# GETTING STARTED GUIDE

# Trimble SPS356 GPS receiver

Version 4.91
Revision A
December 2014

Trimble

## Corporate Office

Trimble Navigation Limited
935 Stewart Drive
Sunnyvale, CA 94085
USA
www.trimble.com

## Heavy Highway business area

Trimble Navigation Limited
5475 Kellenburger Road
USA
800-538-7800 (toll free in USA)
+1-937-245-5600 Phone
+1-937-233-9004 Fax
www.trimble.com
Email: trimble_support@trimble.com


## Legal Notices



## NTP Software Copyright



## Release Notice

This is the December 2014 release (Revision A) of the [System Name] documentation. It applies to version 4.91 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,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.

## 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.

935 Stewart Drive
PO Box 3642
Sunnyvale, CA 94088-3642
United States
+1-408-481-8000

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.

# Contents

# Introduction

Trimble SPS356 Modular GPS receiver is ideal for the following marine construction applications:

- Submeter positioning on marine vessels
- Submeter positioning applications using MSK Beacon corrections

The receiver has a keypad and display, so you can configure the receiver without using a controller or computer.

All the receivers can optionally record GNSS data to the internal memory, and transfer the data over a serial, Ethernet, or Wi-Fi connection.

## 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.

# External Power

Sources of external power include:

- AC power
- 12 V vehicle battery
- Trimble custom external battery pack
- Generator power
- Solar panel

The receiver uses an external power source in preference to its internal batteries. If the receiver is not connected to an external power source, or if the external power supply fails, the internal batteries are used.

While carrying out static measurements for postprocessed computations using the internal memory, if no external power is supplied and the internal battery is drained, the receiver shuts down. No data is lost and when power is restored, the receiver restarts in the same status as it was when power was lost.

## Supported power cables

| Part Number | Receiver Connection | Power Connection | Power Source | Other Connectors |
|---|---|---|---|---|
| 46125-20 | 7-pin Lemo | 'Croc' clips | Power from 12 V vehicle battery | None |
| 83223-02 | Use with 78235-10 or 59044-10 | 'Croc' clips | Power from 12 V vehicle battery | None |
| 59044-HH | 7-pin Lemo | Cable with DC plug | Power to host devices from AC adapter | Serial |
| 59044-10 | 7-pin Lemo | Cable with SAE | Power from SAE connection | Serial |
| 67384 | 7-pin Lemo | Cable with DC plug | Power to host devices from AC adapter | Serial-to-serial for Moving Base applications |
| 57167 | 26-pin | Adapter with DC plug | Power from AC adapter | USB(B) socket and Ethernet socket |
| 57168 | 26-pin | Adapter with DC plug | Power from AC adapter | Serial and Ethernet socket |
| 60789-00, 77070-00 | 26-pin | Cable with DC plug | Power from AC adapter | 2 x Serial, Ethernet plug, USB (A) plug, 1PPS (BNC) |
| 65791-00, 78235-00 | 26-pin | Cable with DC | Power from AC adapter | 2 x Serial, Ethernet socket |
| 78235-10 | 26-pin | Cable with SAE | Power from SAE connection | 2 x Serial, Ethernet socket, 1PPS (BNC) |

## Connecting the receiver to a vehicle battery

**WARNING –** Use caution when connecting battery cable's clip leads to a vehicle battery. Do not allow any metal object or jewelry to connect (short) the battery's positive (+) terminal to either the negative (-) terminal or the metal of the vehicle connected to the battery. This could result in high current, arcing, and high temperatures, exposing the user to possible injury.

**WARNING –** When connecting an external battery, such as a vehicle battery, to the receiver, be sure to use the Trimble cable with proper over-current protection intended for this purpose, to avoid a safety hazard to the user or damage to the product.

# Front Panel Guide

## Keypad and display


| Item | Feature | Description |
|---|---|---|
| 1 | Power LED | LED indicates if the receiver is on or off. |
| 2 | Buttons | Used to turn on and configure the receiver. |
| 3 | Display | The receiver has a Vacuum Fluorescent Display that enables you to see how the receiver is operating and view the configuration settings. |
| 4 | Bluetooth icon | Location of the Bluetooth antenna. |

# Button operations

Use the buttons on the front panel to turn the receiver on and off and to check or change the receiver settings.

| Button | Name | Function |
|---|---|---|
|  | **Power** | Turns the receiver on and off and performs reset operations. |
|  | **Escape** | Returns to the previous screen or cancels changes being made on a screen. |
|  | **Enter** | Advances to the next screen or accepts changes made on a screen. |
|  | **Up** | Moves the cursor between multiple fields on a screen or makes changes to an editable field. |
|  | **Down** | Moves the cursor between multiple fields on a screen or makes changes to an editable field. |
|  | **Left** | Moves the cursor between characters in a field that can be changed. |
|  | **Right** | Moves the cursor between characters in a field that can be changed. |

# Power button operations

Press the **Power** button  to turn the receiver on and off.

In addition, you can tap  to return to the *Home* screen, or hold down  to perform the following operations:

| To... | Hold the Power button for... | Notes |
|---|---|---|
| turn off the receiver | two seconds | The display shows a countdown timer. When the display goes blank, release the **Power**button. |
| clear the almanac, ephemeris, and SV information | 15 seconds | The display shows a countdown timer. When the display goes blank, continue to hold the **Power** button. The display shows a countdown time to clear the almanac and ephemeris. When the counter reaches 0, release the **Power** button. |
| reset the receiver to its factory defaults and the default application file | 35 seconds | The display shows a countdown timer. When the display goes blank, continue to hold the **Power** button. The display show a countdown to clear the almanac and ephemeris. When the counter reaches 0, continue to hold the **Power** button. The display indicates a countdown to resetting the receiver. When the counter reaches 0, release the **Power** button. |
| force the receiver to power down | at least 60 seconds | If the reset method above does not work, use this method to force the receiver to turn off. When the Power LED goes off, release the **Power** button. |

# Home screen

The *Home* screen is the main screen displayed on the receiver. If you briefly press the **Power** button, you return to the *Home* screen. It shows the number of satellites being tracked:

- When the receiver is in Rover mode, the *Home* screen displays the number of satellites used to calculate the position, and the MSK Beacon status (if enabled).


**Tip –** To view these details using the web interface, select *Receiver Status* / *Position*.

# Status screens

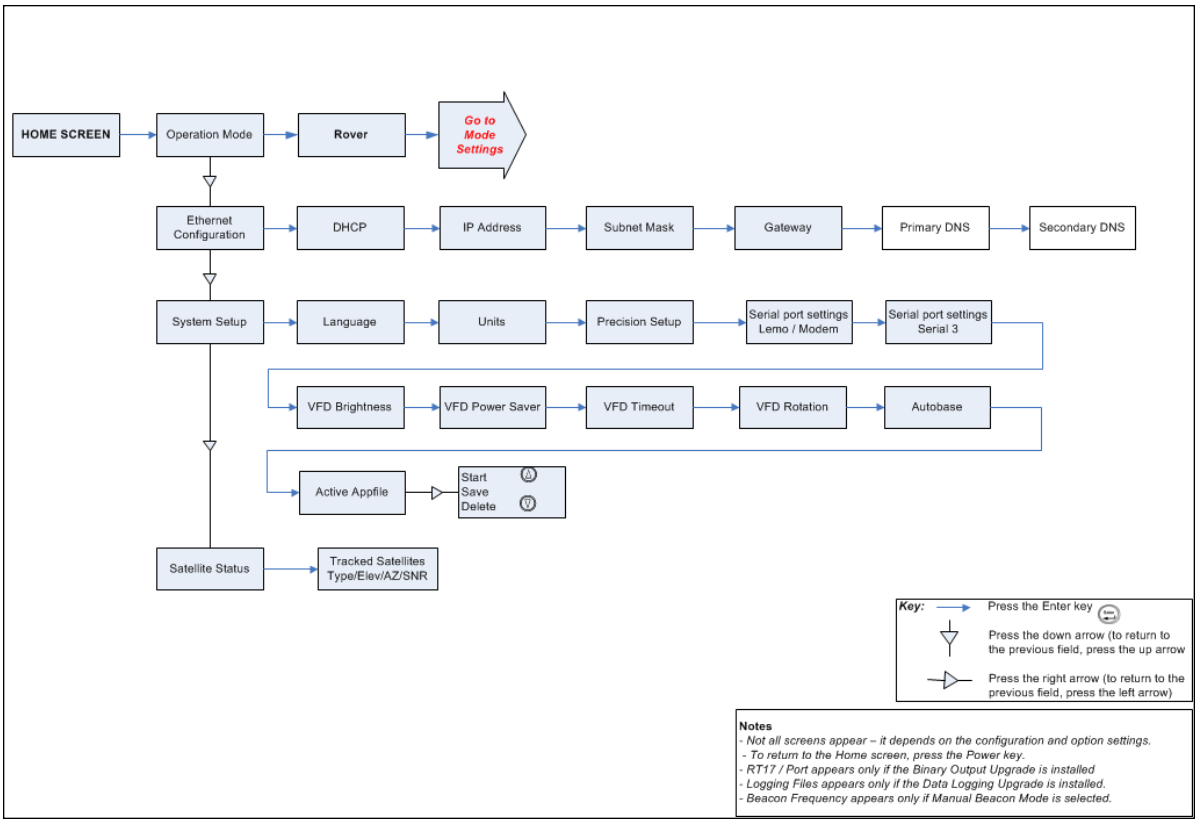
The receiver has several view-only status screens that allow you to review the current settings of the receiver. The status screens provide the following information:

- Position solution and 1-sigma precisions
- CMR and RTCM IDs or OmniSTAR satellite and link status
- MSK beacon station name, quality and age of corrections
- Latitude, longitude, and height
- Antenna height
- Receiver model, installed precision, and hardware version
- Receiver firmware version
- Receiver serial number
- Receiver IP address
- Receiver IP address and MAC address for WAN (Wi-Fi client), UAP (Wi-Fi Access point), and ETH (Wired Ethernet)

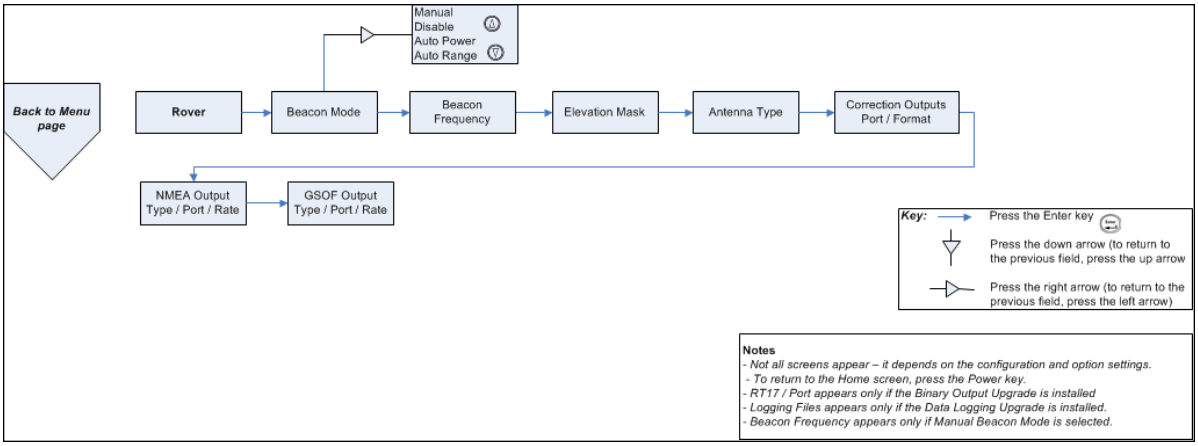
To access these screens from the Home screen, press  or  .

# Front Panel Guide

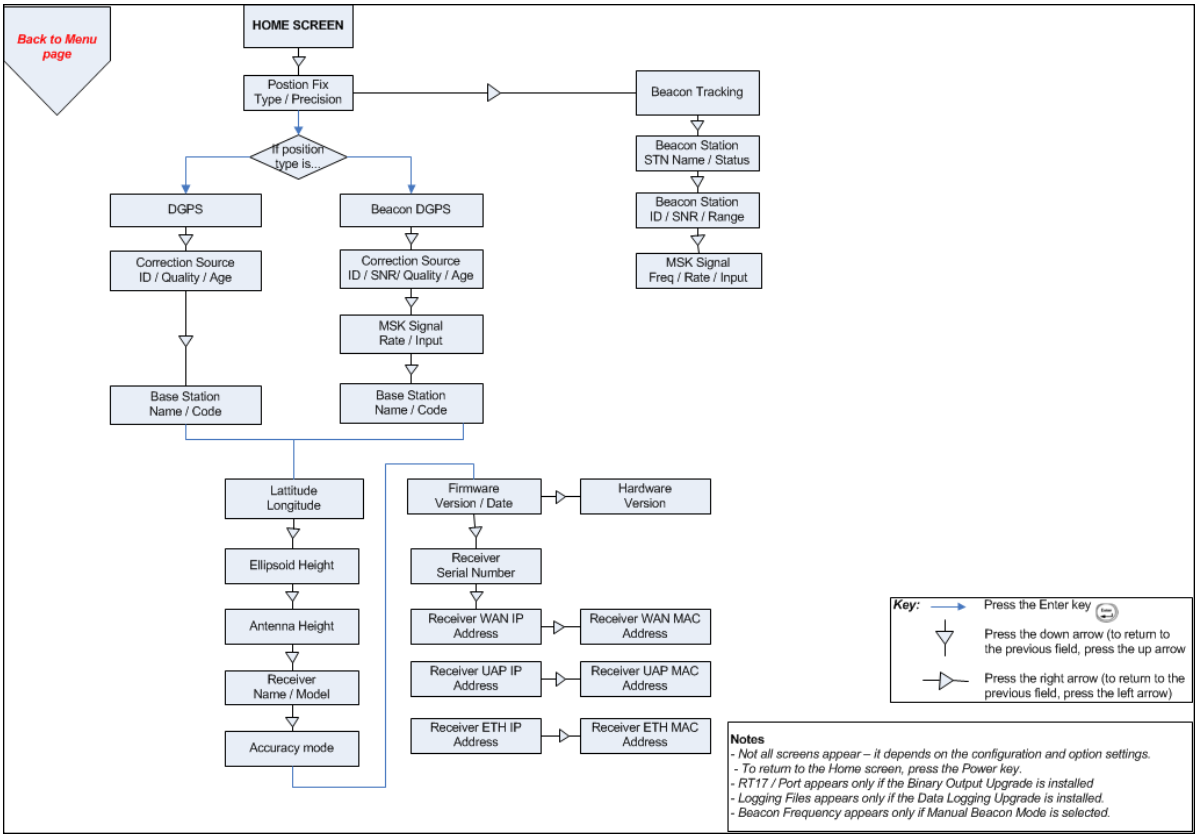
## SPS356 configuration screens



# SPS356 mode screens



# SPS356 status screens



# Configuring System Settings

You can use the keypad and display of the receiver to configure the following settings:

- Ethernet configuration
- Display language
- Display and input units
- Baud rate, parity, data bits, and stop bits for serial ports
- Display power saver, brightness, timeout, and rotation
- Set position precisions
- AutoBase and the current application file

To access the Mode settings:

1. In the *Home* screen, press to get to the *Operating Mode* screen. Press to get to the appropriate section, and then press to edit:
   - Ethernet Config
   - System Setup
   - SV Status

To change the system settings:

1. In the *Home* screen, press .
2. Press . When the operation mode begins to flash, the receiver is in Edit mode and you can change press to change this setting.
3. Press twice to change to *System Setup*.
4. Press to accept the change.
5. Press again.
6. Use the *Display Language* screen, if required, to change the language. Choose English, Finnish, French, German, Italian, Spanish, or Swedish. Press to accept the change.
7. Press again. Use the *Display and Input Units* screen, if required, to change the units to Meters or US Feet.
8. Press to accept the change.
9. Press again. Use the *Precision Setup* screen, if required, to change the required position tolerances.

10. Press  to accept the change.
11. Press  again. Use the *Port Settings* screen, if required, to change the port.
12. Press  to accept the change.
13. Press  again. Use the *VFD Brightness* screen, if required, to change the display brightness.
14. Press  again. Use the *VFD Pwr Savr* screen to choose On, Off, or Auto. If you use the Auto setting, the screen turns off after the timeout period that is set in the next screen. The default setting is 60 seconds of inactivity. The Power LED remains lit so that you can tell if the receiver is on or off. If an error message appears, the screen comes back on. Press  to accept the change and then press  again to move to the next screen.
15. Press  to accept the change.
16. Press  again. Use the *VFD Timeout* screen, if required, to set the VFD Power Saver timeout period.
17. Press  to accept the change.
18. Press  again. Use the *VFD Rotation* screen, if required, to invert the display.
19. Press  again. By default, the *Autobase* screen is set to Off as the SPS356 is only a Rover receiver).
20. Press  again. The *Active Appfile* screen appears.

    To change the application file, press to display START Appfile. Press to show SAVE Appfile. Press to show DELETE Appfile. Press to show START Appfile.
21. Press  to accept the change.
22. Press  again. When the Home screen appears, the system setup is complete.

# Rear Connectors


| Item | Connector Type | Description |
|---|---|---|
| 1 | TNC | Connect to the GNSS antenna |
| 2 | Vent plug | External venting plug for pressure equalization |
| 3 | High Density DB26 | • Ethernet port 10/100 Base-T network through an RJ45 jack on a multiport adapter (P/N 57167 or P/N 57168)<br>• 'Slave' USB port through the USB type B connector on the multiport adapter (P/N 57167)<br>• 'Host' USB port through the connector on the 26-pin cable (P/N 58339)<br>• Primary power input from an external power supply<br>• 5-wire RS-232 serial port using various cables<br>• 1PPS output using breakout cables (P/N 60789-00 or P/N 77070-00)<br>• 3-wire RS-232 serial port (P/N 65791 or P/N 78235-00) |
| 4 | Lemo (7-pin/0-shell) | • 3-wire RS-232 serial port using a 7-pin/ 0 shell Lemo cable<br>• Secondary external power input |

# Connecting to a Device

## Using Bluetooth wireless technology

By default, the SPS356 Modular GNSS receiver 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 "SPS356 <Serial number>: <System Name>", for example: "SPS356 5436R00074: My System".

On a Window 7 device, the SPS356 Modular GNSS receiver will appear as a "Network Infrastructure Device" with an "Access Point" connection. When connected using the "Access Point", the SPS356 Modular GNSS receiver can be accessed using a web browser on the default IP address of 192.168.143.1.

## Using Wi-Fi

By default, the SPS356 Modular GNSS receiver 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 SPS356 Modular GNSS receiver SSID which will be 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. The default username is `admin`. The default password is `password`.
5. For detailed information on each page, use the Help links in the web interface.

# Upgrading the Receiver

The SPS356 receiver can be upgraded to track GLONASS, BeiDou, and Galileo single-frequency satellite signals.

To install an upgrade (option) codes, enter the code supplied by your Trimble Marine dealer into the Option Code field in the web interface of the receiver.

For more information, refer to the topic "Upgrading the Receiver Firmware" in the *Trimble SPS Modular GNSS Receivers Help*.

# Signal Tracking

This table shows the signal tracking capability for the receiver:

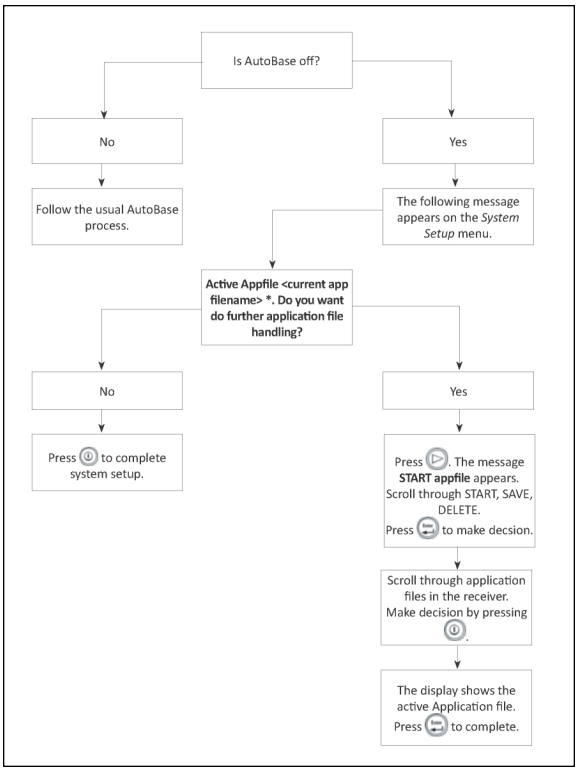
| Signal Type | Class | SPS356 |
|---|---|---|
| GPS signals | L1 | ✓ |
| | L2 | ✗ |
| | L2C | ✗ |
| | L5 | ✗ |
| QZSS | L1 C/A, L1C, L1 SAIF | ✓ |
| GLONASS signals | L1 | ✓ |
| Galileo | L1 | ✓ |
| BeiDou | B1 | ✓ |
| SBAS corrections | WAAS | ✓ |
| | EGNOS | ✓ |
| | MSAS | ✓ |
| OmniSTAR | XP | ✗ |
| | HP | ✗ |
| | VBS | ✗ |
| RTX | CenterPoint | ✗ |
| xFill | xFill | ✗ |

# Managing Application Files

You can use the front panel to manage application files in the receiver. You can see which application file the receiver is currently using and then choose to make changes to it and save it, load a different application file, or delete an application file.

To manage the application files, use the *System Setup* menu (see the figure below).

The following figure shows how application files are handled through the front panel of the receiver:



# 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 rover receiver using 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.

The SPS356 web browser interface can be accessed by connecting to its Wi-Fi Access Point using any Wi-Fi capable device with a web browser.

# Resetting the receiver to factory defaults

To reset the receiver to its factory defaults, do one of the following:

- Press  for 15 seconds.
- 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*.

# 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.<br>The orbit information is a subset of the ephemeris/ephemerides data. |
| **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. |
| **BeiDou** | The BeiDou Navigation Satellite System (also known as BDS ) is a Chinese satellite navigation system.<br>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.<br>The second generation of the system (known as 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.<br>A third generation of the BeiDou system is planned, which will expand coverage globally. This generation is currently scheduled to be completed by 2020. |
| **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. |

| | |
|---|---|
| **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.<br>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.<br>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).<br>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.<br>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.<br>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. |
| **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).<br>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. |
| **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.<br>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.<br>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).<br>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.<br>Most real-time differential correction methods apply corrections to code phase positions.<br>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 position. 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 greater. |
| **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:<br>• data STReams (record type STR)<br>• CASters (record type CAS)<br>• NETworks of data streams (record type NET)<br>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. |
| **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.<br>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.<br>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.<br>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.<br>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.<br>The WGS-84 datum is based on the ellipsoid of the same name. |