

Trimble R8s GNSS Receiver

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Release Notice

This is the February 2016 release (Revision C) of the Trimble R8s 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.

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 be recycled.
廢電池請回收

Brazil

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

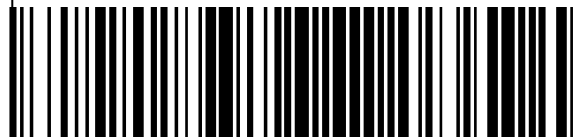
Este equipamento opera em caráter secundário, isto é, não tem direito a proteção contra interferências prejudicial, mesmo de estações do mesmo tipo, e não pode causar interferência a sistemas operando em caráter primário.

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

Modelo CBSMA-110A



0757-13-6140



(0 1) 0 7 8 9 8 9 4 8 5 2 6 1 4 9

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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PO Box 3642
Sunnyvale, CA 94088-3642
United States
+1-408-481-8000

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 Navigation Limited tímto prohlašuje, že tento (Trimble R8s Model 1 GNSS) je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.
Danish	Undertegnede Trimble Navigation Limited erklærer herved, at følgende udstyr (Trimble R8s Model 1 GNSS) overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF.
Dutch	Hierbij verklaart Trimble Navigation Limited dat het toestel (Trimble R8s Model 1 GNSS) in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG.
English	Hereby, Trimble Navigation Limited, declares that this equipment (Trimble R8s Model 1 GNSS) is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Estonian	Käesolevaga kinnitab Trimble Navigation Limited seadme (Trimble R8s Model 1 GNSS) vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.
German	Hiermit erklärt Trimble Navigation Limited, dass sich das Gerät (Trimble R8s Model 1 GNSS) in Übereinstimmung mit den grundlegenden Anforderungen und den übrigen einschlägigen Bestimmungen der Richtlinie 1999/5/EG befindet.
Greek	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Trimble Navigation Limited ΔΗΛΩΝΕΙ ΟΤΙ (Trimble R8s Model 1 GNSS) ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/ΕΚ.
Hungarian	Alulírott, Trimble Navigation Limited nyilatkozom, hogy a (Trimble R8s Model 1 GNSS) megfelel a vonatkozó alapvető követelményeknek és az 1999/5/EC irányelv egyéb előírásainak.
Finnish	Trimble Navigation Limited vakuuttaa täten että (Trimble R8s Model 1 GNSS) tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
French	Par la présente Trimble Navigation Limited déclare que l'appareil (Trimble R8s Model 1 GNSS) est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE.

Icelandic	Hér með lýsir Trimble Navigation Limited yfir því að (Trimble R8s Model 1 GNSS) er í samræmi við grunnkröfur og aðrar kröfur, sem gerðar eru í tilskipun 1999/5/EC.
Italian	Con la presente Trimble Navigation Limited dichiara che questo (Trimble R8s Model 1 GNSS) è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Latvian	Ar šo Trimble Navigation Limited deklarē, ka (Trimble R8s Model 1 GNSS) atbilst Direktīvas 1999/5/EK būtiskajām prasībām un citiem ar to saistītajiem noteikumiem.
Lithuanian	Šiuo Trimble Navigation Limited deklaruoja, kad šis (Trimble R8s Model 1 GNSS) atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.
Maltese	Hawnhekk, Trimble Navigation Limited, jiddikjara li dan (Trimble R8s Model 1 GNSS) jikkonforma mal-ħtiġijiet essenzjali u ma provvedimenti oħrajn relevanti li hemm fid-Direttiva 1999/5/EC.
Norwegian	Trimble Navigation Limited erklærer herved at utstyret (Trimble R8s Model 1 GNSS) i samsvar med de grunnleggende krav og øvrige relevante krav i direktiv 1999/5/EF.
Polish	Niniejszym Trimble Navigation Limited oświadcza, że (Trimble R8s Model 1 GNSS) jest zgodny z zasadniczymi wymogami oraz pozostałymi stosownymi postanowieniami Dyrektywy 1999/5/EC.
Portuguese	Trimble Navigation Limited declara que este (Trimble R8s Model 1 GNSS) está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.
Slovak	Trimble Navigation Limited týmto vyhlasuje, že (Trimble R8s Model 1 GNSS) spĺňa základné požiadavky a všetky príslušné ustanovenia Smernice 1999/5/ES.
Slovenian	Trimble Navigation Limited izjavlja, da je ta (Trimble R8s Model 1 GNSS) skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 1999/5/ES.
Spanish	Por medio de la presente Trimble Navigation Limited declara que el (Trimble R8s Model 1 GNSS) cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE.
Swedish	Härmed intygar Trimble Navigation Limited att denna (Trimble R8s Model 1 GNSS) står i överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.

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 countries 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 20 cm (7.8 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.

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 cm (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.

UHF 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 W..

The antennas that can be used (country dependent) with the 450 MHz radio are 0 dBi and 5 dBi whip antennas.

The antenna that can be used with the GSM radio is the 0 dBi whip antenna.

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.

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 49499-00 (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

- Overview
- Use and care
- COCOM limits
- Related information
- Technical support

This manual describes how to set up and use a Trimble® R8s 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.

Overview

The receiver incorporates a GNSS antenna, receiver, internal radio with a transmit option or an internal GSM module, and a battery in a rugged light-weight unit that is ideally suited as an all-on-the-pole RTK rover. Three LEDs allow you to monitor the satellite tracking, radio reception, data logging status, and power. Bluetooth wireless technology provides cable-free communications between receiver and controller.

The circuitry in the Trimble R8s GNSS receiver provides up to 440 channels for satellite tracking, and supports logging raw GNSS observables to the internal receiver memory or to a handheld controller for postprocessed applications.

The receiver is available in a number of configurations that match the needs of your workflow. This includes configurations for post-processing workflows, for use as a base station or rover, or for total flexibility as both a base station and RTK / VRS rover.

Use and care

The receiver can withstand the rough treatment that typically occurs in the field. However, it is a high-precision electronic instrument and should be treated with reasonable care.

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

High-power signals from a nearby radio or radar transmitter can overwhelm the receiver circuits. This does not harm the instrument, but it can prevent the receiver electronics from functioning correctly. Avoid using the receiver within 400 meters of powerful radar, television, or other transmitters. Low-power transmitters such as those used in cellphones and two-way radios normally do not interfere with receiver operations.

For more information, contact your local Trimble distributor.

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 the receiver.

Immediate access to satellite measurements and navigation results is disabled when the receiver's velocity is computed to be greater than 1000 knots, or its altitude is computed to be above 18,000 meters. The receiver continuously resets until the COCOM situation is cleared.

Related information

An electronic copy of this manual is available in portable document format (PDF) at www.trimble.com. Use Adobe Reader to view the contents of this file.

Sources of related information include the following:

- Release notes – the release notes describe new features of the product, information not included in the manual, and any changes to the manual. They are provided as a PDF at www.trimble.com. Use Adobe Reader to view the contents of the release notes.
- Registration – register your receiver to automatically receive e-mail notifications of receiver firmware upgrades and new functionality. To register, go to www.trimble.com.

Contact your local Trimble distribution partner for more information about the support agreement contracts for software and firmware, and an extended warranty program for hardware.

- Trimble training courses – consider a training course to help you use your GNSS system to its fullest potential. For more information, visit the Trimble website at www.trimble.com/training.html.

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.

Setting up the Receiver

- Parts of the R8s receiver
- Setup guidelines
- Setting up the receiver on a range pole

Parts of the R8s receiver

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

Front panel

The following image shows the receiver front panel, which contains the three indicator light emitting diodes (LEDs), and the Power button.



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

The indicator LEDs show the status of power, satellite tracking, and radio reception. For more information, see [LED behavior](#), page 23.

Lower housing

The following image shows the receiver lower housing, which contains the two serial ports, one TNC radio antenna or GSM antenna connector (depending on the internal communication module ordered), the removable battery compartment and the $\frac{5}{8}$ -11 threaded insert.

2 Setting up the Receiver



- | | |
|---|--------------------------|
| 1 | Radio antenna connection |
| 2 | Port 2 |
| 3 | Port 1 |

Each port or connector on the receiver is marked with an icon to indicate its main function:

Icon	Name	Connection
	Port 1	Device, computer, external radio, power in
	Port 2	Device, computer, external radio
	Radio	Radio communications antenna

Port 1 is a 7-pin 0-shell Lemo connector that supports RS-232 comms and external power input.

Port 1 has no power outputs.

Port 2 is a DB-9 male connector that allows for full 9-pin RS-232 comms. Port 2 does not support power in or out. For more information, see [Cables and Connectors, page 33](#) and [Cables and Connectors, page 33](#).

The TNC 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 radios. This connector is not used if you are using an external UHF radio or GSM.

External UHF or GSM antenna

Depending on which module you have purchased, use this TNC connection for an external antenna for the UHF or GSM antenna.

For more information on connecting the receiver, see the following sections in this chapter.

Setup guidelines

Consider the following guidelines when setting up 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 0 dBi.

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.

Environmental conditions

Although the receiver has a waterproof housing, take reasonable care to protect the unit. Avoid exposure to extreme environmental conditions, including:

- Water
- Heat greater than 65 °C (149 °F)
- Cold less than –40 °C (–40 °F)
- Corrosive fluids and gases

Sources of electrical interference

Avoid the following sources of electrical and magnetic noise:

- Gasoline engines (spark plugs)
- Televisions and PC monitors
- Alternators and generators

2 Setting up the Receiver

- Electric motors
- Equipment with DC-to-AC converters
- Fluorescent lights
- Switching power supplies

General guidelines



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.

The following guidelines apply whenever you set up the receiver for operation:

- When plugging in a Lemo cable, make sure that the red dots on the receiver port and the cable connector line up. Do not use force to plug cables in, as this may damage the connector pins.
- When disconnecting a Lemo cable, grasp the cable by the sliding collar or lanyard and then pull the cable connector straight out of the port. Do not twist the connector or pull on the cable itself.
- To securely connect a TNC cable, align the cable connector with the receiver receptacle and then thread the cable connector onto the receptacle until it is snug.
- To insert the internal battery, 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. Slide the battery and compartment as a unit upward into the receiver until the battery compartment latches are locked into position.

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:

Note – When using a Trimble TSC3, Trimble TSC2,[®] Trimble TCU, Trimble Tablet Rugged PC, or Trimble Slate controller, no cabling is required, as shown below.

2 Setting up the Receiver



Other system components

This section describes optional components that you can use with the receiver.

Radios

Radios are the most common data link for Real-Time Kinematic (RTK) surveying. The receiver is available with an optional internal radio in the 450 MHz UHF band, or with an internal GSM module. You can also connect an external radio to either receiver port, whether or not the internal radio is installed.

The receiver supports the following Trimble base radios with the internal 450 MHz radio:

- Trimble TDL 450H
- Trimble TDL 450L
- Trimble HPB450
- Trimble PDL450
- Receiver internal 450 MHz transmitter
- TRIMMARK™ 3 radio
- SiteNet™ 450 radio

Internal GSM setup

You can configure the optional internal GSM Module using the Trimble Access™ software. For more information, refer to the field software documentation.

Internal radio setup

To configure the optional internal radio, use the Trimble Access software.

For more information, refer to the Trimble Access Help.

By default, the internal radio has only a few “test” frequencies installed at the factory. If you purchased the transmit option, the broadcast frequencies must be programmed by the Trimble distribution partner. You can program the receive frequencies using the Trimble Access software. Refer to the Trimble Access Help.

Cellular modems and external radios

For a data communications link, you can use an internal or external radio, or an internal or external cellular modem.

To connect an external cellular modem to the receiver, you need the following:

- A Trimble R8s GNSS receiver.
- A cellular modem, or a cellphone that can transmit and receive data.
- Serial (cellphone to DB9) cable (supplied with the cellular modem or phone).
- Port 2 of the receiver supports full RS-232 protocol, and should function properly with most cellular phone cables. Some cellular units may require custom cabling.

Alternatively, the receiver also supports a cable-free Bluetooth connection with Bluetooth-enabled cell phones.

For more information on using an external cellular modem as a data link, refer to the Trimble Access or Trimble Survey Controller documentation.

2 Setting up the Receiver

To connect an external radio modem to a receiver, you need the following:

- A receiver.
- An external radio capable of receiving and decoding Trimble data packets.
- Serial cable for either Port 1 or Port 2 of the receiver, as supplied by the radio manufacturer.
- Radio mount for the range pole.

General Operation

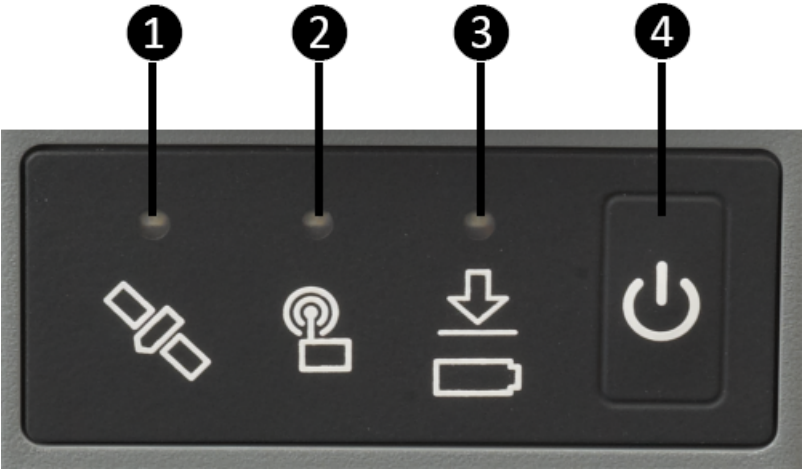
- [Front panel controls](#)
- [Button functions](#)
- [LED behavior](#)
- [Logging data](#)

All the controls that you need for general receiver operation are on the front panel.

For more information about other receiver panels, see [Parts of the R8s receiver, page 14](#).

Front panel controls

The following image shows the receiver front panel controls for the power on/off functions, or receiver reset. The LEDs provide power, radio, data logging, and SV tracking status information.



1	Satellite tracking LED
2	Radio LED
3	Power / Data status LED
4	Power button

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...	Power button
turn on the receiver	Press
turn off the receiver	Hold for 2 seconds
delete the ephemeris file	Hold for 15 seconds
reset the receiver to factory defaults	Hold for 15 seconds
delete application files	Hold for 30 seconds

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 three LEDs on the front panel of the receiver 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 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	Power LED Green	Radio LED Green	Satellite LED Amber
Receiver OFF	OFF	OFF	OFF
Receiver ON: Healthy power	ON	N/A	N/A
Low power	Fast flash	N/A	N/A
Tracking <4 SVs	ON	N/A	Fast flash
Tracking >4 SVs	ON	N/A	Slow flash
Logging data internally	Flashes off every 3 seconds	N/A	N/A
Transmitting internally	N/A	Flashes off when transmitting	N/A
Receiving valid data packets	ON	Slow flash	N/A
No data packets	ON	OFF	N/A
Receiver in monitor	ON	Slow flash	ON

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.

Charging the receiver's battery

 **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 49499-00 (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.
-

The receiver can be powered by its internal battery or by an external power source connected to Port 1.

If an external power source is connected to Port 1, it is used in preference to the internal battery. When there is no external power source connected, or if the external power supply fails, the internal battery is used.

The receiver is supplied with two rechargeable Lithium-ion batteries, and a dual battery charger. 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 49499-00 (yellow/grey) or another charger specified for this battery. The two batteries charge sequentially and take approximately four hours each to fully charge.

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.

Charging the battery

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

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 prior to 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.

Storing the Lithium-ion battery

All battery types discharge over time when they are not being used. Batteries also discharge faster in colder temperatures. If a Lithium-ion battery is to be stored for long periods of time, make sure it is fully charged before storing and re-charged at least every three months.

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.

Power output

The receiver does not supply power from either of its two ports.

Firmware

A receiver's firmware is the program inside the receiver that controls receiver operations and hardware. You can upgrade the firmware for the receiver using the Trimble Installation Manager software that you can download from www.trimble.com.

For more information, refer to the Trimble Installation Manager Help.

 **CAUTION** – Downgrading the firmware deletes all application files on the receiver.

Logging data

You can log data internally or to a Trimble controller.

Logging internally

The receiver logs raw data on internal memory.

You can then use the Trimble Data Transfer utility or Trimble Business Center software to transfer logged data files to the office computer.

Note – If you use the Data Transfer utility to download the internally-logged files, a DAT (*.dat) file is automatically created after the download. DAT files do not contain GLONASS data. If you have Trimble Business Center software, the T0x (T01 or T02) file that is stored on the receiver can be directly downloaded. The T0x files contain any collected GLONASS data. Trimble Business Center software can process GLONASS data, if you purchased that option.

 **CAUTION** – The receiver allows for a maximum of 200 files on the internal memory. The filenames must be in 8.3 format, otherwise, files copied to the internal memory may cause data corruption or loss of data when logging.
Data is logged using the current logging settings configured in the receiver. Data files logged internally are named automatically.

The receiver allows for a maximum of 200 files on the internal memory. The filenames must be in 8.3 format, otherwise, files copied to the internal memory may cause data corruption or loss of data when logging.

Data is logged using the current logging settings configured in the receiver. Data files logged internally are named automatically.

To begin internal logging, you must use a Trimble controller running the Trimble Access software. The receiver does not have a continuously running internal clock when it is turned off, so you can conduct timed survey sessions only if the receiver is turned on and connected to a power source.

When the internal memory is full, the receiver stops logging data, and the Power LED stops flashing and remains on continuously. Existing data files are not overwritten. You can use the Auto-delete option to override this action and automatically delete the oldest files when the receiver memory is full. However, you should use this option with caution because it can result in loss of data.

Approximate storage requirements for different logging rates are shown below. The values shown are for a one-hour logging session with six satellites visible.

Logging rate	Memory required
10 Hz	2,588 KB
1 Hz	335 KB
5 seconds	87 KB
15 seconds	37 KB

Logging to a Trimble controller

When the receiver is connected to a Trimble controller running the Trimble Access software, you can log GNSS data from the receiver to the controller, or to a data card inserted in the controller. When you use a Trimble controller, you do not use the receiver's controls. Instead, you use the controller functions to set logging options, specify filenames, and control when logging occurs.

Controller software job files and the corresponding raw data files can be transferred to an office computer using the Trimble Data Transfer utility.

For more information on logging data from a receiver using a Trimble controller, refer to the user guide for your particular controller.

Configuring the receiver

- [Configuring the receiver in real time](#)
- [Configuring the receiver using application files](#)

The receiver has no controls to change settings. To configure the receiver, do one of the following:

- Configure the receiver in real time using the Trimble Access software.
- Apply the settings in an application file.

This chapter provides a brief overview of each of these methods and describes the contents and use of application files.

Configuring the receiver in real time

The Trimble Access software supports real-time configuration of the receiver.

When you configure the receiver in real time, use the software to specify which settings you want to change. When you apply the changes, the receiver settings change immediately.

Any changes that you apply to the receiver are reflected in the current application file, which is always present in the receiver. The current application file always records the most recent configuration, so if you apply further changes (either in real time or using an application file) the current file is updated and there is no record of the changes that you applied originally.

Configuring the receiver using application files

The receiver Web Interface can be used to create and apply application files. Refer to the receiver Web Interface help for more information.

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.

For more information, see [Configuring the receiver using application files, page 29](#).

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	13°
	PDOP mask	7
	RTK positioning mode	Low Latency
	Motion	Kinematic
Serial Port 1:	Baud rate	38400
	Format	8-None-1
	Flow control	None
Serial Port 2:	Baud rate	38400
	Format	8-None-1
	Flow control	None
Input Setup	Station	Any
NMEA/ASCII (all supported messages)		All ports Off
Streamed Output		All types Off
		Offset=00
RT17/Binary		All ports Off
Reference Position	Latitude	0°
	Longitude	0°
	Altitude	0.00 m HAE
Antenna	Type	Trimble R8s Model 1 internal
	Height (true vertical)	0.00 m
	Group	All
	Measurement method	Bottom of mount

Resetting the receiver to factory defaults

To reset the receiver to its factory defaults, press and hold down the receiver's Power button for 15 seconds.

Default behavior

The factory defaults specified above are applied whenever you start the receiver. If a power up file is present in the receiver, its settings are applied immediately after the default settings, so you can use a power up file to define your own set of defaults.

When you turn the receiver on and ...	then logging settings are ...	and logging ...
it is the first time that the receiver has been used	the factory defaults	does not begin automatically
you have reset the receiver to its factory defaults	the factory defaults, or those in the power up file	does not begin automatically
you have performed a full reset	the factory defaults, because resetting deletes any power up file	does not begin automatically

Power up settings

When you turn off the receiver, any changes that you have made to logging settings are lost and these settings are returned to the factory defaults. Other settings remain as defined in the current file. The next time you turn on the receiver, the receiver checks for a power up file and, if one is present, applies the settings in this file.

When you use the Power button to turn off and then turn on the receiver and ...	then logging settings are ...	and all other settings are ...
you changed the receiver settings by applying an application file	the factory defaults	the last settings used
you changed the receiver settings using configuration software	the factory defaults	the last settings used

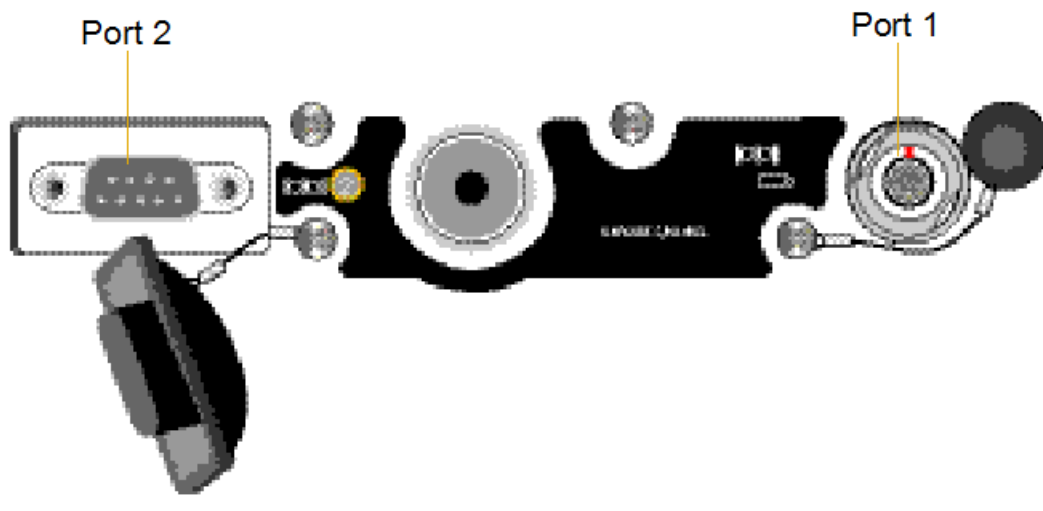
Cables and Connectors

- [Port 1 and 2 connectors](#)
- [Power/serial data cables](#)

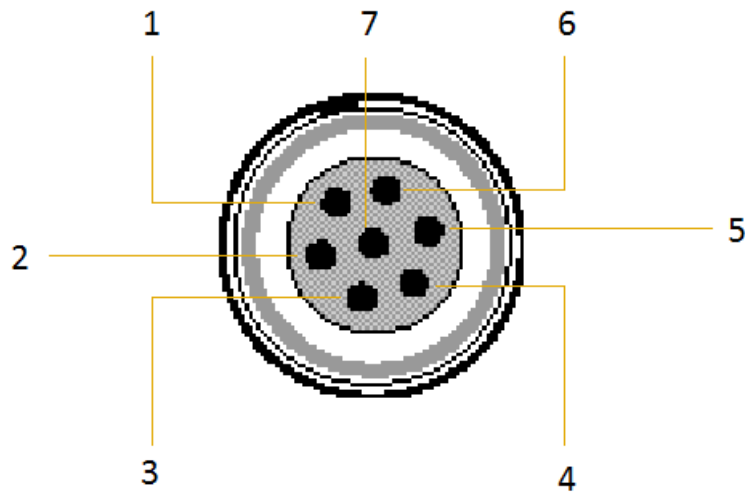
This chapter describes the pinouts for the receiver standard and optional cables. This information can be used to prepare special cables for connecting the receiver to devices and instruments not supported by the standard and optional cables.

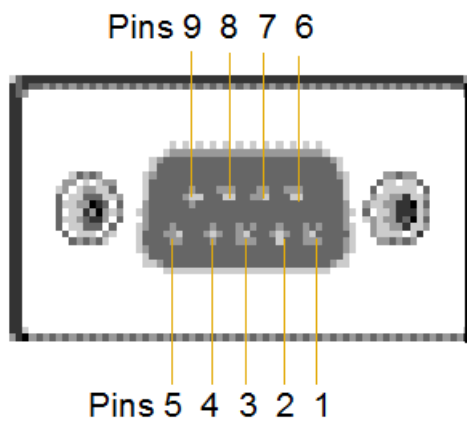
Port 1 and 2 connectors

The following figures show the receiver serial ports and pinout connections.



Port 1:



Port 2:

Pin	Pinout function Port 1 – 7-pin Lemo	Port 2 – DB-9
1	Signal ground	DCD
2	Power ground	RXD
3	TXD	TXD
4	N/C	DTR
5	N/C	Signal ground
6	+ Power in	DSR
7	TRXD	RTS
8	N/A	CTS
9	N/A	Ring indicator

Power/serial data cables

The data-I/O cable is supplied with the receiver.

The table below assumes that the cable is attached to the connector labeled Port 2:

DB-9 Female 9-pin		DB-9 Female 9-pin	
Pin	Function	Pin	Function
1-6	DCD5_232	4	DTR5_232
2	RX5_232	3	TX5_232
3	TX5_232	2	RX5_232
4	DTR5_232	1-6	DCD5_232
5	GND	5	GND
7	RTS5_232	8	CTS5_232
8	CTS5_232	7	RTS5_232
9	no connection RI5_232 9	9	

This data cable may be used for firmware upgrades and other computer functions with the receiver. Power must be supplied to the receiver through Port 1, or from the internal battery.

Note – This pinout information also applies to the power/serial data cable, which is optional for use with the receiver. This cable can be used for firmware upgrades through Port 1, while also supplying external power.

The table below assumes that the cable is attached to the connector labeled Port 1:

Lemo 0-shell connector 7-pin		Direction	DE9-F connector 7 Cond			Power lead 2 Cond	
Pin	Function		Pin	Color	Function	Color	Function
1	GND	<-->	5	Brown	Signal ground		
2	GND	-->				Black	V-OUT
3	TX3_232	-->	2	Orange	TXD		
4	RTS/TXD	-->	8	Blue	RTS		
5	CTS/RXD	<--	7	Green	CTS		
6	PWR_IN	<--				Red	Power IN (+)
7	RX3_232	<--	3	Yellow	TXD		

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 (proprietary Fugro message)
DTM	Datum reference information
GBS	GNSS satellite fault detection (RAIM support)
GGA	Time, position, and fix related data
GGK	Time, position, position type, DOP
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
PJK	Local coordinate position output
PJT	Projection type
PTNL,AVR	Time, yaw, tilt, range, mode, PDOP, and number of SVs for Moving Baseline RTK

Message	Function
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
PTNL,PJK	Time, position, position type, and DOP values
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

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
```

Message values

NMEA messages that the receiver generates contains the following values:

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

Field	Meaning
	S: South
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 ¹ .
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.

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: GLL

Position data: position fix, time of position fix, and status

An example of the GLL message string is:

```
$GPGLL,3953.88008971,N,10506.75318910,W,034138.00,A,D*7A
```

GLL message fields

Field	Meaning
0	Message ID \$GPGLL
1	Latitude in dd mm,mmmm format (0-7 decimal places)
2	Direction of latitude N: North S: South
3	Longitude in ddd mm,mmmm format (0-7 decimal places)
4	Direction of longitude E: East W: West
5	UTC of position in hhmmss.ss format
6	Status indicator: A: Data valid V: Data not valid This value is set to V (Data not valid) for all Mode Indicator values except A (Autonomous) and D (Differential)
7	The checksum data, always begins with * Mode indicator: A: Autonomous mode D: Differential mode E: Estimated (dead reckoning) mode M: Manual input mode S: Simulator mode N: Data not valid

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 the GP and/or GL talker ID 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,,*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. When more than one constellation is used. 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. • Subsequent characters will be added for new constellation. 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 GP and/or GL Age of differential data.
12	Reference station ID¹, range 0000-4095 – Null if Talker ID is GN. Additional GNS messages follow with GP and/or GL Reference station ID.
13	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 simplified 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: GRS

GRS range residuals

The GRS message is used to support the Receiver Autonomous Integrity Monitoring (RAIM).

Note – Because the contents of this NMEA message do not change significantly during a one-second interval, the receiver outputs this message at a maximum rate of 1 Hz.

An example of the GRS message string is:

```
$GPRGS,220320.0,0,-0.8,-0.2,-0.1,-0.2,0.8,0.6,,,,,1,*55
```

GRS message fields

Field	Meaning
0	Message ID \$GPRGS 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 GGA position fix
2	Residuals 0: Residuals used to calculate position given in the matching GGA line 1: Residuals recomputed after the GGA position was computed
3–14	Range residuals for satellites used in the navigation solution, in meters
15	Satellite System ID: GP(1), GL(2), GA(3), GB(4), GQ(0)

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
	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
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
3	Yaw
4	Tilt angle, in degrees
5	Tilt
6	Reserved
7	Reserved
8	Range, in meters
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 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

Field	Meaning
	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)

Field	Meaning
	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
	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

Field	Meaning
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)
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,PJT

Projection type

An example of the PTNL,PJT message string is:

```
$PTNL,PJT,NAD83(Conus),California Zone 4 0404,*51
```

PTNL,PJT message fields

Field	Meaning
0	Message ID \$PTNL,PJT
1	Coordinate system name (can include multiple words)
2	Project name (can include multiple words)
3	The checksum data, always begins with *

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

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
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,VHD
1	UTC of position in hhmmss.ss format
2	Date in mmddyy format

Field	Meaning
3	Azimuth
4	Azimuth/Time
5	Vertical Angle
6	Vertical/Time
7	Range
8	Range/Time
9	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
10	Number of satellites used in solution
11	PDOP
12	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 54](#).

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 \$GPRMC
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 54](#).

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 54](#).

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 \$GPZDA
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.

¹This 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.

RTCM Output

- Generated messages
- Message scheduling

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.rtcn.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

Message scheduling

The following table shows the frequency at which messages are generated when they are enabled in a base receiver:

Type	Frequency
1	Every second
3	The tenth second after the first measurement, then every ten seconds after that
9-3	Every second
18	Every second
19	Every second
22	The fifth second after the first measurement, then every ten seconds after that

Type	Frequency
23	The fourth second after the first measurement, then every ten seconds after that
24	The fourth second after the first measurement, then every ten seconds after that
59-sub, 13	The fifth second after the first measurement, then every ten seconds after that
1004	Every second
1006	Every ten seconds, offset by two seconds
1008	Every ten seconds, offset by one second
1012	Every second
1013	Every ten seconds, offset by three seconds
1033	Every ten seconds

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 12](#).

Troubleshooting LED conditions

An 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 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 flashing rapidly

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

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.

Possible cause	Solution
External power is not properly connected.	Check that the Lemo connection is seated properly.
	Check for broken or bent pins in the connector.
Faulty external power cable.	Try a different cable.
	Check pinouts with multimeter to ensure internal wiring is intact.

The receiver does not log data

Possible cause	Solution
Insufficient internal memory.	Delete old files using the Trimble Access software, or by holding down the Power button for 30 seconds. For more information, see Button functions, page 22 .
The receiver is tracking fewer than four satellites.	Wait until the SV Tracking LED is flashing slowly.

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 22 .
The receiver needs a full reset.	Press the Power button for 30 seconds. For more information, see Button functions, page 22 .

Reference receiver is not broadcasting

Possible cause	Solution
Port settings between reference receiver and radio are incorrect.	Use the Trimble Access software to connect directly to the radio and change the port settings. Try to connect to the radio through the receiver to ensure that they are communicating.
Faulty cable between receiver and radio.	Try a different cable.
	Examine the ports for missing pins.
	Use a multimeter to check pinouts.

Possible cause	Solution
No power to radio.	If the radio has its own power supply, check the charge and connections.

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.
Incorrect port settings between roving external radio and receiver.	If the radio is receiving data (the Power LED is flashing) and the receiver is not getting radio communications, use the Trimble Access software to check that the port settings are correct.
The cellular modem does not have hardware flow control enabled.	Disable flow control on the modem. Use a special cable. For more information, refer to the document Using Cellular and CDPD Modems for RTK, which is available from your Trimble Reseller.