SPS986

DRAFT

GNSS SMART ANTENNA

GETTING STARTED GUIDE

Version 5.32
Revision A
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Corporate Office

Trimble Inc.
935 Stewart Drive
Sunnyvale, CA 94085
USA

www.trimble.com

Civil, Construction, & Engineering

Trimble Inc.
10368 Westmoor Drive
Westminster, CO 80021
USA

+1-800-361-1249 Phone (US Toll Free)
+1-937-245-5154 Phone
+1-937-233-9441 Fax

www.trimble.com

Email: trimble_support@trimble.com

Legal Notices

NTP Software Copyright

Release Notice

This is the December 2017 release (Revision A) of the SPS986 GNSS Smart Antenna Getting Started Guide documentation. It applies to version 5.32 of the receiver firmware.

Product Limited Warranty Information

For applicable product Limited Warranty information, please refer to the Limited Warranty Card included with this Trimble product, or consult your local Trimble authorized dealer.

COCOM limits

The U.S. Department of Commerce requires that all exportable GPS products contain performance limitations so that they cannot be used in a manner that could threaten the security of the United States. The following limitations are implemented on this product:
– Immediate access to satellite measurements and navigation results is disabled when the receiver velocity is computed to be greater than 1,000 knots, or its altitude is computed to be above 18,000 meters. The receiver GPS subsystem resets until the COCOM situation clears. As a result, all logging and stream configurations stop until the GPS subsystem is cleared.

Notices

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

Changes and modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commission rules.

This equipment must be installed and operated in accordance with provided instructions and the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 25 cm (for 900 MHz and Bluetooth) or 45 cm (for 2.0 W UHF 450 MHZ radio) from all persons and must not be co-located or operated in conjunction with any other antenna or transmitters (except in accordance with the FCC multi -transmitter product procedures).

The Federal Communications Commission (FCC, USA) has dictated that on 1 January 2013, all radio users transmitting data between 421 and 512 MHz within the United States of America, must operate within 12.5 kHz channels or transmit using the bits per second (bps) settings of 19200 bps when using a 25 kHz channel. For more information on the FCC mandate, please view http://trl.trimble.com/docushare/dsweb/Get/Document-

618141/Survey_CustomerFAQs_FCencryption or search the Internet.

Canada

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

This apparatus complies with Canadian RSS-GEN, RSS-310, RSS-210, and RSS-119.

Cet appareil est conforme à la norme CNR-GEN, CNR-310, CNR-210, et CNR-119 du Canada.

Europe

CE The products covered by this guide may be operated in all EU member countries (BE, BG, CZ, DK, DE, EE, IE, EL, ES, FR, HR, IT, CY, LV, LT, LU, HU, MT, NL, AT, PL, PT, RO, SI, SK, FI, SE, UK), Norway and Switzerland. Products been tested and found to comply with the requirements for a Class B device pursuant to European Council Directive 2014/30/EU on EMC, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA). Contains a Bluetooth radio module. These requirements are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential or commercial environment. 450 MHz transceiver is now harmonized under the RED 2014/53/EU Directive. The 2.4G Hz transceiver is not supported except BT/WiFi @2.4GHz. And it is also harmonized under the RED 2014/53/EU.

CE Declaration of Conformity

Hereby, Trimble Inc., declares that the GPS receivers are in compliance with the essential requirements and other relevant provisions of Radio Equipment Directive 2014/53/EU.

English	Hereby, Trimble Inc., declares that this receiver is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.
Finnish	Trimble Inc.vakuuttaa täten että vastaanotin tyyppinen laite on direktiivin 2014/53/EU oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Dutch	Hierbij verklaart Trimble Inc. dat het toestel ontvanger in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 2014/53/EU. Bij deze verklaart Trimble Inc. dat deze ontvanger voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 2014/53/EU.
French	Par la présente Trimble Inc. déclare que l'appareil récepteur est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 2014/53/EU. Par la présente, Trimble Inc. déclare que ce récepteur est conforme aux exigences essentielles et aux autres dispositions de la directive 2014/53/EU qui lui sont applicables
Swedish	Härmed intygar Trimble Inc. att denna mottagare står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 2014/53/EU.
Danish	Undertegnede Trimble Inc. erklærer herved, at følgende udstyr modtager overholder de væsentlige krav og øvrige relevante krav i direktiv 2014/53/EU.
German	Hiermit erklärt Trimble Inc., dass empfänger in Übereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 2014/53/EU befindet". (BMWi) Hiermit erklärt Trimble Inc. die Übereinstimmung des Gerätes empfänger mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 2014/53/EU. (Wien)
Greek	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Trimble Inc ΔΗΛΩΝΕΙ ΟΤΙ δέκτης ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 2014/53/EU.
Italian	Con la presente Trimble Inc. dichiara che questo ricevitore è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 2014/53/EU.
Spanish	Por medio de la presente Trimble Inc. declara que el receptor cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 2014/53/EU.
Portuguese	Trimble Inc. declara que este receptor está conforme com os requisitos essenciais e outras disposições da Directiva 2014/53/EU.

Australia and New Zealand

 This product conforms with the regulatory requirements of the Australian Communications and Media Authority (ACMA) EMC framework, thus satisfying the requirements for RCM Marking and sale within Australia and New Zealand.

Taiwan – Battery Recycling Requirements

 The product contains a removable Lithium-ion battery. Taiwanese regulations require that waste batteries are recycled.

廢電池請回收

Restriction of Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)

Trimble products in this guide comply in all material respects with DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 July 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive) and with exemptions for lead in solder pursuant to Paragraph 7 of the Annex to the RoHS Directive applied.

Waste Electrical and Electronic Equipment (WEEE)

 For product recycling instructions and more information, please go to www.trimble.com/Corporate/Environmental_Compliance.aspx.

Recycling in Europe: To recycle Trimble WEEE (Waste Electrical and Electronic Equipment, products that run on electrical power.), Call +31 497 53 24 30, and ask for the "WEEE Associate". Or, mail a request for recycling instructions to:

Trimble Europe BV, c/o Menlo Worldwide Logistics, Meerheide 45, 5521 DZ Eersel, NL

Safety Information

Before you use your Trimble product, make sure that you have read and understood all safety requirements.

⚠ WARNING – This alert warns of a potential hazard which, if not avoided, could result in severe injury or even death.

⚠ CAUTION – This alert warns of a potential hazard or unsafe practice that could result in minor injury or property damage or irretrievable data loss.

NOTE – An absence of specific alerts does not mean that there are no safety risks involved.

Use and care

This product is designed to withstand the rough treatment and tough environment that typically occurs in construction applications. However, the receiver is a high-precision electronic instrument and should be treated with reasonable care.

⚠ CAUTION – Operating or storing the receiver outside the specified temperature range can damage it.

Regulations and safety

Some receiver models with base station capability contain an internal radio-modem for transmission or can transmit through an external data communications radio. Regulations regarding the use of the 410 MHz to 470 MHz radio-modems vary greatly from country to country. In some countries, the unit can be used without obtaining an end-user license. Other countries require end-user licensing. For licensing information, consult your local Trimble dealer.

NOTE – The SPS986 uses the 403 MHz to 473 MHz frequency range.

All Trimble receiver models described in this documentation are capable of transmitting data through Bluetooth wireless technology.

Bluetooth wireless technology, and 900 MHz radio-modems and 2.4 GHz radio-modems operate in license-free bands.

NOTE – 900 MHz radios are not used in Europe. The frequency range of 900 MHz is not marketed in Brazil.

Before operating a Trimble receiver or GSM modem, determine if authorization or a license to operate the unit is required in your country. It is the responsibility of the end user to obtain an operator's permit or license for the receiver for the location or country of use.

For FCC regulations, see Notices.

Type approval

Type approval, or acceptance, covers technical parameters of the equipment related to emissions that can cause interference. Type approval is granted to the manufacturer of the transmission equipment, independent from the operation or licensing of the units. Some countries have unique technical requirements for operation in particular radio-modem frequency bands. To comply with those requirements, Trimble may have modified your equipment to be granted type approval.

Unauthorized modification of the units voids the type approval, the warranty, and the operational license of the equipment.

Exposure to radio frequency radiation

SPS986 (with internal 450 MHz radio operating in base station transmit mode). Note the safe distance is 32 cm (1 foot) for RF Exposure.

For 450 MHz radio

Safety. Exposure to RF energy is an important safety consideration. The FCC has adopted a safety standard for human exposure to radio frequency electromagnetic energy emitted by FCC regulated equipment as a result of its actions in General Docket 79-144 on March 13, 1986.

Proper use of this radio modem results in exposure below government limits. The following precautions are recommended:

- ***DO NOT*** operate the transmitter when someone is within 25 cm (9.8 inches) of the antenna.
- ***DO NOT*** co-locate (place within 45 cm (17.7 inches)) the radio antenna with any other transmitting antenna.
- ***DO NOT*** operate the transmitter unless all RF connectors are secure and any open connectors are properly terminated.
- ***DO NOT*** operate the equipment near electrical blasting caps or in an explosive atmosphere.

- All equipment must be properly grounded according to Trimble installation instructions for safe operation.
- All equipment should be serviced only by a qualified technician.

For license-free 900 MHz radio

⚠ CAUTION – For your own safety, and in terms of the RF exposure requirements of the FCC, always observe these precautions:

- Always maintain a minimum separation distance of 25 cm (9.8 inches) between yourself and the radiating antenna.
- Do not co-locate the antenna with any other transmitting device.

NOTE – 900 MHz radios are not used in Europe.

For Bluetooth radio

The radiated output power of the internal Bluetooth wireless radio and the Wi-Fi radio included in some Trimble receivers is far below the FCC radio frequency exposure limits. Nevertheless, the wireless radio(s) shall be used in such a manner that the Trimble receiver is 25 cm or further from the human body. The internal wireless radio(s) operate within guidelines found in radio frequency safety standards and recommendations, which reflect the consensus of the scientific community. Trimble therefore believes that the internal wireless radio(s) are safe for use by consumers. The level of energy emitted is far less than the electromagnetic energy emitted by wireless devices such as mobile phones. However, the use of wireless radios may be restricted in some situations or environments, such as on aircraft. If you are unsure of restrictions, you are encouraged to ask for authorization before turning on the wireless radio.

Installing antennas

⚠ CAUTION – For your own safety, and in terms of the RF exposure requirements of the FCC, always observe these precautions:

- Always maintain a minimum separation distance of 25 cm (9.8 inches) between yourself and the radiating antenna.
- Do not co-locate the antenna with any other transmitting device.

⚠ WARNING – The GNSS antenna and its cabling should be installed in accordance with all national and local electrical codes, regulations, and practices. The antenna and cabling should be installed where they will not become energized as a result of falling nearby power lines, nor be mounted where they are subjected to over-voltage transients, particularly lightning. Such installations require additional protective means that are detailed in national and local electrical codes.

Trimble receiver internal radios have been designed to operate with the antennas listed below. Antennas not included in this list are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be an approved Trimble antenna, so that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

Contents

Introduction

The SPS986 GNSS smart antenna can be used for the following infrastructure and site development applications:

- Layout of structure foundations, caissons, and piles
- Earthworks, fine grading and finishing stakeout operations
- Initial site measurements to verify design levels and regular subsequent measurements to determine progress volumes
- Vehicular-mounted site supervisor applications
- Measurements and grade/thickness checks on laid materials

The GNSS smart antenna incorporates a GNSS antenna, receiver, internal radio, attitude sensors, and battery in a rugged light-weight unit that is ideally suited as an all-on-the-pole RTK rover or quick setup/rapid mobilization base station. LEDs enable you to monitor satellite tracking, radio reception, data logging status, Wi-Fi, and power. Bluetooth wireless technology provides cable-free communications between the receiver and controller.

You can use the SPS986 smart antenna as part of an RTK GNSS system with the Trimble SCS900 Site Controller software. The receiver can optionally record GPS data to the receiver's optional internal memory and download to a computer using the serial connection.

The GNSS smart antenna has no front panel controls for changing settings. To configure these receivers:

- In real time, use external software such as the SPS web interface, HYDROpro™ construction software, or the WinFlash utility.
- Use an application file. To edit an application file, use the Configuration Toolbox utility.

SPS986 features

The SPS986 GNSS smart antenna has the following features:

- Small, lightweight design – 1.55 kg (3.42 lb) (integrated radio, GNSS receiver, GPS antenna and battery); 3.9 kg (8.6 lb) complete system weight (rover including controller and rod)
- The quick setup, high mobility base or rover receiver, is ideal for any size jobsite as a rover and for working on multiple jobsites on a daily or weekly basis
- Fully-upgradeable receiver. Can be used as a rover, base station, or as both a rover and a base station. Can be upgraded from a rover to a base station. Can be ordered in Location RTK or Precision RTK modes. Heading and Moving Base modes are optional upgrades.
- Attitude sensors for eBubble
- Trimble xFill™ RTK service is already installed.
- 672-channel GPS, QZSS, GLONASS, Galileo, BeiDou
- Internal, removable, smart Lithium-ion battery provides up to 5.5 hrs GNSS rover operation per battery
- Bluetooth wireless technology for cable free, no hassle, base or rover operation
- Simple keypad with on/off key and LED indicators for power, radio, and satellite tracking, Wi-Fi
- 20 Hz update rate
- AutoBase technology for rapid and automated repeated daily base station setups
- Operates within a VRS network or IBSS for conventional base station-free rover capability
- Integrated receive/transmit radio, and Wi-Fi
- Optionally, can be upgraded to use GLONASS, Galileo, BeiDou, and triple frequency
- Optionally, subscribe to MSS (CenterPoint RTX or OmniSTAR services)
- The standard SPS986 receives the GPS L2C and QZSS signals

- 4 SBAS channels
- RoHS compliant

Related information

Sources of related information include the following:

- Release notes – The release notes describe new features of the product, information not included in the manuals, and any changes to the manuals. They can be downloaded from the Trimble website at www.trimble.com/Support/Support_AZ.aspx.
- Trimble training courses – Consider a training course to help you use your GNSS system to its fullest potential. For more information, go to the Trimble website at www.trimble.com/Support/Index_Training.aspx.

Technical support

If you have a problem and cannot find the information you need in the product documentation, contact your local dealer. Alternatively, go to the Support area of the Trimble website (www.trimble.com/Support.shtml). Select the product you need information on. Product updates, documentation, and any support issues are available for download.

Parts of the Smart GNSS Antenna

All operating controls are located on the front panel. Ports and connectors are located on the bottom of the unit.

Front panel

The front panel contains the Power button and four indicator LEDs.

- The Power button controls the receiver's power on or off functions.
- The indicator LEDs show the status of power, satellite tracking, Wi-Fi, and radio reception.

Icon	Connections
	Power button
	Satellites
	Radio
	Battery status
	Wi-Fi

The LEDs on the front panel indicate various operating conditions. Generally, a lit or slowly flashing LED indicates normal operation, an LED that is flashing quickly indicates a condition that may require attention, and an unlit LED indicates that no operation is occurring. For more information, see Button and LED operations, page 18.

Lower housing

The following figure shows the lower housing of the SPS986 GNSS smart antenna. The housing contains one USB port, one TNC radio antenna connector, the removable battery compartment, and the 5/8-11 threaded insert.

Each item is marked with a number to indicate its main function, as shown in the following table:

Icon	Name	Connections/Description
1	Label	The icon on the label shows if the antenna contains an internal radio or if it is a Wi-Fi only smart antenna
2	TNC radio antenna connection	Communications antenna
3	Label	Shows the serial number of the smart antenna
4	Battery door	Removable Lithium-ion battery
5	5/8" insert	Range pole or quick release adapter
6	Lemo port	USB and DC power in

Lemo port is a 7-pin 0-shell 2-key Lemo connector that supports USB communications and external power input. The Lemo port has no power outputs.

The TNC port connector is for connecting a radio antenna to the receiver internal radio. A whip “rubber duck” antenna is supplied with the system. This connector is not used if you are using an external radio receiver. For longer range operation (to provide higher gain and to raise the antenna higher above the ground), you can use a cable to connect an external radio antenna to the TNC port. For more information, refer to the topic "Connecting the receiver to external devices" in the Web Help.

Button and LED operations

The LEDs on the front panel indicate various operating conditions. Generally, a lit or slowly flashing LED indicates normal operation, a LED that is flashing quickly indicates a condition that may require attention, and an unlit LED indicates that no operation is occurring. The following table defines each possible LED state:

The term...	means that the LED...
Very slow flash	is off and on equally with a 1.5 second cycle.
Slow flash	alternates on/off every ½ second.
Radio slow flash	is ***off longer than it is on*** when the smart antenna is ***receiving corrections***. The smart antenna repeats this cycle typically once per second. is ***on more than off*** when the smart antenna is ***transmitting corrections***. The smart antenna repeats this cycle typically once per second.
Medium flash	is off and on equally more than once per second.
Fast flash	alternates rapidly on/off every 1/10 of a second.
On	is lit steady.
Off	is unlit.

Power button

Action	Power button	Description
Turn on the smart antenna	Press (see the note below)	All four LEDs light up and remain lit for 3 seconds. Then all LEDs go off and then the power LED immediately comes back on.
Turn off the smart antenna	Hold for 2 seconds and then release	When holding down the Power button; the battery LED remains on. The Wi-Fi LED remains in its state and then turns off after 2 seconds. The Satellite LED turns constant and then turns off after 2 seconds.

Action	Power button	Description
		After releasing the power button, the battery LED stays lit for about 5 seconds and then all LEDs go blank.
Clear the ephemeris file and reset the smart antenna to the factory defaults	Hold for 15 seconds	The Radio, Wi-Fi, and Satellite LEDs turn off after 2 seconds. The battery LED remains on. After 15 seconds, the Satellite LED comes on to indicate that it is time to release the Power button. Upon restart, the Wi-Fi will also turn on in Access Point mode.
Delete application files	Hold for 30 seconds	The Radio, Wi-Fi, and Satellite LEDs turn off after 2 seconds. After 15 seconds, the Satellite LED comes on and stays on for 15 seconds, then turns off to indicate that it is time to release the Power button. The battery LED then remains on for 15 seconds after releasing the Power button. The smart antenna then restarts.

NOTE – The term "press" means to press the button and release it immediately. The term "hold" means to press the button and hold it down for the given time.

Satellite LED

Receiver mode	Satellite LED Amber
No satellites tracked	Off
Boot up or when in Monitor mode	On
Tracking fewer than 4 SVs	Fast flash
Tracking 4 or more SVs	Slow flash

Radio LED

Radio mode	Radio LED Amber	Description
No receive or transmit	Off	
Receive	Radio slow flash	See the table at the top of this topic. This LED also flashes when using the Wi-Fi only for receiving corrections.
Transmit	Radio slow flash	See the table at the top of this topic. This LED also flashes when using the Wi-Fi only for transmitting corrections

Wi-Fi LED

Receiver mode	Wi-Fi LED Amber
Wi-Fi off	Off
Wi-Fi is access point (base mode/sending corrections)	Medium flash
Wi-Fi is client (and not connected to an access point)	Off
Wi-Fi as client (rover mode receiving corrections)	Very slow flash

Battery LED

Receiver mode	Power LED Green	Description
Off	Off	
On. Healthy power	On	Either internal battery or external power
Low power	Fast flash	(<about 15% power)
Logging data internally	Flashes off every three seconds	

Lemo port

When you load firmware using the WinFlash utility, the LEDs show as:

Button/LED	Appears
	On
	Off
	See the section Button and LED operations, page 18.
	Off

Configuring your SPS986 GNSS Smart Antenna

Before you can use your SPS GNSS receiver, it must be loaded with its configuration that your Trimble dealer has set up:

- Activation (to start one year warranty)
- Operating modes (for example, Base or Rover)
- Options (for example, GLONASS)
- Optional extended warranties
- Optional 450 MHZ radio transmit frequencies and Country Code

The Trimble dealer will usually do this entire task. If you need to do it yourself, you will still need your dealer to assign all the purchased items to the given SPS986 serial number.

To then load the configuration or updates to the receiver, you need to run Trimble Installation Manager on your computer.

Online method

The most common method to configure the SPS986 receiver is to use the online method:

1. Download the online version on the Trimble Installation Manager from www.trimble.com/installationmanager/.

   This program requires the use a virtual serial (COM) port.

   a. Download the USB driver to allow the USB interface to operate as a virtual COM port.

   b. Go to http://www.trimble.com/support/support_az.aspx (search under SPS986 Downloads).

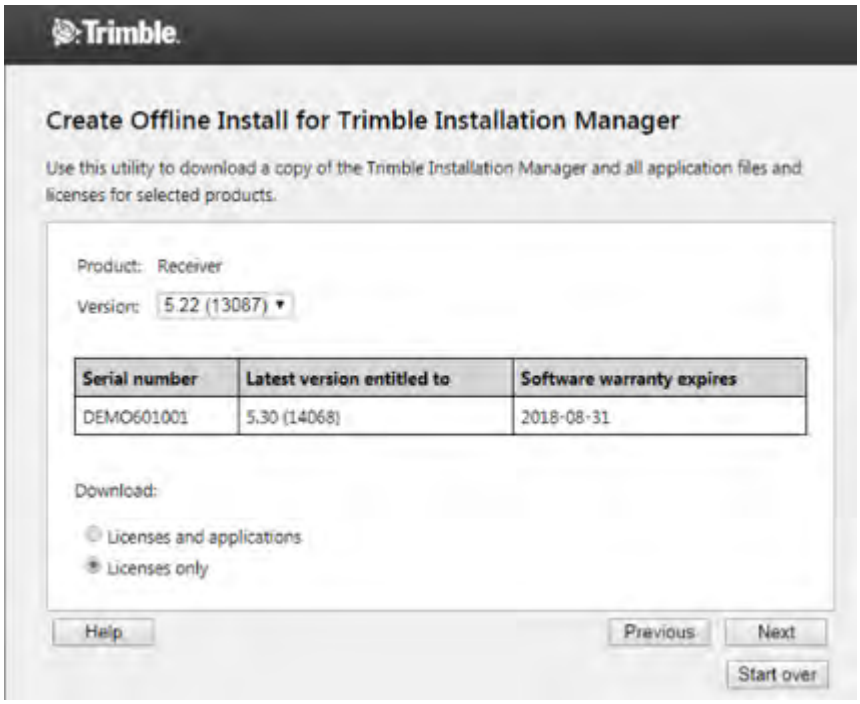
   c. Connect the SPS986 to the computer using the supplied LEMO to USB cable.
2. Turn on the SPS986.
3. Run the Trimble Installation Manager. This application is used to check the receiver to load the latest firmware if the receiver is under Warranty and it also allows receiver configurations to be loaded into the SPS986.

Offline methods

Another method to load a configuration into the the SPS986 is the offline method. There are two ways to do this.

Offline method 1

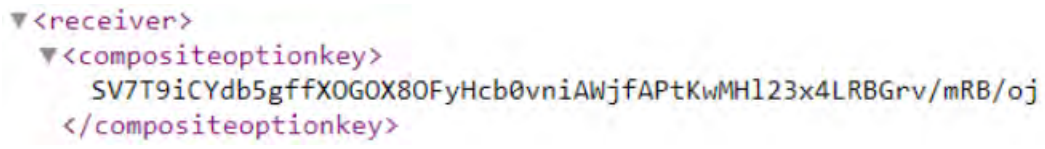
1. Download the Offline version from www.trimble.com/installationmanager/.
2. Run the Offline version.
3. Enter the serial number of the SPS986.
4. Select **Licences Only** if you just require the SPS986 configuration/options updates:



5. Copy the resultant file (package) to your computer. This program requires the use a virtual serial (COM) port.
6. Download the USB driver from http://www.trimble.com/support/support_az.aspx (search under SPS986 Downloads).
7. Connect the SPS986 to the computer using the supplied LEMO to USB cable.
8. Turn on the SPS986.
9. Run the file Trimble Installation Manager Offline.exe.

Offline method 2

1. Unzip the package that was generated from the Installation Manager Offline program.
2. For a specific SPS986 serial number there is a file called Licence.xml. Open that file using an XML editor and copy the compositeoptionkey as shown in black text in this example:



3. Insert that option key into the web interface of the SPS986 under **Receiver Options.**
4. Click **Next**.
5. Restart SPS986.

Using the WinFlash utility

This utility can still be used with the SPS986. It is possible to load a 450MHz SET file from your Trimble dealer after any of the above methods have been used restart the receiver.

Hold the Power button down for 15 seconds or use the web interface and select **Receiver Configuration** / **Reset**. Select **Clear all receiver settings**.

Wi-Fi settings

The SPS986 smart antenna contains Wi-Fi. Please take the time to understand its powerful capabilities.

Before you use a smart antenna, ensure that the dealer has activated it. The smart antenna shipped from Trimble has Wi-Fi enabled. Your Trimble dealer must load the activation code before these services are available.

The smart antenna can be used as a Wi-Fi Access Point or a Wi-Fi Client.

Access Point mode

You use this mode when the smart antenna is set up as a base station. Access Point mode enables other Wi-Fi devices to communicate with the smart antenna without needing another Wi-Fi device. Up to five devices can simultaneously connect to the smart antenna. Devices connected to the smart antenna in Access Point mode can communicate with each other, not just the smart antenna. After you have connected to the smart antenna, you can use the web interface to review and change the settings of the smart antenna. This mode is useful if you are in the field, but do not have a Trimble Tablet or SCS900 software.

In this mode, you can scan for the smart antenna from a laptop, Smartphone, or other Wi-Fi enabled device, to locate the smart antenna Access Point:

1. Turn on the smart antenna in Access point mode. The Wi-Fi LED will flash.

   By default, the smart antenna is in Access point mode. If you are not sure if it is in Access point mode, you can reset it to the factory defaults by pressing the Power button for 15 seconds.

2. From a Wi-Fi enabled device such as a laptop, connect to the smart antenna.

   On a computer running the Windows operating system, click the Network icon in the status bar  . The smart antenna will be called something like "Trimble GNSS 2201". Select it and then click **Connect**.

   For information on how to change the wireless identification of the smart antenna, see SSID Identification (SPS986 only), page 1.

3. Enter the encryption key. By default, it is **abcdeabcde**.

4. Open a web browser on your Wi-Fi enabled device and then type **GNSS** into the address bar.

   The smart antenna web interface appears. With some devices, you may need to enter either **http://GNSS** or **192.168.142.1** to access the web interface.

   On Android PDAs, Trimble recommends that you install the free Opera Mobile browser for this feature to work.

5. Log in to the web interface. Select **Security** / **Login**. The default username is **admin**. The default password is **password**.

Client mode

You use this mode when the smart antenna is set up as a rover. In this mode, the smart antenna is connected to an Access Point. You can view the web interface of the smart antenna when your device is connected to the rover by Wi-Fi as the SPS986 is a concurrent client and Access Point. An Access Point on a site could be another SPS986 smart antenna or a Cisco router.

NOTE – The smart antenna with internal radio has an internal Wi-Fi antenna. It is in the white radome on the side of the smart antenna, however the antenna gain is equal in all directions so the base station radome does not need to point to the work area, and the rover radome does not need to point to the base station. In the smart antenna with no internal radio, then the Wi-Fi antenna is routed to the TNC connector, so when using Wi-Fi in this receiver, it is essential to use the supplied black whip antenna.

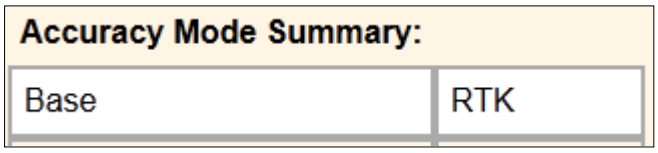
Using the smart antenna Wi-Fi with the SCS900 software

To set up the SPS986 Wi-Fi to both transmit GNSS corrections (in the case of a base station) and set up a smart antenna internal Wi-Fi to receive GNSS corrections (in the case of a rover), you will need the latest version of the Trimble SCS900 Site Controller software. When using the SCS900 software, the SPS986 base station is automatically configured as an Access Point and the SPS986 rover is configured as a Client.

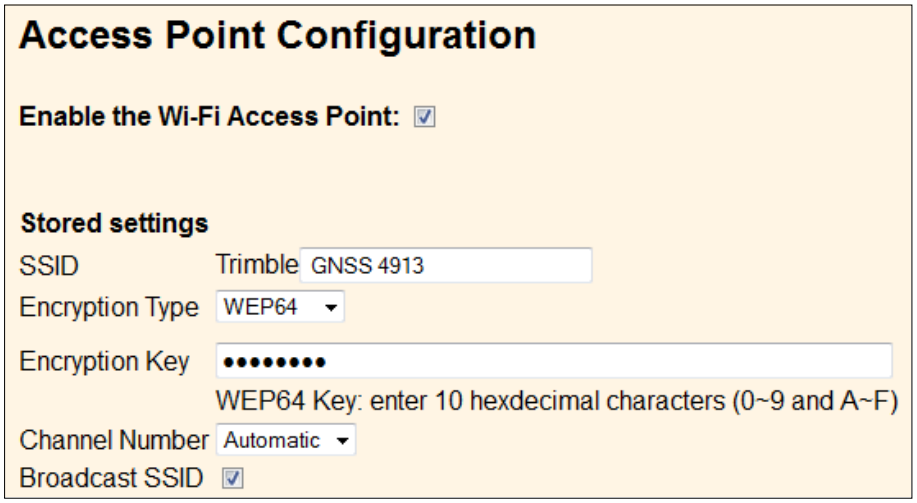
The use of Wi-Fi in the smart antenna is license free. The line-of-sight range can be greater than 300 m although it is restricted if trees, machines, or buildings are between the base station and the rover receiver.

Setting up an SPS986 as a Wi-Fi base station without the SCS900 software

1. Ensure the smart antenna has the Accuracy mode set to Base (Precise Base mode) (select Receiver Status / Receiver Options):

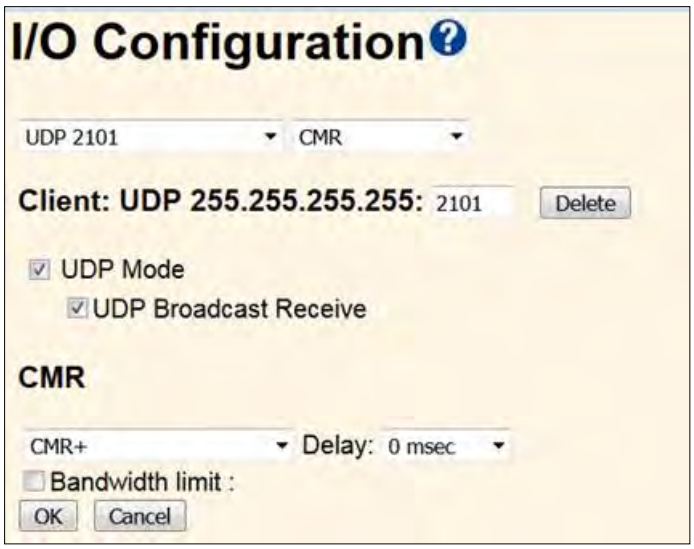


2. Set the smart antenna as the Access Point. To do this, select Wi-Fi / Access point with the following configuration:



3. Select I/O Configuration / Port Configuration.
4. Create a UDP stream out the GNSS corrections:
    1. Select Type UDP from the drop-down menu and add a Port number such as 2101.
    2. Select CMR in the window beside the Type.

3. Tick Client, Output only, UDP mode, UDP Broadcast Transmit.
4. Select CMR+ or CMRx for the corrections.



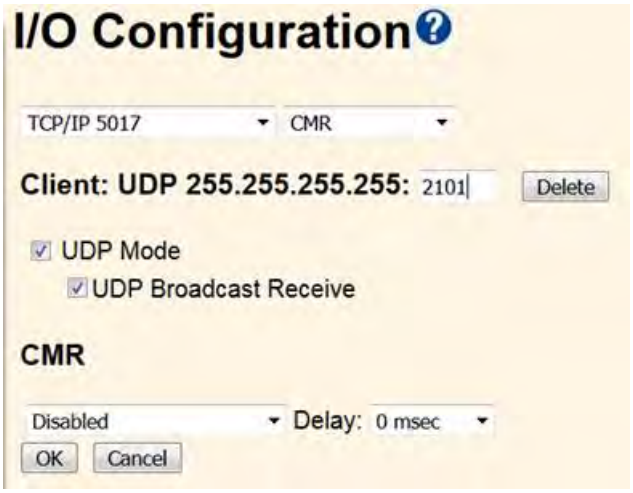
5. Click **OK**. The following port information is displayed in the **I/O Configuration** page:

6. This UDP setup enables the Wi-Fi rover to receive corrections broadcast from the Wi-Fi base without the base having to specify the base IP address in each rover.
7. Turn off the smart antenna and then turn it on again.

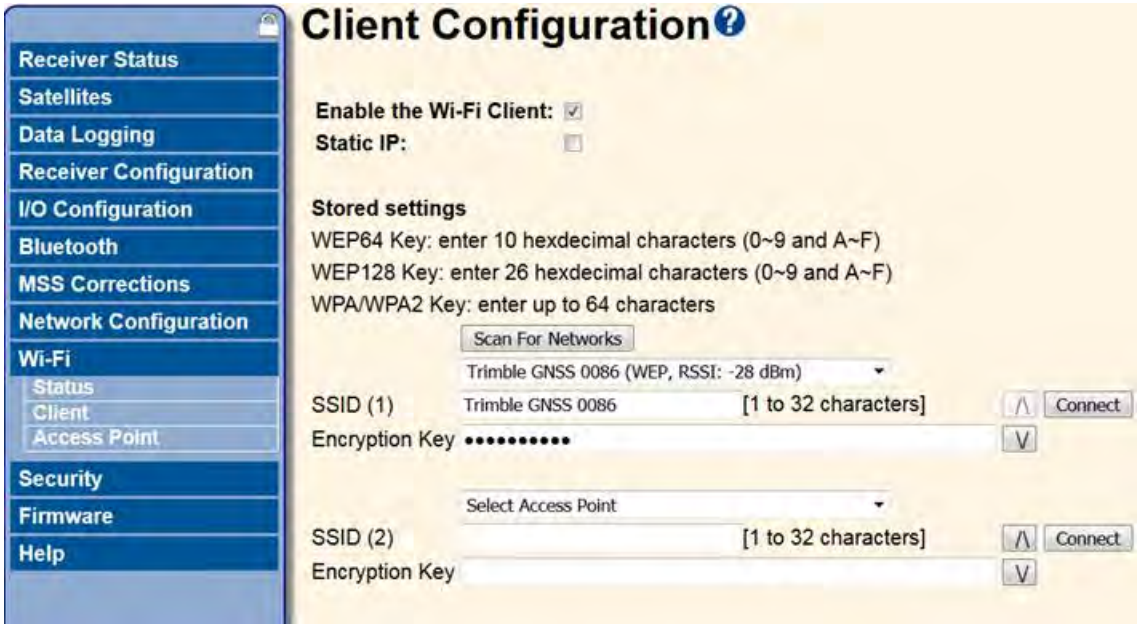
Setting up an SPS986 as a Wi-Fi rover receiver without the SCS900 software

1. Turn on the SPS986 receiver. Connect your Wi-Fi capable device to the SPS986 (password is **abcdeabcde**).
2. To access the web interface, enter the default IP address **192.168.142.1**.
3. You must have a Rover mode selected.
4. Set the SPS986 receiver to accept corrections from the base station:
   a. Go to the **I/O Configuration** page and create a UDP port with the same number as created previously on the base station.
   b. Select the **UDP Mode** check box.
   c. Select the **UDP mode** / **UDP Broadcast Receive** check box.

d. In the **Client** field, enter port **2101** for this example.



5. Set the smart antenna to Client mode. Select **Wi-Fi / Client**. The **Client Configuration** page appears.
6. Select the **Enable the Wi-Fi Client** check box.
7. Click **Scan for Networks** and select the Base station and enter the Access Point password and click **Connect**.

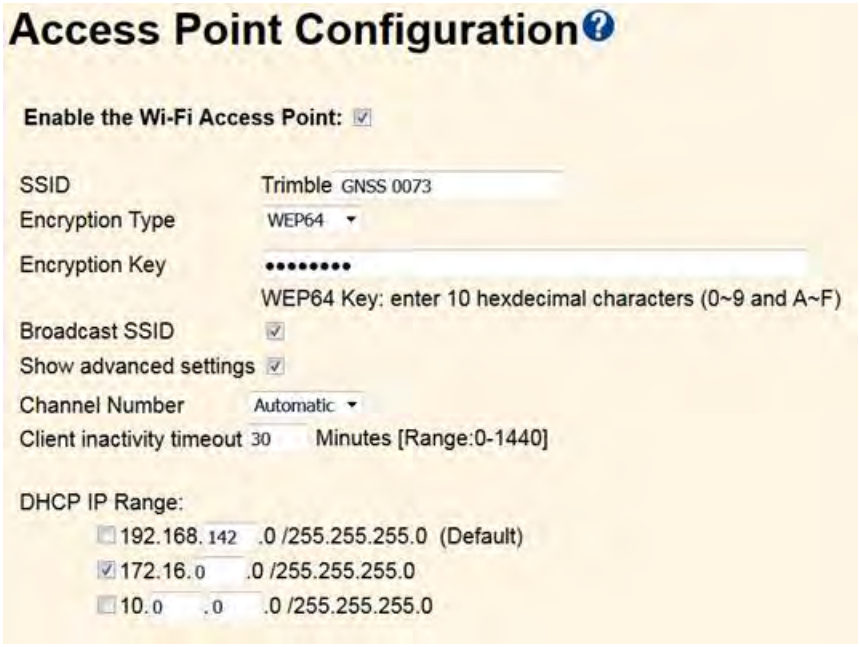


The receiver should now be capable of receiving corrections.

8. This step is essential to stop IP conflict.
   a. Change the default IP address for this receiver's access point from 192.168.142.1 to 172.16.0.1.

b. Select the **Access Point Configuration** page and select the **Show advanced settings** check box.

c. Select the **DHCP IP Range 172.16.0.0** check box.



d. Click **Save**.

9. Save the configuration. Select **Receiver Configuration** / **Application File**. Select the **Store Current File** option.
10. Turn off the smart antenna and then turn it on again.
11. To access the web interface of the SPS986 receiver, connect your Wi-Fi capable device to the SPS986 and in a web browser, enter the IP address 172.16.0.1.

Configuring a PC USB port as a virtual serial port

For example, the Trimble WinFlash utility can be run on a computer that has no physical serial port by connecting the USB cable between the computer and the receiver.

For example, the Trimble Installation Manager can be run on a computer that has no physical serial port by connecting the USB cable between the computer and the receiver.

NOTE – This step is not necessary for Windows 10, or if you have previously installed the Trimble USB driver.

Another example would allow the receiver to stream NMEA messages over a USB interface into a computer's virtual serial port, allowing applications such as HYDROpro™

construction software to use the NMEA messages on a computer that has no physical serial ports.

The SPS modular receivers have a number of USB cables to use. The SPS986 smart antenna has USB cable (P/N 80751-HH) that can be connected to the receiver. The other end of the USB cable then connects to a computer.

The receiver must be running firmware version 4.15 or later.

Windows 8 operating system

1. The simplest way to install the Virtual Serial port for the USB interface to the SPS receivers is to go to the Trimble Support website (www.trimble.com/support) and search for the SPS GNSS receiver you have. In the Downloads section, download the file called *Windows USB Installer* to your computer or USB drive.

   *NOTE – There is no **Windows8 USB Installer** file; the **Windows7 USB Installer** file works for Windows 8.*

   This file contains a Support Note and installation program.

2. Run the installation program. It will load the virtual serial port for the USB interface on your computer.

   NOTE – With Windows 8, the USB ports are often version 3.0. With Windows 8 there is a conflict with the implementation of USB version 3.0. To workaround this, go to the computer's BIOS settings when you start up the computer and then turn off the support for USB 3.0.

   NOTE – If you have installed the Trimble WinFlash utility (www.trimble.com/support) on your computer, then another way to install the virtual serial port for the USB interface is to run the USB Installer program, which is located in C:\Program Files\Common Files\Trimble\USBDriver.

Windows 7 Professional operating system

1. The simplest way to install the Virtual Serial port for the USB interface to the SPS receivers is to go to the Trimble Support website (www.trimble.com/support) and search for the SPS GNSS receiver you have. In the Downloads section, download the file called *Windows7 USB Installer* to your computer or USB drive.

   This file contains a Support Note and installation program.

2. Run the installation program. It will load the virtual serial port for the USB interface on your computer.

   NOTE – If you have installed the Trimble WinFlash utility on your computer, then another way to install the virtual serial port for the USB interface is to run the USB Installer program, which is located in C:\Program Files\Common Files\Trimble\USBDriver.

If this process does not work for your computer, or if you have a different Windows operating system on your computer, then follow the procedure below.

Windows 7 operating system

1. Go to the Trimble Support website (www.trimble.com/support) and search for the receiver you have. In the Support Notes section, download the file called *GNSS Interface to a Virtual COM port on a Computer* to your computeror USB drive.
2. Open the file and place the trmbUsb.inf file in a temporary folder on your computer or USB drive.
3. On the computer, select Control Panel / Device Manager.
4. Click on the name of the computer and then from the Action menu, select Add Legacy Driver.
5. A wizard prompts you to locate the TrimbleUsb.inf file. Locate the file and then follow the prompts in the wizard to continue.

NOTE – If you are running an application such as HYDROpro or WinFlash software orTrimble Installation Manager on the computer and you physically disconnect the USB cable from the computer and then reconnect it, it does not always re-establish the connection. This is because opening the serial port from the application locks the device handle and when the USB device is disconnected, the application does not close the serial port and the device handle is still locked. On reconnecting, the USB cable is unable to get the device handle since it is locked. You must close the application before the reconnect to the port will work. This limitation is due to the behavior of the Microsoft USB serial driver.

Dual slot battery charger

Overview

The charger can charge three types of Lithium-ion batteries. It can be powered by mains or car battery. The charger can be used either in the office or car.

The dual slot battery charger consists of:

- Charger Dual Slot, P/N 109000
- Power Supply for Charger Dual Slot, P/N 107000
- Power Cord AC for Power Supply
- Cable Car to Charger Dual Slot, P/N 108090

Chargeable batteries

- Two sizes of Lithium-ion rechargeable smart batteries (P/N 99511-30, P/N 76767). Note: the small smart battery requires a plastic adapter insert to fit into the charger.
- Lithium-ion rechargeable smart battery.

P/N 99511-30

P/N 76767

- Lithium-ion rechargeable battery (P/N 92670)

P/N 92670

Placement of batteries in charger

Charger slots

The charger has two slots. Each slot can charge one of the three supported battery types. Batteries are charged concurrently for P/N 92670 and P/N 76767 battery types and sequentially for the P/N 99511-30 battery type. Beside each slot are three LED indicators (red, yellow, and green) to indicate the battery and charging / conditioning status.

Power supply

The charger can be powered by mains (using the Power Supply for Charger Dual Slot) or by 12V car voltage (using Cable Car to Charger Dual Slot).

Mains power

Mains power supply is an external adapter, useable worldwide. Different cords for different countries are supplied with the power supply adapter (Power Cord AC for Power Supply).

Vehicle power

The charger can be powered by the vehicle voltage of nominal 12V. It can withstand voltages of a vehicle voltage of nominal 24V (max. 32V). So if the user connects the vehicle cable by mistake to a 24V socket in a vehicle, the charger doesn't start charging but latches in fault condition and flashes all green LEDs. The power must be removed to reset the fault condition.

Charger technical data

DC Power Input Voltage limits	10V to 32V
Absolute maximum input voltage	32V
Over voltage	21V to 32V
Working voltage	10V to 21V
Under voltage	<10V
Charging (19V in, 25°C, 10% to 90% charge)	
• 92670 Battery	<3 Hr
• 76767 Battery	<3 Hr
• 99511-30 Battery	<4 Hr
Charging (12V in, 25°C, 10% to 90% charge)	
• 92670 Battery	<3 Hr
• 76767 Battery	<3 Hr
• 99511-30 Battery	<6 Hr

Battery life

You should expect the battery to take 300 charges. Some batteries may last up to 500 charges. The battery life will decrease over time as the battery is used more, especially if the batteries are used in hot areas or in high current situations, like a base station.

It will not harm the battery if it is half used before you place it in the charger. You do not need to drain the battery fully. However, charging a half-used battery still counts toward the number of expected battery chargers over the life of the battery.

There is no memory build up with these batteries. Trimble recommends that you store the battery when it is fully charged. Batteries may experience a 5 to 20% discharge per month when they are not being used. If the battery is stored for weeks at a time fully discharged, a significant loss of charging capacity could occur.

Temperature considerations

In general, you will see a decrease in battery runtime if the batteries are used in colder temperatures. Higher temperatures are better for battery operation as long as the temperature does not exceed 40 °C (104 °F). If operating in less than 5 °C (41 °F), there will be significant decrease in battery runtime. If the battery has been stored at less than 5 °C (41 °F), it may not work at all until it is stored at room temperature (20 °C to 25 °C (68 °F to 77 °F). Batteries should not be used if temperatures are below -20 °C (-4 °F) or above 50 °C (122 °F).

Removing the battery from the smart antenna

1. Open the battery slot, which is on the side of the smart antenna.

2. Pull the battery out of the slot.

Operation

Battery charging

⚠ CAUTION – Ensure that nothing obstructs the vents in the back of the charger.

The battery is supplied partially charged. Charge the battery completely before using it for the first time.

- To charge the battery, only use a charger that is recommended by Trimble for charging the Lithium-ion batteries.
- Charge the battery before using the equipment if it has been stored for longer than six months.

The charger operates between 0°C (32°F) and 40°C (104°F). Charging a battery at temperatures in the range of 0°C (32°F) to 5°C (41°F) will take longer than charging at room temperature.

To charge the battery:

1. Ensure that the vents in the back of the charger are unobstructed.
2. Place the charger on a hard, flat and level surface, to ensure that there is sufficient airflow around the charger.
3. To apply power to the charger, use the AC to DC power converter or 12V car battery adapter. The red LEDs light up with no batteries inserted to the battery slots. The charger automatically scans the battery slots for a battery.
4. Place the battery in any of the slots. It can take up to five seconds to detect the battery. For an explanation of the LED display, see LED status indicators, page 39.

Charging takes approximately four hours per total station battery P/N 99511-30 and three hours per GNSS receiver battery P/N 76767 or P/N 92670 at room temperature. If two batteries are placed in the charger, the batteries will be charged at the same time except for two total station batteries P/N 99511-30 which will be charged sequentially.

Leave a deeply discharged or shorted battery overnight in the charger to attempt to revive the battery. A shorted battery is typically revived as soon as the slot is scanned. If the red LED turns off, the battery is revived. If the red LED stays on, the battery is no longer functional and needs to be replaced.

Conditioning the battery (valid only for Smart Battery P/N 99511-30)

⚠ CAUTION – The charger is hot during conditioning.

⚠ CAUTION – Ensure that nothing obstructs the vents in the back of the charger.

With the 99511-30 battery, after a number of incomplete charge/discharge cycles the power gauge in the Smart Battery becomes inaccurate. The battery is still safe to use, but the power gauge may no longer be accurate which may decrease the battery run-time in the field. In this case a conditioning of the battery is required. This is a cycle of:

1. Charge battery completely.
2. Discharge the battery until the voltage is below the low-end conditioning threshold.
3. Charge battery again.

The need for conditioning is read out from the battery by the charger and is indicated by a solid yellow LED. Conditioning starts when the conditioning button is pressed by the user. There is one button for each slot. Only the batteries requiring a conditioning can be conditioned.

To condition the battery:

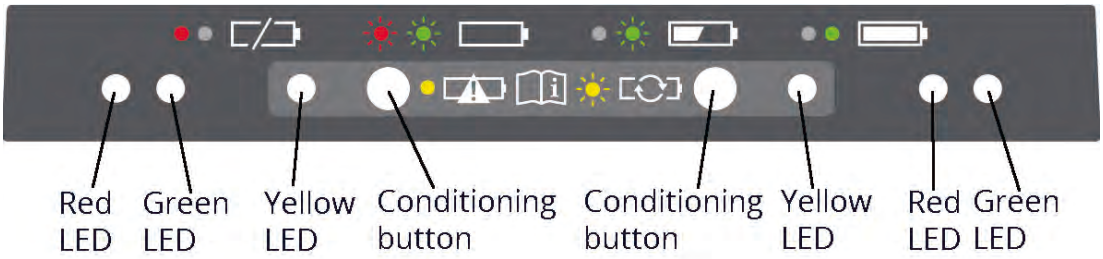
1. Press the conditioning button under the battery. The red LED becomes solid and the yellow LED start to flash. Release the conditioning button.

   Conditioning a single battery can take up to 24 hours. It is recommended that you condition the battery or batteries on a weekend.
2. If you remove the battery while conditioning is in progress, you cancel conditioning. To succeed, a conditioning cycle must be uninterrupted.

NOTE – When conditioning a battery the other slot will stop any current operation and be disabled until conditioning has completed.

LED status indicators

Beside each slot are three LED indicators (red, green, and yellow) to display the battery status. The LED indicators can have the following conditions: Off, On, 1 Hz (one flash per second), and 2 Hz (two flashes per second).



Status	Red LED	Green LED	Yellow LED
No battery detected (means no battery present or battery defect)	ON	OFF	OFF
Battery detected (charging not started yet)			
• Conditioning not required	1 Hz	1 Hz	OFF
• Conditioning required	1 Hz	1 Hz	ON
Charging in progress			
• Conditioning not required	OFF	1 Hz	OFF
• Conditioning required	OFF	1 Hz	ON
• Over/under-temperature (charge is inhibited)	2 Hz	OFF	OFF
Conditioning in progress	ON	OFF	1 Hz
Conditioning done (Charging after 30% battery capacity)	ON	1 Hz	OFF
Conditioning done (Battery fully charged)	ON	ON	OFF
Battery fully charged			
• Conditioning not required	OFF	ON	OFF
• Conditioning required	OFF	ON	ON
Power supply over/under-voltage	OFF	OFF	OFF
When Output Over-Voltage Protection (OOVP) or Output Over Current Protection (OCP) is on	2 Hz	OFF	OFF

Safety notes

Battery safety and environmental information

⚠ CAUTION – Do not damage the rechargeable Lithium-ion battery. A damaged battery can cause an explosion or fire, and can result in personal injury and/or property damage. To prevent injury or damage:

- Do not use or charge the battery if it appears to be damaged. Signs of damage include, but are not limited to, discoloration, warping, and leaking battery fluid.
- Do not expose the battery to fire, high temperature, or direct sunlight.
- Do not immerse the battery in water.
- Do not use or store the battery inside a vehicle during hot weather.
- Do not drop or puncture the battery.
- Do not open the battery or short-circuit its contacts.

⚠ CAUTION – Charge and use the rechargeable Lithium-ion battery only in strict accordance with the instructions. Charging or using the battery in unauthorized equipment can cause an explosion or fire, and can result in personal injury and/or equipment damage. To prevent injury or damage:

- Do not charge or use the battery if it appears to be damaged or leaking.
- Charge the Lithium-ion battery only in a Trimble product that is specified to charge it.
  Be sure to follow all instructions that are provided with the battery charger.
- Discontinue charging a battery that gives off extreme heat or a burning odor.
- Use the battery only in Trimble equipment that is specified to use it.
- Use the battery only for its intended use and according to the instructions in the product documentation.

⚠ CAUTION – Avoid contact with the rechargeable Lithium-ion battery if it appears to be leaking. Battery fluid is corrosive, and contact with it can result in personal injury and/or property damage. To prevent injury or damage:

- If the battery leaks, avoid contact with the battery fluid.
- If battery fluid gets into your eyes, immediately rinse your eyes with clean water and seek medical attention. Do not rub your eyes!
- If battery fluid gets onto your skin or clothing, immediately use clean water to wash off the battery fluid.

Disposal

Before disposal, discharge the battery.

Dispose of the used battery in an environmentally sensitive manner, according to local and national regulations.

Battery charger safety and environment information

⚠ CAUTION – Ensure that nothing obstructs the vents in the back of the charger.

⚠ CAUTION – The charger is hot during conditioning.

Troubleshooting and corrective measures

Battery is not detected (Does not change from only red LED on after battery insertion)

Cause	Corrective measure
Battery not properly inserted.	Properly insert battery into battery charger slot.
Battery contacts contaminated.	Clean the battery (e.g. by inserting and removing the battery several times) or replace battery.
Deeply discharged or shorted battery.	Leave the battery in the charger overnight to attempt to revive the battery.
Battery defective.	Replace the battery.
LED abnormalities occurring.	Remove any batteries from both slots and disconnect the AC adapter from the charger.

Default Settings

Resetting the receiver to factory defaults

To reset the receiver to its factory defaults, press  for 15 seconds.

If you have anMissing variable reference, you can also do the following:

- In the GPS Configurator software, select **Connect to Receiver** and then click **Reset Receiver** in the **General** tab.
- In the Configuration Toolbox software, select the **General** tab and then click **Reset Receiver**.

For more information on the GPS Configurator and Configuration Toolbox software, refer to the "Configuring the Receiver Settings" section of the *Trimble SPS Series Receiver Help*.

To reset the receiver to its factory defaults, press and hold down the receiver's Power button for 15 seconds.

- The Radio, Wi-Fi, and Satellite LEDs turn off after 2 seconds.
- The battery LED remains on.
- After 15 seconds, the Satellite LED comes on to indicate that it is time to release the Power button.
- Upon restart, the Wi-Fi will also turn on in Access Point mode.

Default behavior

If a power-up application file is present in the receiver, its settings are applied immediately after the default settings. This means you can use a power-up file to define your own set of defaults. The factory defaults are also applied when you perform a full reset of the receiver because resetting the receiver deletes the power-up files.

When starting any of the SPS receivers as a base station or rover receiver using the Trimble SCS900 Site Controller software or the HYDRO*pro* Construction software, the settings required for those operations are automatically set and configured in that software. To change the receiver settings for special applications or for use with third-party software, use the GPS Configurator software or the Configuration Toolbox software.

Troubleshooting

Troubleshooting receiver issues

This section describes some possible receiver issues, possible causes, and how to solve them. Please read this section before you contact Technical Support.

The receiver does not turn on

Possible cause	Solution
External power is too low.	Check the charge on the external power supply, and check the fuse if applicable. If required, replace the battery.
Internal power is too low.	Do the following: • Check the charge on the internal batteries and replace if required • Ensure battery contacts are clean.
External power is not properly connected.	Do the following: • Check that the Lemo connection is seated properly. • Check for broken or bent pins in the connector.
Faulty external power cable.	Do the following: • Try a different cable. • Check pinouts with multimeter to ensure internal wiring is intact.

The receiver is not tracking any satellites

Possible cause	Solution
The GNSS antenna does not have clear line of sight to the sky.	Ensure that the antenna has a clear line of sight.

The receiver does not log data

Possible cause	Solution
Insufficient memory in the internal memory.	Delete old files. Press the Power button for 30 seconds.

The receiver is not responding

Possible cause	Solution
The receiver needs a soft reset.	Turn off the receiver and then turn it back on again. For more information, see Button and LED operations, page 18
The receiver needs a full reset.	Press the Power button for 30 seconds. For more information, see Button and LED operations, page 18.

Troubleshooting base station setup and static measurement problems

This section describes some possible station setup and static measurement issues, possible causes, and how to solve them.

Trimble recommends that you use the SCS900 software to restart or configure base and rover receivers. The SCS900 software sets up all radio and receiver operating parameters, and is the most likely route to a successful problem resolution once you have checked all connections, cables, and batteries.

The roving receiver is not receiving radio from the base station

Possible cause	Solution
The base station is not broadcasting.	See "Base station is not broadcasting" below.
Incorrect over air baud rates between base station and rover.	Connect to the roving receiver's radio and make sure that it has the same setting as the base station receiver.
Mismatched channel or network number selection.	Match the base station and rover radio channels/network number and try again.
Incorrect port settings between the rover external radio and receiver.	If the radio is receiving data (the Radio LED is flashing) and the receiver is not receiving data, check the port settings of the receiver and radio using the Trimble SCS900 Site Controller software; match the settings and try again.

The base station is not broadcasting

Possible cause	Solution
Port settings between base receiver and external radio are incorrect. *NOTE – The Smart GNSS antenna has the option for an integrated Tx radio that allows it to be used without an external radio at the base and rover location. The Smart GNSS antenna can also be connected to an external high power radio in certain countries.*	Use the Trimble SCS900 Site Controller software to connect to the radio through the receiver. If no connection is made, connect directly to the radio and change the port settings. Try to connect through the receiver again to ensure that they are communicating. *NOTE – The SCS900 software does not support direct connection to the external radio; it only allows configuration through the receiver.*
Faulty cable between receiver and external radio.	Do one of the following: • Try a different cable • Examine the ports for missing pins • Use a multimeter to check the pins
No power to radio.	If the radio has its own power supply, check the charge and connections.
No Bluetooth connections	Make sure that the radio and receiver are within Bluetooth range of each other and that the Bluetooth antennas are visible to each other.

Troubleshooting LED conditions

The GNSS smart antenna has a simple display panel with LEDs to indicate the current status of the receiver. If you need more detailed information about what the receiver is doing, use a Trimble controller or laptop computer running the SCS900, GPS Configurator, or Configuration Toolbox software.

The receiver has a simple display panel with LEDs to indicate the current status of the receiver. If you need more detailed information about what the receiver is doing, use a Trimble controller or access all configuration settings by connecting the receiver to your smart phone or laptop computer via Configuring the receiver using the web interface, page 1.

This section describes how the LED lights are used on the receiver to indicate current status. An LED that is flashing quickly indicates a condition that may require attention, and

an unlit LED indicates that no operation is occurring. This section describes some LED conditions, possible causes, and how to solve them.

The SV Tracking LED is lit solidly and the Logging/Memory LED is flashing slowly

Possible cause	Solution
The receiver is in Monitor mode, ready for new firmware to be loaded or new options to be added.	Turn on or turn off the receiver. If that does not fix the problem, load the latest version of the firmware, which you can download from the Trimble website (www.trimble.com/support.shtml / <product> / **Downloads**).

The SV Tracking LED is not flashing

Possible cause	Solution
The receiver is tracking fewer than four satellites.	Wait until the SV Tracking LED is flashing slowly.

Glossary

1PPS	Pulse-per-second. Used in hardware timing. A pulse is generated in conjunction with a time stamp. This defines the instant when the time stamp is applicable.
almanac	A file that contains orbit information on all the satellites, clock corrections, and atmospheric delay parameters. The almanac is transmitted by a GNSS satellite to a GNSS receiver, where it facilitates rapid acquisition of GNSS signals when you start collecting data, or when you have lost track of satellites and are trying to regain GNSS signals. The orbit information is a subset of the ephemeris/ephemerides data.
AutoBase	AutoBase technology uses the position of the receiver to automatically select the correct base station; allowing for one button press operation of a base station. It shortens setup time associated with repeated daily base station setups at the same location on jobsites.
base station	Also called *reference station*. In construction, a base station is a receiver placed at a known point on a jobsite that tracks the same satellites as an RTK rover, and provides a real-time differential correction message stream through radio to the rover, to obtain centimeter level positions on a continuous real-time basis. A base station can also be a part of a virtual reference station network, or a location at which GNSS observations are collected over a period of time, for subsequent postprocessing to obtain the most accurate position for the location.
beacon	Source of RTCM DGPS corrections transmitted from coastal reference stations in the 283.5 to 325.0 kHz range.
BeiDou	The BeiDou Navigation Satellite System (also known as BDS or Compass) is a Chinese satellite navigation system. The first BeiDou system (known as BeiDou-1), consists of four satellites and has limited coverage and applications. It has been offering navigation services mainly for customers in

	China and from neighboring regions since 2000. The second generation of the system (known as Compass or BeiDou-2) consists of satellites in a combination of geostationary, inclined geosynchronous, and medium earth orbit configurations. It became operational with coverage of China in December 2011. However, the complete Interface Control Document (which specifies the satellite messages) was not released until December 2012. BeiDou-2 is a regional navigation service which offers services to customers in the Asia-Pacific region. A third generation of the BeiDou system is planned, which will expand coverage globally. This generation is currently scheduled to be completed by 2020.
BINEX	BInary EXchange format. BINEX is an operational binary format standard for GPS/GLONASS/SBAS research purposes. It is designed to grow and allow encapsulation of all (or most) of the information currently allowed for in a range of other formats.
broadcast server	An Internet server that manages authentication and password control for a network of VRS servers, and relays VRS corrections from the VRS server that you select.
carrier	A radio wave having at least one characteristic (such as frequency, amplitude, or phase) that can be varied from a known reference value by modulation.
carrier frequency	The frequency of the unmodulated fundamental output of a radio transmitter. The GPS L1 carrier frequency is 1575.42 MHz.
carrier phase	Is the cumulative phase count of the GPS or GLONASS carrier signal at a given time.
cellular modems	A wireless adapter that connects a laptop computer to a cellular phone system for data transfer. Cellular modems, which contain their own antennas, plug into a PC Card slot or into the USB port of the computer and are available for a variety of wireless data services such as GPRS.
CMR/CMR+	Compact Measurement Record. A real-time message format developed by Trimble for broadcasting corrections to other Trimble receivers. CMR is a more efficient alternative to RTCM.

CMRx	A real-time message format developed by Trimble for transmitting more satellite corrections resulting from more satellite signals, more constellations, and more satellites. Its compactness means more repeaters can be used on a site.
Compass	See BeiDou.
covariance	A statistical measure of the variance of two random variables that are observed or measured in the same mean time period. This measure is equal to the product of the deviations of corresponding values of the two variables from their respective means.
datum	Also called *geodetic datum*. A mathematical model designed to best fit the geoid, defined by the relationship between an ellipsoid and, a point on the topographic surface, established as the origin of the datum. World geodetic datums are typically defined by the size and shape of an ellipsoid and the relationship between the center of the ellipsoid and the center of the earth. Because the earth is not a perfect ellipsoid, any single datum will provide a better model in some locations than in others. Therefore, various datums have been established to suit particular regions. For example, maps in Europe are often based on the European datum of 1950 (ED-50). Maps in the United States are often based on the North American datum of 1927 (NAD-27) or 1983 (NAD-83). All GPS coordinates are based on the WGS-84 datum surface.
deep discharge	Withdrawal of all electrical energy to the end-point voltage before the cell or battery is recharged.
DGPS	See real-time differential GPS.
differential correction	Differential correction is the process of correcting GNSS data collected on a rover with data collected simultaneously at a base station. Because the base station is on a known location, any errors in data collected at the base station can be measured, and the necessary corrections applied to the rover data. Differential correction can be done in real-time, or after the

	data is collected by postprocessing.
differential GPS	See real-time differential GPS.
DOP	Dilution of Precision. A measure of the quality of GNSS positions, based on the geometry of the satellites used to compute the positions. When satellites are widely spaced relative to each other, the DOP value is lower, and position precision is greater. When satellites are close together in the sky, the DOP is higher and GNSS positions may contain a greater level of error. PDOP (Position DOP) indicates the three-dimensional geometry of the satellites. Other DOP values include HDOP (Horizontal DOP) and VDOP (Vertical DOP), which indicate the precision of horizontal measurements (latitude and longitude) and vertical measurements respectively. PDOP is related to HDOP and VDOP as follows: $PDOP^2 = HDOP^2 + VDOP^2$.
dual-frequency GPS	A type of receiver that uses both L1 and L2 signals from GPS satellites. A dual-frequency receiver can compute more precise position fixes over longer distances and under more adverse conditions because it compensates for ionospheric delays.
EGNOS	European Geostationary Navigation Overlay Service. A Satellite-Based Augmentation System (SBAS) that provides a free-to-air differential correction service for GNSS. EGNOS is the European equivalent of WAAS, which is available in the United States.
elevation	The vertical distance from a geoid such as EGM96 to the antenna phase center. The geoid is sometimes referred to as Mean Sea Level. In the SPS GNSS receivers, a user-defined sub gridded geoid can be loaded and used, or for a small site, an inclined vertical plane adjustment is used as an approximation to the geoid for a small site.
elevation mask	The angle below which the receiver will not track satellites. Normally set to 10 degrees to avoid interference problems caused by buildings and trees, atmospheric issues, and multipath errors.
ellipsoid	An ellipsoid is the three-dimensional shape that is used as the basis for mathematically modeling the earth's surface. The

	ellipsoid is defined by the lengths of the minor and major axes. The earth's minor axis is the polar axis and the major axis is the equatorial axis.
EHT	Height above ellipsoid.
ephemeris/ephemerides	A list of predicted (accurate) positions or locations of satellites as a function of time. A set of numerical parameters that can be used to determine a satellite's position. Available as broadcast ephemeris or as postprocessed precise ephemeris.
epoch	The measurement interval of a GNSS receiver. The epoch varies according to the measurement type: for real-time measurement it is set at one second; for postprocessed measurement it can be set to a rate of between one second and one minute. For example, if data is measured every 15 seconds, loading data using 30-second epochs means loading every alternate measurement.
feature	A feature is a physical object or event that has a location in the real world, which you want to collect position and/or descriptive information (attributes) about. Features can be classified as surface or non-surface features, and again as points, lines/break lines, or boundaries/areas.
firmware	The program inside the receiver that controls receiver operations and hardware.
Galileo	Galileo is a GNSS system built by the European Union and the European Space Agency. It is complimentary to GPS and GLONASS.
geoid	The geoid is the equipotential surface that would coincide with the mean ocean surface of the Earth. For a small site this can be approximated as an inclined plane above the Ellipsoid.
GHT	Height above geoid.
GLONASS	Global Orbiting Navigation Satellite System. GLONASS is a Soviet space-based navigation system comparable to the American GPS system. The operational system consists of 21 operational and 3 non-operational satellites in 3 orbit planes.
GNSS	Global Navigation Satellite System.
GSOF	General Serial Output Format. A Trimble proprietary message format.

HDOP	Horizontal Dilution of Precision. HDOP is a DOP value that indicates the precision of horizontal measurements. Other DOP values include VDOP (vertical DOP) and PDOP (Position DOP). Using a maximum HDOP is ideal for situations where vertical precision is not particularly important, and your position yield would be decreased by the vertical component of the PDOP (for example, if you are collecting data under canopy).
height	The vertical distance above the Ellipsoid. The classic Ellipsoid used in GPS is WGS-84.
IBSS	Internet Base Station Service. This Trimble service makes the setup of an Internet-capable receiver as simple as possible. The base station can be connected to the Internet (cable or wirelessly). To access the distribution server, the user enters a password into the receiver. To use the server, the user must have a Trimble Connected Community site license.
ITRF2014	The ITRF2014 datum is the current realization of the International Terrestrial Reference System (ITRS). This datum can be transformed to ITRF2014 epoch 2005 (fixed), or be used in the current epoch. The fixed epoch allows for selecting individual tectonic plates that have been closely modeled to the actual current location. However, there may be large differences due to natural events (such as earthquakes) or proximity to the perimeter of a tectonic plate.
L1	The primary L-band carrier used by GPS and GLONASS satellites to transmit satellite data.
L2	The secondary L-band carrier used by GPS and GLONASS satellites to transmit satellite data.
L2C	A modernized code that allows significantly better ability to track the L2 frequency.
L5	The third L-band carrier used by GPS satellites to transmit satellite data. L5 will provide a higher power level than the other carriers. As a result, acquiring and tracking weak signals will be easier.
Mountpoint	Every single Ntrip Source needs a unique mountpoint on an Ntrip Caster. Before transmitting GNSS data to the Ntrip

	Caster, the Ntrip Server sends an assignment of the mountpoint.
MSAS	MTSAT Satellite-Based Augmentation System. A Satellite-Based Augmentation System (SBAS) that provides a free-to-air differential correction service for GNSS. MSAS is the Japanese equivalent of WAAS, which is available in the United States.
multipath	Interference, similar to ghosts on an analog television screen that occurs when GNSS signals arrive at an antenna having traversed different paths. The signal traversing the longer path yields a larger pseudorange estimate and increases the error. Multiple paths can arise from reflections off the ground or off structures near the antenna.
NavIC (IRNSS)	Navigation with Indian Constellation. Previously the Indian Regional Navigation Satellite System. An autonomous regional satellite navigation system that covers India and surrounding areas.
NMEA	National Marine Electronics Association. NMEA 0183 defines the standard for interfacing marine electronic navigational devices. This standard defines a number of 'strings' referred to as NMEA strings that contain navigational details such as positions. Most Trimble GNSS receivers can output positions as NMEA strings.
Ntrip Protocol	Networked Transport of RTCM via Internet Protocol (Ntrip) is an application-level protocol that supports streaming Global Navigation Satellite System (GNSS) data over the Internet. Ntrip is a generic, stateless protocol based on the Hypertext Transfer Protocol (HTTP). The HTTP objects are extended to GNSS data streams.
Ntrip Caster	The Ntrip Caster is basically an HTTP server supporting a subset of HTTP request/response messages and adjusted to low-bandwidth streaming data. The Ntrip Caster accepts request messages on a single port from either the Ntrip Server or the Ntrip Client. Depending on these messages, the Ntrip Caster decides whether there is streaming data to receive or to send. Trimble Ntrip Caster integrates the Ntrip Server and the Ntrip Caster. This port is used only to accept requests from Ntrip Clients.

Ntrip Client	An Ntrip Client will be accepted by and receive data from an Ntrip Caster, if the Ntrip Client sends the correct request message (TCP/UDP connection to the specified Ntrip Caster IP and listening port).
Ntrip Server	The Ntrip Server is used to transfer GNSS data of an Ntrip Source to the Ntrip Caster. An Ntrip Server in its simplest setup is a computer program running on a PC that sends correction data of an Ntrip Source (for example, as received through the serial communication port from a GNSS receiver) to the Ntrip Caster. The Ntrip Server - Ntrip Caster communication extends HTTP by additional message formats and status codes.
Ntrip Source	The Ntrip Sources provide continuous GNSS data (for example, RTCM-104 corrections) as streaming data. A single source represents GNSS data referring to a specific location. Source description parameters are compiled in the source-table.
OmniSTAR	The OmniSTAR HP/XP service allows the use of new generation dual-frequency receivers with the OmniSTAR service. The HP/XP service does not rely on local reference stations for its signal, but utilizes a global satellite monitoring network. Additionally, while most current dual-frequency GNSS systems are accurate to within a meter or so, OmniSTAR with XP is accurate in 3D to better than 30 cm.
Orthometric elevation	The Orthometric Elevation is the height above the geoid (often termed the height above the 'Mean Sea Level').
PDOP	Position Dilution of Precision. PDOP is a DOP value that indicates the precision of three-dimensional measurements. Other DOP values include VDOP (vertical DOP) and HDOP (Horizontal Dilution of Precision). Using a maximum PDOP value is ideal for situations where both vertical and horizontal precision are important.
postprocessing	Postprocessing is the processing of satellite data after it is collected, in order to eliminate error. This involves using computer software to compare data from the rover with data collected at the base station.

QZSS	Quasi-Zenith Satellite System. A Japanese regional GNSS, eventually consisting of three geosynchronous satellites over Japan.
real-time differential GPS	Also known as *real-time differential correction* or *DGPS*. Real-time differential GPS is the process of correcting GPS data as you collect it. Corrections are calculated at a base station and then sent to the receiver through a radio link. As the rover receives the position it applies the corrections to give you a very accurate position in the field. Most real-time differential correction methods apply corrections to code phase positions. While DGPS is a generic term, its common interpretation is that it entails the use of single-frequency code phase data sent from a GNSS base station to a rover GNSS receiver to provide submeter position accuracy. The rover receiver can be at a long range (greater than 100 kms (62 miles)) from the base station.
rover	A rover is any mobile GNSS receiver that is used to collect or update data in the field, typically at an unknown location.
Roving mode	Roving mode applies to the use of a rover receiver to collect data, stakeout, or control machinery in real time using RTK techniques.
RTCM	Radio Technical Commission for Maritime Services. A commission established to define a differential data link for the real-time differential correction of roving GNSS receivers. There are three versions of RTCM correction messages. All Trimble GNSS receivers use Version 2 protocol for single-frequency DGPS type corrections. Carrier phase corrections are available on Version 2, or on the newer Version 3 RTCM protocol, which is available on certain Trimble dual-frequency receivers. The Version 3 RTCM protocol is more compact but is not as widely supported as Version 2.
RTK	Real-time kinematic. A real-time differential GPS method that uses carrier phase measurements for greater accuracy.
RTX	Trimble RTX (Real Time eXtended) is a high accuracy GNSS correction service. This breakthrough technology provides real-time corrections without the use of a traditional reference

	station-based infrastructure. The delivery of the correction service is the same as OmniSTAR, as they are both Mobile Satellite Services (MSS). However, the method in which the correction is calculated is different and is more accurate with RTX.
SBAS	Satellite-Based Augmentation System. SBAS is based on differential GPS, but applies to wide area (WAAS, EGNOS, MSAS, QZSS, and GAGAN) networks of reference stations. Corrections and additional information are broadcast using geostationary satellites.
signal-to-noise ratio	SNR. The signal strength of a satellite is a measure of the information content of the signal, relative to the signal's noise. The typical SNR of a satellite at 30° elevation is between 47 and 50 dB-Hz.
skyplot	The satellite skyplot confirms reception of a differentially corrected GNSS signal and displays the number of satellites tracked by the GNSS receiver, as well as their relative positions.
SNR	See signal-to-noise ratio.
Source-table	The Ntrip Caster maintains a source-table containing information on available Ntrip Sources, networks of Ntrip Sources, and Ntrip Casters, to be sent to an Ntrip Client on request. Source-table records are dedicated to one of the following: • data STReams (record type STR) • CASters (record type CAS) • NETworks of data streams (record type NET) All Ntrip Clients must be able to decode record type STR. Decoding types CAS and NET is an optional feature. All data fields in the source-table records are separated using the semicolon character.
triple frequency GPS	A type of receiver that uses three carrier phase measurements (L1, L2, and L5).
UTC	Universal Time Coordinated. A time standard based on local solar mean time at the Greenwich meridian.
xFill	Trimble xFill® is a service that extends RTK positioning for

	several minutes when the RTK correction stream is temporarily unavailable. The Trimble xFill service improves field productivity by reducing downtime waiting to re-establish RTK corrections in black spots. It can even expand productivity by allowing short excursions into valleys and other locations where continuous correction messages were not previously possible. Proprietary Trimble xFill corrections are broadcast by satellite and are generally available globally where the GNSS constellations are also visible. It applies to any positioning task being performed with a single-base, Trimble Internet Base Station Service (IBSS), or VRS RTK correction source.
variance	A statistical measure used to describe the spread of a variable in the mean time period. This measure is equal to the square of the deviation of a corresponding measured variable from its mean. See also covariance.
VDOP	Vertical Dilution of Precision. VDOP is a DOP value (dimensionless number) that indicates the quality of GNSS observations in the vertical frame.
VRS	Virtual Reference Station. A VRS system consists of GNSS hardware, software, and communication links. It uses data from a network of base stations to provide corrections to each rover that are more accurate than corrections from a single base station. To start using VRS corrections, the rover sends its position to the VRS server. The VRS server uses the base station data to model systematic errors (such as ionospheric noise) at the rover position. It then sends RTCM, CMRx, or CMR+ correction messages back to the rover.
WAAS	Wide Area Augmentation System. WAAS was established by the Federal Aviation Administration (FAA) for flight and approach navigation for civil aviation. WAAS improves the accuracy and availability of the basic GNSS signals over its coverage area, which includes the continental United States and outlying parts of Canada and Mexico. The WAAS system provides correction data for visible satellites. Corrections are computed from ground station observations and then uploaded to two geostationary satellites. This data is then broadcast on the L1 frequency, and is tracked using a

channel on the GNSS receiver, exactly like a GNSS satellite.

Use WAAS when other correction sources are unavailable, to obtain greater accuracy than autonomous positions. For more information on WAAS, refer to the FAA website at http://gps.faa.gov.

The EGNOS service is the European equivalent and MSAS is the Japanese equivalent of WAAS.

WGS-84

World Geodetic System 1984. Since January 1987, WGS-84 has superseded WGS-72 as the datum used by GPS.

The WGS-84 datum is based on the ellipsoid of the same name.