
Hybrid +

Quick Start Guide

Version 1.00





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1 Hybrid+ Setup

Hybrid+ allows the use of a robotic total station and GPS receiver simultaneously to increase survey reliability and efficiency. The Hybrid+ setup wizard is designed to step you through configuration of Hybrid+, allowing multiple setup options based on user preference. This quick start guide will walk you through two methods of setup and explain the basics of Hybrid+.

1.1 Setup Method 1: Hybrid+ Setup Using Grid Coordinates

Use this setup method if you run a GPS receiver on grid coordinates and would like to configure your robotic total station to run on grid coordinates.

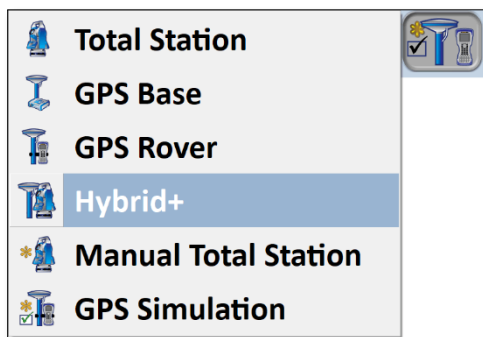
Begin by configuring a GPS Receiver as you normally would, setting up RTK corrections and achieving a fixed position using either a radio or network connection.

The screenshot shows the 'Monitor/Skyplot' interface with a yellow arrow button in the top right. The interface is divided into several sections:

Quality	Position	SATView	SATInfo	Ref
Status: FIXED			Satellites: 14/18	
Latency: 1.0s			Local Elev: 97.2956ft	
Base Selection: VRS_RTCM3				
Local Northing: 5003.2547ft				10/25/2017
Local Easting: 4936.3075ft				08:53:15.0
HDOP: 1.30		VDOP: 1.82		
TDOP: 1.26		PDOP: 2.24		
GDOP: 2.57				
HRMS: 0.041ft				
VRMS: 0.063ft				
		Connected		

Buttons: Reset RTK, Disconnect, Connect

To enter Hybrid+ mode, tap the quick-switch instrument selector in the top bar of the main menu. Select Hybrid +. Click yes when prompted "Switch to Hybrid Survey Mode?" If you have not registered the Hybrid+ module, you will be prompted to temporarily enter demo mode to try Hybrid+. You can revert to your full registered copy at any time by exiting and reentering the software.





If you have not purchased the Hybrid+ module, you will be prompted to temporarily enter demo mode with the Hybrid+ module to try. Demo Mode will only allow a maximum of 15 points. You can revert to your full registered copy of the software by exiting and relaunching the software.

Hybrid+	Hybrid+ Demo
<p>Get even more out of SurvPC with the purchase of the Hybrid+ module. This allows you to connect to total station and GPS at the same time for added power and flexibility. Visit www.survce.com to purchase now, or contact a Carlson dealer to learn more.</p> <p>Try Hybrid+ Now</p> <p>Cancel</p>	<p>SurvPC is now in Demo Mode. Each coordinate file will be limited to a maximum of 15 points. Exit and re-enter the software to resume registered operation.</p> <p>OK</p>

If this is the first time you have used Hybrid+, you will be prompted to use the wizard for configuration. Click on 'Yes' to continue.

SurvPC

Would you like to configure Hybrid+ using the wizard?

Yes No

The first step of setup is to configure the Robotic Total Station (RTS) and GPS receiver. For this example, we have already configured the GPS (note the green check icon). Press 'Configure TS' to begin the configuration of the robotic total station.

Hybrid Survey Setup Wizard

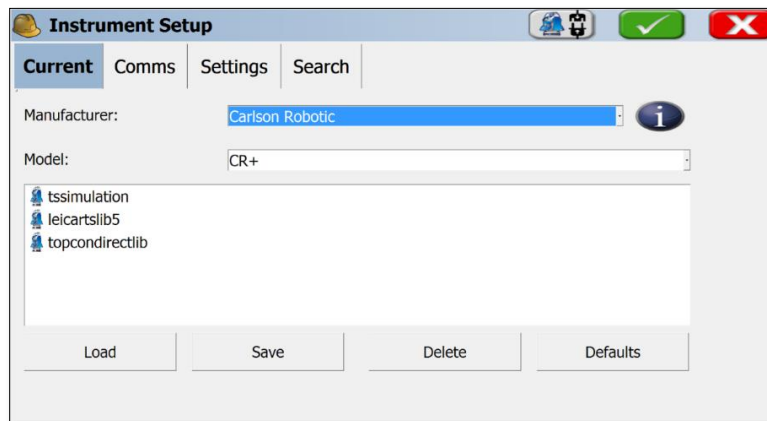
Configure your GPS Receiver and Robotic Total Station here. Press Next to continue.

✓ Configure GPS	BRx6
Configure TS	Not Configured

Next

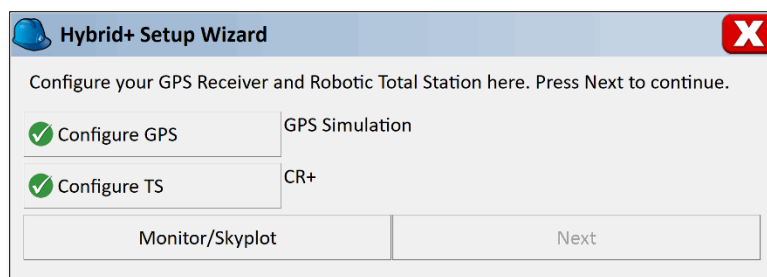


Configure the robotic total station as you normally would.



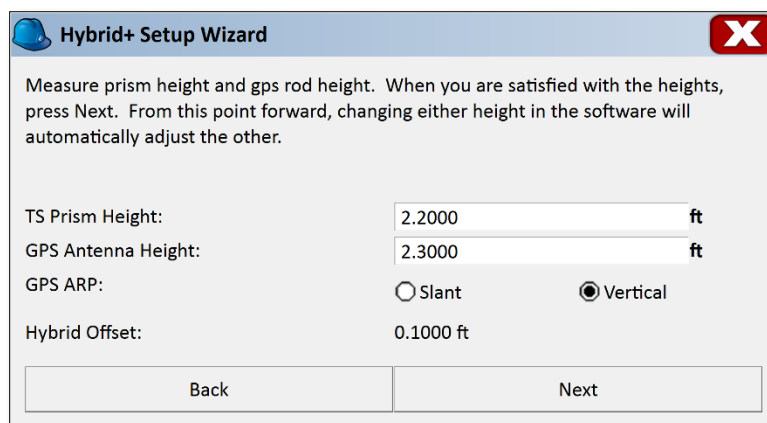
The 'Instrument Setup' dialog box has a title bar with a yellow icon, a green checkmark, and a red X. It contains four tabs: 'Current' (selected), 'Comms', 'Settings', and 'Search'. Under 'Current', there is a 'Manufacturer:' dropdown menu set to 'Carlson Robotic' and a 'Model:' dropdown menu set to 'CR+'. Below these are three list items: 'tssimulation', 'leicartslib5', and 'topcondirectlib'. At the bottom are four buttons: 'Load', 'Save', 'Delete', and 'Defaults'.

Press the green check to connect and return to the wizard. Both buttons should now have a green check to indicate the instruments are configured. Press 'Next' to continue.



The 'Hybrid+ Setup Wizard' dialog box has a title bar with a blue icon and a red X. It contains the text: 'Configure your GPS Receiver and Robotic Total Station here. Press Next to continue.' Below this are two rows of configuration options. The first row has a green checkmark icon, the text 'Configure GPS', and a dropdown menu set to 'GPS Simulation'. The second row has a green checkmark icon, the text 'Configure TS', and a dropdown menu set to 'CR+'. At the bottom are two buttons: 'Monitor/Skyplot' and 'Next'.

Next, the wizard will guide you through setting your GPS and RTS heights. Measure the height of the prism (from the tip of the pole to the center of the prism) and measure the height of the GPS receiver (from the found to the reference mark on the antenna, slant or vertical). Enter in these values in the screen.

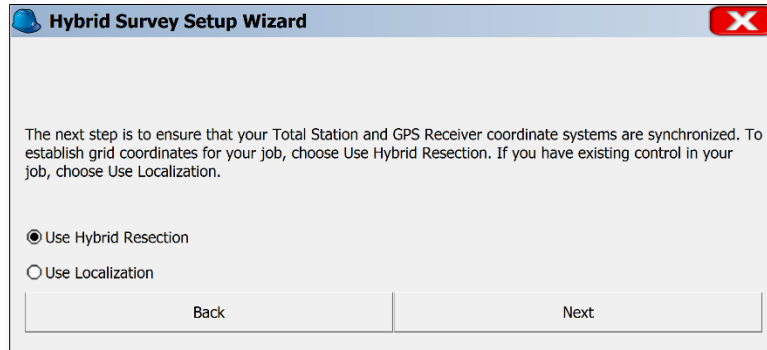


The 'Hybrid+ Setup Wizard' dialog box has a title bar with a blue icon and a red X. It contains the text: 'Measure prism height and gps rod height. When you are satisfied with the heights, press Next. From this point forward, changing either height in the software will automatically adjust the other.' Below this are four rows of input fields. The first row is 'TS Prism Height:' with a text box containing '2.2000' and a unit dropdown set to 'ft'. The second row is 'GPS Antenna Height:' with a text box containing '2.3000' and a unit dropdown set to 'ft'. The third row is 'GPS ARP:' with two radio buttons: 'Slant' (unselected) and 'Vertical' (selected). The fourth row is 'Hybrid Offset:' with a text box containing '0.1000 ft'. At the bottom are two buttons: 'Back' and 'Next'.

The software will now calculate the fixed offset between the center of the prism and the GPS receiver. From this point forward, changing either height (GPS or RTS) will automatically adjust the other using this fixed offset value. Press 'Next' to continue.



To survey in Hybrid+ mode, it is necessary to ensure the robotic total station and GPS are measuring points on the same coordinate system. The next step in the wizard will address this. In this example, we will configure the robotic total station to use state plane grid coordinates using the Hybrid Resection procedure.



Hybrid Survey Setup Wizard

The next step is to ensure that your Total Station and GPS Receiver coordinate systems are synchronized. To establish grid coordinates for your job, choose Use Hybrid Resection. If you have existing control in your job, choose Use Localization.

☒ Use Hybrid Resection
☐ Use Localization

Back Next

In order for coordinates to match over long distances, it is necessary to scale either the robotic total station or GPS measurements. Select your scaling method. In this example, we are using 'Scale TS (Ground to Grid)'. Click 'Next' to continue.



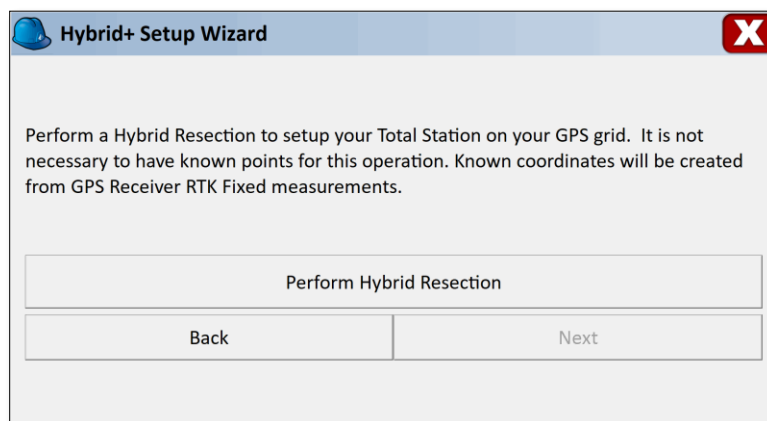
Hybrid+ Setup Wizard

Select Scaling Method

☐ Scale GPS (Grid to Ground)
☒ Scale TS (Ground to Grid)
☐ No Scaling

Back Next

The next screen will allow the Hybrid Resection procedure to begin. When ready, click on 'Perform Hybrid Resection' to continue.



Hybrid+ Setup Wizard

Perform a Hybrid Resection to setup your Total Station on your GPS grid. It is not necessary to have known points for this operation. Known coordinates will be created from GPS Receiver RTK Fixed measurements.

Perform Hybrid Resection

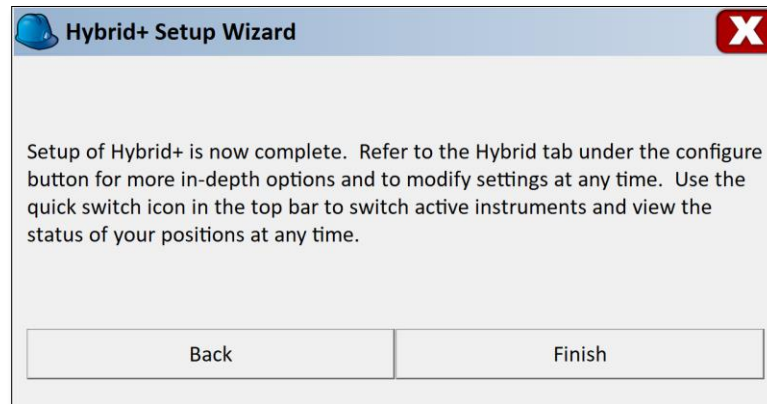
Back Next



It is not necessary to have any known coordinates to perform a hybrid resection. The known points will be measured from the GPS receiver. Simply aim the total station to the prism and press 'Read Hybrid Position' to measure a resection point. The software will measure the total station position and the GPS position at the same time, synchronizing the readings automatically by time. You will be prompted to store the resection point if you desire. Move to a new location and repeat.

When you are satisfied with your resection, press 'Calculate' to view your results and store the calculated position of the robotic total station. The software will then set the orientation angle on the robotic total station and return to the wizard. The next step is to 'Perform a Cross-Check'. Cross-check will measure a position simultaneously using the robotic total station and GPS receiver. It will then compare the coordinates match based on the displayed tolerances.

Cross-check tolerances can be augmented within this screen. Perform a Cross-check by pressing 'Perform Cross-Check'. Once setup is complete, the software will use these tolerances to detect any unacceptable deviations between the RTS and GPS positions. If an unacceptable deviation is present, a warning screen will pop-up to warn the field engineer.



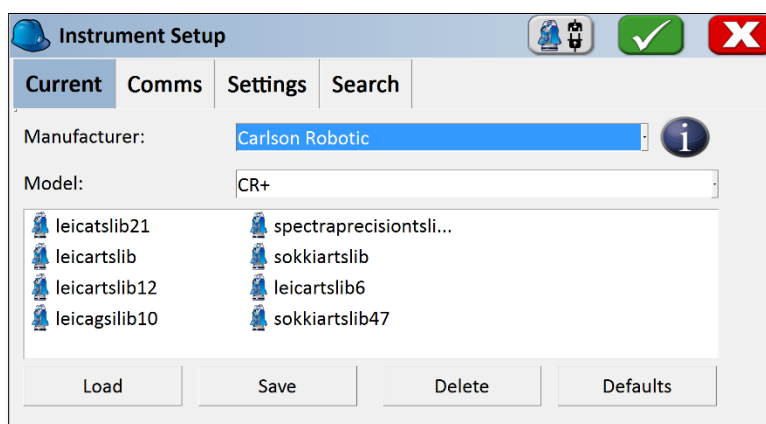
Setup is now complete. Press 'Finish' to exit the wizard and begin using Hybrid+.



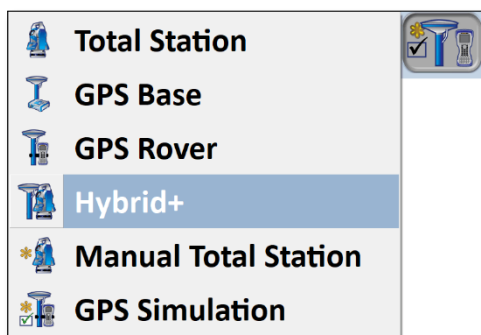
1.2 Setup Method 2: Hybrid+ Setup Using Known Local Coordinates

Use this method if you typically run a robotic total station on ground coordinates and want to localize the GPS receiver to ground coordinates.

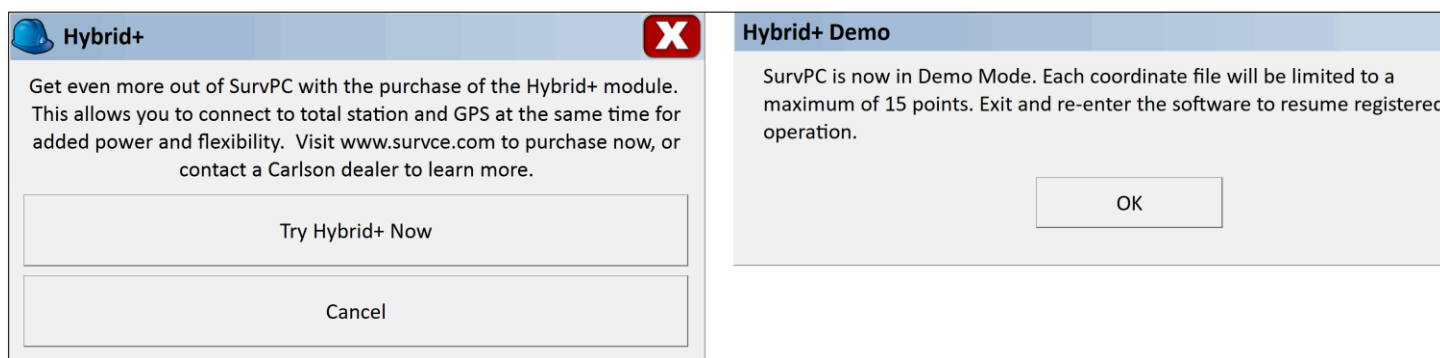
Begin by configuring a robotic total station (RTS) normally, configuring the instrument and setting your backsight and orientation.



To enter Hybrid+ mode, tap the quick-switch instrument selector in the top bar of the main menu. Select Hybrid+.



If you have not purchased the Hybrid+ module, you will be prompted to temporarily enter demo mode with the Hybrid+ module to try. Demo Mode will only allow a maximum of 15 points. You can revert to your full registered copy of the software by exiting and relaunching the software.





If this is the first time you have used Hybrid+, you will be prompted to use the wizard for configuration. Click on 'Yes' to continue.

SurvPC

Would you like to configure Hybrid+ using the wizard?

Yes No

The first step of setup is to configure the Robotic Total Station (RTS) and GPS receiver. For this example, we have already configured the robotic total station (note the green check icon). Press 'Configure GPS' to begin the configuration of the GPS receiver.

Hybrid+ Setup Wizard

Configure your GPS Receiver and Robotic Total Station here. Press Next to continue.

Configure GPS	Not Configured
✓ Configure TS	CR+

Monitor/Skyplot Next

Configure the GPS as you normally would, ensuring a valid RTK correction link. Once the GPS receiver is configured, both buttons will show green check icons. Press 'Next' to continue.

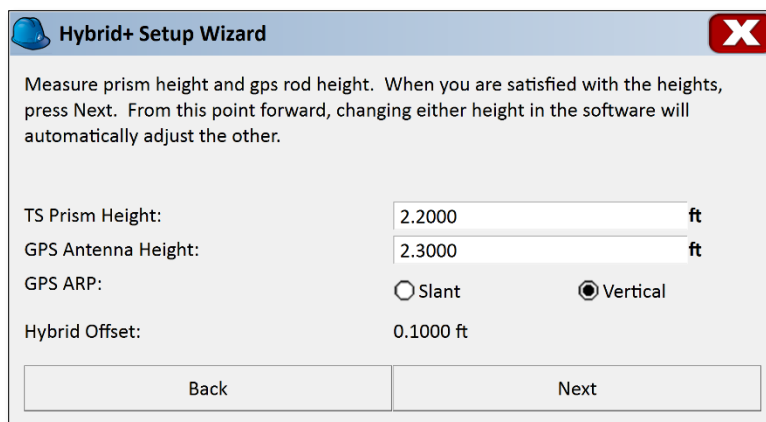
Hybrid+ Setup Wizard

Configure your GPS Receiver and Robotic Total Station here. Press Next to continue.

✓ Configure GPS	GPS Simulation
✓ Configure TS	CR+

Monitor/Skyplot Next

Next, the wizard will guide you through setting your GPS and RTS heights. Measure the height of the prism (from the tip of the pole to the center of the prism) and measure the height of the GPS receiver (from the ground to the reference mark on the antenna, slant or vertical). Enter in these values in the screen.



Hybrid+ Setup Wizard

Measure prism height and gps rod height. When you are satisfied with the heights, press Next. From this point forward, changing either height in the software will automatically adjust the other.

TS Prism Height: 2.2000 ft

GPS Antenna Height: 2.3000 ft

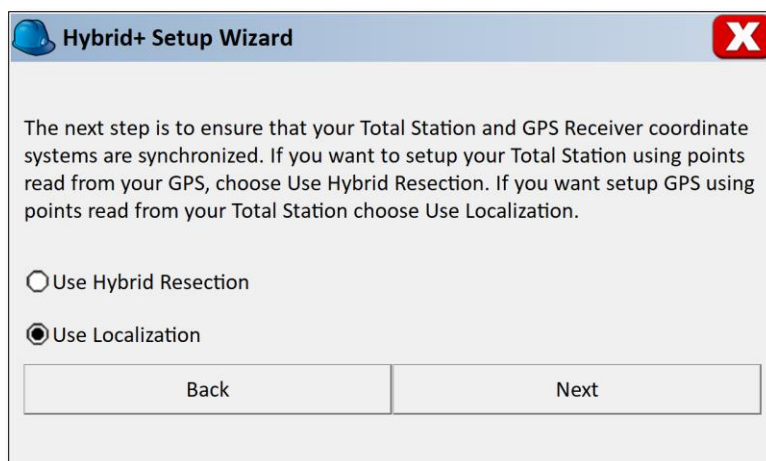
GPS ARP: ☐ Slant ☒ Vertical

Hybrid Offset: 0.1000 ft

Back Next

The software will now calculate the fixed offset between the center of the prism and the GPS receiver. From this point forward, changing either height (GPS or RTS) will automatically adjust the other using this fixed offset value. Press 'Next' to continue.

To survey in Hybrid+ mode, it is necessary to ensure the robotic total station and GPS are measuring points on the same coordinate system. The next step in the wizard will address this. In this example, we will configure the GPS receiver to existing ground coordinates using the 'Use Localization' procedure. Select 'Use Localization' and click 'Next' to continue.



Hybrid+ Setup Wizard

The next step is to ensure that your Total Station and GPS Receiver coordinate systems are synchronized. If you want to setup your Total Station using points read from your GPS, choose Use Hybrid Resection. If you want setup GPS using points read from your Total Station choose Use Localization.

☐ Use Hybrid Resection

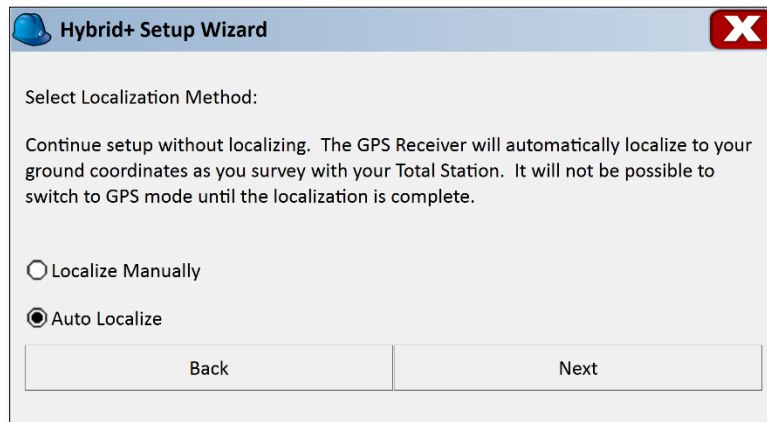
☒ Use Localization

Back Next

There are two methods of performing the localization for Hybrid+, localize manually and auto-localize. Localize Manually will proceed to the SurvCE localization screen where a localization may be created by measuring individual points and adding them to the localization. Auto-Localize will proceed to the Store Points screen and switch the active instrument to the robotic total station. The auto-localization will complete once enough points are measured.



We will run an example of the Auto-Localization method below. Select 'Auto Localize' and click 'Next' to continue.



Hybrid+ Setup Wizard

Select Localization Method:

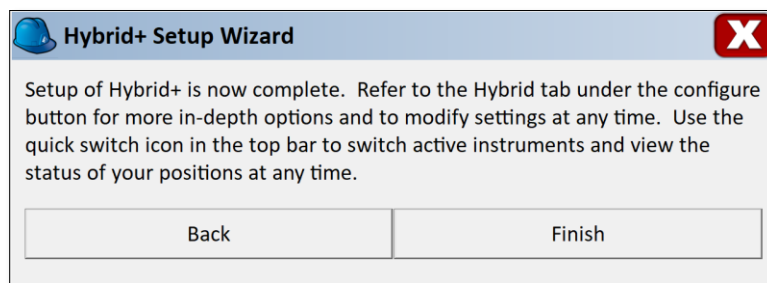
Continue setup without localizing. The GPS Receiver will automatically localize to your ground coordinates as you survey with your Total Station. It will not be possible to switch to GPS mode until the localization is complete.

☐ Localize Manually

☒ Auto Localize

Back Next

The setup wizard will now complete. However, no points have been measured and a Cross-check has not been performed, so Hybrid+ is not yet fully active.

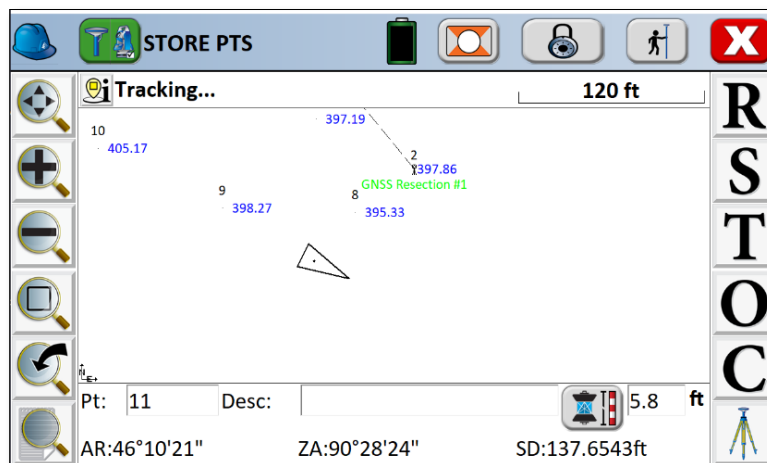


Hybrid+ Setup Wizard

Setup of Hybrid+ is now complete. Refer to the Hybrid tab under the configure button for more in-depth options and to modify settings at any time. Use the quick switch icon in the top bar to switch active instruments and view the status of your positions at any time.

Back Finish

Click on 'Finish' to exit the Hybrid+ Setup Wizard. SurvCE will now automatically set the active instrument to the robotic total station. It will not be possible to switch to GPS mode until enough points are measured with the robotic total station to form a good auto localization. From the main menu, select Survey – Store Points. The Store points routine will be used to form an auto-localization.



STORE PTS

Tracking... 120 ft

10 405.17

9 398.27

8 395.33

2 397.86

1 397.19

GNSS Resection #1

Pt: 11 Desc: 5.8 ft

AR:46°10'21" ZA:90°28'24" SD:137.6543ft

R
S
T
O
C

Within the Store Points screen, each time a point is stored with the robotic total station, the GPS measurement is collected at the same time. A localization will be formed in the background by analyzing all measurements pairs and selecting the best quality measurements.



The status of the auto localization can be viewed at any time by selecting Equip – Configure – Hybrid tab.

Configure Hybrid

General View **Hybrid** Sets IMU

Antenna Height: 6.05 ft ☒ Vert
Prism Height: 5.8 ft ☐ Slant

Cross-Check Status: Not Validated
Auto Localization Status: Insufficient Points [0]

☐ Ignore GPS Search Elv
☐ Require Cross-Check on Store
☐ Backup Tracking
☐ Follow Me

☐ Backup Storing
☒ Smart Lock

0.2500 ft

The screen shot above reflects the status of an Auto Localization routine before any points are stored. When enough points are stored the Auto Localization status will switch from 'Insufficient Points [0]'.

Before the Auto Localization is complete, an attempted switch to GPS mode will be blocked by the software with a warning message.

Use the robotic total station to store several points. An ideal localization will form a triangle around the robotic total station, but it is not necessary to intentionally from a localization. The software will calculate the best localization continuously. When an auto localization is calculated, features like Smart Lock, Follow Me, and GPS Search will be enabled, based on user settings. Once the auto localization is complete, a switch to GPS mode using the instrument status icon can be made. At that time, the auto localization will be finalized and no further localization points will be collected. Press the quick switch icon to switch to GPS Mode.

Tracking... 120 ft

10 397.19

SurvPC

Before switching instruments, you need to review and finalize your localization points. Finalize now?

Yes No

Pt: 11 Desc: SD: 5.8 ft

AR: 46°09'26" ZA: 90°28'27" SD: 137.5361ft

Press 'Yes' to finalize. SurvCE will proceed to the Localization screen.



From this screen, you can review your localization points and quality as you would a manual localization.

Localization

System TS GPS **Points** By Helmert

Pt ID	Northing(ft)	Easting(ft)	Elevation(ft)	H Res(f)
Auto-Localization Pt 5	418179.2762	1779575.0007	403.6775	0.029
Auto-Localization Pt 6	418203.9331	1779648.9891	403.6939	0.037
Auto-Localization Pt 8	418124.3060	1779598.0156	401.8089	0.024

Scale:1.000064 ☐ 2pt Rotate Only
Avg HRes:0.0340 Avg VRes:0.0035

Add Delete Edit On/Off
Load View Monitor Save

Press the green check to finalize the auto localization routine. With the localization complete, the next step is to perform a Cross-Check. The software will direct the user to the cross-check procedure automatically.

Tracking... 120 ft

397.19
405.17

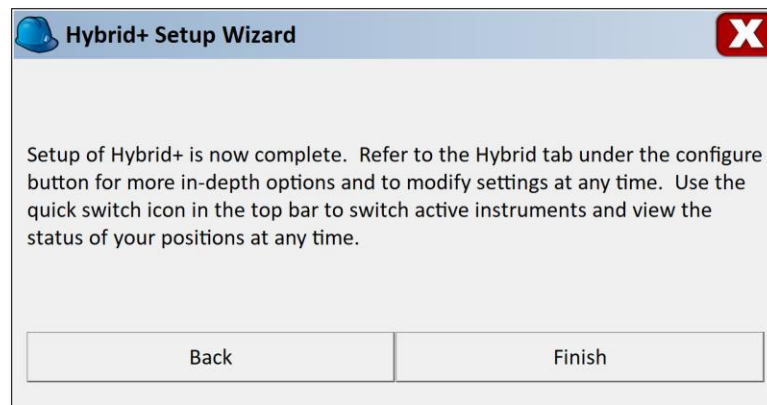
SurvPC
Confirm Hybrid Setup by performing a Cross-Check?

Yes No

Pt: 11 Desc: 5.8 ft
AR:46°09'26" ZA:90°28'27" SD:137.5361ft

Click 'Yes' to perform a cross check. The Cross-check procedure will measure a position simultaneously using the robotic total station and GPS receiver and verify that the coordinates match. If the coordinates match within tolerances, the localization is good and the robotic total station and GPS receiver are on a matching coordinate system. Hybrid+ setup is complete.

Tolerances can be adjusted in the Hybrid tab of Equip – Configure. Once setup is complete, SurvCE will use these tolerances to detect unacceptable deviations between the robotic total station and GPS positions. Unacceptable deviations will be shown as a warning to the user throughout the survey session.



Setup is now complete. Press 'Finish' to exit the wizard and begin using Hybrid+.



2 Using Hybrid+

Once Hybrid+ is active, SurvCE can be used normally. The new Instrument Status icon, shown on the upper-left of the screen, will indicate the status of the configured instruments at all times. The checkmark (shown below the instrument icon) will indicate the active instrument. While both the robotic total station and GPS receiver are connected and may be measuring at any time, the *active* instrument will control the options available in the main menu along with the display in active survey screens. The color on each side of the Instrument Status icon indicates the status of position quality.

- Red: The instrument is not connected.
- Yellow: The instrument is connected but an accurate position is unavailable.
 - Yellow for GPS: Receiver mode is not Fixed RTK. (Receiver mode is Autonomous, DGPS, RTK Float, etc..).
 - Yellow for Robotic Total Station: Standby or lost prism.
- Green: The instrument is connected and an accurate position is available.
 - Green for GPS: Receiver mode is Fixed RTK.
 - Green for Robotic Total Station: Locked / Tracking.



Note: The Instrument Status icon shown above is displaying the robotic total station as active. The yellow color indicates it is not currently tracking a prism. The GPS icon is green, indicating the current Fixed RTK status.

The instrument status icon can be selected from any screen to quickly switch active survey modes. When the GPS instrument is active, the menus and display of SurvCE will be in GPS mode. When the robotic total station instrument is active, the menus and display of SurvCE will be in total station mode.

JOB:					
File	Equip	Survey	COGO	Road	
1 Total Station		6 Localization			
2 GPS Base		7 Monitor/Skyplot			
3 GPS Rover		8 Tolerances			
4 GPS Raw Only		9 Peripherals			
5 Configure		0 GPS Utilities			

Note: Menu shown in GPS mode.

JOB:					
File	Equip	Survey	COGO	Road	
1 Total Station		6 Localization			
2 GPS Base		7 Check Level			
3 GPS Rover		8 Tolerances			
4 GPS Raw Only		9 Peripherals			
5 Configure		0 TS Utilities			

Note: Menu shown in Total Station mode. Check Level and TS Utilities are shown in the main menu.



3 Hybrid+ Features and Settings

Hybrid+ settings can be accessed from the main menu by selecting Equip – Configure and navigating to the Hybrid tab.

The Hybrid tab allows editing / viewing several settings.

- **Antenna / Prism Height:** The Antenna and Prism Heights can be viewed and/or edited. Updating either height elsewhere in the software will automatically adjust the other.
- **Cross-Check Status:** The Cross-Check Status is shown – this will inform if any recently compared GPS and robotic total station points have been compared successfully. The screen shot above indicates Cross-Check has not yet completed. If localization has been used, the auto localization status and/or other localization information will be visible under the Cross-Check Status.
- **Ignore GPS Search Elv:** GPS Search is always available when Hybrid+ is active. To use it, select the down arrow to the right of the search icon from any active screen, and select 'GPS Search'.



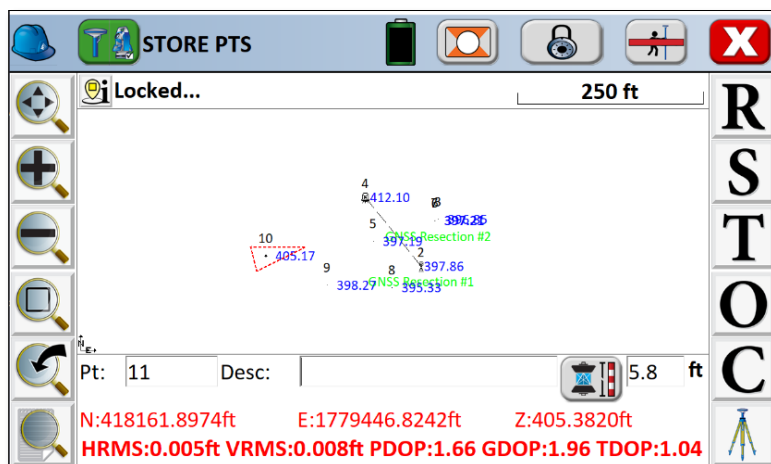
In locations where the GPS cannot get a quality position and elevations are relatively flat, it may be useful to ignore the less accurate elevation measurement of the GPS receiver and still perform GPS searches using only the horizontal position to locate the prism. Enable 'Ignore GPS Search Elv' to do this.

- **Require Cross-Check on Store:** Enable this option to force the software to calculate a cross-check on every stored point. When enabled, this option will affect workflow based on mode.
 - **In GPS Mode:** If the robotic total station is not locked on the prism, a search will be performed.
 - **In Robotic Total Station Mode:** If the GPS is not Fixed RTK, the user will be warned.

Note: Only the active instrument's measurements will be stored in the RW5 file.

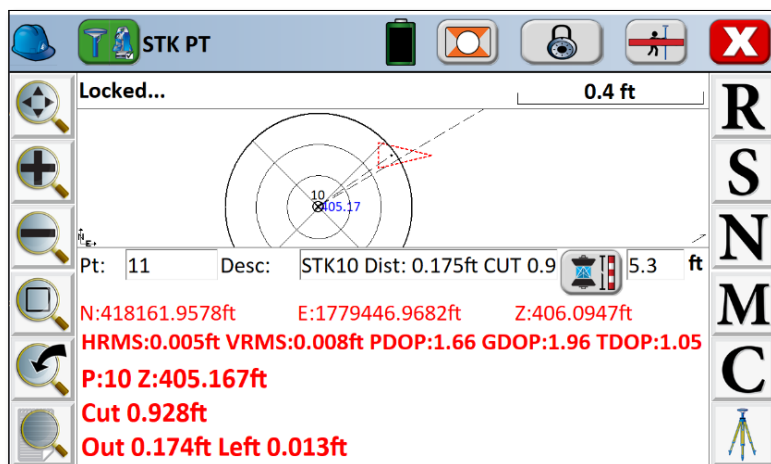
This option forces the software to check both instrument positions for each stored point, allowing the user to see a warning if either instrument's position is sub-optimal.

- **Backup Tracking:** When Backup Tracking is enabled, SurvCE will automatically display the backup (and inactive) instrument position on the screen when the primary (and active) instrument's position is unavailable. The backup instrument position will be displayed in red. This means if the robotic total station is active, and the E.D.M. is obstructed, the software will display the GPS position in the bottom bar as well as the GPS location triangle until the robotic total station position is restored.



Shown in the image above, the robotic total station is the active instrument, but is in a locked state (the E.D.M. is not firing). Since no position is available from the active instrument, and backup tracking is enabled, SurvCE is displaying the backup position of the GPS in red.

In the Stake Points screen, the stakeout directions will continue to be issued using the backup position if the active position is lost. If the 'Follow Me' option is enabled, the robotic total station will continue to follow the prism as it moves toward the field point. If the 'Smart Lock' option is enabled, the software will detect when the prism is within close proximity to the target point and automatically lock. This ensures final directions to the point are from the active instruments (in most cases where precise stakeout is needed, this will be the robotic total station).



Shown in the image above, the robotic total station is the active instrument, but it is in a locked state (the E.D.M. is not firing). Since no position is available from the active instrument, and backup tracking is enabled, SurvCE is displaying the backup stakeout directions from the GPS position in red.

- **Follow Me:** When the 'Follow Me' option is enabled, the robotic total station will automatically 'follow' the GPS receiver as it moves, turning every few seconds to the location of the GPS so that it is always ready to take a measurement at any time. The 'Follow Me' option causes a turn to the prism, but not a lock. This is sometimes called 'GPS Tracking', as the robotic total station is following the prism not by optical tracking, but by using the location of the GPS. Pressing the standby button in the top bar will put the instrument in manual standby mode and temporarily disable the 'Follow Me' option. 'Follow Me' will resume when a position is stored or lock is reacquired.



- **Backup Storing:** When the ‘Backup Storing’ option is enabled, the backup position will be stored when the primary (and active) instrument’s position is unavailable. For more manual control, leave this option disabled, and simply tap the quick-switch icon in the top bar to switch to the active instrument and store the position.
- **Smart Lock:** When the ‘Smart Lock’ option is enabled, the software will monitor the motion of the GPS. When the movement of the GPS slows (i.e. the surveyor is slowing to take a measurement), the robotic total station will rotate to the prism and optically lock on to the prism. ‘Smart Lock’ can operate by itself, or in conjunction with ‘Follow Me’. If the software detects further movements of the GPS while attempting to lock, the Smart Lock routine will cancel automatically in the background. Pressing the standby button in the top bar will put the instrument in manual standby mode and temporarily disable Smart Lock. Smart Lock will resume when a position is stored or lock is reacquired.
- **IMU:** Hybrid+ can take full advantage of tilt sensors on the GPS receiver by applying them to both the robotic total station and the GPS.
- When IMU is enabled during Hybrid+:
 - The tilt sensors of the GPS receiver can be used to adjust the measurements of the robotic total station prism. This is true even when the GPS receiver is *not* Fixed RTK.
 - The digital level bubble can display in active survey screens even when the robotic total station is the active instrument.
 - SurvCE can warn the user when the robotic total station measurements are outside of level tolerance.

4 Exiting Hybrid+

Hybrid+ mode will end automatically when SurvCE is exited, or a new job is started. Alternatively, a return to normal survey mode can be made by selecting any other survey mode using the quick switch icon in the main menu.