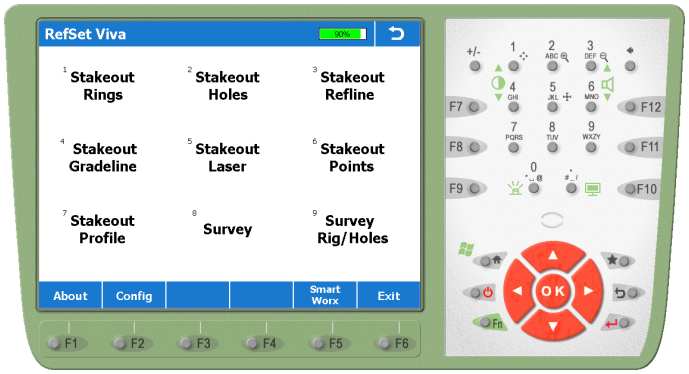
RefSet

Automatic Reference Line and Stakeout Program for Leica Total Station Instruments (TS15, TS16, MS50, MS60)

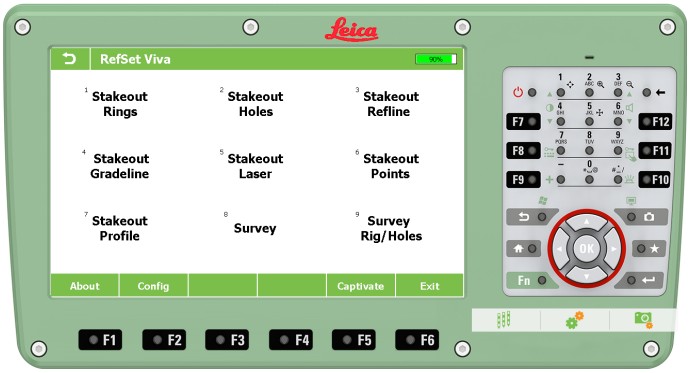
User Manual

Version 3.2

www.refset.com.au



Leica TS15 or MS50



Leica TS16 or MS60

Contents

1. RefSet Program

RefSet System Requirements

RefSet requires two Leica license keys to be installed on the instrument and for a TS16 or MS60 with Leica Captivate firmware lower than v3.0 some extra software that must be installed on the instrument before it will run:

License Key / Software	Needed By
Leica **Robotic Geocom** Key	TS15, TS16, MS50, MS60
Leica **Virtual Geocom** Key	TS15, TS16, MS50, MS60
Microsoft .Net Compact Framework v2.0	Only required for TS16 or MS60 with Leica Captivate firmware lower than v3.0

RefSet Installation on TPS

- Install the required Leica license keys onto the TPS (see above)
- Copy **Install_RefSet_{*version*}.cab** to the memory card
- Insert the card into the TPS
- Exit from the Leica SmartWorx or Leica Captivate program by pressing **Fn** then **F6** (Exit) at the start screen
- Using File Explorer on the instrument navigate to the **Install_RefSet_{*version*}.cab** file on the memory card and double tap it
- Tap on **OK** to *Install RefSet*
- RefSet will then be installed onto the TPS
- A shortcut to the program will be placed in the *Start* menu and on the desktop

RefSet Key File Installation

- Copy the **RefSet_{serial number}.key** or the **RefSet_v2_{serial number}.key** file to the memory card
- Insert the card into the instrument
- Using File Explorer on the instrument copy the **RefSet_{*serial number*}.key** or the **RefSet_v2_{serial number}.key** file to the ***\Program Files\RefSet*** folder on the TPS

Starting RefSet

- To start RefSet first exit from the Leica SmartWorx or Leica Captivate program by pressing **Fn F6** (Exit) at the start screen

  Note: On a TS15 or MS50 with Leica firmware version 6.03 or later you MUST Exit *Smartworx* not just minimise it as this will cause RefSet to behave strangely
- Double tap the **RefSet** shortcut on the windows desktop

RefSet Program Configuration

- *Data File Type*

  Set to the type of control job files to use in RefSet:

STR	Surpac string file
GSI	Leica gsi data file
DXF	Autocad dxf file
ASCII	ASCII Text or CSV file

  Note: Press **F2** for the DXF or ASCII file config (see below)

- *Data Folder*

  Set to the location of the control job files:

SD Card	SD memory card
USB Stick	USB memory stick
Internal	Internal folder on the TPS TS15: '\Leica Geosystems\SmartWorx Viva' TS16: '\Leica Geosystems\Leica Captivate'

  The control job files need to be saved in the following subfolders of the *Data Folder*:

STR	'*Data'* subfolder
GSI	'*Gsi'* subfolder
DXF	'*Data'* subfolder
ASCII	'*Data'* subfolder

- *Use Common Data File*

  Set to **Yes** to use a common data file name for every function

  The Control Job name chosen in one function (eg: Stakeout Rings) will also be set in the other functions (eg: Stakeout Holes, Stakeout Refline, etc). Otherwise each function will 'remember' the Job name chosen previously in that function.

- *Pt ID Description Char*

  Set to the Point ID description character separator

  This character separates the point number part of a Point ID from the description text part. The point number part is then used for point incrementing in the autostake functions and the description part is shown for information.

  eg: For a hole stakeout set the data Point IDs in the data file to '1-R1H1, 2-R1H1, 3-R1H2, 4-R1H2, 5-R2H1, 6-R2H1, etc' and set the *Pt ID Description Char* in RefSet Config to '-'. The point numbers before the '-' character will then be used for point incrementing and the text after the '-' character will be shown for information.

  Note: This setting does not apply to DXF data files because the Point IDs are generated from the point sequence in the file.

- *Log Staked Points*

  Set to **Yes** to save the automatic stakeout points to a log file

  The points staked in all automatic modes will be saved to a file with the same name as the control job with '*_log'* added which will be saved in a subfolder named '*Log'* under the current *Data Folder.*

RefSet Program Configuration (cont)

- *Log File Type* — Set to the type of log file to save the automatic stakeout point data to:

STR	Surpac string file
GSI	Leica gsi data file
CSV	Comma separated text file

- *Distance Units* — Set to the distance units to use in the program

- *Grade Display* — Sets the input and output format for grades:

H:V	Horizontal by vertical distance
V:H	Vertical by horizontal distance
%(V/Hx100)	Percentage of vertical by horizontal distance

ASCII Data File Configuration

- *Header Lines* — Set to the number of header lines with no point data at the start of the ASCII file
- *Delimiter* — Set to the delimiter that separates the data in the ASCII file
- *Positions* — Set to the position of the point info on each line in the ASCII file
- *ASCII File Extension* — Set to the filename extension of the ASCII files

DXF Data Files

The Autocad DXF file format has a large number of versions that have increased in complexity over the years and the version of each DXF file is based on the software that creates the file.

RefSet is able to read any version of DXF file as the *Control Job* in the stakeout functions, however due to the complexity of the various DXF file formats, RefSet cannot save or append data to an existing DXF file that has been created in other software.

RefSet can only save or append data to a simple DXF file that has been created in RefSet itself. This ensures that RefSet writes the new points to a valid DXF file that can be read by any other software.

To create a new empty simple DXF file:

- Press F4 (Create New Job) in the *Job Selection* screens

To convert an existing DXF file to a simple DXF file:

- Select the existing DXF file in the *Job Selection* screens
- For the Stakeout functions press either **F4** (Enter New Point) or **F5** (Measure New Point) in the *Point Selection* screen or for the Survey functions press **F1** (OK)
- Answer *Yes* when prompted to *Convert Job to a Simple DXF File?*
- Enter a name for the new converted simple DXF file and press **F1** (Convert)
- New points can then be added to this new simple DXF file in RefSet

DXF Data File Layers

In the Job Selection screen of any of the stakeout functions or the Survey Rig/Holes function when *Compare to Design Hole* is set to *Yes*, press **F6** (Control Job Layers) to set the DXF layers to use for point data from the Control Job. A list of the layers in the DXF file will then be displayed and the layers to use for point data can then be selected.

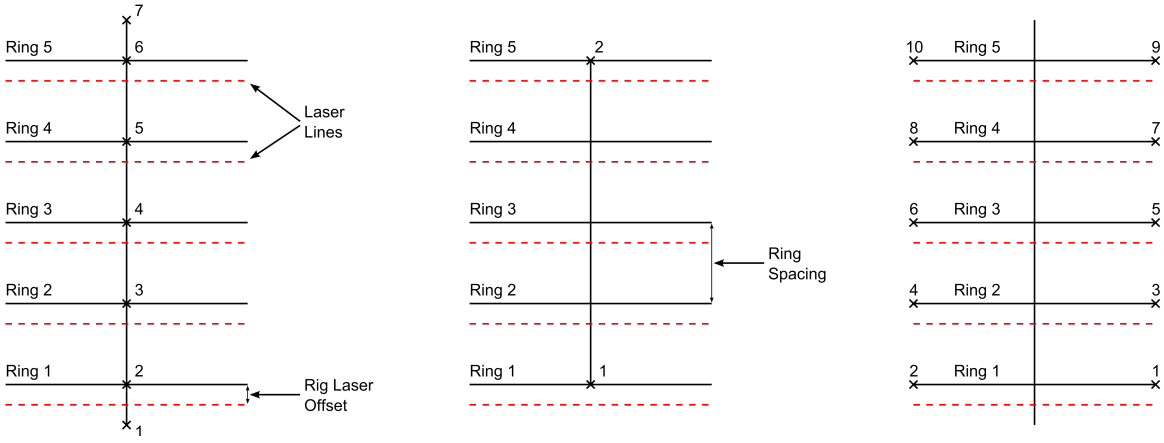
DXF Data File Configuration

- *Entities to use for Point Data* — Set to the entities in the DXF files to be used for point data in RefSet:

Points and Polylines	Both single Points and vertices of the Polylines
Polyline Vertices	Vertices of the Polyline entities only
Points	Single Point entities only

2. Stakeout Rings

Ring Definition Methods



Reference Points **Ring Spacing** **Reference Lines**

There are three methods for defining rings in RefSet:

a) Reference Points — Has two points to define the reference line (eg: 1 & 7) and a point located on each ring (eg: 2 to 6) which need to be numbered in consecutive order to enable RefSet to increment to the next ring in auto stakeout mode

b) Ring Spacing — Has two points to define the reference line (eg: 1 & 2) with one of those points located on the first ring and a spacing between the rings

c) Reference Lines — Has two points on each ring (eg: Ring1: 1 & 2, Ring2: 3 & 4, etc) which need to be numbered in consecutive order to enable RefSet to increment to the next ring in auto stakeout mode

There are two offset values that can be pre-set for the ring stakeout:

a) *Rig Laser Offset* — This sets the distance from the laser position to the drill rod position on the particular drill rig used to drill the rings. A positive value will move the *Laser Lines* in the direction of the reference line for the **Reference Points** and **Ring Spacing** methods and to the right of the ring for the **Reference Lines** method

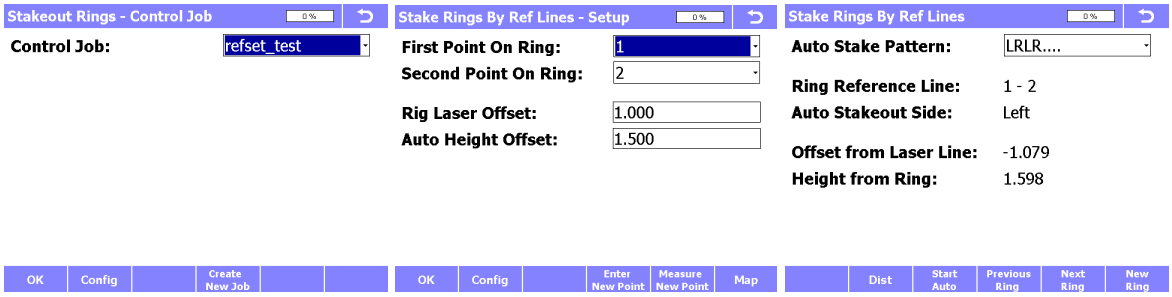
b) *Auto Height Offset* — This sets the *Height* offset of the points that will be staked out in the auto stakeout mode. If this setting is not used then the *Height* value of the first point measured when the auto stakeout is started will be used to set the stakeout *Height* offset

Note: These two settings can be enabled or disabled in the Stakeout Rings Configuration

Stakeout Rings Procedure

1. Tap or select **Stakeout Rings** on the start menu screen
2. Select the *Control Job* to use from the list and press **F1** (OK)

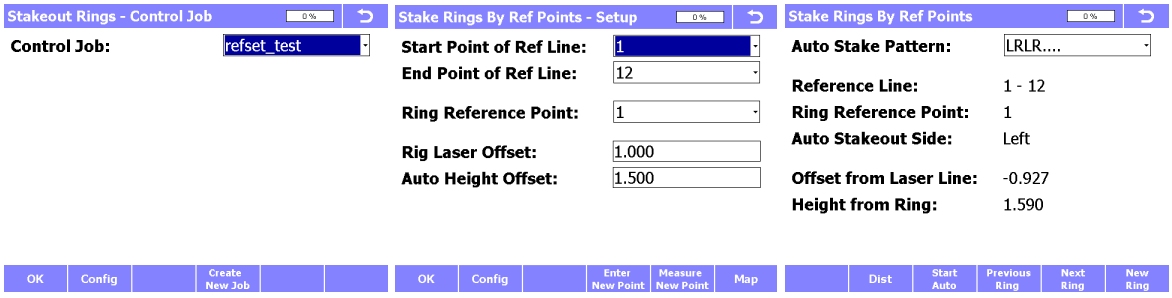
3. Stakeout Rings by Reference Lines



3.1. Select the *First Point* and *Second Point* of the ring to be staked out from the lists

3.2. If the *Use Rig Laser Offset* and/or *Use Set Height Offset For Auto Stakeout* settings have been set in the Configuration then enter these values and press **F1** (OK)

3. Stakeout Rings by Reference Points

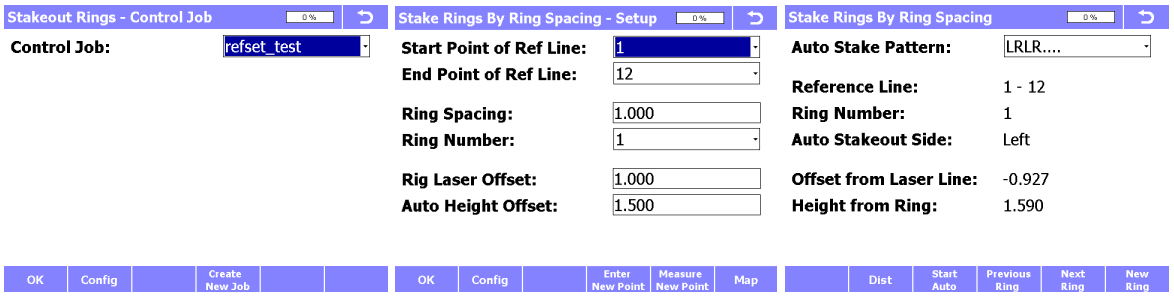


3.1. Select the *Start Point* and *End Point* of the reference line used to define the rings from the lists

3.2. Select the *Ring Reference Point* of the ring to be staked out from the list

3.3. If the *Use Rig Laser Offset* and/or *Use Set Height Offset For Auto Stakeout* settings have been set in the Configuration then enter these values and press **F1** (OK)

3. Stakeout Rings by Ring Spacing



3.1. Select the *Start Point* and *End Point* of the reference line used to define the rings from the lists

3.2. Enter the *Ring Spacing* of the rings

3.3. The *Ring Numbers* will then be generated from the reference line points and the ring spacing – ring number one will be located at the *Start Point* of the reference line

3.4. Select the *Ring Number* of the ring to be staked out from the list

3.5. If the *Use Rig Laser Offset* and/or *Use Set Height Offset For Auto Stakeout* settings have been set in the Configuration then enter these values and press **F1** (OK)

All Stakeout Rings Methods

4. Choose the *Auto Stake Pattern* to use:

LRLR.... Will stakeout the left wall, right wall, left wall, etc
LRRL.... Will stakeout the left wall, right wall, right wall, left wall, etc
One Side Will stakeout the wall on which the auto stakeout is started

5. Point the TPS towards the first ring on the wall to be staked

For the **LRLR....** and **LRRL....** patterns the auto stakeout needs to always be started with the TPS pointing towards the left wall - that is standing behind the instrument facing the first ring to be staked out then the left wall is the one to the left

For all patterns the auto stakeout needs to be started at a point on the wall that is as near to the first ring position as is possible

6. Press **F3** (Start Auto) to start the auto stakeout

Stakeout Rings Configuration

- *Start Dist Measure* Set to **Yes** to start distance measuring when the function starts

- *Auto Offset Accuracy* Sets the accuracy at which the *Offset* value is staked out in auto stakeout mode

  (eg: if set to 0.025 the TPS will stake the rings/laser lines *Offset* value to within ±25mm before moving to the next ring)

- *Auto Height Accuracy* Sets the accuracy at which the *Height* value is staked out in auto stakeout mode

  (eg: if set to 0.200 the TPS will stake the rings/laser lines *Height* value to within ±200mm before moving to the next ring)

- *Auto Start Delay (secs)* Sets the time the TPS will wait after the *Start Auto* button is pressed before starting the auto stakeout

- *Auto Wait Time (secs)* Sets the time the TPS will stop on an auto stakeout point when it has been successfully staked out

  (eg: if set to 5 the TPS will wait 5 seconds after it stakes out a point before it moves on to the next ring)

- *Maximum Auto Search Time (secs)*

  Sets the maximum time the TPS will search for an auto stakeout point. If set to zero the search time is infinite

  (eg: if set to 30 the TPS will search for 30 seconds and if the point is not found it moves on to the next ring)

- *Ring Stakeout Method* Sets the method for defining the rings (see the Ring Definition Methods above):

  Reference Lines
  Reference Points
  Ring Spacing

- *Use Rig Laser Offset* Set to **Yes** to enable a *Rig Laser Offset* to be set and applied to the ring positions

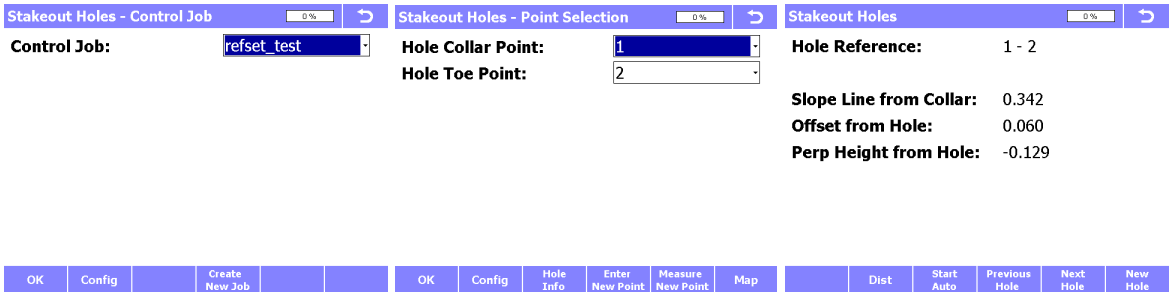
- *Use Set Height Offset For Auto Stakeout*

  Set to **Yes** to enable the *Height* offset of the rings/laser lines staked in auto mode to be staked at a set value, set to **No** to stake the rings/laser lines at the *Height o*ffset of the first point measured when the auto stakeout is started

3. Stakeout Holes

Blast holes are defined by two points on each hole, the hole design collar and the hole design toe. (eg: Hole1: 1 & 2, Hole2: 3 & 4, etc) These points need to be numbered in consecutive order to enable RefSet to increment to the next hole in auto stakeout mode

Stakeout Holes Procedure



1. Tap or select **Stakeout Holes** on the start menu screen
2. Select the *Control Job* to use from the list and press **F1** (OK)
3. Select the *Hole Collar Point* and *Hole Toe Point* of the hole to be staked out from the lists and press **F1** (OK)
4. Point the TPS towards the wall near to the first hole to be staked
5. Press **F3** (Start Auto) to start the auto stakeout

Missed Holes Procedure

If any holes are missed during the auto stakeout due to the *Maximum Auto Search Time* being exceeded then when the auto stakeout is stopped or finished a message will be shown asking to stake the missed holes manually

1. Tap or select **Yes** or **No** to stake the holes manually
2. If **Yes** the collar and toe points for the first missed hole will be loaded and the hole can then be staked by manually pointing the telescope
3. Press **F5** (Next Hole) or **F4** (Previous Hole) to cycle through the missed holes
4. Press **F6** (New Hole) to finish the missed hole stakeout and resume normal operation

Stakeout Holes Configuration

- *Start Dist Measure* Set to **Yes** to start distance measuring when the function starts
- *Auto Position Accuracy* Sets the accuracy at which the *Offset* and *Perp Height* values are staked out in auto stakeout mode

  (eg: if set to 0.025 the TPS will stake the holes *Offset* and *Perp Height* values to within ±25mm before moving to the next hole)
- *Auto Start Delay (secs)* Sets the time the TPS will wait after the *Start Auto* button is pressed before starting the auto stakeout
- *Auto Wait Time (secs)* Sets the time the TPS will stop on an auto stakeout point when it has been successfully staked out

  (eg: if set to 5 the TPS will wait 5 seconds after it stakes out a point before it moves on to the next hole)
- *Maximum Auto Search Time (secs)*

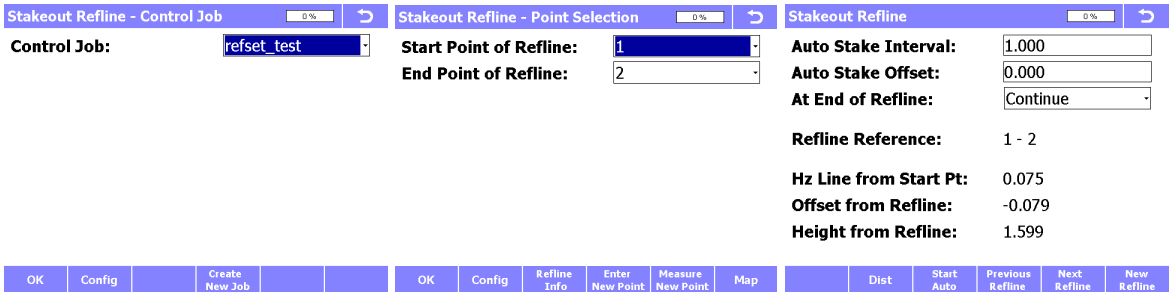
  Sets the maximum time the TPS will search for an auto stakeout point. If set to zero the search time is infinite

  (eg: if set to 30 the TPS will search for 30 seconds and if the point is not found it moves on to the next hole)

4. Stakeout Refline

Reference Lines (centrelines) are defined by two points, these points need to be numbered in consecutive order to enable RefSet to increment to the next refline in auto stakeout mode (eg: First Refline: 1 & 2, Second Refline 2 & 3, etc)

Stakeout Refline Procedure



1. Tap or select **Stakeout Refline** on the start menu screen
2. Select the *Control Job* to use from the list and press **F1** (OK)
3. Select the *Start Point* and *End Point* of the reference line (centreline) to be staked out from the lists and press **F1** (OK)
4. Check the *Auto Stake Interval* value – this is the slope distance between the points staked in auto stakeout mode
5. Check the *Auto Stake Offset* value – this is the *Offset* that will be staked in auto stakeout mode (eg: for a centreline it will be zero)
6. Check the *At End of Refline* setting – this defines the behaviour of the program when the end of the current reference line is reached in auto stakeout mode

   Continue The auto stakeout will continue on the same line past the end of the current reference line

   Stop The auto stakeout will stop at the end of the current reference line

   Next Refline The auto stakeout will increment to the next reference line at the end of the current reference line (eg: First Refline: 1 & 2, Next Refline 2 & 3, etc)
7. Point the TPS towards the wall or backs near to the reference line at a position near where you want to start the stakeout
8. Press **F3** (Start Auto) to start the auto stakeout

Stakeout Refline Configuration

- *Start Dist Measure* Set to **Yes** to start distance measuring when the function starts

- *Auto Offset Accuracy* Sets the accuracy at which the *Offset* value is staked out in auto stakeout mode

  (eg: if set to 0.025 the TPS will stake the reference line *Offset* value to within ±25mm of the *Auto Stake Offset* value before moving to the next point on the refline)

- *Auto Interval Accuracy* Sets the accuracy at which the slope distance interval between the points is staked out in auto stakeout mode

  (eg: if set to 0.200 the TPS will stake the points on the reference line to within ±200mm of the *Auto Stake Interval* setting from the previous point before moving to the next point)

- *Auto Start Delay (secs)* Sets the time the TPS will wait after the *Start Auto* button is pressed before starting the auto stakeout

- *Auto Wait Time (secs)* Sets the time the TPS will stop on an auto stakeout point when it has been successfully staked out

  (eg: if set to 5 the TPS will wait 5 seconds after it stakes out a point before it moves on to the next point)

- *Maximum Auto Search Time (secs)*

  Sets the maximum time the TPS will search for an auto stakeout point. If set to zero the search time is infinite

  (eg: if set to 30 the TPS will search for 30 seconds and if the point is not found it moves on to the next point)

5. Stakeout Gradeline

There are three methods for defining grade lines in RefSet:

a) Line — Uses two design points from the *Control Job*, these points need to be numbered in consecutive order to enable RefSet to increment to the next grade line in auto stakeout mode (eg: First Gradeline: 1 & 2, Second Gradeline 2 & 3, etc)

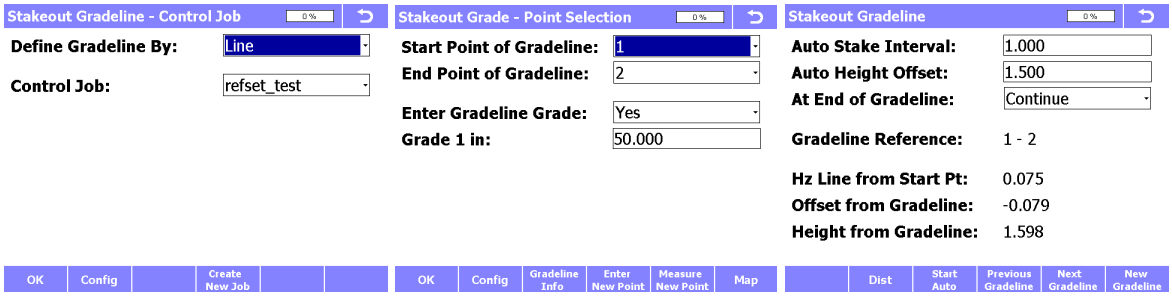
b) Measured Line — Uses two measured temporary points which will not be saved in a *Control Job* and optionally an entered grade

c) Arc — Uses three design points from the *Control Job* to define an arc

Stakeout Gradeline Procedure

1. Tap or select **Stakeout Gradeline** on the start menu screen
2. Select the method to *Define Gradeline By*

3. Stakeout Gradeline by Line

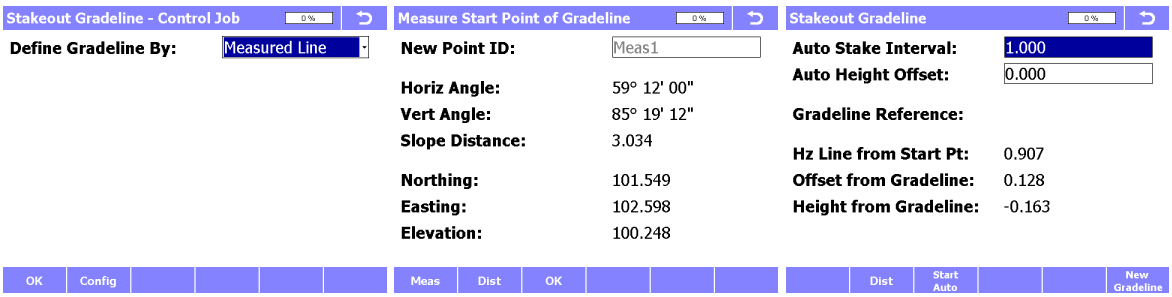


3.1. Select the *Control Job* to use from the list and press **F1** (OK)

3.2. Select the *Start Point* and *End Point* of the grade line to be staked out from the lists

3.3. Select **Yes** or **No** to *Enter Gradeline Grade* and if **Yes** enter the grade of the grade line (the grade line will then start at the elevation of the start point and go towards the end point at the entered grade) and press **F1** (OK)

3. Stakeout Gradeline by Measured Line



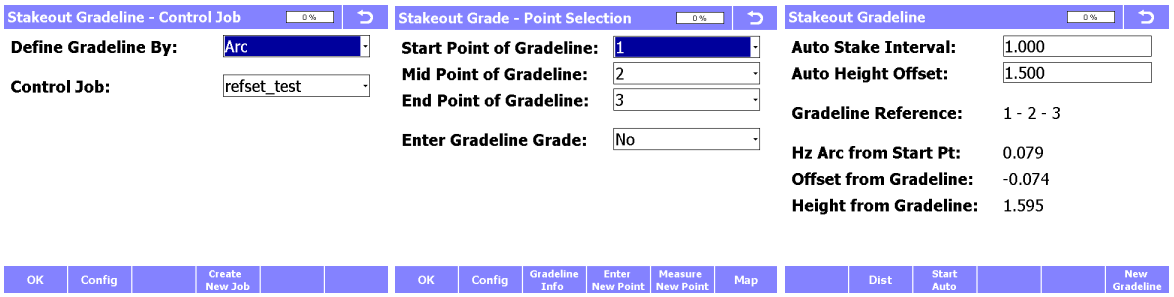
3.1. Press **F1** (OK)

3.2. Point the TPS at the start point of the grade line (eg: at a point on an existing grade paintline) and press **F1** (Meas)

3.3. Point the TPS at the end point of the grade line (eg: at a point near the drive face) and press **F1** (Meas)

3.4. Select **Yes** or **No** to *Enter Gradeline Grade* and if **Yes** enter the grade of the grade line (the grade line will then start at the elevation of the start point and go towards the end point at the entered grade) and press **F1** (OK)

3. Stakeout Gradeline by Arc



3.1. Select the *Control Job* to use from the list and press **F1** (OK)

3.2. Select the *Start Point*, *Mid Point* and *End Point* of the grade line to be staked out from the lists

3.3. Select **Yes** or **No** to *Enter Gradeline Grade* and if **Yes** enter the grade of the grade line (the grade line will then start at the elevation of the start point and go on an arc through the midpoint towards the end point at the entered grade) and press **F1** (OK)

All Stakeout Gradeline Methods

4. Check the *Auto Stake Interval* value – this is the distance between the points staked in auto stakeout mode

5. Check the *Auto Height Offset* value – this is the *Height* offset that will be staked in auto stakeout mode

6. Check the *At End of Gradeline* setting – this defines the behaviour of the program when the end of the current grade line is reached in auto stakeout mode

Continue	The auto stakeout will continue on the same line past the end of the current grade line
Stop	The auto stakeout will stop at the end of the current grade line
Next Gradeline	The auto stakeout will increment to the next grade line at the end of the current grade line (eg: First Gradeline: 1 & 2, Next Gradeline 2 & 3, etc)

7. Point the TPS towards the wall <u>at a position near where you want to start the stakeout</u>

8. Press **F3** (Start Auto) to start the auto stakeout

Stakeout Gradeline Configuration

- *Start Dist Measure* Set to **Yes** to start distance measuring when the function starts

- *Auto Height Accuracy* Sets the accuracy at which the *Height* value is staked out in auto stakeout mode

  (eg: if set to 0.025 the TPS will stake the grade line *Height* value to within ±25mm of the *Auto Height Offset* value before moving to the next interval on the grade line)

- *Auto Interval Accuracy* Sets the accuracy at which the distance *Interval* between the points is staked out in auto stakeout mode

  (eg: if set to 0.200 the TPS will stake the points on the grade line to within ±200mm of the *Interval* setting from the previous point before moving to the next interval)

- *Auto Start Delay (secs)* Sets the time the TPS will wait after the *Start Auto* button is pressed before starting the auto stakeout

- *Auto Wait Time (secs)* Sets the time the TPS will stop on an auto stakeout point when it has been successfully staked out

  (eg: if set to 5 the TPS will wait 5 seconds after it stakes out a point before it moves on to the next point)

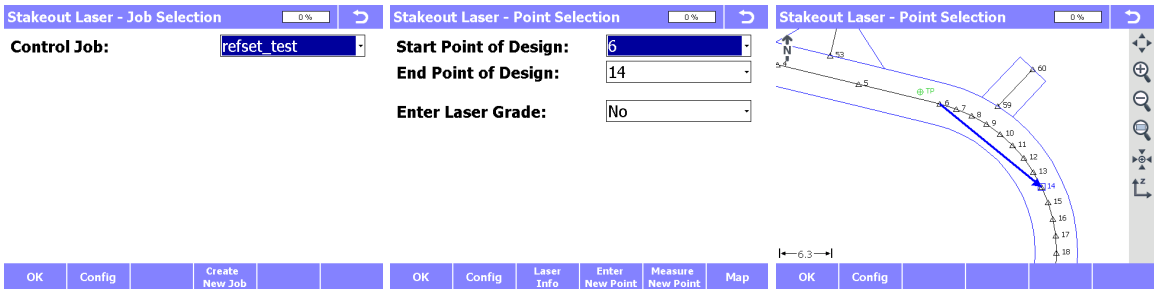
- *Maximum Auto Search Time (secs)*

  Sets the maximum time the TPS will search for an auto stakeout point. If set to zero the search time is infinite

  (eg: if set to 30 the TPS will search for 30 seconds and if the point is not found it moves on to the next point)

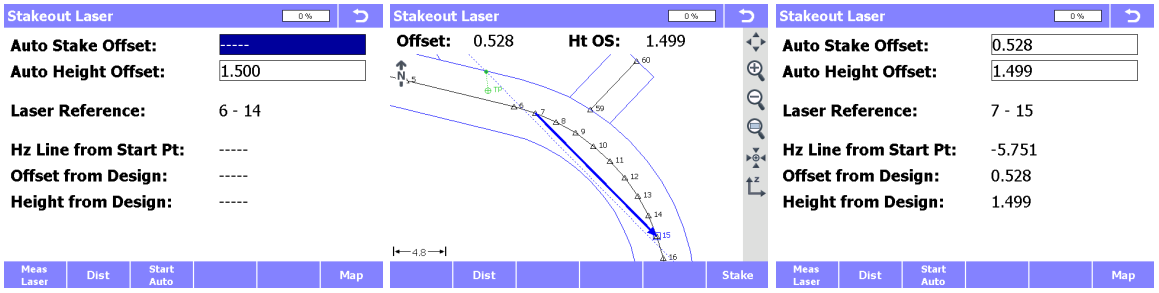
6. Stakeout Laser

Stakeout Laser Procedure



1. Tap or select **Stakeout Laser** on the start menu screen
2. Select the *Control Job* to use from the list and press **F1** (OK)
3. Select the *Start Point* and *End Point* of the laser design reference line to be staked out from the lists or press **F6** (Map) and select the points there
4. Select **Yes** or **No** to *Enter Laser Grade* and if **Yes** enter the grade of the laser (the laser design reference line will then start at the elevation of the start point and go towards the end point at the entered grade) and press **F1** (OK)

5. Stakeout Laser on Curve



5.1. In the Stakeout Laser screen - press **F6** (Map) to go to the map view and then window in the map to the relevant area

5.2. Point the TPS towards the drive wall at a good position for the laser and Press **F2** (Dist) to start measuring - the measured position will then be shown on the map view with a blue dashed line showing the offset line from the laser design reference line

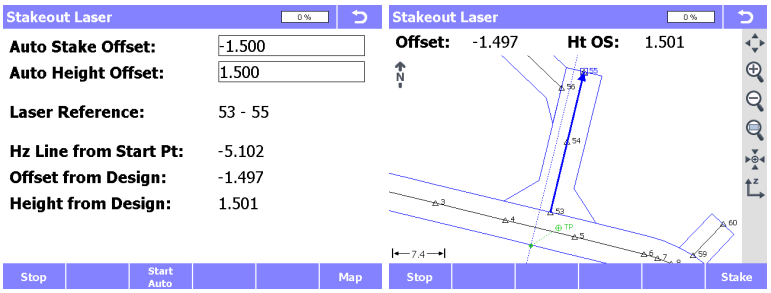
5.3. While measuring, turn the TPS and/or reselect the laser design reference line *Start* and *End Points* (by tapping on or near a point symbol) to adjust the dashed offset line to the best position for the laser - including using the displayed *Ht OS* value to position the laser vertically

5.4. When the best laser position has been found, mark the position on the drive wall and then press **F6** (Stake) to go back to the laser stake view

5.5. With the TPS still pointing towards the laser position, press **F1** (Meas Laser) - the TPS will then measure the laser position and set the *Auto Stake Offset* and *Auto Height Offset* values on the stake screen to the measured values

5.6. Point the TPS towards the drive face near to the laser target position and press **F3** (Start Auto) to start the auto stakeout of the laser target position

5. Stakeout Laser on Straight



5.7. In the *Stakeout Laser* screen - enter the *Auto Stake Offset* value and check the *Auto Height Offset* value - these are the values that will be staked out in the auto stakeout mode

5.8. Point the TPS towards the drive wall near to the laser position and press **F3** (Start Auto) to start the auto stakeout of the laser position

5.9. When the laser position has been established and marked point the TPS towards the drive face near to the laser target position and press **F3** (Start Auto) to start the auto stakeout of the laser target position

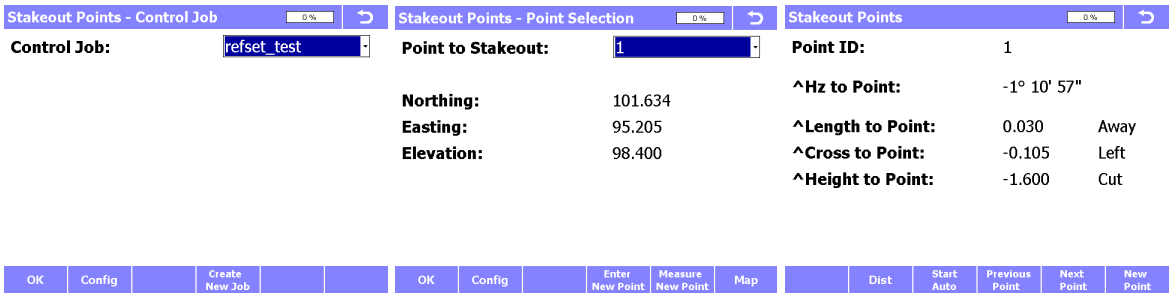
Stakeout Laser Configuration

- *Start Dist Measure* — Set to **Yes** to start distance measuring when the function starts
- *Auto Position Accuracy* — Sets the accuracy at which the *Offset* and *Height Offset* values are staked out in auto stakeout mode

  (eg: if set to 0.005 the TPS will stake the laser point *Offset* and *Height Offset* values to within ±5mm)
- *Default Auto Height OS* — The *Auto Height Offset* value that is used for the auto stakeout will be reset to this value when the function starts

7. Stakeout Points

Stakeout Points Procedure



1. Tap or select **Stakeout Points** on the start menu screen
2. Select the *Control Job* to use from the list and press **F1** (OK)
3. Select the *Point to Stakeout* from the list and press **F1** (OK)
4. Point the TPS towards the backs near to the first point to be staked
5. Press **F3** (Start Auto) to start the auto stakeout

Missed Points Procedure

If any points are missed during the auto stakeout due to the *Maximum Auto Search Time* being exceeded then when the auto stakeout is stopped or finished a message will be shown asking to stake the missed points manually

1. Tap or select **Yes** or **No** to stake the points manually
2. If **Yes** the first missed point will be loaded and the point can then be staked by manually pointing the telescope
3. Press **F5** (Next Point) or **F4** (Previous Point) to cycle through the missed points
4. Press **F6** (New Point) to finish the missed point stakeout and resume normal operation

Stakeout Points Configuration

- *Turn to Point at Start* Set to turn the TPS towards the stakeout point when the function starts:

  Yes – 2D Turns the horizontal axis only
  Yes – 3D Turns both the horizontal and vertical axis
  No Does not turn the TPS

- *Start Dist Measure* Set to **Yes** to start distance measuring when the function starts

- *Auto Position Accuracy* Sets the accuracy at which the *Length* and *Cross* offset values are staked out in auto stakeout mode

  (eg: if set to 0.025 the TPS will stake the points *Length* and *Cross* values to within ±25mm before moving to the next point)

- *Auto Start Delay (secs)* Sets the time the TPS will wait after the *Start Auto* button is pressed before starting the auto stakeout

- *Auto Wait Time (secs)* Sets the time the TPS will stop on an auto stakeout point when it has been successfully staked out

  (eg: if set to 5 the TPS will wait 5 seconds after it stakes out a point before it moves on to the next point)

- *Maximum Auto Search Time (secs)*

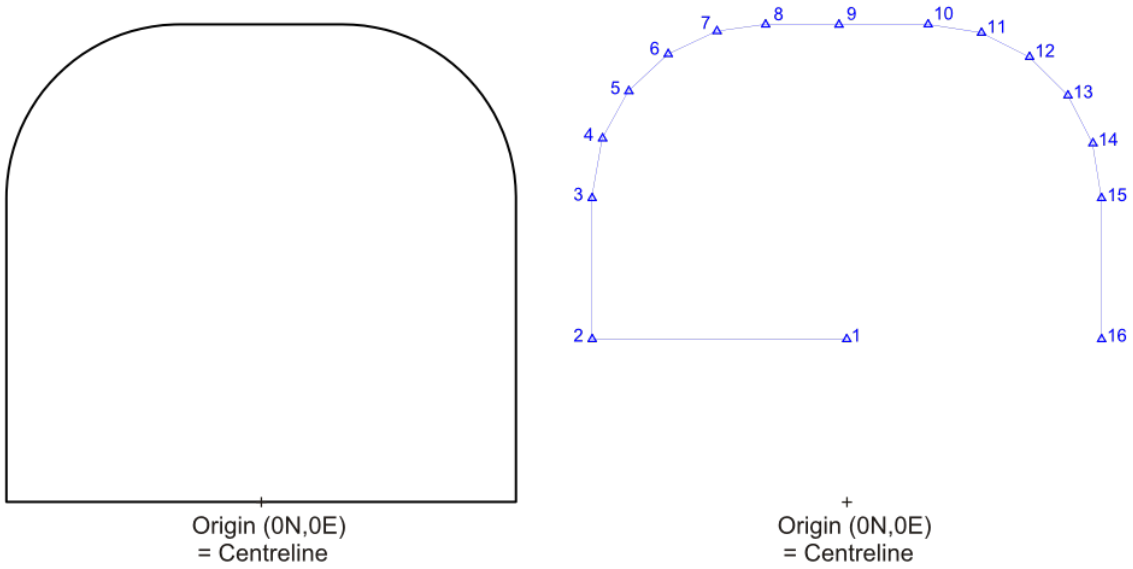
  Sets the maximum time the TPS will search for an auto stakeout point. If set to zero the search time is infinite

  (eg: if set to 30 the TPS will search for 30 seconds and if the point is not found it moves on to the next point)

8. Stakeout Profile

Profile Job Data Files

The *Profile Job* data files used in RefSet need to be setup in plan view coordinates (ie: Easting=Drive Width and Northing=Drive Height) with the coordinate origin (0E,0N) located at the centreline point of the profile. Note: The centreline does not need to be located on the profile outline (eg: it may be at the centre point of the profile).



Profile File Stakeout Point File

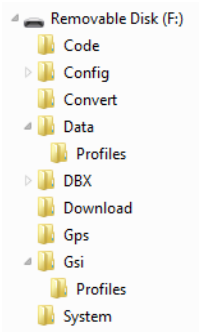
Each *Profile Job* needs two data files:

a) Profile File — Contains the full (detailed) profile outline string. The profile outline string needs to be a closed string in a clockwise direction. The point numbering is not important (eg: the point id's of the string may be blank). This outline is used to calculate the *Profile Offset* which is the shortest distance between a measured point and the profile and can be used to check for overbreak and underbreak.

b) Stakeout Point File — Contains the points that are to be staked out on the face in the auto stakeout mode. These points need to have individual point id's in consecutive order. Note: These points do not need to be located on the profile outline (eg: there can be a point on the centreline at gradeline height - Pt 1 in the above diagram).

The *Profile Job* data files need to be in the same format that is set in the *Data File Type* in the RefSet Program Configuration (ie: str, gsi or dxf). These files need to be located in a subfolder of the data files folder called *Profiles*. (ie: for str and dxf files the files need to be located in the *Profiles* folder under the *Data* folder and for gsi files in the *Profiles* folder under the *GSI* folder)

Profile Job Data Files Setup Procedure

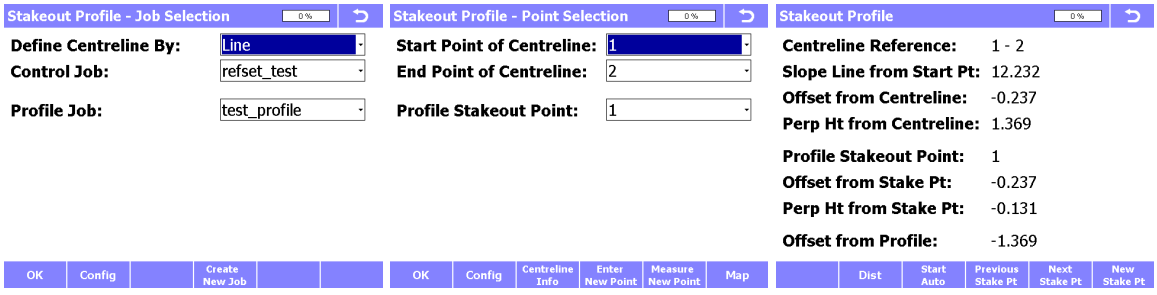


1. Create a *Profiles* folder on the memory card under the data folder for the *Data File Type* set in RefSet (ie: for str and dxf files under the *Data* folder and for gsi files under the *GSI* folder)
2. Create a profile outline string (see diagram above) and **ensure the profile outline string is a closed string in a clockwise direction**
3. Use this string to create the Profile File in the same *Data File Type* set in RefSet and **ensure that this file contains only the outline string**
4. **The Profile File needs to be named with a '_profile' suffix** (eg: *5x5_profile.gsi*)
5. Create the profile stakeout points to be staked out on the face (see diagram above) and **ensure these points have individual point id's in consecutive order**
6. Use these points to create the Profile Stakeout Point File in the same *Data File Type* set in RefSet
7. **The Stakeout Point File needs to be named with the same name as the Profile File but with a '_stake' suffix** (eg: *5x5_stake.gsi*)
8. Copy both the Profile File and the Stakeout Point File to the *Profiles* folder on the memory card (Note: These two files will represent one *Profile Job* in RefSet)

Stakeout Profile Procedure

1. Tap or select **Stakeout Profile** on the start menu screen
2. Select the method to *Define Centreline By*
3. Select the *Control Job* to use from the list
4. Select the *Profile Job* to use from the list and press **F1** (OK)

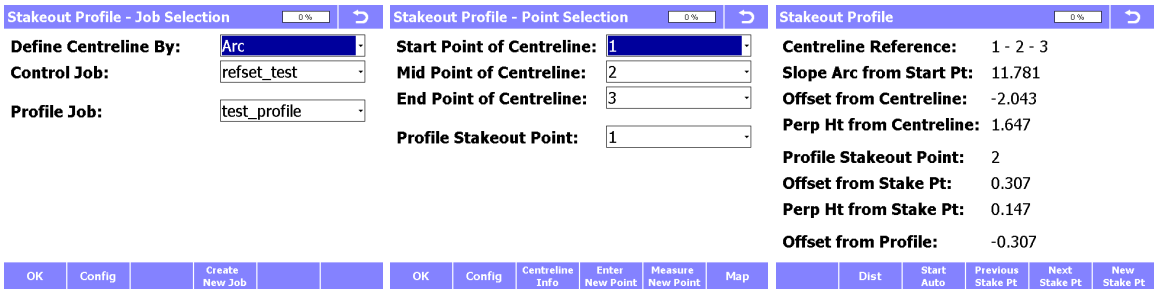
5. Stakeout Profile Centreline by Line



5.1. Select the *Start Point* and *End Point* of the centreline of the profile to be staked out from the lists

5.2. Select the *Profile Stakeout Point* to be staked out from the list and press **F1** (OK)

5. Stakeout Profile Centreline by Arc



5.1. Select the *Start Point*, *Mid Point* and *End Point* of the centreline of the profile to be staked out from the lists

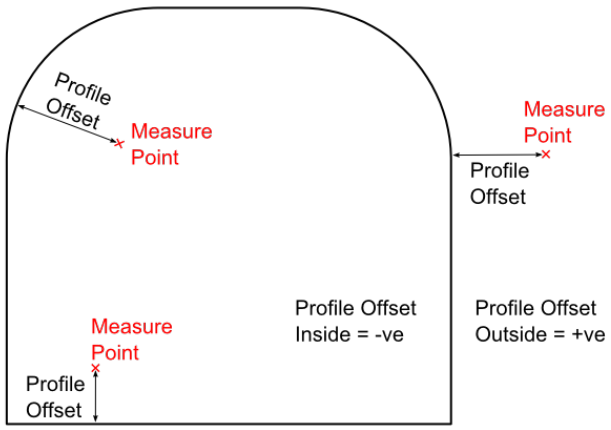
5.2. Select the *Profile Stakeout Point* of the profile to be staked out from the list and press **F1** (OK)

Both Stakeout Profile Methods

6. Point the TPS towards the drive face near to the first point to be staked
7. Press **F3** (Start Auto) to start the auto stakeout

Check Profile Procedure

1. Tap or select **Stakeout Profile** on the start menu screen
2. Setup the Profile Centreline and *Profile Job* as per points 1-5 in the Stakeout Profile Procedure above.
3. Point the TPS towards the point to be checked and Press **F2** (Dist) to start measuring
4. The *Offset from Profile* value can be used to check for overbreak and underbreak of the drive. Overbreak will have a positive *Offset from Profile* while underbreak will be negative (Note: ensure the profile outline string in the Profile File is a closed string in a clockwise direction otherwise this convention will be the opposite)



Stakeout Profile Configuration

- *Start Dist Measure* Set to **Yes** to start distance measuring when the function starts

- *Auto Position Accuracy* Sets the accuracy at which the stakeout point *Offset* and *Perp Height* values are staked out in auto stakeout mode

  (eg: if set to 0.025 the TPS will stake the profile stakeout point *Offset* and *Perp Height* values to within ±25mm before moving to the next stakeout point)

- *Auto Start Delay (secs)* Sets the time the TPS will wait after the *Start Auto* button is pressed before starting the auto stakeout

- *Auto Wait Time (secs)* Sets the time the TPS will stop on an auto stakeout point when it has been successfully staked out

  (eg: if set to 5 the TPS will wait 5 seconds after it stakes out a point before it moves on to the next point)

- *Maximum Auto Search Time (secs)*

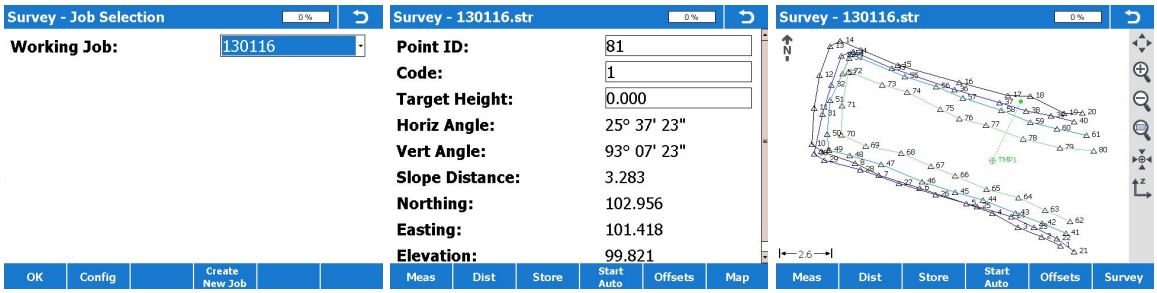
  Sets the maximum time the TPS will search for an auto stakeout point. If set to zero the search time is infinite

  (eg: if set to 30 the TPS will search for 30 seconds and if the point is not found it moves on to the next point)

- *Auto Search Limit (m)* Sets the distance limit for the point search in the auto stakeout mode. The auto stakeout will be restricted to within this distance from the start point of the auto stakeout

9. Survey

Survey Procedure



1. Tap or select **Survey** on the start menu screen
2. Select the *Working Job* to use from the list or press **F4** (Create New Job) to create a new working job file
3. Press **F1** (OK)
4. Press **F1** (Meas) to measure and store the point using the **Reflectorless Standard** EDM mode - this method can be used where more accuracy is needed
5. Press **F2** (Dist) to start measuring using the **Reflectorless Continuous** EDM mode and then press **F3** (Store) to store the measured point - this method can be used where more speed is needed

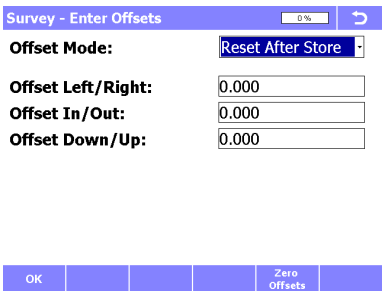
   Note: When **F3** (Store) is pressed the TPS will not store the point until it has measured two shots that are within 50mm - this ensures that the stored point coordinates are not affected by any large TPS movements during measurement

Auto Survey Procedure

Point the TPS towards the first point to survey and press **F4** (Start Auto) to start the Auto Survey - the TPS will start measuring using the Reflectorless Continuous EDM mode and will then store the first point - then move the TPS to the second point to survey and stop - the TPS will then auto store the second point - continue moving the TPS and stopping to survey the points and then press **F1** (Stop) to stop the auto survey

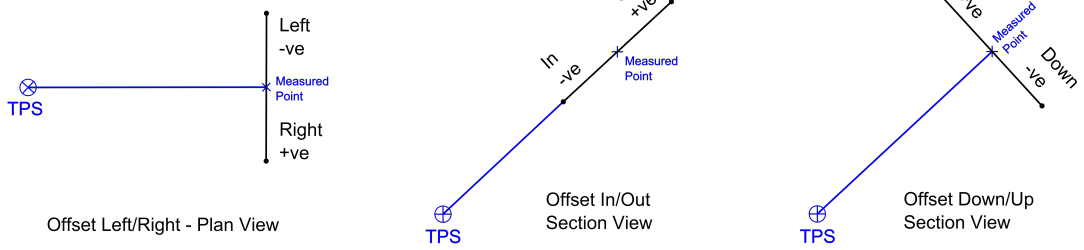
Note: The Auto Survey Mode is based on the TPS movement - the TPS will not store the point while it is moving and when the TPS is stopped the TPS will store the point only when it has measured two shots that are within 50mm and then wait until it is moved again

Measured Point Offsets



1. Press **F5** (Offsets) to enter and apply offsets to the measured points
2. Select the *Offset Mode* to use. Select **Reset After Store** to apply the offsets to a single measured point or select **Permanent** to apply the offsets to all following measured points
6. Enter the offsets to use for the following measured point/s and then press **F1** (OK)

Measured Point Offsets

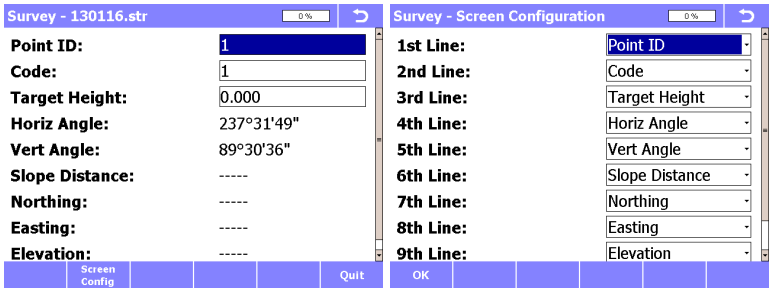


Survey Configuration

- *Flash EGL on Pt Stored* — When set to **Yes** the guide light will flash briefly when the point has been stored as a visual indicator

- *Save Raw Data DAT File* — Set to **Yes** to save the raw survey data (Hz Angle, Vt Angle, Slope Dist, etc) to a DAT file. The raw data will be saved to a file with the same name as the *Working Job* with a '_srvrep' suffix and '*.dat*' extension which will be saved in the same folder as the *Working Job* file (eg: xxx_srvrep.dat)

Survey Screen Configuration

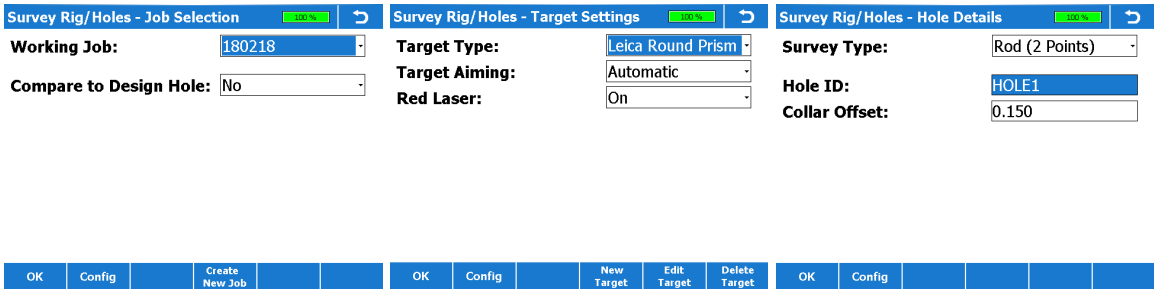


1. In the Survey screen
2. Press **Fn** then **F2** (Screen Config)
3. Adjust the display settings to define the parameters shown on each line of the Survey screen

10. Survey Rig/Holes

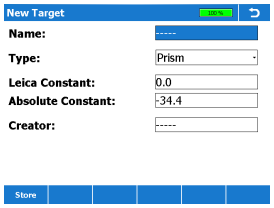
The *Survey Rig/Holes* function can be used to either check the alignment (azimuth and dip) of a drill rig setup (raise bore, blasthole rig, diamond drill rig, etc) or to survey completed drill holes and produce a drill hole survey report with the collar coordinates, azimuth and dip for each hole recorded.

Survey Holes Procedure

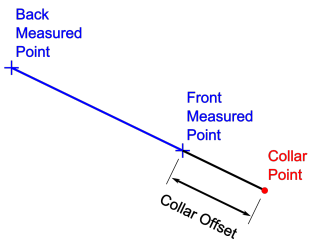


1. Tap or select **Survey Rig/Holes** on the start menu screen
2. Select the *Working Job* to use from the list or press **F4** (Create New Job) to create a new working job file
3. Select **No** to *Compare to Design Hole* and press **F1** (OK)
4. Select the *Target Type* to use for the survey (Reflectorless or a Prism)

   Note: To add a new user prism press **F4** (New Target) and then enter the new prism details, to edit an existing user prism select the prism in the *Target Type* and then press **F5** (Edit Target) and change the prism details or to delete a prism select the prism in the *Target Type* and then press **F6** (Delete Target)

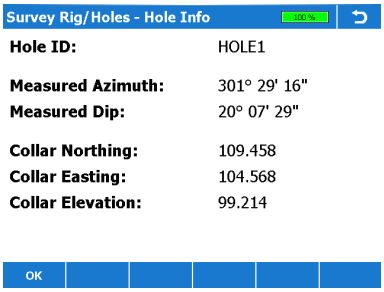


5. If a prism *Target Type* has been selected (ie: not *Reflectorless*) then select either Automatic (ATR) or Manual for the *Target Aiming* to use for the survey, and then select to have the *Red Laser* on or off during the survey and press **F1** (OK)
6. Select the *Survey Type* of the survey. Select **Rod (2 Points)** to measure 2 points on a drill rod to calculate the azimuth and dip of the hole as well as the collar position of the hole or select **Collar (1 Point)** to measure just the collar position
7. Enter the *Hole ID* of the hole being surveyed
8. If using the **Rod** *Survey Type* enter the *Collar Offset* which is the slope distance from the front measured point on the rod to the collar position in line with the back measured point
9. If using the **Rod** *Survey Type* point the TPS towards the front point on the rod and press **F1** (Meas), then point the TPS towards the back point on the rod and press **F1** (Meas)
10. If using the **Collar** *Survey Type* point the TPS towards the collar point of the hole and press **F1** (Meas)



Rod Survey - Section View

11. The measured hole information will then be displayed and will also be written to the survey drill hole report file which is saved in the same folder and has the same filename as the *Working Job* with either a '.csv' or '.txt' extension depending on the *DH Report File Type* set in the Survey Rig/Holes Configuration



12. Press **F1** (OK) to survey the next drill hole

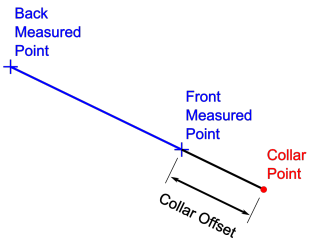
Check Drill Rig Procedure

1. Tap or select **Survey Rig/Holes** on the start menu screen
2. Select the *Working Job* to use from the list or press **F4** (Create New Job) to create a new working job file
3. Select **Yes** or **No** to *Compare to Design Hole* and then if **Yes** select the *Control Job* to use from the list and press **F1** (OK)
4. If comparing to a design hole select the *Design Hole Collar* and *Design Hole Toe* points from the lists and press **F1** (OK)

13. Select the *Target Type* to use for the survey (Reflectorless or a Prism)

    Note: To add a new user prism press **F4** (New Target) and then enter the new prism details, to edit an existing user prism select the prism in the *Target Type* and then press **F5** (Edit Target) and change the prism details or to delete a prism select the prism in the *Target Type* and then press **F6** (Delete Target)

5. If a prism *Target Type* has been selected (ie: not *Reflectorless*) then select either Automatic (ATR) or Manual for the *Target Aiming* to use for the survey, and then select to have the *Red Laser* on or off during the survey and press **F1** (OK)
6. Select **Rod (2 Points)** for the *Survey Type*, then enter the *Hole ID* of the drill rig survey - this is not really relevant for a drill rig check so can be set to a dummy number (eg: 1)
7. Enter the *Collar Offset* of the drill rig survey which is the slope distance from the front measured point on the rig or rod to the collar position in line with the back measured point
8. Point the TPS towards the front or bottom point on the rig or rod and press **F1** (Meas), then point the TPS towards the back or top point on the rig or rod and press **F1** (Meas)



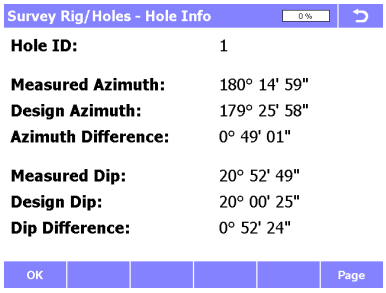
Rod Survey - Section View

9. The drill rig check information will then be displayed and will also be written to the survey drill hole report file which is saved in the same folder and has the same filename as the *Working Job* with either a '.csv' or '.txt' extension depending on the *DH Report File Type* set in the Survey Rig/Holes Configuration

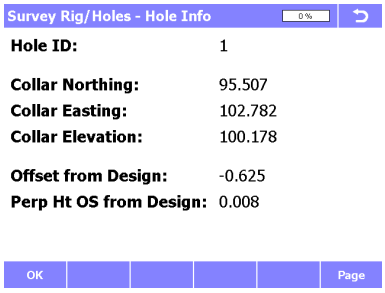
    Note: If comparing to a design hole the drill rig check information includes the *Projected Toe* coordinates. These coordinates are calculated using the measured dip and azi and projecting the hole from the collar position for the same length as the design hole

10. Press **F1** (OK) to resurvey the drill rig check

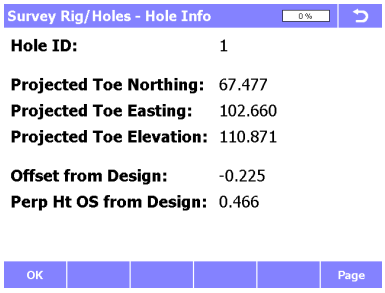
Check Drill Rig Info



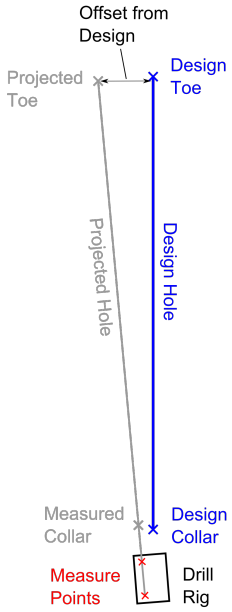
Angle Info

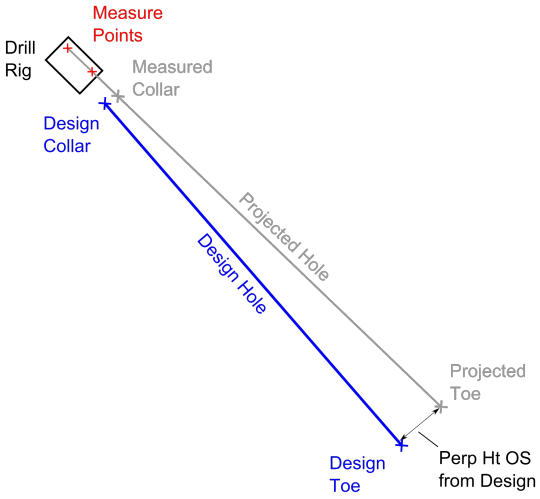


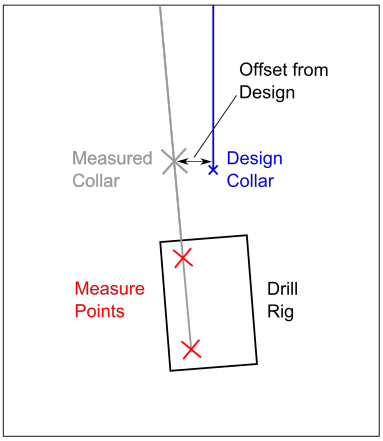
Collar Info



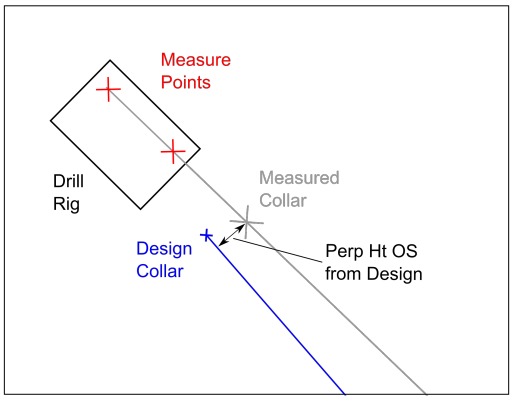
Projected Toe Info







Plan View



Section View

Survey Rig/Holes Configuration

- *DH Report File Type*

  Set to the type of drill hole report file to save the drill hole information to. This file will be saved in the same folder as the *Working Job* with a '_dhrep' suffix (eg: xxx_dhrep.csv):

CSV	Comma separated text file
TXT	Space separated text file

- *DH Report Angle Format*

  Set to the angle format used for the azimuth and dip in the drill hole information display and the drill hole report file:

Deg Min Sec	Degrees, minutes, seconds
Decimal Deg	Decimal degrees

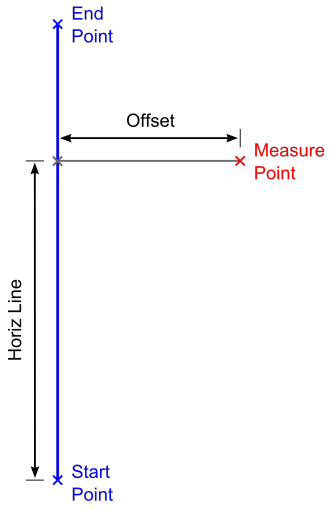
- *Save Raw Data DAT File*

  Set to **Yes** to save the raw survey data (Hz Angle, Vt Angle, Slope Dist, etc) to a DAT file. The raw data will be saved to a file with the same name as the *Working Job* with a '_srvrep' suffix and '*.dat'* extension which will be saved in the same folder as the *Working Job* file (eg: xxx_srvrep.dat)

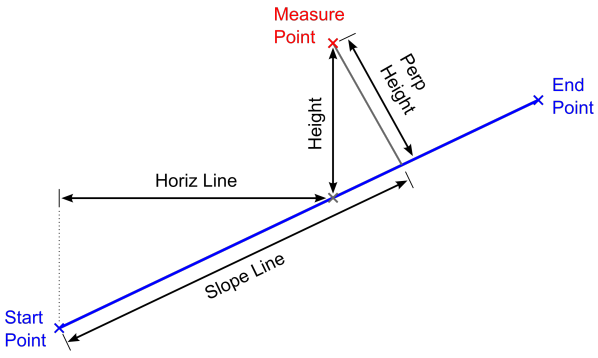
11. RefSet General

- Press **F5** in the main start menu to exit RefSet and start the Leica Captivate or SmartWorx program
- Press **Fn**, **F6** (Quit) to return to the main start menu from any screen in the program
- The *Control Job* lists can be searched using the alpha keys (eg: press **3** once to jump to the control jobs starting with the letter D, twice to jump to E, etc)
- It is important to number the points in the control job in a logical consecutive order to enable RefSet to increment to the next feature in auto stakeout modes
- Always point the TPS towards the first feature to stakeout before starting any of the auto stakeout modes, RefSet basically uses a trial and error method to do the auto stakeout, so it helps if it is near the first feature when it starts
- In the **Measure New Point** function pressing **Meas** will measure the point in standard reflectorless mode, while pressing **Dist** will measure in reflectorless continuous mode

Reference Line Offsets Description



Plan View



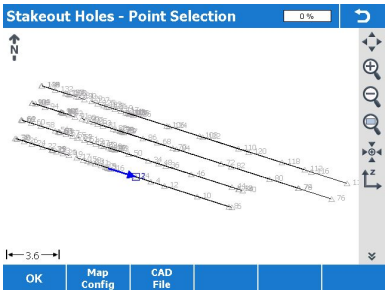
Section View

Map View

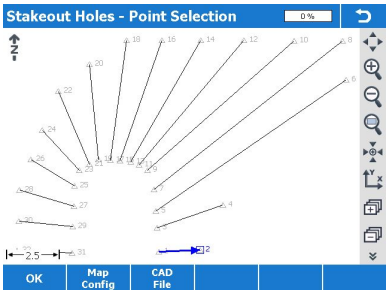
The Map View may be accessed from the point selection screens in the stakeout functions to display the control job and select the design point/s used in the functions or from the stakeout or survey functions to display the control or working job as points are staked or surveyed.

Map View Menu Functions

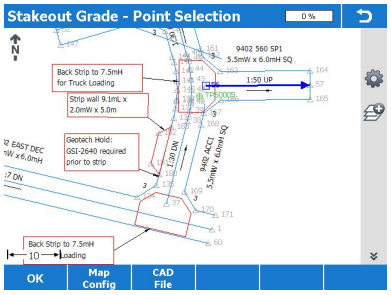
Icon	Key	Description
	1	**Zoom All** – Fits all the map data to the screen
	2	**Zoom In** - Zoom in to the map a set amount
	3	**Zoom Out** - Zoom out of the map a set amount
		**Zoom Window** - The zoom window can be defined by either tapping and dragging to draw a rectangle or by tapping the two corners of the rectangle. The map will then zoom to the selected window
	5	**Centre** - Centre the map on the TPS or target point position
		**Section View** - The section view can be defined by either tapping and dragging to draw a line or by tapping the two ends of the line. The map will then change to the section view. Note: Tapping on or near a point symbol will snap the section line to that point
		**Plan View** - Change the map back to the plan view
	6	**Step Section Forward** - Steps the section view forward by the step distance set in the map configuration
	4	**Step Section Backward** - Steps the section view backward by the step distance set in the map configuration
		**Next Menu** - Display next map view menu
		**Map Config** - Show map configuration screen
		**CAD File** - Show Background CAD file selection screen
	←↑↓→	**Pan Map** - Tap anywhere on the screen and drag to pan the map



Map Plan View



Map Section View



Map Plan View
With Background CAD File

Design Point / Line Selection

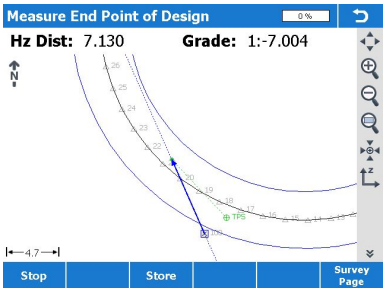
The design points used in the stakeout functions can be selected by tapping on or near a point symbol. The point will then be highlighted with a blue box

The design lines used in the stakeout functions can be selected by tapping on or near a point symbol and will alternate from the start point of the line to the end point of the line. The line will then be highlighted in blue with the line direction shown by an arrow.

The design lines can also be selected by tapping on or near a line between two point symbols, with the line direction initially the same as the string direction, tapping on the line again will reverse the line direction

Measure New Point Information

When in the *Measure New Point* map view select a data point by tapping on it to display information about the line between the selected point and the measured point. The line will be displayed as well as a projected line extending to the map extents.



Information about the line will be displayed at the top of the screen. The information displayed can be changed by tapping on the information titles (eg: *Azi*) and will cycle through:

Azi, Dip, Grade, Slp Dist, Hz Dist, Ht Diff

Map View CAD File Selection

When using STR, GSI or ASCII data file types in RefSet, a DXF file can be loaded and used as a background map in the map view to display text labels, arrows and lines from the DXF file on the map. In the map view tap the **Next Menu** button then the **CAD File** button or in the point selection map, press **F3** (CAD File) to setup the background DXF file

- *Background DXF File* Sets the DXF file to use as a background map in the map view
- *Display Map Lines From* When a background DXF file is selected, sets which file/s to use to display the lines in the map view:

  Background DXF
  Control / Working Job
  Both Files

Map View Configuration

- *Section View Width* — Sets the width of the section view. Only points and lines that are within this width around the section line will be visible in the map section view
- *Section View Step* — Sets the step distance when stepping forward and backward in the map section view

- *Display Points* — Set to **Yes** to display the data points in the map view
- *Display Point IDs* — Set to **Yes** to display the point IDs of the points in the map view
- *Display Lines* — Set to **Yes** to display the lines in the map view
- *Display Text Labels* — Set to **Yes** to display the text and arrow labels in the map view

- *Point Label Size* — Sets the size of the data point labels on the map
- *Point Label Colour* — Sets the colour of the data point labels on the map

- *Centre To* — Sets the point to centre the map view on when tapping the **Centre** button:

TPS	Centre on TPS
Target	Centre on target point
Alternate	Alternate between TPS and target point