GETTING STARTED GUIDE

SPS351 MODULAR GPS RECEIVER

Version 4.17
Revision A
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Trimble

Legal Notice

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Legal Notices

Product Limited Warranty Information

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

COCOM limits

The U.S. Department of Commerce requires that all exportable GPS products contain performance limitations so that they cannot be used in a manner that could threaten the security of the United States. The following limitations are implemented on this product:

- Immediate access to satellite measurements and navigation results is disabled when the receiver velocity is computed to be greater than 1,000 knots, or its altitude is computed to be above 18,000 meters. The receiver GPS subsystem resets until the COCOM situation clears. As a result, all logging and stream configurations stop until the GPS subsystem is cleared.

Notices

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 and 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:

- Reorient or relocate the receiving antenna.
- 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.

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
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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.

Table of Contents

Safety Information

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

Use and care

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

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

Regulations and safety

All SPS receiver models are capable of transmitting data through Bluetooth wireless technology.

Bluetooth wireless technology operates in license-free bands.

The SNM910 cellular modem contains an internal Quad-Band GSM 850/900/1800/1900MHz radio modem.

Before operating a Trimble GPS 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 Legal 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 is far below the FCC radio frequency exposure limits. Nevertheless, the wireless radio shall be used in such a manner that the Trimble receiver is 20 cm or further from the human body. The internal wireless radio operates 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 is 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.

For GSM/GPRS radio

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

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

- ***DO NOT*** operate the transmitter when someone is within 28 cm (11 inches) of the antenna.
- All equipment should be serviced only by a qualified technician.

Installing antennas

Caution – For your own safety, and in terms of the RF exposure requirements of the FCC, always observe these precautions:
– Always maintain a minimum separation distance of 20 cm (7.8 inches) between yourself and the radiating antenna.
– Do not co-locate the antenna with any other transmitting device.

Warning – The GPS antenna and its cabling should be installed in accordance with all national and local electrical codes, regulations, and practices.

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

Battery safety

Connecting SPS receivers 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 an SPS 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.

Introduction

Trimble SPS351 Modular GPS receivers are ideal for the following marine construction applications:

- DGPS rover receiver on marine vessel
- Site and marine rover applications using Location GPS augmentation, including OmniSTAR, Location RTK, SBAS, Beacon, and DGPS RTCM

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 GPS data to the internal memory, and transfer the data over a serial or Ethernet 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 (www.trimble.com/support.shtml).

Trimble training courses – Consider a training course to help you use your GPS system to its fullest potential. For more information, go to the Trimble website at www.trimble.com/training.html.

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.

If you need to contact Trimble technical support, complete the online inquiry form at www.trimble.com/support_form.asp.

Your comments

Your feedback about the supporting documentation helps us to improve it with each revision. Email your comments to ReaderFeedback@trimble.com.

External Power

Sources of external power include:

- AC power
- 12 V car or truck battery
- Trimble custom external battery pack
- Generator power
- Solar panel

Use the supplied Trimble AC power adapter and one of the cables listed below as 'Power from AC adapter' when connecting to an AC supply.

Supported power cables

Part Number	SPS connection	Power connection	Power source	Other connectors
46125-20	7-pin Lemo	'Croc' clips	Power from 12 V car battery	None
56653-10	26-pin	Adapter with Hirose	Power from SPS700 total station battery cradle system	None
59044	7-pin Lemo	Cable with DC plug	Power to host devices from AC adapter	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 plug	Power from AC adapter	2 x Serial, Ethernet socket

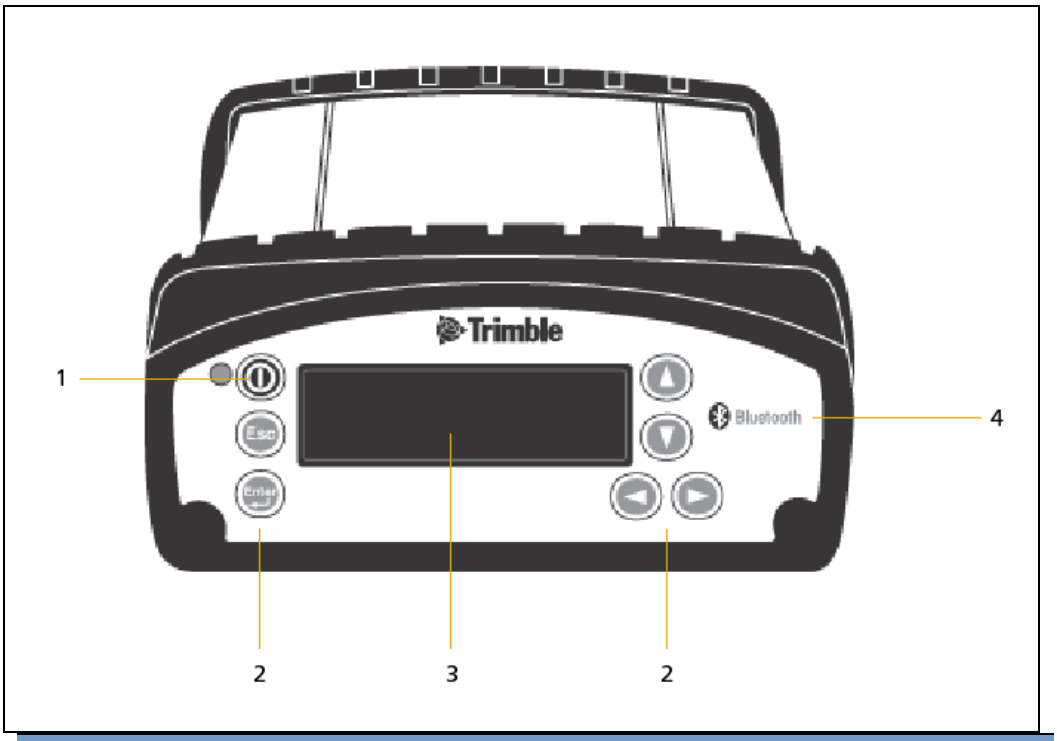
Connecting SPS receivers to a vehicle battery

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 an SPS receiver, ensure that you 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



	Feature	Description
1	Power button	Indicates if the receiver is turned 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 antenna	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.
Esc	Escape	Returns to the previous screen or cancels changes being made on a screen.
Enter	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. Press this button to enter Edit mode.

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 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 and use the default application file	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 (all stored memory is cleared)	35 seconds	The display shows a countdown timer. When the display goes blank, continue to hold the **Power** button. The display shows 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. It shows the following information:

- 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.
  - If the receiver is computing an autonomous solution, the Home screen displays all satellites in view, that is, all satellites above the elevation mask.

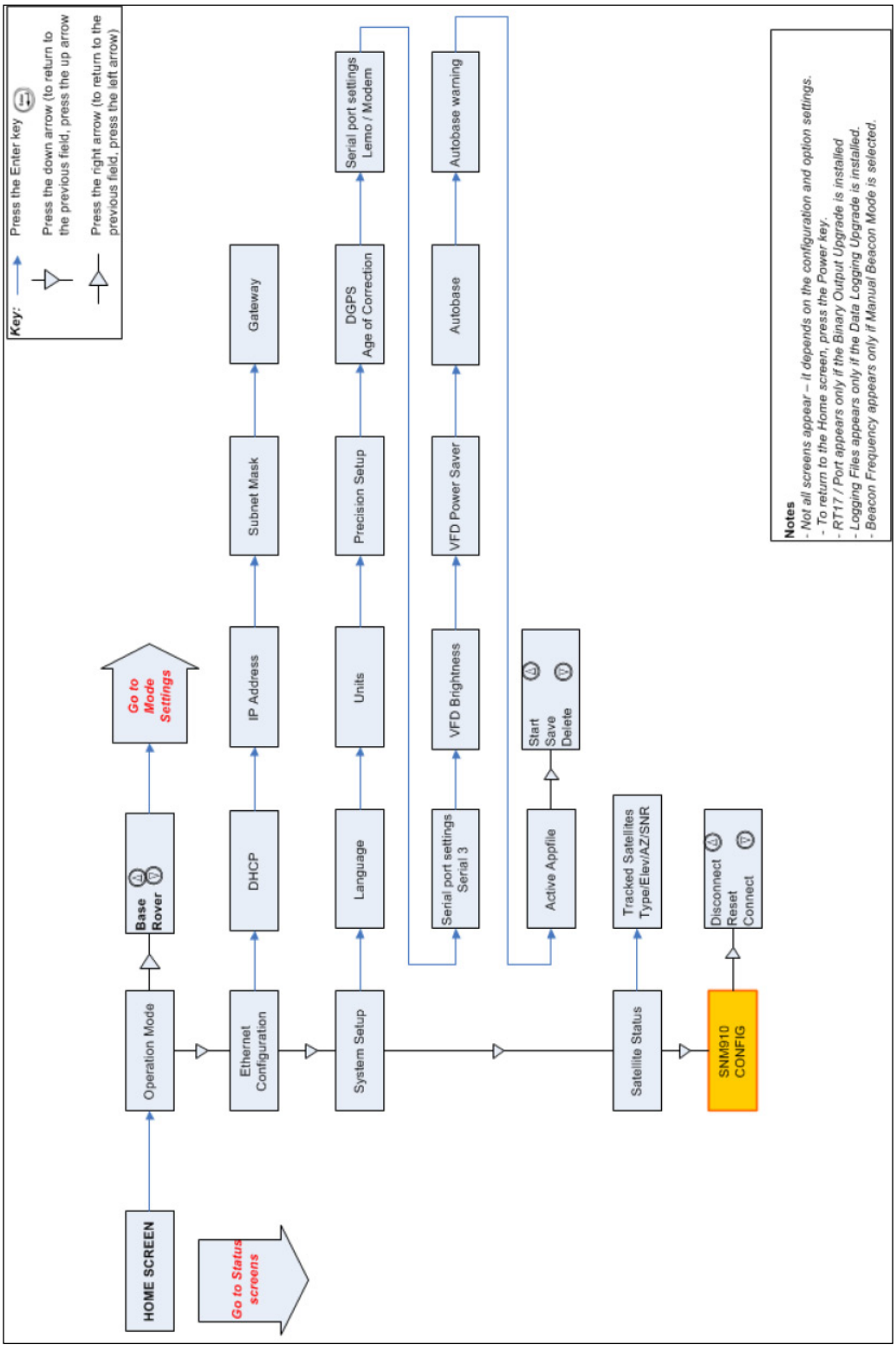
Tip – To view these details using the web interface, select ***Receiver Status*** / ***Position***.

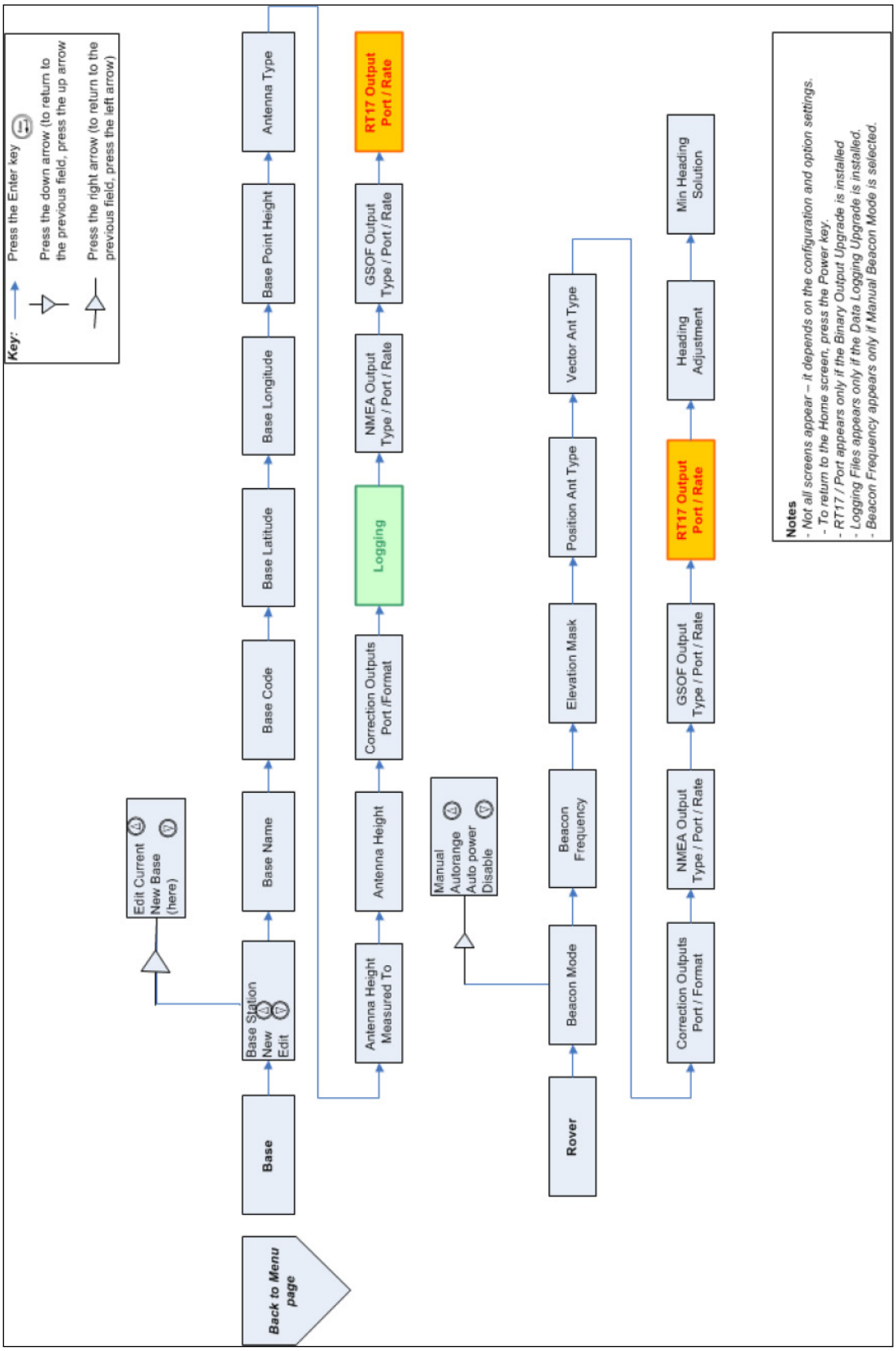
- MSK Beacon Status
  - If the internal Beacon receiver is enabled, the Home screen displays the Status of the Beacon and the frequency of the MSK Beacon station.
- Current mode configuration

Configuration screens

Use the front panel to do basic receiver configuration. Press Enter to navigate through the configuration screens and the arrow keys to change the selection.

For the full range of receiver configuration options, connect the receiver to a laptop using an ethernet cable and then enter the receiver IP address into a web browser to access the browser interface.



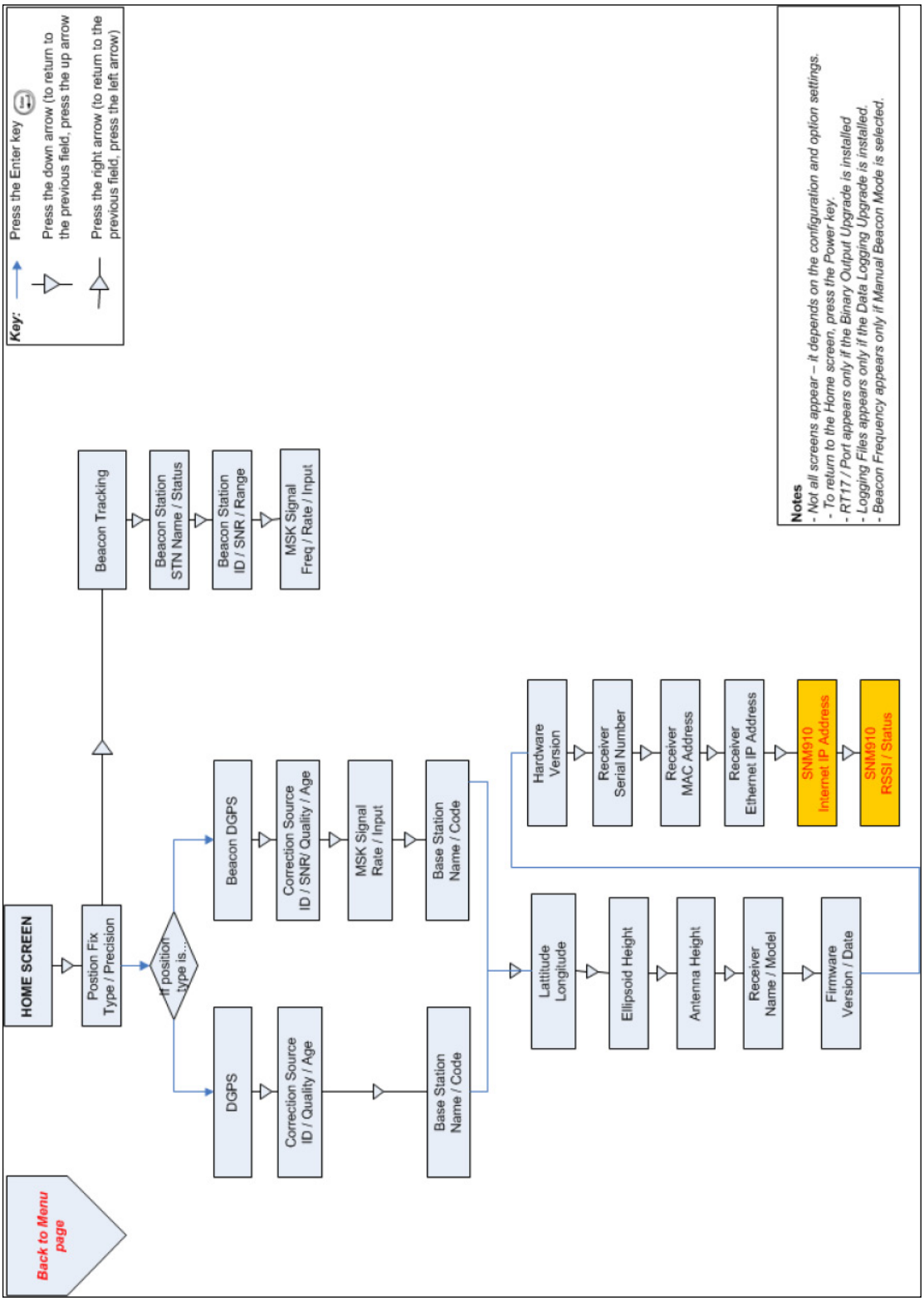

Key:
Press the Enter key
Press the down arrow (to return to the previous field, press the up arrow
Press the right arrow (to return to the previous field, press the left arrow)
Back to Menu page
Base
Base Station New Edit
Edit Current New Base (here)
Base Name
Base Code
Base Latitude
Base Longitude
Base Point Height
Antenna Type
Antenna Height Measured To
Antenna Height
Correction Outputs Port /Format
Logging
NMEA Output Type / Port / Rate
GSOF Output Type / Port / Rate
RT17 Output Port / Rate
Manual Autorange Auto power Disable
Rover
Beacon Mode
Beacon Frequency
Elevation Mask
Position Ant Type
Vector Ant Type
Correction Outputs Port / Format
NMEA Output Type / Port / Rate
GSOF Output Type / Port / Rate
RT17 Output Port / Rate
Heading Adjustment
Min Heading Solution
Notes
- Not all screens appear – it depends on the configuration and option settings.
- To return to the Home screen, press the Power key.
- RT17 / Port appears only if the Binary Output Upgrade is installed
- Logging Files appears only if the Data Logging Upgrade is installed.
- Beacon Frequency appears only if Manual Beacon Mode is selected.

Status screens

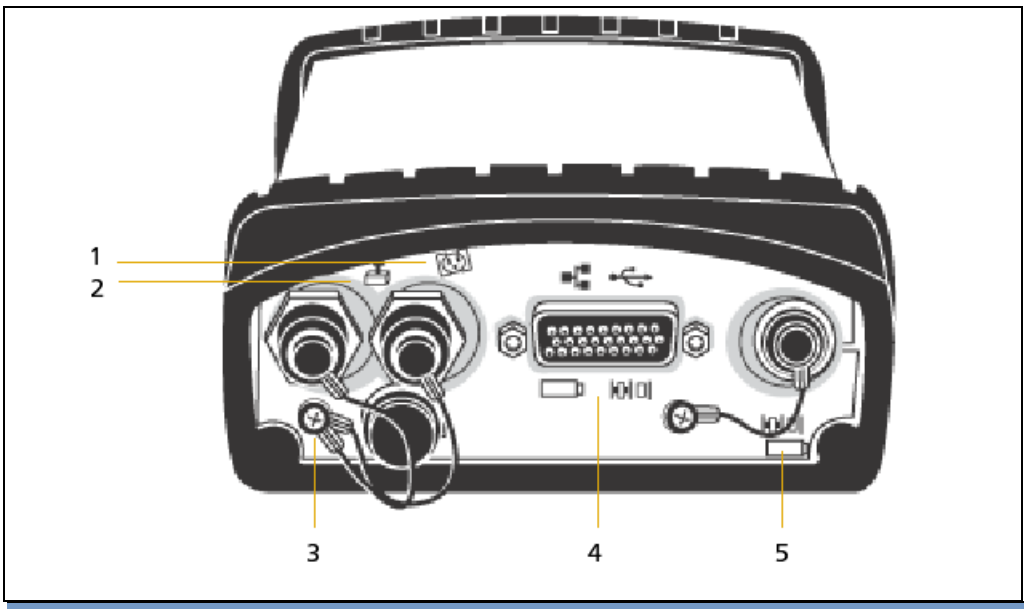
The receiver has several view-only status screens that allow you to review the current settings of the receiver. The status screens provide the following information:

- Position solution and precisions
- Beacon, CMR and RTCM IDs or OmniSTAR satellite
- Base ID, link quality and correction latency
- Beacon Signal details
- Base name and code
- Latitude, longitude, and height
- Antenna height
- Receiver model
- Receiver firmware version
- Receiver Hardware version
- Receiver serial number
- Receiver MAC address
- Receiver IP address

To access these screens from the Home screen, press  or  . For the full range of receiver status options, connect the receiver to a laptop using an ethernet cable and then enter the receiver IP address into a web browser to access the browser interface.


Key:
Press the Enter key
Press the down arrow (to return to the previous field, press the up arrow
Press the right arrow (to return to the previous field, press the left arrow)
Notes
- Not all screens appear – it depends on the configuration and option settings.
- To return to the Home screen, press the Power key.
- RT17 / Port appears only if the Binary Output Upgrade is installed
- Logging Files appears only if the Data Logging Upgrade is installed.
- Beacon Frequency appears only if Manual Beacon Mode is selected.
HOME SCREEN
Back to Menu page
Postion Fix Type / Precision
If position type is...
Beacon Tracking
Beacon Station STN Name / Status
Beacon Station ID / SNR / Range
MSK Signal Freq / Rate / Input
Beacon DGPS
Correction Source ID / SNR/ Quality / Age
MSK Signal Rate / Input
Base Station Name / Code
DGPS
Correction Source ID / Quality / Age
Base Station Name / Code
Lattitude Longitude
Ellipsoid Height
Antenna Height
Receiver Name / Model
Firmware Version / Date
Hardware Version
Receiver Serial Number
Receiver MAC Address
Receiver Ethernet IP Address
SNM910 Internet IP Address
SNM910 RSSI / Status

Rear Connectors



	Connector type	Description
1	TNC	Connect to the GPS antenna
2	Not applicable to the SPS351 receiver	
3	Vent plug	External venting plug for pressure equalization
4	High Density DB26	Ethernet connectivity to a 10/100 Base-T network through an RJ45 jack on a multiport adaptor (P/N 57167 or P/N 57168) 'Slave' USB communications through the USB type B connector on the multiport adaptor (P/N 57167) 'Host' USB communications through the connector on the 26-pin cable (P/N 58339) Primary power from an external power supply Full 9-wire RS-232 serial communications using the 26-9-pin multiport adaptor (P/N 57168) or a 26-pin serial communications cable 1PPS, 2 x RS-232 input DC, USB, Ethernet plug (P/N 60789-00 or P/N 77070-00) 2 x RS-232, DC, Ethernet socket (P/N 65791 or P/N 78235-00)
5	Lemo (7-pin/0-shell)	3 wire RS-232 serial communications using a 7-pin/ 0 shell Lemo cable Secondary external power input CAN

Signal Tracking

This table shows the signal tracking capability for the SPS351 receiver:

GPS signal type	Class	SPS351
GPS signals	L1	✓
	L2	✗
	L2C	✗
	L5	✗
GLONASS signals	L1/L2	✗
Galileo GIOVE		✗
GPS SBAS corrections	WAAS	✓
	EGNOS	✓
	MSAS	✓
OmniSTAR corrections	XP	✗
	HP	✗
	VBS	✗
Beacon corrections	MSK	✓

Variable Configuration Options

This table lists the default options for the SPS351 receiver:

Configuration option	SPS351
Rover options	
Precise horizontal	0.30m
Precise vertical	0.30m
Beacon	Autopower
Location RTK	DGPS only
RTK range limit	None
Base options	
Static RTK	N/A
Moving Base	N/A
RTCM DGPS	Optional
General options	
Data logging	Optional
VRS support	DGPS only
Max data rate	10 Hz

Upgrading the receiver

The SPS351 can be upgraded to include DGPS reference station capability.

When you purchase the upgrade after you have received the receiver, your Trimble dealer will provide you with a code to change the receiver configuration.

Managing Application Files

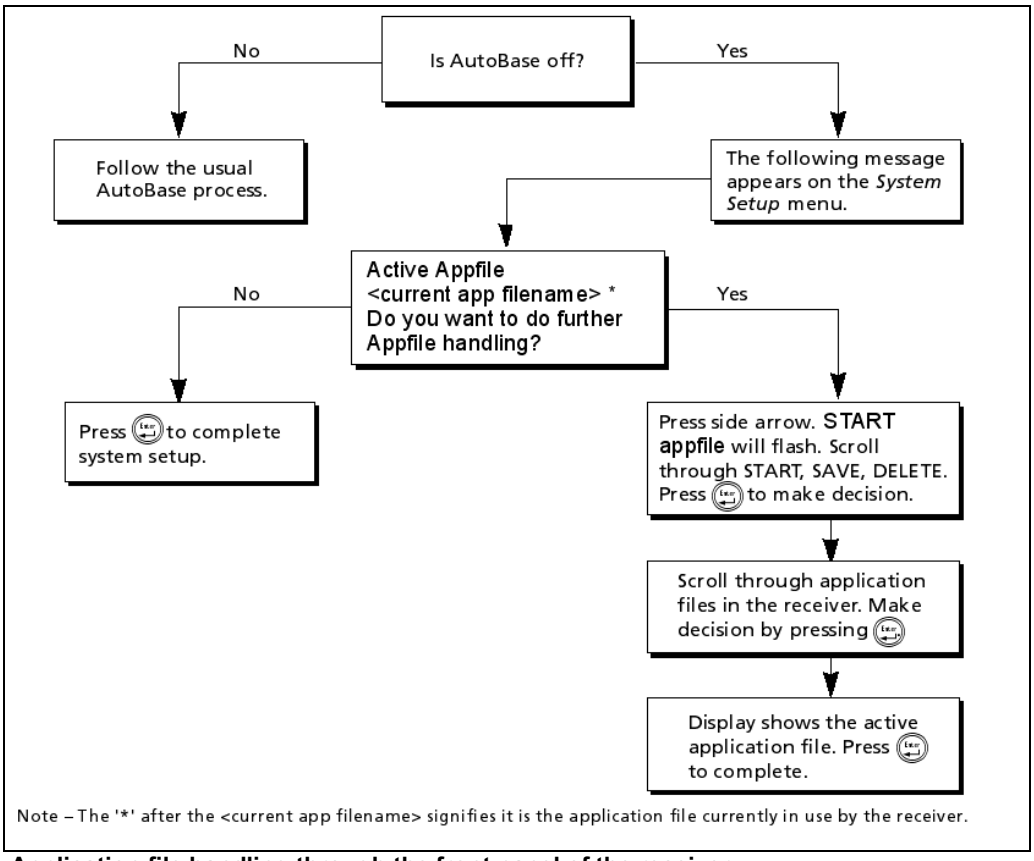
You can use the front panel to manage application files in the receiver. You can see which application file the receiver is currently using and then choose to make changes to it and save it, load a different application file, or delete an application file.

To manage the application files, use the ***System Setup*** menu (see the figure below). You can only manage application files when the AutoBase feature is turned off.

To save an application file, configure all the settings you need through the front panel and then save the file. When you save the file, the receiver provides a default filename, which you can change, based on the currently set mode. For example:

If the receiver is set to the following mode:	The suggested application filename is:
Base	BASE01
Rover	ROV01

Note *– If you start an application file that is saved with AutoBase turned* ***on*** *in the file, then it turns* ***on*** *AutoBase in the receiver, even if it was off before the file was loaded.*



Application file handling through the front panel of the receiver

Default Settings

All settings are stored in application files. The default application file, Default.cfg, is stored permanently in the receiver, and contains the factory default settings. Whenever the receiver is reset to its factory defaults, the current settings (stored in the current application file, Current.cfg) are reset to the values in the default application file.

You cannot modify the default application file. However, you can create a power-up application file so that the settings in this file can be applied immediately after the default application file, overriding the factory defaults. For more information, see Configuring the receiver using application files.

These settings are defined in the default application file.

Function	Settings	Factory default
SV Enable	-	All SVs enabled
General Controls	Autobase Operation Mode 1PPS VFD Configuration	Disabled Rover Enabled Enabled
Tracking Controls	Elevation Mask Everest (Multipath mitigation) SBAS tracking	10° Enabled L1-C/A
Position controls	PDOP Mask RTK Mode Motion Horizontal precision Vertical precision Age of corrections (max)	99 Low Latency Kinematic 0.30m 0.30m 60 sec
Lemo Port	Baud rate Format Flow control	38,400 8-None-1 None
Modem Port	Baud rate Format Flow control	38,400 8-None-1 None
Input Setup	Station	Any
NMEA/ASCII (all supported messages)		All ports Off
Streamed output		All Types Off Offset = 00
RT17/Binary		All ports Off
Reference position	Latitude Longitude Altitude	0° 0° 0.00 m HAE
Antenna	Type Height (true vertical) Measurement method	GA530 0.00 m Antenna phase center

Resetting the receiver to use default configuration

To reset the receiver to its default settings, do one of the following:

- On the receiver, press  for 15 seconds.
- In the Configuration Toolbox software, select the *Communications* menu and then click **Reset Receiver**.
- Using the Browser interface go to the Receiver Configuration menu, Reset tab and select Use Default Application File.

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 HYDRO***pro*** 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 Browser interface or the Configuration Toolbox software.

Troubleshooting

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

Issue	Possible cause	Solution
The receiver does not turn on	External power is too low.	Check the charge on the external power supply, and check the fuse if applicable. If required, replace the battery.
	External power is not properly connected.	Check that the Lemo connection is seated properly. Check for broken or bent pins in the connector.
	Faulty external power cable.	Try a different cable. Check pinouts with multimeter to ensure internal wiring is intact.
Receiver is not tracking any satellites	GPS antenna does not have clear line of sight to the sky.	Ensure that the antenna has a clear line of sight.
	The cable between receiver and the GPS antenna is damaged.	Replace the cable.
	Cable connections at receiver or antenna are not tightly seated, or are connected incorrectly.	Check all cable connections.
The receiver is not responding	Receiver needs a soft reset.	Turn off the receiver and then turn it back on again.
	Receiver needs a full reset.	Press  for 35 seconds.
The SPS Modular receiver cannot be set up as a base station using the SCS900 software	The SPS Modular receiver may have been purchased as a rover receiver rather than with the optional base station capability.	Ask your local dealer to check the Option Bit settings, else check the setting yourself using the WinFlash utility. If required, upgrade the receiver.

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 GPS satellite to a GPS receiver, where it facilitates rapid acquisition of GPS signals when you start collecting data, or when you have lost track of satellites and are trying to regain GPS 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 GPS 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.

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 adaptor 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. 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 GPS 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 GPS 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 accuracy is greater. When satellites are close together in the sky, the DOP is higher and GPS 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 accuracy 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 GPS. EGNOS is the European equivalent of WAAS, which is available in the United States.
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 GPS 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/breaklines, 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 PPS and GLONASS.
GHT	Height above geoid.
GIOVE	Galileo In-Orbit Validation Element. The name of each satellite for the European Space Agency to test the Galileo positioning system.
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 accuracy 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).
IBSS	Internet Base Station Service. This Trimble service makes the setup of an Internet-capable SPS receiver as simple as possible. The base station can be connected to the Internet (cable or wirelessly). To access the distribution server, the user enter 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.
Location RTK	Some applications such as vehicular-mounted site supervisor systems do not require Precision RTK accuracy. Location RTK is a mode in which, once initialized, the receiver will operate either in 10 cm horizontal and 10 cm vertical accuracy, or in 10 cm horizontal and 2 cm vertical accuracy.
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.

Moving Base	Moving Base is an RTK positioning technique in which both reference and rover receivers are mobile. Corrections are sent from a “base” receiver to a “rover” receiver and the resultant baseline (vector) has centimeter-level accuracy.
MSAS	MTSAT Satellite-Based Augmentation System. A Satellite-Based Augmentation System (SBAS) that provides a free-to-air differential correction service for GPS. MSAS is the Japanese equivalent of WAAS, which is available in the United States.
multipath	Interference, similar to ghosts on an analog television screen, that occurs when GPS 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 GPS 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 GPS systems are accurate to within a meter or so, OmniSTAR with XP is accurate in 3D to better than 30 cm.
PDOP	Position Dilution of Precision. PDOP is a DOP value that indicates the accuracy 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.
POE	Power Over Ethernet. Provides DC power to the SPS Modular receiver using an Ethernet cable.
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.
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 GPS base station to a rover GPS receiver to provide sub-meter position accuracy. The rover receiver can be at a long range (greater than 100 kms (62 miles)) from the base station.
rover	A rover is any mobile GPS 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 GPS receivers. There are three versions of RTCM correction messages. All Trimble GPS receivers use Version 2 protocol for single-frequency DGPS type corrections. Carrier phase corrections are available on Version 2, or on the newer Version 3 RTCM protocol, which is available on certain Trimble dual-frequency receivers. The Version 3 RTCM protocol is more compact but is not as widely supported as Version 2.
RTK	real-time kinematic. A real-time differential GPS method that uses carrier phase measurements for greater accuracy.
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 GPS signal and displays the number of satellites tracked by the GPS 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.
VRS	Virtual Reference Station. A VRS system consists of GPS 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 GPS 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 GPS receiver, exactly like a GPS 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.