USER GUIDE

Trimble BX960 GNSS Receiver Enclosure

Version 4.44
Revision A
April 2012

Corporate Office

Trimble Navigation Limited
Integrated Technologies
510 DeGuigne Drive
Sunnyvale, CA 94085
USA
+1-408-481-8070 Phone
+1-408-481-8984 Fax
www.trimble.com/gnss-inertial
Email: GNSSOEMSupport@trimble.com

Legal Notices

Support for Galileo is developed under a license of the European Union and the European Space Agency (BD910/BD920/BD970/BD982/BX982).

Release Notice

This is the April 2012 release (Revision A) of the [System Name] documentation. It applies to version 4.44 of the receiver firmware.

LIMITED WARRANTY TERMS AND CONDITIONS

Product Limited Warranty

Subject to the following terms and conditions, Trimble Navigation Limited ("Trimble") warrants that for a period of one (1) year from date of purchase (except the BD970 which is warranted for 18 months), this Trimble product (the "Product") will substantially conform to Trimble's publicly available specifications for the Product and that the hardware and any storage media components of the Product will be substantially free from defects in materials and workmanship.

Product Software

Product software, whether built into hardware circuitry as firmware, provided as a standalone computer software product, embedded in flash memory, or stored on magnetic or other media, is licensed solely for use with or as an integral part of the Product and is not sold. If accompanied by a separate end user license agreement ("EULA"), use of any such software will be subject to the terms of such end user license agreement (including any differing limited warranty terms, exclusions, and limitations), which shall control over the terms and conditions set forth in this limited warranty.

Software Fixes

During the limited warranty period you will be entitled to receive such Fixes to the Product software that Trimble releases and makes commercially available and for which it does not charge separately, subject to the procedures for delivery to purchasers of Trimble products generally. If you have purchased the Product from an authorized Trimble dealer rather than from Trimble directly, Trimble may, at its option, forward the software Fix to the Trimble dealer for final distribution to you. Minor Updates, Major Upgrades, new products, or substantially new software releases, as identified by Trimble, are expressly excluded from this update process and limited warranty. Receipt of software Fixes or other enhancements shall not serve to extend the limited warranty period.
For purposes of this warranty the following definitions shall apply: (1) "Fix(es)" means an error correction or other update created to fix a previous software version that does not substantially conform to its Trimble specifications; (2) "Minor Update" occurs when enhancements are made to current features in a software program; and (3) "Major Upgrade" occurs when significant new features are added to software, or when a new product containing new features replaces the further development of a current product line. Trimble reserves the right to determine, in its sole discretion, what constitutes a Fix, Minor Update, or Major Upgrade.

Warranty Remedies

If the Trimble Product fails during the warranty period for reasons covered by this limited warranty and you notify Trimble of such failure during the warranty period, Trimble will repair OR replace the nonconforming Product with new, equivalent to new, or reconditioned parts or Product, OR refund the Product purchase price paid by you, at Trimble's option, upon your return of the Product in accordance with Trimble's product return procedures then in effect.

How to Obtain Warranty Service

To obtain warranty service for the Product, please contact your local Trimble authorized dealer. Alternatively, you may contact Trimble to request warranty service at +1-408-481-8081 or e-mail your request to GNSSOEMSupport@trimble.com. Please be prepared to provide:
– your name, address, and telephone numbers
– proof of purchase
– a copy of this Trimble warranty
– a description of the nonconforming Product including the model number
– an explanation of the problem
The customer service representative may need additional information from you depending on the nature of the problem.

Warranty Exclusions or Disclaimer

This Product limited warranty shall only apply in the event and to the extent that (a) the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Trimble's applicable operator's manual and specifications, and; (b) the Product is not modified or misused. This Product limited warranty shall not apply to, and Trimble shall not be responsible for, defects or performance problems resulting from (i) the combination or utilization of the Product with hardware or software products, information, data, systems, interfaces, or devices not made, supplied, or specified by Trimble; (ii) the operation of the Product under any specification other than, or in addition to, Trimble's standard specifications for its products; (iii) the unauthorized installation, modification, or use of the Product; (iv) damage caused by: accident, lightning or other electrical discharge, fresh or salt water immersion or spray (outside of Product specifications); or exposure to environmental conditions for which the Product is not intended; (v) normal wear and tear on consumable parts (e.g., batteries); or (vi) cosmetic damage. Trimble does not warrant or guarantee the results obtained through the use of the Product, or that software components will operate error free.

NOTICE REGARDING PRODUCTS EQUIPPED WITH TECHNOLOGY CAPABLE OF TRACKING SATELLITE SIGNALS FROM SATELLITE BASED AUGMENTATION SYSTEMS (SBAS) (WAAS/EGNOS, AND MSAS), OMNISTAR, GPS, MODERNIZED GPS OR GLONASS SATELLITES, OR FROM IALA BEACON SOURCES: *TRIMBLE IS NOT RESPONSIBLE FOR THE OPERATION OR FAILURE OF OPERATION OF ANY SATELLITE BASED POSITIONING SYSTEM OR THE AVAILABILITY OF ANY SATELLITE BASED POSITIONING SIGNALS.*

THE FOREGOING LIMITED WARRANTY TERMS STATE TRIMBLE'S ENTIRE LIABILITY, AND YOUR EXCLUSIVE REMEDIES, RELATING TO THE TRIMBLE PRODUCT. EXCEPT AS OTHERWISE EXPRESSLY PROVIDED HEREIN, THE PRODUCT, AND ACCOMPANYING DOCUMENTATION AND MATERIALS ARE PROVIDED "AS-IS" AND WITHOUT EXPRESS OR IMPLIED WARRANTY OF ANY KIND, BY EITHER TRIMBLE OR ANYONE WHO HAS BEEN INVOLVED IN ITS CREATION, PRODUCTION, INSTALLATION, OR DISTRIBUTION, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, TITLE, AND NONINFRINGEMENT. THE STATED EXPRESS WARRANTIES ARE IN LIEU OF ALL OBLIGATIONS OR LIABILITIES ON THE PART OF TRIMBLE ARISING OUT OF, OR IN CONNECTION WITH, ANY PRODUCT. BECAUSE SOME STATES AND JURISDICTIONS DO NOT ALLOW LIMITATIONS ON DURATION OR THE EXCLUSION OF AN IMPLIED WARRANTY, THE ABOVE LIMITATION MAY NOT APPLY OR FULLY APPLY TO YOU.

Limitation of Liability

TRIMBLE'S ENTIRE LIABILITY UNDER ANY PROVISION HEREIN SHALL BE LIMITED TO THE AMOUNT PAID BY YOU FOR THE PRODUCT. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, IN NO EVENT SHALL TRIMBLE OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGE WHATSOEVER UNDER ANY CIRCUMSTANCE OR LEGAL THEORY RELATING IN ANYWAY TO THE PRODUCTS, SOFTWARE AND ACCOMPANYING DOCUMENTATION AND MATERIALS, (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF DATA, OR ANY OTHER PECUNIARY LOSS), REGARDLESS OF WHETHER TRIMBLE HAS BEEN ADVISED OF THE POSSIBILITY OF ANY SUCH LOSS AND REGARDLESS OF THE COURSE OF DEALING WHICH DEVELOPS OR HAS DEVELOPED BETWEEN YOU AND TRIMBLE. BECAUSE SOME STATES AND JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, THE ABOVE LIMITATION MAY NOT APPLY OR FULLY APPLY TO YOU.

PLEASE NOTE: THE ABOVE TRIMBLE LIMITED WARRANTY PROVISIONS WILL NOT APPLY TO PRODUCTS PURCHASED IN THOSE JURISDICTIONS (E.G., MEMBER STATES OF THE EUROPEAN ECONOMIC AREA) IN WHICH PRODUCT WARRANTIES ARE THE RESPONSIBILITY OF THE LOCAL TRIMBLE AUTHORIZED DEALER FROM WHOM THE PRODUCTS ARE ACQUIRED. IN SUCH A CASE, PLEASE CONTACT YOUR LOCAL TRIMBLE AUTHORIZED DEALER FOR APPLICABLE WARRANTY INFORMATION.

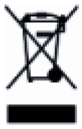
Official Language

THE OFFICIAL LANGUAGE OF THESE TERMS AND CONDITIONS IS ENGLISH. IN THE EVENT OF A CONFLICT BETWEEN ENGLISH AND OTHER LANGUAGE VERSIONS, THE ENGLISH LANGUAGE SHALL CONTROL.

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

Contents

CHAPTER

1

Introduction

In this chapter:

This manual describes how to set up and use the Trimble GNSS receiver module. The receiver uses advanced navigation architecture to achieve real-time centimeter accuracies with minimal latencies.

Even if you have used other GNSS or GPS products before, Trimble recommends that you spend some time reading this manual to learn about the special features of this product. If you are not familiar with GNSS or GPS, visit the Trimble website (www.trimble.com).

About the BX960 and BX960-2 receivers

The BX960 receiver enclosure allows OEM and system integrator customers to rapidly integrate high accuracy GNSS into their applications. The single-board BX960 is ideal as either a base station or a rover. The two-board model (the BX960-2) is suited for applications that require precise heading in addition to positions.

The BX960 receiver provides reliable operation in all environments, and a positioning interface to an office computer, external processing device, or control system. You can control the receiver through a serial or Ethernet port using binary interface commands or web interface.

Both receivers are packaged with an AC-to-DC power supply and a DB26-to-DB9/RJ45/power cable.

Note – *Use the information in this manual with the BD960 GNSS Receiver User Guide*

BX960 features

The receiver has the following features:

- 72-channel L1/L2/L2C/L5 GPS plus L1/L2 GLONASS receiver
- OmniSTAR XP/HP/VBS service capable
- SBAS (Satellite Based Augmentation System) compatible:
  – WAAS (Wide Area Augmentation System)
  – EGNOS (European Geo-Stationary Navigation System)
  – MSAS (MTSAT Satellite-Based Augmentation System)
- Configuration and monitoring through the following methods:
  – Web interface
  – Networked or peer-to-peer Ethernet
  – Binary interface commands
- Choice of external GPS antenna for base station or rover operation
- –40 °C to +67 °C (–40 °F to +152 °F) operating temperature range
- 9 V to 28 V DC input power range, with over-voltage protection
- Moving baseline capability
- 5 Hz, 10 Hz, or 20 Hz measurement update rate
- RoHS compliant
- 1 pulse per second (1PPS) output
- 3 LEDs that indicate power, satellite tracking, and differential data
- DB9, DB26, and TNC antenna connectors
- Rugged 4-hole mounting aluminium housing

BX960-2 features

The receiver has the following features:

- Two 72-channel L1/L2/L2C/L5 GPS plus L1/L2 GLONASS receivers
- OmniSTAR XP/HP/VBS service capable
- SBAS compatible:
  – WAAS
  – EGNOS
  – MSAS
- Configuration and monitoring through the following methods:
  – Web interface
  – Networked or peer-to-peer Ethernet
  – Binary interface commands
- Choice of external GPS antenna for base station or rover operation
- –40 °C to +67 °C (–40 °F to +152 °F) operating temperature range
- 9 V to 28 V DC input power range, with over-voltage protection
- Moving baseline capability
- 5 Hz, 10 Hz, or 20 Hz measurement update rate
- RoHS compliant
- 1 pulse per second (1PPS) output
- 6 LEDs that indicate power, satellite tracking, and differential data
- 2 x DB9, DB26, and 2 x TNC antenna connectors
- Rugged 4-hole mounting aluminium housing

Receiver architecture

BX960

The BX960 receiver provides an enclosure for a single BD960 GNSS receiver. Simply connect power and an antenna to create a complete GNSS system. Three LEDs indicate power, differential corrections, and satellite tracking status. Access to serial, Ethernet, and 1PPS is available through DB connectors.

BX960-2

When computing offsets from the antenna to the point of interest, or providing consistent vehicle orientation, heading information is critical.

The BX960-2 receiver enclosure contains two BD960 GNSS receivers, and so can provide that heading information. The technique of Moving Base RTK provides an accurate vector between the two boards. CMR corrections from the master to slave board are routed inside the receiver on a serial port. The Moving Base RTK vector outputs can be sent in ASCII or binary format through the slave board DB9 serial port. An additional DB9 connector, antenna connector, and three more LEDs are installed on the BX960-2 enclosure.

Configuring the BX960 and BX960-2 receiver

Use this manual with the *BD960 GNSS Receiver User Guide*. All firmware features and software configuration utilities are documented in that manual.

The connectors support the following I/O. For more information, see BX960 receiver pinout information, page 18 and BX960-2 receiver pinout information.

BX960 receiver I/O

Type	Connector
Serial Port 1	DB26 connector labeled Data/Power
Ethernet	
1PPS	
Serial Port 2	DB9 connector labeled GPS1

BX960-2 receiver I/O

Type	Connector
Serial Port 1 (for the master)	DB26 connector labeled Data/Power
Ethernet (for the master)	
1PPS	
Serial Port 2 (for the master)	DB9 connector labeled GPS1
Serial Port 2 (for the slave)	DB9 connector labeled GPS2

Configuring the BX960 receiver to output reference station data

1. Connect the computer to the DB9 port labeled GPS1 or use the provided adapter cable to connect to the DB26 port labeled Data/Power.
2. Do one of the following:
   - Enter a base station position using known coordinates (MSController, Configuration Toolbox, or web interface software).
   - Select the *Here* position (MSController or web interface software only), to set the base station position.

3. Use the MSController, Configuration Toolbox, or Web interface software to enable CMR or RTCM outputs from serial port 1 or 2.

Configuring the BX960 or BX960-2 receiver to output rover RTK positions

1. Supply differential data to either the DB9 port labeled GPS1 or the DB26 port labeled Data/Power.

   If there is an antenna attached, the differential data (middle) LED on receiver 1 lights up. This shows that you are receiving valid differential data. It does ***not*** show that you are computing a fixed solution. For additional details on LED functionality, operation and troubleshooting, refer to the *BD960 GNSS Receiver User Guide*.
2. Connect the computer to the DB9 port labeled GPS1 or use the provided cable to connect to the DB26 port labeled Data/Power.
3. Use the MSController or web interface software to ensure that you are computing fixed solutions.
4. Use the MSController, Configuration Toolbox, or web interface software to enable the required ASCII (NMEA) or Binary (Data Collector Format Report Packets) messages from serial port 1, or 2.

Configuring the BX960-2 receiver to output heading data

1. Connect the computer to the DB9 port labeled GPS1 or use the provided adapter cable to connect to the DB26 port labeled Data/Power.
2. Use the MSController, Configuration Toolbox, or web interface software to enable CMR+ outputs at 10 Hz on port 3.

   If there is an antenna attached, the differential data (middle) LED on receiver 2 lights up.
3. Connect the computer to the DB9 port labeled GPS2.
4. Use the MSController, Configuration Toolbox, or web interface software to enable either ASCII messages (NMEA AVR or VHD) or Binary (Report Packet 40h, Type 27 record) messages from serial port 2.

For more information

For more advanced information on how to configure the receivers inside the BX960-2 receiver enclosure, refer to the *BD960 GNSS Receiver User Guide*.

Technical support

If you have a problem and cannot find the information you need in the product documentation, send an email to GNSSOEMSupport@trimble.com.

Documentation, firmware, and software updates are available at: www.trimble.com/gnss-inertial/GNSS-Positioning-and-Heading-Systems.aspx.

CHAPTER

2

Specifications

In this chapter:

This chapter details the specifications for the receiver.

Specifications are subject to change without notice.

Performance specifications

Feature	Specification

Measurements	• Advanced Trimble Maxwell™ Custom Survey GNSS Technology
	• High precision multiple correlator for GNSS pseudorange measurements
	• Unfiltered, unsmoothed pseudorange measurements data for low noise, low multipath error, low time domain correlation and high dynamic response
	• Very low noise GNSS carrier phase measurements with <1 mm precision in a 1 Hz bandwidth
	• Signal-to-Noise ratios reported in dBHz
	• 72 channels:
	    • GPS L1 C/A Code, L2C, L1/L2/L5 Full Cycle Carrier
	    • GLONASS L1 C/A Code, L1 P Code, L2 C/A2, L2 P Code
	    • 4 additional channels for SBAS (WAAS, EGNOS and MSAS) support
	    • L-Band OmniSTAR VBS, HP, and XP
	• The BX960-2 receiver contains an additional 72-channel receiver that is configured for heading only

Code differential GPS positioning accuracy[1]	3D: Typically, < 1 m
SBAS accuracy[2]	Horizontal: Typically <1 m Vertical: Typically <5 m
OmniSTAR positioning accuracy	VBS service: Horizontal <1 m XP service: Horizontal 20 cm, Vertical 30 cm HP service: Horizontal 10 cm, Vertical 15 cm
RTK positioning accuracy (<30 km)	Horizontal: ±8 mm + 1 ppm) RMS Vertical: ±(15 mm + 1 ppm) RMS
Initialization time	Typically, 10 seconds
Initialization reliability[3]	Typically >99.9%

[1]Accuracy and reliability may be subject to anomalies such as multipath, obstructions, satellite geometry, and atmospheric conditions. Always follow recommended practices.

[2]Depends on WAAS, EGNOS, and MSAS system performance.

[3]May be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.

Physical specifications

Feature	Specification
Dimensions (L x W x H)	261 mm x 140 mm x 55 mm
Temperature	Operating:–40 °C to +67 °C (–40 °F to +152 °F)
	Storage:–55 °C to +85 °C (–67 °F to +185 °F)
Vibration	MIL810F, tailored Random 6.2 gRMS operating Random 8 gRMS survival
Mechanical shock	MIL810D ±40 g operating ±75 g survival
I/O connector	D-sub DE9 and DA26 The BX960-2 receiver has an additional DE9 connector
Antenna connector	TNC The BX960-2 receiver has an additional TNC connector

Electrical specifications

Feature	Specification
Voltage	9 V to 28 V DC external power input with over-voltage protection
Power consumption	Maximum 8.8 W (BX960-2)

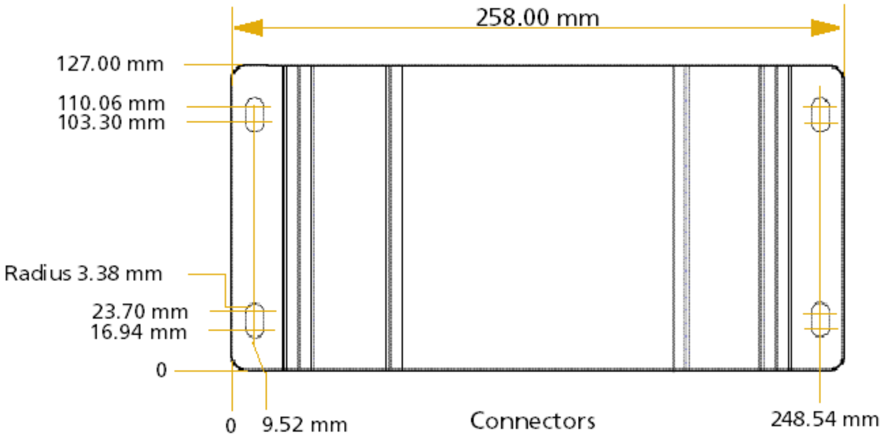
Communication specifications

Feature	Specification	
Communications	1 LAN port	• Supports links to 10BaseT/100BaseT networks. • All functions are performed through a single IP address simultaneously – including web interface access and data streaming.
	RS-232 ports	Baud rates up to 115,200 • BX960 receiver: two RS-232 ports • BX960-2 receiver: three RS-232 ports
Receiver position update rate	1 Hz, 2 Hz, 5 Hz, 10 Hz, and 20 Hz positioning	
Correction data input	CMR, CMR+™, sCMRx, RTCM 2.0–2.3, RTCM 3.0	
Correction data output	CMR, CMR+, sCMRx, RTCM 2.0 DGPS (select RTCM 2.1), RTCM 2.1–2.3, RTCM 3.0	
Data outputs	1PPS, NMEA, Binary GSOF, ASCII Time Tags	

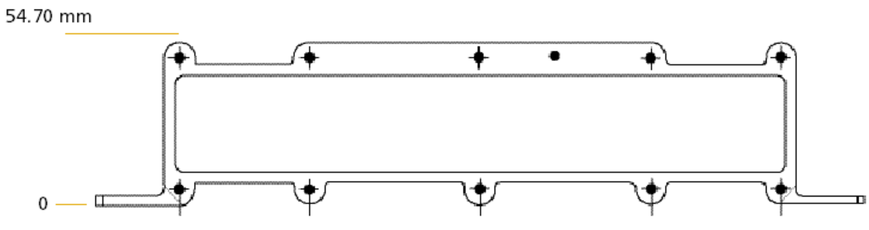
Receiver drawings

The following drawings show the dimensions of the BX960 receiver. Refer to these drawings if you need to build mounting brackets and housings for the receiver.

Plan view



Edge view



BX960 receiver pinout information

GPS1 DE9 (M) connector

Pin 1 is the top left pin.

Pin	Usage
1	Not connected
2	RS-232 RX data in (Master Port 2)
3	RS-232 TX data out (Master Port 2)
4	Not connected
5	GND
6	Not connected
7	RTS
8	CTS
9	Not connected

Data/power DA26 (M) connector

Pin 1 is the top left pin.

Pin	Usage
1	Not connected
2	Not connected
3	Not connected
4	Not connected
5	Not connected
6	GND
7	Not connected
8	Not connected
9	Not connected
10	Not connected

Pin	Usage
11	Not connected
12	RS-232 TX data out (Master Port 1)
13	Not connected
14	Not connected
15	Not connected
16	Ethernet receive data (RD-RJ45 Pin 6)
17	Ethernet transmit data (TD-RJ45 Pin 2)
18	Not connected
19	Not connected
20	1PPS
21	RS-232 RX data in (Master Port 1)
22	Not connected
23	GND
24	DC power in, 9 – 28 V DC
25	Ethernet receive data (RD+ RJ45 Pin 3)
26	Ethernet transmit data (TD+ RJ45 Pin 1)

BX960-2 receiver pinout information

GPS1 DE9 (M) connector

Pin 1 is the top left pin.

Pin	Usage
1	Not connected
2	RS-232 RX data in (Master Port 2)
3	RS-232 TX data out (Master Port 2)
4	Not connected
5	GND
6	Not connected
7	RTS
8	CTS
9	Not connected

GPS2 DE9 (M) connector

Pin 1 is the top left pin.

Pin	Usage
1	Not connected
2	RS-232 RX data in (Slave Port 2)
3	RS-232 TX data out (Slave Port 2)
4	Not connected
5	GND
6	Not connected
7	RTS
8	CTS
9	Not connected

Data/power DA26 (M) connector

Pin 1 is the top left pin.

Pin	Usage
1	Not connected
2	Not connected
3	Not connected
4	Not connected
5	Not connected
6	GND
7	Not connected
8	Not connected
9	Not connected
10	Not connected
11	Not connected
12	RS-232 TX data out (Master Port 1)
13	Not connected
14	Not connected
15	Not connected
16	Ethernet receive data (RD-RJ45 Pin 6)
17	Ethernet transmit data (TD-RJ45 Pin 2)
18	Not connected
19	Not connected
20	1PPS
21	RS-232 RX data in (Master Port 1)
22	Not connected
23	GND
24	DC power in, 9 – 28 V DC
25	Ethernet receive data (RD+ RJ45 Pin 3)
26	Ethernet transmit data (TD+ RJ45 Pin 1)

Master Port 3 TX line

Internally, the Master Port 3 TX line is connected to the Slave Port 3 RX line.

Troubleshooting receiver issues

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

Issue	Possible cause	Solution
The receiver does not turn on.	External power is too low.	Check that the input voltage is within limits.
The base station receiver is not broadcasting.	Port settings between reference receiver and radio are incorrect.	Check the settings on the radio and the receiver.
	Faulty cable between receiver and radio.	Try a different cable.
		Examine the ports for missing pins.
		Use a multimeter to check pinouts.
	No power to radio.	If the radio has its own power supply, check the charge and connections.
		Examine the ports for missing pins.
		Use a multimeter to check pinouts.
Rover receiver is not receiving radio.	The base station receiver is not broadcasting.	See the issue "The base station receiver is not broadcasting" above.
	Incorrect over air baud rates between reference and rover.	Connect to the rover receiver radio, and make sure that it has the same setting as the reference receiver.
	Incorrect port settings between roving external radio and receiver.	If the radio is receiving data and the receiver is not getting radio communications, check that the port settings are correct.
The receiver is not receiving satellite signals.	The GPS antenna cable is loose.	Make sure that the GPS antenna cable is tightly seated in the GPS antenna connection on the GPS antenna.
	The cable is damaged.	Check the cable for any signs of damage. A damaged cable can inhibit signal detection from the antenna at the receiver.
	The GPS antenna is not in clear line of sight to the sky.	Make sure that the GPS antenna is located with a clear view of the sky.
		Restart the receiver as a last resort (turn off and then turn it on again).

Glossary

1PPS	Pulse-per-second. Used in hardware timing. A pulse is generated in conjunction with a time stamp. This defines the instant when the time stamp is applicable.
almanac	A file that contains orbit information on all the satellites, clock corrections, and atmospheric delay parameters. The almanac is transmitted by a GNSS satellite to a GNSS receiver, where it facilitates rapid acquisition of GNSS signals when you start collecting data, or when you have lost track of satellites and are trying to regain GNSS signals. The orbit information is a subset of the ephemeris/ephemerides data.
AutoBase	AutoBase technology uses the position of the receiver to automatically select the correct base station; allowing for one button press operation of a base station. It shortens setup time associated with repeated daily base station setups at the same location on jobsites.
base station	Also called *reference station*. In construction, a base station is a receiver placed at a known point on a jobsite that tracks the same satellites as an RTK rover, and provides a real-time differential correction message stream through radio to the rover, to obtain centimeter level positions on a continuous real-time basis. A base station can also be a part of a virtual reference station network, or a location at which GNSS observations are collected over a period of time, for subsequent postprocessing to obtain the most accurate position for the location.
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.
Compass	The BeiDou Navigation Satellite System (Compass) is a Chinese satellite navigation system. The first BeiDou system (known as BeiDou-1), consists of three satellites and has limited coverage and applications. It has been offering navigation services mainly for customers in China and from neighboring regions since 2000. The second generation of the system (known as Compass or BeiDou-2) consists of 35 satellites. It became operational with coverage of China in December 2011 with 10 satellites in use. It is planned to offer services to customers in Asia-Pacific region by 2012 and the global system should be finished by 2020.
covariance	A statistical measure of the variance of two random variables that are observed or measured in the same mean time period. This measure is equal to the product of the deviations of corresponding values of the two variables from their respective means.
datum	Also called *geodetic datum*. A mathematical model designed to best fit the geoid, defined by the relationship between an ellipsoid and, a point on the topographic surface, established as the origin of the datum. World geodetic datums are typically defined by the size and shape of an ellipsoid and the relationship between the center of the ellipsoid and the center of the earth. Because the earth is not a perfect ellipsoid, any single datum will provide a better model in some locations than in others. Therefore, various datums have been established to suit particular regions. For example, maps in Europe are often based on the European datum of 1950 (ED-50). Maps in the United States are often based on the North American datum of 1927 (NAD-27) or 1983 (NAD-83). All GPS coordinates are based on the WGS-84 datum surface.
deep discharge	Withdrawal of all electrical energy to the end-point voltage before the cell or battery is recharged.
DGPS	See real-time differential GPS.
differential correction	Differential correction is the process of correcting GNSS data collected on a rover with data collected simultaneously at a base station. Because the base station is on a known location, any errors in data collected at the base station can be measured, and the necessary corrections applied to the rover data. Differential correction can be done in real-time, or after the data is collected by postprocessing.
differential GPS	See real-time differential GPS.

DOP	Dilution of Precision. A measure of the quality of GNSS positions, based on the geometry of the satellites used to compute the positions. When satellites are widely spaced relative to each other, the DOP value is lower, and position accuracy is greater. When satellites are close together in the sky, the DOP is higher and GNSS positions may contain a greater level of error. PDOP (Position DOP) indicates the three-dimensional geometry of the satellites. Other DOP values include HDOP (Horizontal DOP) and VDOP (Vertical DOP), which indicate the 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 GNSS. 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 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/breaklines, or boundaries/areas.
firmware	The program inside the receiver that controls receiver operations and hardware.
GAGAN	GPS Aided Geo Augmented Navigation. A regional SBAS system currently in

	development by the Indian government.
Galileo	Galileo is a GNSS system built by the European Union and the European Space Agency. It is complimentary to GPS 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.
GPS	Global Positioning System. GPS is a space-based satellite navigation system consisting of multiple satellites in six orbit planes.
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 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 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 GNSS. MSAS is the Japanese equivalent of WAAS, which is available in the United States.
multipath	Interference, similar to ghosts on an analog television screen, that occurs when GNSS signals arrive at an antenna having traversed different paths. The signal traversing the longer path yields a larger pseudorange estimate and increases the error. Multiple paths can arise from reflections off the ground or off structures near the antenna.
NMEA	National Marine Electronics Association. NMEA 0183 defines the standard for interfacing marine electronic navigational devices. This standard defines a number of 'strings' referred to as NMEA strings that contain navigational details such as positions. Most Trimble GNSS receivers can output positions as NMEA strings.
NTrip Protocol	Networked Transport of RTCM via Internet Protocol (NTrip) is an application-level protocol that supports streaming Global Navigation Satellite System (GNSS) data over the Internet. NTrip is a generic, stateless protocol based on the Hypertext Transfer Protocol (HTTP). The HTTP objects are extended to GNSS data streams.
NTripCaster	The NTripCaster is basically an HTTP server supporting a subset of HTTP request/response messages and adjusted to low-bandwidth streaming data. The NTripCaster accepts request messages on a single port from either the NTripServer or the NTripClient. Depending on these messages, the NTripCaster decides whether there is streaming data to receive or to send. Trimble NTripCaster integrates the NTripServer and the NTripCaster. This port is used only to accept requests from NTripClients.
NTripClient	An NTripClient will be accepted by and receive data from an NTripCaster, if the NTripClient sends the correct request message (TCP/UDP connection to the specified NTripCaster IP and listening port).
NTripServer	The NTripServer is used to transfer GNSS data of an NTripSource to the NTripCaster. An NTripServer in its simplest setup is a computer program running on a PC that sends correction data of an NTripSource (for example, as received through the serial communication port from a GNSS receiver) to the NTripCaster. The NTripServer - NTripCaster communication extends HTTP by additional message formats and status codes.
NTripSource	The NTripSources provide continuous GNSS data (for example, RTCM-104 corrections) as streaming data. A single source represents GNSS data referring to a specific location. Source description parameters are compiled in the source-

	table.
OmniSTAR	The OmniSTAR HP/XP service allows the use of new generation dual-frequency receivers with the OmniSTAR service. The HP/XP service does not rely on local reference stations for its signal, but utilizes a global satellite monitoring network. Additionally, while most current dual-frequency GNSS systems are accurate to within a meter or so, OmniSTAR with XP is accurate in 3D to better than 30 cm.
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.
QZSS	Quasi-Zenith Satellite System. A Japanese regional GNSS eventually consisting of three geosynchronous satellites over Japan.
real-time differential GPS	Also known as *real-time differential correction* or *DGPS*. Real-time differential GPS is the process of correcting GPS data as you collect it. Corrections are calculated at a base station and then sent to the receiver through a radio link. As the rover receives the position it applies the corrections to give you a very accurate position in the field. Most real-time differential correction methods apply corrections to code phase positions. While DGPS is a generic term, its common interpretation is that it entails the use of single-frequency code phase data sent from a GNSS base station to a rover GNSS receiver to provide sub-meter position accuracy. The rover receiver can be at a long range (greater than 100 kms (62 miles)) from the base station.
rover	A rover is any mobile GNSS receiver that is used to collect or update data in the field, typically at an unknown location.
Roving mode	Roving mode applies to the use of a rover receiver to collect data, stakeout, or control 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 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.
sCMRx	Scrambled CMRx. CMRx is a new Trimble message format that offers much higher data compression than Trimble's CMR/CMR+ formats.
signal-to-noise ratio	SNR. The signal strength of a satellite is a measure of the information content of the signal, relative to the signal's noise. The typical SNR of a satellite at 30° elevation is between 47 and 50 dBHz.
skyplot	The satellite skyplot confirms reception of a differentially corrected GNSS signal and displays the number of satellites tracked by the GNSS receiver, as well as their relative positions.
SNR	See signal-to-noise ratio.
Source-table	The NTripCaster maintains a source-table containing information on available NTripSources, networks of NTripSources, and NTripCasters, to be sent to an NTripClient on request. Source-table records are dedicated to one of the following: • data STReams (record type STR) • CASters (record type CAS) • NETworks of data streams (record type NET) All NTripClients must be able to decode record type STR. Decoding types CAS and NET is an optional feature. All data fields in the source-table records are separated using the semicolon character.
triple frequency GPS	A type of receiver that uses three carrier phase measurements (L1, L2, and L5).
UTC	Universal Time Coordinated. A time standard based on local solar mean time at the Greenwich meridian.
variance	A statistical measure used to describe the spread of a variable in the mean time period. This measure is equal to the square of the deviation of a corresponding measured variable from its mean. See also covariance.
VDOP	Vertical Dilution of Precision. VDOP is a DOP value (dimensionless number) that indicates the quality of GNSS observations in the vertical frame.
VRS	Virtual Reference Station. A VRS system consists of GNSS hardware, software, and communication links. It uses data from a network of base stations to provide corrections to each rover that are more accurate than corrections from a single base station. To start using VRS corrections, the rover sends its position to the VRS server. The VRS server uses the base station data to model systematic errors (such as ionospheric noise) at the rover position. It then sends RTCM correction messages back to the rover.
WAAS	Wide Area Augmentation System. WAAS was established by the Federal Aviation Administration (FAA) for flight and approach navigation for civil aviation. WAAS improves the accuracy and availability of the basic GNSS signals over its coverage

	area, which includes the continental United States and outlying parts of Canada and Mexico. The WAAS system provides correction data for visible satellites. Corrections are computed from ground station observations and then uploaded to two geostationary satellites. This data is then broadcast on the L1 frequency, and is tracked using a channel on the GNSS receiver, exactly like a GNSS satellite. Use WAAS when other correction sources are unavailable, to obtain greater accuracy than autonomous positions. For more information on WAAS, refer to the FAA website at http://gps.faa.gov. The EGNOS service is the European equivalent and MSAS is the Japanese equivalent of WAAS.
WGS-84	World Geodetic System 1984. Since January 1987, WGS-84 has superseded WGS-72 as the datum used by GPS. The WGS-84 datum is based on the ellipsoid of the same name.