

# Trimble ABX-TWO

## HIGH PERFORMANCE COMPACT OEM SENSOR

### HIGH PERFORMANCE RTK, PPP AND 3D ATTITUDE

Trimble has continued to raise the bar in OEM GNSS attitude determination and real time positioning with the new ABX-Two OEM sensor. Built on the strength of its predecessors, ABX-Two delivers unsurpassed accuracy in a compact, rugged system. Powered by two MB-Two boards, the ABX-Two is a comprehensive sensor that will deliver precise heading, pitch and roll along with 3D position solutions up to centimeter-level accuracy. Unlike inertial sensors, ABX-Two provides drift-free, absolute attitude solution. Versatile, lightweight and smart, ABX-Two is the ideal solution for a wide variety of airborne, marine and terrestrial applications.

The ABX-Two allows a wide range of option-upgradeable GNSS configurations from single sensor/single frequency/single GNSS to multi sensor/multi frequency/multi GNSS. Trimble's patented Z-Blade technology drives a powerful GNSS agnostic engine allowing the ABX-Two to use any single GNSS system (or arbitrary GNSS subset) without any dependency on GPS. The GNSS engine utilizes over-the-air satellite corrections via embedded L-Band hardware to achieve centimeter/decimeter PPP accuracy level with Trimble RTX corrections. Worldwide inland availability of RTX corrections allows the ABX-Two to deliver centimeter-level positioning without a dedicated base station.

### PRECISE PLATFORM POSITIONING

- ▶ Multi-antenna GNSS raw data
- ▶ RTK/PPP + Full Attitude
- ▶ Precise 6D sensor

### POWERFUL RTK ENGINE

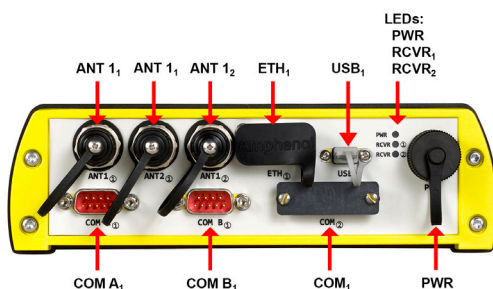
The ABX-Two has a powerful RTK engine that delivers centimeter-level accuracy for systems using corrections from a local base station or RTK network. It also features RTK against a moving base for relative positioning. The network RTK capabilities include third-party network corrections such as VRS, FKP, and MAC. When two or more alternative RTK correcting data are available, ABX-Two runs the Trimble Hot Standby RTK algorithm allowing it to use them simultaneously in the positioning process.

### EASY INTEGRATION

The ABX-Two is housed in a small, weatherproof, lightweight and rugged enclosure that is built around the MB-Two modules. It can operate in harsh environments while requiring minimum space for installation. The ABX-Two allows a wide range of input voltage from 9 V DC to 36 V DC and maintains a low power consumption regardless of the input voltage. The variety of interface connections further eases the ABX-Two integration process.

### Key Features

- ▶ Z-Blade Technology
- ▶ 5 Dual-Band GNSS
- ▶ Conventional and Advanced RTK
- ▶ Precise Point Positioning (PPP)
- ▶ Precise Full Attitude
- ▶ Precise Platform Positioning (P-cube)
- ▶ Web User Interface
- ▶ Superior Connectivity
- ▶ Compact, Lightweight Enclosure
  - 190mm x 58mm x 160mm
  - 1.27 kg



## DATASHEET

### TECHNICAL SPECIFICATIONS

THE SENSOR USES TWO INTERCONNECTED MB-TWO BOARDS. THE SAME GNSS ENGINE IS IMPLEMENTED IN EACH OF THE TWO BOARDS.

#### GNSS ENGINE

- 240 Tracking Channels
- Two tightly coupled, all-in-view GNSS sensors delivering simultaneously:
  - GPS L1+L2
  - QZSS L1+L2
  - BeiDou B1+B2
  - GLONASS G1+G2 FDMA<sup>1</sup>
  - GALILEO E1+E5b
  - SBAS L1<sup>2</sup>
- 2 MSS L-Band Tracking Channels

#### FEATURES

- Patented Strobe Correlator™ to reduce GNSS multi path
- Patented Z-tracking to track encrypted GPS P(Y) signal
- Patented Z-Blade technology to process multi-GNSS data
- GPS-only, GLONASS-only or BeiDou-only solutions possible (from Autonomous to RTK)
- Fast Search Engine to improve TTFF
- Position in local datums and projections with RTCM-3 transformation data
- RTX™ PPP engine
- Hot Standby RTK and Flying RTK Algorithms
- RTK with Static & Moving Base corrections supported
- Heading engine with optional baseline length self-calibration
- Full attitude engine with optional baseline self-calibration
- Multi-dynamic mode (static/moving Base and Rover functions simultaneously)
- Adaptive velocity filter to meet specific dynamic applications
- Up to 250 MB of internal memory for data logging; on-board memory for various applications
- Up to 50 Hz position/velocity/heading/ attitude/observables output<sup>3</sup>
- Reference Inputs/Outputs: RTCM 3.2<sup>4</sup>, RTCM2.3, CMR/CMRx<sup>5</sup>, ATOM<sup>6</sup>
- RTK Networks Supported: VRS, FKP, MAC
- Navigation Outputs: NMEA-0183, ATOM
- One-push Trouble Log (ATL)
- Programmable startup protection

#### GNSS SENSOR PERFORMANCE

- Cold start: < 60 seconds
- Warm Start: < 45 seconds
- Hot Start: < 11 seconds
- Signal re-acquisition: < 2 seconds
- Position accuracy (HRMS), SBAS: 0.50 m<sup>7</sup>
- Velocity Accuracy: 0.02 m/sec HRMS
- Update rate: Up to 50 Hz
- Latency: < 10 s<sup>8</sup>
- Maximum Operating Limits<sup>17</sup>
  - Velocity: 515 m/sec
  - Attitude: 18,000 m

#### PRECISE POSITIONING PERFORMANCE

##### RTK<sup>9,10,11</sup>

- L1 only (fixed ambiguity)
  - Accuracy (HRMS): < 12 mm + 1.5 ppm
  - Initialization time: < 10 min typical
  - Operating range: < 10 km
- L1/L2 (fixed ambiguity)
  - Accuracy (HRMS): < 8 mm + 1 ppm
  - Initialization time: < 1 min typical
  - Operating range: > 40 km

##### RTX<sup>12,13</sup>

- CenterPoint
  - Accuracy (H95): 4 cm
  - Initialization time: < 30 min. typical
  - Operating range (inland): Almost unlimited

##### HEADING<sup>10,14,15</sup>

- Accuracy (RMS): 0.2° per 1 m of baseline length
- Initialization time: < 10 sec typical
- Baseline length: < 100 m

##### 3D ATTITUDE<sup>10,14,15</sup>

- Accuracy: 2 x heading accuracy
- Initialization time: < 10 sec typical

# Trimble ABX-Two Module

#### I/O INTERFACE

- D-Sub 26 pin connector (Positronics WDD26P4C7AT7U/AA)
- 2 x RS232 serial ports allowing up to 921,600 bps
- USB 2.0 OTG port allowing up to 12Mbps (USB/Serial Link, USB Memory Stick, Onboard Memory Access)
- 1 PPS out/Event In
- 1 LAN Ethernet port
  - Supports links to 10BaseT/100BaseT networks
  - All functions are performed through a single IP address simultaneously, including web GUI access and raw data streaming
- Network Protocols supported
  - > HTTP (web GUI)
  - > NTP Server
  - > NtripCaster, NtripServer, NtripClient
  - > Dynamic DNS

#### PHYSICAL AND ELECTRICAL CHARACTERISTICS

Size (W x H x D)	190 mm x 58 mm x 160 mm
Power	9 to 36 VDC
Power Consumption <sup>16</sup>	.3 to 5.5 Watt
Weight	1.27 kg
Connectors	
Serial Ports	2 x D-Sub 9-pin male
Ethernet	RJ45
USB	mini USB
Power	4-pin (BINDER USA 99-3431-601-04)
I/O	D-Sub 26-pin connector
Antenna	3 x TNC female connectors
Antenna LNA Power Input	
Input Voltage Range	5.0 VDC, +/-10%
Maximum current	100 mA
Minimum current	.5 mA
LNA Gain Range	17 to 47 dB for L1/G1/B1/E1 band 23 to 50 dB for L2/G2/B2/E5 band

#### ENVIRONMENTAL CHARACTERISTICS<sup>17</sup>

Operating Temperature	-30 °C to +60 °C
Storage	-40 °C to +70 °C
Vibration	MIL-STD 810F, Fig. 514.5C-17 Random 6.2 gRMS operating Random 8 gRMS survival
Mechanical Shock	MIL-STD 810F, Fig. 516.5-10 (40g, 11ms, saw-tooth)
Operating Humidity	100% non-condensing
Maximum Acceleration	11 g

#### RECOMMENDED ANTENNAS

- Compact GNSS Machine/Marine/Aviation Antennas: Trimble AV33 & AV34
- GNSS Machine/Marine/Aviation Antennas: Trimble AV59 & LV59

#### ORDERING INFORMATION

Enclosure Part Number	107456-XX
Enclosure	Trimble ABX-Two available in a variety of configurations from SBAS upwards

1. Hardware ready for G1 and G2 CDMA. This is based on the assumption that these new signals will be transmitted within natural GLONASS L1, L2 or within GPS L1/L2 frequency bands.
2. In some modes, SBAS L1 is available only for single sensor.
3. At 50 Hz, a limited set of messages can be generated simultaneously through a single port.
4. RTCM-3.2 Multiple Signal Messaging (MSM) guarantees compatibility with 3rd party for each GNSS data.
5. A Trimble proprietary format. CMRx output is not supported.
6. ATOM: Open Ashtech format.
7. VRMS for Autonomous/SBAS positions are usually twice as high as HRMS.
8. Heading latency is usually twice as high.
9. VRMS = 2 x HRMS
10. Accuracy and TTFF specifications may be affected by atmospheric conditions, signal multipath, satellite geometry and corrections availability and quality.
11. Same for single base and network.
12. Requires L1/L2 GPS+GLONASS at a minimum.
13. Accuracy and TTFF specifications may be affected by atmospheric conditions, signal multipath, satellite geometry and L-band service availability. Trimble RTX correction services are only available on land.
14. L1/L2 data required.
15. Figures of pitch accuracy are twice as high.
16. Power consumption depends on the operating mode.
17. As required by the U.S. Department of Commerce to comply with export licensing restrictions.

NOTE: All performance values are given assuming a minimum of five satellites are used, and following the procedures recommended in the product manual. High PDOP values and periods of severe atmospheric conditions may degrade performance.

Specifications subject to change without notice.

Contact your local dealer today

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TRANSFORMING THE WAY THE WORLD WORKS

[www.trimble.com/Precision-GNSS](http://www.trimble.com/Precision-GNSS)



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# Trimble AX940

## GNSS TRIPLE-FREQUENCY SMART ANTENNA WITH MSS BAND DEMODULATOR FOR PRECISE POSITIONING APPLICATIONS

### MULTI CONSTELLATION GNSS

The Trimble AX940 supports both triple-frequency for the GPS and GLONASS constellations plus dual-frequency from BeiDou and Galileo. As the number of satellites in the constellations grows the AX940 is ready to take advantage of the additional signals. The Trimble ProPoint™ positioning engine delivers the quickest and most reliable RTK initializations for 1–2 centimeter positioning. For applications that do not require centimeter accuracy, the AX940 delivers high accuracy GNSS, DGNSS positions in the most challenging environments such as urban canyons. Different configurations of the module are available. These include everything from a DGPS L1 unit all the way to a four constellation, triple-frequency RTK unit. Choose the receiver that suits your application and price point. All features are password-upgradeable, allowing functionality to be upgraded as your requirements change.

With the option of utilizing OmniSTAR or RTX services with Integrity Monitoring, the AX940 delivers varying levels of performance down to centimeter-level without the use of a base station or cell modem.

### TRIMBLE MAXWELL™ 7 TECHNOLOGY

Industry professionals trust Trimble embedded positioning technologies as the core of their precision applications. With the latest Trimble Maxwell™ 7 Technology, the AX940 provides assurance of long-term future-proofing and trouble-free operation. Moving the industry forward, the Trimble AX940 redefines high performance positioning:

- ▶ 336 Tracking Channels
- ▶ Trimble Everest Plus™ multipath mitigation
- ▶ Advanced RF Spectrum Monitoring and Analysis
- ▶ Proven low-elevation tracking technology

### FLEXIBLE INTERFACING

The Trimble AX940 was designed for easy integration and rugged dependability. Customers benefit from the Ethernet connectivity available on the board, allowing high speed data transfer and configuration via standard web browsers. CAN, USB and RS-232 are also supported. Just like other Trimble embedded technologies, easy-to-use software commands simplify integration and reduce development times. An intuitive 3D interactive graphical web page allows easy input of lever arms.

### RUGGED PACKAGE

The unit comes in an environmentally sealed enclosure that is very easy to install. The unit is rigorously tested to perform in harsh environmental conditions with the reliability you expect from Trimble.

### Key Features

- ▶ Trimble Maxwell™ 7 Technology
- ▶ Trimble ProPoint™ positioning engine
- ▶ 336 Channels for multi-constellation GNSS support
- ▶ Trimble RTX and OmniSTAR Support
- ▶ Rugged IP67 Smart Antenna
- ▶ Compact design for mobile applications
- ▶ Flexible RS232, USB and Ethernet interfacing
- ▶ Centimeter-level position accuracy
- ▶ Advanced RF Spectrum Monitoring



# Trimble AX940 Smart Antenna

## TECHNICAL SPECIFICATIONS<sup>1</sup>

- Trimble Maxwell™ 7 Technology
- Trimble ProPoint™ positioning engine
- 336 Tracking Channels:
  - GPS: L1 C/A, L2E, L2C, L5
  - BeiDou: B1, B2
  - GLONASS: L1 C/A, L2 C/A, L3 CDMA<sup>2</sup>
  - Galileo<sup>3</sup>: E1, E5A, E5B, E5AltBOC
  - IRNSS: L5
  - QZSS: L1 C/A, L1 SAIF, L2C, L5, LEX
  - SBAS: L1 C/A, L5
  - MSS L-Band: OmniSTAR, Trimble RTX
- High-precision multiple correlator for GNSS pseudorange measurements
- Trimble Everest Plus™ multipath mitigation
- Advanced RF Spectrum Monitoring and Analysis
- 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
- Proven Trimble low elevation tracking technology
- Reference outputs/inputs
  - CMR, CMR+, sCMRx, RTCM 3.0, 3.1<sup>4</sup>, 3.2, 3.3
- Navigation Outputs:
  - ASCII: NMEA-0183 GSV, AVR, RMC, HDT, VGK, VHD, ROT, GKG, GGA, GSA, ZDA, VTG, GST, PJT, PJK, BPQ, GLL, GRS, GBS and Binary: Trimble GSOF, NMEA2000
- 1 Pulse Per Second Output
- Event Marker Input Support
- Supports Fault Detection & Exclusion (FDE), Receiver Autonomous Integrity Monitoring (RAIM)

## COMMUNICATION

- 1 USB 2.0 Device port
- 1 LAN Ethernet port:
  - Supports links to 10BaseT/100BaseT auto-negotiate networks
  - All functions are performed through a single IP address simultaneously—including web GUI access and raw data streaming
  - Network Protocols supported:
    - > HTTP (web GUI)
    - > 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 via PPP
    - > RNDIS Support
- 2 x RS232 ports:
  - Baud rates up to 460,800
- 1 CAN Port
- Control Software:
  - HTML web browser, Internet Explorer, Firefox, Safari, Opera, Google Chrome

## PERFORMANCE SPECIFICATIONS

Time to First Fix (TTFF) <sup>5</sup>	<60 seconds
Cold Start <sup>6</sup>	<30 seconds
Warm Start <sup>7</sup>	<5 seconds
Signal Re-acquisition <sup>8,9</sup>	<5 seconds
Velocity Accuracy <sup>8,9</sup>	0.007 m/sec
Horizontal	0.020 m/sec
Vertical	+/- 11g
Maximum acceleration GNSS tracking	+/- 11g
Maximum Operating Limits <sup>10</sup>	
Velocity	.515 m/sec
Altitude	.18,000 m
RTK initialization time <sup>8</sup>	typically <20ms
RTK initialization reliability <sup>8</sup>	>99.9%
Position Latency <sup>11</sup>	<20ms
Maximum Position/Attitude Update Rate	50 Hz

## PHYSICAL AND ELECTRICAL CHARACTERISTICS

Size	221 mm x 218 mm x 52 mm
Power	9 VDC to 28 VDC
	Typical 3.0 W (L1/L2 GPS + L1/L2 GLONASS)
Weight	0.66 kg
Connectors	
I/O	26-pin Tyco SUPERSEAL

## ENVIRONMENTAL CHARACTERISTICS<sup>12</sup>

Temperature	
Operating	-40 °C to +70 °C
Storage	-40 °C to +80 °C
Vibration	9.8 gRMS operating
Mechanical shock	MIL810D
	±40 g 10ms operating
	±75 g 6ms survival
Operating Humidity	.5% to 95% R.H. non-condensing, at +60 °C
IP Rating	IP67

## ORDERING INFORMATION

Module Part Number	129400-XX
Module	Trimble AX940 GNSS available in a variety of configurations from L1 SBAS upwards

- Trimble AX940 is available in a variety of software configurations. Specifications shown reflect full capability.
- There is no public GLONASS L3 CDMA. The current capability in the receivers is based on publicly available information. As such, Trimble cannot guarantee that these receivers will be fully compatible.
- Developed under a License of the European Union and the European Space Agency.
- Input only network correction
- Typical observed values (95%).
- No previous satellite (ephemerides / almanac) or position (approximate position or time) information.
- Ephemerides and last used position known
- May be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
- 1 sigma level add 1 ppm for RTK position accuracies.
- As required by the U.S. Department of Commerce to comply with export licensing restrictions.
- At maximum output rate.
- Dependent on appropriate mounting design.
- Also available in configurations with RTK accuracies limited to 10 and 30 centimeters.
- Trimble RTX and OmniSTAR accuracies depend on correction service chosen.

Specifications subject to change without notice.

## POSITIONING SPECIFICATIONS<sup>8,9,13,14</sup>

	Autonomous	SBAS	DGNSS	RTK
<b>No GNSS Outages</b>				
Position (m)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.25 (H) 0.50 (V)	0.008 (H) 0.015 (V)
Roll/Pitch (deg)	N/A	N/A	N/A	N/A
Heading (deg)	N/A	N/A	N/A	N/A

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# Trimble AX940i

## GNSS TRIPLE-FREQUENCY SMART ANTENNA WITH INTEGRATED INERTIAL NAVIGATION SYSTEM

### GNSS AND INERTIAL TIGHT INTEGRATION

Taking advantage of Trimble's expertise in both GNSS and Inertial technology the Trimble® AX940i has been designed for applications requiring continuous centimeter accuracy in a compact package. By integrating inertial sensors on the same module, robust high accuracy positions are produced in all environments using the advanced Trimble ProPoint™ positioning engine.

The receiver is also ideal for use as a GNSS DGPS/RTK base station.

### MULTI CONSTELLATION GNSS

The Trimble AX940i supports both triple-frequency for the GPS and GLONASS constellations plus dual-frequency from BeiDou and Galileo. As the number of satellites in the constellations grows the AX940i is ready to take advantage of the additional signals. This delivers the quickest and most reliable RTK initializations for 1–2 centimeter positioning. For applications that do not require centimeter accuracy, the AX940i integrated GNSS-inertial engine delivers high accuracy GNSS, DGNSS positions in the most challenging environments such as urban canyons. Different configurations of the module are available. These include everything from a DGPS L1 unit all the way to a four constellation, triple-frequency RTK unit. Choose the receiver that suits your application and price point. All features are password-upgradeable, allowing functionality to be upgraded as your requirements change.

With the option of utilizing OmniSTAR or RTX services with Integrity Monitoring, the AX940i delivers varying levels of performance down to centimeter-level without the use of a base station or cell modem.

### HIGH PERFORMANCE INTEGRATED INERTIAL SENSORS

The Trimble AX940i integrates the latest in precision inertial sensors in a compact package.

With the AX940i you are buying a robust navigation solution, not just a GNSS receiver.

#### Key features include:

- ▶ High update rate position and orientation solutions
- ▶ Continuous positioning in GNSS denied environment
- ▶ Lever arm calculation from antenna to navigation point of interest
- ▶ Robust moving baseline RTK for precision landing on moving platform
- ▶ Single-antenna heading not influenced by magnetic field variations

### FLEXIBLE INTERFACING

The Trimble AX940i was designed for easy integration and rugged dependability. Customers benefit from the Ethernet connectivity available on the board, allowing high speed data transfer and configuration via standard web browsers. USB, CAN and RS-232 are also supported. Just like other Trimble embedded technologies, easy to use software commands simplify integration and reduce development times. An intuitive 3D interactive graphical web page allows easy input of lever arms. Dynamic and graphic models for various vehicle types can also be selected.

### RUGGED PACKAGE

The unit comes in an environmentally sealed enclosure that is very easy to install. The unit is rigorously tested to perform in harsh environmental conditions with the reliability you expect from Trimble.

### Key Features

- ▶ Trimble Maxwell™ 7 Technology
- ▶ Trimble ProPoint™ positioning engine
- ▶ Onboard high accuracy inertial sensor package integrated with GNSS for precise position and orientation
- ▶ 336 Channels for multi-constellation GNSS support
- ▶ Trimble RTX and OmniSTAR Support
- ▶ Rugged IP67 Smart Antenna
- ▶ Compact design for mobile applications
- ▶ Flexible RS232, USB, CAN and Ethernet interfacing
- ▶ Centimeter-level position accuracy
- ▶ Advanced RF Spectrum Monitoring
- ▶ Integrated WiFi, Bluetooth





# Trimble AX940i Smart Antenna

## TECHNICAL SPECIFICATIONS<sup>1</sup>

- Trimble Maxwell™ 7 Technology
- Trimble ProPoint™ positioning engine
- On-board Advanced MMS inertial sensors
- 336 Tracking Channels:
  - GPS: L1 C/A, L2E, L2C, L5
  - BeiDou: B1, B2
  - GLONASS: L1 C/A, L2 C/A, L3 CDMA<sup>2</sup>
  - Galileo<sup>3</sup>: E1, E5A, E5B, E5AltBOC
  - IRNSS: L5
  - QZSS: L1 C/A, L1 SAIF, L2C, L5, LEX
  - SBAS: L1 C/A, L5
  - MSS L-Band: OmniSTAR, Trimble RTX
- High-precision multiple correlator for GNSS pseudorange measurements
- Trimble Everest Plus™ multipath mitigation
- Advanced RF Spectrum Monitoring and Analysis
- 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
- Proven Trimble low elevation tracking technology
- Reference outputs/inputs
  - CMR, CMR+, sCMRx, RTCM 3.0, 3.1<sup>4</sup>, 3.2, 3.3
- Navigation Outputs:
  - ASCII: NMEA-0183 GSV, AVR, RMC, HDT, VGK, VHD, ROT, GKG, GGA, GSA, ZDA, VTG, GST, PJT, PJK, BPQ, GLL, GRS, GBS and Binary: Trimble GSOF, NMEA2000
- 1 Pulse Per Second Output
- Event Marker Input Support
- Supports Fault Detection & Exclusion (FDE), Receiver Autonomous Integrity Monitoring (RAIM)

## COMMUNICATION

- 1 USB 2.0 Device port
- 1 LAN Ethernet port:
  - Supports links to 10BaseT/100BaseT auto-negotiate networks
  - All functions are performed through a single IP address simultaneously—including web GUI access and raw data streaming
  - Network Protocols supported:
    - HTTP (web GUI)
    - 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 via PPP
    - RNDIS Support
- 2 x RS232 ports:
  - Baud rates up to 460,800
- 1 CAN Port
- Control Software:
  - HTML web browser, Internet Explorer, Firefox, Safari, Opera, Google Chrome
- Bluetooth, fully integrated, fully sealed 2.4 GHz communication port
- WiFi, 802.11 b/g, access point and client mode, WPA / WPA2 / WEP64 / WEP128 encryption

## PERFORMANCE SPECIFICATIONS

Time to First Fix (TTFF) <sup>5</sup>	
Cold Start <sup>6</sup>	<60 seconds
Warm Start <sup>7</sup>	<30 seconds
Signal Re-acquisition	<5 seconds
Velocity Accuracy <sup>8,9</sup>	
Horizontal	0.007 m/sec
Vertical	0.020 m/sec
Maximum acceleration GNSS tracking	+/- 11g
Inertial Sensors	
Maximum accelerations	±6 g
Maximum angular rate	±350 deg/sec
Maximum Operating Limits <sup>10</sup>	
Velocity	515 m/sec
Altitude	18,000 m
RTK initialization time <sup>8</sup>	typically <10 seconds
RTK initialization reliability <sup>8</sup>	>99.9%
Position Latency <sup>11</sup>	<20ms
Maximum Position/Attitude Update Rate	100 Hz

## PHYSICAL AND ELECTRICAL CHARACTERISTICS

Size	221 mm x 218 mm x 52 mm
Power	9 VDC to 28 VDC
	Typical 3.0 W (L1/L2 GPS + L1/L2 GLONASS)
Weight	0.66 kg
Connectors	
I/O	26-pin Tyco SUPERSEAL

## ENVIRONMENTAL CHARACTERISTICS<sup>12</sup>

Temperature	
Operating	-40 °C to +70 °C
Storage	-40 °C to +80 °C
Vibration	9.8 gRMS operating
Mechanical shock	MIL810D
	±40 g 10ms operating
	±75 g 6ms survival
Operating Humidity	5% to 95% R.H. non-condensing, at +60 °C
IP Rating	IP67

## ORDERING INFORMATION

Smart Antenna Part Number	129401-XX
Smart Antenna	Trimble AX940i GNSS available in a variety of configurations from L1 SBAS upwards

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- Input only network correction
- Typical observed values (95%).
- No previous satellite (ephemerides / almanac) or position (approximate position or time) information.
- Ephemerides and last used position known
- May be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
- 1 sigma level add 1 ppm for RTK position accuracies.
- As required by the U.S. Department of Commerce to comply with export licensing restrictions.
- At maximum output rate.
- Dependent on appropriate mounting design.
- Also available in configurations with RTK accuracies limited to 10 and 30 centimeters.
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Specifications subject to change without notice.

## POSITIONING SPECIFICATIONS<sup>8,13,14</sup>

	Autonomous	SBAS	DGNSS	RTK	INS-Autonomous	INS-SBAS	INS-DGNSS	INS-RTK
<b>No GNSS Outages</b>								
Position (m)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.25 (H) 0.50 (V)	0.008 (H) 0.015 (V)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.40 (H) 0.60 (V)	0.05 (H) 0.03 (V)
Roll/Pitch (deg)	N/A	N/A	N/A	N/A	0.10	0.10	0.10	0.10
Heading (deg)	N/A	N/A	N/A	N/A	0.50	0.50	0.50	0.50

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# Trimble BD940

## TRIPLE-FREQUENCY RECEIVER INTEGRATED WITH MSS BAND DEMODULATOR FOR PRECISE POSITIONING APPLICATIONS

### MULTI-CONSTELLATION/ MULTI-FREQUENCY GNSS

The Trimble® BD940 supports both triple-frequency from the GPS and GLONASS constellations plus dual-frequency from BeiDou and Galileo. As the number of satellites in the constellations grow the BD940 is ready to take advantage of the additional signals. This delivers the quickest and most reliable RTK and RTX initializations for centimeter positioning. For applications that do not require centimeter accuracy the BD940 contains an advanced Kalman filter PVT engine that delivers high accuracy GNSS, DGNSS positions in the most challenging environments.

Different configurations of the module are available. These include everything from an autonomous GPS L1 unit all the way to a four constellation triple-frequency RTK unit. Choose the receiver that suits your application and price point. All features are password-upgradeable, allowing functionality to be upgraded as your requirements change. The receiver also supports Fault Detection and Exclusion (FDE) and Receiver Autonomous Integrity Monitoring (RAIM) for safety-critical applications.

### COMPACT FULL METAL JACKET DESIGN

The Trimble BD940 GNSS receiver module has been designed for applications requiring centimeter accuracy in a very small package. Mobile platforms can now embed proven Trimble RTK technology using a shielded module with a 51 mm x 41 mm x 7 mm form factor. The Trimble BD940 is a complete drop-in, solder-down module manufactured and tested to Trimble's highest quality standards. This design ensures the high quality GNSS signals are protected from the sources of EMI on the host platform. It also significantly reduces radiated emissions which speeds compliance certification and time to market.

### TRIMBLE MAXWELL™ 7 TECHNOLOGY

Industry professionals trust Trimble embedded positioning technologies as the core of their precision applications. With the latest Trimble Maxwell™ 7 Technology, the BD940 provides assurance of long-term future-proofing and trouble-free operation. Moving the industry forward, the Trimble BD940 redefines high performance positioning:

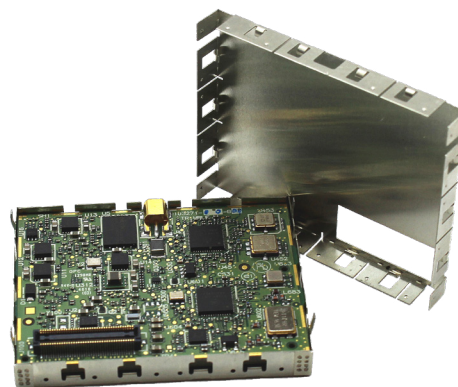
- ▶ 336 Tracking Channels
- ▶ Trimble Everest Plus™ multipath mitigation
- ▶ Advanced RF Spectrum Monitoring and Analysis
- ▶ Proven low-elevation tracking technology

### FLEXIBLE INTERFACING

The Trimble BD940 was designed for easy integration and rugged dependability. Customers benefit from the Ethernet connectivity available on the board, allowing high speed data transfer and configuration via standard web browsers. USB and RS-232 are also supported. Just like other Trimble embedded technologies, easy to use software commands simplify integration and reduce development times.

### Key Features

- ▶ Trimble Maxwell™ 7 Technology
- ▶ 336 Channels for multi-constellation GNSS support
- ▶ Trimble RTX and OmniSTAR Support
- ▶ EMI shielded module
- ▶ Compact design for mobile applications
- ▶ Flexible RS232, USB and Ethernet interfacing
- ▶ Centimeter-level position accuracy
- ▶ Advanced RF Spectrum Monitoring



# Trimble BD940 Module

## TECHNICAL SPECIFICATIONS<sup>1</sup>

- Trimble Maxwell™ 7 Technology
- 336 Tracking Channels:
  - GPS: L1 C/A, L2E, L2C, L5
  - BeiDou: B1, B2
  - GLONASS: L1 C/A, L2 C/A, L3 CDMA<sup>13</sup>
  - Galileo<sup>2</sup>: E1, E5A, E5B, E5AltBOC
  - IRNSS: L5
  - QZSS: L1 C/A, L1 SAIF, L2C, L5, LEX
  - SBAS: L1 C/A, L5
  - MSS L-Band: OmniSTAR, Trimble RTX
- High-precision multiple correlator for GNSS pseudorange measurements
- Trimble Everest Plus™ multipath mitigation
- Advanced RF Spectrum Monitoring and Analysis
- 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
- Proven Trimble low elevation tracking technology
- Reference outputs/inputs:
  - CMR, CMR+, sCMRx, RTCM 2.1, 2.2, 2.3, 3.0, 3.1<sup>12</sup>, 3.2
- Navigation Outputs:
  - ASCII: NMEA-0183 GSV, AVR, RMC, HDT, VGK, VHD, ROT, GKG, GGA, ZDA, VTG, GST, PJT, PJK, BPQ, GLL, GRS, GBS and Binary: Trimble GSOF, NMEA2000
- 1 Pulse Per Second Output
- Event Marker Input Support
- Supports Fault Detection & Exclusion (FDE), Receiver Autonomous Integrity Monitoring (RAIM)

## COMMUNICATION

- 1 USB 2.0 Device port
- 1 LAN Ethernet port:
  - Supports links to 10BaseT/100BaseT auto-negotiate networks
  - All functions are performed through a single IP address simultaneously—including web GUI access and raw data streaming
  - Network Protocols supported:
    - > HTTP (web GUI)
    - > 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 via PPP
    - > RNDIS Support
- 4 x RS232 ports:
  - Baud rates up to 230,400
- Control Software:
  - HTML web browser, Internet Explorer, Firefox, Safari, Opera, Google Chrome
- 1 CAN Port (requires addition of CAN Transceiver by customer)

## PERFORMANCE SPECIFICATIONS

Time to First Fix (TTFF) <sup>7</sup>	<45 seconds
Cold Start <sup>8</sup>	<30 seconds
Warm Start <sup>9</sup>	<2 seconds
Signal Re-acquisition	<2 seconds
Velocity Accuracy <sup>3,4</sup>	
Horizontal	0.007 m/sec
Vertical	0.020 m/sec
Maximum Operating Limits <sup>10</sup>	
Velocity	515 m/sec
Altitude	18,000 m
Maximum acceleration GNSS tracking	+/- 11g
RTK initialization time <sup>3</sup>	typically <8 seconds
RTK initialization reliability <sup>3</sup>	>99.9%
Position Latency <sup>5</sup>	<20ms
Maximum Position	.50 Hz

## PHYSICAL AND ELECTRICAL CHARACTERISTICS

Size	51 mm x 41 mm x 7 mm
Power	3.3 VDC +5%/-3%
	Typical 1.4 W (L1/L2 GPS + L1/L2 GLONASS)
	Typical 2.2 W (L1/L2/L5 GPS/GLONASS/BeiDou/Galileo)
Weight	27 grams
Connectors	
I/O	80 pin Narrow Pitch Panasonic Socket
GNSS Antenna	MMCX receptacle
Antenna LNA Power Input	
Input voltage	3.3 VDC to 5 VDC
Maximum current	400 mA
Minimum required LNA Gain	+32.0 dB

## ENVIRONMENTAL CHARACTERISTICS<sup>11</sup>

Temperature	
Operating	-40 °C to +75 °C
Storage	-55 °C to +85 °C
Vibration	MIL810F, tailored
	Random 6.2 gRMS operating
	Random 8 gRMS survival
	MIL810D
	±40 g 10ms operating
	±75 g 6ms survival
Operating Humidity	5% to 95% R.H. non-condensing, at +60 °C

## ORDERING INFORMATION

Module Part Number	90940-XX
Module	Trimble BD940 GNSS available in a variety of configurations from L1 SBAS upwards
Evaluation Kit	Includes interface board, power supply

- Trimble BD940 is available in a variety of software configurations. Specifications shown reflect full capability.
- Developed under a License of the European Union and the European Space Agency.
- May be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
- 1 sigma level, when using Trimble Zephyr 2/3 antennas, add 1 ppm to RTK Position accuracies.
- At maximum output rate.
- GPS only and depends on SBAS System performance. FAA WAAS accuracy specifications are <5 m 3DRMS.
- Typical observed values.
- No previous satellite (ephemerides / almanac) or position (approximate position or time) information.
- Ephemerides and last used position known
- As required by the U.S. Department of Commerce to comply with export licensing restrictions.
- Dependent on appropriate mounting/enclosure design.
- Input only network correction
- There is no public GLONASS L3 CDMA. The current capability in the receivers is based on publicly available information. As such, Trimble cannot guarantee that these receivers will be fully compatible.
- Trimble RTX and OmniSTAR accuracies depend on correction service chosen. Trimble CenterPoint RTX provides <4cm horizontal accuracy 95% of the time with initializations of less than 30 minutes.
- Also available in configurations with RTK accuracies limited to 10 and 30 centimeters.

Specifications subject to change without notice.

## POSITIONING SPECIFICATIONS<sup>3,4,14,15</sup>

	Autonomous	SBAS	DGNSS	RTK	INS-Autonomous	INS-SBAS	INS-DGNSS	INS-RTK
<b>No GNSS Outages</b>								
Position (m)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.25 (H) 0.50 (V)	0.008 (H) 0.015 (V)	N/A	N/A	N/A	N/A
Roll/Pitch (deg)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Heading (deg)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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# Trimble BD940-INS

## TRIPLE-FREQUENCY RECEIVER WITH INTEGRATED INERTIAL NAVIGATION SYSTEM AND MSS BAND DEMODULATOR

### GNSS AND INERTIAL TIGHT INTEGRATION

Taking advantage of Trimble's expertise in both GNSS and Inertial technology the Trimble® BD940-INS module has been designed for applications requiring continuous centimeter accuracy in a compact package. By integrating inertial sensors on the same module, robust high accuracy positions are produced in all environments.

The GNSS components are fully shielded. This design ensures the high quality signals are protected from the sources of EMI on the host platform.

### MULTI-CONSTELLATION GNSS

The Trimble BD940-INS supports both triple-frequency for the GPS and GLONASS constellations plus dual-frequency from BeiDou and Galileo. As the number of satellites in the constellations grows the BD940-INS is ready to take advantage of the additional signals. This delivers the quickest and most reliable RTK initializations for 1–2 centimeter positioning. For applications that do not require centimeter accuracy the BD940-INS integrated GNSS Inertial engine delivers high accuracy GNSS, DGNSS positions in the most challenging environments, such as urban canyons. Different configurations of the module are available. These include everything from a DGPS L1 unit all the way to a four constellation, triple-frequency RTK unit. Choose the receiver that suits your application and price point. All features are password-upgradeable, allowing functionality to be upgraded as your requirements change.

With the option of utilizing OmniSTAR or RTX services, the BD940-INS delivers varying levels of performance down to centimeter-level without the use of a base station.

### HIGH PERFORMANCE INTEGRATED INERTIAL SENSORS

The Trimble BD940-INS integrates the latest in precision inertial sensors in a compact package. With the BD940-INS you are buying a robust navigation solution, not just a GNSS receiver.

Key features include:

- ▶ High update rate position and orientation solutions
- ▶ Continuous positioning in GNSS denied environments
- ▶ Lever arm calculation from antenna to navigation point of interest
- ▶ Robust Moving Baseline RTK for precision landing on moving platforms
- ▶ Single-antenna heading not influenced by magnetic field variations

### FLEXIBLE INTERFACING

The Trimble BD940-INS was designed for easy integration and rugged dependability. Customers benefit from the Ethernet connectivity available on the board, allowing high speed data transfer and configuration via standard web browsers. USB and RS-232 are also supported. Just like other Trimble embedded technologies, easy to use software commands simplify integration and reduce development times. An intuitive 3D interactive graphical web page allows easy input of lever arms. Dynamic and graphic models for various vehicle types can also be selected.

### Key Features

- ▶ Trimble Maxwell™ 7 Technology
- ▶ Onboard high accuracy inertial sensor package integrated with GNSS for precise position and orientation
- ▶ 336 Channels for multi-constellation GNSS support
- ▶ Trimble RTX and OmniSTAR Support
- ▶ EMI shielded module
- ▶ Compact design for mobile applications
- ▶ Flexible RS232, USB and Ethernet interfacing
- ▶ Centimeter-level position accuracy
- ▶ Advanced RF Spectrum Monitoring



# Trimble BD940-INS Module

## TECHNICAL SPECIFICATIONS<sup>1</sup>

- Trimble Maxwell™ 7 Technology
- On-board Advanced MEMS inertial sensors
- 336 Channels:
  - GPS: L1 C/A, L2E, L2C, L5
  - BeiDou: B1, B2
  - GLONASS: L1 C/A, L2 C/A, L3 CDMA<sup>13</sup>
  - Galileo<sup>2</sup>: E1, E5A, E5B, E5AltBOC
  - IRNSS: L5
  - QZSS: L1 C/A, L1 SAIF, L2C, L5, LEX
  - SBAS: L1 C/A, L5
- High-precision multiple correlator for GNSS pseudorange measurements
- Trimble Everest Plus™ multipath mitigation
- 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
- Proven Trimble low elevation tracking technology
- Reference outputs/inputs:
  - CMR, CMR+, sCMRx, RTCM 2.1, 2.2, 2.3, 3.0, 3.1<sup>12</sup>, 3.2
- Navigation outputs
  - ASCII: NMEA-0183 GSV, AVR, RMC, HDT, VGK, VHD, ROT, GKG, GGA, ZDA, VTG, GST, PJT, PJK, BPQ, GLL, GRS, GBS and Binary: Trimble GSOF, NMEA2000
- 1 Pulse Per Second Output
- Event Marker Input Support
- Supports Fault Detection & Exclusion (FDE), Receiver Autonomous Integrity Monitoring (RAIM)

## COMMUNICATION

- 1 USB 2.0 Device port
- 1 LAN Ethernet port:
  - Supports links to 10BaseT/100BaseT auto-negotiate networks
  - All functions are performed through a single IP address simultaneously—including web GUI access and raw data streaming
  - Network Protocols supported:
    - > HTTP (web GUI)
    - > 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 via PPP
    - > RNDIS Support
- 2 x RS232 ports:
  - Baud rates up to 230,400
- Control Software:
  - HTML web browser, Internet Explorer, Firefox, Safari, Opera, Google Chrome

## PERFORMANCE SPECIFICATIONS

Time to First Fix (TTFF) <sup>7</sup>	
Cold Start <sup>8</sup>	<45 seconds
Warm Start <sup>9</sup>	<30 seconds
Signal Re-acquisition	<2 seconds
Velocity Accuracy <sup>3,4</sup>	
Horizontal	0.007 m/sec
Vertical	0.020 m/sec
Maximum acceleration GNSS Tracking	+/- 11g
Inertial Sensors	
Maximum acceleration	±6g
Maximum angular rate	±350 deg/sec
Maximum Operating Limits <sup>10</sup>	
Velocity	515 m/sec
Altitude	18,000 m
RTK initialization time <sup>3</sup>	typically <8 seconds
RTK initialization reliability <sup>3</sup>	>99.9%
Position Latency <sup>5</sup>	<20ms
Maximum Position/Attitude Update Rate	100 Hz

## PHYSICAL AND ELECTRICAL CHARACTERISTICS

Size	60 mm x 67 mm x 15 mm
Power	5.5 VDC to 30 VDC Typical 2.0 W (L1/L2 GPS + L1/L2 GLONASS)
Weight	60 grams
Connectors	
I/O	44-pin header
GNSS Antenna	MMCX receptacle
Antenna LNA Power Input	
Input voltage	3.3 VDC to 5 VDC
Maximum current	400 mA
Minimum required LNA Gain	32.0 dB

## ENVIRONMENTAL CHARACTERISTICS<sup>11</sup>

Temperature	
Operating	-40 °C to +75 °C
Storage	-55 °C to +85 °C
Vibration	MIL810F, tailored Random 6.2 gRMS operating Random 8 gRMS survival MIL810D
Mechanical shock	±40 g 10ms operating ±75 g 6ms survival
Operating Humidity	5% to 95% R.H. non-condensing, at +60 °C

## ORDERING INFORMATION

Module Part Number	112078-XX
Module	Trimble BD940-INS GNSS available in a variety of configurations from L1 SBAS upwards
Evaluation Kit	Includes interface board, power supply

- Trimble BD940-INS is available in a variety of software configurations. Specifications shown reflect full capability.
- Developed under a License of the European Union and the European Space Agency.
- May be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
- 1 sigma level, when using Trimble Zephyr 2/3 antennas, add 1 ppm for RTK position accuracies. Heading accuracy is after dynamic alignment and during motion. Performance may be reduced with long stationary or hovering periods.
- At maximum output rate.
- GPS only and depends on SBAS System performance. FAA WAAS accuracy specifications are <5 m 3DRMS.
- Typical observed values.
- No previous satellite (ephemerides / almanac) or position (approximate position or time) information.
- Ephemerides and last used position known
- As required by the U.S. Department of Commerce to comply with export licensing restrictions.
- Dependent on appropriate mounting/enclosure design.
- Input only network correction
- There is no public GLONASS L3 CDMA. The current capability in the receivers is based on publicly available information. As such, Trimble cannot guarantee that these receivers will be fully compatible.
- Trimble RTX and OmniSTAR accuracies depend on correction service chosen. Trimble CenterPoint RTX provides <4cm horizontal accuracy 95% of the time with initializations of less than 30 minutes.
- Also available in configurations with RTK accuracies limited to 10 and 30 centimeters.

Specifications subject to change without notice.

## POSITIONING SPECIFICATIONS<sup>3,4,14,15</sup>

	Autonomous	SBAS	DGNSS	RTK	INS-Autonomous	INS-SBAS	INS-DGNSS	INS-RTK
<b>No GNSS Outages</b>								
Position (m)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.25 (H) 0.50 (V)	0.008 (H) 0.015 (V)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.40 (H) 0.60 (V)	0.05 (H) 0.03 (V)
Roll/Pitch (deg)	N/A	N/A	N/A	N/A	0.10	0.10	0.10	0.10
Heading (deg)	N/A	N/A	N/A	N/A	0.50	0.50	0.50	0.50
<b>10 second GNSS Outages</b>								
Position (m)	N/A	N/A	N/A	N/A	1.50 (H) 1.80 (V)	1.20 (H) 1.20 (V)	1.00 (H) 1.00 (V)	0.30 (H) 0.20 (V)
Roll/Pitch (deg)	N/A	N/A	N/A	N/A	0.10	0.10	0.10	0.10
Heading (deg)	N/A	N/A	N/A	N/A	0.50	0.50	0.50	0.50

Contact your local dealer today

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# Trimble BD992

## DUAL-ANTENNA RECEIVER DELIVERS CENTIMETER ACCURATE POSITIONS AND PRECISE HEADING

### DUAL-ANTENNA INPUT

The Trimble® BD992 GNSS system is a single board solution for precise position and heading. Single-antenna GNSS systems have difficulty determining where the antenna is positioned relative to the vehicle and object of interest, especially when dynamics are low. External sensors can be used to augment this however these tend to drift when static. Heading derived from dual-antenna GNSS measurements overcomes these issues and is now economically the right choice.

### TRIMBLE MAXWELL™ 7 TECHNOLOGY

The Trimble BD992 supports triple-frequency for the GPS, GLONASS, BeiDou and Galileo constellations. As the number of satellites in the constellations grows the BD992 is ready to take advantage of the additional signals. This delivers the quickest and most reliable RTK initializations for centimeter positioning. With the latest Trimble Maxwell™ 7 Technology, the BD992 provides:

- ▶ 336 Tracking Channels
- ▶ Trimble Everest Plus™ multipath mitigation
- ▶ Advanced RF Spectrum Monitoring and Analysis
- ▶ Proven low-elevation tracking technology

With the option of utilizing OmniSTAR or RTX services, the BD992 delivers varying levels of performance down to centimeter-level without the use of a base station.

### ROBUST CENTIMETER ACCURATE SOLUTIONS

The Trimble BD992 integrates the latest in precision inertial sensors in a compact package. With the BD992 you are buying a robust navigation solution, not just a GNSS receiver.

Key features include:

- ▶ High update rate position and heading solutions
- ▶ Robust Moving Baseline RTK for precision landing on moving platforms

### FLEXIBLE INTERFACING

The Trimble BD992 was designed for easy integration and rugged dependability. Customers benefit from the Ethernet connectivity available on the board, allowing high speed data transfer and configuration via standard web browsers. USB, CAN and RS-232 are also supported. Just like other Trimble embedded technologies, easy to use software commands simplify integration and reduce development times.

Different configurations of the module are available. These include everything from a DGPS L1 unit all the way to a four constellation, triple-frequency RTK unit. All features are password upgradeable, allowing functionality to be upgraded as your requirements change.

### Key Features

- ▶ Trimble Maxwell™ 7 Technology
- ▶ Dual-antenna inputs for precise heading calculation
- ▶ 336 Channels for multi-constellation GNSS support
- ▶ Trimble RTX and OmniSTAR Support
- ▶ Compact design for mobile applications
- ▶ Flexible RS232, USB and Ethernet interfacing
- ▶ Centimeter-level position accuracy
- ▶ Advanced RF Spectrum Monitoring



TECHNICAL SPECIFICATIONS<sup>1</sup>

- Trimble Maxwell™ 7 Technology
- Position Antenna based on 336 Channel Maxwell™ 7 chip:
  - GPS: L1 C/A, L2E, L2C, L5
  - BeiDou: B1, B2, B3<sup>13</sup>
  - GLONASS: L1 C/A, L2 C/A, L3 CDMA<sup>14</sup>
  - Galileo<sup>2</sup>: E1, E5A, E5B, E5AltBOC, E6<sup>14</sup>
  - IRNSS: L5
  - QZSS: L1 C/A, L1 SAIF, L2C, L5, LEX
  - SBAS: L1 C/A, L5
  - MSS L-Band: OmniSTAR, Trimble RTX
- Vector Antenna based on second 336 Channel Maxwell™ 7 chip:
  - GPS: L1 C/A, L2E, L2C, L5
  - BeiDou: B1, B2, B3
  - GLONASS: L1 C/A, L2 C/A, L3 CDMA<sup>14</sup>
  - Galileo<sup>2</sup>: E1, E5A, E5B, E5AltBOC, E6<sup>14</sup>
  - IRNSS: L5
  - QZSS: L1 C/A, L1 SAIF, L1C, L2C, L5, LEX
- High-precision multiple correlator for GNSS pseudorange measurements
- Trimble Everest Plus™ multipath mitigation
- Advanced RF Spectrum Monitoring and Analysis
- 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
- Proven Trimble low elevation tracking technology
- Reference outputs/inputs:
  - CMR, CMR+, sCMRx, RTCM 2.1, 2.2, 2.3, 3.0, 3.1<sup>12</sup>, 3.2
- Navigation Outputs:
  - ASCII: NMEA-0183 GSV, AVR, RMC, HDT, VGK, VHD, ROT, GKG, GGA, GSA, ZDA, VTG, GST, PJT, PJK, BPQ, GLL, GRS, GBS and Binary: Trimble GSOF, NMEA2000
- 1 Pulse Per Second Output
- Event Marker Input Support
- Supports Fault Detection & Exclusion (FDE), Receiver Autonomous Integrity Monitoring (RAIM)

## COMMUNICATION

- 1 USB 2.0 Device port
- 1 LAN Ethernet port:
  - Supports links to 10BaseT/100BaseT auto-negotiate networks
  - All functions are performed through a single IP address simultaneously—including web GUI access and raw data streaming
  - Network Protocols supported:
    - HTTP (web GUI)
    - 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 via PPP
    - RNDIS Support
- 3 x RS232 ports:
  - Baud rates up to 460,800
- 1 CAN Port
- Control Software:
  - HTML web browser, Internet Explorer, Firefox, Safari, Opera, Google Chrome

## PERFORMANCE SPECIFICATIONS

Time to First Fix (TTFF) <sup>7</sup>	
Cold Start <sup>8</sup>	<45 seconds
Warm Start <sup>8</sup>	<30 seconds
Signal Re-acquisition	<2 seconds
Velocity Accuracy <sup>3,4</sup>	
Horizontal	.0007 m/sec
Vertical	0.020 m/sec
Maximum Operating Limits <sup>10</sup>	
Velocity	.515 m/sec
Altitude	18,000 m
Maximum acceleration GNSS tracking	+/- 11g
RTK initialization time <sup>3</sup>	typically <8 seconds
RTK initialization reliability <sup>3</sup>	>99.9%
Position Latency <sup>5</sup>	<20ms
Maximum Position/Attitude Update Rate	50 Hz

## PHYSICAL AND ELECTRICAL CHARACTERISTICS

Size	100 mm x 60 mm x 11.6 mm
Power	3.3 VDC +5%/-3% Typical 2.3 W (L1/L2 GPS + L1/L2 GLONASS)
Weight	.60 grams
Connectors	
I/O	44-pin header
GNSS Antenna	.2 x MMCX receptacle
Antenna LNA Power Input	
Input voltage	3.3 VDC to 5 VDC
Maximum current	400 mA
Minimum required LNA Gain	32.0 dB

ENVIRONMENTAL CHARACTERISTICS<sup>11</sup>

Temperature	
Operating	-40 °C to +75 °C
Storage	-55 °C to +85 °C
Vibration	MIL810F, tailored Random 6.2 gRMS operating Random 8 gRMS survival
Mechanical shock	MIL810D ±40 g 10ms operating ±75 g 6ms survival
Operating Humidity	.5% to 95% R.H. non-condensing, at +60 °C

## ORDERING INFORMATION

Module Part Number	100992-XX
Module	Trimble BD992 GNSS available in a variety of configurations from L1 SBAS upwards
Evaluation Kit	Includes interface board, power supply

- Trimble BD992 is available in a variety of software configurations. Specifications shown reflect full capability.
- Developed under a License of the European Union and the European Space Agency.
- May be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
- 1 sigma level, when using Trimble Zephyr 2/3 antennas. Add 1 ppm for RTK position accuracies.
- At maximum output rate.
- GPS only and depends on SBAS System performance. FAA WAAS accuracy specifications are <5 m 3DRMS.
- Typical observed values.
- No previous satellite (ephemerides / almanac) or position (approximate position or time) information.
- Ephemerides and last used position known.
- As required by the U.S. Department of Commerce to comply with export licensing restrictions.
- Dependent on appropriate mounting/enclosure design.
- Input only network correction.
- The hardware of this product is designed for Beidou B3 compatibility (trial version) and its firmware will be enhanced to fully support such new signals as soon as the officially published signal interface control documentation (ICD) becomes available.
- There is no public GLONASS L3 CDMA or Galileo E6 ICD. The current capability in the receivers is based on publicly available information. As such, Trimble cannot guarantee that these receivers will be fully compatible.
- Trimble RTX and OmniSTAR accuracies depend on correction service chosen. Trimble CenterPoint RTX provides <4cm horizontal accuracy 95% of the time with initializations of less than 30 minutes.
- Also available in configurations with RTK accuracies limited to 10 and 30 centimeters.

Specifications subject to change without notice.

POSITIONING SPECIFICATIONS<sup>3,4,15,16</sup>

	Autonomous	SBAS	DGNSS	RTK
<b>No GNSS Outages</b>				
Position (m)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.25 (H) 0.50 (V)	0.008 (H) 0.015 (V)
Roll/Pitch (deg)	0.20	0.20	0.20	0.20
Heading (deg) on 2m Baseline	<0.09°	<0.09°	<0.09°	<0.09°

Contact your local dealer today

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# Trimble BD992-INS

## DUAL-ANTENNA RECEIVER WITH INTEGRATED INERTIAL NAVIGATION SYSTEM AND MSS BAND DEMODULATOR

### GNSS AND INERTIAL TIGHT INTEGRATION

Taking advantage of Trimble's expertise in both GNSS and Inertial technology the Trimble® BD992-INS module has been designed for applications requiring continuous centimeter accuracy in a compact package. By integrating inertial sensors on the same module, robust high accuracy positions and orientations are produced in all environments.

### TRIMBLE MAXWELL™ 7 TECHNOLOGY

The Trimble BD992-INS supports triple-frequency for the GPS, GLONASS, BeiDou and Galileo constellations. As the number of satellites in the constellations grows the BD992-INS is ready to take advantage of the additional signals. This delivers the quickest and most reliable RTK initializations for centimeter positioning. For applications that do not require centimeter accuracy the BD992-INS integrated GNSS-Inertial engine also delivers high accuracy GNSS, DGNSS positions in the most challenging environments such as urban canyons. With the latest Trimble Maxwell™ 7 Technology, the BD992-INS provides:

- ▶ 336 Tracking Channels
- ▶ Trimble Everest Plus™ multipath mitigation
- ▶ Advanced RF Spectrum Monitoring and Analysis
- ▶ Proven low-elevation tracking technology

With the option of utilizing OmniSTAR or RTX services, the BD992-INS delivers varying levels of performance down to centimeter-level without the use of a base station.

### ROBUST CENTIMETER ACCURATE SOLUTIONS

The Trimble BD992-INS integrates the latest in precision inertial sensors in a compact package. With the BD992-INS you are buying a robust navigation solution, not just a GNSS receiver.

**Key features include:**

- ▶ High update rate position and orientation solutions
- ▶ Dual-antenna for rapid heading alignment
- ▶ Continuous positioning in GNSS denied environments
- ▶ Lever arm calculation from antenna to navigation point of interest
- ▶ Robust Moving Baseline RTK for precision landing on moving platforms

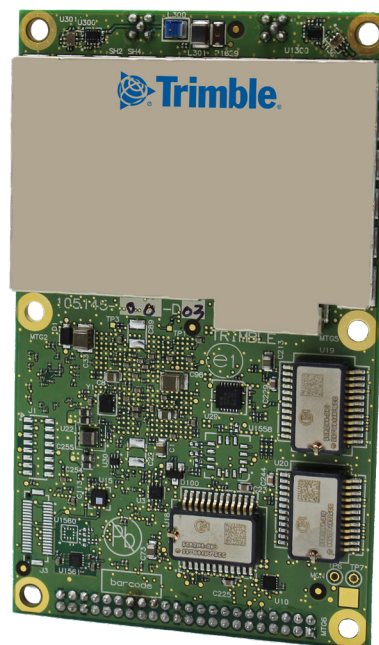
### FLEXIBLE INTERFACING

The Trimble BD992-INS was designed for easy integration and rugged dependability. Customers benefit from the Ethernet connectivity available on the board, allowing high speed data transfer and configuration via standard web browsers. USB, CAN and RS-232 are also supported. Just like other Trimble embedded technologies, easy to use software commands simplify integration and reduce development times. An intuitive 3D interactive graphical web page allows easy input of lever arms. Dynamic and graphic models for various vehicle types can also be selected.

Different configurations of the module are available. These include everything from a DGPS L1 unit all the way to a four constellation triple-frequency RTK unit. All features are password-upgradeable, allowing functionality to be upgraded as your requirements change.

### Key Features

- ▶ Trimble Maxwell™ 7 Technology
- ▶ Onboard high accuracy inertial sensor package integrated with GNSS for precise position and orientation
- ▶ 336 Channels for multi-constellation GNSS support
- ▶ Trimble RTX and OmniSTAR Support
- ▶ Compact design for mobile applications
- ▶ Flexible RS232, USB and Ethernet interfacing
- ▶ Centimeter-level position accuracy
- ▶ Advanced RF Spectrum Monitoring





TECHNICAL SPECIFICATIONS<sup>1</sup>

- Trimble Maxwell™ 7 Technology
- Onboard Advanced MEMS inertial sensors
- Position Antenna based on 336 Channel Maxwell™ 7 chip:
  - GPS: L1 C/A, L2E, L2C, L5
  - BeiDou: B1, B2, B313
  - GLONASS: L1 C/A, L2 C/A, L3 CDMA<sup>14</sup>
  - Galileo<sup>2</sup>: E1, E5A, E5B, E5AltBOC, E6<sup>14</sup>
  - IRNSS: L5
  - QZSS: L1 C/A, L1 SAIF, L1C, L2C, L5, LEX
  - SBAS: L1 C/A, L5
  - MSS L-Band: OmniSTAR, Trimble RTX
- Vector Antenna based on second 336 Channel Maxwell™ 7 chip:
  - GPS: L1 C/A, L2E, L2C, L5
  - BeiDou: B1, B2, B3
  - GLONASS: L1 C/A, L2 C/A, L3 CDMA<sup>14</sup>
  - Galileo<sup>2</sup>: E1, E5A, E5B, E5AltBOC, E6<sup>14</sup>
  - IRNSS: L5
  - QZSS: L1 C/A, L1 SAIF, L1C, L2C, L5, LEX
- High-precision multiple correlator for GNSS pseudorange measurements
- Trimble Everest Plus™ multipath mitigation
- Advanced RF Spectrum Monitoring and Analysis
- 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
- Proven Trimble low elevation tracking technology
- Reference outputs/inputs:
  - CMR, CMR+, sCMR<sub>x</sub>, RTCM 2.1, 2.2, 2.3, 3.0, 3.1<sup>12</sup>, 3.2
- Navigation Outputs:
  - ASCII: NMEA-0183 GSV, AVR, RMC, HDT, VGK, VHD, ROT, GKG, GGA, GSA, ZDA, VTG, GST, PJT, PJK, BPQ, GLL, GRS, GBS and Binary: Trimble GSOF, NMEA2000
- 1 Pulse Per Second Output
- Event Marker Input Support
- Supports Fault Detection & Exclusion (FDE), Receiver Autonomous Integrity Monitoring (RAIM)

## COMMUNICATION

- 1 USB 2.0 Device port
- 1 LAN Ethernet port:
  - Supports links to 10BaseT/100BaseT auto-negotiate networks
  - All functions are performed through a single IP address simultaneously—including web GUI access and raw data streaming
  - Network Protocols supported
    - > HTTP (web GUI)
    - > 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 via PPP
    - > RNDIS Support
- 3 x RS232 ports:
  - Baud rates up to 460,800
- 1 CAN Port
- Control Software:
  - HTML web browser, Internet Explorer, Firefox, Safari, Opera, Google Chrome

## PERFORMANCE SPECIFICATIONS

Time to First Fix (TTFF) <sup>7</sup>	
Cold Start <sup>8</sup>	<45 seconds
Warm Start <sup>9</sup>	<30 seconds
Signal Re-acquisition	<2 seconds
Velocity Accuracy <sup>3,4</sup>	
Horizontal	.0007 m/sec
Vertical	0.020 m/sec
Maximum acceleration GNSS tracking	+/- 11g
Inertial Sensors	
Maximum acceleration	±6 g
Maximum angular rate	±350 deg/sec
Maximum Operating Limits <sup>10</sup>	
Velocity	.515 m/sec
Altitude	18,000 m
RTK initialization time <sup>3</sup>	typically <8 seconds
RTK initialization reliability <sup>3</sup>	>99.9%
Position Latency <sup>5</sup>	<20ms
Maximum Position/Attitude Update Rate	100 Hz

## PHYSICAL AND ELECTRICAL CHARACTERISTICS

Size	100 mm x 60 mm x 11.6 mm
Power	3.3 V DC +5%/-3% Typical 2.6 W (L1/L2 GPS + L1/L2 GLONASS)
Weight	.62 grams
Connectors	
I/O	44-pin header
GNSS Antenna	.2 x MMCX receptacle
Antenna LNA Power Input	
Input voltage	3.3V DC to 5V DC
Maximum current	400 mA
Minimum required LNA Gain	32.0 dB

ENVIRONMENTAL CHARACTERISTICS<sup>11</sup>

Temperature	
Operating	-40 °C to +75 °C
Storage	-55 °C to +85 °C
Vibration	MIL810F, tailored Random 6.2 gRMS operating Random 8 gRMS survival
Mechanical shock	MIL810D ±40 g 10ms operating ±75 g 6ms survival
Operating Humidity	.5% to 95% R.H. non-condensing, at +60 °C

## ORDERING INFORMATION

Module Part Number	120992-XX
Module	Trimble BD992-INS GNSS available in a variety of configurations from L1 SBAS upwards Includes interface board, power supply

- Evaluation Kit
- Trimble BD992-INS is available in a variety of software configurations. Specifications shown reflect full capability.
  - Developed under a License of the European Union and the European Space Agency.
  - May be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
  - 1 sigma level, when using Trimble Zephyr 2/3 antennas. Add 1 ppm for RTK position accuracies.
  - At maximum output rate.
  - GPS only and depends on SBAS System performance. FAA WAAS accuracy specifications are <5 m 3DRMS.
  - Typical observed values.
  - No previous satellite (ephemerides / almanac) or position (approximate position or time) information.
  - Ephemerides and last used position known
  - As required by the U.S. Department of Commerce to comply with export licensing restrictions.
  - Dependent on appropriate mounting/enclosure design.
  - Input only network correction
  - The hardware of this product is designed for BeiDou B3 compatibility (trial version) and its firmware will be enhanced to fully support such new signals as soon as the officially published signal interface control documentation (ICD) becomes available.
  - There is no public GLONASS L3 CDMA or Galileo E6 ICD. The current capability in the receivers is based on publicly available information. As such, Trimble cannot guarantee that these receivers will be fully compatible.
  - Trimble RTX and OmniSTAR accuracies depend on correction service chosen. Trimble CenterPoint RTX provides <4cm horizontal accuracy 95% of the time with initializations of less than 30 minutes.
  - Also available in configurations with RTK accuracies limited to 10 and 30 centimeters.

Specifications subject to change without notice.

POSITIONING SPECIFICATIONS<sup>3, 4, 15, 16</sup>

	Autonomous	SBAS	DGNSS	RTK	INS-Autonomous	INS-SBAS	INS-DGNSS	INS-RTK
<b>No GNSS Outages</b>								
Position (m)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.25 (H) 0.50 (V)	0.008 (H) 0.015 (V)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.40 (H) 0.60 (V)	0.05 (H) 0.03 (V)
Roll/Pitch (deg)	0.20	0.20	0.20	0.20	0.10	0.10	0.10	0.10
Heading (deg) on 2m Baseline	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
<b>10 second GNSS Outages</b>								
Position (m)	N/A	N/A	N/A	N/A	1.50 (H) 1.80 (V)	1.20 (H) 1.20 (V)	1.00 (H) 1.00 (V)	0.30 (H) 0.20 (V)
Roll/Pitch (deg)	N/A	N/A	N/A	N/A	0.10	0.10	0.10	0.10
Heading (deg) on 2m Baseline	N/A	N/A	N/A	N/A	0.50	0.50	0.50	0.50

Contact your local dealer today

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# Trimble BX940

## TRIPLE-FREQUENCY RECEIVER WITH INTEGRATED INERTIAL NAVIGATION SYSTEM IN RUGGED ENCLOSURE

### GNSS AND INERTIAL TIGHT INTEGRATION

Taking advantage of Trimble's expertise in both GNSS and Inertial technology the Trimble® BX940 enclosure has been designed for applications requiring continuous centimeter accuracy in a compact package. By integrating inertial sensors on the same module, robust high accuracy positions are produced in all environments.

The receiver is also ideal for use as a GNSS DGPS/RTK base station.

### MULTI CONSTELLATION GNSS

The Trimble BX940 supports both triple-frequency for the GPS and GLONASS constellations plus dual-frequency from BeiDou and Galileo. As the number of satellites in the constellations grows the BX940 is ready to take advantage of the additional signals. This delivers the quickest and most reliable RTK initializations for 1–2 centimeter positioning. For applications that do not require centimeter accuracy the BX940 integrated GNSS-Inertial engine delivers high accuracy GNSS, DGNSS positions in the most challenging environments such as urban canyons. Different configurations of the module are available. These include everything from a DGPS L1 unit all the way to a four constellation triple-frequency RTK unit. Choose the receiver that suits your application and price point. All features are password-upgradeable, allowing functionality to be upgraded as your requirements change.

With the option of utilizing OmniSTAR or RTX services, the BX940 delivers varying levels of performance down to centimeter level without the use of a base station.

### HIGH PERFORMANCE INTEGRATED INERTIAL SENSORS

The Trimble BX940 integrates the latest in precision inertial sensors in a compact package.

With the BX940 you are buying a robust navigation solution, not just a GNSS receiver.

#### Key features include:

- ▶ High update rate position and orientation solutions
- ▶ Continuous positioning in GNSS denied environments
- ▶ Lever arm calculation from antenna to navigation point of interest
- ▶ Robust Moving Baseline RTK for precision landing on moving platforms
- ▶ Single antenna heading not influenced by magnetic field variations

### FLEXIBLE INTERFACING

The Trimble BX940 was designed for easy integration and rugged dependability. Customers benefit from the Ethernet connectivity available on the board, allowing high speed data transfer and configuration via standard web browsers. USB and RS-232 are also supported. Just like other Trimble embedded technologies, easy to use software commands simplify integration and reduce development times. An intuitive 3D interactive graphical web page allows easy input of lever arms. Dynamic and graphic models for various vehicle types can also be selected.

### RUGGED RECEIVER ENCLOSURE

The Trimble BX940 packages a single BD940-INS receiver module in a rugged enclosure. The unit comes in an environmentally sealed enclosure that is very easy to install. The unit is rigorously tested to perform in harsh environmental conditions with the reliability you expect from Trimble.

### Key Features

- ▶ Trimble Maxwell™ 7 Technology
- ▶ Onboard high accuracy inertial sensor package integrated with GNSS for precise position and orientation
- ▶ 336 channels for multi-constellation GNSS support
- ▶ Trimble RTX and OmniSTAR support
- ▶ Rugged IP67 enclosure
- ▶ Compact design for mobile applications
- ▶ Flexible RS232, USB and Ethernet interfacing
- ▶ Centimeter-level position accuracy
- ▶ Advanced RF spectrum monitoring



# Trimble BX940 Enclosure

## TECHNICAL SPECIFICATIONS<sup>1</sup>

- Trimble Maxwell™ 7 Technology
- On-board Advanced MEMS inertial sensors
- 336 Tracking Channels:
  - GPS: L1 C/A, L2E, L2C, L5
  - BeiDou: B1, B2
  - GLONASS: L1 C/A, L2 C/A, L3 CDMA<sup>13</sup>
  - Galileo<sup>2</sup>: E1, E5A, E5B, E5AltBOC
  - IRNSS: L5
  - QZSS: L1 C/A, L1 SAIF, L2C, L5, LEX
  - SBAS: L1 C/A, L5
  - MSS L-Band: OmniSTAR, Trimble RTX
- High-precision multiple correlator for GNSS pseudorange measurements
- Trimble Everest Plus™ multipath mitigation
- Advanced RF Spectrum Monitoring and Analysis
- 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
- Proven Trimble low elevation tracking technology
- Reference outputs/inputs
  - CMR, CMR+, sCMRx, RTCM 2.1, 2.2, 2.3, 3.0, 3.1<sup>12</sup>, 3.2
- Navigation Outputs:
  - ASCII: NMEA-0183 GSV, AVR, RMC, HDT, VGK, VHD, ROT, GKG, GGA, GSA, ZDA, VTG, GST, PJT, PJK, BPQ, GLL, GRS, GBS and Binary: Trimble GSOF, NMEA2000
- 1 Pulse Per Second Output
- Event Marker Input Support
- Supports Fault Detection & Exclusion (FDE), Receiver Autonomous Integrity Monitoring (RAIM)

## COMMUNICATION

- 1 USB 2.0 Device port
- 1 LAN Ethernet port:
  - Supports links to 10BaseT/100BaseT auto-negotiate networks
  - All functions are performed through a single IP address simultaneously—including web GUI access and raw data streaming
  - Network Protocols supported:
    - > HTTP (web GUI)
    - > 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 via PPP
    - > RNDIS Support
- 2 x RS232 ports:
  - Baud rates up to 230,400
- 1 CAN Port (requires addition of CAN Transceiver by customer)
- Control Software:
  - HTML web browser, Internet Explorer, Firefox, Safari, Opera, Google Chrome

## PERFORMANCE SPECIFICATIONS

Time to First Fix (TTFF) <sup>7</sup>	
Cold Start <sup>8</sup>	<45 seconds
Warm Start <sup>9</sup>	<30 seconds
Signal Re-acquisition	<2 seconds
Velocity Accuracy <sup>3,4</sup>	
Horizontal	.0007 m/sec
Vertical	.0020 m/sec
Maximum acceleration GNSS tracking	+/- 11g
Inertial Sensors	
Maximum accelerations	±6 g
Maximum angular rate	±350 deg/sec
Maximum Operating Limits <sup>10</sup>	
Velocity	.515 m/sec
Altitude	18,000 m
RTK initialization time <sup>3</sup>	typically <8 seconds
RTK initialization reliability <sup>3</sup>	>99.9%
Position Latency <sup>5</sup>	<20ms
Maximum Position/Attitude Update Rate	100 Hz

## PHYSICAL AND ELECTRICAL CHARACTERISTICS

Size	149 mm x 93 mm x 43 mm
Power	9 VDC to 30 VDC
	Typical 2.3 W (L1/L2 GPS + L1/L2 GLONASS)
Weight	0.66 kg
Connectors	
I/O	.D-sub DE9 and DA26
GNSS Antenna	TNC Female
Antenna LNA Power Input	
Input voltage	3.3 VDC to 5 VDC
Maximum current	400 mA
Minimum required LNA Gain	32.0 dB

## ENVIRONMENTAL CHARACTERISTICS<sup>11</sup>

Temperature	
Operating	-40 °C to +75 °C
Storage	-55 °C to +85 °C
Vibration	MIL810F, tailored
	Random 6.2 gRMS operating
	Random 8 gRMS survival
Mechanical shock	MIL810D
	±40 g 10ms operating
	±75 g 6ms survival
Operating Humidity	.5% to 95% R.H. non-condensing, at +60 °C

## ORDERING INFORMATION

Module Part Number	110854-XX
Module	Trimble BX940 GNSS available in a variety of configurations from L1 SBAS upwards

- Trimble BX940 is available in a variety of software configurations. Specifications shown reflect full capability.
- Developed under a License of the European Union and the European Space Agency.
- May be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
- 1 sigma level, when using Trimble Zephyr 2/3 antennas, add 1 ppm for RTK position accuracies. Heading accuracy is after dynamic alignment and during motion. Performance may be reduced with long stationary or hovering periods.
- At maximum output rate.
- GPS only and depends on SBAS System performance. FAA WAAS accuracy specifications are <5 m 3DRMS.
- Typical observed values.
- No previous satellite (ephemerides / almanac) or position (approximate position or time) information.
- Ephemerides and last used position known.
- As required by the U.S. Department of Commerce to comply with export licensing restrictions.
- Dependent on appropriate mounting design.
- Input only network correction.
- There is no public GLONASS L3 CDMA. The current capability in the receivers is based on publicly available information. As such, Trimble cannot guarantee that these receivers will be fully compatible.
- Trimble RTX and OmniSTAR accuracies depend on correction service chosen. Trimble CenterPoint RTX provides <4cm horizontal accuracy 95% of the time with initializations of less than 30 minutes.
- Also available in configurations with RTK accuracies limited to 10 and 30 centimeters.

Specifications subject to change without notice.

## POSITIONING SPECIFICATIONS<sup>3, 4, 14, 15</sup>

	Autonomous	SBAS	DGNSS	RTK	INS-Autonomous	INS-SBAS	INS-DGNSS	INS-RTK
<b>No GNSS Outages</b>								
Position (m)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.25 (H) 0.50 (V)	0.008 (H) 0.015 (V)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.40 (H) 0.60 (V)	0.05 (H) 0.03 (V)
Roll/Pitch (deg)	N/A	N/A	N/A	N/A	0.10	0.10	0.10	0.10
Heading (deg)	N/A	N/A	N/A	N/A	0.50	0.50	0.50	0.50
<b>10 second GNSS Outages</b>								
Position (m)	N/A	N/A	N/A	N/A	1.50 (H) 1.80 (V)	1.20 (H) 1.20 (V)	1.00 (H) 1.00 (V)	0.30 (H) 0.20 (V)
Roll/Pitch (deg)	N/A	N/A	N/A	N/A	0.10	0.10	0.10	0.10
Heading (deg)	N/A	N/A	N/A	N/A	0.50	0.50	0.50	0.50

Contact your local dealer today

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# Trimble BX992

## DUAL ANTENNA RECEIVER WITH INTEGRATED INERTIAL NAVIGATION SYSTEM AND MSS BAND DEMODULATOR

### GNSS AND INERTIAL TIGHT INTEGRATION

Taking advantage of Trimble's expertise in both GNSS and Inertial technology the Trimble® BX992 module has been designed for applications requiring continuous centimeter accuracy in a compact package. By integrating inertial sensors on the same module, robust high accuracy positions and orientations are produced in all environments.

### TRIMBLE MAXWELL™ 7 TECHNOLOGY

The Trimble BX992 supports triple frequency for the GPS, GLONASS, BeiDou and Galileo constellations. As the number of satellites in the constellations grows the BX992 is ready to take advantage of the additional signals. This delivers the quickest and most reliable RTK initializations for centimeter positioning. For applications that do not require centimeter accuracy the BX992 integrated GNSS-Inertial engine also delivers high accuracy GNSS, DGNSS positions in the most challenging environments such as urban canyons. With the latest Trimble Maxwell™ 7 Technology, the BX992 provides:

- ▶ 2 x 336 Tracking Channels
- ▶ Trimble Everest Plus™ multipath mitigation
- ▶ Advanced RF Spectrum Monitoring and Analysis
- ▶ Proven low-elevation tracking technology

With the option of utilizing OmniSTAR or RTX services, the BX992 delivers varying levels of performance down to centimeter-level without the use of a base station.

### ROBUST CENTIMETER ACCURATE SOLUTIONS

The Trimble BX992 integrates the latest in precision inertial sensors in a compact package. With the BX992 you are buying a robust navigation solution, not just a GNSS receiver.

Key features include:

- ▶ High update rate position and orientation solutions
- ▶ Dual antenna for rapid heading alignment
- ▶ Continuous positioning in GNSS denied environments
- ▶ Lever arm calculation from antenna to navigation point of interest
- ▶ Robust Moving Baseline RTK for precision landing on moving platforms

### FLEXIBLE INTERFACING

The Trimble BX992 was designed for easy integration and rugged dependability. Customers benefit from the Ethernet connectivity available on the board, allowing high speed data transfer and configuration via standard web browsers. USB, CAN and RS-232 are also supported. Just like other Trimble embedded technologies, easy to use software commands simplify integration and reduce development times. An intuitive 3D interactive graphical web page allows easy input of lever arms. Dynamic and graphic models for various vehicle types can also be selected.

Different configurations of the module are available. These include everything from a DGPS L1 unit all the way to a four constellation triple frequency RTK unit. All features are password-upgradeable, allowing functionality to be upgraded as your requirements change.

### Key Features

- ▶ Trimble Maxwell™ 7 technology
- ▶ Onboard high accuracy inertial sensor package integrated with GNSS for precise position and orientation
- ▶ 336 channels for multi-constellation GNSS support
- ▶ Trimble RTX and OmniSTAR Support
- ▶ Compact design for mobile applications
- ▶ Flexible RS232, USB and Ethernet interfacing
- ▶ Centimeter-level position accuracy
- ▶ Advanced RF spectrum monitoring
- ▶ Rugged IP67 enclosure



# Trimble BX992 Enclosure

## TECHNICAL SPECIFICATIONS<sup>1</sup>

- Trimble Maxwell™ 7 Technology
- Onboard Advanced MEMS inertial sensors
- Position Antenna based on 336 Channel Maxwell™ 7 chip:
  - GPS: L1 C/A, L2E, L2C, L5
  - BeiDou: B1, B2, B313
  - GLONASS: L1 C/A, L2 C/A, L3 CDMA<sup>14</sup>
  - Galileo<sup>2</sup>: E1, E5A, E5B, E5AltBOC, E6<sup>14</sup>
  - IRNSS: L5
  - QZSS: L1 C/A, L1 SAIF, L1C, L2C, L5, LEX
  - SBAS: L1 C/A, L5
  - MSS L-Band: OmniSTAR, Trimble RTX
- Vector Antenna based on second 336 Channel Maxwell™ 7 chip:
  - GPS: L1 C/A, L2E, L2C, L5
  - BeiDou: B1, B2, B3
  - GLONASS: L1 C/A, L2 C/A, L3 CDMA<sup>14</sup>
  - Galileo<sup>2</sup>: E1, E5A, E5B, E5AltBOC, E6<sup>14</sup>
  - IRNSS: L5
  - QZSS: L1 C/A, L1 SAIF, L1C, L2C, L5, LEX
- High-precision multiple correlator for GNSS pseudorange measurements
- Trimble Everest Plus™ multipath mitigation
- Advanced RF Spectrum Monitoring and Analysis
- 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
- Proven Trimble low elevation tracking technology
- Reference outputs/inputs:
  - CMR, CMR+, sCMRx, RTCM 2.1, 2.2, 2.3, 3.0, 3.1<sup>12</sup>, 3.2
- Navigation Outputs:
  - ASCII: NMEA-0183 GSV, AVR, RMC, HDT, VGK, VHD, ROT, GKG, GGA, GSA, ZDA, VTG, GST, PJT, PJK, BPQ, GLL, GRS, GBS and Binary: Trimble GSOF, NMEA2000
- 1 Pulse Per Second Output
- Event Marker Input Support
- Supports Fault Detection & Exclusion (FDE), Receiver Autonomous Integrity Monitoring (RAIM)

## COMMUNICATION

- 1 USB 2.0 Device port
- 1 LAN Ethernet port:
  - Supports links to 10BaseT/100BaseT auto-negotiate networks
  - All functions are performed through a single IP address simultaneously—including web GUI access and raw data streaming
  - Network Protocols supported:
    - > HTTP (web GUI)
    - > 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 via PPP
    - > RNDIS Support
- 2 x RS232 ports:
  - Baud rates up to 460,800
- 1 CAN Port
- Control Software:
  - HTML web browser, Internet Explorer, Firefox, Safari, Opera, Google Chrome

## POSITIONING SPECIFICATIONS<sup>3,4,15,16</sup>

	Autonomous	SBAS	DGNSS	RTK	INS-Autonomous	INS-SBAS	INS-DGNSS	INS-RTK
<b>No GNSS Outages</b>								
Position (m)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.25 (H) 0.50 (V)	0.008 (H) 0.015 (V)	1.00 (H) 1.50 (V)	0.50 (H) 0.85 (V)	0.40 (H) 0.60 (V)	0.05 (H) 0.03 (V)
Roll/Pitch (deg)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Heading (deg) on 2m Baseline	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
<b>10 second GNSS Outages</b>								
Position (m)	N/A	N/A	N/A	N/A	1.50 (H) 1.80 (V)	1.20 (H) 1.20 (V)	1.00 (H) 1.00 (V)	0.30 (H) 0.20 (V)
Roll/Pitch (deg)	N/A	N/A	N/A	N/A	0.10	0.10	0.10	0.10
Heading (deg) on 2m Baseline	N/A	N/A	N/A	N/A	0.50	0.50	0.50	0.50

## PERFORMANCE SPECIFICATIONS

Time to First Fix (TTFF) <sup>7</sup>	
Cold Start <sup>8</sup>	<45 seconds
Warm Start <sup>9</sup>	<30 seconds
Signal Re-acquisition	<2 seconds
Velocity Accuracy <sup>3,4</sup>	
Horizontal	.0007 m/sec
Vertical	0.020 m/sec
Maximum acceleration GNSS tracking	+/- 11g
Inertial Sensors	
Maximum acceleration	±6 g
Maximum angular rate	±350 deg/sec
Maximum Operating Limits <sup>10</sup>	
Velocity	.515 m/sec
Altitude	.18,000 m
RTK initialization time <sup>13</sup>	typically <8 seconds
RTK initialization reliability <sup>2</sup>	>99.9%
Position Latency <sup>5</sup>	<20ms
Maximum Position/Attitude Update Rate	100 Hz

## PHYSICAL AND ELECTRICAL CHARACTERISTICS

Size	185 mm x 93 mm x 43 mm
Power	9 VDC to 30 VDC Typical 3.0 W (L1/L2 GPS + L1/L2 GLONASS)
Weight	0.76 kg
Connectors	
I/O	D-sub DE9 and DA26
GNSS Antenna	2 x TNC (Female)
Antenna LNA Power Input	
Input voltage	3.3 VDC to 5 VDC
Maximum current	400 mA
Minimum required LNA Gain	32.0 dB

## ENVIRONMENTAL CHARACTERISTICS<sup>11</sup>

Temperature	
Operating	-40 °C to +75 °C
Storage	-55 °C to +85 °C
Vibration	MIL810F, tailored Random 6.2 gRMS operating Random 8 gRMS survival
Mechanical shock	MIL810D ±40 g 10ms operating ±75 g 6ms survival
Operating Humidity	.5% to 95% R.H. non-condensing, at +60 °C
IP Rating	IP67

## ORDERING INFORMATION

Module Part Number	108567-XX
Module	Trimble BX992 GNSS available in a variety of configurations from L1 SBAS upwards
Evaluation Kit	Includes interface board, power supply

- Trimble BX992 is available in a variety of software configurations. Specifications shown reflect full capability.
- Developed under a License of the European Union and the European Space Agency.
- May be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
- 1 sigma level, when using Trimble Zephyr 2/3 antennas. Add 1 ppm for RTK position accuracies.
- At maximum output rate.
- GPS only and depends on SBAS System performance. FAA WAAS accuracy specifications are <5 m 3DRMS.
- Typical observed values.
- No previous satellite (ephemerides / almanac) or position (approximate position or time) information.
- Ephemerides and last used position known
- As required by the U.S. Department of Commerce to comply with export licensing restrictions.
- Dependent on appropriate mounting/enclosure design.
- Input only network correction
- The hardware of this product is designed for Beidou B3 compatibility (trial version) and its firmware will be enhanced to fully support such new signals as soon as the officially published signal interface control documentation (ICD) becomes available.
- There is no public GLONASS L3 CDMA or Galileo E6 ICD. The current capability in the receivers is based on publicly available information. As such, Trimble cannot guarantee that these receivers will be fully compatible.
- Trimble RTX and OmniSTAR accuracies depend on correction service chosen. Trimble CenterPoint RTX provides <4cm horizontal accuracy 95% of the time with initializations of less than 30 minutes.
- Also available in configurations with RTK accuracies limited to 10 and 30 centimeters.

Specifications subject to change without notice.

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# Trimble MB-Two

## HIGH PERFORMANCE COMPACT OEM MODULE

### RTK/PPP AND HEADING IN A SINGLE OEM MODULE

The Trimble MB-Two is the successor to the Trimble MB-One OEM receiver module. The MB-Two maintains the identical form-factor as its predecessor and offers customers a drop-in replacement to utilize the latest GNSS design innovations. Versatile, powerful, compact and smart, the Trimble MB-Two provides faster dual-frequency-based heading acquisition and an improved RTK/PPP positioning engine with multiple GNSS signals. In addition, two MB-Two modules can be easily connected to each other to build a Precise Platform Positioning module (no firmware upgrade required), utilizing up to four dual-band GNSS antennas for multisensory raw data output, precise position and attitude simultaneously.

The MB-Two allows a wide range of option-upgradable GNSS configurations from single antenna/frequency (GPS) to dual antenna/frequency (GPS, QZSS, GLONASS, Beidou, Galileo). Ashtech's patented Z-Blade technology drives a powerful GNSS agnostic engine allowing MB-Two to use any single GNSS system for positioning (or any combination of them) without relying on GPS. The GNSS engine utilizes over-the-air satellite corrections via embedded L-band hardware to achieve centimeter/decimeter level accuracy with PPP Trimble™ RTX corrections removing the dedicated base station/Network and communication link.

### DUAL ANTENNA/SENSOR

- ▶ Heading + Pitch/Roll
- ▶ Accurate/Fast Heading using dual-frequency multi-GNSS algorithms
- ▶ Dual GNSS sensor raw data with common clock
- ▶ Single board for RTK/PPP and heading simultaneously

### POWERFUL RTK ENGINE

The MB-Two has a powerful RTK engine that delivers centimeter-level accuracy for systems using corrections from a local base or an RTK network. It also features RTK against a moving base for relative positioning. The network RTK capabilities include third-party network corrections such as VRS, FKP, and MAC. When two or more alternative RTK correcting data are available, MB-Two runs the Ashtech Hot Standby RTK algorithm allowing it to use them simultaneously in the positioning process

### NEXT GENERATION HARDWARE DESIGN

- ▶ Low power consumption in a compact size
- ▶ Dual-core CPU for optimal performance
- ▶ Web User Interface for ease of use and evaluation
- ▶ Two tightly integrated dual-band GNSS engines
- ▶ L-band RF/digital with up to two MSS channels

### Key Features

- ▶ Z-Blade technology
- ▶ 5 dual-band GNSS
- ▶ Conventional and Advanced RTK
- ▶ Precise Point Positioning
- ▶ Heading + Pitch/Roll
- ▶ Full Attitude
- ▶ Web User Interface
- ▶ Superior Connectivity
- ▶ Standardized form factor and interfaces
- ▶ Low power consumption



# Trimble MB-Two GNSS Module

## TECHNICAL SPECIFICATIONS

### GNSS ENGINE

- 240 Tracking Channels
- Two tightly coupled, all-in-view GNSS sensors delivering simultaneously:
  - GPS L1+L2
  - QZSS L1+L2
  - BeiDou B1+B2
  - GLONASS L1+L2 FDMA<sup>1</sup>
  - GALILEO E1+E5b
  - SBAS L1<sup>2</sup>
- 2 x MSS L-Band Tracking Channels

### FEATURES

- Ashtech patented Strobe Correlator™ to reduce GNSS multi path
- Ashtech patented Z-tracking to track encrypted GPS P(Y) signal
- Ashtech patented Z-Blade technology to process multi-GNSS data
- GPS-only, GLONASS-only or BeiDou-only solutions possible (from Autonomous to RTK)
- Fast Search Engine to improve TTFF
- Position in local datums and projections with RTCM-3 transformation data
- Trimble RTX™ PPP engine
- Ashtech Hot Standby RTK Algorithms
- Ashtech Flying RTK Algorithms
- Full attitude engine with two MB-Two boards connected
- RTK with Static & Moving Base corrections supported
- Heading engine with optional baseline length self-calibration
- Multi-dynamic mode (static/moving Base and Rover functions simultaneously)
- Adaptive velocity filter to meet specific dynamic applications
- Up to 250 MB of internal memory for data logging; on-board memory for various applications
- Up to 50 Hz position/velocity/heading/observables output<sup>3</sup>
- Reference Inputs/Outputs: RTCM 3.2<sup>4</sup>, RTCM2.3, CMR/CMRx<sup>5</sup>, ATOM<sup>6</sup>
- RTK Networks Supported: VRS, FKP, MAC
- Navigation Outputs: NMEA-0183, ATOM
- One-push Ashtech Trouble Log (ATL)
- Programmable startup protection

### GNSS SENSOR PERFORMANCE

- Time to First Fix (TTFF):
  - Cold start: < 60 seconds
  - Warm Start: < 45 seconds
  - Hot Start: < 11 seconds
  - Signal re-acquisition: < 2 seconds
- Position accuracy (HRMS), SBAS: 0.50 m<sup>7</sup>
- Update rate: Up to 50 Hz
- Latency: < 10 ms<sup>8</sup>
- Velocity Accuracy: 0.02 m/sec HRMS
- Maximum Operating Limits<sup>19</sup>:
  - Velocity: 515 m/sec
  - Attitude: 18,000 m

### PRECISE POSITIONING PERFORMANCE

#### RTK<sup>9,10,11</sup>

L1 only (fixed ambiguity):

- Accuracy (HRMS): < 12 mm + 1.5 ppm
- Initialization time: < 10 min typical
- Operating range: < 10 km

L1/L2 (fixed ambiguity):

- Accuracy (HRMS): < 8 mm + 1 ppm
- Initialization time: < 1 min typical
- Operating range: > 40 km

#### RTX<sup>12,13</sup>

CenterPoint

- Accuracy (H95): 4 cm
- Initialization time: < 30 min. typical
- Operating range (inland): Almost unlimited

#### HEADING<sup>10,14,15</sup>

- Accuracy (RMS): 0.2° per 1 m of baseline length
- Initialization time: < 10 sec typical
- Baseline length: < 100 m

### I/O INTERFACE

- SAMTEC 28 Pin I/O Connector (TMM-114-03-G-D) with backward compatibility for current industry standards
- 3 x LVTTTL (UART types) serial ports allowing up to 921,600 bps
- USB 2.0 OTG port allowing up to 12Mbps (USB/Serial Link, USB Memory Stick, Onboard Memory Access)
- CAN bus interface
- 1 PPS out / Event In
- 1 LAN Ethernet port:
  - Supports links to 10BaseT/100BaseT networks
  - All functions are performed through a single IP address simultaneously-including web GUI access and raw data streaming
  - Network Protocols supported:
    - > HTTP (web GUI)
    - > NTP Server
    - > NTripcaster, NTripcServer, NTripcClient
    - > Dynamic DNS

### PHYSICAL AND ELECTRICAL CHARACTERISTICS

Size (W x H x D)	71 mm x 46 mm x 11 mm
Power	3.2 to 4.5 V DC
Power Consumption <sup>16</sup>	<1.2 Watt
Weight	24 grams
Connectors	
I/O	28 pin dual-row male header
Antenna	2 x MMCX female connectors
Antenna LNA Power Input	
Input Voltage Range	4.0 to 12.0 V DC on I/O connector pin 5 <sup>17</sup>
Maximum current	150 mA
Minimum current	5 mA
LNA Gain Range (minus signal loss)	17 to 47 dB for L1/G1/B1/E1 band 23 to 50 dB for L2/G2/B2/E5 band

### ENVIRONMENTAL CHARACTERISTICS<sup>18</sup>

Operating Temperature	–40°C to +85°C
Storage Temperature	–40°C to +85°C
Vibration	MIL-STD 810F, Fig. 514.5C-17 Random 6.2 gRMS operating Random 8 gRMS survival
Mechanical Shock	MIL-STD 810F, Fig. 516.5-10 (40g, 11ms, saw-tooth)
Operating Humidity	95% non-condensing
Maximum Acceleration	11 g

### RECOMMENDED ANTENNAS

- Compact GNSS Machine/Marine/Aviation Antennas: Trimble AV33 & AV 34
- GNSS Machine/Marine/Aviation Antennas: Trimble AV59 & LV 59

### ORDERING INFORMATION

Module Part Number	106960-XX
Module	Trimble MB-Two available in a variety of configurations from SBAS upwards
Evaluation Kit	Includes interface board and power supply

1. Hardware ready for G1 and G2 CDMA. This is based on the assumption that these new signals will be transmitted within natural GLONASS L1, L2 or within GPS L1/L2 frequency bands.
2. In some modes, SBAS L1 is available only for single sensor.
3. At 50 Hz, a limited set of messages can be generated simultaneously through a single port.
4. RTCM-3.2 Multiple Signal Messaging (MSM) guarantees compatibility with 3rd party for each GNSS data.
5. A Trimble proprietary format. CMRx output is not supported.
6. ATOM: Open Ashtech format.
7. VRMS for Autonomous/SBAS positions are usually twice as high as HRMS.
8. Heading latency is usually twice as high.
9. VRMS = 2 x HRMS
10. Accuracy and TTFF specifications may be affected by atmospheric conditions, signal multipath, satellite geometry and corrections availability and quality.
11. Same for single base and network.
12. Requires L1/L2 GPS+GLONASS at a minimum.
13. Accuracy and TTFF specifications may be affected by atmospheric conditions, signal multipath, satellite geometry and L-band service availability. Trimble RTX correction services are only available on land.
14. L1/L2 data required.
15. Figures of pitch accuracy are twice as high.
16. Typical power consumption for single antenna L1 GPS/GLONASS.
17. This will be used if greater than the main power input voltage.
18. Dependent on appropriate mounting / enclosure design
19. As required by the U.S. Department of Commerce to comply with export licensing restrictions.
20. Typical power consumption for a 12V input source

NOTE: All performance values are given assuming a minimum of five satellites are used, and following the procedures recommended in the product manual. High multipath areas, high PDOP values and periods of severe atmospheric conditions may degrade performance.

Specifications subject to change without notice.

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# Trimble RTX Frequently Asked Questions









## Why Trimble Correction Services are the Right Choice

### Experience You Can Trust

Corrections is all we do, and we've been at it for over 2 decades	Over 200 team members with dedicated focus on delivering best-in-class positioning solutions.
Technology	Industry-leading Trimble RTX® technology proprietary to Trimble, Trimble develops GNSS hardware, software and corrections technology as a full solution powering Trimble RTX correction services.
World class customer service	Dedicated customer care specialists fluent in multiple languages providing customer support 24/7.
Expansive network coverage	Trimble RTX coverage is available worldwide.

### Maximize Productivity / Minimize Downtime

Global network operations team been at it for over 2 decades	A global team of network engineers and IT professionals on 3 continents monitoring global network systems and performance around the clock.
Redundant system architecture	State-of-the-art processing centers on multiple continents, providing network redundancy to ensure consistent system uptime.
Corrections delivery options for any work environment	GNSS corrections delivered via satellite and cellular/IP.
Back-up service delivery	Trimble xFill® – satellite delivered corrections seamlessly engage if RTK radio or cellular/IP connectivity is lost. xFill allows users to stay in the field longer without interruptions.

### Ease Of Use - Tools And Resources

Subscription/Account Management	Phone and email support available at anytime.
In the field support	Sales and technical associates available to help you manage your business.



# Trimble RTX

## Frequently Asked Questions

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- ▶ What is initialization?
- ▶ How long does initialization or convergence take?
- ▶ Can I start working before the receiver is fully initialized?
- ▶ Does the receiver need to remain stationary while initializing?
- ▶ How long will I need to wait for initialization if I temporarily lose the Trimble RTX correction stream or GNSS satellites?
- ▶ What is CenterPoint RTX QuickStart (or CenterPoint RTX Fast Restart)?
- ▶ Why do CenterPoint RTX, FieldPoint RTX and xFill Premium have multiple initialization times listed?
- ▶ Which GNSS constellations do Trimble RTX corrections support?
- ▶ In which coordinate reference frame are Trimble RTX positions calculated and stored?
- ▶ What are ITRF and ITRF2014?
- ▶ What is the difference between ITRF and WGS84?
- ▶ Is CenterPoint RTX the same as RTK?
- ▶ How are Trimble RTX correction services different from SBAS systems (e.g. WAAS, EGNOS, etc.)?
- ▶ How do Trimble RTX correction services differ from other GNSS correction methods in terms of accuracy, cost, convenience, etc.?
- ▶ Are there any factors that can cause errors or outages of Trimble RTX correction services?
- ▶ Will Trimble RTX corrections work indoors?
- ▶ How reliable are Trimble RTX services?

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# About Trimble RTX Correction Services



## WHAT ARE TRIMBLE RTX CORRECTION SERVICES?

- ▶ Trimble RTX® represents a family of GNSS correction services that provide customers with high-accuracy positioning via satellite or Internet. While stand-alone GNSS positioning without corrections provide horizontal accuracies that are typically more than 1 meter, Trimble RTX correction services can provide horizontal accuracies better than 2 cm.



## WHAT CORRECTION SERVICES ARE AVAILABLE?

	Horizontal Accuracy (cm)	Vertical Accuracy (cm)	Initialization (mins) <sup>1</sup> Fast / Standard
CenterPoint® RTX			
RMS	2 cm	5 cm	<1 / <15
95%	2.5 cm	-	<2 / <20
FieldPoint RTX™			
RMS	10 cm	-	<1 and <15
95%	20 cm	-	
RangePoint® RTX			
RMS	30 cm	-	<5
95%	50 cm (15 cm pass-to-pass for Agriculture)	-	
ViewPoint RTX™			
RMS	50 cm	-	<5
95%	100 cm	-	
ViewPoint RTX for Agriculture			
95%	30 cm pass-to-pass	-	<5
xFill® Premium			
RMS	2 cm	-	<1 / <15
95%	2.5 cm	-	<2 / <20

<sup>1</sup> RMS/95% performance based on in field measurements. Achievable accuracy and initialization time may vary based on type and capability of receiver and antenna, user's geographic location and atmospheric activity, scintillation levels, GNSS constellation health and availability and level of multipath including obstructions such as large trees and buildings.



## WHAT ARE TRIMBLE RTX CORRECTIONS USED FOR?

- ▶ Trimble RTX corrections can be used in agriculture, automotive, forestry, utilities, land survey, construction, mining, cadastral mapping, oil and gas and more.

# About Trimble RTX Technology



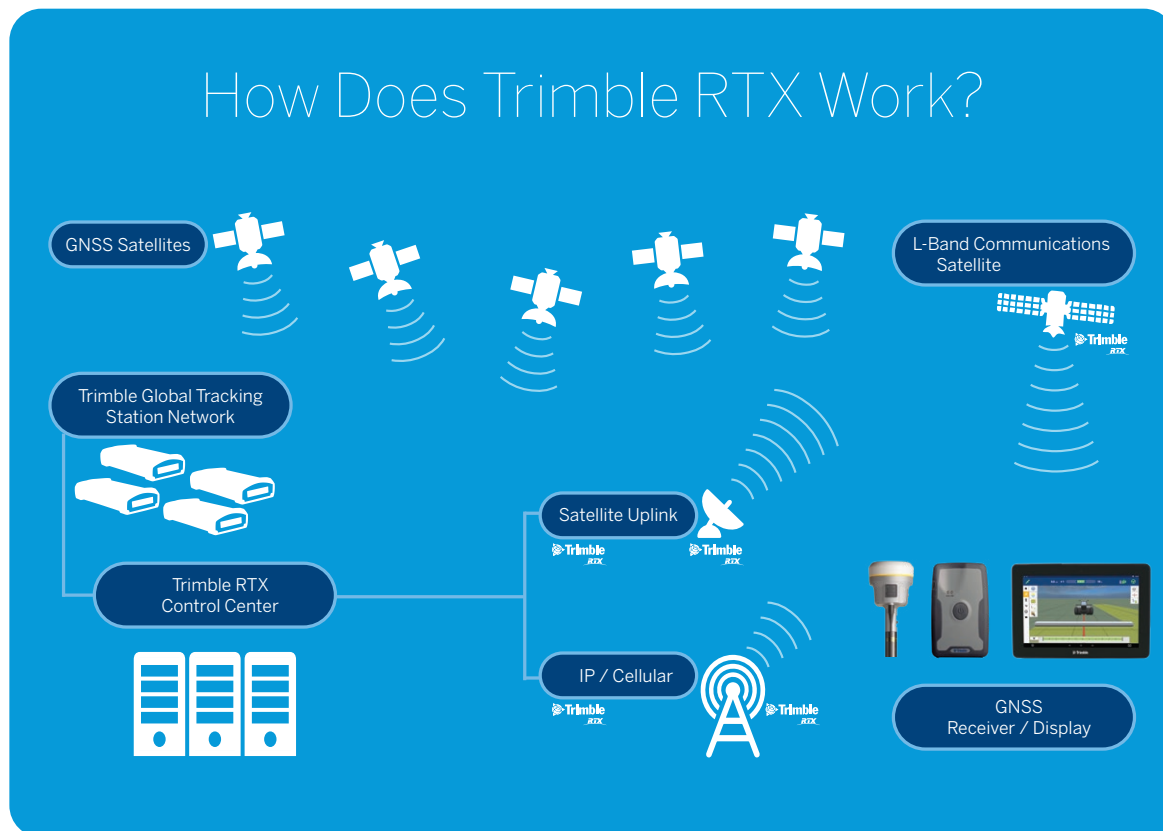
## WHAT DOES RTX MEAN?

- ▶ RTX stands for Real Time eXtended (RTX). It is the technology that powers Trimble RTX correction services.



## HOW DOES TRIMBLE RTX TECHNOLOGY WORK?

- ▶ Trimble RTX utilize real-time satellite measurements from a global network of tracking stations, along with highly accurate atmospheric models and algorithms to generate Trimble RTX corrections. These corrections are then broadcast to the receiver via a set of geostationary satellites or over the Internet, which the receiver uses to improve the accuracy of its GNSS positions.



# About Trimble RTX Technology



## WHAT IS XFILL PREMIUM?

- ▶ xFill Premium is an unlimited backup solution for RTK and VRS. It can be used to bridge correction signal interruptions with high accuracy for the duration of the interruption, and to mitigate outages due to scintillation interference.



## HOW DOES XFILL PREMIUM WORK?

- ▶ xFill Premium runs seamlessly in the background calculating Trimble RTX positions and will automatically bridge positioning gaps if a user's RTK or VRS correction source is interrupted; these interruptions typically occur due to cellular signal disruption or loss of radio connectivity. The Trimble RTX corrections are delivered via satellite, allowing continued field operations during RTK/VRS signal interruptions and during most periods of scintillation interference that renders RTK inoperable. xFill Premium delivers close to CenterPoint RTX positioning accuracy for the duration of the interruption, extending Trimble's standard xFill service, which is limited to 5-20 minutes.



# Performance and Operation



## WHAT PERFORMANCE CAN I EXPECT FROM TRIMBLE RTX CORRECTION SERVICES?

- The performance specifications for Trimble RTX correction services are listed below, dependent on receiver type and region of operation.

	Horizontal Accuracy (cm)	Vertical Accuracy (cm)	Initialization (mins) <sup>1</sup> Fast / Standard
CenterPoint® RTX			
RMS	2 cm	5 cm	< 1 / < 15
95%	2.5 cm	-	< 2 / < 20
FieldPoint RTX™			
RMS	10 cm	-	< 1 and < 15
95%	20 cm	-	
RangePoint® RTX			
RMS	30 cm	-	< 5
95%	50 cm (15 cm pass-to-pass for Agriculture)	-	
ViewPoint RTX™			
RMS	50 cm	-	< 5
95%	100 cm	-	
ViewPoint RTX for Agriculture			
95%	30 cm pass-to-pass	-	< 5
xFill® Premium			
RMS	2 cm	-	< 1 / < 15
95%	2.5 cm	-	< 2 / < 20

<sup>1</sup> RMS/95% performance based on in field measurements. Achievable accuracy and initialization time may vary based on type and capability of receiver and antenna, user's geographic location and atmospheric activity, scintillation levels, GNSS constellation health and availability and level of multipath including obstructions such as large trees and buildings.



## WHAT IS INITIALIZATION?

- Initialization (also known as convergence) is the process of calculating your position to a desired accuracy level. When a receiver's position reaches full accuracy, then it is considered to be fully initialized.

# Performance and Operation



## HOW LONG DOES INITIALIZATION OR CONVERGENCE TAKE?

- ▶ Trimble RTX correction services have different initialization times ranging from 1-20 minutes based on the correction service type. Refer to the performance specifications table above for details.



## CAN I START WORKING BEFORE THE RECEIVER IS FULLY INITIALIZED?

- ▶ Yes, you may begin operating the receiver before it has fully initialized, however, to work with the correction service's full accuracy, it is recommended that your receiver has been fully initialized. Most Trimble RTX capable receivers will allow you to set a "convergence threshold", which determines what accuracy level must be reached before you can begin working.



## DOES THE RECEIVER NEED TO REMAIN STATIONARY WHILE INITIALIZING?

- ▶ No, you may move the receiver while waiting for it to initialize. The initialization time will be similar whether the receiver is static or not.



## HOW LONG WILL I NEED TO WAIT FOR INITIALIZATION IF I TEMPORARILY LOSE THE TRIMBLE RTX CORRECTION STREAM OR GNSS SATELLITES?

- ▶ The GNSS receiver will rapidly re-initialize to specified accuracies after the loss of GNSS signals and/or the Trimble RTX correction stream. The Trimble RTX correction stream may be lost for up to 200 seconds, while GNSS signals may be lost for up to four minutes before the receiver requires full re-initialization.



## WHAT IS CENTERPOINT RTX FAST?

- ▶ CenterPoint RTX Fast is a regionally available service that significantly reduces the convergence time for Trimble RTX services, down to as little as 1 minute for 2 cm horizontal accuracy.



## WHAT IS CENTERPOINT RTX QUICKSTART (OR CENTERPOINT RTX FAST RESTART)?

- ▶ CenterPoint RTX QuickStart and CenterPoint RTX Fast Restart are features that allow rapid re-initialization of CenterPoint RTX on a precisely known point. By starting the receiver on a known point, or in the same location that it was in when it was turned off last, CenterPoint RTX can fully initialize in less than 5 minutes. When using Trimble RTX Fast, this feature is not applicable, as the solution can fully initialize in less than 2 minutes.



## WHY DO CENTERPOINT RTX, FIELDPOINT RTX AND XFILL PREMIUM HAVE MULTIPLE INITIALIZATION TIMES LISTED?

- ▶ An initialization time of < 1 minute for CenterPoint RTX, FieldPoint RTX and xFill Premium correction services is available on most receivers when used in the fast regions in central North America and throughout Europe, while all other regions (non-fast regions) have an initialization time of < 15 minutes for the same services. Both RangePoint RTX and ViewPoint RTX initialization times are typically less than 5 minutes worldwide.



## WHICH GNSS CONSTELLATIONS DO TRIMBLE RTX CORRECTIONS SUPPORT?

- ▶ Trimble RTX correction services support GPS, GLONASS, Galileo, QZSS and BeiDou.



## IN WHICH COORDINATE REFERENCE FRAME ARE TRIMBLE RTX POSITIONS CALCULATED AND STORED?

- ▶ Trimble RTX coordinates are computed in ITRF2014 current epoch; these coordinates will be transformed to a fixed epoch dependent on the receiver and field software. For example, Trimble Access will transform the coordinates of an R10 using RTX to ITRF2014 Epoch 2005.0. xFill Premium applies an offset to the Trimble RTX positions resulting in positions that match the RTK/VRS coordinate reference frame that is being used.

*NOTE: You can use the Trimble CenterPoint RTX Post Processing service to determine an ITRF2014 epoch 2005.00 position for your base station and control points. Trimble CenterPoint RTX Post Processing service is available at [www.TrimbleRTX.com](http://www.TrimbleRTX.com).*

# Performance and Operation



## WHAT ARE ITRF AND ITRF2014?

- ▶ The International Terrestrial Reference Frame (ITRF) is a terrestrial reference frame established and maintained by the International Earth Rotation and Reference Systems Service (IERS). ITRF is the realization of an ideal reference frame, the International Celestial Reference System (ICRS), which is also maintained by IERS; this realization is based on estimates of position and velocity of terrestrial stations observed by VLBI, LLR, GPS, SLR, and DORIS. Due to the motion of the Earth's crust, the terrestrial positions of points on Earth are constantly changing. A position at a specific instance in time will have both a reference frame (e.g. ITRF2014) and an epoch (e.g. epoch 2005.00); the epoch is the time the realization refers to.



## WHAT IS THE DIFFERENCE BETWEEN ITRF AND WGS84?

- ▶ Both ITRF and WGS84 are global datums; WGS84 is used by GPS, and is based on a specific realization being updated periodically. Since 1997, WGS84 has been maintained to within 10 cm of the then current ITRF realization. While Trimble RTX positions are computed in ITRF2014 current epoch, autonomous GPS positions are provided in the current realization of WGS84. This discrepancy in time will usually result in a small difference between the coordinates of a position in ITRF and the coordinates of the same position in WGS84.



## IS CENTERPOINT RTX THE SAME AS RTK?

- ▶ No. RTK requires the use of either a temporary or permanent base station (can be in the form of VRS corrections), and performance is dependent on, and directly impacted by distance from the base station. A local RTK base station may be required for the highest accuracy requirements, such as field leveling in agriculture. While RTK works on the basis of cancelling GNSS error sources between the local base and rover, Trimble RTX models these errors on a global scale. As such, Trimble RTX is available worldwide, broadcast via satellite or cellular delivery, and allows users to work without the constraints of a local RTK base station(s) or VRS network.



## HOW ARE TRIMBLE RTX CORRECTION SERVICES DIFFERENT FROM SBAS SYSTEMS (E.G. WAAS, EGNOS, ETC.)?

- ▶ SBAS systems typically use only one GNSS constellation, such as GPS. Trimble RTX technology is compatible with multiple GNSS constellations, including GPS, GLONASS, Galileo, BeiDou and QZSS. Trimble RTX technology provides more accurate, consistent and reliable positioning than WAAS or EGNOS. Trimble RTX correction services are also available worldwide; SBAS systems (such as WAAS and EGNOS) are limited to certain regions.



## HOW ARE TRIMBLE RTX CORRECTION SERVICES DIFFERENT FROM OTHER GNSS CORRECTION METHODS IN TERMS OF ACCURACY, COST, CONVENIENCE, ETC.?

- ▶ Refer to the table below for a summary of different GNSS correction methods.

Solution	Availability	Delivery Method	Horizontal Accuracy (RMS)	Vertical Accuracy (RMS)	Initialization Time	Additional Hardware
Autonomous	Global	N/A	3 - 5 m	6 -10 m	Instant	N/A
SBAS – WAAS, EGNOS, etc.	Continental	Satellite	1 m	2 m	Instant	N/A
Real Time Kinematic (RTK) (Single-Baseline RTK)	Local	Radio Internet	8 mm + 1.0 ppm <sup>1</sup> (2 cm when 12 km from the base station)	15 mm + 1.0 ppm <sup>1</sup> (2.7 cm when 12 km from the base station)	Instant	Radio or Modem (with data plan)
Virtual Reference Station (VRS) (Network RTK)	Regional	Internet	8 mm + 0.5 ppm <sup>1</sup> (2 cm or better in most networks)	15 mm + 0.5 ppm <sup>1</sup> (3 cm or better in most networks)	Instant	Modem (with data plan)
Trimble RTX® (No base station required)	Global Local (Fast)	Satellite Internet	2 - 50 cm (subscription level dependent)	5 cm (subscription level dependent) CenterPoint RTX only	< 1 - < 20 minutes (subscription level dependent)	N/A

<sup>1</sup> ppm refers to parts per million, e.g. 1 ppm is equivalent to 1 mm in additional error for every 1 km in distance from the closest base station



# Performance and Operation



## ARE THERE ANY FACTORS THAT CAN CAUSE ERRORS OR OUTAGES OF TRIMBLE RTX CORRECTION SERVICES?

- ▶ There are several environmental factors that can degrade accuracy and convergence or cause outages in GNSS systems when using any correction source:
  - ▶ **Solar activity:** GNSS signals can be impacted by solar activity as they pass through the Earth's ionosphere.
  - ▶ **Obstructions:** Any objects that prevent a receiver from receiving information from GNSS satellites or the Trimble RTX correction stream can impact accuracy or cause outages. Tall trees, buildings, overpasses, and steep terrain are common obstructions that impact GNSS users. Trimble RTX delivered via IP can help mitigate outages when the Trimble RTX satellite is blocked by obstructions, but won't help with obstructions limiting GNSS satellite availability or causing a degradation in GNSS signals.
  - ▶ **Interference:** Any localized interference on similar or adjacent frequencies of GNSS signals or the correction signal will disrupt the reception of those signals.



## WILL TRIMBLE RTX CORRECTIONS WORK INDOORS?

- ▶ No. Unless there is a clear line of sight between the GNSS receiver and positioning satellites, Trimble RTX positioning will not work very well, or at all. Trimble only recommends Trimble RTX usage outside, with an unobstructed view of the sky.



## HOW RELIABLE ARE TRIMBLE RTX SERVICES?

- ▶ Trimble RTX services use a worldwide network of base stations, with redundancy in infrastructure for calculating and delivering correction services. All base stations, correction solutions, and delivery mechanisms are monitored 24/7, 365 days in the year by a global team of network engineers and IT specialists to ensure reliability in worldwide positioning and broadcasting.

# Delivery and Availability



## HOW ARE TRIMBLE RTX CORRECTION SERVICES DELIVERED TO THE RECEIVER?

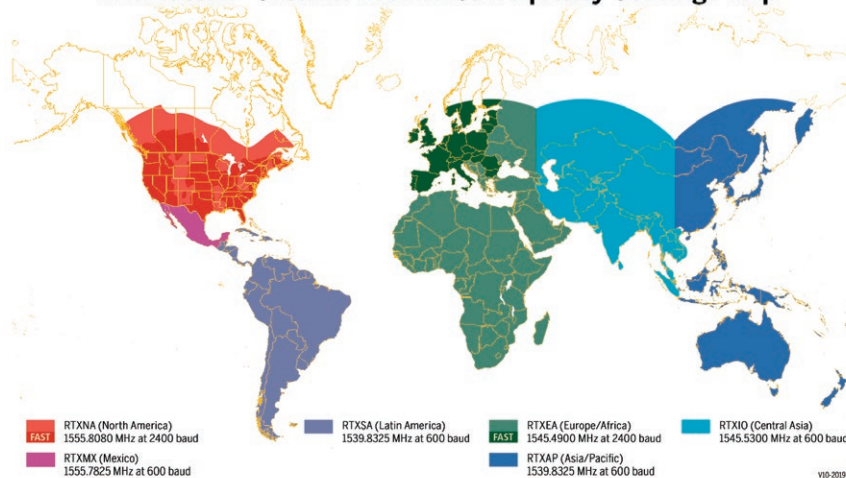
- ▶ Trimble RTX correction services are delivered by satellite or Internet (e.g. through a cellular data connection). xFill Premium is only delivered by satellite. A subscription is required to use Trimble RTX correction services.



## WHERE ARE TRIMBLE RTX CORRECTIONS AVAILABLE?

- ▶ Trimble RTX corrections are available worldwide via satellite and internet delivery. The satellite coverage area is shown on the map below. Trimble RTX Fast is available in most of North America and Europe. For the most up-to-date coverage maps, visit <https://positioningservices.trimble.com/resources/coverage-maps>.

**Trimble RTX® Satellite Broadcast Frequency Coverage Map**



**IP/ cellular coverage anywhere an internet connection is available**



## CAN I USE TRIMBLE RTX CORRECTION SERVICES OVER WATER?

- ▶ No, Trimble RTX correction services are only available for land use.

# Delivery and Availability



## WHAT RECEIVERS ARE COMPATIBLE WITH TRIMBLE RTX CORRECTION SERVICES?

► Trimble RTX correction services are available for the following list of receivers:

### CenterPoint RTX

NAV-900	R10-2	SPS986	MB-TWO
AG-372	R12	SPS785	APX15 v3
CFX-750	R2	BX982	APX15 EI
FmX	R9s	SP80	APX18
TMX-2050	NetR9 Geospatial	SP60	APX20
AFS-372	Geo7x	SP90m	AVX210 v3
FM-750	Alloy	SNS	LVX POS
FM-1000	NetR9	BD982	AV V6/AP
PLM-372	Kestrel	BD935-INS	AV POST
XCN-2050	SPS855	BD940	LV V5/AP LV
AG-382	SPS985 & SPS985L	BD990	MPS865
R10	SPS585	BD992	

### FieldPoint RTX

Geo7x	R2	SP60	SP20	TDC150
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### RangePoint RTX

NAV-900	AFS-372	Geo7x
AG-372	FM-750	R2
CFX-750	FM-1000	SP60
FmX	PLM 372	BD982
TMX-2050	XCN-2050	

### ViewPoint RTX

Geo7x	PG-200	Trimble EM100
R1	SP60	NAV-500
R2	BD982	AG-200

### xFill Premium

NAV-900	AG-382	R10-2
AG-372	TMX-2050	R12
AFS-372	XCN-2050	R9s
PLM 372	R10	NetR9 Geospatial

# Subscriptions



## WHAT TYPES OF TRIMBLE RTX SUBSCRIPTIONS ARE AVAILABLE?

- ▶ Trimble offers a variety of subscriptions to suit customer needs. For information on subscriptions available in your region, please contact your local Trimble reseller, Correction Services Customer Care or visit our online store at [tpsstore.trimble.com](https://tpsstore.trimble.com)



## HOW ARE TRIMBLE RTX CORRECTION SERVICES ACTIVATED?

- ▶ Trimble RTX correction services are activated via a subscription. These subscriptions can be activated either Over-The-Air (OTA) or through a manual passcode entry. Some receivers also support activation through scanning a QR Code, or uploading a License File.
  - ▶ **Over-The-Air Activation:** This is an activation that is sent via satellite and/or Internet directly to the receiver. Once this activation is received, the service will be ready to use.
  - ▶ **Manual Activation:** With manual activation, an activation passcode is emailed to you when you purchase a Trimble RTX subscription. You then key this passcode into your receiver to activate your subscription, which can be used right away.
  - ▶ **QR Code:** The activation email will include a QR Code that can be scanned using the camera on your display. This is currently supported on the TMX-2050, SNS, and NAV-900 (Using GFX-750/XCN-1050).
  - ▶ **License File:** The activation email will include a license file that can be uploaded onto the display or controller, which is then read by the software to activate the subscription. This is currently supported on the TMX-2050, SNS, NAV-900. (Using GFX-750/XCN-1050), and Geo7x.



## I MISSED THE OVER-THE-AIR ACTIVATION. WHAT CAN I DO?

- ▶ You can manage your subscriptions via the Correction Services online store at: [tpsstore.trimble.com](https://tpsstore.trimble.com). If you received a passcode, you may manually enter the passcode into the receiver. You may also contact your local Trimble reseller or Correction Services Customer Care and request the activation broadcast be re-sent. Please have your account information and/or serial number on hand when contacting Customer Care.



# Subscriptions



## DOES TRIMBLE AUTOMATICALLY RENEW MY SUBSCRIPTION?

- ▶ Your subscription will automatically renew if you are enrolled in the automatic renewal. For more information, contact Correction Services Customer Care. If you are not enrolled in Automatic Renewal, you'll need to renew your subscription by going to [tpsstore.trimble.com](https://tpsstore.trimble.com) or contacting Correction Services Customer Care. More information about auto-renewal can be found in our Terms & Conditions: [trimble.com/TPS\\_Terms/](https://trimble.com/TPS_Terms/)



## HOW WILL I KNOW WHEN MY CURRENT SUBSCRIPTION WILL EXPIRE?

- ▶ You will receive a renewal notice about 4-6 weeks before your subscription is due to expire advising you of your expiration date and the renewal process. All subscription information is also available by logging into your account on [tpsstore.trimble.com](https://tpsstore.trimble.com).
- ▶ Most receivers will show the expiration date on the display or user interface. If you are unsure on how to find this, you can contact Correction Services Customer Care and a member of our team will be able to advise you.



# Purchasing and Support



## ARE THERE TRIMBLE RTX DEMO SUBSCRIPTIONS AVAILABLE?

- ▶ Yes. A free 3-day demo subscription is available for all compatible receivers. This can be activated on [tpsdemo.trimble.com](https://tpsdemo.trimble.com) or by contacting Correction Services Customer Care.



## HOW CAN CUSTOMERS PURCHASE TRIMBLE RTX SERVICES?

- ▶ Subscriptions can be ordered and managed directly via the Correction Services online store at: [tpsstore.trimble.com](https://tpsstore.trimble.com). Customers can also place orders through a local Trimble reseller or by contacting Correction Services Customer Care, via phone or email. Contact information for your region can be found at the following link: [trimble.com/positioning-services/contact-us.aspx](https://trimble.com/positioning-services/contact-us.aspx)



## HOW MUCH WILL TRIMBLE RTX SERVICES COST FOR MY DEVICE?

- ▶ Pricing is available on the Positioning Services online store at: [tpsstore.trimble.com](https://tpsstore.trimble.com). Please contact your local Trimble reseller or Correction Services Customer Care for any further details.



## WHAT KIND OF CUSTOMER SUPPORT IS AVAILABLE FOR TRIMBLE RTX CORRECTION SERVICES?

- ▶ With regional offices worldwide, phone and email support is available at anytime. For more information and contact details, refer to [trimble.com/positioning-services/contact-us.aspx](https://trimble.com/positioning-services/contact-us.aspx).



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