USER GUIDE

Trimble R10 GNSS receiver

Version 1.00
Revision A
October 2012

Trimble

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Legal Notices

NTP Software Copyright

Release Notice

This is the October 2012 release (Revision A) of the Trimble R10 GNSS receiver documentation.

Product Limited Warranty Information

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

COCOM limits

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

Notices

Class B Statement – Notice to Users. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules and Part 90. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
– Increase the separation between the equipment and the receiver.
– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
– Consult the dealer or an experienced radio/TV technician for help.
Changes and modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commission rules.

Canada

This Class B digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.
This apparatus complies with Canadian RSS-GEN, RSS-310, RSS-210, and RSS-119.
Cet appareil est conforme à la norme CNR-GEN, CNR-310, CNR-210, et CNR-119 du Canada.

Europe

The product covered by this guide are intended to be used in all EU member countries, Norway, and Switzerland. Products been tested and found to comply with the requirements for a Class B device pursuant to European Council Directive 89/336/EEC on EMC, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA). Contains a Bluetooth radio module. These requirements are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential or commercial environment. The 450 MHZ (PMR) bands are non-harmonized throughout Europe.

CE Declaration of Conformity

Hereby, Trimble Navigation, declares that the GPS receivers are in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

Australia and New Zealand

This product conforms with the regulatory requirements of the Australian Communications and Media Authority (ACMA) EMC framework, thus satisfying the requirements for C-Tick Marking and sale within Australia and New Zealand.

Taiwan – Battery Recycling Requirements

The product contains a removable Lithium-ion battery. Taiwanese regulations require that waste batteries are recycled.
廢電池請回收

Restriction of Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)

Trimble products in this guide comply in all material respects with DIRECTIVE 2002/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive) and Amendment 2005/618/EC filed under C(2005) 3143, with exemptions for lead in solder pursuant to Paragraph 7 of the Annex to the RoHS Directive applied.

Waste Electrical and Electronic Equipment (WEEE)

For product recycling instructions and more information, please go to www.trimble.com/ev.shtml.
Recycling in Europe: To recycle Trimble WEEE (Waste Electrical and Electronic Equipment, products that run on electrical power.), Call +31 497 53 24 30, and ask for the "WEEE Associate". Or, mail a request for recycling instructions to:
Trimble Europe BV
c/o Menlo Worldwide Logistics
Meerheide 45
5521 DZ Eersel, NL

FCC Declaration of Conformity

We, Trimble Navigation Limited.

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Declare under sole responsibility that DoC products comply with Part 15 of FCC Rules.

Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation

Unlicensed radios in products

This device complies with part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation.

Licensed radios in products

This device complies with part 15 of the FCC Rules.
Operation is subject to the condition that this device may not cause harmful interference.

Safety Information

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

WARNING – This alert warns of a potential hazard which, if not avoided, could result in severe injury or even death.

CAUTION – This alert warns of a potential hazard or unsafe practice that could result in minor injury or property damage or irretrievable data loss.

Note – *An absence of specific alerts does not mean that there are no safety risks involved.*

Use and care

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

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

Exposure to radio frequency radiation

For 450 MHz radio

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

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

- ***DO NOT*** operate the transmitter when someone is within the following distances of the antenna:
  - Bluetooth, Wi-Fi, GSM/UTMS – less than 20 cm (7.9 inches)
  - 410-470 MHz UHF radio – less than 35 cm (13.8 inches)
- ***DO NOT*** operate the transmitter unless all RF connectors are secure and any open connectors are properly terminated.
- ***DO NOT*** operate the equipment near electrical blasting caps or in an explosive atmosphere.

- All equipment must be properly grounded according to Trimble installation instructions for safe operation.
- All equipment should be serviced only by a qualified technician.

For internal wireless radio transmitters

The radiated output power of the internal Bluetooth wireless radio and the Wi-Fi radio included in some Trimble receivers is far below the FCC radio frequency exposure limits. Nevertheless, the wireless radio(s) shall be used in such a manner that the Trimble receiver is 20 cm or further from the human body. The internal wireless radio(s) operate within guidelines found in radio frequency safety standards and recommendations, which reflect the consensus of the scientific community. Trimble therefore believes that the internal wireless radio(s) are safe for use by consumers. The level of energy emitted is far less than the electromagnetic energy emitted by wireless devices such as mobile phones. However, the use of wireless radios may be restricted in some situations or environments, such as on aircraft. If you are unsure of restrictions, you are encouraged to ask for authorization before turning on the wireless radio.

Exposure to radio frequency radiation from cellular wireless transmitters

Trimble receivers equipped with wireless cellular modem radios have been designed and manufactured to meet safety requirements for limiting exposure to radio waves. When used in accordance with the instructions set forth in this manual, the equipment has been independently verified to not exceed the emission limits for safe exposure to radio frequency (RF) energy as specified by the Federal Communications Commission of the U.S. Government in 47 CFR §2.1093. These limits are part of comprehensive guidelines and establish permitted levels of RF energy for the general population. The guidelines are based on standards that were developed by independent scientific organization through periodic and thorough evaluation of scientific studies. The standards include a substantial safety margin designed to assure the safety of all persons, regardless of age and health.

For UMTS radio

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

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

- ***DO NOT*** operate the transmitter when someone is within 20 cm (7.9 inches) of the antenna.
- All equipment should be serviced only by a qualified technician.

Installing antennas

CAUTION – For your own safety, and in terms of the RF exposure requirements of the FCC, always observe these precautions:
– Always maintain a minimum separation distance of 20 cm (7.9 inches) between yourself and the radiating antenna.
– Do not co-locate the antenna with any other transmitting device.

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

Trimble receiver internal radios have been designed to operate with the antennas listed below. Antennas not included in this list are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

The antennas that can be used (country dependent) with the:

- ***450 MHz radio*** are 0 dBi and 5 dBi whip antennas

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen so that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

Type approval

Type approval, or acceptance, covers technical parameters of the equipment related to emissions that can cause interference. Type approval is granted to the manufacturer of the transmission equipment, independent from the operation or licensing of the units. Some countries have unique technical requirements for operation in particular radio-modem frequency bands. To comply with those requirements, Trimble may have modified your equipment to be granted type approval.

Unauthorized modification of the units voids the type approval, the warranty, and the operational license of the equipment.

Contents

CHAPTER

1

Getting Started

In this chapter:

The Trimble R10 GNSS receiver

The Trimble R10 GNSS receiver incorporates a GNSS antenna, receiver, internal radio, and battery in a rugged light-weight unit that is ideally suited as an all-on-the-pole RTK rover or quick setup/rapid mobilization base station. LEDs enable you to monitor satellite tracking, radio reception, data logging status, Wi-Fi status, and power. Bluetooth wireless technology provides cable-free communications between the receiver and controller.

You can use the receiver as part of an RTK GNSS system with the Trimble Access™ software. The receiver can optionally record GNSS data to the receiver's internal memory and download to a computer or USB flash memory stick.

The receiver has no front panel controls for changing settings. To configure the receiver, use the web interface which is available by connecting to the receiver's Wi-Fi via a PC or a smartphone.

Features

The Trimble R10 GNSS receiver has the following features:

- Small, lightweight design – 1.12 kg (2.49 lb) (integrated radio, GNSS receiver, GNSS antenna and battery); 3.57 kg (7.86 lb) complete system weight (rover including TSC3 controller and rod)
- The quick setup, high mobility base or rover receiver, is ideal for any size jobsite as a rover and for working on multiple jobsites on a daily or weekly basis
- 440-channel L1/L2/L5 GPS and L1/L2 GLONASS receiver
- Measure points sooner, faster and in harsh environments with HD-GNSS™
- Increased measurement traceability with Surepoint™ technology
- Reduced downtime due to loss of radio signal with xFill™ technology
- Capable of tracking all OmniSTAR® signals
- Performs all site measurement and stakeout operations within the operating range of the radio
- Internal, removable, smart Lithium-ion battery provides up to 5+ hrs GNSS rover operation per battery
- Bluetooth wireless technology for cable free, no hassle, base or rover operation
- Simple keypad with on/off key and LED indicators for power, radio, Wi-Fi, and satellite tracking
- 20 Hz update rate
- Full base/rover interoperability
- Operates within a VRS™ network for conventional base station-free rover capability
- Fully integrated 3.5G UMTS cellular modem
- Integrated receive and transmit radio
- Tracks GLONASS L1/L2 signals for increased satellite availability and operation in harsh GPS environments
- The standard Trimble R10 GNSS receiver receives the GPS L2C and L5 signal
- Fully future-proof signal tracking of current GNSS systems
- Capable of tracking all SBAS systems

Parts of the receiver

All operating controls are located on the front panel. Serial ports and connectors are located on the bottom of the unit.

Front panel

The following figure shows a front view of the receiver. The front panel contains the four indicator LEDs and the Power button with LED.

The **Power** button controls the receiver's power on or off functions.

The indicator LEDs show the status of data logging/downloading, power, satellite tracking, Bluetooth/Wi-Fi, and radio transmit/receive.

For more information, see Button and LED operations, page 26.

Lower housing

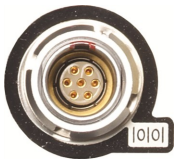
The lower housing contains the two communication and power ports, one TNC radio antenna connector, and the Quick Release Socket.

1. SMA Connection: UHF/VHF antenna
2. Quick Release socket
3. Lemo Port 1: Serial connection
4. Lemo Port 2: USB connection

Receiver ports

Icon	Name	Connections
	Port 1	Device, computer, external radio, power in, power out
	Port 2	Device, computer, USB flash memory stick, power in
	RADIO	Radio communications antenna

Port 1 is a 7-pin 0-shell Lemo connector that supports RS-232 communications and external power input. Port 1 has no power outputs.



Port 2 is a 7-pin 0-shell Lemo connector that allows for USB 2.0 communications and external power input. For more information, see Default receiver settings .

The SMA port connector is for connecting a radio antenna to the receiver internal radio. A whip “rubber duck” antenna is supplied with the system for units with internal UHF or VHF MHz radios. This connector is not used if you are using an external UHF/VHF radio. For longer range operation (to provide higher gain and to raise the antenna higher above the ground), you can use a cable to connect an external radio antenna to the SMA port. For more information, refer to the "Connecting the receiver to external devices" topic in the Web Help.

Batteries

The receiver has one rechargeable Lithium-ion battery, which can be removed for charging. You can also connect the receiver to an external power source through Port 1 or Port 2.

During measurement operations, the internal battery typically provides about 5.5 hours of power if using the internal Rx (receive) radio and about 4.5 hours operating as a base station using the internal 450 MHz Tx (transmit at 0.5 watt) radio. These times vary according to the type of measurement and the operating conditions.

Battery safety

Charge and use the battery only in strict accordance with the instructions provided.

WARNING – Do not damage the rechargeable Lithium-ion battery. A damaged battery can cause an explosion or fire, and can result in personal injury and/or property damage.
To prevent injury or damage:
– Do not use or charge the battery if it appears to be damaged. Signs of damage include, but are not limited to, discoloration, warping, and leaking battery fluid.
– Do not expose the battery to fire, high temperature, or direct sunlight.
– Do not immerse the battery in water.
– Do not use or store the battery inside a vehicle during hot weather.
– Do not drop or puncture the battery.
– Do not open the battery or short-circuit its contacts.

WARNING – Avoid contact with the rechargeable Lithium-ion battery if it appears to be leaking. Battery fluid is corrosive, and contact with it can result in personal injury and/or property damage.
To prevent injury or damage:
– If the battery leaks, avoid contact with the battery fluid.
– If battery fluid gets into your eyes, immediately rinse your eyes with clean water and seek medical attention. Do not rub your eyes!
– If battery fluid gets onto your skin or clothing, immediately use clean water to wash off the battery fluid.

Connecting the receiver to a vehicle battery

WARNING – Use caution when connecting battery cable's clip leads to a vehicle battery. Do not allow any metal object or jewelry to connect (short) the battery's positive (+) terminal to either the negative (-) terminal or the metal of the vehicle connected to the battery. This could result in high current, arcing, and high temperatures, exposing the user to possible injury.

WARNING – When connecting an external battery, such as a vehicle battery, to the receiver, be sure to use the Trimble cable with proper over-current protection intended for this purpose, to avoid a safety hazard to the user or damage to the product.

Wet locations

WARNING – This product is not intended to be used outdoors or in a wet location when it is powered by the external power supply. The connection is not waterproof and could be subject to electrical shorting.

WARNING – The external power adaptor and its associated power cord and plug are not intended to be installed outdoors, or in a wet location.

Charging the Lithium-ion battery

The rechargeable Lithium-ion battery is supplied partially charged. Charge the battery completely before using it for the first time. Charging takes approximately 3 hours per battery at room temperature. If the battery has been stored for longer than three months, charge it before use.

WARNING Charge and use the rechargeable Lithium-ion battery only in strict accordance with the instructions. Charging or using the battery in unauthorized equipment can cause an explosion or fire, and can result in personal injury and/or equipment damage.

To prevent injury or damage:

– Do not charge or use the battery if it appears to be damaged or leaking.

– Charge the Lithium-ion battery only in a Trimble product that is specified to charge it. Be sure to follow all instructions that are provided with the battery charger.

– Discontinue charging a battery that gives off extreme heat or a burning odor.

– Use the battery only in Trimble equipment that is specified to use it.

– Use the battery only for its intended use and according to the instructions in the product documentation.

To charge the battery, first remove the battery from the receiver, and then place it in the battery charger, which is connected to AC power.

Battery charger

The charger can charge three types of Lithium-ion batteries. It can be powered by AC power or vehicle battery.

The Charger Kit Dual Slot consists of:

- Charger dual-battery slot (P/N 53018010)
- Power supply for charger (P/N 55001403, Japan: P/N 78650)
- Cable Kit-AC for power supply (P/N 55001402; Japan: P/N 78656)
- Charger battery slot insert (P/N 89843-00)

Chargeable batteries

The charge can charge the following types of batteries:

- Lithium-ion Rechargeable Battery (Smart Battery), 3.7 Ah, 7.4 V, (P/N 76767, P/N 89840-00)
- Lithium-ion Rechargeable Battery, 2.6 Ah, 7.4 V, P/N 92600 (remove battery slot inserts to charge this type of battery)
- Lithium-ion Rechargeable Battery, 4,4 Ah, 11.1.V, P/N 49400 (remove battery slot inserts to charge this type of battery)

Charger slots

The charger has two slots. Each slot can charge either type of battery. When charging the smart battery, you must place the inserts into the battery slot before inserting the battery. Batteries are charged sequentially. Beside each slot are two LED indicators (red and green) to indicate the battery status.

Power supply

The charger can be powered by AC power (using the power supply for the charger) or by car voltage using a 12V vehicle adapter for dual battery charger (P/N 89844-00, not included with receiver kit).

AC power supply is an external adapter, usable worldwide. Different cords with appropriate plugs for different countries are supplied with adapter.

Vehicle power

The charger can be powered by vehicle voltage of nominal 12 V. It can withstand voltages of a vehicle voltage of nominal 24 V (maximum 32 V). So if the user connects the vehicle cable by mistake to a 24 V socket in a vehicle the charger does not start charging but latches in fault condition and flashes all green LEDs. The power must be removed to reset the fault condition.

Technical data

Power Supply	Receiver Connection
AC Input Voltage	100 to 240 V AC +/-10%
AC Frequency	50 to 60 Hz
DC Output Voltage	19 V

Power Supply	Receiver Connection
DC Output current charger	Approx. 3.5 A
DC Power Input Voltage operation	10V to 21 V Unit switches off if voltage is out of range
DC Power Input Voltage limits	8 V to 32 V
Absolute maximum input voltage	32 V
Over voltage	21 V to 32 V
Working voltage	10 V to 21 V
Under voltage charging	<10V
Sum of charge time for all batteries	5 to 6 hours
Charger in first hour	>60%

Charging the battery

Caution – Ensure that nothing obstructs the vents in the back and bottom of the charger.

The battery is supplied partially charged. Charge the battery completely before using it for the first time.

- To charge the battery, use only a charger that Trimble recommends for charging the Lithium-ion battery.
- If the equipment has been stored for longer than three months, charge the battery before using the receiver.

The charger operates between 0 C (32 F) and 40 C (104 F). Charging a battery at temperatures in the range of 0 C (32 F) to 5 C (41 F) will take longer than charging at room temperature.

To charge the battery:

1. Ensure that the vents in the back and bottom of the charger are unobstructed.
2. Place the charger on a hard, flat and level surface, to ensure that there is airflow under the charger.
3. To apply power to the charger, use the AC to DC converter or 12 V vehicle adapter. The charger scans the slots for a battery.
4. Place the battery in any of the slots. The red light turns off (can take up to 5s). For an explanation of the LED, see LED Status Indicator.
5. Charging takes approximately 3 hours per battery at room temperature. If several batteries are charging in the battery charger, the batteries will be charged sequentially, from left to right.

Leave a deeply discharged or shorted battery overnight in the charger to attempt to revive the battery. A shorted battery is typically revived as soon as the slot is scanned. If the red LED turns off, the battery is revived. If the red LED stays on, the battery is no longer functional and needs to be replaced.

LED status indicator

Beside each slot are two LED indicators (Red and Green) to display the battery status:

Status	Red	Green
No battery detected (no battery present or battery defect)	On	Off
Battery detected (charging not started yet) - Conditioning not required - Conditioning required	 Off Blinking	 Off Off
Charging in progress - Conditioning not required - Conditioning required - Over/under temperature (charge is inhibited)	 Off Blinking One flash every 2.5 seconds	 Off Blinking Blinking
Conditioning in progress	On	Blinking
Conditioning done (battery fully charged)	On	On
Battery fully charged - Conditioning not required - Conditioning required	 Off Blinking	 On On
Power supply over/under voltage	Off	One flash every 2.5 seconds

Troubleshooting

Issue	Solution
Battery is not detected (Red LED does not turn off)	The battery is not properly inserted. Reinsert battery into battery charger slot.
Battery contacts contaminated.	Clean the battery (for example, by inserting and removing the battery several times) or replace the battery.
Deeply discharged.	Leave the battery overnight in the charger to attempt to revive the battery.
Battery defective.	Replace the battery.

Storing the Lithium-ion battery

Do not store batteries in the receiver or in the external charger unless power is applied.

Keep all batteries on continuous charge when not in use. You can keep batteries on charge indefinitely without damage to the batteries.

Disposing of the rechargeable Lithium-ion battery

Discharge a Lithium-ion battery before disposing of it. Dispose of batteries in an environmentally sensitive manner, and adhere to any local and national regulations concerning battery disposal or recycling.

Inserting the battery and SIM card

Align the arrows and on the battery and battery compartment and then insert the battery as indicated in the images below.

To remove the battery, slide the battery bail to the left.

Note – *The gasket on the inside of the battery door should be clean of any dirt or dust to ensure proper sealing of the battery compartment.*

Insert the SIM card with the contacts facing upward, as indicated by the SIM card icon next to the SIM card slot.

To eject the SIM card, slightly push it in to trigger the spring-loaded release mechanism.

Tip – The SIM card is provided by your cellular network service provider.

Accessories

Attaching the quick release adapter

Push down the spring-loaded button of the quick release adapter and then align the white dots on the bottom of the receiver and the quick release adapter. Slide in the quick release adapter and then release the button.

Height measurement methods

The following antenna height measurement methods are available in the field/office software and web interface:

1. Bottom of antenna mount
2. Bottom of quick release
3. Lever of R10 extension

Base station extension with measurement lever

The Trimble R10 GNSS receiver uses a base station extension pole that increases the height of the receiver to allow clearance for the 450 MHz internal radio antenna and also allows for easy and accurate measurement of the base station antenna height. The extension pole includes a height measurement lever with a defined measurement point:

To measure the height of the base station extension with measurement lever,measure the slant height from the control point on the ground to the height measurement point on the lever. Enter the slant height into the field software (or web interface) and then select the *Lever of R10 extension* measurement method. The field software (or web interface) automatically calculates the antenna height from the slant height. The base station extension with measurement lever should be used when setting up a base station or static session on an extension leg tripod with tribrach.

The illustration below shows the Trimble R10 GNSS receiver with base station extension with measurement lever (P/N 89846-00):

The Base Station Extension with Measurement Lever is available as a standalone accessory (P/N 89846-00) or within the Base Kit or Post processed (PP) Kit.

Note – *Measuring to the measurement lever is not required when using a fixed height tripod. If the base station extension with measurement lever is used with a fixed height tripod, the height of the extension pole (0.15m (0.49ft)) should be added to the height of the fixed height tripod and the measurement method "bottom of quick release" used.*

Base Extension with Measurement Lever (P/N 89846-00):

Base Kit (P/N 89861-00):

PP Kit (P/N 89862-00):

Note – *Measuring to the measurement lever is not required when using a fixed height tripod. If the base station extension with measurement lever is used with a fixed height tripod, the height of the extension pole (0.15m (0.49ft)) should be added to the height of the fixed height tripod and the measurement method "bottom of quick release" used.*

Button and LED operations

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

The term...	means that the LED...
Very slow flash	is off and on equally with a 1.5 second cycle.
Slow flash	alternates on/off every ½ second.
Radio slow flash	is ***off longer than it is on*** when the receiver is ***receiving corrections***. The receiver repeats this cycle typically once per second. is ***on more than off*** when the receiver is ***transmitting corrections***. The receiver repeats this cycle typically once per second.
Medium flash	is off and on equally more than once per second.
Fast flash	alternates rapidly on/off every 1/10 of a second.
On	is lit steady.
Off	is unlit.

Power button

Action	Power button	Description
Turn on the receiver	Press (see the note below)	All four LEDs light up and remain lit for 3 seconds. Then all LEDs go off and then the power LED immediately comes back on.
Turn off the receiver	Hold for 2 seconds and then release	When holding down the Power button; the battery LED remains on. The Satellite LED turns constant and then turns off after 2 seconds. After releasing the power button, the battery LED stays lit for about 5 seconds and then all LEDs go blank.

Action	Power button	Description
Clear the ephemeris file and reset the receiver to the factory defaults	Hold for 15 seconds	The Radio, Wi-Fi, and Satellite LEDs turn off after 2 seconds. The battery LED remains on. After 15 seconds, the Satellite LED comes on to indicate that it is time to release the Power button.
Delete application files and data logging files	Hold for 30 seconds	The Radio, Wi-Fi, and Satellite LEDs turn off after 2 seconds. After 15 seconds, the Satellite LED comes on and stays on for 15 seconds, then turns off to indicate that it is time to release the Power button. The receiver then restarts.

Note – *The term "press" means to press the button and release it immediately. The term "hold" means to press the button and hold it down for the given time.*

Satellite LED

Receiver mode	Satellite LED Amber
No satellites tracked	Off
Boot up or when in Monitor mode	On
Tracking fewer than 4 SVs	Fast flash
Tracking more than 4 SVs	Slow flash

Radio LED

Radio mode	Radio LED Amber	Description
No receive or transmit	Off	
Receive	Radio slow flash	See the table at the top of this topic. This LED also flashes when using the Wi-Fi only for receiving corrections.
Transmit	Radio slow flash	See the table at the top of this topic. This LED also flashes when using the Wi-Fi only for transmitting corrections

Wi-Fi LED

Receiver mode	Wi-Fi LED Amber
Wi-Fi off	Off
Wi-Fi is access point (base mode / sending corrections)	Medium flash
Wi-Fi is client (and not connected to an access point)	Off
Wi-Fi as client (rover mode receiving corrections)	Very slow flash

Data logging/downloading LED

Receiver mode	Data LED Amber
Data logging off	Off
Data logging on	On
Downloading to USB flash memory stick	Slow flash
Full USB flash memory stick detected	Fast flash
Download to USB flash memory stick complete	Very slow flash

LED flash patterns

The following table details the possible flash patterns to indicate various states of receiver operation.

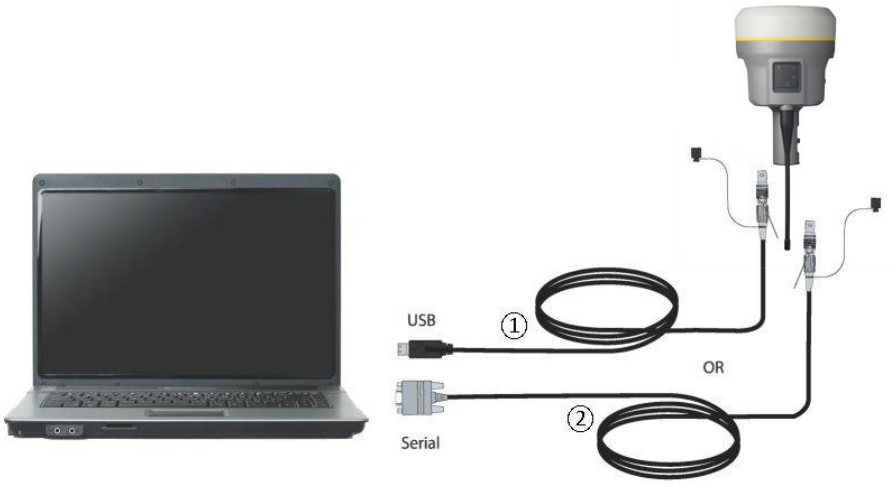
Receiver mode	Power button	Radio LED	Satellite LED	Data LED	Wi-Fi LED
Receiver OFF	OFF	OFF	OFF	OFF	OFF
Receiver ON, healthy power	ON	N/A	N/A	N/A	N/A
Low power	Fast flash	N/A	N/A	N/A	N/A
Transmitting correction messages	N/A	Flashes off when transmitting	N/A	N/A	N/A
Receiving valid data packets	N/A	Slow flash	N/A	N/A	N/A
Tracking fewer than 4 SVs	ON	N/A	Fast flash	N/A	N/A
Tracking more than 4 SVs	ON	N/A	Slow flash	N/A	N/A
Logging data internally	N/A	N/A	N/A	Solid	N/A
Transferring data to flash memory stick	N/A	N/A	N/A	Slow flash	N/A
All data transferred to flash memory stick	N/A	N/A	N/A	Very slow flash	N/A
Flash memory stick full	N/A	N/A	N/A	Fast flash	N/A
Wi-Fi configured as an access point	N/A	N/A	N/A	N/A	Slow flash
Wi-Fi configured as a client	N/A	N/A	N/A	N/A	On
Receiver in monitor mode (loading firmware from WinFlash)	ON	Slow flash	Solid	OFF	OFF

Note – *If a column shows "N/A", that specific LED may or may not be on, but it is not relevant to that particular mode.*

Connecting to an office computer

The receiver can communicate with the office computer using a serial connection by either using a serial cable (P/N 89851-00 or P/N 59046), or by using the USB cable (P/N 89852-00 or P/N 80751) and then Configuring a PC USB port as a virtual serial port, page 32. Before you connect to the office computer, ensure that the receiver battery is fully charged.

The following figure shows how to connect to the computer for serial data transfer:



①	USB cable (P/N 89852-00 or 80751)
②	Serial cable (P/N 89851-00 or P/N 59046)

Connecting to a USB flash memory stick

The receiver can download logged data directly to a USB flash memory stick using the supplied USB field data cable (P/N 80799 or 89850-00). After the cable is connected to the receiver's port 2 (USB) and the flash memory stick attached, the receiver will download all logged files to the flash memory stick.

Note – *The USB field data cable is used to download logged (existing) data files from the receiver memory to the flash memory stick. The USB field data cable cannot be used to log data files directly to the flash memory stick.*

The following figure shows a flash memory stick connected to the receiver using the USB download cable:

Configuring a PC USB port as a virtual serial port

It is possible to use the USB interface from a Trimble R10 GNSS receiver with a software application that requires a serial port.

For example, the Trimble WinFlash utility can be run on a computer that has no physical serial port by connecting the USB cable between the computer and the receiver.

Windows 7 Professional operating system

1. The simplest way to install the Virtual Serial port for the USB interface to the receiver is to go to the Trimble Support website (www.trimble.com/support) and search for the Trimble R10 GNSS receiver. In the Downloads section, download the file called *Windows7 USB Installer* to your computer.

   This file contains a Support Note and installation program.

2. Run the installation program. It will load the Virtual Serial port for the USB interface on your computer.

   Note – *If you have installed the Trimble WinFlash utility (www.trimble.com/support) on your computer, then another way to install the Virtual serial port for the USB interface is to run the USB Installer program, which is located in C:\Program Files\Common Files\Trimble\USBDriver.*

If this process does not work for your computer, or if you have a different Windows operating system on your computer, then follow the procedure below.

Windows Vista and Windows 7 operating system

1. Go to the Trimble Support website (www.trimble.com/support) and search for the receiver you have. In the Support Notes section, download the file called *R10 GNSS Interface to a Virtual COM port on a Computer* to your computer.
2. Open the file and place the trmbUsb.inf file in a temporary folder on your computer.
3. On the computer, select *Control Panel* / *Device Manager*.
4. Click on the name of the computer and then from the *Action* menu, select *Add Legacy Driver*.
5. A wizard prompts you to locate the TrimbleUsb.inf file. Locate the file and then follow the prompts in the wizard to continue.

Windows XP operating system

1. Go to the Trimble Support website (www.trimble.com/support) and search for the Trimble R10 GNSS receiver. In the Support Notes section, download the file called *R10 GNSS Interface to a Virtual COM port on a Computer* to your computer or USB drive.
2. Open the file and place the trimble.Usb.INF file in a temporary folder on your computer.
3. Turn on the receiver and then connect the USB cable to the computer. The *New Hardware* wizard appears.
4. Select the *No, not this time* option and then click **Next**.

5. A dialog prompts you to specify the location of the USBSer.sys file. For example, C:\Windows\System32\Drivers.
6. On some computers you may need to repeat Step 4 for the TrimbleUsb.inf file.
7. Check that the receiver is available for use. Go to the *Device Manager* menu on the computer. The receiver should appear in the *Ports* list.

Note – *If you are running an application such as WinFlash software on the computer and you physically disconnect the USB cable from the computer and then reconnect it, it does not always re-establish the connection. This is because opening the serial port from the application locks the device handle and when the USB device is disconnected, the application does not close the serial port and the device handle is still locked. On reconnecting, the USB cable is unable to get the device handle since it is locked. You must close the application before the reconnect to the port will work. This limitation is due to the behavior of the Microsoft USB serial driver.*

Configuring the receiver

You can configure the receiver in a number of ways. These topics describe the different configuration methods, and explain when and why each method is used.

Trimble Access Help is likely to be your main tool to set up and operate the receiver on a daily basis. All required field configurations are handled through the Trimble Access software running on a Trimble Tablet, TSC3, or Trimble CU controller. For more information, refer to the *Trimble Access Help*.

Configuring the receiver in real time

You can configure the receiver in real time using the web interface on your PC via Wi-Fi, Bluetooth (PPP), USB (PPP) or Serial (PPP). A new feature available on the Trimble R10 GNSS receiver is the mini-browser, easily accessed using a smartphone with Wi-Fi. The new mini-browser makes a select group of Web GUI menus available, with the option of showing the full set of Web GUI menus. When you apply the changes you have made to the settings in the web interface, the receiver settings change immediately.

Note – *Instructions for connecting to the Trimble R10 GNSS receiver via PPP (Point-to-Point Protocol) are found on the Trimble web site under the Trimble R10 GNSS receiver support notes.*

Any changes that you apply to the receiver are reflected in the current application file, which is always present in the receiver.

Configuring the receiver using the Web User Interface (Web UI)

The receiver has a Wi-Fi port so that the receiver can connect directly to a PC or smartphone (access point mode) or to a wireless network (client mode). You can use Wi-Fi to access, configure, and monitor the receiver. No cable connection to the receiver is required.

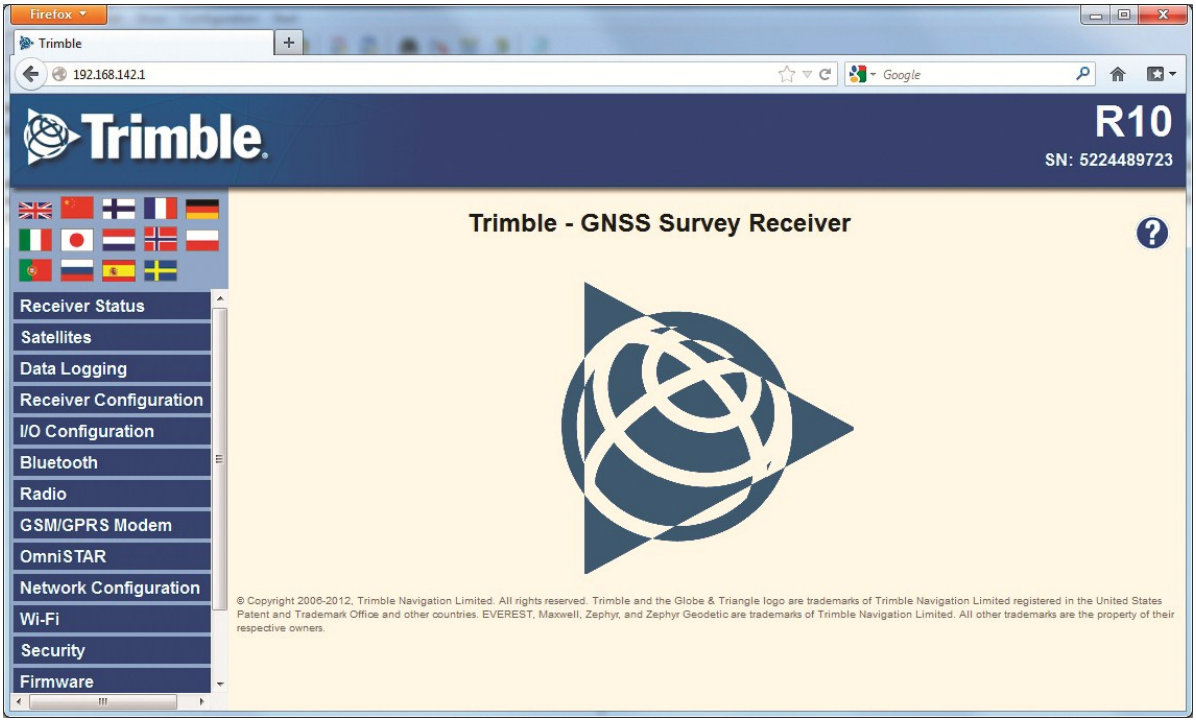
Connecting via Wi-Fi (access point)

The receiver is set to access point by default. In access point mode, the user can connect directly to the receiver from a PC or smartphone.

1. Using the Wi-Fi connection application on your PC or Smartphone, find the access point SSID for the receiver. Turn on the Trimble R10 GNSS receiver and wait for the words "**Trimble GNSS**" and last four digits of the receiver serial number to appear in your Wi-Fi connection application. For example, **Trimble GNSS xxxx** (where **xxxx** represents the last four digits of the receiver serial number.
2. Connect to the receiver. By default, all encryption is turned off in the receiver.
3. Open your web browser and then type the receiver IP address into the *URL* field. By default the IP address of the receiver is **http://192.168.142.1**.
4. Enter the login and password for the receiver. By default, the login is **admin** and the password is **password**.
5. The receiver web interface is displayed and the receiver is ready for real-time configuration.

The web page on the smartphone mini-browser opens with a select number of menus. To view the Full (Classic) menu, use the Show Classic Web GUI link in the heading area. To return to the mini-browser, the Wi-Fi connection or receiver must be reset (that is, turned on or off).

For more information, search for the topic "Web Interface Menus" in the Trimble R10 GNSS Receiver WebHelp.



Default Wi-Fi connection settings

Out of the box, the receiver is configured to default settings for Wi-Fi connections. You can change any of these settings as required.

The default settings are:

- Wi-Fi mode: access point
- Wi-Fi SSID: Receiver serial number
- Wi-Fi Encryption: Off
- Wi-Fi IP Address: 192.168.142.1
- Receiver Login: admin
- Receiver Password: password

Logging data

Data logging involves the collection of GNSS measurement data over a period of time at a static point or points, and subsequent postprocessing of the information to accurately compute baseline information. Data logging using receivers requires access to suitable GNSS postprocessing software such as the Trimble Business Center software.

Postprocessed GNSS data is typically used for control network measurement applications and precise monitoring. GNSS measurement data is collected over a period of time at a static point or points and then postprocessed to accurately compute baseline information.

Logging data after a power loss

If power is unexpectedly lost while the receiver is logging data, the receiver tries to return to the state it was in immediately before the power loss. The receiver does not reset itself to default settings.

If the receiver was logging data when power was lost, it resumes logging data when power is restored.

Default receiver settings

These settings are defined in the default application file.

Function	Settings	Factory default
SV Enable	-	All SVs enabled
General Controls	Elevation mask	10°
	PDOP mask	25
	RTK positioning mode	Low Latency
	Motion	Kinematic
Serial Port 1	Baud rate	38,400
	Format	8-None-1
	Flow control	None
Serial Port 2	USB	
Input Setup	Station	Any
NMEA/ASCII (all supported messages)		All ports Off
Streamed Output		All types Off
		Offset=00
RT17/Binary		All ports Off
Reference Position	Latitude	0°
	Longitude	0°
	Altitude	0.00 m HAE
Antenna	Type	Trimble R10 GNSS receiver, Internal
	Height (true vertical)	0.00 m
	Group	All
	Measurement method	Antenna Phase Center

CHAPTER

2

Base Station Operation

In this chapter:

Base station operation guidelines

This topic introduces the concept of base station operation, provides information to help you identify good setup locations, describes best practices for setting up the equipment, and outlines the precautions that you need to take to protect the equipment.

Real-Time Kinematic (RTK) operation provides centimeter-level precision by eliminating errors that are present in the GNSS system. For all RTK operations, you require both a rover receiver and a source of corrections from a base station or network of base stations.

A base station consists of a receiver that is placed at a known (and fixed) position. The receiver tracks the same satellites that are being tracked by the rover receiver, at the same time that the rover is tracking them. Errors in the GNSS system are monitored at the fixed (and known) base station, and a series of position corrections are computed. The messages are sent through a radio link to the rover receiver, where they are used to correct the real time positions of the rover.

Base station components

The base station has the following components:

- GNSS receiver
- GNSS antenna
- Height extension pole with measurement lever
- Base station radio and antenna
- Power source

GNSS receiver and GNSS antenna

The base station GNSS receiver can be one of following types:

- An integrated receiver that incorporates a GNSS receiver, GNSS antenna, power source, and radio into a single compact unit. An integrated GNSS antenna can be rapidly set up on a tripod, fixed height tripod, or T-Bar anywhere that is convenient on the jobsite.
- A modular receiver that incorporates a GNSS receiver and separate GNSS antenna. The GNSS antenna (and, optionally, the base station radio antenna) is separate from the receiver. Because the GNSS antenna is separate, you can use the following optimized components:
  - a geodetic antenna with large ground plane, to eliminate multipath (the major source of GNSS errors) at the base station
  - a high-gain or directional radio antenna, to increase broadcast range and to provide maximum coverage

You can place a modular receiver in an easily accessible and secure location, safe from theft and the weather, while the antennas are placed high on a tower or building, clear of obstructions and able to deliver maximum performance.

You can use either type of receiver in a permanent, semi-permanent, or daily quick setup configuration. If semi-permanent or permanent operation is required, however, the modular receiver delivers significant advantages.

Base station setup guidelines

For good performance, observe the following base station setup guidelines:

- Place the GNSS receiver in a location on the jobsite where equal range in all directions provides full coverage of the site. This is more important on larger jobsites, where the broadcast range of the base station radio may limit the operations of the system.
- Place the GNSS antenna in a location that has a clear line of sight to the sky in all directions. Do not place the antenna near vertical obstructions such as buildings, deep cuttings, site vehicles, towers, or tree canopy.
- Place the GNSS and radio antennas as high as practical. This minimizes multipath from the surrounding area, and enables the radio to broadcast to the maximum distance.

  Note – *The GNSS antenna must have a clear line of sight to the sky at all times during operation.*
- Choose the most appropriate radio antenna for the size and footprint of the site. The higher the gain on the antenna, the longer the range. If there is more focus on the transmission signal, there is a reduced coverage area. A 5 db gain antenna provides a mix of good range and reasonable directional coverage.

  Note – *A 5 db gain antenna with remote mount and cable is available as an accessory for the internal radio.*
- Make sure that the GNSS receiver does not lose power. To operate continuously for more than a few hours without loss of power at the base station, provide external power. Sources of external power include:
  - AC power
  - 12 V vehicle battery
  - Trimble custom external battery pack
  - Generator power
  - Solar panel

    When you use an external power supply, the integrated battery provides a backup power supply, enabling you to maintain continuous operation through a mains power failure.
- Do not locate a GNSS receiver, GNSS antenna, or radio antenna within 400 meters (about 1,300 feet) of:
  - a powerful radar, television, or cellular communications tower
  - another transmitter

- another GNSS antenna

  Cell phone towers can interfere with the base station radio broadcast and can stop corrections from reaching the rover receiver. High-power signals from a nearby radio or radar transmitter can overwhelm the receiver circuits. This does not harm the receiver, but can prevent the receiver electronics from functioning correctly.

  Low-power transmitters, such as those in cell phones and two-way radios, do not interfere with receiver operations

- Do not set up the base station directly beneath or close to overhead power lines or electrical generation facilities. The electromagnetic fields associated with these utilities can interfere with GNSS receiver operation. Other sources of electromagnetic interference include:
  - Gasoline engines (spark plugs)
  - Televisions and computer monitors
  - Alternators and generators
  - Electric motors
  - Equipment with DC-to-AC converters
  - Fluorescent lights
  - Switching power supplies
- Place the GNSS receivers in a protected and secure location. If the base station is in the center of a jobsite where heavy machinery is operating, place flags around the base station to warn operators of its existence.
- If you place the receiver in a lock box on the jobsite to protect the receiver from theft or from the weather, shield the lock box from direct sunlight and provide ventilation for the receiver through an inlet and extractor fan. A receiver that has a broadcast radio generates significant heat. Do not allow the temperature in the box to exceed 50 °C (122 °F).

  If working in a cold climate, you may need to provide heat to the receiver. Do not operate the receiver below –40 °C (–40 °F)
- Trimble recommends that, wherever possible, you keep GNSS receiver equipment dry. The receivers are designed to withstand wet weather, but keeping them dry prolongs their life and reduces the effects of corrosion on ports and connectors. If the equipment gets wet, use a clean dry cloth to dry the equipment and then leave the equipment open to the air to dry. Do not lock wet equipment in a transport case for prolonged periods. Avoid exposing the receiver to corrosive liquids and salt water wherever possible.
- Trimble recommends that you install lightning protection equipment at permanent base station locations. Equipment should include a gas capsule lightning protector in the GNSS and radio antenna feed line and appropriate safety grounding. A static dissipater near the antennas can reduce the likelihood of a direct lightning strike. Also protect any communications and power lines at building entry points. For more information, contact your local Trimble dealer, or go to the Huber and Suhner website (www.hubersuhnerinc.com).

- Trimble recommends that you use surge protection equipment on all permanently installed equipment.

Common ways to set up a base station

Trimble recommends that you use a tripod and tribrach setup or a fixed height tripod. The fixed height tripod is quicker and easier to set up over a control point.

Take great care to ensure that the GNSS antenna is set up accurately over the control point, and that the GNSS antenna height is measured accurately, in the right way (vertical or slope height) to the right location on the antenna (base of antenna or to a specified location on the antenna) or height extension pole with height measurement lever (P/N 89846-00) or Base Station Kit (P/N 89861-00). When you start the rover receiver, it is important to check in, at one or more known locations, to check for possible position or height errors. Checking in at a known location is good practice and can avoid costly errors caused by a bad setup.

Tripod and tribrach setup

In the tripod setup, the tripod is located over the control point, and the tribrach, tribrach adaptor, and height extension pole with measurement lever is mounted on the tripod and centered over the point.

1. Mount the quick release adapter onto the height extension pole with measurement lever.
2. Screw the height extension pole with measurement lever into the tribrach. Attach the GNSS receiver to the quick release adapter.
3. Level and plumb the GNSS receiver over the control point.
4. Measure the height of the base station GNSS antenna by measuring the slant height from the control point to the measurement lever. Select the “lever of R10 extension” as the measurement method when starting the base station. Trimble Access calculates the height to the Antenna Phase Center (APC) automatically.
5. If required, connect the GNSS receiver to an external 12 V power supply. Use the external battery cable set (P/N 89864-00) or the Trimble customer 6Ah power pack.

Receiver tripod and tribrach setup with an internal 450 MHz Tx radio (Measuring Slant Height)

Fixed height tripod setup

A fixed height tripod setup is similar to a tripod setup, but is simplified by the central leg of the tripod, which is placed directly on the control point. If the central leg is leveled accurately, the fixed height tripod is quick and easy to set up, and provides an accurate way to measure the true antenna height.

1. Screw the quick release adapter onto the tripod head or extension pole used to increase the height of the receiver above the tripod head .
2. Attach the GNSS receiver to the quick release adapter.
3. Plumb and level the tripod over the control point.
4. Determine the height of the base station GNSS antenna by adding the fixed height of the tripod from the control point to the tripod head to the height of any extension pole used to increase the height of the receiver. Select the “bottom of Quick Release” as the measurement method when starting the base station. Trimble Access calculates the height to the Antenna Phase Center (APC) automatically.
5. If required, connect the GNSS receiver to an external 12 V power supply. Use the crocodile clip cable or the Trimble custom power pack.

1. Base extension with height measurement lever
2. Standard 20 cm extension pole

Receiver with an internal 450 MHz Transmit radio on a fixed height tripod

Note – *Measuring to the measurement lever is not required when using a fixed height tripod. If the base station extension with measurement lever is used with a fixed height tripod, the height of the extension pole (0.15m (0.49ft)) should be added to the height of the fixed height tripod and the measurement method "bottom of quick release" used.*

Using a remote radio antenna with the receiver

A remote radio antenna can be used with the Trimble R10 GNSS receiver's internal 450 MHz radio. The remote antenna allows the use of a high gain antenna (country dependent) and the ability to increase the height of the radio antenna for a larger coverage area. The remote antenna cable and mount, along with the high gain antenna, is available as an accessory for the receiver (P/N 89856-00-6x Radio frequency dependent) .

Typically, the tripod and fixed height tripod methods do not give significant height clearance above the ground, and can reduce the range of operation caused by radio limitations.

Connecting remote radio antenna cable to the receiver

Receiver with a remote radio antenna

Using an external radio with the receiver

An external radio can be used with the Trimble R10 GNSS receiver. Using a high powered UHF radio will increase the radio coverage area. The external radio data cable is connected to Port 1 (Serial) on the receiver.

Outputting corrections using a TDL450/HPB450 radio-modem

The TDL450/HPB450 radio comes with a 5-pin Lemo to 7-pin Lemo connector with a power connection lead:

1. Connect the 7-pin Lemo connector to the serial port (Port 1) on the receiver.
2. Connect the 5-pin Lemo connector to the TDL450/HPB450 radio.
3. Connect the DC power lead to an external power source.
4. Turn on the TDL450/HPB450 radio.

To configure the system, do one of the following:

- Use the Trimble Access software to connect to the receiver. Set up the base station with the external radio. The Trimble Access software will locate the TDL450/HPB450 radio and then allow you to set the radio channel.
- Use the web interface to configure the settings. Select *I/O Configuration* / *Port Configuration*. Select the *Serial 1 / Lemo* option and select corrections to be sent on the Lemo port at those baud rate settings (the TDL450/HPB450 serial interface is shipped with the default rates 38400 8/N/1).

Configuration software accompanies the TDL450/HPB450 radio if you need to change the serial connection baud rate.

CHAPTER

3

Rover Setup and Operation

In this chapter:

Rover operation guidelines

Real-Time Kinematic (RTK) operation provides centimeter-level precision by eliminating errors that are present in the GNSS system. For all RTK operations, you require both a rover receiver and a source of corrections from a base station or network of base stations.

This topic introduces the concept of rover operation, provides information to help you identify good setup locations, describes best practices for setting up the equipment, and outlines the precautions that you need to take to protect the equipment.

The second part of the RTK GNSS system is the rover receiver. The rover receiver is moved between the points that require measurement or stakeout. The rover receiver is connected to a base station or to a source of RTK corrections such as a VRS system. The connection is provided by:

- an integrated radio
- an integrated cellular modem
- an integrated Wi-Fi module
- a cellular modem in the controller

In most rover applications, the receiver operates entirely from its own integrated battery unit. However, you can use an external power supply if one is provided. The internal battery then acts as an uninterruptible power supply, covering any external power failures.

For good rover operation, observe the following setup guidelines:

- Place the GNSS antenna in a location that has a clear line of sight to the sky in all directions. Do not place the antenna near vertical obstructions such as buildings, deep cuttings, site vehicles, towers, or tree canopy. GNSS rovers and the base station receive the same satellite signals from the same satellites. The system needs five common satellites to provide RTK positioning.

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

  WARNING – Take care not to touch overhead power lines with the Trimble R10 GNSS receiver or the range pole when moving the equipment into position. Touching overhead power lines may cause electrocution, leading to serious injury.

- GNSS satellites are constantly moving. Because you cannot measure at a specific location now does not mean that you will not be able to measure there later, when satellite coverage at the location improves. Use GNSS planning software to identify the daily best and worst satellite coverage times for your location and then choose measurement times that coincide with optimal GNSS performance. This is especially important when operating in the worst GNSS locations. You can download the Trimble Planning software from the Trimble website

(www.trimble.com/planningsoftware_ts.asp). You can also use Trimble GNSS Planning Online at www.trimble.com/GNSSPlanningOnline/#/Settings. To use online GNSS planning, may need to first install the Microsoft Silverlight® add-on for your Internet browser.

- To get a fixed position solution with centimeter precision, initialize the RTK rover receiver. For initialization to take place, the receiver must track at least five satellites that the base station is also tracking. In a dual-satellite constellation operation, for example, GPS and GLONASS, the receiver must track at least six satellites.
- To continue to survey at centimeter precisions, the rover must continuously track at least four satellites that the base station is also tracking.The radio link between the base and rover receivers must also be maintained.
- Loss of the satellite signals will result in a loss of centimeter position precision.
- If the radio link is lost, xFill takes over, which allows for centimeter precisions.

CAUTION – The Trimble R10 GNSS receiver is not suited to on-vehicle operation where it will be subject to heavy vibration, that is, operation in rough ungraded terrain. Use in these conditions can damage the receiver.

Integrated tilt sensor (eBubble)

The receiver comes with an integrated tilt sensor, which allows the use of an eBubble (electronic bubble). The eBubble is displayed within the Trimble Access software. The eBubble is displayed in a separate window for use during any aspect of your survey. To use the eBubble correctly, the TSC3 or Trimble Tablet must be aligned correctly in relationship to the receiver. When the receiver is placed on a range pole, the controller or tablet must be placed on the right or left side of the receiver with the screen of the controller or tablet in the same axis as the receiver front panel:

Calibrating the eBubble

It is very important to ensure the eBubble is correctly calibrated in the same way that mechanical bubbles are calibrated on your range poles and tribrachs. When calibrating the eBubble you must use a range pole with bi-pod or a tripod with tribrach that have been well calibrated. The quality of the eBubble calibration is directly related to the quality of the mechanic bubble and its calibration.

The eBubble calibration is performed within the Trimble Access software. To calibrate the eBubble, place the receiver on a stable range pole or tripod with tribrach. Level the receiver using the mechanical bubble on the range pole or tribrach. Turn on the receiver and TSC3 or Trimble Tablet. Run Trimble Access, then:

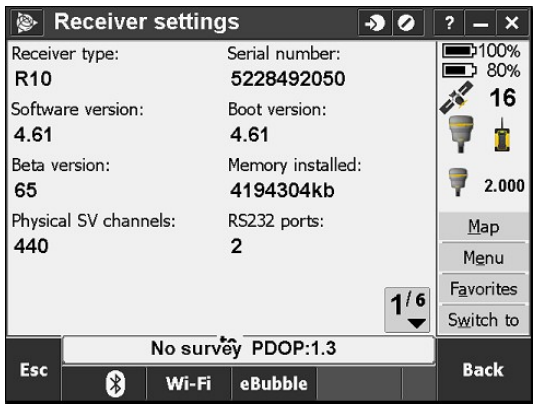
1. In the General Survey menu:

   Tap **Instrument**.

   Select *Receiver settings*.

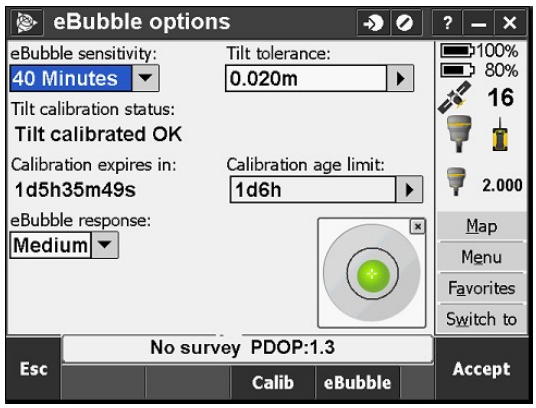
2. In the *Receiver settings* screen:

   Tap **eBubble**.



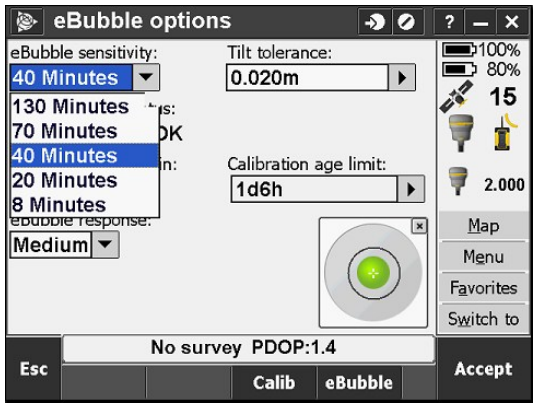
   The *eBubble options* screen is now displayed.

   Note – *An electronic bubble is displayed to indicate if you are holding the instrument level.*



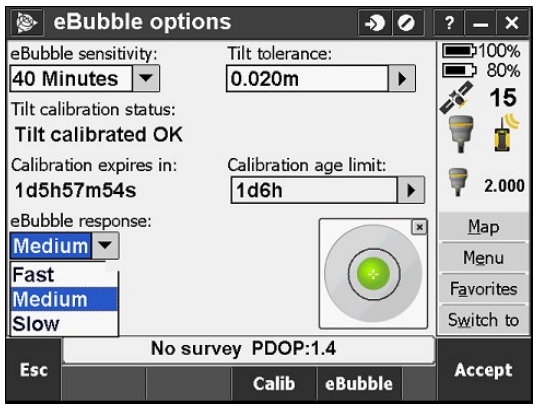
3. Edit the options by making the selections for eBubble sensitivity (in the *Calibration age limit* field), eBubble response and changing the tilt tolerance.

   Note – *For a detailed explanation of all fields in the eBubble options, refer to the Trimble Access Help (click ?).*



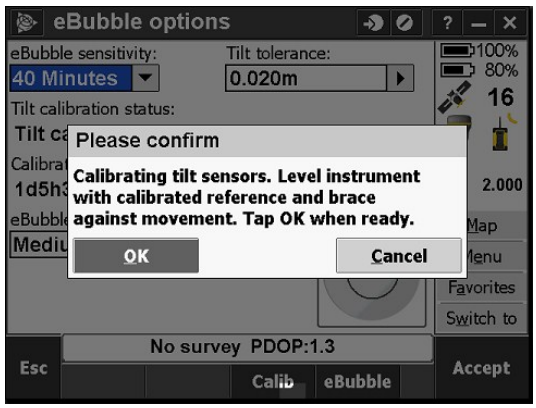
   You are now ready to perform the calibration.

   Tap **Calib**.



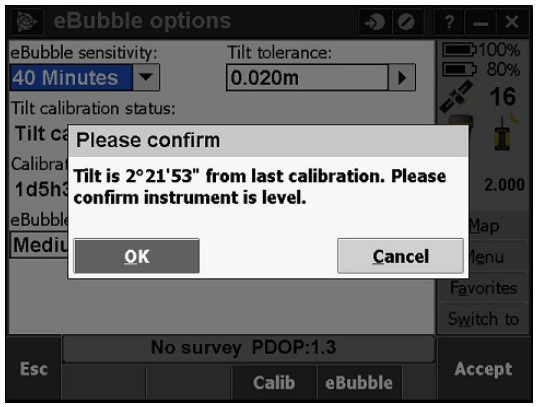
4. A message asks you to level the instrument and brace it against movement.

   Tap **OK** to confirm that you have done this.

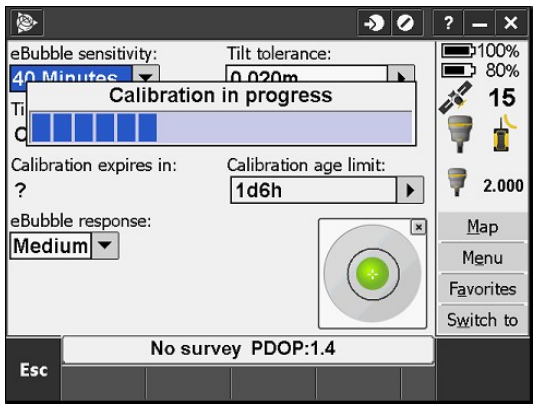


5. Another message asks you to confirm the last calibration setting and that you are level.

   Tap **OK**.



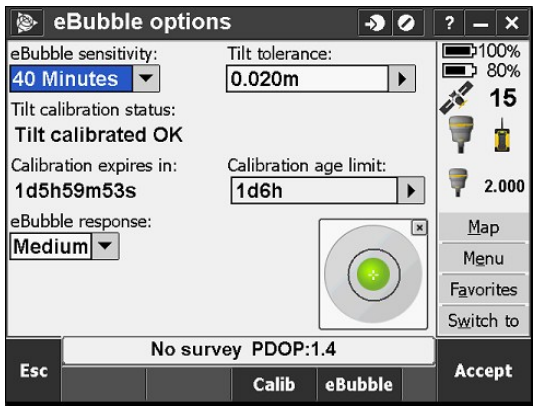
6. On the Trimble Access screen, a progress bar indicates calibration is in progress.



7. Once calibration is complete you will return to the *eBubble options* screen. You can set the *Calibration age limit* to any time period within 0 to 30 days to ensure survey crews are using a good eBubble calibration.

   Tap **Accept**.

   The eBubble calibration is complete.



Integrated cellular modem

Instead of the internal radio, you can use the integrated cellular modem as your data communications link. This will allow you to connect to VRS networks in your area. See your local Trimble representative for more information on VRS networks.

Using the integrated cellular modem requires a SIM card from your local cellular service provider. The SIM card is inserted into the SIM card slot in the battery compartment of the receiver. For more information about setting up your SIM card and cellular service in the receiver, please see your local Trimble representative.

For more information on using a cellular modem as a data link, refer to the *Trimble Access Help*.

Connecting the receiver to external devices

You can connect the receiver to the following devices:

- a Trimble controller running Trimble Access software
- an external radio-modem

Connecting to a Trimble controller running Trimble Access software

You can operate a Trimble R10 GNSS receiver with any Trimble controller, for example, a TSC3 or a Trimble Tablet. Typically, the receiver and the controller operate from their own individual power sources. The receiver and controller can communicate through Bluetooth wireless technology and can be connected without a cable. However, if a cable is required, the following table lists the cables available for the receiver.

To connect a Trimble R10 GNSS receiver to a...	Use cable P/N...	Use cable connector...	and connect the cable to the...
computer serial port	89853-00 or 59044	7-pin serial Lemo DB-9	Receiver Computer
computer USB port	89852-00 or 80751	7-pin USB Lemo USB	Receiver Computer
TSC3 or Trimble Tablet	89851-00 or 59046	DB-9 Serial Lemo	TSC Receiver
USB flash memory stick	89850-00 or 80799	7-pin USB Lemo USB flash drive	Receiver Flash drive
TDL450	66656	7-pin serial Lemo 5-pin Lemo	Receiver TDL450

Internal radio-modems

The most common data link for Real-Time Kinematic (RTK) operation is a radio. The receiver is available with the following internal radios:

- 410 MHz – 470 MHz (Transmit/Receive)

External radio-modems

If the receiver does not have an internal transmit radio, or you want to connect to a higher powered external transmit radio or cellular modem, use the Lemo serial port.

The Trimble R10 GNSS receiver supports the following Trimble base radios:

- Trimble TDL450
- Trimble SNB900

- Legacy radios such as the Trimble PDL450 radio, Trimble HPB450 radio-modem, and TRIMMARK™ 3 radio

The receiver also supports third-party transparent radios and third-party cellular modems.

To use an external radio with the receiver, you need an external power source for the radio—except for the SNB900 radio, which contains an internal battery. To configure the radio modem separately, use the external radio's configuration program, or the display and keypad.

Transferring files directly from the receiver

Data is stored in the internal flash memory. To transfer files between the receiver and an office computer, use one of the following methods.

- Lemo (Port 1) to traditional serial port and the Trimble Business Center.
- Lemo (Port 2) to USB PC connection (Trimble R10 GNSS receiver appears as a Trimble data external drive).
- Lemo (Port 2) to USB field data cable (transfer to USB flash memory stick and then plug flash memory stick into PC).
- Connect via Wi-Fi to the receiver's Web UI, then use the *Datalogging* menu to navigate to the receiver's file directory. Select the files to download to a directory on your PC, and the file format you want to download the data in (for example, RINEX).

Deleting files in the receiver

You can delete files stored in the receiver at any time. Do one of the following:

- Press  for 30 seconds after the receiver is turned on. (When you use this method, all data is deleted.)
- Use the web interface (*Data Logging* menu).

CHAPTER

4

Troubleshooting

In this chapter:

Troubleshooting receiver issues

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

The receiver does not turn on

Possible cause	Solution
External power is too low.	Check the charge on the external power supply, and check the fuse if applicable. If required, replace the battery.
Internal power is too low.	Do the following: • Check the charge on the internal batteries and replace if required. • Ensure battery contacts are clean.
External power is not properly connected.	Do the following: • Check that the Lemo connection is seated properly. • Check for broken or bent pins in the connector.
Faulty external power cable.	Do the following: • Try a different cable. • Check pinouts with multimeter to ensure internal wiring is intact.

The receiver is not tracking any satellites

Possible cause	Solution
The GNSS antenna does not have clear line of sight to the sky.	Ensure that the antenna has a clear line of sight.

The receiver does not log data

Possible cause	Solution
Insufficient memory in the internal memory.	Delete old files. Press the Power button for 30 seconds.

The receiver is not responding

Possible cause	Solution
The receiver needs a soft reset.	Turn off the receiver and then turn it back on again. For more information, see Button and LED operations, page 26
The receiver needs a full reset.	Press the Power button for 30 seconds. For more information, see Button and LED operations, page 26.

Troubleshooting LED conditions

The receiver has a simple display panel with LEDs to indicate the current status of the receiver. If you need more detailed information about what the receiver is doing, use a Trimble controller or access all configuration settings by connecting the receiver to your smart phone or laptop computer via Configuring the receiver using the Web User Interface (Web UI), page 34.

This section describes how the LED lights are used on the receiver to indicate current status. An LED that is flashing quickly indicates a condition that may require attention, and an unlit LED indicates that no operation is occurring. This section describes some LED conditions, possible causes, and how to solve them.

The SV Tracking LED is lit solidly and the Logging/Memory LED is flashing slowly

Possible cause	Solution
The receiver is in Monitor mode, ready for new firmware to be loaded or new options to be added.	Turn on or turn off the receiver. If that does not fix the problem, load the latest version of the firmware, which you can download from the Trimble website (www.trimble.com/support.shtml / <product> / *Downloads*).

The SV Tracking LED is not flashing

Possible cause	Solution
The receiver is tracking fewer than four satellites.	Wait until the SV Tracking LED is flashing slowly.

Troubleshooting base station setup and static measurement problems

This section describes some possible station setup and static measurement issues, possible causes, and how to solve them.

Trimble recommends that you use the Trimble Access software to restart or configure base and rover receivers. The Trimble Access software sets up all radio and receiver operating parameters, and is the most likely route to a successful problem resolution once you have checked all connections, cables, and batteries.

The roving receiver is not receiving radio from the base station

Possible cause	Solution
The base station is not broadcasting.	See "Base station is not broadcasting" below.
Incorrect over air baud rates between base station and rover.	Connect to the roving receiver's radio and make sure that it has the same setting as the base station receiver.
Mismatched channel or network number selection.	Match the base station and rover radio channels/network number and try again.
Incorrect port settings between the rover external radio and receiver.	If the radio is receiving data (the Radio LED is flashing) and the receiver is not receiving data, check the port settings of the receiver and radio using the Trimble Access software; match the settings and try again.

The base station is not broadcasting

Possible cause	Solution
Port settings between base receiver and external radio are incorrect. ***Note –*** *The Trimble R10 GNSS receiver has the option for an integrated Tx radio that allows it to be used without an external radio at the base and rover location. The receiver can also be connected to an external high power radio in certain countries.*	Use Trimble Access software to connect to the radio through the receiver. If no connection is made, connect directly to the radio and change the port settings. Try to connect through the receiver again to ensure that they are communicating. ***Note –*** *Trimble Access software does not support direct connection to the external radio; it only allows configuration through the receiver.*
Faulty cable between receiver and external radio.	Do one of the following: • Try a different cable

Possible cause	Solution
	• Examine the ports for missing pins • Use a multimeter to check the pins

CHAPTER

5

Specifications

In this chapter:

Measurements

- Advanced Trimble Maxwell™ 6 Custom Survey GNSS chips with 440 channels
- Satellite signals tracked simultaneously:
  - GPS: L1C/A, L1C, L2C, L2E, L5
  - GLONASS: L1C/A, L1P, L2C/A, L2P, L3
  - SBAS: L1C/A, L5 (For SBAS satellites that support L5)
  - Galileo: E1, E5a, E5B
  - COMPASS: B1, B2, B3
  - OmniSTAR HP, XP, G2, VBS positioning
  - QZSS, WAAS, MSAS, EGNOS, GAGAN
- Very low noise GNSS carrier phase measurements with <1 mm precision in a 1 Hz bandwidth
- Signal-to-noise ratios reported in dB-Hz
- Proven Trimble low elevation tracking technology
- Positioning Rates: 1 Hz, 2 Hz, 5 Hz, 10 Hz, and 20 Hz

Positioning performance

Note – *Precision and reliability may be subject to anomalies due to multipath, obstructions, satellite geometry, and atmospheric conditions. The specifications stated recommend the use of stable mounts in an open sky view, EMI and multipath clean environment, optimal GNSS constellation configurations, along with the use of survey practices that are generally accepted for performing the highest-order surveys for the applicable application including occupation times appropriate for baseline length. Baselines longer than 30 km require precise ephemeris and occupations up to 24 hours may be required to achieve the high precision static specification.*

Code differential GNSS positioning

Horizontal.....+/-0.25 m + 1 ppm RMS

Vertical.....+/-0.5m + 1 ppm RMS

SBAS differential .....typically <5 m 3DRMS

Note – *SBAS differential performance depends on WAAS/EGNOS system performance.*

Static GNSS surveying

High Precision Static

Horizontal.....+/-3 mm + 0.1 ppm RMS

Vertical.....+/-3.5 mm + 0.4 ppm RMS

Static and Fast Static

Horizontal.....+/-3 mm + 0.5 ppm RMS

Vertical.....+/-5 mm + 0.5 ppm RMS

Real Time Kinematic surveying

Single Baseline <30 km

Horizontal.....+/-8 mm + 1 ppm RMS

Vertical.....+/-15 mm + 1 ppm RMS

Network RTK

Horizontal.....+/-8 mm + 0.5 ppm RMS

Vertical.....+/-15 mm + 0.5 ppm RMS

RTK Start-up time for specified precisions.....typically <8 seconds

RTK position reliability.....typically >99.9%

Note – *Network RTK PPM values are referenced to the closest physical base station. RTK precision times may be affected by atmospheric conditions, signal multipath, obstructions and satellite geometry. Positioning reliability is continuously monitored to ensure highest quality.*

Trimble xFill

Horizontal ..... RTK + 10 mm/minute RMS

Vertical..... RTK + 20 mm/minute RMS

Note – *Precisions are dependent on GNSS satellite availability. xFill positioning ends after 5 minutes of radio downtime. When using a single base station, xFill requires the location of the base antenna to be within 2 meters of the base coordinate in a known global reference frame such as WGS-84. When establishing a single base station using the "Here" key in Trimble Access, the required accuracy is usually only achieved when the position is augmented with WAAS or EGNOS. VRS subscribers should check with their network administrator that the network is setup in a*

known coordinate system. RTK refers to the reported precision when the correction source is lost and xFill starts.

Hardware

Physical

Dimensions (diameter x height)	11.9 cm x 13.6 cm (4.6 in x 5.4 in)
Weight	1.12 kg (2.49 lb) with internal battery, internal radio with UHF antenna
	3.57 kg (7.86 lb) items above plus range pole, controller & bracket
Temperature	
Operating	-40 °C to +65 °C (-40 °F to +149 °F)
Storage	-40 °C to +75 °C (-40 °F to +167 °F)
	Note – *Receiver will operate normally to –40 °C, internal batteries are rated to –20 °C.*
Humidity	100%, condensing
Ingress protection	IP67 dustproof, protected from temporary immersion to depth of 1 m (3.28 ft)
Shock and vibration	Tested and meets the following environmental standards:
Shock	Non-operating: Designed to survive a 2 m (6.6 ft) pole drop onto concrete. Operating: to 40 G, 10 msec, sawtooth
Vibration	MIL-STD-810F, FIG.514.5C-1

Electrical

Voltage	11 to 24 V DC external power input with over-voltage protection on Port 1 and Port 2 (7-pin Lemo)
Battery	Rechargeable, removable 7.4 V, 3.7 Ah Lithium-Ion smart battery with LED status indicators
Power consumption	5.1 Watts in RTK rover mode with internal radio
	Operating times on internal battery:
	450 MHz receive only option — 5.5 hours
	450 MHz receive/transmit option (0.5 watts) — 4.5 hours
	450 MHz receive/transmit option (2.0 watts) — 3.7 hours
	Cellular receive option — 5 hours
	Note – *Operating times vary with temperature and wireless data rate. When using a receiver and internal radio in transmit mode, Trimble recommends using an external 6 Ah or higher battery.*

GNSS antenna

Ultra compact Trimble Zephy technology

Type.....Dual 4 Point Feed

Polarization.....Right-hand circular

Axial Ratio.....2 dB at zenith

Low Noise Amplifier.....advanced multi-stage tuned for all GNSS

Integrated level sensor

Accuracy.....+/- 0.01° horizontal axis

Resolution.....0.014°

Range.....+/- 20° from horizontal

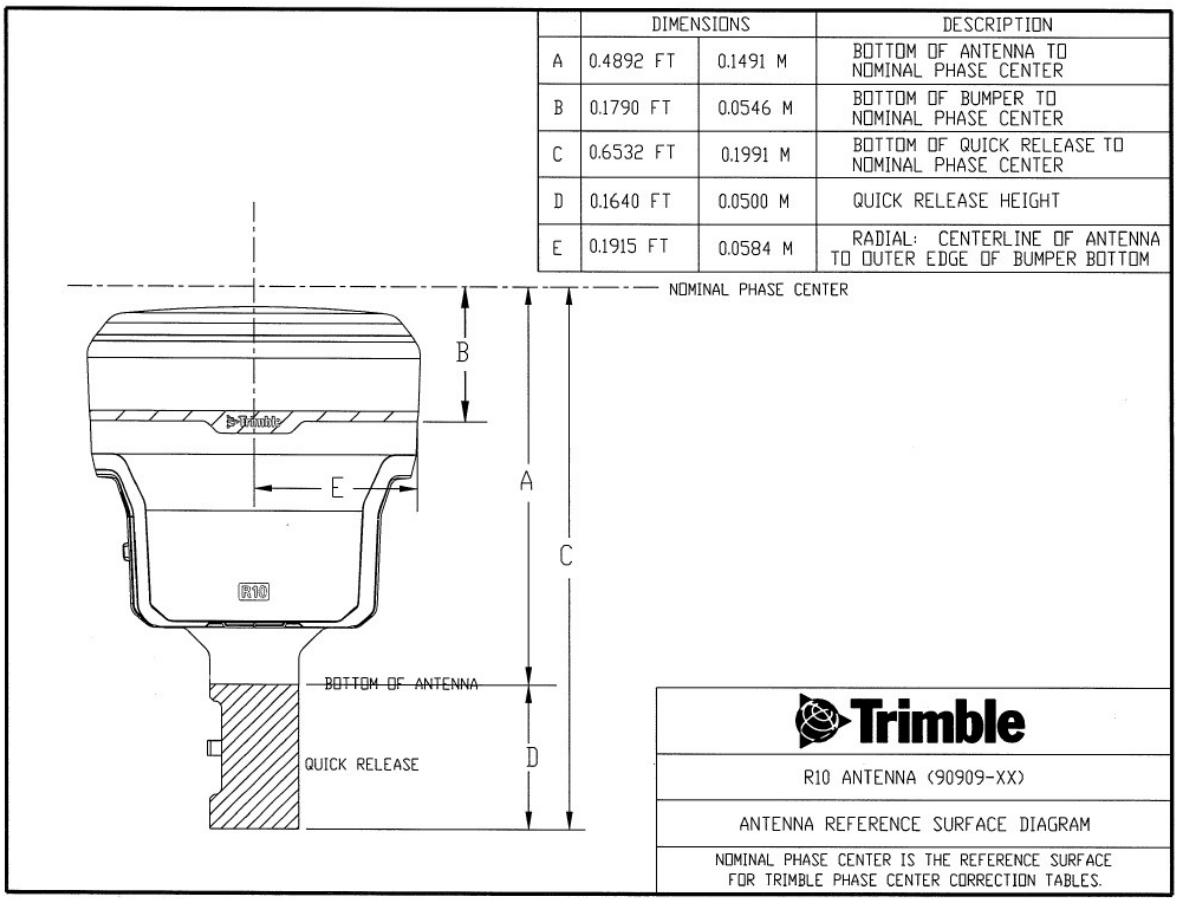
Maximum Update Rate.....50Hz

Communications and data storage

- Serial – 3-wire serial (7-pin Lemo)
- USB – Supports data download and high speed communications
- Radio modem – Integrated, sealed, 450 MHz wide band receiver/transmitter with Frequency Range of 410 – 470MHz, Transmit power of 2 Watts maximum, Range: 3-5 km typical /10 km optimal. Varies with terrain and operating conditions.
- Cellular – Integrated, 3.5G modem, HSDPA 7.2 Mbps (Download), GPRS multi-slot class 12, EDGE multi-slot class 12, UMTS/HSDPA (WCDMA/FDD) 850/1900/2100MHz, Quad-band EGSM 850/900/1800/1900 MHz, GSM CSD, 3GPP LTE
- Bluetooth – Fully integrated, fully sealed 2.4 GHz communications port

  Note – *Bluetooth type approvals are country-specific.*
- Wi-Fi – 802.11 b,g, access point and client mode, WEP64/WEP128 encryption
- External communication devices for corrections supported on: Serial, USB, Ethernet, and Bluetooth ports
- Data storage – 4 GB internal memory: over three years of raw observables (approx.. 1.4 MB / Day), based on recording every 15 seconds from an average of 14 satellites
- CMR, CMR+, CMRx, RTCM 2.1, RTCM 2.2, RTCM 2.3, RTCM 3.0, RTCM 3.1 Input and Output
- 24 NMEA outputs, GSOF, RT17 and RT27 outputs

Antenna phase center offsets

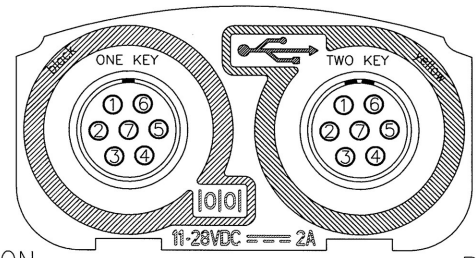


Pinout information

Port 1 is a 7-pin 0-shell Lemo connector that supports RS-232 communications and external power input. Port 1 has no power outputs.

Port 2 is a 7-pin 0-shell Lemo connector that allows for USB 2.0 communications and external power input.

PIN OUTS
VIEW LOOKING AT CONNECTORS
ON R10 RECEIVER



PIN	FUNCTION
1	GROUND (–)
2	GROUND (–)
3	TX DATA (OUTPUT)
4	RTS (OUTPUT)
5	CTS (INPUT)
6	POWER (+)
7	RX DATA (INPUT)

|O|O|

PIN	FUNCTION
1	GROUND (–)
2	GROUND (–)
3	VBUS
4	D–
5	D+
6	POWER (+)
7	ID

Glossary

1PPS	Pulse-per-second. Used in hardware timing. A pulse is generated in conjunction with a time stamp. This defines the instant when the time stamp is applicable.
almanac	A file that contains orbit information on all the satellites, clock corrections, and atmospheric delay parameters. The almanac is transmitted by a GNSS satellite to a GNSS receiver, where it facilitates rapid acquisition of GNSS signals when you start collecting data, or when you have lost track of satellites and are trying to regain GNSS signals. The orbit information is a subset of the ephemeris/ephemerides data.
base station	Also called *reference station*. In construction, a base station is a receiver placed at a known point on a jobsite that tracks the same satellites as an RTK rover, and provides a real-time differential correction message stream through radio to the rover, to obtain centimeter level positions on a continuous real-time basis. A base station can also be a part of a virtual reference station network, or a location at which GNSS observations are collected over a period of time, for subsequent postprocessing to obtain the most accurate position for the location.
broadcast server	An Internet server that manages authentication and password control for a network of VRS servers, and relays VRS corrections from the VRS server that you select.
carrier	A radio wave having at least one characteristic (such as frequency, amplitude, or phase) that can be varied from a known reference value by modulation.
carrier frequency	The frequency of the unmodulated fundamental output of a radio transmitter. The GPS L1 carrier frequency is 1575.42 MHz.
carrier phase	Is the cumulative phase count of the GPS or GLONASS carrier signal at a given time.
cellular modems	A wireless adaptor that connects a laptop computer to a cellular phone system for data transfer. Cellular modems, which contain their own antennas, plug into a PC Card slot or into the USB port of the computer and are available for a variety of wireless data services such as GPRS.
CMR/CMR+	Compact Measurement Record. A real-time message format developed by Trimble for broadcasting corrections to other Trimble receivers. CMR is a more efficient alternative to RTCM.
CMRx	A real-time message format developed by Trimble for transmitting more satellite corrections resulting from more satellite signals, more constellations, and more satellites. Its compactness means more repeaters can be used on a site.
Compass	The BeiDou Navigation Satellite System (Compass) is a Chinese satellite navigation system. The first BeiDou system (known as BeiDou-1), consists of three satellites and has

	limited coverage and applications. It has been offering navigation services mainly for customers in China and from neighboring regions since 2000. The second generation of the system (known as Compass or BeiDou-2) consists of 35 satellites. It became operational with coverage of China in December 2011 with 10 satellites in use. It is planned to offer services to customers in Asia-Pacific region by 2012 and the global system should be finished by 2020.
covariance	A statistical measure of the variance of two random variables that are observed or measured in the same mean time period. This measure is equal to the product of the deviations of corresponding values of the two variables from their respective means.
datum	Also called *geodetic datum*. A mathematical model designed to best fit the geoid, defined by the relationship between an ellipsoid and, a point on the topographic surface, established as the origin of the datum. World geodetic datums are typically defined by the size and shape of an ellipsoid and the relationship between the center of the ellipsoid and the center of the earth. Because the earth is not a perfect ellipsoid, any single datum will provide a better model in some locations than in others. Therefore, various datums have been established to suit particular regions. For example, maps in Europe are often based on the European datum of 1950 (ED-50). Maps in the United States are often based on the North American datum of 1927 (NAD-27) or 1983 (NAD-83). All GPS coordinates are based on the WGS-84 datum surface.
deep discharge	Withdrawal of all electrical energy to the end-point voltage before the cell or battery is recharged.
DGPS	See real-time differential GPS.
differential correction	Differential correction is the process of correcting GNSS data collected on a rover with data collected simultaneously at a base station. Because the base station is on a known location, any errors in data collected at the base station can be measured, and the necessary corrections applied to the rover data. Differential correction can be done in real-time, or after the data is collected by postprocessing.
differential GPS	See real-time differential GPS.
DOP	Dilution of Precision. A measure of the quality of GNSS positions, based on the geometry of the satellites used to compute the positions. When satellites are widely spaced relative to each other, the DOP value is lower, and position precision is greater. When satellites are close together in the sky, the DOP is higher and GNSS positions may contain a greater level of error. PDOP (Position DOP) indicates the three-dimensional geometry of the satellites. Other DOP values include HDOP (Horizontal DOP) and VDOP (Vertical DOP), which indicate the precision of horizontal measurements (latitude and longitude) and vertical measurements respectively. PDOP is related to HDOP and VDOP as follows: $PDOP^2 = HDOP^2 + VDOP^2$.

dual-frequency GPS	A type of receiver that uses both L1 and L2 signals from GPS satellites. A dual-frequency receiver can compute more precise position fixes over longer distances and under more adverse conditions because it compensates for ionospheric delays.
EGNOS	European Geostationary Navigation Overlay Service. A Satellite-Based Augmentation System (SBAS) that provides a free-to-air differential correction service for GNSS. EGNOS is the European equivalent of WAAS, which is available in the United States.
elevation mask	The angle below which the receiver will not track satellites. Normally set to 10 degrees to avoid interference problems caused by buildings and trees, atmospheric issues, and multipath errors.
ellipsoid	An ellipsoid is the three-dimensional shape that is used as the basis for mathematically modeling the earth's surface. The ellipsoid is defined by the lengths of the minor and major axes. The earth's minor axis is the polar axis and the major axis is the equatorial axis.
EHT	Height above ellipsoid.
ephemeris/ephemerides	A list of predicted (accurate) positions or locations of satellites as a function of time. A set of numerical parameters that can be used to determine a satellite's position. Available as broadcast ephemeris or as postprocessed precise ephemeris.
epoch	The measurement interval of a GNSS receiver. The epoch varies according to the measurement type: for real-time measurement it is set at one second; for postprocessed measurement it can be set to a rate of between one second and one minute. For example, if data is measured every 15 seconds, loading data using 30-second epochs means loading every alternate measurement.
feature	A feature is a physical object or event that has a location in the real world, which you want to collect position and/or descriptive information (attributes) about. Features can be classified as surface or non-surface features, and again as points, lines/break lines, or boundaries/areas.
firmware	The program inside the receiver that controls receiver operations and hardware.
Galileo	Galileo is a GNSS system built by the European Union and the European Space Agency. It is complimentary to GPS and GLONASS.
GHT	Height above geoid.
GLONASS	Global Orbiting Navigation Satellite System. GLONASS is a Soviet space-based navigation system comparable to the American GPS system. The operational system consists of 21 operational and 3 non-operational satellites in 3 orbit planes.
GNSS	Global Navigation Satellite System.
GSOF	General Serial Output Format. A Trimble proprietary message format.
HDOP	Horizontal Dilution of Precision. HDOP is a DOP value that indicates the precision

	of horizontal measurements. Other DOP values include VDOP (vertical DOP) and PDOP (Position DOP). Using a maximum HDOP is ideal for situations where vertical precision is not particularly important, and your position yield would be decreased by the vertical component of the PDOP (for example, if you are collecting data under canopy).
IBSS	Internet Base Station Service. This Trimble service makes the setup of an Internet-capable receiver as simple as possible. The base station can be connected to the Internet (cable or wirelessly). To access the distribution server, the user enters a password into the receiver. To use the server, the user must have a Trimble Connected Community site license.
L1	The primary L-band carrier used by GPS and GLONASS satellites to transmit satellite data.
L2	The secondary L-band carrier used by GPS and GLONASS satellites to transmit satellite data.
L2C	A modernized code that allows significantly better ability to track the L2 frequency.
L5	The third L-band carrier used by GPS satellites to transmit satellite data. L5 will provide a higher power level than the other carriers. As a result, acquiring and tracking weak signals will be easier.
Mountpoint	Every single NTripSource needs a unique mountpoint on an NTripCaster. Before transmitting GNSS data to the NTripCaster, the NTripServer sends an assignment of the mountpoint.
MSAS	MTSAT Satellite-Based Augmentation System. A Satellite-Based Augmentation System (SBAS) that provides a free-to-air differential correction service for GNSS. MSAS is the Japanese equivalent of WAAS, which is available in the United States.
multipath	Interference, similar to ghosts on an analog television screen, that occurs when GNSS signals arrive at an antenna having traversed different paths. The signal traversing the longer path yields a larger pseudorange estimate and increases the error. Multiple paths can arise from reflections off the ground or off structures near the antenna.
NMEA	National Marine Electronics Association. NMEA 0183 defines the standard for interfacing marine electronic navigational devices. This standard defines a number of 'strings' referred to as NMEA strings that contain navigational details such as positions. Most Trimble GNSS receivers can output positions as NMEA strings.
NTrip Protocol	Networked Transport of RTCM via Internet Protocol (NTrip) is an application-level protocol that supports streaming Global Navigation Satellite System (GNSS) data over the Internet. NTrip is a generic, stateless protocol based on the Hypertext Transfer Protocol (HTTP). The HTTP objects are extended to GNSS data streams.
NTripCaster	The NTripCaster is basically an HTTP server supporting a subset of HTTP

	request/response messages and adjusted to low-bandwidth streaming data. The NTripCaster accepts request messages on a single port from either the NTripServer or the NTripClient. Depending on these messages, the NTripCaster decides whether there is streaming data to receive or to send. Trimble NTripCaster integrates the NTripServer and the NTripCaster. This port is used only to accept requests from NTripClients.
NTripClient	An NTripClient will be accepted by and receive data from an NTripCaster, if the NTripClient sends the correct request message (TCP/UDP connection to the specified NTripCaster IP and listening port).
NTripServer	The NTripServer is used to transfer GNSS data of an NTripSource to the NTripCaster. An NTripServer in its simplest setup is a computer program running on a PC that sends correction data of an NTripSource (for example, as received through the serial communication port from a GNSS receiver) to the NTripCaster. The NTripServer - NTripCaster communication extends HTTP by additional message formats and status codes.
NTripSource	The NTripSources provide continuous GNSS data (for example, RTCM-104 corrections) as streaming data. A single source represents GNSS data referring to a specific location. Source description parameters are compiled in the source-table.
OmniSTAR	The OmniSTAR HP/XP service allows the use of new generation dual-frequency receivers with the OmniSTAR service. The HP/XP service does not rely on local reference stations for its signal, but utilizes a global satellite monitoring network. Additionally, while most current dual-frequency GNSS systems are accurate to within a meter or so, OmniSTAR with XP is accurate in 3D to better than 30 cm.
PDOP	Position Dilution of Precision. PDOP is a DOP value that indicates the precision of three-dimensional measurements. Other DOP values include VDOP (vertical DOP) and HDOP (Horizontal Dilution of Precision). Using a maximum PDOP value is ideal for situations where both vertical and horizontal precision are important.
POE	Power Over Ethernet. Provides DC power to the receiver using an Ethernet cable.
postprocessing	Postprocessing is the processing of satellite data after it is collected, in order to eliminate error. This involves using computer software to compare data from the rover with data collected at the base station.
QZSS	Quasi-Zenith Satellite System. A Japanese regional GNSS eventually consisting of three geosynchronous satellites over Japan.
real-time differential GPS	Also known as *real-time differential correction* or *DGPS*. Real-time differential GPS is the process of correcting GPS data as you collect it. Corrections are calculated at a base station and then sent to the receiver through a radio link. As the rover receives the position it applies the corrections to give you a very accurate position in the field.

	Most real-time differential correction methods apply corrections to code phase positions. While DGPS is a generic term, its common interpretation is that it entails the use of single-frequency code phase data sent from a GNSS base station to a rover GNSS receiver to provide sub-meter position precision. The rover receiver can be at a long range (greater than 100 kms (62 miles)) from the base station.
rover	A rover is any mobile GNSS receiver that is used to collect or update data in the field, typically at an unknown location.
Roving mode	Roving mode applies to the use of a rover receiver to collect data, stakeout, or control earthmoving machinery in real time using RTK techniques.
RTCM	Radio Technical Commission for Maritime Services. A commission established to define a differential data link for the real-time differential correction of roving GNSS receivers. There are three versions of RTCM correction messages. All Trimble GNSS receivers use Version 2 protocol for single-frequency DGPS type corrections. Carrier phase corrections are available on Version 2, or on the newer Version 3 RTCM protocol, which is available on certain Trimble dual-frequency receivers. The Version 3 RTCM protocol is more compact but is not as widely supported as Version 2.
RTK	real-time kinematic. A real-time differential GPS method that uses carrier phase measurements for greater precision.
SBAS	Satellite-Based Augmentation System. SBAS is based on differential GPS, but applies to wide area (WAAS/EGNOS/MSAS) networks of reference stations. Corrections and additional information are broadcast using geostationary satellites.
signal-to-noise ratio	SNR. The signal strength of a satellite is a measure of the information content of the signal, relative to the signal's noise. The typical SNR of a satellite at 30° elevation is between 47 and 50 dBHz.
skyplot	The satellite skyplot confirms reception of a differentially corrected GNSS signal and displays the number of satellites tracked by the GNSS receiver, as well as their relative positions.
SNR	See signal-to-noise ratio.
Source-table	The NTripCaster maintains a source-table containing information on available NTripSources, networks of NTripSources, and NTripCasters, to be sent to an NTripClient on request. Source-table records are dedicated to one of the following: • data STReams (record type STR) • CASters (record type CAS) • NETworks of data streams (record type NET) All NTripClients must be able to decode record type STR. Decoding types CAS and

	NET is an optional feature. All data fields in the source-table records are separated using the semicolon character.
triple frequency GPS	A type of receiver that uses three carrier phase measurements (L1, L2, and L5).
UTC	Universal Time Coordinated. A time standard based on local solar mean time at the Greenwich meridian.
VRS	Virtual Reference Station. A VRS system consists of GNSS hardware, software, and communication links. It uses data from a network of base stations to provide corrections to each rover that are more accurate than corrections from a single base station. To start using VRS corrections, the rover sends its position to the VRS server. The VRS server uses the base station data to model systematic errors (such as ionospheric noise) at the rover position. It then sends RTCM correction messages back to the rover.
WAAS	Wide Area Augmentation System. WAAS was established by the Federal Aviation Administration (FAA) for flight and approach navigation for civil aviation. WAAS improves the accuracy and availability of the basic GNSS signals over its coverage area, which includes the continental United States and outlying parts of Canada and Mexico. The WAAS system provides correction data for visible satellites. Corrections are computed from ground station observations and then uploaded to two geostationary satellites. This data is then broadcast on the L1 frequency, and is tracked using a channel on the GNSS receiver, exactly like a GNSS satellite. Use WAAS when other correction sources are unavailable, to obtain greater accuracy than autonomous positions. For more information on WAAS, refer to the FAA website at http://gps.faa.gov. The EGNOS service is the European equivalent and MSAS is the Japanese equivalent of WAAS.
WGS-84	World Geodetic System 1984. Since January 1987, WGS-84 has superseded WGS-72 as the datum used by GPS. The WGS-84 datum is based on the ellipsoid of the same name.