USER GUIDE

Trimble BD910

GNSS Receiver Module

Version 4.82
Revision A
November 2013

Corporate Office

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Legal Notices

Release Notice

This is the November 2013 release (Revision A) of the BD910 GNSS Receiver Module User Guide. It applies to version 4.82 of the receiver firmware.

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– your name, address, and telephone numbers
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– a description of the nonconforming Product including the model number
– an explanation of the problem
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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.

COCOM limits

This notice applies to the BD910, BD920, BD930, BD960, BD970, BD982, BX960, BX960-2, and BX982 receivers.

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

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

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

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Introduction

In this chapter:

This manual describes how to set up and use the Trimble BD910 GNSS receiver module. The BD910 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 BD910 GNSS receiver

The receiver is used for a wide range of precise positioning and navigation applications. These uses include unmanned vehicles and port and terminal equipment automation, and any other application requiring reliable, centimeter-level positioning at a high update rate and low latency.

The receiver offers centimeter-level accuracy based on carrier phase RTK and submeter accuracy code-based solutions.

Automatic initialization and switching between positioning modes allow for the best position solutions possible. Low latency (less than 30 msec) and high update rates give the response time and accuracy required for precise dynamic applications.

You can configure the receiver as an autonomous base station (sometimes called a reference station) or as a rover receiver (sometimes called a mobile receiver). Streamed outputs from the receiver provide detailed information, including the time, position, heading, quality assurance (figure of merit) numbers, and the number of tracked satellites. The receiver also outputs a one pulse per second (1 PPS) strobe signal which lets remote devices precisely synchronize time.

Designed for reliable operation in all environments, the receiver provides a positioning interface to an office computer, external processing device, or control system. The receiver can be controlled through a serial, ethernet, or USB port using binary interface commands or the web interface.

BD910 features

The receiver has the following features:

- Position antenna based a on 220-channel Trimble Maxwell™ 6 chip:
  - GPS: L1 C/A
  - GLONASS: L1 C/A
  - Galileo: E1
  - BeiDou: B1
  - QZSS: L1 C/A, L1 SAIF
  - SBAS: L1 C/A
- Advanced Trimble Maxwell 6 Custom Survey GNSS Technology
- Very low noise GNSS carrier phase measurements with <1 mm precision in a 1 Hz bandwidth
- Proven Trimble low elevation tracking technology
- 1 USB port (device only)
- 1 LAN Ethernet port:
  - Supports links to 10BaseT/100BaseT networks
  - All functions are performed through a single IP address simultaneously—including web interface access and raw data streaming
- Network Protocols supported:
  - HTTP (web GUI)
  - NTP Server
  - NMEA, GSOF, CMR, and so on over TCP/IP or UDP
  - NTripCaster, NTripServer, NTripClient
  - mDNS/UPnP Service discovery
  - Dynamic DNS
  - Email alerts
  - Network link to Google Earth
  - Support for external modems through PPP
- 4 x RS-232 ports (baud rates up to 460,800)
- 1 Hz, 2 Hz, 5 Hz, 10 Hz, and 20 Hz positioning and heading outputs (depending on the installed option)
- Up to 20 Hz raw measurement and position outputs

- Correction inputs/outputs: CMR, CMR+™, sCMRx, RTCM 2.1, 2.2, 2.3, 3.0. Note:
  - The functionality to input or output any of these corrections depends on the installed options.
  - Different manufacturers may have established different packet structures for their correction messages. Thus, the BD9xx receivers may not receive corrections from other manufacturers receivers, and other manufacturers receivers may not be able to receive corrections from BD9xx receivers.
- Navigation outputs:
  - ASCII: NMEA-0183: GBS; GGA; GLL; GNS; GRS; GSA; GST; GSV; HDT; LLQ; PFUGDP; DTM; PTNL,AVR; PTNL,BPQ; PTNL,GGK; PTNL,PJK; PTNL,PJT; PTNL,VGK; PTNL,VHD; RMC; ROT; VTG; ZDA.
  - Binary: Trimble GSOF.
- Control software: HTML Web browser (Google Chrome (recommended), Internet Explorer®, Mozilla Firefox, Apple Safari, Opera)
- 1 Pulse Per Second Output
- Event Marker Input Support
- LED drive support
- Supports Fault Detection and Exclusion (FDE), Receiver Autonomous Integrity Monitoring (RAIM)

Note – *Galileo support is developed under a license of the European Union and the European Space Agency.*

Note – *At the time of this publication, no public BeiDou ICD was available. The current capability in the receiver is based on publicly available information. As such, Trimble cannot guarantee that these receivers will be fully compatible with a future generation of BeiDou satellites or signals.*

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.

These settings are defined in the default application file.

Function	Settings	Factory default
SV Enable	-	All SVs enabled
General Controls	Elevation mask	10°
	PDOP mask	99
	RTK positioning mode	Low Latency
	Motion	Kinematic
Ports	Baud rate	38,400
	Format	8-None-1
	Flow control	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	0°
	Longitude	0°
	Altitude	0.00 m HAE
Antenna	Type	Unknown
	Height (true vertical)	0.00 m
	Measurement method	Antenna Phase Center
1PPS		Disabled

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.

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Specifications

In this chapter:

This chapter details the specifications for the receiver.

Specifications are subject to change without notice.

Positioning specifications

Note – *The following specifications are provided at 1 sigma level when using a Trimble Zephyr 2 antenna. These specifications may be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.*

Feature		**Specification**	
Initialization time		Typically <1 minute	
Initialization accuracy		>99.9%	
Mode	**Accuracy**	**Latency (at max. output rate)**	**Maximum Rate**
Single Baseline RTK (<5 km)	0.008 m + 1 ppm horizontal	<30 ms	20 Hz
	0.15 m + 1 ppm vertical		
DGPS	0.25 m + 1 ppm horizontal	<20 ms	20 Hz
	0.5 m + 1 ppm vertical		
SBAS[1]	0.5 m horizontal	<20 ms	20 Hz
	0.85 m vertical		

Performance specifications

Note – *The Time to First Fix specifications are typical observed values. A cold start is when the receiver has no previous satellite (ephemerides/almanac) or position (approximate position or time) information. A warm start is when the ephemerides and last used position is known.*

Feature	**Specification**	
Time to First Fix (TFF)	Cold Start	<45 seconds
	Warm Start	<30 seconds
	Signal Re-acquisition	<2 seconds
Velocity Accuracy[2]	Horizontal	0.007 m/sec
	Vertical	0.020 m/sec
Maximum Operating Limits[3]	Velocity	515 m/sec
	Altitude	18,000 m
Acceleration	11g	

[1]GPS only and depends on SBAS system performance. FAA WAAS accuracy specifications are <5m 3DRMS.

[2]1 sigma level when using a Trimble Zephyr 2 antenna. These specifications may be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.

[3]As required by the US Department of Commerce to comply with export licensing restrictions.

Physical and electrical characteristics

Feature	Specification
Dimensions (L x W x H)	41 mm x 41 mm x 7 mm
Power	3.3 V DC +5%/-3%
	Typical 1.1 W (L1 GPS + L1 GLONASS)
Weight	19 grams
Connectors	I/O: 80-pin Narrow Pitch Panasonic (AXK780327G) Socket Panasonic AXK880125WG required mating connector (Rated 50 cycles)
	Antenna: MMCX receptacle (Rated for 500 cycles)
Antenna LNA Power Output	Output voltage: 3.3 to 5 V DC
	Current rating: 200 mA Maximum current: 400 mA
Minimum required LNA gain	24.5 dB

Environmental specifications

Feature	Specification
Temperature	Operating: -40°C to 85°C (-40°F to 185°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
Operating humidity	5% to 95% R.H. non-condensing, at +60°C (140°F)

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.
	4 x RS-232 ports	Baud rates up to 460,800
	1 USB 2.0 port	
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, 3.1	
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	

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Electrical System Integration

In this chapter:

80-pin header connector pinouts

The 80-pin Narrow Pitch Panasonic Socket has the following pinouts.

Pin	Signal name	Description	Integration notes
1	VCC Input DC Card power	VCC Input DC Card power (3.3V only)	VCC Input DC Card power (3.3V only)
2	VCC Input DC Card power	VCC Input DC Card power (3.3V only)	VCC Input DC Card power (3.3V only)
3	ANTENNA_POWER	VCC Input DC Card power (3.3V to 5V)	This feeds antenna power. Voltage and current requirement based on antenna voltage used. Ripple Voltage should be 100mV Vpp or better. This can be shorted directly to 3.3V used to supply power to the unit if the antenna can handle 3.3V. It can handle a maximum current of 400 mA.
4	Power LED	POWER Indicator. High when unit is on, low when off. This is similar to all BD9xx products, except for the requirement for an external resistor. This allows user to use this as a control line.	When used to drive an LED, a series resistor with a typical value of 300 Ohms is required. This pin supplies a maximum current of 4mA. For LEDs with Vf above 2.7 or current excess of 4mA, an external buffer is required.
5	RESET_IN	RESET_IN - ground to reset	Drive low to reset the unit. Otherwise, leave unconnected.
6	RTK LED	RTK LED. Flashes when an RTK correction is present. This is similar to all BD9xx products, except for the requirement for an external resistor.	When used to drive an LED, a series resistor with a typical value of 300 Ohms is required. This pin supplies a maximum current of 4mA. For LEDs with Vf above 2.7 or current excess of 4mA, an external buffer is required.
7	GND	Ground Digital Ground	Ground Digital Ground
8	Satellite	Satellite LED. Rapid flash indicates <5 satellites. Slow flash indicates >5 satellites.	When used to drive an LED, a series resistor with a typical value of 300 Ohms is required. This pin supplies a maximum current of 4mA. For LEDs with Vf above 2.7 or current excess of 4mA, an external buffer is required.
9	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. This pin can be left floating since the receiver does not support USB in a host mode.
10	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.

Pin	Signal name	Description	Integration notes
11	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
12	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
13	BOOT_MONITOR*	Boot to Monitor pin. This prevents the unit from executing the application firmware.	Drive the pin low at boot up to force the receiver into monitor mode. Do not connect for normal operation.
14	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
15	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
16	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
17	GND	Ground Digital Ground	Ground Digital Ground
18	COM2_Rx	COM 2 Receive Data - TTL Level	Connect COM2_RX to a transceiver if RS-232 level is required. ***Note –*** *This pin is connected to two physical pins.*
19	COM2_CTS	COM 2 Clear to Send - TTL Level	Connect COM2_CTS to a transceiver if RS-232 level is required. ***Note –*** *This pin is connected to two physical pins.*
20	COM2_Tx	COM 2 Transmit Data - TTL Level	Connect COM2_TX to a transceiver if RS-232 level is required.
21	COM2_RTS	COM 2 Request to Send	Request to Send for COM 2 connect to a transceiver if RS-232 level is required.
22	COM1_Tx	COM 1 Transmit Data – TTL Level	Connect COM1_TX to a transceiver if RS-232 level is required.
23	GND	Ground Digital Ground	Ground Digital Ground
24	COM1_Rx	COM 1 Receive Data – TTL Level	Connect COM1_RX to a transceiver if RS-232 level is required.
25	USB D (-)	USB D (-) Bi-directional USB interface data (-)	Device Mode only. If VCC is supplied, USB detects VBUS.
26	GND	Ground Digital Ground	Ground Digital Ground
27	USB D (+)	USB D (+) Bi-directional USB interface data (+)	Device Mode only. If VCC is supplied, USB detects VBUS.

Pin	Signal name	Description	Integration notes
28	GND	Ground Digital Ground	Ground Digital Ground
29	GND	Ground Digital Ground	Ground Digital Ground
30	PPS (Pulse per Second)	Pulse per second	This is 3.3V TTL level, 4mA max drive capability. To drive 50 Ohm load to ground, an external buffer is required. PPS Jitter spec is 7nS.
31	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
32	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
33	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
34	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
35	GND	Ground Digital Ground	Ground Digital Ground
36	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
37	Event1	Event1 - Input	Event1 (must be 3.3V TTL level)
38	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
39	Event2	Event2 - Input	Event2 (must be 3.3V TTL level)
40	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
41	GND	Ground Digital Ground	Ground Digital Ground
42	GND	Ground Digital Ground	Ground Digital Ground
43	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
44	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
45	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.

Pin	Signal name	Description	Integration notes
46	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
47	GND	Ground Digital Ground	Ground Digital Ground
48	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
49	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
50	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
51	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
52	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
53	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
54	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
55	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
56	COM4_CTS	COM 4 Clear to Send - TTL Level	Connect COM4_CTS to a transceiver if RS-232 level is required.
57	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
58	COM4_RTS	COM 4 Request to Send - TTL Level	Request to Send for COM 4 connect to a transceiver if RS-232 level is required.
59	NO_CONNECT	RESERVED	For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
60	COM3_Rx	COM 3 Receive Data – TTL Level	Connect COM3_RX to a transceiver if RS-232 level is required.
61	NO_CONNECT	RESERVED	For proper operation of the receiver, do not

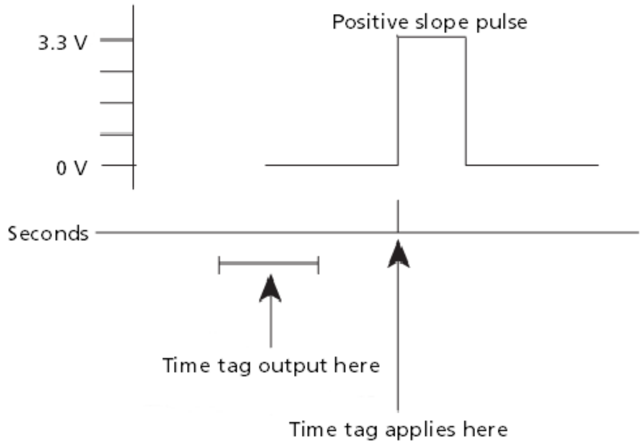
Pin	Signal name	Description	Integration notes
			connect anything to this pin. Reserved for internal use.
62	COM3_Tx	COM 3 Transmit Data – TTL Level	Connect COM3_TX to a transceiver if RS-232 level is required.
63	COM4_Rx	COM 4 Receive Data – TTL Level	Connect COM4_RX to a transceiver if RS-232 level is required.
64	COM4_Tx	COM 4 Transmit Data – TTL Level	Connect COM4_TX to a transceiver if RS-232 level is required.
65	GND	Ground Digital Ground	Ground Digital Ground
66	GND	Ground Digital Ground	Ground Digital Ground
67	GND	Ground Digital Ground	Ground Digital Ground
68	GND	Ground Digital Ground	Ground Digital Ground
69	ETH_RD+	Ethernet Receive line plus. Differential pair.	Connect to Magnetics RD+
70	GND	Ground Digital Ground	Ground Digital Ground
71	ETH_RD-	Ethernet Receive line minus. Differential pair.	Connect to Magnetics RD-
72	GND	Ground Digital Ground	Ground Digital Ground
73	GND	Ground Digital Ground	Ground Digital Ground
74	I/O_READY	I/O status ready	This pin indicates that the signal lines can now be drive. For proper operation of the receiver, do not connect anything to this pin. Reserved for internal use.
75	ETH_TD+	Ethernet Transmit line plus. Differential pair.	Connect to Magnetics TD+
76	GND	Ground Digital Ground	Ground Digital Ground
77	ETH_TD-	Ethernet Transmit line minus. Differential pair.	Connect to Magnetics TD-
78	GND	Ground Digital Ground	Ground Digital Ground
79	GND	Ground Digital Ground	Ground Digital Ground
80	DO NOT CONNECT	Reserved	DO NOT CONNECT

1PPS and ASCII time tag

The receiver can output a 1 pulse-per-second (1PPS) time strobe and an associated time tag message. The time tags are output on a user-selected port.

The leading edge of the pulse coincides with the beginning of each UTC second. The pulse is driven between nominal levels of 0.0 V and 3.3 V (see below). The leading edge is positive (rising from 0 V to 3.3 V). The receiver PPS out is a 3.3 V TTL level with a maximum source/sink current of 4 mA. If the system requires a voltage level or current source/sink level beyond these levels, you must have an external buffer. This line has ESD protection.

The illustration below shows the time tag relation to 1PPS wave form:



The pulse is about 8 microseconds wide, with rise and fall times of about 100 nsec. Resolution is approximately 40 nsec, where the 40 nsec resolution means that the PPS shifting mechanism in the receiver can align the PPS to UTC/GPS time only within +/- 20 nsec, but the following external factor limits accuracy to approximately ±1 microsecond:

- Antenna cable length

  Each meter of cable adds a delay of about 2 nsec to satellite signals, and a corresponding delay in the 1PPS pulse.

ASCII time tag

Each time tag is output about 0.5 second before the corresponding pulse. Time tags are in ASCII format on a user-selected serial port. The format of a time tag is:

UTC yy.mm.dd hh:mm:ss ab

Where:

- UTC is fixed text.
- *yy.mm.dd* is the year, month, and date.
- *hh:mm:ss* is the hour (on a 24-hour clock), minute, and second. The time is in UTC, not GPS.
- *a* is an integer number representing the position-fix type:

  1 = time solution only

  2 = 1D position and time solution

  3 = currently unused

  4 = 2D position and time solution

  5 = 3D position and time solution
- *b* is the number of GNSS satellites being tracked. If the receiver is tracking 9 or more satellites, b will always be displayed as 9.
- Each time tag is terminated by a *carriage return*, *line feed* sequence. A typical printout looks like:

  UTC 02.12.21 20:21:16 56

  UTC 02.12.21 20:21:17 56

  UTC 02.12.21 20:21:18 56

Note – *If the receiver is not tracking satellites, the time tag is based on the receiver clock. In this case, a and b are represented by "??". The time readings from the receiver clock are less accurate than time readings determined from the satellite signals.*

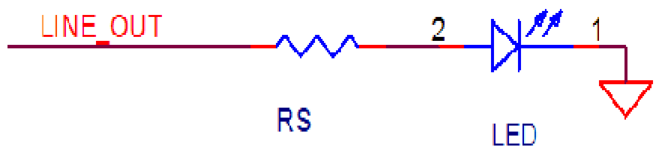
Power input

Item	Description
Power requirement	The unit, excluding the antenna, operates at 3.3 V +5%/-3%. The 3.3 V should be able to supply 1 A of surge current. The typical power consumption based on band usage is: • L1 GPS + L1 GLONASS = 1.1 W

Antenna power output

Item	Description
Power output specification	The antenna DC power is supplied directly from Pin 3 on the Multipin Interface Connector J5. The antenna output is rated to a maximum voltage of 10Vdc and can source a maximum of 400mAmps. Power is a separate pin and it can be powered externally or shorted to the input power if the antenna can handle 3.3 V. This pin can handle a maximum supply of 100mA at 5V.
Short-circuit protection	The unit does not have over-current / short circuit protection related to antenna bias. Short circuits may cause damage to the antenna port bias filtering components if the sourcing supply is not current limited to less than 400 mA.

LED control lines

Item	Description
Driving LEDs	The outputs are 3.3V TTL level with a maximum source/sink current of 4mA. An external series resistor must be used to limit the current. The value of the series resistor in Ohms is determined by: (3.3-Vf)/(If) > Rs > (3.3 V - Vf)/(.004) Rs = Series resistor If = LED forward current, max typical If of the LED should be less than 3mA Vf = LED forward voltage, max typical Vf of the LED should be less than 2.7V Most LEDs can be driven directly as shown in the circuit below:  LEDs that do not meet If and Vf specification must be driven with a buffer to ensure proper voltage level and source/sink current.
Power LED	This active-high line indicates that the unit is powered on.
Satellite LED	This active-high line indicates that the unit has acquired satellites. A rapid flash indicates that the unit has less than 5 satellites acquired while a slow flash indicates greater than 5 satellites acquired. This line will stay on if the unit is in monitor mode.
RTK Correction	A slow flash indicates that the unit is receiving corrections. This will also flash when the unit is in monitor mode.

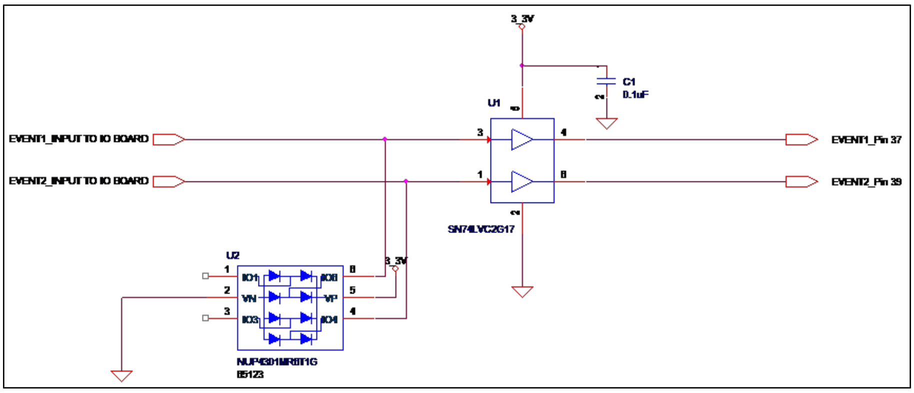
Power switch and reset

Item	Description
Reset switch	Driving Reset_IN_L, Pin 5, low will cause the unit to reset. The unit will remain reset at least 300 mS after the Reset_In_L is deasserted. The unit remains powered while in reset.
Power Switch	Driving Boot_Monitor low while the unit is starting will cause the receiver to go into the boot monitor. This keeps the application from loading. For normal operation, keep Boot_Monitor floating.

Event

Item	Description
Event 1	Pin 37 is dedicated as an Event_In pin. This is a TTL only input, it is not buffered or protected for any inputs outside of 0V to 3.3V. It does have ESD protection. If the system requires event to handle a voltage outside this range, the system integrator must condition the signal prior to connecting to the unit.
Event 2	Pin 39 is dedicated as an Event_In pin. This is a TTL only input, it is not buffered or protected for any inputs outside of 0V to 3.3V. It does have ESD protection but if the system requires event to handle a voltage outside this range, the system integrator must condition the signal prior to connecting to the unit.

Trimble recommends adding a Schmitt trigger and ESD protection to the Event_In pin. This prevents any "ringing" on the input from causing multiple and incorrect events to be recognized.



U1 is Texas instrument: SN74LVC2G17

U2 is ON Semiconductor: NUP4301MR6T1G

SN74LVC2G17 is also suitable for 5 V systems. It accepts inputs up to 5.5 V even when using 3.3 V VCC. Take care to make sure that I/O does not exceed 3.3 V.

For more information, go to www.trimble.com/OEM_ReceiverHelp/V4.82/default.html#AppNote_EventInput.html.

Serial port

Item	Description
COM 1 TTL level no flow control	Com 1 is at 0-3.3V TTL. If the integrator needs this port to be at RS-232 level, a proper transceiver powered by the same 3.3V that powers the receiver needs to be added. For development using the I/O board, this Com port is already connected to an RS-232 transceiver. This is labeled Port 1 on the I/O board. All TTL-COM will support either 3.3v CMOS or TTL levels.
COM 2 TTL level with flow control	Com 2 is at 0-3.3V TTL. This port has RTS/CTS to support hardware flow control. If the integrator needs this port to be at RS-232 level, a proper transceiver powered by the same 3.3V that powers the receiver needs to be added. For development using the I/O board, this Com port is already connected to an RS-232 transceiver. This is labeled Port 2 on the I/O board. All TTL-COM will support either 3.3v CMOS or TTL levels.
COM 3 TTL level no flow control	Com 3 is at 0-3.3V TTL. If the integrator needs this port to be at RS-232 level, a proper transceiver powered by the same 3.3V that powers the receiver needs to be added. For development using the I/O board, this Com port is already connected to an RS-232 transceiver. This is labeled Port 3 on the I/O board. All TTL-COM will support either 3.3v CMOS or TTL levels
COM 4 TTL level with flow control	Com 4 is at 0-3.3V TTL. This port has RTS/CTS to support hardware flow control. If the integrator needs this port to be at RS-232 level, a proper transceiver powered by the same 3.3V that powers the receiver needs to be added. For development using the I/O board, this Com port is already connected to an RS-232 transceiver. This is labeled Port 4 on the I/O board. All TTL-COM will support either 3.3v CMOS or TTL levels.

USB

The USB has a built-in PHY. The unit supports USB 2.0 Device configuration at low speed, full speed and high speed configuration. The port has ESD protection; however a USB 2.0 compliant common mode choke located near the connector should be added to ensure EMI compliance.

The BD910 only supports USB device mode.

Ethernet

The receiver contains the Ethernet MAC and PHY, but requires external magnetics. The PHY layer is based on the Micrel KSZ8041NLI it is set to default to 100Mbps, full duplex with auto-negotiation enabled.

Since the Ethernet functionality will typically increase the receiver power consumption by approximately 10%, the receiver shuts down the Ethernet controller if no Ethernet devices are connected within 2 minutes.

Isolation transformer selection

Parameters	Value	Test condition
Turns Ratio	1CT:1CT	
Open-circuit inductance (min.)	350 uH	100 mV, 100 kHz, 8 mA
Leakage inductance (max.)	0.4 uH	1 MHz (min.)
DC resistance (max.)	0.9 Ohms	
Insertion loss (max.)	1.0 dB	0 MHz–65 MHz
HiPot (min.	1500 Vrms	

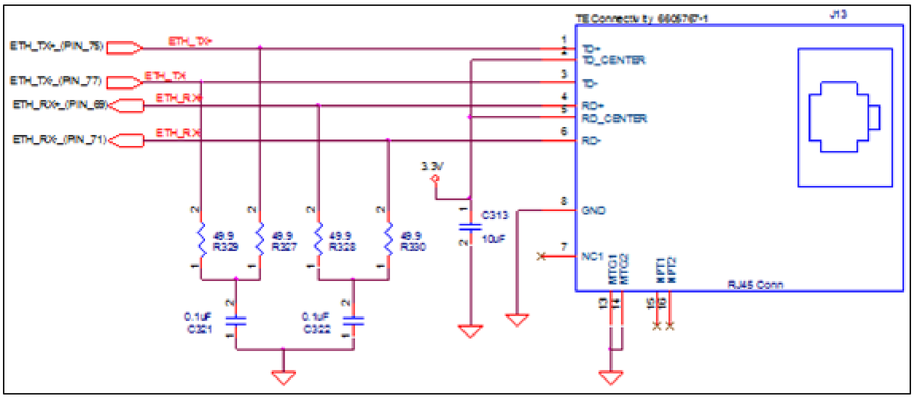
Ethernet reference design

The ethernet interface can be implemented using a single part or using discrete components. For more information, see:

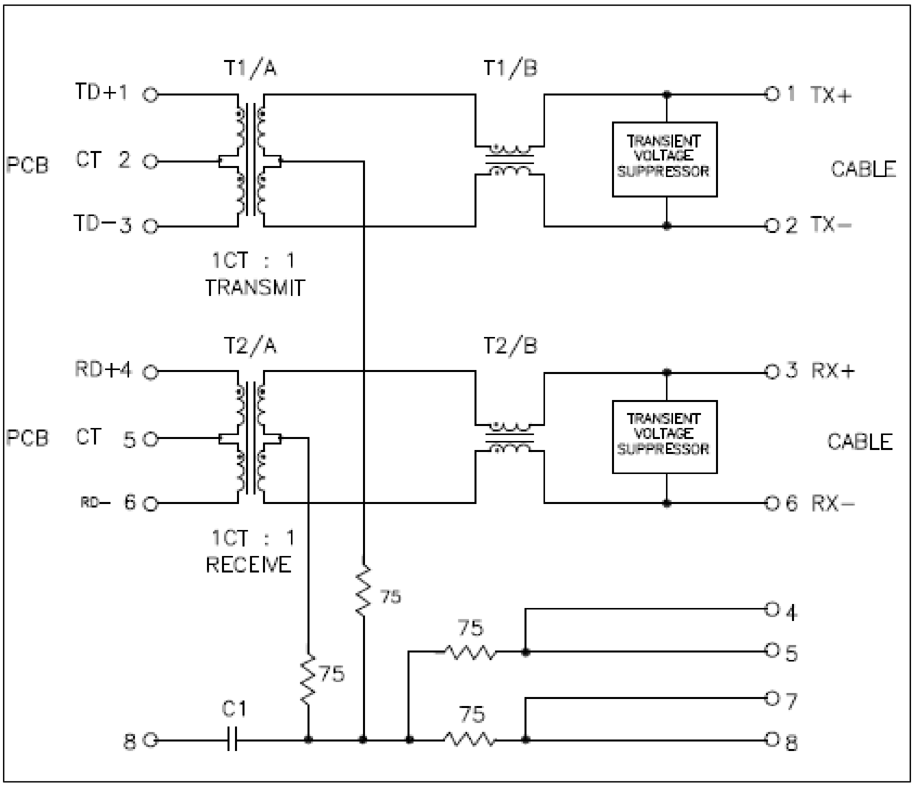
- Ethernet design using RJ-45 with integrated magnetics, page 29
- Ethernet design using discrete components, page 30

Ethernet design using RJ-45 with integrated magnetics

The Ethernet interface can be implemented with a single part by using an integrated part like TE Connectivity’s 6605767-1 which has magnetics, common mode choke, termination and transient voltage suppression fully integrated in one part.



RJ-45 drawing



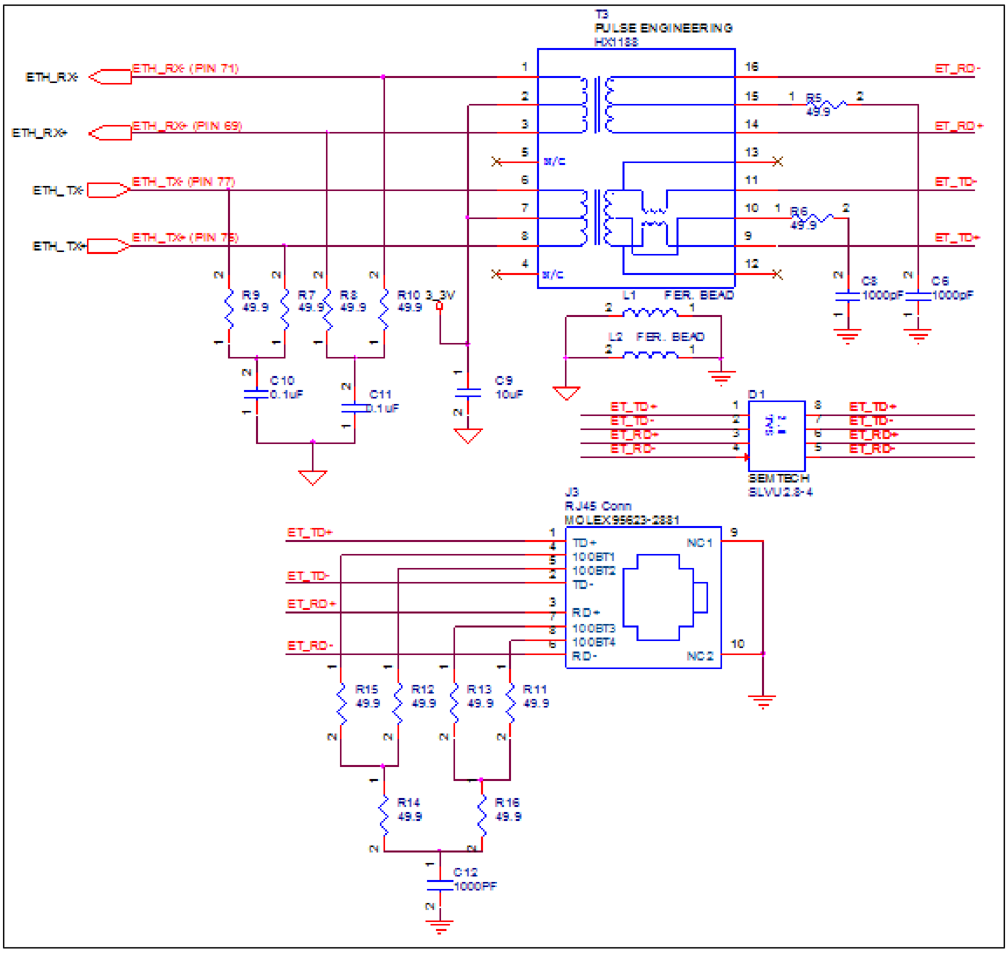
JX10-0006NL schematic

Electrical characteristics

Parameter	Specifications	
Insertion loss	100 kHz	1-125 MHz
	-1.2 dB max.	-0.2–0.002*f^1.4 db max.
Return loss (Z out = 100 Ohm +/- 15%)	0.1–30 MHz: 30–60 MHz: 60–80 MHz:	-16 dB min. $-10+20*LOG_{10}$ (f/60 MHz dB min.) -10 dB min.
Inductance (OCL) (Media side -40°C + 85°C)	350 uH min.	Measured at 100 kHz, 100 mVRMS and with 8 mA DC bias)
Crosstalk, adjacent channels	1 MHz	10-100 MHz
	-50 dB min.	$-50+17*LOG_{10}$(f/10) dB min.
Common mode rejection radio	2 MHz	30–200 MHz
	-50 dB min.	$-15+20*LOG_{10}$ (f/200) dB min.
DC resistance 1/2 winding	0.6 Ohms max.	
DC resistance imbalance	+/- 0.065 Ohms max. (center tap symmetry)	
input - output isolation	1500 Vrms min. at 60 seconds	

Ethernet design using discrete components

For maximum flexibility, a system integrator may choose to implement the Ethernet using discrete parts. The design below shows an example of such a design. It includes the Ethernet magnetics, termination of unused lines as well as surge protection. The magnetics used is a Pulse Engineering HX1188. Surge protection is provided by a Semtech SLVU2.8-4. In order to meet electrical isolation requirements, it is recommended to use capacitors with a greater than 2kV breakdown voltage.



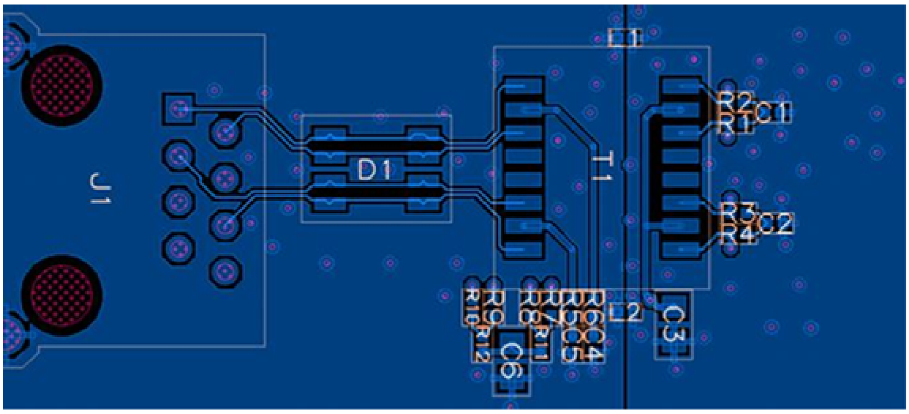
Ethernet schematic

Part Reference	Value
C4–C6	1000pF 2kV
C3	10 uF X5R 6.3V
D1	SEMTECH SLVU2.8–4
J1	RJ45 Conn
L1, L2	Ferrite Bead
R1–R11	49.9 0402 1%
T1	Pulse engineering HX1188

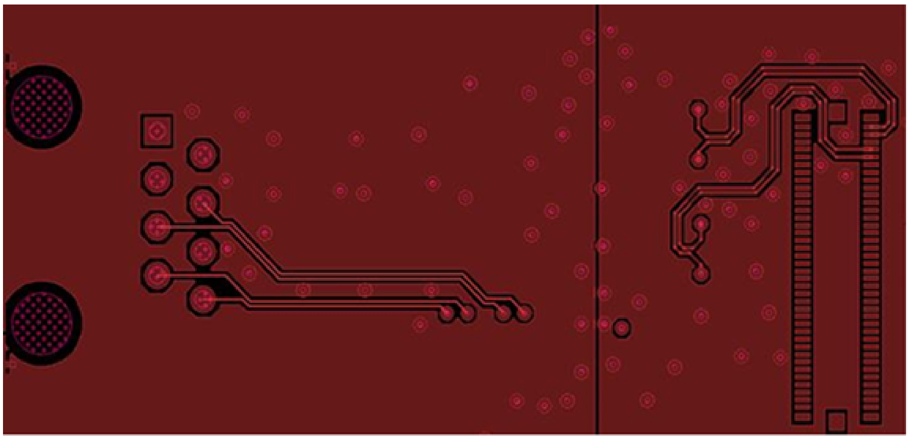
Ethernet routing

The distance from the BD910/BD920 connector, the Ethernet connector and the magnetics should be less than 2 inches. The distance from the RJ-45 and the magnetics should be minimized to prevent conducted emissions issues. In this design, the chassis ground and signal ground are separated to improve radiated emissions. The integrator may choose to combine the ground. The application note from the IC vendor is provided below for more detailed routing guidelines.

The sample routing below shows a two-layer stack up, with single side board placement. The routing shown below makes sure that the differential pairs are routed over solid planes.



Top view



Bottom view

Recommended electrical specifications for the antenna

The receiver has been designed to support a wide variety of GPS antenna elements. GNSS band coverage will be dictated by the bandwidth of the antenna chosen. In addition, the unit is capable of supporting antenna elements with a minimum LNA gain of +24.5 dB. For optimum performance, the recommended antenna electrical specifications are outlined below:

Feature	Specification
Frequency	1565.5 to 1614 MHz 1217 to 1257 MHz
VSWR	2.0 max.
Bandwidth	60 MHz
Impedance	50 Ohm
Peak Gain	4 dBic min.
Amplifier Gain	+27 to +37 dB typical ***Note –*** *Required LNA gain does not account for antenna cable insertion loss.*
Noise Figure	1.5 dB typical
Output VSWR	1.5:1 typical
Filtering	-30 dB (+/- 100 MHz)
DC Voltage	+3.3 to +5 V DC ***Note –*** *Antenna LNA bias voltage is supplied directly from pin 3 on the Multi-pin Interface Connector J5. The antenna output is rated to 10 V and can source a maximum of 400 mA*
DC Current	300 mA max.

4

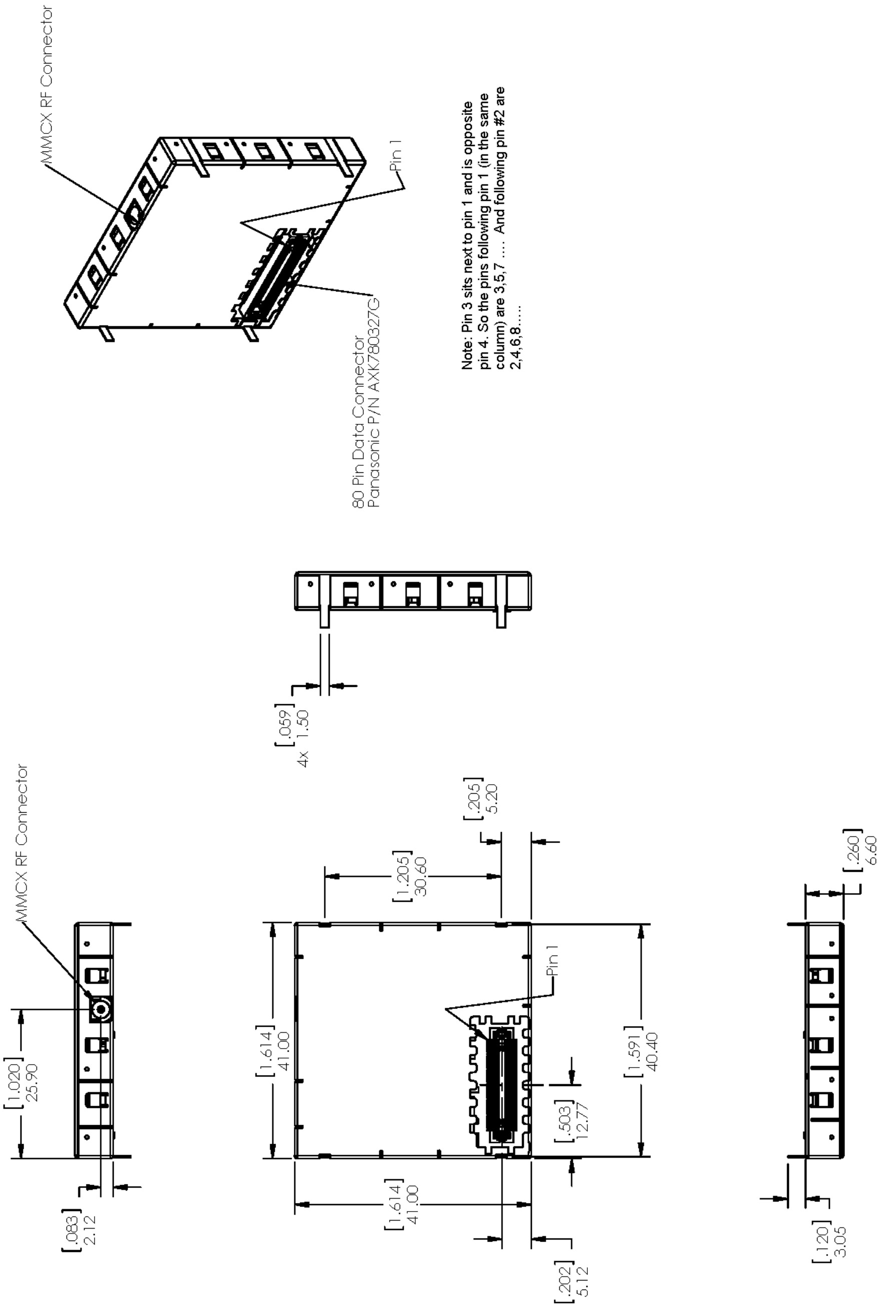
Mechanical Drawings

In this chapter:

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

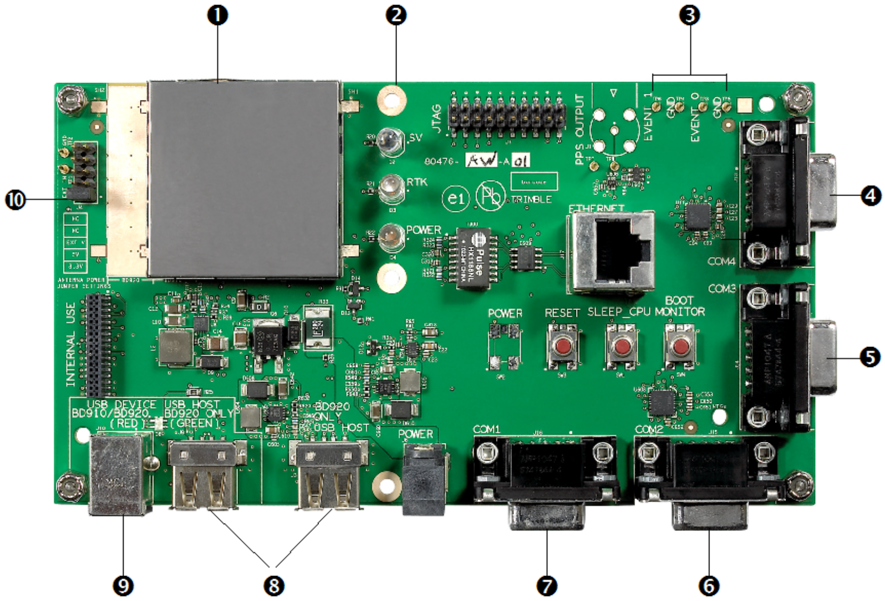
BD910 module mechanical drawing

Note – *Dimensions are shown in millimeters (mm). Dimensions shown in brackets are in inches.*



BD910 evaluation I/O board

The same evaluation board is used for the BD910 and the BD920 receiver module. Current or prospective customers may obtain schematic drawings or Gerber files of the evaluation I/O board by contacting GNSSOEMSupport@trimble.com.

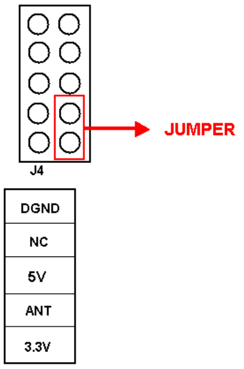


1. GNSS Receiver module
2. Receiver status LEDs
3. Event Pins
4. Serial Port 4
5. Serial Port 3
6. Serial Port 2
7. Serial Port 1
8. USB Type A (not used)
9. USB Type B
10. Antenna Power Select

Antenna jumper setting

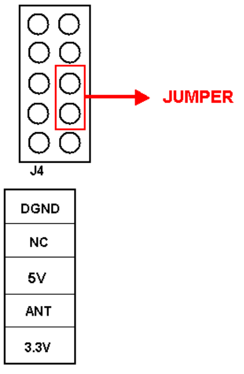
The development board has a unique configuration to control the voltage sent to the antenna. The board has two preset voltages that the developer can use in addition to the option of setting their own voltage to the antenna.

The figure below shows the pre-loaded configuration:

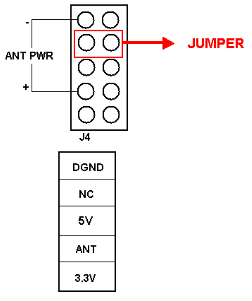


In this mode, the antenna voltage is 3.3V.

To configure antenna voltage to 5V (the other preset voltage), connect the jumper as shown:



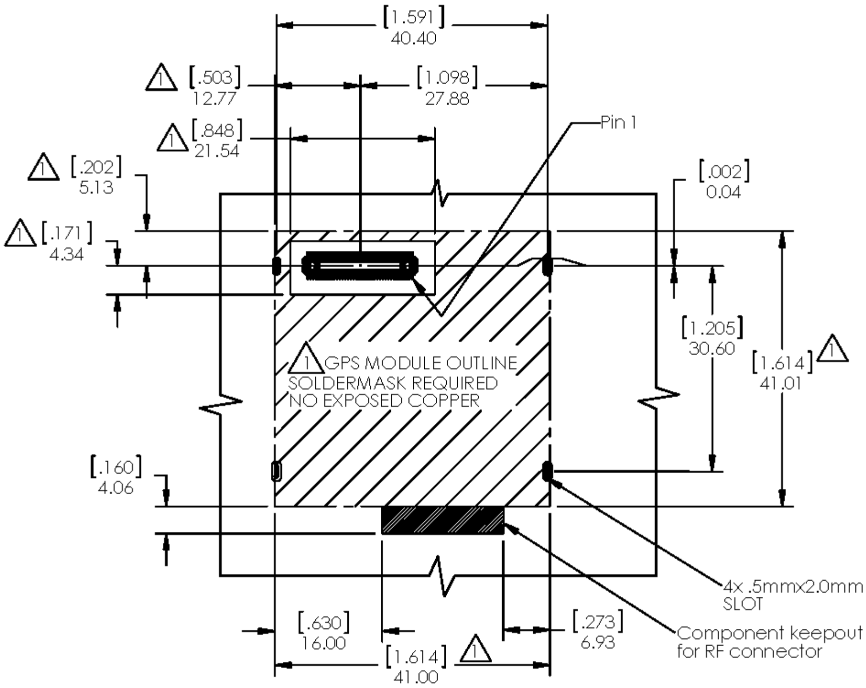
The final option is to manually set the antenna voltage by attaching a voltage across the two pins shown:



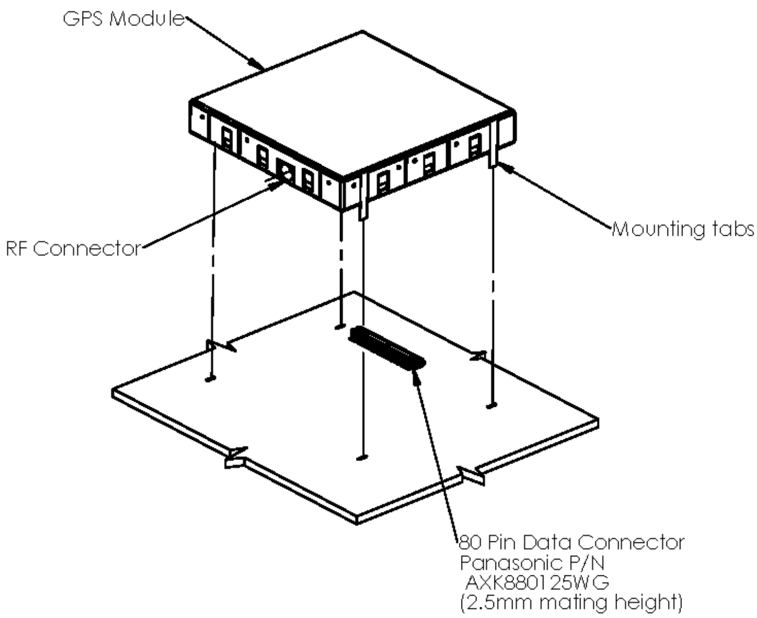
In this configuration, the jumper can be anywhere as long as it is not attached to the 4th row (the one marked ANT PWR). Antenna power is rated at a maximum of 5V and 400mA.

BD910 PCB assembly schematics

PCB layout recommendations



PCB assembly recommendations



Trimble recommends that integrators design their PCB so that when the mounting tabs are soldered this will ground the shield of the BD910/BD920 to their PCB. However, this is not required for functional bench-level evaluation since the primary ground paths are through the 80-pin connector.

5

Installation

In this chapter:

Unpacking and inspecting the shipment

Visually inspect the shipping cartons for any signs of damage or mishandling before unpacking the receiver. Immediately report any damage to the shipping carrier.

Shipment carton contents

The shipment will include one or more cartons. This depends on the number of optional accessories ordered. Open the shipping cartons and make sure that all of the components indicated on the bill of lading are present.

Reporting shipping problems

Report any problems discovered after you unpack the shipping cartons to both Trimble Customer Support and the shipping carrier.

Installation guidelines

The receiver module is shipped in an unsoldered form along with the I/O evaluation board (if ordered). The I/O evaluation board has mounting slots to accommodate the GNSS module. For more information, refer to the drawings of the receiver.

Considering environmental conditions

Install the receiver in a location situated in a dry environment. Avoid exposure to extreme environmental conditions. This includes:

- Water or excessive moisture
- Excessive heat greater than 85 °C (185 °F)
- Excessive cold less than –40 °C (–40 °F)
- Corrosive fluids and gases

Avoiding these conditions improves the receiver’s performance and long-term product reliability.

Supported antennas

The receiver tracks multiple GNSS frequencies; the Trimble Zephyr™ II antenna supports these frequencies.

Other antennas may be used with the receiver. However, ensure that the antenna you choose supports the frequencies you need to track.

For the BD910 receiver, the minimum required LNA gain is 24.5 dB.

Mounting the antennas

Choosing the correct location for the antenna is critical to the installation. Poor or incorrect placement of the antenna can influence accuracy and reliability and may result in damage during normal operation. Follow these guidelines to select the antenna location:

- If the application is mobile, place the antenna on a flat surface along the centerline of the vehicle.
- Choose an area with clear view to the sky above metallic objects.
- ***Avoid*** areas with high vibration, excessive heat, electrical interference, and strong magnetic fields.
- ***Avoid*** mounting the antenna close to stays, electrical cables, metal masts, and other antennas.
- ***Avoid*** mounting the antenna near transmitting antennas, radar arrays, or satellite communication equipment.

Sources of electrical interference

Avoid the following sources of electrical and magnetic noise:

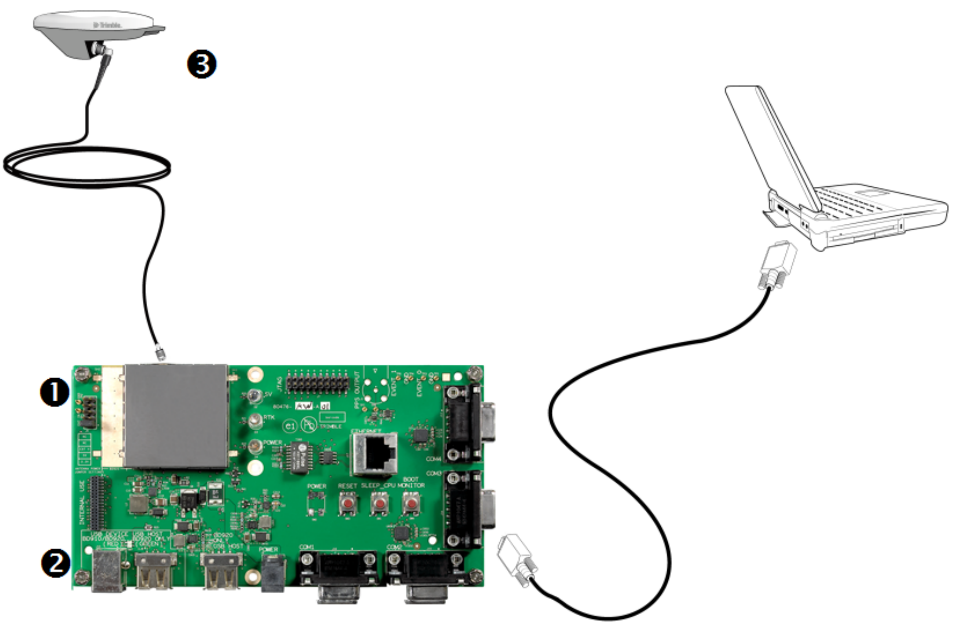
- gasoline engines (spark plugs)
- television and computer monitors
- alternators and generators
- electric motors
- propeller shafts
- equipment with DC-to-AC converters
- fluorescent lights
- switching power supplies

Interface board evaluation kit

An evaluation kit is available for testing the receiver. This includes an I/O board that gives access to the following:

- Power input connector
- Power ON/OFF switch
- Four serial ports through DB9 connectors
- Ethernet through an RJ45 connector
- USB port through USB Type B receptacle for device mode (the BD910 does not support the A receptacle for host mode).
- Two pairs (Event and Ground) of pins for Event 1 and 2 respectively.
- One pair of pins (PPS and GND) for the 1 PPS Output
- Three LEDs to indicate satellite tracking, receipt of corrections, and power.

The following figure shows a typical I/O board setup:



1 BD910 receiver	2 I/O board	3 Zephyr antenna

The computer connection provides a means to set up and configure the receiver.

Routing and connecting the antenna cable

1. After mounting the antenna, route the antenna cable from the GPS antenna to the receiver.

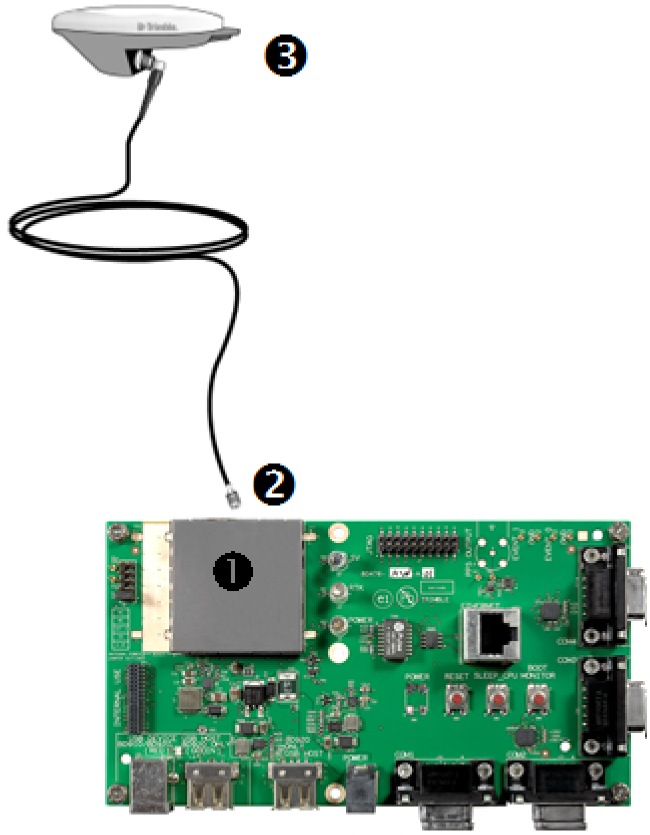
   Avoid the following hazards when routing the antenna cable:

   - Sharp ends or kinks in the cable
   - Hot surfaces (such as exhaust manifolds or stacks)
   - Rotating or reciprocating equipment
   - Sharp or abrasive surfaces
   - Door and window jams
   - Corrosive fluids or gases

2. After routing the cable, connect it to the receiver. Use tie-wraps to secure the cable at several points along the route. For example, to provide strain relief for the antenna cable connection use a tie-wrap to secure the cable near the base of the antenna.

   Note – *When securing the cable, start at the antenna and work towards the receiver.*

3. When the cable is secured, coil any slack. Secure the coil with a tie-wrap and tuck it in a safe place.



❶ BD910 GNSS receiver ❷ MMCX connector ❸ GNSS antenna

***Note –** The MMCX connector at the end of antenna cable needs a CBL ASSY TNC-MMCX connector to interface with the receiver module.*

LED functionality and operation

The evaluation interface board comes with three LEDs to indicate satellite tracking, RTK receptions, and power. The initial boot-up sequence for a receiver lights all the three LEDs for about three seconds followed by a brief duration where all three LEDs are off. Thereafter, use the following table to confirm tracking of satellite signals or for basic troubleshooting.

For single antenna configurations, the following LED patterns apply:

Power LED	RTK Corrections LED	SV Tracking LED	Status
On (continuous)	Off	Off	The receiver is turned on, but not tracking satellites.
On (continuous)	Off	Blinking at 1 Hz	The receiver is tracking satellites, but no incoming RTK corrections are being received.
On (continuous)	Blinking at 1 Hz	Blinking at 1 Hz	The receiver is tracking satellites and receiving incoming RTK corrections.
On (continuous)	Off or blinking (receiving corrections)	Blinking at 5 Hz for a short while	Occurs after a power boot sequence when the receiver is tracking less than 5 satellites and searching for more satellites.
On (continuous)	Blinking at 1 Hz	Off	The receiver is receiving incoming RTK corrections, but not tracking satellites.
On (continuous)	Blinking at 5 Hz	Blinking at 1 Hz	The receiver is receiving Moving Base RTK corrections at 5 Hz.
On (continuous)	On (continuous)	Blinking at 1 Hz	The receiver is receiving Moving Base RTK corrections at 10 or 20 Hz (the RTK LED turns off for 100 ms if a correction is lost).
On (continuous)	On, blinking off briefly at 1 Hz	Blinking at 1 Hz	The receiver is in a base station mode, tracking satellites and transmitting RTK corrections.
On (continuous)	Blinking at 1 Hz	On (continuous)	The receiver is in Boot Monitor Mode. Use the WinFlash utility to reload application firmware onto the board. For more information, contact technical support.

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).

Issue	Possible cause	Solution
Communication to the receiver is lost and the LEDs are not behaving normally.	The internal firmware may be corrupt.	With the receiver in the I/O board, apply power while pressing the Boot Monitor button. Reload firmware using the WinFlash utility. Refer to the topic "Upgrading the receiver firmware" in the BD9xx Receiver WebHelp.

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.
base station	Also called *reference station*. In construction, a base station is a receiver placed at a known point on a jobsite that tracks the same satellites as an RTK rover, and provides a real-time differential correction message stream through radio to the rover, to obtain centimeter level positions on a continuous real-time basis. A base station can also be a part of a virtual reference station network, or a location at which GNSS observations are collected over a period of time, for subsequent postprocessing to obtain the most accurate position for the location.
BeiDou	The BeiDou Navigation Satellite System (also known as BDS) is a Chinese satellite navigation system. The first BeiDou system (known as BeiDou-1), consists of four satellites and has limited coverage and applications. It has been offering navigation services mainly for customers in China and from neighboring regions since 2000. The second generation of the system (known as BeiDou-2) consists of satellites in a combination of geostationary, inclined geosynchronous, and medium earth orbit configurations. It became operational with coverage of China in December 2011. However, the complete Interface Control Document (which specifies the satellite messages) was not released until December 2012. BeiDou-2 is a regional navigation service which offers services to customers in the Asia-Pacific region. A third generation of the BeiDou system is planned, which will expand coverage globally. This generation is currently scheduled to be completed by 2020.
BINEX	BInary EXchange format. BINEX is an operational binary format standard for GPS/GLONASS/SBAS research purposes. It is designed to grow and allow encapsulation of all (or most) of the information currently allowed for in a range of other formats.
broadcast server	An Internet server that manages authentication and password control for a network of VRS servers, and relays VRS corrections from the VRS server that you select.
carrier	A radio wave having at least one characteristic (such as frequency, amplitude, or phase) that can be varied from a known reference value by modulation.
carrier frequency	The frequency of the unmodulated fundamental output of a radio transmitter. The GPS L1 carrier frequency is 1575.42 MHz.
carrier phase	Is the cumulative phase count of the GPS or GLONASS carrier signal at a given time.
cellular modems	A wireless 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 GNSS data collected on a rover with data collected simultaneously at a base station. Because the base station is on a known location, any errors in data collected at the base station can be measured, and the necessary corrections applied to the rover data. Differential correction can be done in real-time, or after the data is collected by postprocessing.
differential GPS	See real-time differential GPS.
DOP	Dilution of Precision. A measure of the quality of GNSS positions, based on the geometry of the satellites used to compute the positions. When satellites are widely spaced relative to each other, the DOP value is lower, and position precision is greater. When satellites are close together in the sky, the DOP is higher and GNSS positions may contain a greater level of error. PDOP (Position DOP) indicates the three-dimensional geometry of the satellites. Other DOP values include HDOP(Horizontal DOP) and VDOP (Vertical DOP), which indicate the precision of horizontal measurements (latitude and longitude) and vertical measurements respectively. PDOP is related to HDOP and VDOP as follows: $PDOP^2 = HDOP^2 + VDOP^2$.
dual-frequency GPS	A type of receiver that uses both L1 and L2 signals from GPS satellites. A dual-

	frequency receiver can compute more precise position fixes over longer distances and under more adverse conditions because it compensates for ionospheric delays.
EGNOS	European Geostationary Navigation Overlay Service. A Satellite-Based Augmentation System (SBAS) that provides a free-to-air differential correction service for GNSS. EGNOS is the European equivalent of WAAS, which is available in the United States.
elevation	The vertical distance from a geoid such as EGM96 to the antenna phase center. The geoid is sometimes referred to as Mean Sea Level. In the SPS GNSS receivers, a user-defined sub gridded geoid can be loaded and used, or for a small site, an inclined vertical plane adjustment is used as an approximation to the geoid for a small site.
elevation mask	The angle below which the receiver will not track satellites. Normally set to 10 degrees to avoid interference problems caused by buildings and trees, atmospheric issues, and multipath errors.
ellipsoid	An ellipsoid is the three-dimensional shape that is used as the basis for mathematically modeling the earth's surface. The ellipsoid is defined by the lengths of the minor and major axes. The earth's minor axis is the polar axis and the major axis is the equatorial axis.
EHT	Height above ellipsoid.
ephemeris/ephemerides	A list of predicted (accurate) positions or locations of satellites as a function of time. A set of numerical parameters that can be used to determine a satellite's position. Available as broadcast ephemeris or as postprocessed precise ephemeris.
epoch	The measurement interval of a GNSS receiver. The epoch varies according to the measurement type: for real-time measurement it is set at one second; for postprocessed measurement it can be set to a rate of between one second and one minute. For example, if data is measured every 15 seconds, loading data using 30-second epochs means loading every alternate measurement.
feature	A feature is a physical object or event that has a location in the real world, which you want to collect position and/or descriptive information (attributes) about. Features can be classified as surface or non-surface features, and again as points, lines/break lines, or boundaries/areas.
firmware	The program inside the receiver that controls receiver operations and hardware.
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.
geoid	The geoid is the equipotential surface that would coincide with the mean ocean surface of the Earth. For a small site this can be approximated as an inclined plane above the Ellipsoid.
GHT	Height above geoid.
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 DOPvalue that indicates the precision of horizontal measurements. Other DOP values include VDOP (vertical DOP) and PDOP (Position DOP). Using a maximum HDOP is ideal for situations where vertical precision is not particularly important, and your position yield would be decreased by the vertical component of the PDOP (for example, if you are collecting data under canopy).
height	The vertical distance above the Ellipsoid. The classic Ellipsoid used in GPS is WGS-84.
IBSS	Internet Base Station Service. This Trimble service makes the setup of an Internet-capable receiver as simple as possible. The base station can be connected to the Internet (cable or wirelessly). To access the distribution server, the user enters a password into the receiver. To use the server, the user must have a Trimble Connected Community site license.
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.
Orthometric elevation	The Orthometric Elevation is the height above the geoid (often termed the height above the 'Mean Sea Level').
PDOP	Position Dilution of Precision. PDOP is a DOP value that indicates the precision of three-dimensional measurements. Other DOP values include VDOP (vertical DOP) and HDOP (Horizontal Dilution of Precision). Using a maximum PDOP value is ideal for situations where both vertical and horizontal precision are important.
postprocessing	Postprocessing is the processing of satellite data after it is collected, in order to eliminate error. This involves using computer software to compare data from the rover with data collected at the base station.
QZSS	Quasi-Zenith Satellite System. A Japanese regional GNSS eventually consisting of three geosynchronous satellites over Japan.
real-time differential GPS	Also known as *real-time differential correction* or *DGPS*. Real-time differential GPS is the process of correcting GPS data as you collect it. Corrections are calculated at a base station and then sent to the receiver through a radio link. As the rover

	receives the position it applies the corrections to give you a very accurate position in the field. Most real-time differential correction methods apply corrections to code phase positions. While DGPS is a generic term, its common interpretation is that it entails the use of single-frequency code phase data sent from a GNSS base station to a rover GNSS receiver to provide sub-meter positionaccuracy. The rover receiver can be at a long range (greater than 100 kms (62 miles)) from the base station.
rover	A rover is any mobile GNSS receiver that is used to collect or update data in the field, typically at an unknown location.
Roving mode	Roving mode applies to the use of a rover receiver to collect data, stakeout, or control earthmoving machinery in real time using RTK techniques.
RTCM	Radio Technical Commission for Maritime Services. A commission established to define a differential data link for the real-time differential correction of roving GNSS receivers. There are three versions of RTCM correction messages. All Trimble GNSS receivers use Version 2 protocol for single-frequency DGPS type corrections. Carrier phase corrections are available on Version 2, or on the newer Version 3 RTCM protocol, which is available on certain Trimble dual-frequency receivers. The Version 3 RTCM protocol is more compact but is not as widely supported as Version 2.
RTK	real-time kinematic. A real-time differential GPS method that uses carrier phasemeasurements for greateraccuracy.
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.
xFill	Trimble xFill™ is a new service that extends RTK positioning for several minutes when the RTK correction stream is temporarily unavailable. The Trimble xFill service improves field productivity by reducing downtime waiting to re-establish RTK corrections in black spots. It can even expand productivity by allowing short excursions into valleys and other locations where continuous correction messages were not previously possible. Proprietary Trimble xFill corrections are broadcast by satellite and are generally available on construction sites globally where the GNSS constellations are also visible. It applies to any positioning task being performed with a single-base, Trimble Internet Base Station Service (IBSS), or VRS™ RTK correction source.
variance	A statistical measure used to describe the spread of a variable in the mean time period. This measure is equal to the square of the deviation of a corresponding measured variable from its mean. See also covariance.
VDOP	Vertical Dilution of Precision. VDOP is a DOP value (dimensionless number) that indicates the quality of GNSS observations in the vertical frame.
VRS	Virtual Reference Station. A VRS system consists of GNSS hardware, software, and communication links. It uses data from a network of base stations to provide corrections to each rover that are more accurate than corrections from a single base station. To start using VRS corrections, the rover sends its position to the VRS server. The VRS server uses the base station data to model systematic errors (such as ionospheric noise) at the rover position. It then sends RTCM correction messages back to the rover.
WAAS	Wide Area Augmentation System. WAAS was established by the Federal Aviation Administration (FAA) for flight and approach navigation for civil aviation. WAAS improves the accuracy and availability of the basic GNSS signals over its coverage area, which includes the continental United States and outlying parts of Canada and Mexico. The WAAS system provides correction data for visible satellites. Corrections are computed from ground station observations and then uploaded to two geostationary satellites. This data is then broadcast on the L1 frequency, and is tracked using a channel on the GNSS receiver, exactly like a GNSS satellite. Use WAAS when other correction sources are unavailable, to obtain greater accuracy than autonomous positions. For more information on WAAS, refer to the FAA website at http://gps.faa.gov. The EGNOS service is the European equivalent and MSAS is the Japanese equivalent of WAAS.
WGS-84	World Geodetic System 1984. Since January 1987, WGS-84 has superseded WGS-72 as the datum used by GPS. The WGS-84 datum is based on the ellipsoid of the same name.