dot can vary. At a height of 1.5 m an average diameter of 2.5 mm is estimated.

11.8 Servicing the Tripod

Service the tripod step-by-step



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

1) Tighten the leg cap screws moderately with the allen key supplied.
2) Tighten the articulated joints on the tripod head just enough to keep the tripod legs open when lifting the tripod off the ground.
3) Tighten the screws of the tripod legs.

12 Care and Transport

12.1 Care

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

12.2 Transport

Transport in the field

When transporting the equipment in the field, always make sure that you
- either carry the product in its original transport container,
- or carry the tripod with its legs splayed across your shoulder, keeping the attached product upright.

Transport in a road vehicle

Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container 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

Periodically carry out test measurements and perform the field adjustments indicated in the User Manual, particularly after the product has been dropped, stored for long periods or transported.

12.3 Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "14 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.

Li-Ion batteries

- Refer to "14 Technical Data" for information about storage temperature range.
- Remove batteries from the product and the charger before storing.
- After storage recharge batteries before using.
- Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use.
- A storage temperature range of -20°C to +30°C/-4°F to 86°F in a dry environment is recommended to minimise self-discharging of the battery.
- At the recommended storage temperature range, batteries containing a 50% to 100% charge can be stored for up to one year. After this storage period the batteries must be recharged.

12.4 Cleaning and Drying

Objective, eyepiece and reflectors

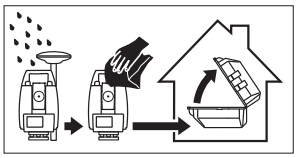
- Blow dust off lenses and prisms.
- Never touch the glass with your fingers.
- Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol. Do not use other liquids; these may attack the polymer components.

Fogging of prisms

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. Remove the battery cover and dry the battery compartment. Do not repack until everything is completely dry. Always close the transport container when using in the field.



Cables and plugs

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

13 Safety Directions

13.1 General

Description

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

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

13.2 Definition of Use

Intended use

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

Adverse use

- Use of the product without instruction.
- Use outside of the intended use and limits.
- Disabling safety systems.
- Removal of hazard notices.
- Opening the product using tools, for example screwdriver, unless this is permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.
- Use of products with recognisable damages or defects.
- Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.
- Deliberate dazzling of third parties.
- Controlling of machines, moving objects or similar monitoring application without additional control- and safety installations.
- Aiming directly into the sun.
- Inadequate safeguards at the working site.

13.3 Limits of Use

Environment

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

DANGER

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

13.4 Responsibilities

Manufacturer of the product

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

Person responsible for the product

The person responsible for the product has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual.
- To ensure that it is used in accordance with the instructions.
- To be familiar with local regulations relating to safety and accident prevention.
- To inform Leica Geosystems immediately if the product and the application becomes unsafe.
- To ensure that the national laws, regulations and conditions for the operation of e.g. radio transmitters, lasers are respected.

13.5 Hazards of Use

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 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.

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.

CAUTION

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

Precautions:

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

Avoid subjecting the product to mechanical stress.

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

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

Precautions:

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

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

WARNING

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

Precautions:

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

WARNING

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

Precautions:

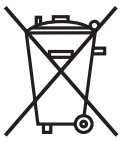
Make sure that the battery terminals do not come into contact with metallic objects.

WARNING

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

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

Precautions:



The product must not be disposed with household waste.

Dispose of the product appropriately in accordance with the national regulations in force in your country.

Always prevent access to the product by unauthorised personnel.

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

WARNING

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

13.6 Laser Classification

13.6.1 General

General

The following chapters provide instructions and training information about laser safety according to international standard IEC 60825-1 (2007-03) and technical report IEC TR 60825-14 (2004-02). The information enables the person responsible for the product and the person who actually uses the equipment, to anticipate and avoid operational hazards.

☞ According to IEC TR 60825-14 (2004-02), 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 Mnual due to the low eye hazard level..

☞ National laws and local regulations could impose more stringent instructions for the safe use of lasers than IEC 60825-1 (2007-03) and IEC TR 60825-14 (2004-02).

13.6.2 Distancer, Measurements with Reflectors

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:

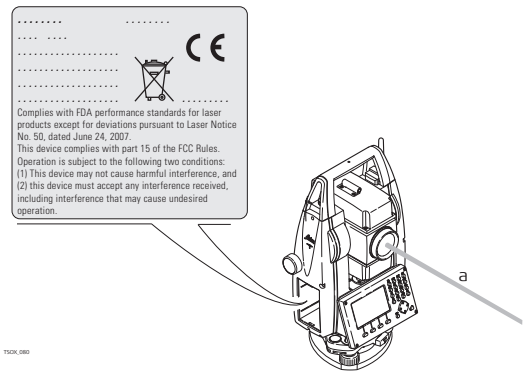
- IEC 60825-1 (2007-03): "Safety of laser products"
- EN 60825-1 (2007-10): "Safety of laser products"

These 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

Class 1 Laser Product
according to
IEC 60825-1 (2007 - 03)



a) Laser beam

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 3R in accordance with:

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

Direct intrabeam viewing may be hazardous (low eye hazard level), in particular for deliberate ocular exposure. The beam may cause dazzle, flash-blindness and after-images, particularly under low ambient light conditions. 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 (R500/R1000)
Maximum average radiant power	5.00 mW
Pulse duration	800 ps
Pulse repetition frequency	100 MHz - 150 MHz
Wavelength	650 nm - 690 nm
Beam divergence	0.2 mrad x 0.3 mrad
NOHD (Nominal Ocular Hazard Distance) @ 0.25 s	80 m / 262 ft

CAUTION

From a safety perspective, class 3R laser products should be treated as potentially hazardous.

Precautions:

1) Prevent direct eye exposure to the beam.
2) Do not direct the beam at other people.

CAUTION

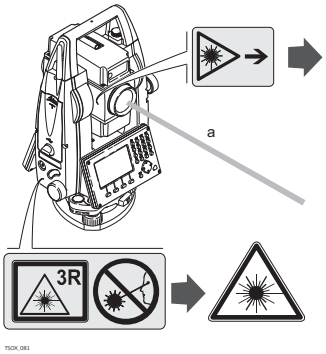
Potential hazards are not only related to direct beams but also to reflected beams aimed at reflecting surfaces such as prisms, windows, mirrors, metallic surfaces, and so on.

Precautions:

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

Labelling

Laser Aperture



Laser Radiation
Avoid direct eye exposure
Class 3R Laser Product according to IEC 60825-1 (2007 - 03)
Po ≤ 5.00 mW
λ = 650-690 nm

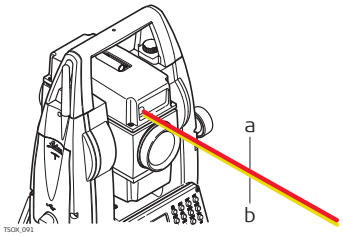
a) Laser beam

13.6.4 Electronic Guide Light EGL

General

The Electronic Guide Light built into the product produces a visible LED beam which emerges from the front side of the telescope.

The product described in this section, is excluded from the scope of IEC 60825-1 (2007-03): "Safety of laser products".
The product described in this section, is classified as exempt group in accordance with IEC 62471 (2006-07) and does not pose any hazard provided that the product is used and maintained in accordance with this user manual.



a) LED beam red
b) LED beam yellow

13.6.5 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"

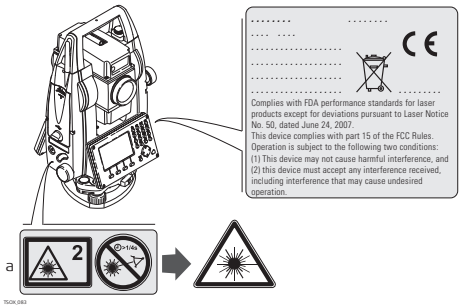
These products are safe for momentary exposures but can be hazardous for deliberate staring into the beam. The beam may cause dazzle, flash-blindness and after-images, particularly under low ambient light conditions.

Description	Value
Maximum average radiant power	0.95 mW
Pulse duration	c.w.
Pulse repetition frequency	c.w.
Wavelength	635 nm

CAUTION

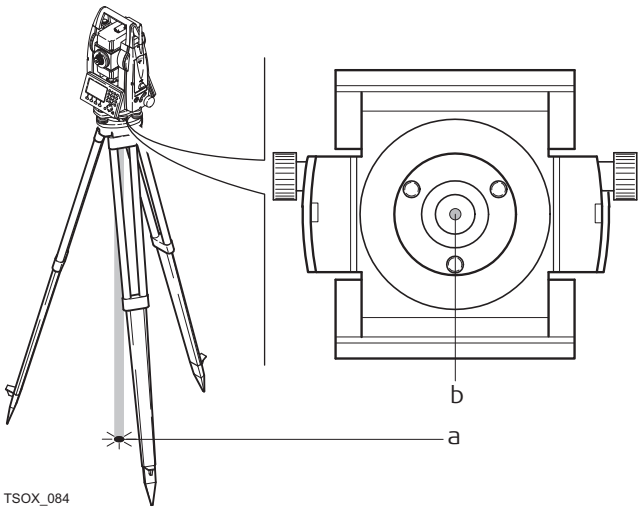
From a safety perspective, class 2 laser products are not inherently safe for the eyes.
Precautions:
1) Avoid staring into the beam.
2) Avoid pointing the beam at other people.

Labelling



Laser Radiation
Do not stare into the beam
Class 2 Laser Product
according to IEC 60825-1 (2007 - 03)
Po ≤ 1.00 mW
λ = 620 - 690 nm

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



a) Laser beam
b) Exit for laser beam

13.7 Electromagnetic Compatibility EMC

Description

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

WARNING

Electromagnetic radiation can cause disturbances in other equipment.

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

CAUTION

There is a risk that disturbances may be caused in other equipment if the product is used with accessories from other manufacturers, for example field computers, personal computers, 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 intense electromagnetic radiation, for example, near radio transmitters, two-way radios or diesel generators.

Precautions:

Check the plausibility of results obtained under these conditions.

CAUTION

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

Precautions:

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

Bluetooth

Use of product with Bluetooth:

WARNING

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

Precautions:

Although the product meets in combination with radio or digital cellular phone devices recommended by Leica Geosystems the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment may be disturbed or that humans or animals may be affected.

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

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

WARNING

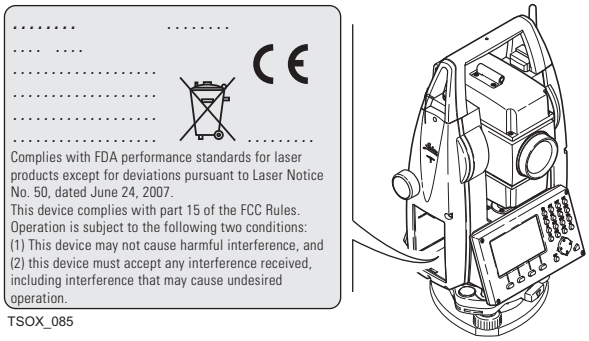
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate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

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

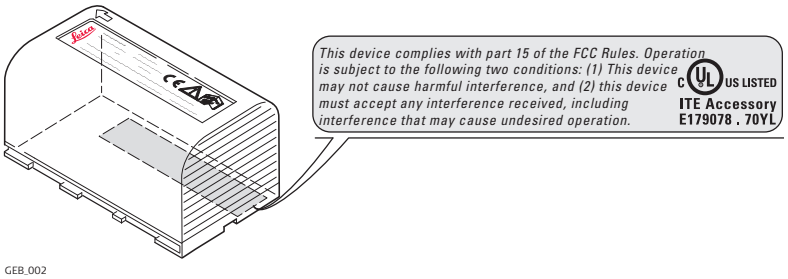
WARNING

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

Labelling FlexLine plus instrument



Labelling internal battery GEB211, GEB212, GEB221, GEB222



14 Technical Data

14.1 Angle Measurement

Accuracy

Available angular accuracies	Standard deviation Hz, V, ISO 17123-3	Display resolution			
["]	[mgon]	["]	[°]	[mgon]	[mil]
1	0.3	0.1	0.0001	0.1	0.01
2	0.6	0.1	0.0001	0.1	0.01
3	1.0	0.1	0.0001	0.1	0.01
5	1.5	0.1	0.0001	0.1	0.01
7	2	0.1	0.0001	0.1	0.01

Characteristics

Absolute, continuous, diametric. Updates each 0.1 to 0.3 s.

14.2 Distance Measurement with Reflectors

Range

Reflector	Range A		Range B		Range C	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard prism (GPR1)	1800	6000	3000	10000	3500	12000
3 prisms (GPR1)	2300	7500	4500	14700	5400	17700
360° prism (GRZ4, GRZ122)	800	2600	1500	5000	2000	7000
Reflector tape 60 mm x 60 mm	150	500	250	800	250	800
Mini prism (GMP101)	800	2600	1200	4000	2000	7000
360° Mini prism (GRZ101)	450	1500	800	2600	1000	3300

Shortest measuring distance: 1.5 m

Atmospheric conditions

Range A: Strong haze, visibility 5 km; or strong sunlight, severe heat shimmer
Range B: Light haze, visibility about 20 km; or moderate sunlight, slight heat shimmer
Range C: Overcast, no haze, visibility about 40 km; no heat shimmer

Accuracy

Accuracy refers to measurements to standard reflectors.

EDM measuring mode	Standard deviation ISO 17123-4	Measurement time, typical [s]
P-Precise+	1.5 mm + 2 ppm	2.4
P-Precise & Fast	2 mm + 2 ppm	1.0
P-Tracking	3 mm + 2 ppm	0.3
Tape	5 mm + 2 ppm	2.4

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

Characteristics

Principle: Phase measurement
Type: Coaxial, visible red laser
Carrier wave: 658 nm
Measuring system: System analyser basis 100 MHz - 150 MHz

Range

Power Pinpoint R500 (without reflector)

Kodak Gray Card	Range D		Range E		Range F	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
White side, 90 % reflective	250	820	400	1312	>500	>1640
Grey side, 18 % reflective	100	330	150	490	>250	>820

Ultra Pinpoint R1000 (without reflector)

Kodak Gray Card	Range D		Range E		Range F	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
White side, 90 % reflective	800	2630	1000	3280	>1000	>3280
Grey side, 18 % reflective	400	1320	500	1640	>500	>1640

Range of Measurement: 1.5 m to 1200 m
Range of Measurement, FlexPoint: 1.5 m to 30 m
Display unambiguous: up to 1200 m

Atmospheric conditions

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

Accuracy

Standard measuring	ISO 17123-4	Measure time, typical [s]	Measure time, maximum [s]
0 m - 500 m	2 mm + 2 ppm	3 - 6	15
>500 m	4 mm + 2 ppm	3 - 6	15

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

Measurement Mode*	Standard deviation	Measure time, typical [s]
NP-Tracking	5 mm + 3 ppm	0.25

* Accuracy and measure time depend on atmospheric conditions, target object and observation situation.

Characteristics

Type: Coaxial, visible red laser
Carrier wave: 658 nm
Measuring system: System analyser basis 100 MHz - 150 MHz

Laser dot size

Distance [m]	Laser dot size, approximately [mm]
at 30	7 x 10
at 50	8 x 20

14.4 Distance Measurement Reflector (>4.0 km)

Range

R500, R1000	Range A		Range B		Range C	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard prism (GPR1)	2200	7300	7500	24600	>10000	>33000
Reflector tape 60 mm x 60 mm	600	2000	1000	3300	1300	4200

Range of measurement: From 1000 m up to 12000 m
Display unambiguous: Up to 12 km

Atmospheric conditions

Range A: Strong haze, visibility 5 km; or strong sunlight, severe heat shimmer
Range B: Light haze, visibility about 20 km; or moderate sunlight, slight heat shimmer
Range C: Overcast, no haze, visibility about 40 km; no heat shimmer

Accuracy

Measurement Mode	ISO 17123-4	Measure time, typical [s]	Measure time, maximum [s]
P-Long (>4.0 km)	5 mm + 2 ppm	2.5	12

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

Characteristics

Principle: Phase measurement
Type: Coaxial, visible red laser
Carrier wave: 658 nm
Measuring system: System analyser basis 100 MHz - 150 MHz

14.5 Conformity to National Regulations

14.5.1 Products without Communication side cover

Conformity to national regulations

CE

Hereby, Leica Geosystems AG, declares that the instrument is in compliance with the essential requirements and other relevant provisions of applicable European Directives. The declaration of conformity may be consulted at http://www.leica-geosystems.com/ce.

Conformity to national regulations

- FCC Part 15 (applicable in US).
- Hereby, Leica Geosystems AG, declares that the instrument with Communication side cover is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity may be consulted at http://www.leica-geosystems.com/ce.

CE Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA Member state.

- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

Frequency band

2402 - 2480 MHz

Output power

Bluetooth: 2.5 mW

Antenna

Type: Mono pole
Gain: +2 dBi

Range

Aproximatelly 150 m, >1000 m when using TCPS29
No obstacles, few vehicles or sources of radio emissions/interference in the near vicinity of the instrument, no rain.

Telescope

Magnification:	30 x
Free Objective aperture:	40 mm
Focusing:	1.7 m/5.6 ft to infinity
Field of view:	1°30′/1.66 gon. 2.7 m at 100 m

Compensation

Quadruple axis compensation (2-axis compensator with Hz-collimation and V-Index).

Angular accuracy	Setting accuracy		Setting range	
["]	["]	[mgon]	[′]	[gon]
1	0.5	0.2	±4	0.07
2	0.5	0.2	±4	0.07
3	1	0.3	±4	0.07
5	1.5	0.5	±4	0.07
7	2	0.7	±4	0.07

Level

Circular level sensitivity:	6′/2 mm
Electronic level resolution:	2"

Control unit

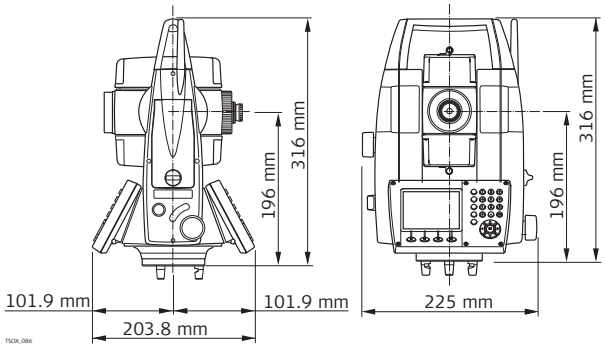
B&W display:	288 x 160 pixels, LCD, backlit, 8 lines with 31 characters each, heatable (temp. < -5°).
C&T display:	320 x 240 pixels (QVGA), LCD, backlit, 9 lines with 31 characters each, keyboard illumination

Instrument Ports

Name	Description
RS232	5 pin LEMO-0 for power, communication, data transfer. This port is located at the base of the instrument.
USB host port*	USB memory stick port for data transfer.
USB device port*	Cable connections from USB devices for communication and data transfer.
Bluetooth*	Bluetooth connections for communication and data transfer.

* Only for instruments fitted with a Communication side cover.

Instrument dimensions



Weight

Instrument:	4.2 kg - 4.5 kg (depending on hardware configuration)
Tribrach:	760 g
Battery GEB211:	110 g
Battery GEB212:	110 g
Battery GEB221:	210 g
Battery GEB222:	210 g

Tilting axis height

Without tribrach:	196 mm
With tribrach (GDF111):	240 mm ±5 mm

Recording

Model	Memory Type	Capacity [MB]	Number of measurements
TS06 plus / TS09 plus	Internal memory	11	60,000

Laser plummet

Type:	Visible red laser class 2
Location:	In standing axis of instrument
Accuracy:	Deviation from plumb line: 1.5 mm (2 sigma) at 1.5 m instrument height
Diameter of laser point:	2.5 mm at 1.5 m instrument height

Power

External supply voltage: (via serial interface)	Nominal voltage 12.8 V DC, Range 11.5 V-14 V

Internal battery

Type	Battery	Voltage	Capacity	Operating time, typically*
GEB211	Li-Ion	7.4 V	2.2 Ah	~ 10 h
GEB212	Li-Ion	7.4 V	2.6 Ah	~ 12 h
GEB221	Li-Ion	7.4 V	4.4 Ah	~ 20 h
GEB222	Li-Ion	7.4 V	6.0 Ah	~ 30 h

* Based on a single measurement every 30 s at 25°C. Operating time may be shorter if battery is not new.

Environmental specifications

Temperature

Type	Operating temperature		Storage temperature	
	[°C]	[°F]	[°C]	[°F]
All instruments	-20 to +50	-4 to +122	-40 to +70	-40 to +158
Battery	-20 to +50	-4 to +122	-40 to +70	-40 to +158
USB memory stick	-40 to +85	-40 to +185	-50 to +95	-58 to +203

Protection against water, dust and sand

Type	Protection
All instruments	IP55 (IEC 60529)

Humidity

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

Arctic model

Operating range: -35°C to +50°C (-31°F to +122°F)

To minimise unavoidable slowdown of display performance for the Arctic option, switch display heating on and connect the external battery. Allow for a short warm-up time.

Electronic Guide Light EGL

Working range: 5 m to 150 m (15 ft to 500 ft)
Position accuracy: 5 cm at 100 m (1.97" at 330 ft)

Automatic corrections

The following automatic corrections are made:

- Line of sight error
- Tilting axis error
- Earth curvature
- Standing axis tilt
- Vertical index error
- Refraction
- Compensator index error
- Circle eccentricity

14.7 Scale Correction

Use of scale correction

By entering a scale correction, reductions proportional to distance can be taken into account.

- Atmospheric correction.
- Reduction to mean sea level.
- Projection distortion.

Atmospheric correction

The distance displayed is correct if the scale correction in ppm, mm/km, which has been entered corresponds to the atmospheric conditions prevailing at the time of the measurement.

The atmospheric correction includes:

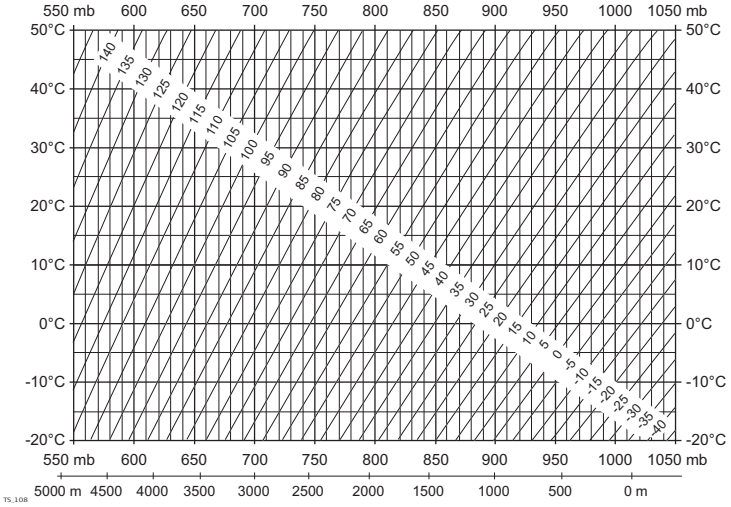
- Adjustments for air pressure
- Air temperature

For highest precision distance measurements, the atmospheric correction should be determined with:

- An accuracy of 1 ppm
- Air temperature to 1°C
- Air pressure to 3 mbar

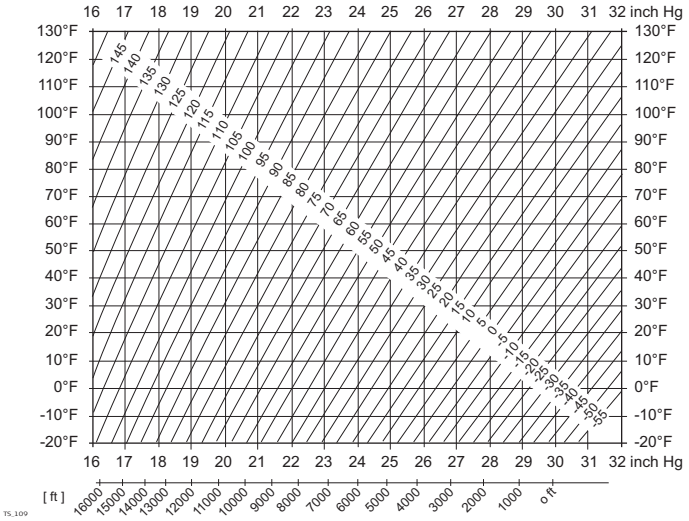
Atmospheric corrections °C

Atmospheric corrections in ppm with temperature [°C], air pressure [mb] and height [m] at 60 % relative humidity.

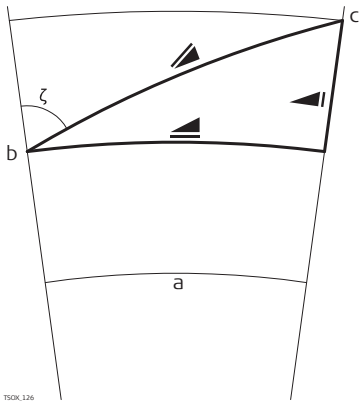


Atmospheric correction °F

Atmospheric corrections in ppm with temperature [°F], air pressure [inch Hg] and height [ft] at 60 % relative humidity.



Formulas



a Mean Sea Level
b Instrument
c Reflector
Slope distance
Horizontal distance
Height difference

The instrument calculates the slope distance, horizontal distance, and height difference in accordance with the following formulas. Earth curvature (1/R) and mean refraction coefficient (k = 0.13) are automatically taken into account when calculating the horizontal distance and height difference. The calculated horizontal distance relates to the station height and not to the reflector height.

Slope distance

$= D_0 \cdot (1 + ppm \cdot 10^{-6}) + mm$

TSOK_127

Displayed slope distance [m]
D0 Uncorrected distance [m]
ppm Atmospheric scale correction [mm/km]
mm prism constant [mm]

Horizontal distance

$= Y - A \cdot X \cdot Y$

TSOK_128

Horizontal distance [m]
Y * sinζ
X * cosζ
ζ = Vertical circle reading
A (1 - k/2)/R = 1.47 * 10-7 [m-1]
k = 0.13 (mean refraction coefficient)
R = 6.378 * 106 m (radius of the earth)

Height difference

$= X + B \cdot Y^2$

TSOK_129

Height difference [m]
Y * sinζ
X * cosζ
ζ = Vertical circle reading
B (1 - k)/2R = 6.83 * 10-8 [m-1]
k = 0.13 (mean refraction coefficient)
R = 6.378 * 106 m (radius of the earth)

15 Software Licence Agreement

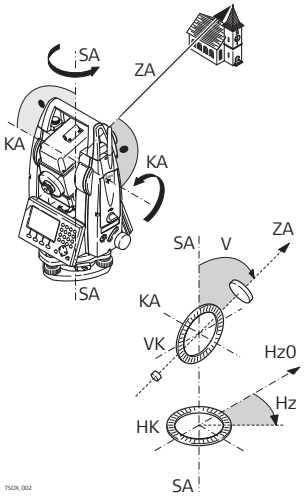
Software Licence Agreement

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

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

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

Instrument axis

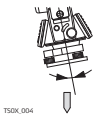


ZA = Line of sight / collimation axis
Telescope axis = line from the reticle to the center of the objective.
SA = Standing axis
Vertical rotation axis of the telescope.
KA = Tilting axis
Horizontal rotation axis of the telescope. Also known as the Trunion axis.
V = Vertical angle / zenith angle
VK = Vertical circle
With coded circular division for reading the vertical angle.
Hz = Horizontal direction
HK = Horizontal circle
With coded circular division for reading the horizontal angle.

Plumb line / compensator

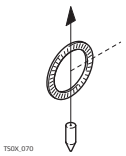
Direction of gravity. The compensator defines the plumb line within the instrument.

Standing axis inclination



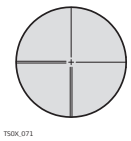
Angle between plumb line and standing axis.
Standing axis tilt is not an instrument error and is not eliminated by measuring in both faces. Any possible influence it may have on the horizontal direction or vertical angle is eliminated by the dual axis compensator.

Zenith



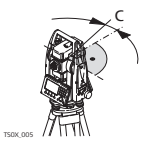
Point on the plumb line above the observer.

Reticle



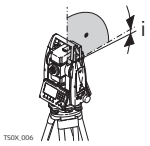
Glass plate within the telescope with reticle.

Line-of-sight error (horizontal collimation)



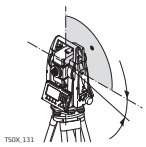
The line-of-sight error (c) is the deviation from the perpendicular between the tilting axis and line of sight. This could be eliminated by measuring in both faces.

Vertical index error



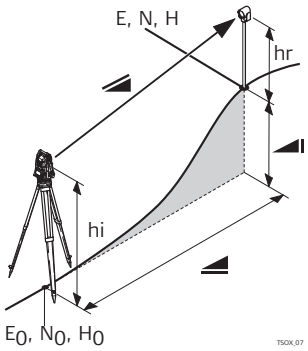
With a horizontal line of sight the vertical circle reading should be exactly 90°(100 gon). The deviation from this value is termed the Vertical index error (i).

Tilting axis error



The tilting axis error is the deviation within the horizontal rotation axis, between measurements in both faces.

Explanation of displayed data



- Indicated meteorological corrected slope distance between instrument tilting axis and center 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

E0, N0, H0
Easting, Northing and Height coordinates of station

E, N, H
Easting, Northing and Height coordinates of target point

Appendix AMenu Tree

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

Menu Tree

- Q-Survey
- Programs
  - Station Setup
  - Survey
  - Stakeout
  - Tie Distance
  - COGO
  - Area & DTM Volume
  - Remote Height
  - Traverse
  - Reference Line
  - Reference Arc
  - Reference Plane
  - Road 2D
  - Road 3D
- Manage
  - Job
  - Fixpoints
  - Meas.Data
  - Codes
  - Formats
  - Del.Data
  - USB-Stick
- Transfer
  - Export
  - Import
- Settings
  - Work
    Trigger Key1, Trigger Key2, USER Key 1, USER Key 2, Tilt Corr., Hz Corr., Face I Def.
  - Regional
    Hz Increment, V-Setting, V After DIST, Language, Lang.Choice, Angle Unit, Min. Reading, Dist. Unit, Dist.Decimal, Temp. Unit, Press.Unit, Grade Unit, Time (24h), Date, Format
  - Data
    Double PtID, Sort Type, Sort Order, Code Record, Code, Data Output, GSI-Format, GSI-Mask
  - Screen…
    Display Ill., Keyb. Ill.**, Reticle Ill., Contrast*, Displ.Heater*, Touch Screen**, Auto-Off, Screensaver, Beep, Sector Beep, Stakeout Beep
  - EDM
    EDM Mode, Prism Type, Leica Const., Abs. Const., Laser-Point, Guide Light
  - Interface
    Port :, Bluetooth:, Baud rate:, Data bits:, Parity :, Endmark :, Stop bits: 1, Acknowlge:
- Tools
  - Adjust
    F1 Hz-Collimation, F2 Vertical Index, F3 Compensator Index, F4 Tilt Axis, F1 View Adjustment Data, F2 Adjustment Reminder
  - Startup
  - Info

Instr. Type, Serial No., Equip.No., NP-Type, Instr.Temp., Battery, Instr.-Firmware, Build Number, Active Language, EDM-Firmware, Oper. System, Job, Stations, Fixpoints, Meas.Records, Occupied Memory, Maint.-End Date, Next Service Date

| |—— Licence

| |—— PIN

Use PIN-Code, New PIN-Code

| |—— Load FW

F1 Firmware,EDM-FW,Logo, F2 Language(s) only

* Valid for Black&White displays only

** Valid for Color&Touch displays only

Appendix BDirectory Structure

Description

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

Directory Structure

|—— CODES	• Codelists (*.cls)
|—— FORMATS	• Format files (*.frt)
|—— JOBS	• GSI, DXF, ASCII and LandXML files (*.*) • Logfiles created from programs
|—— SYSTEM	• Firmware files (FlexField.fw and FlexField_EDM.fw) • Language files (FlexField_Lang_xx.fw) • Licence file (*.key) • Configuration files (*.cfg)