TRIMBLE R2

GNSS Receiver

USER GUIDE

Version 5.22
Revision G
March 2020

Trimble

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This is the March 2020 release (Revision G) of the Trimble R2 receiver documentation.

Limited Warranty Terms and Conditions

Product Limited Warranty

Subject to the terms and conditions set forth herein, Trimble Inc. (“Trimble”) warrants that for a period of 1 year from date of purchase this Trimble product (the “Product”) will substantially conform to Trimble's publicly available specifications for the Product and that the hardware and any storage media components of the Product will be substantially free from defects in materials and workmanship.

Product Software

Product software, whether built into hardware circuitry as firmware, provided as a standalone computer software product, embedded in flash memory, or stored on magnetic or other media, is licensed solely for use with or as an integral part of the Product and is not sold. The terms of the end user license agreement, as included below, govern the use of the Product Software, including any differing limited warranty terms, exclusions and limitations, which shall control over the terms and conditions set forth in the limited Product warranty.

Warranty Remedies

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

How to Obtain Warranty Service

To obtain warranty service for the Product, please contact your Trimble dealer. Alternatively, you may contact Trimble to request warranty service at +1-408-481-6940 (24 hours a day) or email your request to trimble_support@trimble.com. Please be prepared to provide:

–your name, address, and telephone numbers;

–proof of purchase;

–a copy of this Trimble warranty

–a description of the nonconforming Product including the model number; and

–an explanation of the problem.

The customer service representative may need additional information from you depending on the nature of the problem.

Warranty Exclusions and Disclaimer

This Product limited warranty shall only apply in the event and to the extent that (i) the Product is properly and correctly installed, configured, interfaced, maintained, stored, and

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

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

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

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:

– Reorient or relocate the receiving antenna.

– 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 digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus as set out in the radio interference regulations of the Canadian Department of Communications. This Category II radiocommunication device complies with Industry Canada Standard RSS-310.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de Classe B prescrites dans le règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada. Ce dispositif de radiocommunication de catégorie II respecte la norme CNR-310 d'Industrie Canada.

Europe

This product has been tested and found to comply with the essential requirements for a Class B device pursuant to European Council Directive 1999/5/EC on R&TTE on EMC, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA). 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 band is not harmonised across the European Community.

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 RCM 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

Brazil

GSM/GPRS technologies will not be commercialized in Brazil and the model R2 operates as RX only for 450 MHz technology.

Este produto está homologado pela ANATEL, de acordo com os procedimentos regulamentados pela Resolução 242/2000, e atende aos requisitos técnicos aplicados.

Este equipamento opera em caráter secundário, isto é, não tem direito a proteção contra interferências prejudicial, mesmo de estações do mesmo tipo, e não pode causar interferência a sistemas operando em caráter primário.

Para maiores informações, consulte o site da ANATEL www.anatel.gov.br.

Modelo CBSMA-110A

ANATEL
Agência Nacional de Telecomunicações

0757-13-6140

(01)07898948526149

Waste Electrical and Electronic Equipment (WEEE)

For product recycling instructions and more information, please go to www.trimble.com/Corporate/Environmental_Compliance.aspx.

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 B.V. & Trimble International B.V.

Industrieweg 187a

5683 CC Best

The Netherlands

FCC Declaration of Conformity

We, Trimble Inc.

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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

RTTE Compliance statements

Czech	Trimble Inc. tímto prohlašuje, že tento (R2 GNSS přijímač) je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.
Danish	Undertegnede Trimble Inc. erklærer herved, at følgende udstyr (R2 GNSS modtager) overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF.
Dutch	Hierbij verklaart Trimble Inc. dat het toestel (R2 GNSS ontvanger) in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG.
English	Hereby, Trimble Inc., declares that this equipment (R2 GNSS receiver) is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Estonian	Käesolevaga kinnitab Trimble Inc. seadme (R2 GNSS vastuvõtja) vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.
German	Hiermit erklärt Trimble Inc., dass sich das Gerät (R2-GNSS-Empfänger) in Übereinstimmung mit den grundlegenden Anforderungen und den übrigen einschlägigen Bestimmungen der Richtlinie 1999/5/EG befindet.
Greek	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Trimble Inc. ΔΗΛΩΝΕΙ ΟΤΙ (R2 GNSS δέκτη) ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/ΕΚ.
Hungarian	Alulírott, Trimble Inc. nyilatkozom, hogy a (R2 GNSS vevő) megfelel a vonatkozó alapvetõ követelményeknek és az 1999/5/EC irányelv egyéb elõírásainak.
Finnish	Trimble Inc. vakuuttaa täten että (R2 GNSS-vastaanotin) tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
French	Par la présente Trimble Inc. déclare que l'appareil (R2 récepteur GNSS) est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE.
Icelandic	Hér með lýsir Trimble Inc. yfir því að (R2 GNSS móttakari) er í samræmi við grunnkröfur og aðrar kröfur, sem gerðar eru í tilskipun 1999/5/EC.
Italian	Con la presente Trimble Inc. dichiara che questo (Ricevitore R2 GNSS) è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Latvian	Ar šo Trimble Inc. deklarē, ka (R2 GNSS uztvērējs) atbilst Direktīvas 1999/5/EK būtiskajām prasībām un citiem ar to saistītajiem noteikumiem.
Lithuanian	Šiuo Trimble Inc. deklaruoja, kad šis (R2 GNSS imtuvas) atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.
Maltese	Hawnhekk, Trimble Inc., jiddikjara li dan (R2 GNSS riċevitur) jikkonforma mal-ħtiġijiet essenzjali u ma provvedimenti oħrajn relevanti li hemm fid-Dirrettiva 1999/5/EC.
Norwegian	Trimble Inc. erklærer herved at utstyret (R2 GNSS-mottaker) i samsvar med de grunnleggende krav og øvrige relevante krav i direktiv 1999/5/EF.
Polish	Niniejszym Trimble Inc. oświadcza, że (Odbiornik R2 GNSS jest zgodny z zasadniczymi wymogami oraz

	pozostałymi stosownymi postanowieniami Dyrektywy 1999/5/EC.
Portuguese	Trimble Inc. declara que este (Receptor GNSS R2) está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.
Slovak	Trimble Inc. týmto vyhlasuje, že (Prijímač R2 GNSS) spĺňa základné požiadavky a všetky príslušné ustanovenia Smernice 1999/5/ES.
Slovenian	Trimble Inc. izjavlja, da je ta (Sprejemnik R2 GNSS) skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 1999/5/ES.
Spanish	Por medio de la presente Trimble Inc. declara que el (R2 GNSS receptor) cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE.
Swedish	Härmed intygar Trimble Inc. att denna (R2 GNSS-mottagare) står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.

The Trimble R2 GNSS receiver integrates the Murata Bluetooth/Wi-Fi radio module, Model: LBEE1DARRC-519 , FCC ID: JUP-95807WFBT, IC: 1756A-95807WFBT.

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.

Regulations and safety

The receivers contain integral Bluetooth® wireless technology, and may also send radio signals through the antenna of an internal radio-modem, or through an externally-connected data communications radio. Regulations regarding the use of the 450 MHz radio-modems vary greatly from country to country. In some countries, the unit can be used without obtaining an end-user license. Other countries require end-user licensing. For licensing information, consult your local Trimble distribution partner. Bluetooth operates in license-free bands.

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.

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.

Operation near other radio equipment

When operating the receiver in member states of the European Union and in other counties which adhere to the EU R&TTE requirements, while in the vicinity of aeronautical radionavigation equipment operating between 2700 and 2900 MHz, or Fixed, Fixed Satellite (space to Earth), or Mobile systems operating at 4170 MHz, a minimum separation of 5 meters must be maintained between the receiver and such radio equipment.

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 20 cm (7.8 inches) of the antenna.
- *DO NOT* co-locate (place within 25 cm (9.8 inches)) the radio antenna with any other transmitting antenna.
- *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.
- The radio is using GMSK digital modulation.

For GSM radio

For your own safety, and in terms of the RF Exposure requirements of the FCC, always observe the precautions listed here.

- Always maintain a minimum separation distance of 20 cm (7.8 inches) between yourself and the radiating antenna on the receiver radio modem.
- Do not collocate (place within 20 cm) the radio antenna with any other transmitting antenna

NOTE – The optional GSM radio cannot legally be operated in Brazil.

For Bluetooth radio

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.

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 (7.8 inches) between yourself and the radiating antenna.
- Do not co-locate the antenna with any other transmitting device.

This device has been designed to operate with the antennas listed below, and having a maximum gain of 6.35 dBi. Antennas not included in this list or having a gain greater than 6.35 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

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

Approved external antennas: Trimble P/N 44085-60.

Trimble receiver internal radios have been designed to operate with the antennas listed below. Antennas not included in this list, or that have a gain greater than 5 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Trimble-approved antennas that can be used (country dependent) are:

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

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

Lithium-ion Battery safety

⚠ 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 batteries only in a Trimble battery charger, such as the dual battery charger P/N 61116-00 (black) or P/N 53018010 (grey), or the five-battery system charger P/N (yellow/grey) or another charger specified for this battery. 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.

⚠ 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.

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Introduction

- Introduction
- R2 GNSS receiver features
- Related information
- Technical support

This manual describes how to set up and use a Trimble® R2 GNSS receiver.

Even if you have used other Global Navigation Satellite System (GNSS) products before, Trimble recommends that you spend some time reading this manual to learn about the special features of your receiver.

If you are not familiar with GNSS, visit our website for an interactive look at Trimble and GNSS at www.trimble.com.

Introduction

The Trimble R2 GNSS smart antenna incorporates a GNSS antenna, receiver, Bluetooth® wireless technology, Wi-Fi, an optional internal 450 MHz radio with a receive option which can be used as a rover, and a battery in a rugged light-weight unit. The LED enables you to monitor radio reception and power. Bluetooth wireless technology provides cable-free communications between the receiver and the controller.

The R2 GNSS receiver does not have a front panel to change settings. To configure the receiver, see Configuring and using the receiver, page 30.

R2 GNSS receiver features

The R2 GNSS smart antenna has the following features:

- 8 mm +1 ppm RMS (0.026 ft +1 ppm RMS) horizontal and vertical precision when using RTK or RTX corrections
- Supported by version 2015.20 and later of the Trimble Access field software
- CenterPoint® RTX, RangePoint® RTX, ViewPoint™ RTX, and FieldPoint™ RTX ready; subscription required
- Small, lightweight design – 1.08 kg (2.38 lb) receiver only
- USB power cable included
- Fully functional out-of-the-box, with dual-frequency GNSS tracking (GPS, GLONASS, BeiDou, and Galileo)
- 220-channel GNSS tracking (all available constellations)
- Replaceable, rechargeable, smart Lithium-ion battery provides more than four hours GPS rover operation per charge
- Bluetooth wireless technology for cable-free, no-hassle operation with Trimble field software
- Power button with LED indicator for power and corrections
- 5 Hz update rate
- Operates within a VRS network or IBSS for conventional base station-free rover capability
- Integrated Bluetooth and Wi-Fi

- Four SBAS channels
- RoHS compliant

Related information

Sources of related information include the following:

- Release notes – The release notes describe new features of the product, information not included in the manuals, and any changes to the manuals. They can be downloaded from the Trimble website at www.trimble.com/Support/Support_AZ.aspx.
- Trimble training courses – Consider a training course to help you use your GNSS system to its fullest potential. For more information, go to the Trimble website at www.trimble.com/Support/Index_Training.aspx.

Technical support

If you have a problem and cannot find the information you need in the product documentation, contact your local dealer. Alternatively, go to the Support area of the Trimble website (www.trimble.com/Support.shtml). Select the product you need information on. Product updates, documentation, and any support issues are available for download.

2

Setting up the Receiver

- Parts of the R2 receiver
- Setup guidelines
- Setting up the receiver on a range pole
- Setting up the receiver on a backpack

Parts of the R2 receiver

The front panel contains the Power button, which also shows the Status LED.

The Power button controls the receiver's power on or off functions. See Button functions, page 31.

The Status LED show the status of the power and radio reception. See LED behavior, page 31.

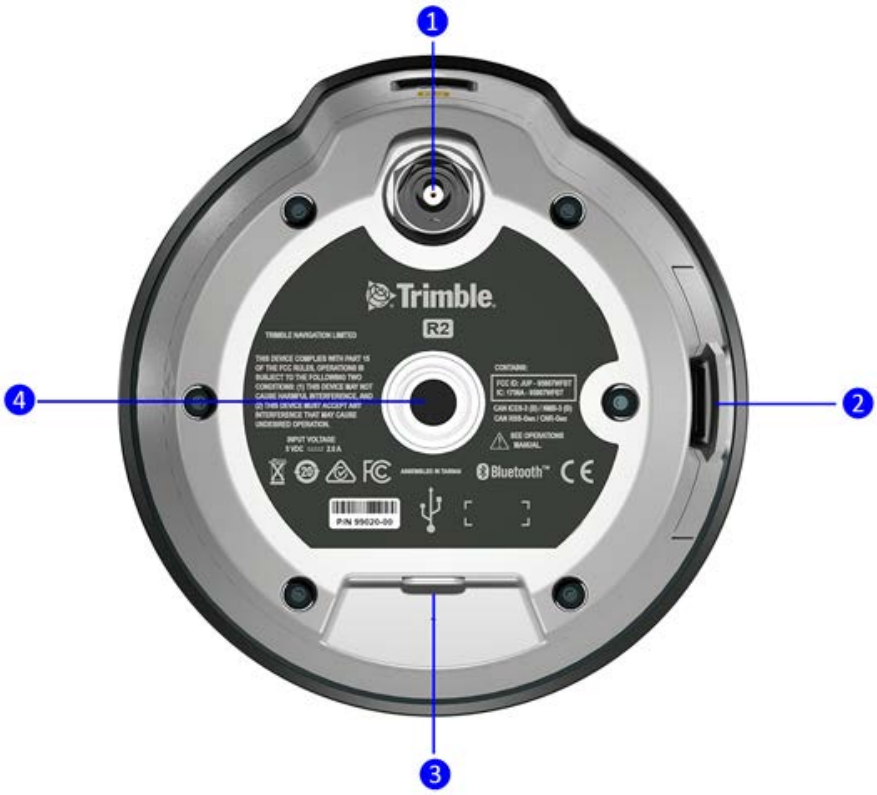
The lower housing contains:

❶ TNC radio antenna connector. Use the TNC connection for the antenna for the optional 450 MHZ UHF radio.

❷ removable battery compartment.

❸ micro USB port.

❹ ⅝-11 threaded insert.



Setup guidelines

Consider the following guidelines when setting up the receiver:

- When operating the receiver in member states of the European Union and in other counties which adhere to the EU R&TTE requirements, while in the vicinity of aeronautical radionavigation equipment operating between 2700 and 2900 MHz, or Fixed, Fixed Satellite (space to Earth) or Mobile systems operating at 4170 MHz, a minimum separation of 5 meters must be maintained between the receiver and such radio equipment.
- 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.
- 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 daily 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. From this webpage (www.trimble.com/gnssplanningonline/) you can also use Trimble GNSS Planning Online. To use online GNSS planning, you 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.
- Although the receiver has a waterproof housing, take reasonable care to protect the unit. Avoid exposure to extreme environmental conditions when operating the receiver, including:

  - Water
  - Heat greater than 55 °C (131 °F)
  - Cold less than –20 °C (–4 °F)
  - Corrosive fluids and gases
- Avoid the following sources of electrical and magnetic noise:
  - Gasoline engines (spark plugs)
  - Televisions and PC monitors
  - Alternators and generators
  - Electric motors
  - Equipment with DC-to-AC converters
  - Fluorescent lights
  - Switching power supplies

⚠ CAUTION – The Trimble R2 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.

⚠ CAUTION – To satisfy the RF Exposure requirements of the FCC, you must maintain a minimum separation distance of 20 cm (approximately 8 in.) between yourself and the radiating UHF antenna for this device. For mobile operation, the maximum gain of the UHF antenna must not exceed 5 dBi.

⚠ WARNING – These receivers use a rechargeable Lithium-ion battery. To avoid personal injury or equipment damage, ensure that you read and understand the Safety Information at the front of this manual.

Optional radio

Radios are the most common data link for Real-Time Kinematic (RTK) surveying. The receiver is available with an optional internal receive radio in the 450 MHz UHF band.

To configure the optional internal radio, use the appropriate Trimble software. For more information, refer to the documentation for your Trimble software.

Charging the receiver's battery

The receiver can be powered by its internal battery or by an external power source connected to the micro USB connector on the receiver.

To insert the internal battery:

1. Place the battery in the battery compartment, ensuring that the contact points are in the correct position to align with the contacts in the receiver:

2. Slide the battery and compartment as a unit into the receiver until the battery compartment latches are locked into position.

The rechargeable Lithium-ion battery is supplied partially charged. Charge the battery completely for 12 hours before using the device for the first time. If the battery has been stored for longer than three months, charge it before use.

Charge the Lithium-ion battery only in a Trimble batter charger, such as the dual-battery charger (P/N 53018010 - gray), or the five-battery system charger (P/N 49499-00 - yellow/gray). If there is more than one battery charging, the batteries charge sequentially and take approximately four hours each to fully charge.

⚠ 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.

⚠ 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.

To protect the battery from deep discharge (5 V or less), the receiver is designed to switch batteries or cease drawing power when the battery pack discharges to 5.9 V.

A battery that has reached the deep discharge level cannot be recharged and must be replaced. The following recommendations provide optimal performance and extend the life of your batteries:

- Fully charge all new batteries before use.
- Do not allow the batteries to discharge below 5 V.
- Keep all batteries on continuous charge when not in use. Batteries may be kept on charge indefinitely without damage to the receiver or batteries.
- Do not store batteries in the receiver or external charger unless power is applied.
- If you must store the batteries, fully charge them before storing and then recharge them at least every three months.

Battery charger

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

The Dual-Slot Charger Kit consists of:

- Charger dual-battery slot
- Power supply for charger
- Cable Kit-AC for power supply
- Charger battery slot insert

Chargeable batteries

The charger can charge the following types of batteries:

- Lithium-ion Rechargeable Battery, 2.6 Ah, 7.4 V, P/N 92600 (remove battery slot inserts to charge this type of battery. This battery is used for the Trimble R2 receiver.)
- Lithium-ion Rechargeable Battery (Smart Battery), 3.7 Ah, 7.4 V, (P/N 76767, P/N 89840-00)
- 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 R2 battery, you must remove the inserts from 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 12 V vehicle adapter for dual battery charger (P/N 89844-00, not included with the receiver kit).

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

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 you connect 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
DC Output current charger	Approx. 3.5 A
DC Power Input Voltage operation	10 V to 21 V Unit switches off if voltage is out of range
DC Power Input Voltage limits	8 V to 32 V

Power Supply	Receiver Connection
Absolute maximum input voltage	32 V
Over voltage	21 V to 32 V
Working voltage	10 V to 21 V
Under voltage charging	<10 V
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 Battery charger LED status indicator below.
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.

Battery charger 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	Clean the battery (for example, by inserting and removing

Issue	Solution
contaminated	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 the Lithium-ion battery before disposing of it. When disposing of the battery, ensure that you do so in an environmentally sensitive manner. Adhere to any local and national regulations concerning battery disposal or recycling.

Setting up the receiver on a range pole

To mount the receiver on a range pole:

1. Thread the receiver onto the range pole.

2. Attach the controller bracket to the pole.
3. Insert the controller into the controller bracket.

Setting up the receiver on a backpack

If you prefer to work free of the weight of the receiver on a pole, you can mount the receiver on a backpack.

Using the receiver mounted on a backpack is a good option if you require only sub-meter accuracy. For high accuracy or survey-grade positioning, Trimble recommends that you use the receiver on a range pole.

3

Configuring and using the receiver

- Button functions
- LED behavior
- Configuring the receiver using Wi-Fi and the Web Interface
- Configuring the receiver using Trimble software and Bluetooth wireless technology
- Configuring a PC USB port as a virtual serial port
- Configuring the receiver using the GNSS Status utility
- Logging data

The receiver has no controls to change settings.The receiver can be configured in three ways:

- using the receiver Web Interface, connected using Wi-Fi.
- using the Trimble GNSS Status utility. Any settings configured in the GNSS Status utility will override the Web Interface settings.

  NOTE – This is required for Android devices, even if you are using Trimble software.
- using Trimble software, connected using Bluetooth wireless technology or a USB connection. Any settings configured in Trimble software will override the GNSS Status utility and Web Interface settings.

When you apply the changes you have made to the receiver settings, the receiver settings change immediately.

This chapter provides a brief overview of each of these methods.

Button functions

The receiver has only one button, the **Power** button. Press the **Power** button to turn on or turn off the receiver, and to perform other functions, as described below:

To...	Press the Power button for...	LED behavior	Notes
turn off the receiver	more than 2 seconds but less than 15 seconds	Green: Off after 2 seconds. Yellow: On after 2 seconds and remains On till shutdown complete.	
clear the ephemeris file and reset the receiver to the factory defaults	more than 15 seconds but less than 30 seconds	Green: Off after 2 seconds. Yellow: On after 2 seconds and then Slow Flash after 15 seconds to indicate 15 seconds has elapsed.	If the button is released, the 15 seconds data is cleared. The yellow flash continues until the operation is complete. The receiver then enters the reboot cycle.

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.

LED behavior

The receiver has only one LED.

The LED flash rates are:

- SLOW FLASH = LED is on and off equally for 0.5 seconds.
- FAST FLASH = LED is on and off equally for 0.1 seconds.

Receiver mode	Green	Yellow	Notes
Off	Off	Off	
On - Healthy power	On	–	
Low power	–	Fast flash	
Receiver in monitor mode	Fast flash	–	
Receiving corrections	Slow flash	–	This pattern is for receiving any corrections irrespective of the source (for example, radio, TCP, Bluetooth wireless technology).
Receiving corrections and low power	Slow flash	Fast flash	Green and Yellow flash patterns will alternate every 5 seconds.
Diagnostic On (Green)	On	–	Controlled through TRIMCOMM 91h subcommand 02.
Diagnostic On (Yellow)	–	On	Controlled through TRIMCOMM 91h subcommand 03.
Diagnostic Off	Off	Off	Controlled through TRIMCOMM 91h subcommand 05.

Configuring the receiver using Wi-Fi and the Web Interface

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

Connecting via Wi-Fi

You 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 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 or 192.168.143.1.
4. If security is enabled on the receiver, you are prompted to enter a username and password. By default, the login is **admin** and the password is **password**. If you cannot connect to the receiver, the password for the admin account may have been changed, or a different account may be in use. Contact your receiver administrator for the appropriate login information.
5. The receiver web interface is displayed and the receiver is ready for real-time configuration.

   The web page on a 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).

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

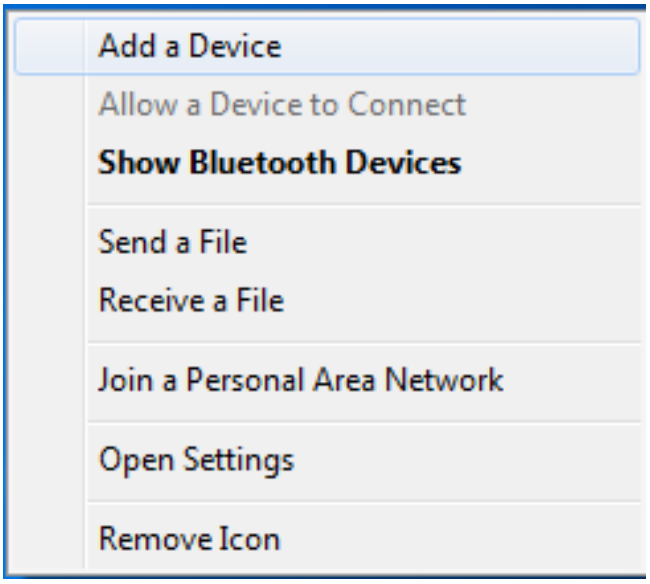
- Receiver Login: admin
- Receiver Password: password

Configuring the receiver using Trimble software and Bluetooth wireless technology

This topic describes how to connect to and configure the receiver using Trimble field software.

Step 1: Create a Bluetooth connection between the computer and the receiver

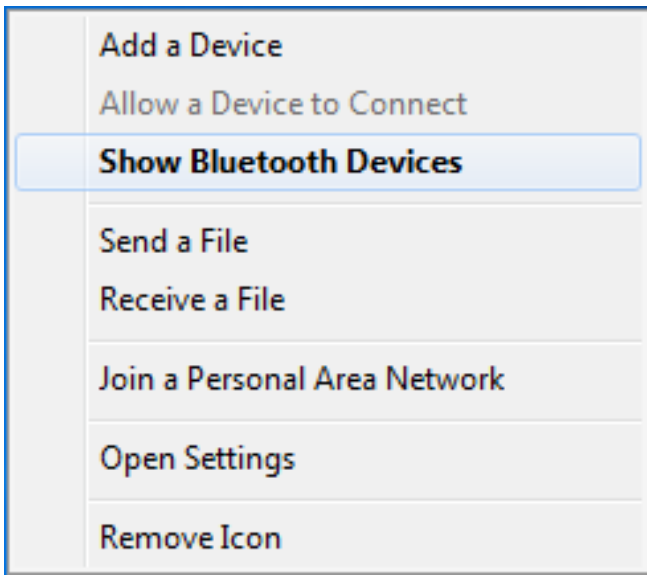
1. In the system tray (in the lower right corner of the Windows taskbar), click the Up arrow and then click the Bluetooth icon. From the shortcut menu that appears, select **Add a Device**:



2. The computer searches for Bluetooth devices. Make sure that the receiver is switched on; it will appear in the list of Bluetooth devices. Select the receiver in the list and click **Next**.
3. If prompted, select the **Enter the device's pairing code** option.

   By default, the pairing code is 0000. Enter it in the dialog and then click **Next.**
4. When the device has been successfully added, you can inspect its properties. Click on the **Devices and Printers** link in the success window.

   Alternatively, select **Show Bluetooth Devices** from the Bluetooth context menu:



   In the **Bluetooth Device** window, right-click the device and then select **Properties** from the shortcut menu.

Step 2: Configure the receiver using Trimble software

Use Trimble software (for example, Trimble TerraSync or Trimble TerraFlex software) to configure the receiver as required. For more information, refer to the user guide for the Trimble field software that you are using.

Configuring a PC USB port as a virtual serial port

It is possible to use the USB interface from a Trimble R2 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 8 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 (http://www.trimble.com/Support/Support_AZ.aspx) and search for the GNSS receiver you have. In the **Technical Support** / **Downloads** section, download the file called *Windows7 USB Installer* to your computer.

   *NOTE – There is no **Windows8 USB Installer** file; the **Windows7 USB Installer** file works for Windows 8.*

   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 – With Windows 8, the USB ports are often version 3.0. With Windows 8 there is a conflict with the implementation of USB version 3.0. To workaround this, go to the computer's BIOS settings when you start up the computer and then turn off the support for USB 3.0.

   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.

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 R2 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.

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 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 *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.

NOTE – If you are running an application such as WinFlash software or 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 using the GNSS Status utility

To configure a receiver using the Trimble GNSS Status utility, you must pair the receiver with the device that is running the GNSS Status utility, and, on Android devices, you must enable Mock Locations.

You can connect a R2 GNSS receiver to a handheld device or tablet powered by the following operating systems:

- Android versions 4.1x and later
- iOS
- Windows® 7, Windows 8.x, Windows 10
- Windows Embedded Handheld

The method for enabling Mock Locations differs for different Android devices. Generally, this is done under **Settings** / **Developer options**, **Allow mock locations**. Refer to the documentation for your device for specific instructions.

To use the GNSS Status utility with the R2 receiver:

1. Make sure the device you want to use has Bluetooth wireless technology turned on.
2. Make sure the receiver is turned on.
3. Depending on the device you want to connect the receiver to, do one of the following:
   - On a device powered by the Windows 7, 8.x, or 10 operating system, Windows Embedded Handheld 6.5, or Android versions 4.1x or later, use the GNSS Status utility to connect to the receiver.
     a. Tap GNSS Status  to launch the GNSS Status utility. The device you are using searches for receivers within range.

b. If no receiver is connected, the utility shows **Location Services**. Select **Source** from the menu. From the **Position Source** dropdown, select **Bluetooth**. If you are using a Trimble TSC7 controller or T7 tablet or Kenai™ tablet, you can also select **Internal Receiver** to use the device's internal GNSS receiver.

c. When the required receiver appears in the **Select Receiver** list, tap it, then tap **Select**.

- On an iPhone or iPad, go to **Settings** / **Bluetooth**, and tap the R2 [ID] device you want to pair with.

To reconnect to a receiver at any time, make sure it is turned on, then:

- On a device powered by the Windows 7, 8.x, or 10 operating system, Windows Embedded Handheld 6.5, or Android versions 4.1x or later, use the GNSS Status utility to connect to the receiver:

  a. Tap GNSS Status  to launch the GNSS Status utility.

  b. Tap the R2 [ID] at the bottom of the screen to bring up the **Select Receiver** list. Tap the device [R2 ID] you want to reconnect to, then tap **Select**.

- On an iPhone or iPad, go to **Settings** / **Bluetooth**, and tap the R2 [ID] device you want to connect to.

For full instructions on using the GNSS Status utility, refer to the *Trimble GNSS Status Utility User Guide*.

Using Location Services

If no receiver is connected, the GNSS Status utility shows shows **Location Services** as the **Position Source**. Once a receiver is connected, it feeds GNSS positions to Location Services. All apps and web browsers that use Location Services have access to these GNSS positions

Using the receiver with GIS software on Windows Embedded Handheld and Windows devices

Using Trimble software

For more information on using subscription service options, contact to Trimble reseller and refer to the *Licensing* section in the *Trimble GNSS Status Utility User Guide*.

If you are using Trimble software on devices powered by the Windows Embedded Handheld or Windows Desktop operating systems, you do not need to install the

GNSS Status utility. You can connect to the R2 GNSS receiver from within the software when the receiver is in Bluetooth pairing mode, as with other Trimble external receivers.

Using other software with NMEA

When using software that understands NMEA for position information, you must use the GNSS Status utility to configure the receiver to output NMEA on the correct port. Because the receiver uses Serial Port Profile (SPP) ports, and software run on a Windows device uses Windows COM ports, it is important to understand the relationship between Bluetooth Serial Port Profile ports and Windows COM ports, as described below.

Understanding the relationship between Bluetooth Serial Port Profile (SPP) ports and Windows COM ports

NOTE – This process is specific to the Windows 7 operating system; instructions are similar for Windows 8 / 8.1 and Windows 10 operating systems.

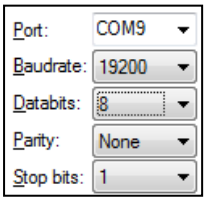
When you first connect a R2 receiver, the Windows operating system installs the appropriate drivers and associates Bluetooth Serial Port Profile (SPP) ports with Windows COM ports. The receiver is listed in the **Bluetooth Devices** screen:

To see which Windows COM ports are associated with the device SPP ports, right-click on the device and select **Properties**. Then select the **Services** tab.

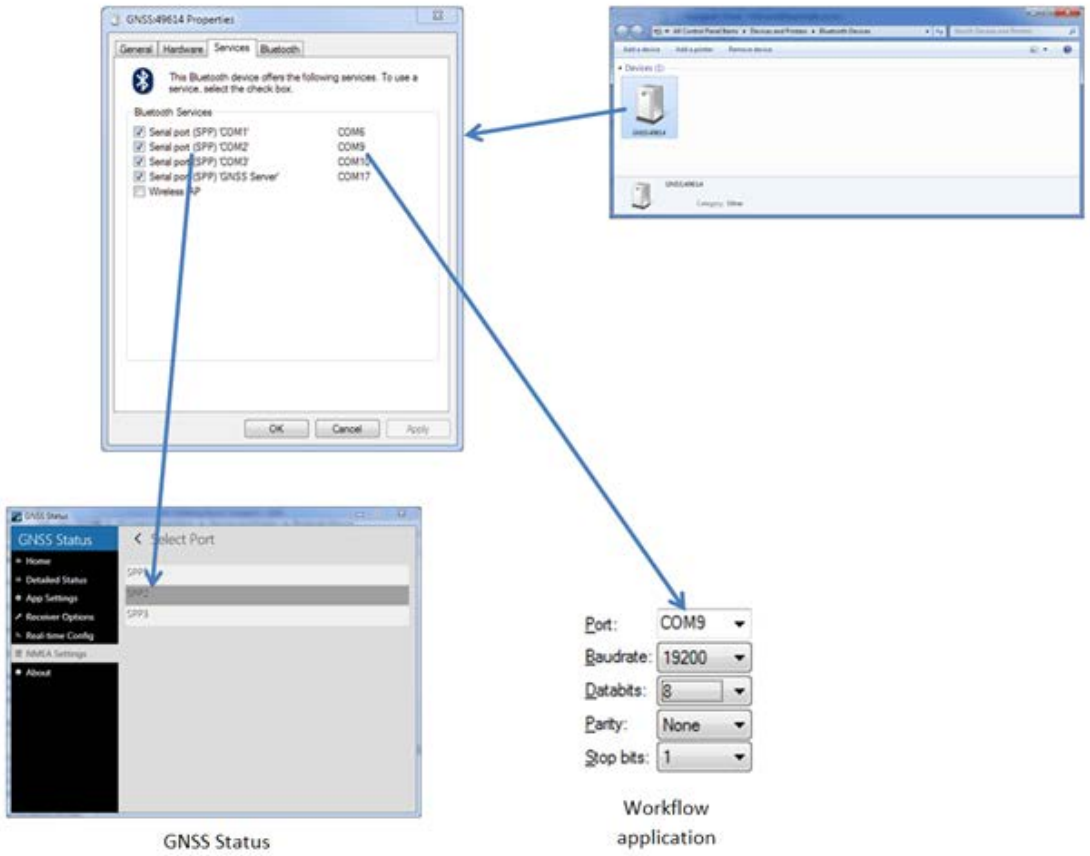
Applications that run on Windows devices (for example, the Trimble TerraFlex software) will see, in this example, COM6, COM9, COM10 and COM17. COM17 is the **GNSS Server** SPP port; it should NOT be selected for use by applications as it is used to supply positions to **Location Services** on the device. The **GNSS Server** port will reset to a default configuration each time it is connected, irrespective of any changes you make.

NOTE – Different installations will result in different Windows COM port assignments.

The application you are using to collect data will have a configuration screen that will include options such as:



In this example, the COM9 Windows COM port is selected, which corresponds to SPP2 on the receiver.



The above diagram illustrates the overall association. The following is specific to the example above (your Windows COM Port numbers may be different):

Bluetooth Serial Port Profile (SPP)	Windows COM Port
SPP1	COM6
SPP2	COM9
SPP3	COM10

Logging data

You can log data onto the R2 GNSS receiver itself, or onto a handheld device, smartphone, or tablet.

To log GNSS data using the R2 GNSS receiver:

- connect the receiver to a Trimble handheld / controller using Bluetooth wireless technology. See Configuring the receiver using Trimble software and Bluetooth wireless technology for details on connecting the receiver. Use Trimble field software

(for example, Trimble Access software, Trimble TerraSync software, Trimble TerraFlex software) to log GNSS data from the receiver to the handheld / controller, or to a data card in the controller. For more information, refer to the user guide for your particular handheld / controller, and the Trimble field software that you are using.

- Use the R2 GNSS receiver with the Trimble DL app on Android™ smartphones and tablets. The Trimble DL app is available to download from the Google Play store. Contact your local Trimble dealer for more information on the Trimble DL app for Android devices.
- To log received corrections onto the internal memory, connect to the Web Interface and go to **Data Logging** / **Summary** / **Configure** and select **Log Received Corrections**.

4

Default Settings

- Default receiver settings
- Resetting the receiver to factory defaults

All receiver settings are stored in application files. The default application file is stored permanently in the receiver, and contains the factory default settings for the receiver. Whenever the receiver is reset to its factory defaults, the current settings (stored in the current application file, current.cfg) are reset to the values in the default application file.

You cannot modify the default application file. however, if there is a power up application file (Power_up.cfg) in the receiver, the settings in this file can be applied immediately after the default application file, overriding the factory defaults.

NOTE – NMEA must be configured to use the second port; Anything configured to use the first port will be reset when the receiver is reset.

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	99
	RTK positioning mode	Low Latency
	Motion	Kinematic
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 R2 internal
	Height (true vertical)	0.00 m
	Group	All
	Measurement method	Antenna Phase Center

Resetting the receiver to factory defaults

To reset the receiver to its factory defaults, press  for 15 seconds until the LED changes to a slow yellow flash and then release immediately.

5

NMEA Output Messages

- NMEA-0183 messages: Overview
- NMEA-0183 messages: Common message elements
- List of supported NMEA messages

This appendix describes the formats of the subset of NMEA-0183 messages that are available for output by the receiver. For a copy of the NMEA-0183 Standard, go to the National Marine Electronics Association website at www.nmea.org.

NMEA-0183 messages: Overview

When NMEA-0183 output is enabled, a subset of NMEA-0183 messages can be output to external instruments and equipment connected to the receiver serial ports. These NMEA-0183 messages let external devices use selected data collected or computed by the GNSS receiver.

All messages conform to the NMEA-0183 version 3.01 format. All begin with $ and end with a carriage return and a line feed. Data fields follow comma (,) delimiters and are variable in length. Null fields still follow comma (,) delimiters, but contain no information.

An asterisk (*) delimiter and checksum value follow the last field of data contained in an NMEA-0183 message. The checksum is the 8-bit exclusive of all characters in the message, including the commas between fields, but not including the $ and asterisk delimiters. The hexadecimal result is converted to two ASCII characters (0–9, A–F). The most significant character appears first.

The following table summarizes the set of NMEA messages supported by the receiver.

Message	Function
DP	Dynamic positioning
GBS	GNSS satellite fault detection (RAIM support)
GLL	Position data: position fix, time of position fix, and status
GNS	GNS Fix data
GRS	GRS range residuals
GSA	GPS DOP and active satellites
GST	Position error statistics
GSV	Number of SVs in view, PRN, elevation, azimuth, and SNR
HDT	Heading from True North
LLQ	Leica local position and quality
PTNL,AVR	Time, yaw, tilt, range, mode, PDOP, and number of SVs for Moving Baseline RTK
PTNL,BPQ	Base station position and position quality indicator
PTNL,DG	L-band corrections and beacon signal strength and related information
PTNL,GGK	Time, position, position type, and DOP values

Message	Function
PTNL,PJK	Time, position, position type, and DOP values
PTNL,PJT	Projection type
PTNL, REX	Rover Extended output
PTNL,VGK	Time, locator vector, type, and DOP values
PTNL,VHD	Heading Information
RMC	Position, Velocity, and Time
ROT	Rate of turn
VTG	Actual track made good and speed over ground
ZDA	UTC day, month, and year, and local time zone offset

To enable or disable the output of individual NMEA messages, do one of the following:

- Create an application file in the Configuration Toolbox software that contains NMEA output settings and then send the file to the receiver.
- Add NMEA outputs in the **Serial outputs** tab of the GPS Configurator software and then apply the settings.

For a copy of the NMEA-0183 Standard, go to the National Marine Electronics Association website at www.nmea.org.

NMEA-0183 messages: Common message elements

Each message contains:

- a message ID consisting of $GP followed by the message type. For example, the message ID of the GGA message is $GPGGA.
- a comma.
- a number of fields, depending on the message type, separated by commas.
- an asterisk.
- a checksum value.

The following example shows a simple message with a message ID ($GPGGA), followed by 13 fields and a checksum value:

$GPGGA,172814.0,3723.46587704,N,12202.26957864,W,2,6,1.2,18.893,M,-25.669,M,2.0,0031*4F

NMEA Message values

NMEA messages that the receiver generates contains the following values:

Value	Description
Latitude and Longitude	Latitude is represented as ddmm.mmmm and longitude is represented as dddmm.mmmm, where: • dd or ddd is degrees • mm.mmmm is minutes and decimal fractions of minutes
Direction	Direction (north, south, east, or west) is represented by a single character: N , S , E , or W.
Time	Time values are presented in Universal Time Coordinated (UTC) and are represented as hhmmss.ss, where: • hh is hours, from 00 through 23 • mm is minutes • ss.ss is seconds with variable length decimal-fraction of seconds

List of supported NMEA messages

NMEA-0183 message: DP (Dynamic Positioning)

Proprietary Fugro message

The resulting message is shorter than the maximum defined message length of 82 characters, even with mm level resolution in Latitude/Longitude.

$PFUGDP,GG,hhmmss.ss, ddmm.mmmmm,N, dddmm.mmmmm,E, NN,Q,DD,aa.a,bb.b,ddd,rr.r

An example of the DP message string is:

$PFUGDP,GN,033615.00,3953.88002,N,10506.75324,W,13,9,FF,0.1,0.1,149,0.1*13

DP message fields

Field	Meaning
0	Message ID $PFUGDP
1	Two-character code for GPS (GP), GLONASS (GL) or GNSS (GN) data
2	UTC time (hhmmss.ss)
3-4	Latitude, in degrees and decimal minutes (ddmm.mmmmm) and Latitude sign (N/S)
5-6	Longitude, in degrees and decimal minutes (dddmm.mmmmm) and Longitude sign (E/W)
7	Total number of satellites (GPS + GLONASS)
8	DPVOA (UK00A) quality indicator[1]
9	DGNSS mode indicator (as NMEA standard for $ GNS)
10	Error ellipse standard deviation semi-major axis, in meters (aa.a)
11	Error ellipse standard deviation semi-minor axis, in meters (bb.b)
12	Direction of the error ellipse, in degrees
13	RMS value of the standard deviation of the range inputs to the navigation process[1]

[1] This quality indicator is defined in *Guidelines on the use of DGPS in as a positioning reference in DP Control Systems* IMCA M141, dated Oct 1997 www.imca-

int.com/publications/marine/imca.html.

NMEA-0183 message: DTM

The DTM message identifies the local geodetic datum and datum offsets from a reference datum. This sentence is used to define the datum to which a position location, and geographic locations in subsequent sentences, is referenced.

An example of the DTM message string is:

$GPDTM,W84,,0.0,N,0.0,W,0.0,W84*7D

DTM message fields

Field	Meaning
0	Message ID $GPDTM
1	Local datum code (CCC): W84 – WGS-84 W72 – WGS-72 S85 – SGS85 P90 – PE90 999 – User-defined IHO datum code
2	Local datum subdivision code (x)
3	Latitude offset, in minutes (x.x)
4	N/S (x)
5	Longitude offset, in minutes (x.x)
6	E/W (x)
7	Altitude offset, in meters (x.x)
8	Reference datum code (CCC): W84 – WGS-84 W72 – WGS-72 S85 – SGS85 P90 – PE90

NMEA-0183 message: GBS

GNSS satellite fault detection (RAIM support)

An example of the GBS message string is:

$GPGBS,015509.00,-0.031,-0.186,0.219,19,0.000,-0.354,6.972*4D

GBS message fields

Field	Meaning
0	Message ID $--GBS. Talker ID can be: GA: Galileo GB: BeiDou GP: GPS. To provide information specific to the GPS constellation when more than one constellation is used for the differential position fix. GL: GLONASS. To provide information specific to the GLONASS constellation when more than one constellation is used for the differential position fix. GN: Combined GNSS position. GNSS position fix from more than one constellation, for example, GPS and GLONASS. GQ: QZSS
1	UTC of position fix
2	Expected error in latitude, in meters, due to bias, with noise = 0
3	Expected error in longitude, in meters, due to bias, with noise = 0
4	Expected error in altitude, in meters, due to bias, with noise = 0
5	ID number of most likely failed satellite
6	Probability of missed detection of most likely failed satellite
7	Estimate of bias, in meters, on the most likely failed satellite
8	Standard deviation of bias estimate
9	The checksum data, always begins with *

If NMEA-0183 version 4.10 is selected, the 9th, 10th, and 11th fields become:

Field	Meaning	
9	System ID based on:	
	GPS	1
	GLONASS	2
	Galileo	3
	BeiDou	4
	QZSS	0
10	Signal ID based on:	
	GPS	1
	GLONASS	1
	Galileo	7
	BeiDou	Null
	QZSS	Null
11	The checksum data, always begins with *	

NMEA-0183 message: GGA

Time, position, and fix related data

An example of the GBS message string is:

$GPGGA,172814.0,3723.46587704,N,12202.26957864,W,2,6,1.2,18.893,M,-25.669,M,2.0 0031*4F

NOTE – The data string exceeds the NMEA standard length.

GGA message fields

Field	Meaning
0	Message ID $GPGGA
1	UTC of position fix
2	Latitude
3	Direction of latitude: N: North S: South

Field	Meaning
4	Longitude
5	Direction of longitude: E: East W: West
6	GPS Quality indicator: 0: Fix not valid 1: GPS fix 2: Differential GPS fix (DGNSS), SBAS, OmniSTAR VBS, Beacon, RTX in GVBS mode 3: Not applicable 4: RTK Fixed, xFill 5: RTK Float, OmniSTAR XP/HP, Location RTK, RTX 6: INS Dead reckoning
7	Number of SVs in use, range from 00 through to 24+
8	HDOP
9	Orthometric height (MSL reference)
10	M: unit of measure for orthometric height is meters
11	Geoid separation
12	M: geoid separation measured in meters
13	Age of differential GPS data record, Type 1 or Type 9. Null field when DGPS is not used.
14	Reference station ID, range 0000-4095. A null field when any reference station ID is selected and no corrections are received. See table below for a description of the field values.
15	The checksum data, always begins with *

NOTE – If a user-defined geoid model, or an inclined plane is loaded into the receiver, then the height output in the NMEA GGA string is always the orthometric height (height above a geoid). The orthometric height is output even if no user-defined geoid is loaded (there is a simplified default geoid in the receiver), or if a user-defined geoid is loaded, or if an inclined plane is used.

When using one of the MSS (Mobile Satellite Services), the **Reference Station ID** field indicates the following services:

Reference Station ID	Service
0002	CenterPoint or ViewPoint RTX
0005	RangePoint RTX
0006	FieldPoint RTX
0100	VBS
1000	HP
1001	HP/XP (Orbits)
1002	HP/G2 (Orbits)
1008	XP (GPS)
1012	G2 (GPS)
1013	G2 (GPS/GLONASS)
1014	G2 (GLONASS)
1016	HP/XP (GPS)
1020	HP/G2 (GPS)
1021	HP/G2 (GPS/GLONASS)

NMEA-0183 message: GNS

GNSS fix data

GNSS capable receivers will always output this message with the GN talker ID.

GNSS capable receivers will also output this message with other talker ID's when using more than one constellation for the position fix.

An example of the GNS message output from a GNSS capable receiver is:

$GNGNS,014035.00,4332.69262,S,17235.48549,E,RR,13,0.9,25.63,11.24,,U,*70<CR><LF>

$GPGNS,014035.00,,,,,,8,,,,1.0,23*76<CR><LF>

$GLGNS,014035.00,,,,,,5,,,,1.0,23*67<CR><LF>

GNS message fields

Field	Meaning
0	Message ID $--GNS Talker ID can be: GA: Galileo GB: BeiDou GP: GPS GL: GLONASS. When more than one constellation is used. GN: Combined GNSS position, for example, GPS and GLONASS. GQ: QZSS
1	UTC of position fix
2	Latitude
3	Direction of latitude: N: North S: South
4	Longitude
5	Direction of longitude: E: East W: West
6	Mode indicator: • Variable character field with one character for each supported constellation. • First character is for GPS. • Second character is for GLONASS. • Third character is Galileo. • Fourth character is for BeiDou. • Fifth character is for QZSS. • Subsequent characters will be added for new constellations. Each character will be one of the following: N = No fix. Satellite system not used in position fix, or fix not valid

Field	Meaning
	A = Autonomous. Satellite system used in non-differential mode in position fix D = Differential (including all OmniSTAR services). Satellite system used in differential mode in position fix P = Precise. Satellite system used in precision mode. Precision mode is defined as: no deliberate degradation (such as Selective Availability) and higher resolution code (P-code) is used to compute position fix R = Real Time Kinematic. Satellite system used in RTK mode with fixed integers F = Float RTK. Satellite system used in real-time kinematic mode with floating integers E = Estimated (dead reckoning) Mode M = Manual Input Mode S = Simulator Mode
7	Number of SVs in use, range 00–99
8	HDOP calculated using all the satellites (GPS, GLONASS, and any future satellites) used in computing the solution reported in each GNS sentence.
9	Orthometric height in meters (MSL reference)
10	Geoidal separation in meters – The difference between the earth ellipsoid surface and mean-sea-level (geoid) surface defined by the reference datum used in the position solution. "-" = mean-sea-level surface below ellipsoid.
11	Age of differential data – Null if talker ID is GN, additional GNS messages follow with Age of differential data.
12	Reference station ID[1], range 0000-4095 – Null if Talker ID is GN. Additional GNS messages follow with Reference station ID.
13	This field is added when the *IEC61162-1:2010/NMEA 0183 V4.10* option is selected in the NMEA I/O Configuration page. It shows if a position is safe (S) or unsafe (U).
14	The checksum data, always begins with *

NOTE – If a user-defined geoid model, or an inclined plane is loaded into the receiver, then the height output in the NMEA GNS string is always the orthometric height (height above a geoid). The

orthometric height is output even if no user-defined geoid is loaded (there is a default geoid in the receiver), or if a user-defined geoid is loaded, or if an inclined plane is used.

1

When using OmniSTAR services, the Reference Station ID indicates the following services:

VBS 100=VBS; 1000=HP; 1001 = HP/XP (Orbits) ; 1002 = HP/G2 (Orbits); 1008 = XP (GPS); 1012 = G2 (GPS); 1013 = G2 (GPS/GLONASS); 1014 = G2 (GLONASS); 1016 = HP/XP (GPS); 1020 = HP/G2 (GPS) ; 1021 = HP/G2 (GPS/GLONASS).

NMEA-0183 message: GSA

GPS DOP and active satellites

An example of the GSA message string is:

$GNGSA,A,3,21,5,29,25,12,10,26,2,,,,,1.2,0.7,1.0*27

$GNGSA,A,3,65,67,80,81,82,88,66,,,,,,1.2,0.7,1.0*20

GSA message fields

Field	Meaning
0	Message ID $GNGSA
1	Mode 1, M = manual, A = automatic
2	Mode 2, Fix type, 1 = not available, 2 = 2D, 3 = 3D
3	PRN number, 01 through 32 for GPS, 33 through 64 for SBAS, 64+ for GLONASS
4	PDOP: 0.5 through 99.9
5	HDOP: 0.5 through 99.9
6	VDOP: 0.5 through 99.9
7	The checksum data, always begins with *

If NMEA-0183 version 4.10 is selected, the 7th and 8th fields become:

Field	Meaning	
7	System ID based on:	
	GPS	1
	GLONASS	2
	Galileo	3
	BeiDou	4

Field	Meaning	
	QZSS	0
8	The checksum data, always begins with *	

NMEA-0183 message: GST

Position error statistics

An example of the GST message string is:

$GPGST,172814.0,0.006,0.023,0.020,273.6,0.023,0.020,0.031*6A

The Talker ID ($--) will vary depending on the satellite system used for the position solution:

- $GP - GPS only
- $GL - GLONASS only
- $GN - Combined

GST message fields

Field	Meaning
0	Message ID $GPGST
1	UTC of position fix
2	RMS value of the pseudorange residuals; includes carrier phase residuals during periods of RTK (float) and RTK (fixed) processing
3	Error ellipse semi-major axis 1 sigma error, in meters
4	Error ellipse semi-minor axis 1 sigma error, in meters
5	Error ellipse orientation, degrees from true north
6	Latitude 1 sigma error, in meters
7	Longitude 1 sigma error, in meters
8	Height 1 sigma error, in meters
9	The checksum data, always begins with *

NMEA-0183 message: GSV

Satellite information

The GSV message string identifies the number of SVs in view, the PRN numbers, elevations, azimuths, and SNR values. Example GSV message strings are:

$GPGSV,8,1,25,21,44,141,47,15,14,049,44,6,31,255,46,3,25,280,44*75

$GPGSV,8,2,25,18,61,057,48,22,68,320,52,27,34,268,47,24,32,076,45*76

$GPGSV,8,3,25,14,51,214,49,19,23,308,46*7E

$GPGSV,8,4,25,51,44,183,49,46,41,169,43,48,36,220,45*47

$GLGSV,8,5,25,82,49,219,52,76,22,051,41,83,37,316,51,67,57,010,51*6C

$GLGSV,8,6,25,77,24,108,44,81,10,181,46,78,1,152,34,66,18,060,45*50

$GLGSV,8,7,25,68,37,284,50*5C

$GBGSV,8,8,25,111,35,221,47,112,4,179,39,114,48,290,48*11

GSV message fields

Field	Meaning
0	Message ID
1	Total number of messages of this type in this cycle
2	Message number
3	Total number of SVs visible
4	SV PRN number
5	Elevation, in degrees, 90° maximum
6	Azimuth, degrees from True North, 000° through 359°
7	SNR, 00 through 99 dB (null when not tracking)
8–11	Information about second SV, same format as fields 4 through 7
12–15	Information about third SV, same format as fields 4 through 7
16–19	Information about fourth SV, same format as fields 4 through 7
20	The checksum data, always begins with *

NOTE –

$GPGSV indicates GPS and SBAS satellites. If the PRN is greater than 32, this indicates an SBAS PRN, 87 should be added to the GSV PRN number to determine the SBAS PRN number.

$GLGSV indicates GLONASS satellites. 64 should be subtracted from the GSV PRN number to determine the GLONASS PRN number.

$GBGSV indicates BeiDou satellites. 100 should be subtracted from the GSV PRN number to determine the BeiDou PRN number.

$GAGSV indicates Galileo satellites.

$GQGSV indicates QZSS satellites.

NMEA-0183 message: HDT

Heading from True North

NOTE – The heading computation in this message is computed from the moving baseline vector, which requires a two-antenna system.

An example of the HDT string is:

$GPHDT,123.456,T*00

Heading from true north message fields

Field	Meaning
0	Message ID $GPHDT
1	Heading in degrees
2	T: Indicates heading relative to True North
3	The checksum data, always begins with *

NMEA-0183 message: LLQ

Leica local position and quality

An example of the LLQ message string is:

$GPLLQ,034137.00,210712,,M,,M,3,15,0.011,,M*15

Field	Meaning
0	Message ID $GPLLQ

Field	Meaning
1	hhmmss.ss – UTC time of position
2	ddmmyy – UTC date
3	xxx.xxx – Grid easting (meters)
4	M – Meter, fixed text
5	xxxx.xxxx – Grid northing (meters)
6	M – Meter, fixed text
7	x – GPS quality. 0 = not valid. 1 = GPS Nav Fix. 2 = DGPS Fix. 3 = RTK Fix.
8	x – Number of satellites used in computation
9	xx.xx – Position quality (meters)
10	xxxx.xxxx – Height (meters)
11	M – Meter, fixed text
	*hh – checksum
	<CR> – carriage return
	<LF> – Line feed

NMEA-0183 message: PTNL,AVR

Time, yaw, tilt/roll, range for moving baseline RTK

NOTE – The heading computation in this message is computed from the moving baseline vector, which requires a two-antenna system.

An example of the PTNL,AVR message string is:

$PTNL,AVR,212405.20,+52.1531,Yaw,-0.0806,Tilt,,,12.575,3,1.4,16*39

$PTNL,AVR,212604.30,+52.1800,Yaw,,,-0.0807,Roll,12.579,3,1.4,16*21

AVR message fields

Field	Meaning
0	Message ID $PTNL,AVR
1	UTC of vector fix
2	Yaw angle, in degrees

Field	Meaning
3	Yaw
4	Tilt angle, in degrees
5	Tilt
8	Range, in meters (between antennas)
9	GPS quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 2: Differential carrier phase solution RTK (Float) 3: Differential carrier phase solution RTK (Fix) 4: Differential code-based solution, DGPS
10	PDOP
11	Number of satellites used in solution
12	The checksum data, always begins with *

NMEA-0183 message: PTNL,BPQ

Base station position and quality indicator

This message describes the base station position and its quality. It is used when the moving base antenna position and quality are required on one serial port (along with a heading message) from a receiver in heading mode.

An example of the PTNL,BPQ message string is:

$PTNL,BPQ,224445.06,021207,3723.09383914,N,12200.32620132,W,EHT-5.923,M,5*

BPQ message fields

Field	Meaning
0	Talker ID
1	BPQ
2	UTC time of position fix, in hhmmss.ss format. Hours must be two numbers, so may be padded, for example, 7 is shown as 07.
3	UTC date of position fix, in ddmmyy format. Day must be two numbers, so may

Field	Meaning
	be padded, for example, 8 is shown as 08.
4	Latitude, in degrees and decimal minutes (ddmm.mmmmmmm)
5	Direction of latitude: N: North S: South
6	Longitude, in degrees and decimal minutes (dddmm.mmmmmmm). Should contain 3 digits of ddd.
7	Direction of longitude: E: East W: West
8	Height Ellipsoidal height of fix (antenna height above ellipsoid). Must start with EHT.
9	M: ellipsoidal height is measured in meters
10	GPS quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 2: Differential SBAS, or OmniSTAR VBS 4: RTK Fixed 5: OmniSTAR XP, OmniSTAR HP, CenterPoint RTX, Float RTK, or Location RTK
11	The checksum data, always begins with *

NMEA-0183 message: PTNL,GGK

Time, position, position type, DOP

An example of the PTNL,GGK message string is:

$PTNL,GGK,102939.00,051910,5000.97323841,N,00827.62010742,E,5,09,1.9,EHT150.790,M*73

PTNL,GGK message fields

Field	Meaning
0	Talker ID $PTNL
1	Message ID GGK
2	UTC time of position fix, in hhmmss.ss format. Hours must be two numbers, so may be padded. For example, 7 is shown as 07.
3	UTC date of position fix, in ddmmyy format. Day must be two numbers, so may be padded. For example, 8 is shown as 08.
4	Latitude, in degrees and decimal minutes (dddmm.mmmmmmm)
5	Direction of latitude: N: North S: South
6	Longitude, in degrees and decimal minutes (dddmm.mmmmmmm). Should contain three digits of ddd.
7	Direction of longitude: E: East W: West
8	GPS Quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 2: RTK float solution 3: RTK fix solution 4: Differential, code phase only solution (DGPS) 5: SBAS solution – WAAS/EGNOS/MSAS 6: RTK float or RTK location 3D Network solution 7: RTK fixed 3D Network solution 8: RTK float or RTK location 2D in a Network solution 9: RTK fixed 2D Network solution 10: OmniSTAR HP/XP solution 11: OmniSTAR VBS solution

Field	Meaning
	12: Location RTK solution 13: Beacon DGPS 14: CenterPoint RTX 15: xFill
9	Number of satellites in fix
10	Dilution of Precision of fix (DOP)
11	Ellipsoidal height of fix (antenna height above ellipsoid). Must start with EHT.
12	M: ellipsoidal height is measured in meters
13	The checksum data, always begins with *

NOTE – The PTNL,GGK message is longer than the NMEA-0183 standard of 80 characters.

NOTE – Even if a user-defined geoid model, or an inclined plane is loaded into the receiver, then the height output in the NMEA GGK string is always an ellipsoid height, for example, EHT24.123.

NMEA-0183 message: PTNL,PJK

Local coordinate position output

Some examples of the PTNL,PJK message string are:

$PTNL,PJK,202831.50,011112,+805083.350,N,+388997.346,E,10,09,1.5,GHT+25.478,M*77

$PTNL,PJK,010717.00,081796,+732646.511,N,+1731051.091,E,1,05,2.7,EHT+28.345,M*7C

PTNL,PJK message fields

Field	Meaning
0	Message ID $PTNL,PJK
1	UTC of position fix
2	Date
3	Northing, in meters
4	Direction of Northing will always be N (North)
5	Easting, in meters
6	Direction of Easting will always be E (East)

Field	Meaning
7	GPS Quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 2: RTK float solution 3: RTK fix solution 4: Differential, code phase only solution (DGPS) 5: SBAS solution – WAAS/EGNOS/MSAS 6: RTK Float 3D network solution 7: RTK Fixed 3D network solution 8: RTK Float 2D network solution 9: RTK Fixed 2D network solution 10: OmniSTAR HP/XP solution 11: OmniSTAR VBS solution 12: Location RTK 13: Beacon DGPS 14: CenterPoint RTX 15: xFill
8	Number of satellites in fix
9	DOP of fix
10	Height of Antenna Phase Center (see Note below)
11	M: height is measured in meters
12	The checksum data, always begins with *

NOTE – The PTNL,PJK message is longer than the NMEA-0183 standard of 80 characters.

NOTE – If a user-defined geoid model, or an inclined plane is loaded into the receiver, then the NMEA PJK string will always report the orthometric height (the field starts with the letters GHT). If the latitude/longitude of the receiver is outside the user-defined geoid model bounds, then the height is shown as ellipsoidal height (the field starts with the letters EHT).

NOTE – If the receiver does not have an application file, this string returns nothing in fields 3, 4, 5, 6, or 10.

NMEA-0183 message: PTNL,VGK

Vector information

An example of the PTNL,VGK message string is:

$PTNL,VGK,160159.00,010997,-0000.161,00009.985,-0000.002,3,07,1,4,M*0B

PTNL,VGK message fields

Field	Meaning
0	Message ID $PTNL,VGK
1	UTC of vector in hhmmss.ss format
2	Date in mmddyy format
3	East component of vector, in meters
4	North component of vector, in meters
5	Up component of vector, in meters
6	GPS Quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 2: RTK float solution 3: RTK fix solution 4: Differential, code phase only solution (DGPS) 5: SBAS solution – WAAS/EGNOS/MSAS 6: RTK Float 3D network solution 7: RTK Fixed 3D network solution 8: RTK Float 2D network solution 9: RTK Fixed 2D network solution 10: OmniSTAR HP/XP solution 11: OmniSTAR VBS solution 12: Location RTK 13: Beacon DGPS 14: CenterPoint RTX

Field	Meaning
	15: xFill
7	Number of satellites if fix solution
8	DOP of fix
9	M: Vector components are in meters
10	The checksum data, always begins with *

NMEA-0183 message: PTNL,VHD

Heading information

NOTE – The heading computation in this message is computed from the moving baseline vector, which requires a two-antenna system.

An example of the PTNL,VHD message string is:

$PTNL,VHD,030556.00,093098,187.718,-22.138,-76.929,-5.015,0.033,0.006,3,07,2.4,M*22

PTNL,VHD message fields

Field	Meaning
0	Message ID $PTNL
1	VHD
2	UTC of position in hhmmss.ss format
3	Date in mmddyy format
4	Azimuth
5	Rate of change of azimuth = azimuth/time
6	Vertical angle
7	Rate of change of vertical angle = vertical/time
8	Range
9	Rate of change of range between antenna = range/time
10	GPS Quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix

Field	Meaning
	2: RTK float solution 3: RTK fix solution 4: Differential, code phase only solution (DGPS) 5: SBAS solution – WAAS/EGNOS/MSAS 6: RTK Float 3D network solution 7: RTK Fixed 3D network solution 8: RTK Float 2D network solution 9: RTK Fixed 2D network solution 10: OmniSTAR HP/XP solution 11: OmniSTAR VBS solution 12: Location RTK 13: Beacon DGPS 14: CenterPoint RTX 15: xFill
11	Number of satellites used in solution
12	PDOP
13	M
14	The checksum data, always begins with *

NMEA-0183 message: RMC

Position, velocity, and time

NOTE – The heading computation in this message is derived from consecutive positions. For heading using a moving baseline system, see NMEA-0183 message: PTNL,AVR, page 60.

The RMC string is:

$GPRMC,123519,A,4807.038,N,01131.000,E,022.4,084.4,230394,003.1,W*6A

GPRMC message fields

Field	Meaning
0	Message ID $--RMC

Field	Meaning
	Talker ID can be: GP: GPS only GN: More than one constellation
1	UTC of position fix
2	Status A=active or V=void
3	Latitude
4	Longitude
5	Speed over the ground in knots
6	Track angle in degrees (True)
7	Date
8	Magnetic variation, in degrees
9	The checksum data, always begins with *

NMEA-0183 message: ROT

Rate and direction of turn

NOTE – The heading computation in this message is derived from consecutive positions. For heading using a moving baseline system, see *NMEA-0183 message: PTNL,AVR, page 60*.

An example of the ROT string is:

$GPROT,35.6,A*4E

ROT message fields

Field	Meaning
0	Message ID $GPROT
1	Rate of turn, degrees/minutes, "–" indicates bow turns to port
2	A: Valid data V: Invalid data
3	The checksum data, always begins with *

NMEA-0183 message: VTG

Track made good and speed over ground

NOTE – The heading computation in this message is derived from consecutive positions. For heading using a moving baseline system, see NMEA-0183 message: PTNL,AVR, page 60.

An example of the VTG message string is:

$GPVTG,140.88,T,,M,8.04,N,14.89,K,D*05

VTG message fields

Field	Meaning
0	Message ID $GPVTG
1	Track made good (degrees true)
2	T: track made good is relative to true north
3	Track made good (degrees magnetic)
4	M: track made good is relative to magnetic north
5	Speed, in knots
6	N: speed is measured in knots
7	Speed over ground in kilometers/hour (kph)
8	K: speed over ground is measured in kph
9	Mode indicator: A: Autonomous mode D: Differential mode E: Estimated (dead reckoning) mode M: Manual Input mode S: Simulator mode N: Data not valid
10	The checksum data, always begins with *

NMEA-0183 message: ZDA

UTC day, month, and year, and local time zone offset

An example of the ZDA message string is:

$GPZDA,172809.456,12,07,1996,00,00*45

ZDA message fields

Field	Meaning
0	Message ID $--ZDA Talker ID can be: GP: GPS only GN: More than one constellation
1	UTC
2	Day, ranging between 01 and 31
3	Month, ranging between 01 and 12
4	Year
5	Local time zone offset from GMT, ranging from 00 through ±13 hours
6	Local time zone offset from GMT, ranging from 00 through 59 minutes
7	The checksum data, always begins with *

Fields 5 and 6 together yield the total offset. For example, if field 5 is -5 and field 6 is +15, local time is 5 hours and 15 minutes earlier than GMT.

[1]This is the same as the definition in the GST message in the *NMEA 183 Standard For Interfacing Marine Electronic Devices* from version 2.20, dated January 1 1997 www.nmea.org/0183.htm.

6

RTCM Output

RTCM Output: Generated messages

Messages that are generated when you select a specific RTCM version are shown in the following table. For details of the individual messages, refer to the RTCM documentation at www.rtcm.org.

Selection	Message							
Version 2	1	3			22			59
USCG, 9-3		3	9-3					
RTCM/RTK, 2.2+2.3	1	3	18	19	22	23	24	59
RTK Only, 2.2+2.3		3	18	19	22	23	24	59
RTCM/RTK, 2.3			18	19		23	24	
RTK Only, 2.3			18	19	22			
RTCM/RTK, 2.2	1	3	18	19	22			59
RTK Only, 2.2		3	18	19	22			59
RTCM/RTK, 2.1	1	3	18	19	22			59
RTK Only, 2.1		3	18	19	22			59
RTCM/RTK, 3.x			1004	1006	1008	1012	1013	1033

7

Troubleshooting

- Troubleshooting LED conditions
- Troubleshooting receiver issues

This chapter provides a brief overview problems and causes. Please read this section before you contact Technical support, page 17.

Troubleshooting LED conditions

The receiver has a simple display panel with an LED to indicate the current status of the receiver. If you need more detailed information about what the receiver is doing, use a Trimble controller and Trimble field software (connected to the receiver using Bluetooth wireless technology), or access all configuration settings by connecting the receiver to your smart phone or laptop computer via Configuring the receiver using Wi-Fi and the Web Interface, page 33.

The LED is green and flashing fast

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 R2 GNSS receiver's Downloads page on the Trimble website.

Troubleshooting receiver issues

This section describes some possible receiver issues, possible causes, and how to solve them.

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.	Check that the USB connection is secured properly.
Faulty external power cable.	Try a different cable.

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 functions, page 31.
The receiver needs a full reset.	Press the Power button for 30 seconds. For more information, see Button functions, page 31.

The rover receiver is not receiving radio

Possible cause	Solution
Reference receiver is not broadcasting.	Ensure the reference base GNSS receiver is set up, powered, and transmitting GNSS corrections.
Incorrect over air baud rates between reference and rover.	Connect to the roving receiver's radio and check to ensure it has the same setting as the reference receiver.

Possible cause	Solution
Incorrect port settings between roving external radio and receiver.	If the radio is receiving data (the Power LED is flashing a slow green) and the receiver is not getting radio communications, use the Trimble Access software to check that the port settings are correct.
Incorrect message type selected	The Broadcast format must be the same on both the reference receiver and the rover(s). Connect to the rover receiver using the Trimble Access software to ensure that the R2 rover receiver Broadcast format has the same settings as the reference receiver. Check under Settings / Survey Styles / RTK / Rover Options / Broadcast Format = CMRx (for example).