GETTING STARTED GUIDE

Trimble SPS585 GNSS Smart Antenna

Version 5.00
Revision A
April 2015

Trimble

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Legal Notices

NTP Software Copyright

Release Notice

This is the April 2015 release (Revision A) of the SPS585 documentation. It applies to version 5.00 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

This notice applies to the SPS351, SPS555H, SPS585, SPSx61, SPS855, and SPS985/SPS985L receivers.
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

Class B Statement – Notice to Users. This equipment has been tested and found to comply with the limits for a Class B digital device pursuant to Part 15 of the FCC Rules. Some equipment configurations include an optional 410 MHz to 470 MHz UHF radio transceiver module compliant with Part 90. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
– Increase the separation between the equipment and the receiver.
– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
– Consult the dealer or an experienced radio/TV technician for help.
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 20 cm 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

The product covered by this guide are intended to be used in all EU member countries, Norway, and Switzerland. Products been tested and found to comply with the requirements for a Class B device pursuant to European Council Directive 89/336/EEC 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. The 450 MHZ (PMR) bands and 2.4 GHz are non-harmonized throughout Europe.

CE Declaration of Conformity

Hereby, Trimble Navigation, declares that the GPS receivers are in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

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 C-Tick Marking and sale within Australia and New Zealand.

Taiwan – Battery Recycling Requirements

廢電池請回收
ANATEL approval applies to SPS985 (P/N 82500-60) and SPS985L (P/N 93985-67) only.

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 2002/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on the restriction of the use of certain

hazardous substances in electrical and electronic equipment (RoHS Directive) and Amendment 2005/618/EC filed under C(2005) 3143, 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/ev.shtml.
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

FCC Declaration of Conformity

We, Trimble Navigation Limited.

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Sunnyvale, CA 94088-3642
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Declare under sole responsibility that DoC products comply with Part 15 of 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.

Unlicensed radios in products

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.

Licensed radios in products

This device complies with part 15 of the FCC Rules.
Operation is subject to the condition that this device may not cause harmful interference.

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.

WARNING – The magnetic mount option for this device must not be used on vehicles while they are being driven on public roads and highways due to the possible risk of personal injury or property damage should the unit become detached. Use the permanent exterior mounting options or secure the unit inside the vehicle if driving on public roads and highways.

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. 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.

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

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

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

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 20 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.

Lithium-ion Battery safety

WARNING – Charge and use the rechargeable Lithium-ion battery only in strict accordance with the instructions. To prevent injury or damage:

– 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.

Contents

Introduction

The SPS585 GNSS smart antenna can be used for a number of construction site applications including:

- 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
- Digital design interrogation
- Site positioning for environmental and geotechnical services

The SPS585 GNSS smart antenna incorporates a GNSS antenna, receiver, Wi-Fi Access Point, and battery in a rugged light-weight magnetic-mounted unit that is ideally suited for vehicle and pole-mounted applications. LEDs enable you to monitor position tolerance, correction status, Wi-Fi, Bluetooth wireless technology, and power. Wi-Fi and Bluetooth wireless technology provides cable-free communications between the receiver and the device (such as a tablet, smartphone, or laptop).

You can use the SPS585 GNSS smart antenna as part of an RTK GNSS system with the Trimble SCS900 Site Controller and the Trimble SitePulse™ software.

The SPS585 GNSS smart antenna has no front panel controls for changing settings. To configure the receivers:

- Directly access the SPS web interface from a connected device
- Connect via Bluetooth wireless technology from a device running the SCS900 Site Controller or SitePulse software

SPS585 GNSS smart antenna features

The SPS585 GNSS smart antenna has the following features:

- 10 cm (0.34 ft) horizontal and vertical precision when using RTK or RTX corrections
- Supported by version 1.0 of the SitePulse™ field software and version 3.41 of the SCS900 software
- CenterPoint® RTX ready; just purchase a subscription
- Small, lightweight design – 0.73 kg (1.62 lb) (GNSS receiver, GNSS antenna, and battery)
- Integrated magnets for mounting on a vehicle roof or pole top mounting bracket.
- USB power cable and chargers included
- Fully functional out-of-the-box, with dual-frequency GNSS tracking (GPS, GLONASS, BeiDou, and Galileo)
- Trimble xFill™ RTK service is already installed.
- 220-channel GNSS tracking (all available constellations)
- Internal, rechargeable, smart Lithium-ion battery provides more than four hrs GPS rover operation per charge
- Bluetooth wireless technology for cable-free, no-hassle operation with the SCS900 or SitePulse field software
- Simple keypad with on/off key and LED indicators for power, corrections, communications, and position
- 5 Hz update rate
- Operates within a VRS network or IBSS for conventional base station-free rover capability
- Integrated Bluetooth and Wi-Fi
- Two SBAS channels
- RoHS compliant

High precision positioning

The Trimble CenterPoint® RTX™ service is a high-accuracy, low convergence-time Precise Point Positioning (PPP) service that provides real-time high precision positioning without the need for an RTK base station or VRS™ network. GNSS corrections are delivered over the air using L-band satellites. Once subscribed, the SPS585 GNSS Smart Antenna delivers 10 cm precise positions to your Trimble applications. For more information, contact your SITECH or Trimble authorized dealer.

xFill technology

Trimble xFill™ uses Trimble RTX technology, delivered via satellite, to "fill in" for RTK corrections in the event of temporary correction outages. The xFill technology maintains the RTK 10 cm accuracy for five minutes after the loss of RTK corrections. Trimble xFill capability is factory installed on the SPS585 GNSS Smart Antenna.

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.

Charging the SPS585 Smart Antenna

The rechargeable Lithium-ion batteries are supplied partially charged. Charge the battery completely for 12 hours before using the device for the first time. If the SPS585 GNSS Smart Antenna has been stored for longer than three months, charge it before use.

The charge time is 3 hours when the product is running or turned off. For the best charging performance, use the Trimble provided cable and charger. The internal battery charger stops charging when the internal temperature of the receiver is greater than 50 °C (122 °F) or less than 5 °C (41 °F).

WARNING – Charge and use the rechargeable Lithium-ion battery only in strict accordance with the instructions. To prevent injury or damage:

– Discontinue charging a battery that gives off extreme heat or a burning odor.

– Never attempt to remove, replace, or repair the battery yourself.

– If the battery requires attention, send the receiver to an authorized Trimble Service Center.

Parts of the SPS585 GNSS Smart 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 (❶) and four indicator LEDs (❷).

- The Power button controls the receiver's power on or off functions and can be used to reset the receiver.
- The indicator LEDs show the status of the battery, corrections, wireless reception, and positioning.

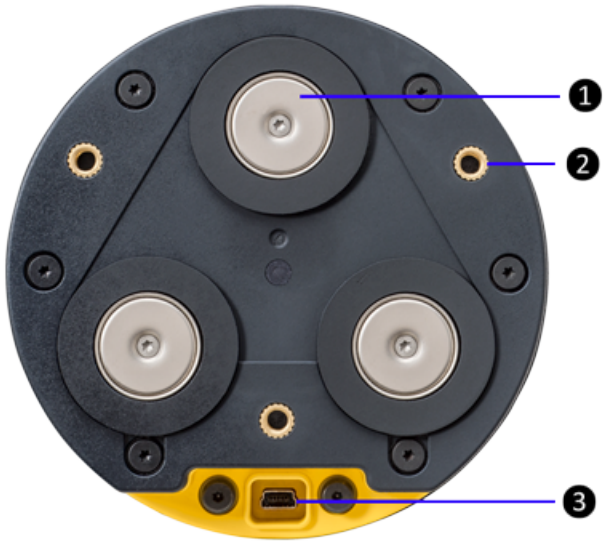
The LEDs on the front panel indicate various operating conditions. For more information, see Button and LED Operations, page 13.

Icon	Connections
	Power button
	Position icon
	GNSS corrections icon

Icon	Connections
	Battery icon
	Wireless communications icon

Lower housing

The lower housing contains the magnetic mounts (❶), three M5 threaded holes for permanent mounting (❷), and one USB port (❸).



Button and LED Operations

To turn on the SPS585 GNSS smart antenna, hold the **On/Off** button down for 2 seconds until the Positioning icon flashes and then release the button.

To turn off the SPS585 GNSS smart antenna, hold the **On/Off** button down until the Positioning icon turns off and then release the button.

To reset the SPS585 GNSS smart antenna to factory default settings, hold the **On/Off** button down until only the battery icon is illuminated. Continue to hold the button down until the Positioning icon flashes (about 15 seconds) and then release immediately.

The general rules to interpret the LED flash patterns are as follows:

- Solid. Indicates you are getting what you want and it is okay to do a positioning task.
- Slow flash. Indicates an intermediary condition, the mode is ready, or you have to wait until something improves.
- Fast flash. Indicates an error condition and you need to take action to fix it.

Item	Description	
	**Wireless communications icon** ***Note –*** *On this dual-color LED, blue represents Bluetooth® wireless technology and amber represents Wi-Fi. If both types of wireless communications are active, the LED alternates every 15 seconds.*	
	Off	Bluetooth is not discoverable ***or*** the Wi-Fi client is not connected.
	Solid Blue	Bluetooth is connected to an external device (any of the three available ports).
	Solid amber	Wi-Fi in Access Point (AP) mode and an external Wi-Fi client device is connected. Wi-Fi in Client mode and connected to an external Access Point (AP).
	Slow Flash Blue	Bluetooth is discoverable but not connected.
	Slow Flash Amber	Wi-Fi Access Point (AP) mode is available but no Wi-Fi Client device is connected.
	Very Slow Flash Amber	Wi-Fi Client mode is on but not connected to a Wi-Fi AP.
	**Positioning icon**	
	Off	Fewer than 4 satellites are being tracked.
	Solid	Positioning at specified precision (user-defined H and V tolerance).
	Slow Flash	Computed position is below the specified precision.
	Fast Flash	Tracking 4 or more satellites but not computing a position.

Item	Description	
	**Corrections icon**	
	Off	No corrections detected on any incoming port.
	Solid	Corrections are being used.
	Slow Flash	xFill is ***in use*** for positioning.
	Very Slow Flash	Corrections are being used and xFill is not ***available/not ready***.
	**Battery icon**	
	Solid	Good battery condition and not charging.
	Slow Flash	Fast charging, 10 W input (for example, using cable and charger supplied in the kit).
	Very Slow Flash	Slow charging, less than 10 W input (for example, connected to tablet).
	Fast Flash	Low battery (less than 15% remaining).
	**Positioning, corrections, and battery icon together**	
	Slow Flash	Firmware expired.
	Very Slow Flash	If this problem persists, contact Trimble Support.
	Very Fast for 30 sec then Off	Contact Trimble Support.
	Solid	File system formatting.

Connecting to a Device

Connecting to a Bluetooth device

By default, the SPS585 GNSS smart antenna is *Discoverable* and will be listed on your Bluetooth capable device when you scan for nearby Bluetooth devices. The default Bluetooth device name is in the format **SPS585 <Serial number>: <System Name>**, for example: "SPS585 5436R00074: My System".

On a device running the Windows 7 operating system, the SPS585 GNSS smart antenna will appear as a *Network Infrastructure Device* with an *Access Point* connection. When connected using the *Access Point*, the smart antenna can be accessed using a web browser on the default IP address of 192.168.143.1. Select *Security* / *Login*. The default username is **admin**. The default password is **password**.

Connecting to a Wi-Fi device

By default, the device is configured as an *Access Point*, so you can connect to it using any Wi-Fi capable device with a standard web browser.

1. On a Wi-Fi enabled device, search for the SPS585 SSID. This is in the format **Trimble GNSS 1234** where 1234 are the last 4 digits of the serial number.
2. Connect using the default WEP64 encryption key: **abcdeabcde**.
3. Open a web browser on your Wi-Fi enabled device and then type `GNSS` into the address bar.

   Note – *With some devices, you may need to enter either* `http://GNSS` *or* `192.168.142.1` *to access the web interface.*
4. Log in to the web interface. Select *Security* / *Login*. The default username is **admin**. The default password is **password**. For detailed information on each page, use the Help links in the web interface.

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.

Windows 7 Professional operating system

1. 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 (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.*

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 Vista and 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 computer.
2. Open the file and place the trmbUsb.inf file in a temporary folder on your computer.
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.

Windows XP operating system

1. Go to the Trimble Support website (www.trimble.com/support) and search for the GNSS receiver. In the Support Notes section, download the file called *GNSS Interface to a Virtual COM port on a Computer* to your computer.
2. Open the file and place the trimble.Usb.INF file in a temporary folder on your computer.
3. Turn on the receiver and then connect the USB cable to the computer. The *New Hardware* wizard appears.
4. Select the *No, not this time* option and then click **Next**.
5. A dialog prompts you to specify the location of the USBSer.sys file. For example, C:\Windows\System32\Drivers.
6. On some computers you may need to repeat Step 4 for the TrimbleUsb.inf file.
7. Check that the receiver is available for use. Go to the *Device Manager* menu on the computer. The receiver should appear in the *Ports* list.

Note – *If you are running an application such as WinFlash software 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.*

Default Settings

Resetting the receiver to factory defaults

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

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, the SitePulse™ 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 web interface.

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.
ITRF2008	The ITRF2008 datum is the current realization of the International Terrestrial Reference System (ITRS). This datum can be transformed to ITRF2008 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 NTripSource needs a unique mountpoint on an NTripCaster. Before transmitting GNSS data to the NTripCaster, the NTripServer 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, which 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.
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.
NTripCaster	The NTripCaster is basically an HTTP server supporting a subset of HTTP request/response messages and adjusted to low-bandwidth streaming data. The NTripCaster accepts request messages on a single port from either the NTripServer or the NTripClient. Depending on these messages, the NTripCaster decides whether there is streaming data to receive or to send.

	Trimble NTripCaster integrates the NTripServer and the NTripCaster. This port is used only to accept requests from NTripClients.
NTripClient	An NTripClient will be accepted by and receive data from an NTripCaster, if the NTripClient sends the correct request message (TCP/UDP connection to the specified NTripCaster IP and listening port).
NTripServer	The NTripServer is used to transfer GNSS data of an NTripSource to the NTripCaster. An NTripServer in its simplest setup is a computer program running on a PC that sends correction data of an NTripSource (for example, as received through the serial communication port from a GNSS receiver) to the NTripCaster. The NTripServer - NTripCaster communication extends HTTP by additional message formats and status codes.
NTripSource	The NTripSources 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 sub-meter positionaccuracy. 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 earthmoving 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 phasemeasurements for greateraccuracy.
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) 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 dBHz.
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 NTripCaster maintains a source-table containing information on available NTripSources, networks of NTripSources, and NTripCasters, to be sent to an NTripClient 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 NTripClients 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 new 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 on construction sites 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 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.