PRODUCT GUIDE

BD982

GNSS RECEIVER MODULE

Version 5.60 and 6.20
Revision D
May 2023

Trimble®

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Legal Notices

Release Notice

This is the May 2023 release (Revision D) of the *BD982 GNSS Receiver Module Product Guide*. It applies to version 5.60 and 6.20 of the receiver firmware.

LIMITED WARRANTY TERMS AND CONDITIONS

Product Limited Warranty

See the terms and conditions of the product(s) purchase agreement or contract. If not otherwise specified, the following applies to these products:

– AX940 and AX940i smart antennas.
– BD940, BD940-INS, BD970, BD982, BD990, BD992-INS, and BD9250 receiver modules.
– BX940, BX982, and BX992 receiver enclosures.

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– a description of the nonconforming Product including the model number

– an explanation of the problem

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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.

COCOM limits

This notice applies to the BD982 receiver module.

The U.S. Department of Commerce requires that all exportable GPS products contain performance limitations so that they cannot be used in a manner that could threaten the security of the United States. The following limitations are implemented on this product:
– Immediate access to satellite measurements and navigation results is disabled when the receiver velocity is computed to be greater than 1,000 knots, or its altitude is computed to be above 18,000 meters. The receiver GPS subsystem resets until the COCOM situation clears. As a result, all logging and stream configurations stop until the GPS subsystem is cleared.

Notices

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)

Recycling in Europe: For product recycling instructions and more information, please go to www.trimble.com/en/our-commitment/responsible-business/corporate-compliance/environmental-compliance.

Contents

1

Introduction

This guide describes how to set up, configure, and use the Trimble® BD982 GNSS receiver module.

For more information including configuring the receiver, the web interface, application notes, and output messages, please go to https://receiverhelp.trimble.com/oem-gnss.

About the BD982 GNSS receiver module

This receiver module (also referred to as a *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 20 ms) and high update rates give the response time and accuracy required for precise dynamic applications.

The receiver can be configured 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 (1PPS) 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, USB, or CAN port using API commands or the web interface.

Features

- Position antenna based a on 220-channel Trimble Maxwell™ 6 chip:
  - GPS: Simultaneous L1 C/A, L2E, L2C, L5
  - GLONASS: Simultaneous L1 C/A, L1 P, L2 C/A L2 P
  - SBAS: Simultaneous L1 C/A, L5
  - GALILEO: Simultaneous L1 BOC, E5A, E5B, E5AltBOC
  - BeiDou: Simultaneous B1, B2
  - QZSS: Simultaneous L1 C/A, L1 SAIF, L2C, L5
  - L-Band OmniSTAR VBS, HP, and XP
- Vector antenna based on a second 220-channel Maxwell 6 chip:
  - GPS: Simultaneous L1 C/A, L2E, L2C
  - GLONASS: Simultaneous L1 C/A, L1 P, L2 C/A, L2 P
  - BeiDou: Simultaneous B1
- Advanced Trimble Maxwell 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
- 1 CAN port
- 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 interface)
  - NTP Server
  - NMEA, GSOF, CMR 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 × RS-232 ports (baud rates up to 460,800)
- 1 Hz, 2 Hz, 5 Hz, 10 Hz, 20, and 50 Hz positioning and heading outputs (depending on the installed option)
- Up to 50 Hz raw measurement and position outputs

- Correction inputs/outputs: CMR, CMR+™, sCMRx, RTCM 2.1, 2.2, 2.3, 2.4, 3.X, 3.2.

  NOTES –

  - 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, Trimble OEM GNSS receivers may not receive corrections from other manufacturers' receivers, and other manufacturers' receivers may not be able to receive corrections from Trimble OEM GNSS receivers.

- Navigation outputs:
  - ASCII: NMEA-0183: GBS; GGA; GLL; GNS; GRS; GSA; GST; GSV; HDT; LLQ; PTNL,AVR; PTNL,BPQ; PTNL,DG; PFUGDP; DTM; 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 (1PPS) output
- Event Marker Input support
- LED drive support

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		Enabled
Event Ports		Disabled

If a factory reset is performed, the above defaults are applied to the receiver.

When receivers are factory reset, if they had a static IP address configured, the receiver is returned to a DHCP mode. Security is enabled (with a default login of **admin** and the password of **password**), or for units with Enhanced Security enabled, the password will be reset to the serial number of the unit (which you must change at first login).

To perform a factory reset:

- From the web interface, select **Receiver Configuration** / **Reset** and then clear the **Clear All Receiver Settings** option.
- Send the Command 58h with a 03h reset value. Refer to receiverhelp.trimble.com/oem-gnss/ICD_Pkt_Command58hRESETRCVR.html.
- Use the Configuration Toolbox utility and from the **Communications** menu, select **Reset Receiver**. Select both the **Erase Battery-Backed RAM** and **Erase File System** options.

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.

2

Specifications

This chapter details the specifications for the receiver.

Specifications are subject to change without notice.

Performance specifications

Feature	Specification

Measurements	• Position antenna based on a 220-channel Maxwell 6 chip:
	  • GPS: Simultaneous L1 C/A, L2E, L2C, L5
	  • GLONASS: Simultaneous L1 C/A, L1 P, L2 C/A (GLONASS M Only), L2 P
	  • SBAS: Simultaneous L1 C/A, L5
	  • GALILEO: Simultaneous L1 BOC, E5A, E5B, E5AltBOC
	  • BeiDou: Simultaneous B1, B2
	  • QZSS: Simultaneous L1 C/A, L1 SAIF, L2C, L5
	  • L-Band OmniSTAR VBS, HP, and XP
	• Vector antenna based on a second 220-channel Maxwell 6 chip:
	  • GPS: Simultaneous L1 C/A, L2E, L2C
	  • GLONASS: Simultaneous L1 C/A, L1 P, L2 C/A, L2 P
	  • BeiDou: Simultaneous B1
	• Advanced Trimble Maxwell 6 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 dB-Hz
	• Proven Trimble low elevation tracking technology

Code differential GPS positioning accuracy [1]	0.25 m + 1 ppm Horizontal 0.50 m + 1 ppm Vertical
SBAS accuracy [2]	<5 m 3DRMS
RTK positioning accuracy (<30 km)	Horizontal: ±(8 mm + 1 ppm) RMS Vertical: ±(15 mm + 1 ppm) RMS Heading: 2 m baseline <0.09°; 10 m baseline <0.05°
Initialization time	Typically, less than 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 × W × H)	100 mm × 84.9 mm × 11.6 mm
Vibration	MIL810F, tailored Random 6.2 gRMS operating Random 8 gRMS survival
Mechanical shock	MIL810D ±40 g operating ±75 g survival
I/O connector	40-pin header (Samtec TMM-120-03-L-D) (Rated for 1000 cycles)
Antenna connector	2 × MMCX receptacle (Huber-Suhner 82MMCX-50-0-1/111) (Rated for 500 cycles); mating connectors are MMCX plug (Suhner 11MMCX-50-2-1C) or right-angle plug (Suhner 16MMCX-50-2-1C, or 16MMCX-50-2-10)

Electrical specifications

Feature	Specification
Voltage	3.3 V DC +5%/-3%
Power consumption	Typically, 2.1 W (L1/L2 GPS) Typically, 2.2 W (L1/L2 GPS and G1/G2 GLONASS) Typically, 3.1 W (L1/L2/L5 GPS, G1/G2 GLONASS, B1/B2 BeiDou, L1/E5 Galileo) Typically, 3.4 W (L1/L2/L5 GPS, G1/G2 GLONASS, B1/B2 BeiDou, L1/E5 Galileo, OmniSTAR/SPOT) These values were characterized using v4.84 firmware.
Minimum required LNA gain	32.5 dB This receiver is designed to operate with the Zephyr Model 2 antenna which has a gain of 50 dB. Higher-gain antennas have not been tested.

Environmental specifications

Feature	Specification
Temperature	Operating: -40 °C to 75 °C (-40 °F to 167 °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 × 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, 20 Hz and 50 Hz positioning	
Correction data input	CMR, CMR+™, sCMRx, RTCM 2.0–2.4, RTCM 3.X, 3.2	
Correction data output	CMR, CMR+, sCMRx, RTCM 2.0 DGPS (select RTCM 2.1), RTCM 2.1–2.4, RTCM 3.X, 3.2	
Data outputs	NMEA-0183, 1PPS & ASCII Time Tags, Binary GSOF, Binary RT17 / RT27, BINEX, NMEA2000 (over CAN when available)	

3

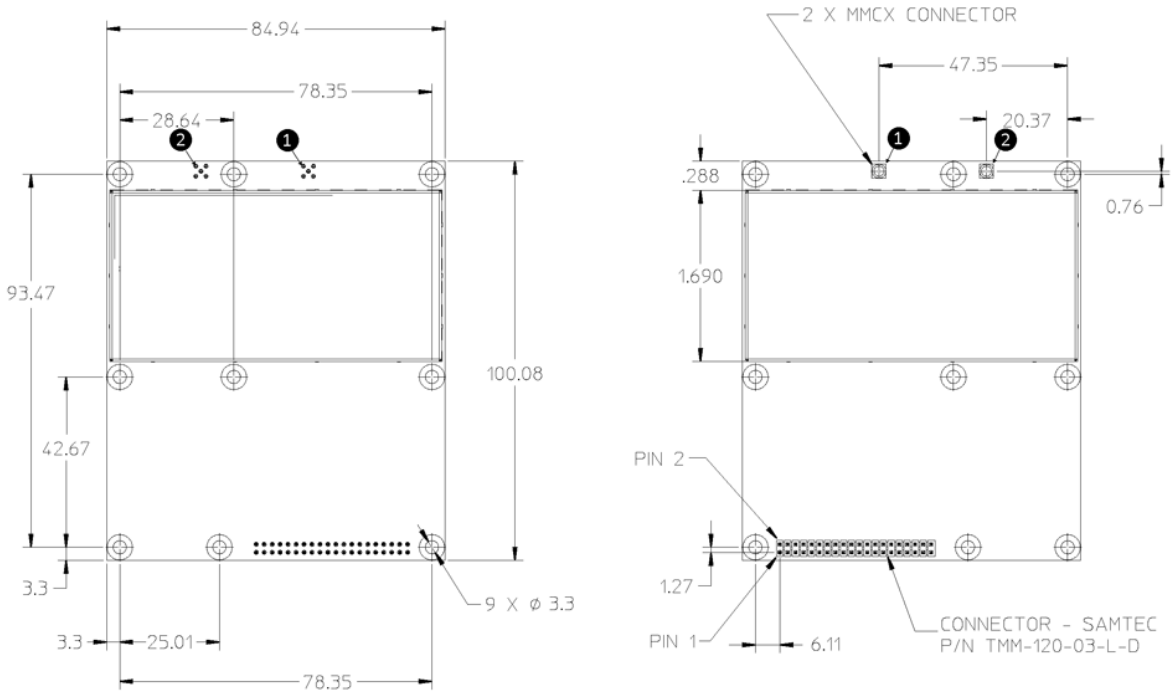
Drawings

The following drawings show the dimensions of the BD982 receiver module. Refer to these drawings if you need to build mounting brackets and housings for the receiver.

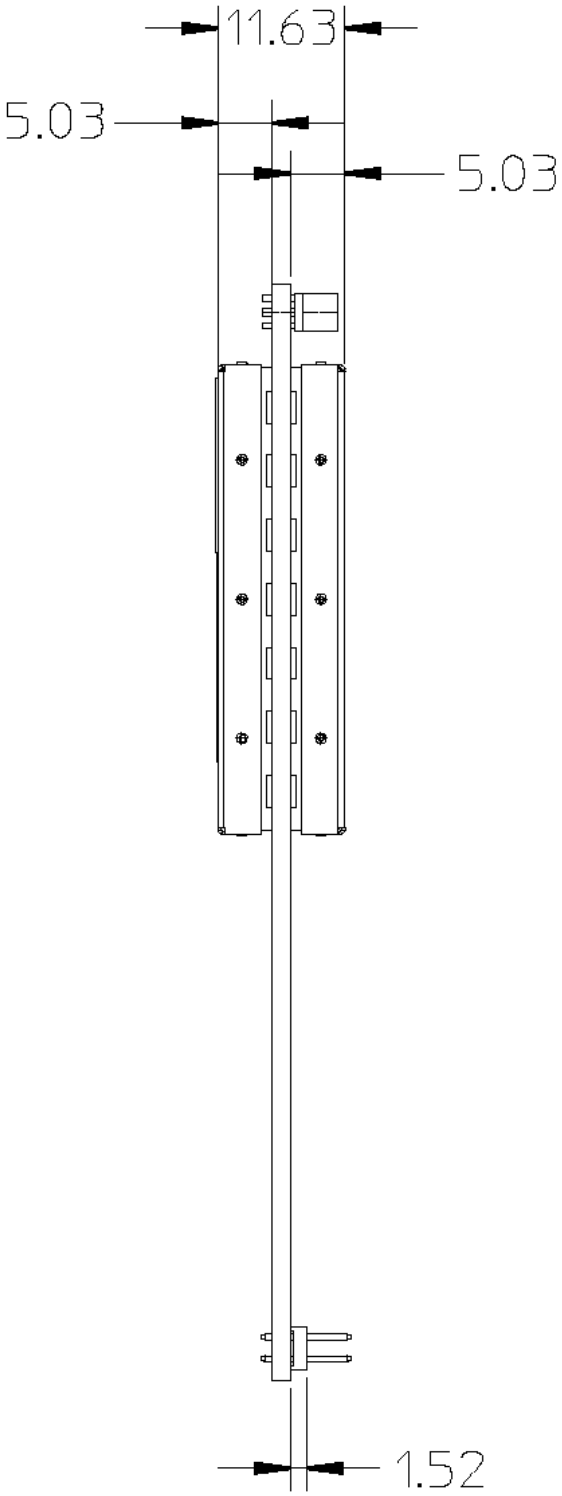
Dimensions are shown in millimeters (mm).

Plan view

1 Primary/position antenna **2** Secondary/vector antenna



Edge view



4

Electrical System Integration

- Receiver pinouts
- 1PPS and ASCII time tag
- Power input
- Antenna power output
- LED control lines
- Power switch and reset
- Event input using the evaluation board
- Serial port
- USB
- Ethernet
- CAN

Receiver pinouts

40-pin header

The 40-pin header (J1) has the following pinouts:

Pin	Signal name	Description	Integration notes
1	GND	Ground Digital ground	Ground Digital ground
2	RTK LED	RTK LED. Flashes when an RTK correction is present. This is similar to all OEM GNSS 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 4 mA For LEDs with Vf above 2.7 or current excess of 4 mA, an external buffer is required.
3	POWER_ OFF	Powers the unit on and off.	Drive high with a 3.3 V to turn off, leave floating or ground to keep the unit on. Integrators should not drive TTL signals when the unit is not powered.
4	PPS (Pulse Per Second)	Pulse Per Second	This is 3.3 V TTL level, 4 mA max drive capability. To drive 50 load to ground, an external buffer is required.
5	VCC Input DC Card Power	VCC Input DC Card power (3.3 V only)	VCC Input DC Card power (3.3 V only)
6	VCC Input DC Card Power	VCC Input DC Card power (3.3 V only)	VCC Input DC Card power (3.3 V only)
7	Event2, CAN1_Rx and COM3_ Rx	Event2 – Event input CAN1_Rx - CAN Receive line COM3_Rx – COM3 Receive line	MUTUALLY EXCLUSIVE and TTL level. Connect Event2 to a TTL level signal to use as Event. Connect CAN1_Rx to RX line of a CAN driver to use as CAN. Connect COM3_Rx to a transceiver if RS-232 level is required.
8	Event1	Event1 – Input	Event1 (must be 3.3 V TTL level)
9	Power LED	POWER Indicator. High when unit is on, low when off. This is similar to all OEM GNSS 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 4 mA For LEDs with Vf above 2.7 or current excess of 4 mA, an external buffer is required.

Pin	Signal name	Description	Integration notes
10	Satellite LED	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 4 mA For LEDs with Vf above 2.7 or current excess of 4 mA, an external buffer is required.
11	COM2_CTS	COM2 Clear to Send – TTL Level	Connect COM2_CTS to a transceiver if RS-232 level is required.
12	RESET_IN	RESET_IN – ground to reset	Drive low to reset the unit. Otherwise, leave unconnected.
13	COM2_RTS	COM 2 Request to Send – TTL Level	Request to Send for COM 2 connect to a transceiver if RS-232 level is required.
14	COM2_Rx	COM 2 Receive Data – TTL Level	Connect COM2_RX to a transceiver if RS-232 level is required.
15	NO CONNECT	Reserved	
16	COM2_Tx	COM 2 Transmit Data – TTL Level	Connect COM2_TX to a transceiver if RS-232 level is required
17	NO CONNECT	Reserved	
18	COM1_Rx	COM 1 Receive Data – RS-232 Level	
19	CAN1_Tx and COM3_ Tx	CAN1_Tx - CAN Transmit line COM3_ Tx – COM3 Transmit line	MUTUALLY EXCLUSIVE and TTL level. Connect CAN1_Tx to TX line of a CAN driver to use as CAN. Connect COM3_Tx to a transceiver if RS-232 level is required.
20	COM1_Tx	COM 1 Transmit Data – RS-232 Level	
21	USB D (-)	USB D (-) Bi-directional USB interface data (-)	USB data for OTG mode (device and host).
22	USB D (+)	USB D (+) Bi-directional USB interface data (+)	USB data for OTG mode (device and host).
23	GND	Ground Digital ground	Ground Digital ground
24	GND	Ground Digital ground	Ground Digital ground
25	USB ID	USB OTG ID	Driving a low level puts unit into USB host mode. High level or no-connect puts unit in device mode. Pull-up is on unit and not required for integration.
26	USB Vbus	USB Vbus	In USB device operation, Vbus is only used for detection. In USB host mode, the unit supplies power per USB spec (500 mA at 5 V max).
27	GND	Ground Digital ground	Ground Digital ground
28	GND	Ground Digital ground	Ground Digital ground
29	GND	Ground Digital ground	Ground Digital ground

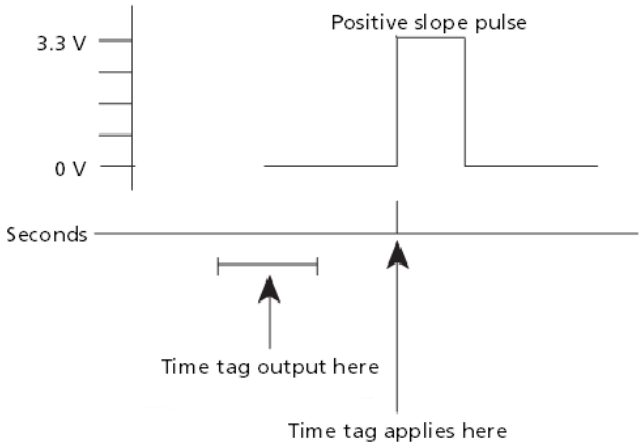
Pin	Signal name	Description	Integration notes
30	GND	Ground Digital ground	Ground Digital ground
31	GND	Ground Digital ground	Ground Digital ground
32	GND	Ground Digital ground	Ground Digital ground
33	ETH_TD+	Ethernet Transmit. Positive side of differential pair.	Connect straight to ethernet connector. Magnetics are on-board unit.
34	ETH_RD+	Ethernet Receive. Positive side of differential pair.	Connect straight to ethernet connector. Magnetics are on-board unit.
35	ETH_TD-	Ethernet Transmit. Negative side of differential pair.	Connect straight to ethernet connector. Magnetics are on-board unit.
36	ETH_RD-	Ethernet Receive. Negative side of differential pair.	Connect straight to ethernet connector. Magnetics are on-board unit.
37	COM4_Rx	COM 4 Receive data – RS-232 level	–
38	COM4_Tx	COM 4 Transmit data – RS-232 level	–
39	GND	Ground Digital ground	Ground Digital ground
40	GND	Ground Digital ground	Ground Digital ground

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 (although this is adjustable), with rise and fall times of about 100 ns. Resolution is approximately 40 ns RMS. Factors such as signal tracking quality (which affect position-time computation quality) may limit accuracy. Additionally, cable length adds delay which can be accounted for, each meter of cable adds a delay of about 2 ns to satellite signals and a corresponding delay in the 1PPS pulse.

Each time tag is output about 0.8 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 nine 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.

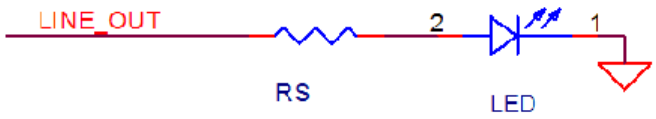
Power input

Item	Description
Power requirement	The unit operates at 3.3 V +5%/-3%. The 3.3 V should be able to supply 2 A of surge current. ***Additional integration notes –*** 1. To fully protect against the unit resetting while shorting any antenna output, Trimble recommends that the 3.3 V input be rated at least 3.5 A. Power supplies under 3.5 A will lead to the 3.3 V rail drooping, triggering a reset to the system. 2. Worst case operation requires a 3 A supply. Worst case operation is defined as: both antennas supplying 5 V at 100 mA, USB supplying 5 V at 250 mA, and actively using all RF bands. The typical power consumption based on band usage is: • L1/L2 = 2.08 W • L1/L2/G1/G2 = 2.24 W • L1/L2/G1/G2/SBAS = 2.27 W • L1/L2/G1/G2/SBAS/L5 = 2.54 W • L1/L2/G1/G2/SBAS/L5/Galileo= 2.79 W • L1/L2/G1/G2/SBAS/L5/Galileo + Omnistar = 3.10 W
Power switch	Pin 3 is an optional power-off pin. When driven high with 3.3 V, the receiver is powered off. This unit can be left floating or ground to keep the unit on. System integrators should not drive TTL signals when unit is not powered.
Over-voltage protection	The absolute maximum voltage is 3.6 V.
Under-voltage protection	The absolute minimum voltage is 3.2 V below nominal.
Reverse voltage protection	The unit is protected down to -3.6 V.

Antenna power output

Item	Description
Power output specification	The antenna supplies 100 mA at 5 V.
Short-circuit protection	The unit has an over-current / short circuit protection. Short circuits may cause the unit to reset.

LED control lines

Item	Description
Driving LEDs	The outputs are 3.3 V TTL level with a maximum source/sink current of 4 mA. 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 3 mA Vf = LED forward voltage, max typical Vf of the LED should be less than 2.7 V 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 five satellites acquired while a slow flash indicates greater than five 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

Power switch

The integrator may choose to power on or power off the unit. If a 3.3 V level signal is applied to pin 3, Power_Off pin, the unit will disconnect VCC. The system integrator must ensure that other TTL level pins remain unpowered when Power_Off is asserted. Powering TTL-level pins while the unit is powered off will cause excessive leakage current to be sinked by the unit.

The integrator may choose to always have the unit powered on. This is accomplished by leaving the Power_Off pin floating or grounded.

Reset switch

Driving Reset_IN_L, Pin 12, low will cause the unit to reset. The unit will remain reset at least 140 mS after the Reset_IN_L is deasserted. The unit remains powered while in reset.

Event input using the evaluation board

This topic describes how to condition and analyze event input signals when using the OEM GNSS I/O development boards. This knowledge also applies to the customers' implementation of event inputs on their carrier board for the BD9xx.

Useful links:

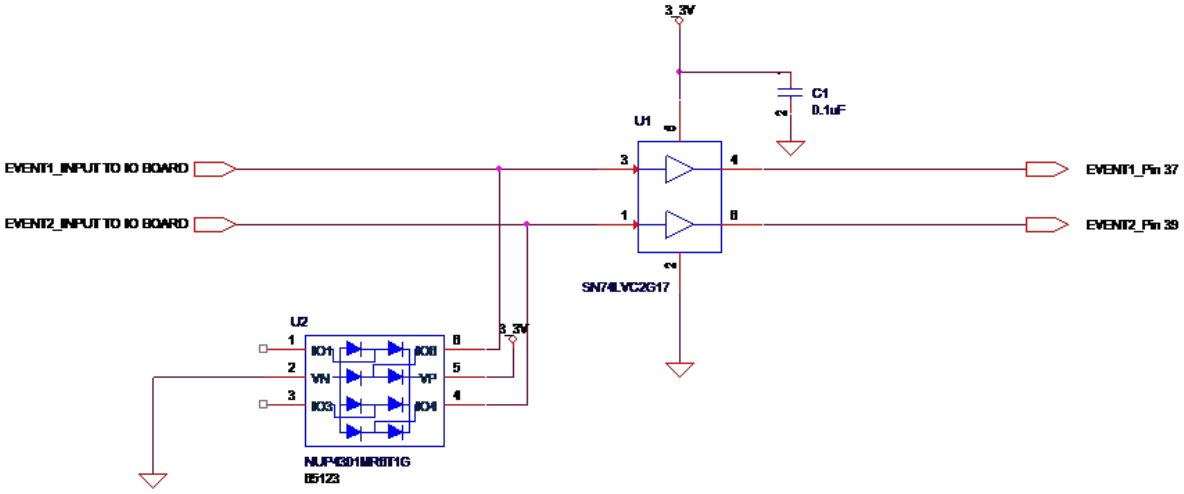
- For information about the web interface settings, see the topic, Receiver Configuration – General in the OEM GNSS help.
- Application note: Event (0) 1PPS Input Example in the OEM GNSS help.
- For Event 1 and Event 2 information, see below.

Event

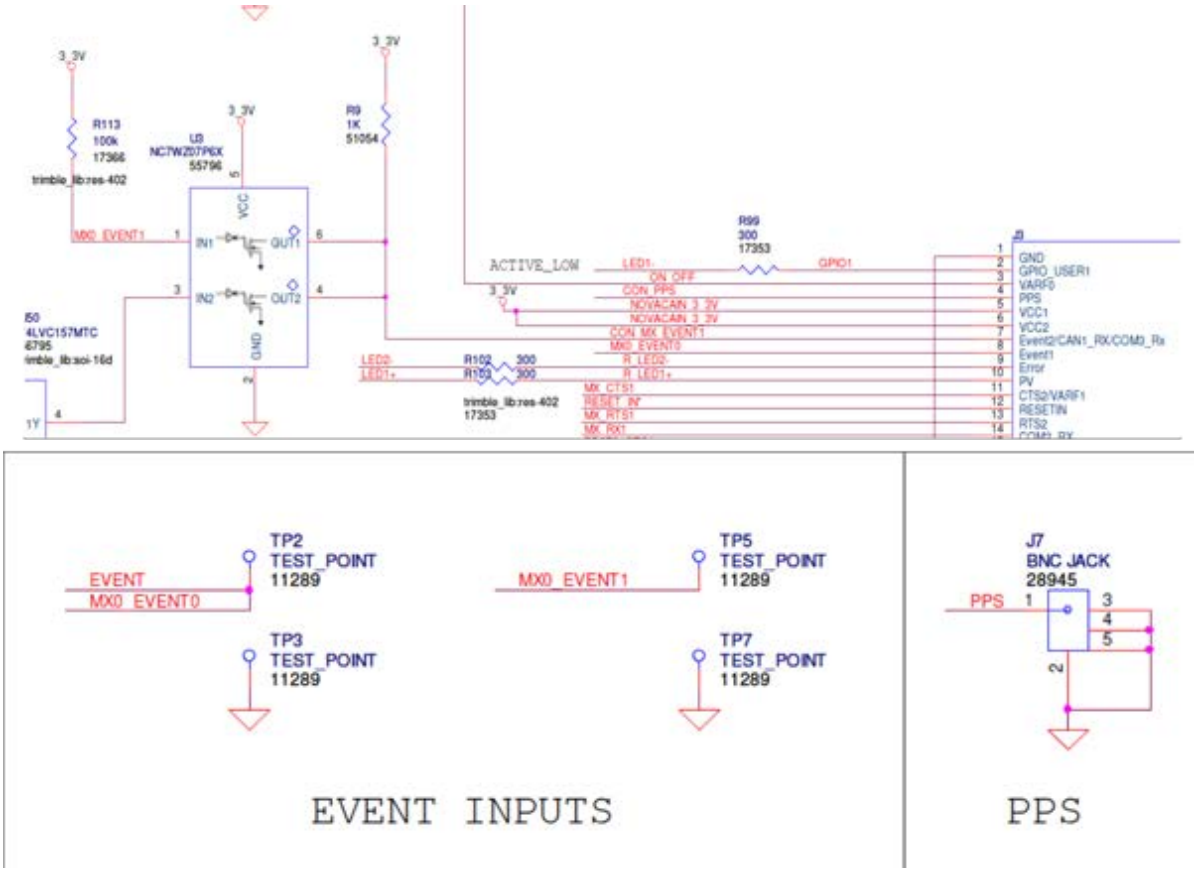
Item	Description
Event 1	On the BD982 receiver module, pin 8 is dedicated as an Event_In pin. This is a TTL only input; it is not buffered or protected for any inputs outside of 0 V to 3.3 V. It does have ESD protection. If the system requires event to handle a voltage outside this range, the system integrator must condition the signal before connecting to the unit.
Event 2	On the BD982 receiver module, pin 7 is Event 2; however, it is multiplexed with COM3_RX and CAN_RX. The default setting is to have this line set to COM3_RX. The Event 2 must be enabled to use Event2. This is a TTL only input; it is not buffered or protected for any inputs outside of 0 V to 3.3 V. It does have ESD protection. If the system requires event to handle a voltage outside this range, the system integrator must condition the signal before connecting to the unit.

Event schematrics of the BD9xx evaluation PCB

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.



PPS output and event inputs BD982



Serial port

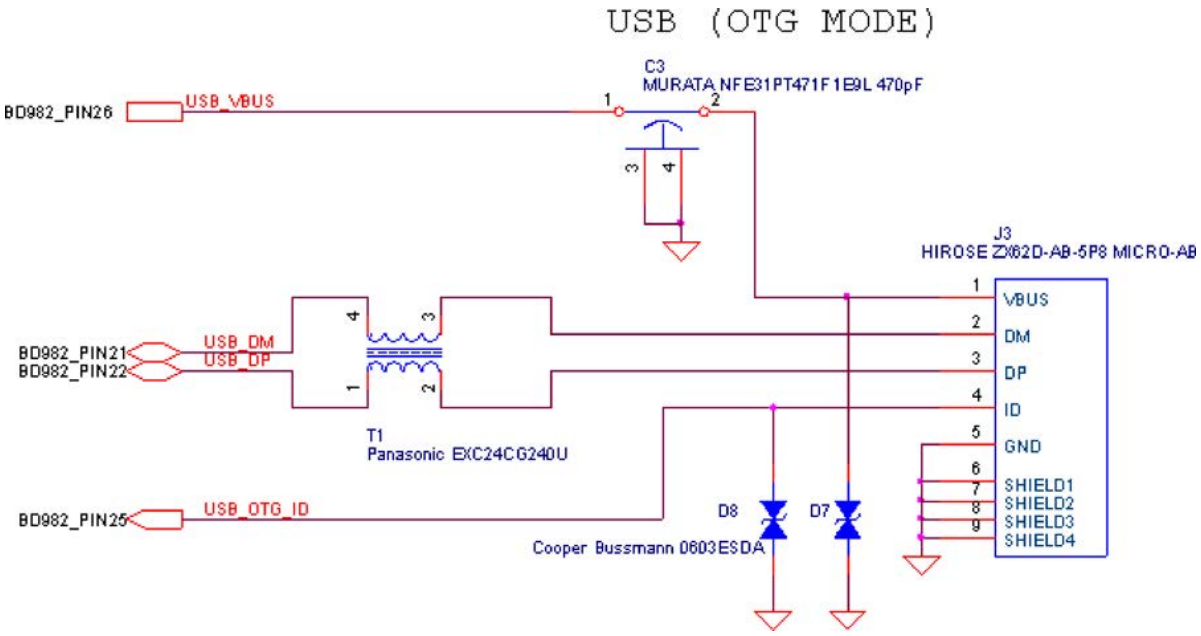
Item	Description
COM 1 RS-232 level no flow control	COM 1 is already at RS-232 level and already has 8 kV contact discharge/15 kV air gap discharge ESD Protection. This is labeled Port 1 on the I/O board.
COM 2 TTL level with flow control	COM 2 is at 0-3.3 V TTL. This port has RTS/CTS to support hardware 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.
COM 3 TTL level no flow control	COM 3 is at 0-3.3 V TTL and is multiplexed with CAN. The receive line is also multiplexed with Event 2. The integrator must have a BD982 receiver configured to use the serial port in order to use this port as a serial port. The functionality cannot be multiplexed in real time. If the integrator needs this port to be at RS-232 level, a proper transceiver powered by the same 3.3 V 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. SW4, labeled COM3 HW Xciever Selection, must be set to RS-232. There should not be anything connected to TP5, labeled Event 2.
COM 4 RS-232 level no flow control	COM 4 is on-board level translated to RS-232 voltages, with 8 kV contact discharge/15 kV air gap discharge ESD protection. This is labeled Port 4 on the I/O board.

USB

The CPU of the receiver has an integrated PHY that supports both USB 2.0 Device and Host configuration at low-speed, full-speed, and high-speed. In Host mode, the receiver supplies 5 V to a USB device, such as a memory stick. In Device mode, the receiver behaves like an external storage device to a computer.

USB OTG reference design

To be OTG-compliant, the connector must be MICRO AB. An OTG-compliant cable has A and B ends. When the B-side of the cable is inserted, the ID pin is not connected (floating) and the receiver enters Device mode through a pull-up resistor. The A-side of the cable connects the ID pin to ground, which enables Host mode on the receiver.



To reduce EMI, place a USB 2.0 compliant common mode choke on the data lines. To ensure best EMI performance, locate the choke near the USB MICRO AB connector. Trimble recommends that you use an L-C-L type EMI filter for the output power.

For product robustness and protection, place ESD protection diodes on both the USB_VBUS and USB_OTG_ID lines. The receiver has internal high-speed ESD protection on the USB data lines.

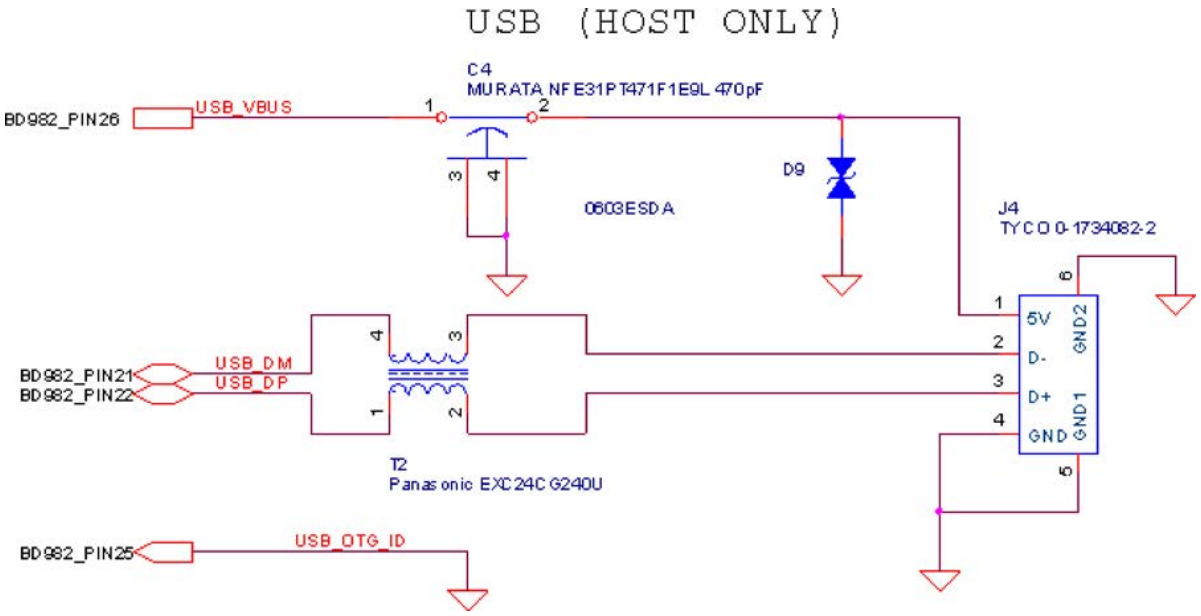
To ensure best USB high-speed performance, carefully consider PCB routing and placement practices:

- Place components so the trace length is minimized.
- Do not have stubs on data lines more than 0.200".
- Route data lines differentially but as parallel as possible.
- Data lines must be controlled to 90 Ohms differential impedance, and 45 Ohms single-ended impedance.
- Route over continuous reference plane (either ground or power).

For more detailed information, refer to the *Intel High Speed USB Platform Design Guidelines*.

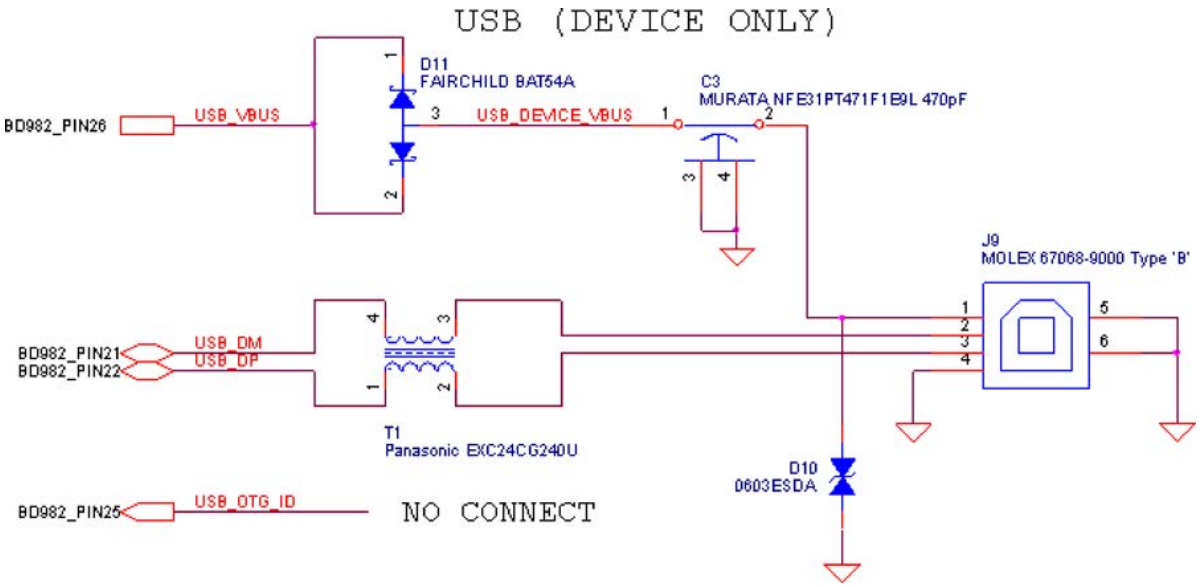
USB host-only reference design

For USB host-only support, a type-A connector is required. Since the receiver dos not support dynamic role switching, the ID pin should be grounded on the receiver. In Host mode, the receiver supplies nominal 5 V output at 500 mA to the USB device.



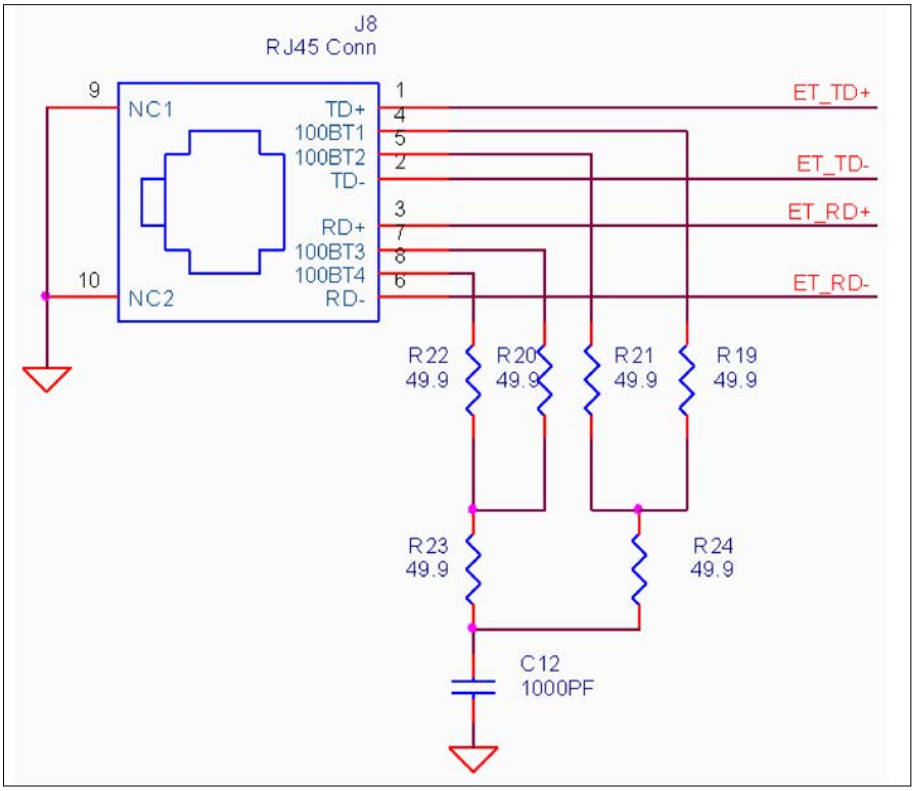
USB device-only reference design

For device-only operation, the USB_OTG_ID pin is left floating. For reference, the receiver has an internal 10 K Ohm pull-up to 3.3 V. In this mode, the USB_DEVICE_VBUS is used only by receiver to detect if host power is connected.

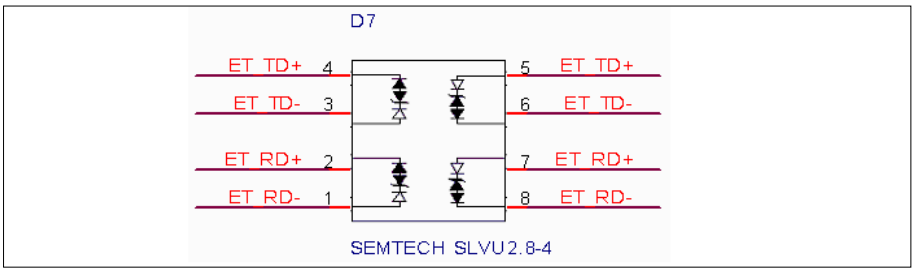


Ethernet

Since the magnetics are on-board, the ethernet interface can be implemented using only a RJ-45 connector, and termination discretes. See design example below:



Optional surge protection is provided by a Semtech SLVU2.8-4. To meet electrical isolation requirements, Trimble recommends using capacitors with a greater than 2 kV breakdown voltage.

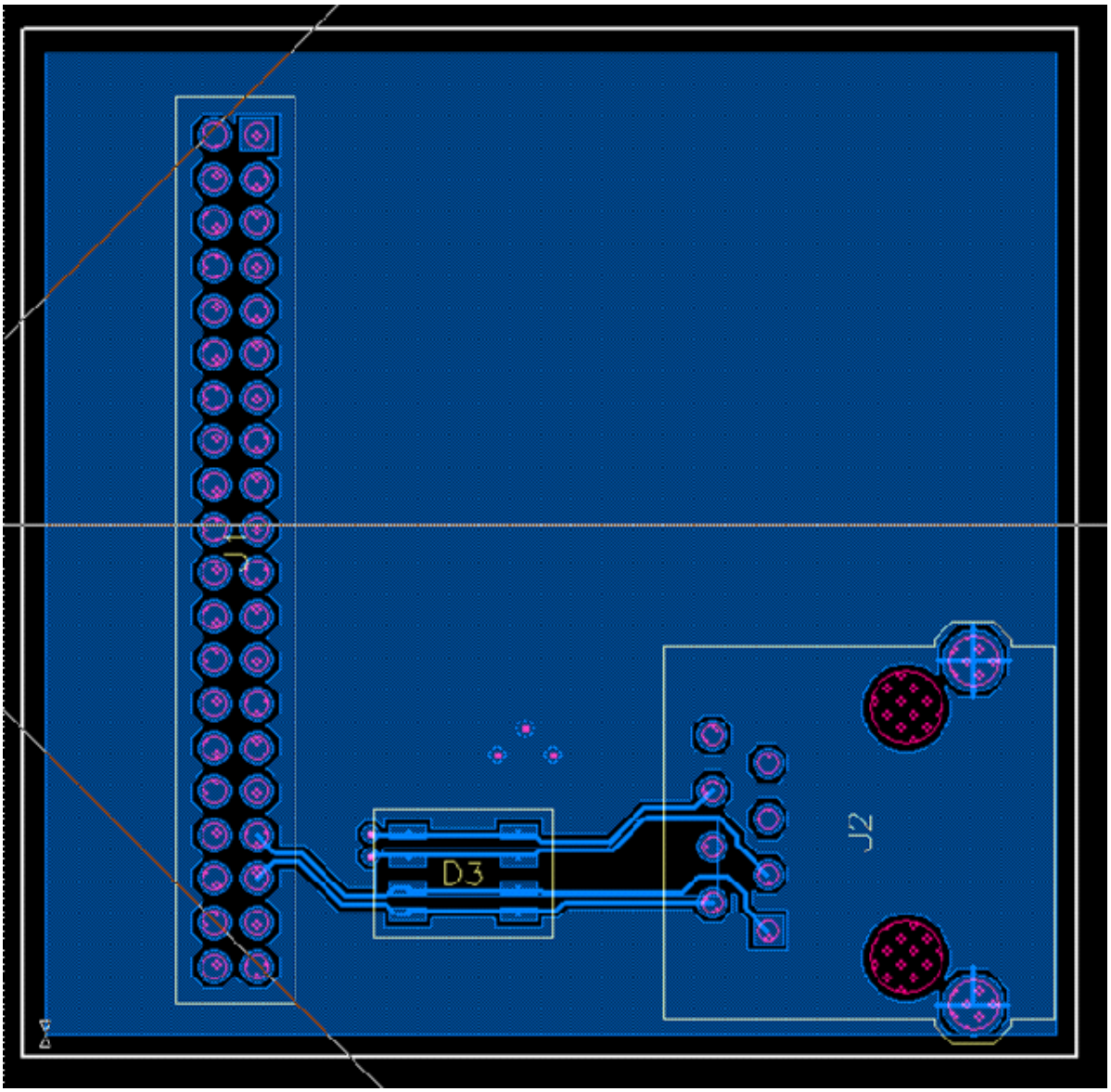


Ethernet routing

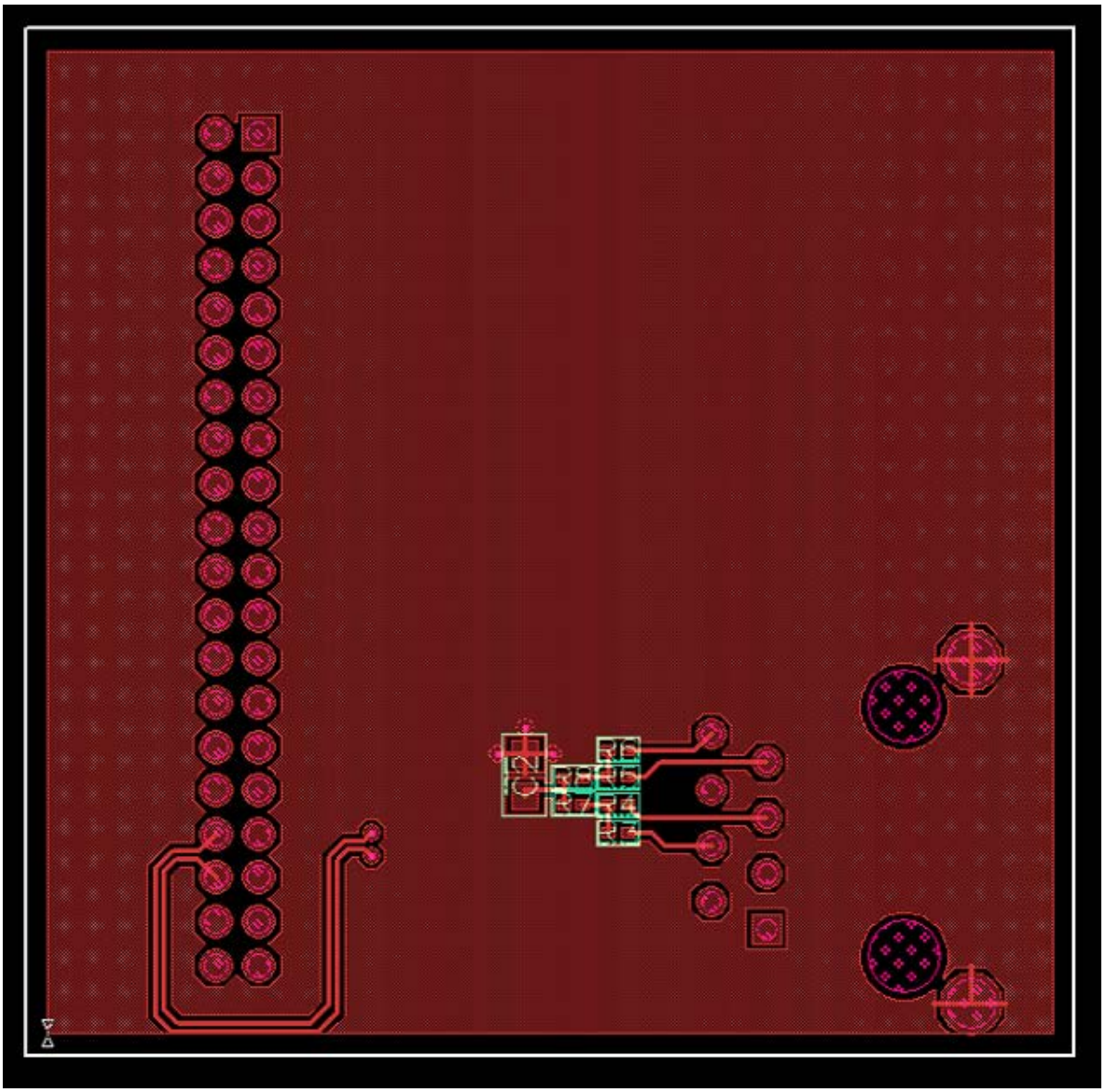
Minimize the distance from the RJ-45 to the receiver main connector to prevent issues with conducted emissions.

The sample routing below shows a four-layer stack up, with dual-side board placement. The routing shown ensures that the differential pairs are routed over solid internal planes.

Top view



Bottom view

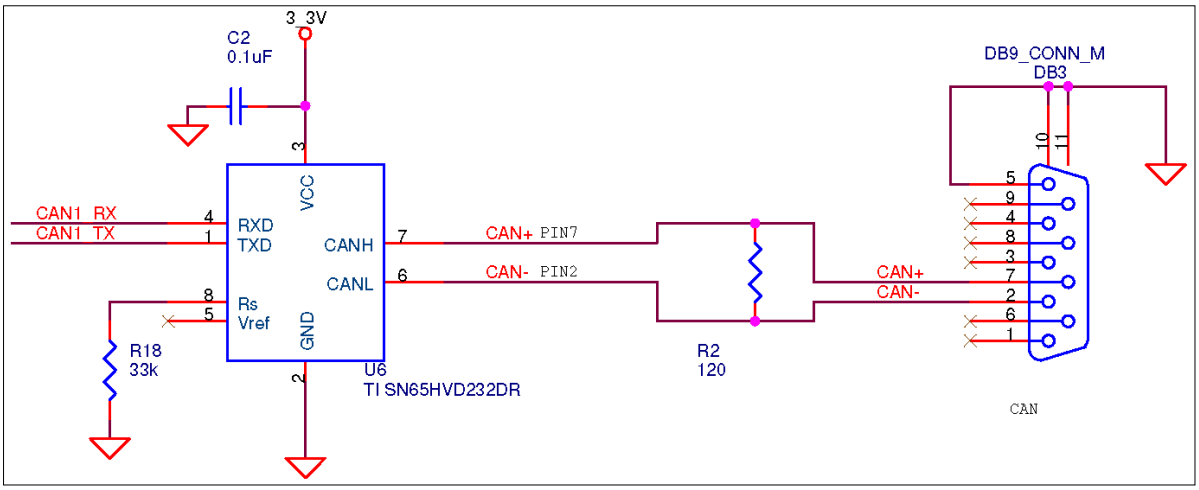


CAN

COM 3 is at 0 to 3.3 V TTL and is multiplexed with CAN. The receive line is also multiplexed with Event 2. The integrator must have a receiver configured to use the CAN port in order to use this port as a serial port. The functionality cannot be multiplexed in real time. The integrator must add a CAN transceiver in order to use the CAN Port.

For development using the I/O board, this com port is already connected to a CAN transceiver. This is labeled CAN on the I/O board. SW4, labeled COM3 HW Xciever Selection, must be set to CAN. There shouldn't be anything connected to TP5, labeled Event 2.

The following figure shows a typical implementation with a 3.3 V CAN transceiver. It also shows a common mode choke as well as ESD protection. A 5 V CAN transceiver can be used if proper level translation is added.



5

Installation

Follow the guidelines in this chapter to install and mount the receiver.

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 depending 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.

Trimble's customer support for the GNSS receiver can be reached at GNSSOEMsupport@trimble.com.

Installation guidelines

For the receivers to perform optimally, the following precautions should be taken or followed.

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 75 °C (167 °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.

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

Mounting the antennas

Choosing the correct location for the antenna is critical for a high quality 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.

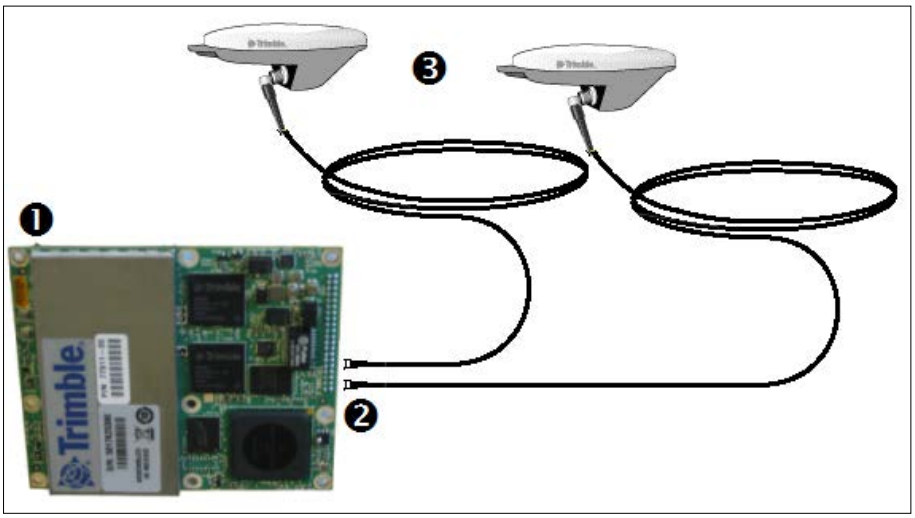
Routing and connecting the antenna cable

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.



1 GNSS receiver **2** MMCX connectors **3** GNSS antennas

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

6

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

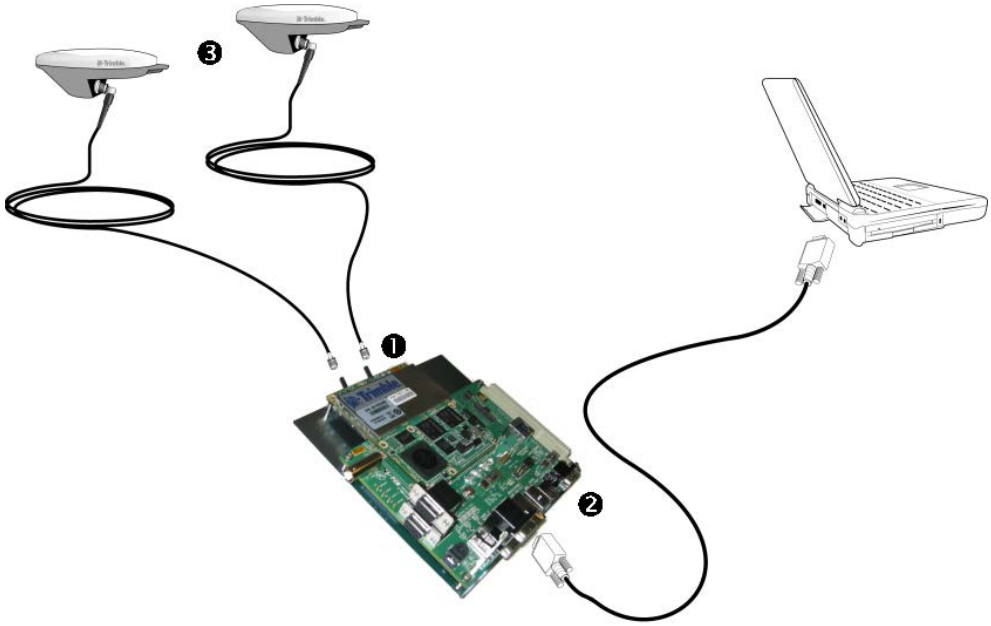
  > **NOTE –** There are separate ethernet jacks for the BD970 and BD982 boards.

- USB port through USB Type A and Type B receptacles
- CAN port through a DB9 connector
- Two event input pins
- 1PPS output on BNC connector
- CAN / Serial port 3 switch

  > **NOTE –** To switch between serial port 3 and CAN, you must configure the receiver using the web interface or binary commands. If you do not set an option bit to make CAN the default, the receiver defaults to serial.

- Three LEDs to indicate satellite tracking, receipt of corrections, and power

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



1 BD982 receiver **2** I/O board **3** Zephyr antennas

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

Included with the BD982 I/O board is a small plastic bag that contains four standoffs. Screw these into the I/O board to coincide with the four corner holes of the receiver when seated on the J3 connector.

Current or prospective customers may obtain schematic drawings of the evaluation I/O board by contacting GNSSOEMSupport@trimble.com.

LED operations

The LEDs indicate various operating conditions. Generally, a lit or slowly flashing LED indicates normal operation. A LED that is flashing quickly indicates a condition that may require attention, and an unlit LED indicates that no operation is occurring. The following tables defines each possible LED state.

Power LED

Receiver mode	Power LED
Off	Off
On. Healthy power	On
Monitor mode [1]	On
Logging data internally	Briefly flashes off every three seconds

Satellite LED

Receiver mode	Satellite LED
No satellites tracked	Off

Receiver mode	Satellite LED
Boot up	On
Monitor mode [1]	On
Searching for satellites	Flashes at 5 Hz

For dual-antenna configurations

Receiver mode	
Tracking satellites on both position and vector antennas.	Flashes at 1 Hz, then a high-frequency burst every five seconds.
Tracking satellites only on the position antenna. The vector antenna is not tracking.	Flashes at 1 Hz (the high-frequency burst does not occur).
Tracking satellites only on the vector antenna. The position antenna is not tracking.	Off, then a high-frequency burst every five seconds.

Correction LED

Radio mode	Correction LED
No receive or transmit	Off.
Monitor mode [1]	Flashes at 1 Hz (off and on equally).
Receive	Off, briefly blinking on when receiving corrections. This LED flashes when a correction is received. When receiving moving base corrections at 5 Hz, 10 Hz, or 20 Hz, the LED may either flash rapidly (at 5 Hz) or remain lit solid.
Transmit	On, briefly blinking off when transmitting corrections. This LED flashes off when a correction is transmitted. When corrections are received, often from MSS sources, the LED is a combination of the transmit and receive LED flashing.

IMU LED

Receiver mode	Power LED
No INS solution	Off
Coarse leveling	Flashes at 5 Hz
Degraded solution	Flashes at 2 Hz
Aligned solution	Flashes at 1 Hz

1 A condition where the receiver has booted into the monitor firmware, but not loaded the application firmware. It indicates firmware corruption or misconfiguration. When this occurs, a multiple LED pattern with the power and satellite LEDs are lit solid and the correction LED flashes at 1 Hz. To resolve monitor mode issues, cycle the power. If the problem persists, reload the firmware. If this does not fix the issue, please contact GNSSOEMsupport@trimble.com.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