ALLOY

GNSS REFERENCE RECEIVER

USER GUIDE

Version 5.45
Revision B
September 2020

Corporate Office

Trimble Inc.
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USA

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Legal Notices

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Microsoft, and Windows are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

The Bluetooth word mark and logos are owned by the Bluetooth SIG, Inc. and any use of such marks by Trimble Inc. is under license.

All other trademarks are the property of their respective owners.

Support for Galileo is developed under a license of the European Union and the European Space Agency.

Release Notice

This is the September 2020 release (Revision B) of the [System Name] documentation. It applies to version 5.45 of the receiver firmware.

Product Limited Warranty Information

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

COCOM limits

This notice applies to the Alloy receiver.

The U.S. Department of Commerce requires that all exportable GPS products contain performance limitations so that they cannot be used in a manner that could threaten the security of the United States. The following limitations are implemented on this product:

– Immediate access to satellite measurements and navigation results is disabled when the receiver velocity is computed to be greater than 1,000 knots, or its altitude is computed to be above 18,000 meters. The receiver GPS subsystem resets until the COCOM situation clears. As a result, all logging and stream configurations stop until the GPS subsystem is cleared.

Notices

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

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.

This equipment must be installed and operated in accordance with provided instructions and the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm (for Bluetooth) from all persons and must not be co-located or operated in conjunction with any other antenna or transmitters (except in accordance with the FCC multi -transmitter product procedures).

Korea

잡동은 다음 두 조건을 전제로 합니다.

(1) 이 기기가 유해한 간섭을 초래하지 않을 수 있음,

(2) 작동 장애를 초래할 간섭 등 제반 간섭을 이 기기가 수용해야 함.

Canada

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

This apparatus complies with Canadian RSS-GEN, RSS-247, and RSS-119.

Cet appareil est conforme à la norme CNR-GEN, CNR-247, et CNR-119 du Canada.

Europe

The products covered by this guide may be operated in all EU member countries (BE, BG, CZ, DK, DE, EE, IE, EL, ES, FR, HR, IT, CY, LV, LT, LU, HU, MT, NL, AT, PL, PT, RO, SI, SK, FI, SE, UK), Norway and Switzerland. Products been tested and found to comply with the requirements for a Radio Equipment device pursuant to European Council Directive 2014/53/EU on EMC, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA). Contains a Bluetooth radio module. These requirements are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential or commercial environment.

CE Declaration of Conformity

Hereby, Trimble Inc., declares that the GNSS receiver is in compliance with the essential requirements and other relevant provisions of Radio Equipment Directive 2014/53/EU.

English	Hereby, Trimble Inc., declares that this receiver is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.
Finnish	Trimble Inc.vakuuttaa täten että vastaanotin tyyppinen laite on direktiivin 2014/53/EU oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Dutch	Hierbij verklaart Trimble Inc. dat het toestel ontvanger in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 2014/53/EU. Bij deze verklaart Trimble Inc. dat deze ontvanger voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 2014/53/EU.
French	Par la présente Trimble Inc. déclare que l'appareil récepteur est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 2014/53/EU. Par la présente, Trimble Inc. déclare que ce récepteur est conforme aux exigences essentielles et aux autres dispositions de la directive 2014/53/EU qui lui sont applicables.
Swedish	Härmed intygar Trimble Inc. att denna mottagare står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 2014/53/EU.
Danish	Undertegnede Trimble Inc. erklærer herved, at følgende udstyr modtager overholder de væsentlige krav og øvrige relevante krav i direktiv 2014/53/EU.
German	Hiermit erklärt Trimble Inc., dass empfänger in Übereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 2014/53/EU befindet". (BMWi) Hiermit erklärt Trimble Inc. die Übereinstimmung des Gerätes empfänger mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 2014/53/EU. (Wien)
Greek	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Trimble Inc ΔΗΛΩΝΕΙ ΟΤΙ δέκτης ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 2014/53/EU.
Italian	Con la presente Trimble Inc. dichiara che questo ricevitore è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 2014/53/EU.
Spanish	Por medio de la presente Trimble Inc. declara que el receptor cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 2014/53/EU.
Portuguese	Trimble Inc. declara que este receptor está conforme com os requisitos essenciais e outras disposições da Directiva 2014/53/EU.

Australia and New Zealand

This product conforms with the regulatory requirements of the Australian Communications and Media Authority (ACMA) Radiocommunications Act, thus satisfying the requirements for RCM Marking and sale within Australia and New Zealand.

South Africa

This product conforms with the applicable radio regulations under the Electronic Communications Act 2005 (Act No. 36 of 2005). The Radio Equipment Type Approval Certificate number is TA-2018/157.

Malaysia

RFCM/06A/0818/S(18-2465)

Taiwan – Battery Recycling Requirements

This notice applies to the Alloy GNSS receiver.

The product contains a removable Lithium-ion battery. Taiwanese regulations require that waste batteries are recycled.

廢電池請回收

Taiwan – Type approval

經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。

前項合法通信，指依電信法規定作業之無線電通信。

低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

Singapore

Info-communications Media Development Authority.

Complies with
IMDA Standards
DA105282

Vietnam

Rossmap Joint Stock Co.
A0693108I8AE01A2
ICT

Mexico

La operación de este equipo está sujeta a las siguientes dos condiciones.

1. Es posible que este equipo o dispositivo no cause interferencia perjudicial.

2. Este equipo o dispositivo debe aceptar cualquier interferencia. Incluyendo la que pueda causar su operación no deseada.

Este equipo ha sido diseñado para operar con las antenas que enseguida se enlistan y para una ganancia máxima de antena de 1.6 dBi. El uso con este equipo de antenas no incluidas en esta lista o que tengan una ganancia mayor que 1.6 dBi quedan prohibidas. La impedancia requerida de la antena es de 50 ohms.

Instituto Federal de Telecomunicaciones, Certificado de Homogación Número: RCPTRAL18-0907

Brazil

ANATEL approval applies to Alloy.

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 Alloy

ANATEL
Agência Nacional de Telecomunicações

06313-18-06140

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

Trimble products in this guide comply in all material respects with DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 July 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive) and with exemptions for lead in solder pursuant to Paragraph 7 of the Annex to the RoHS Directive applied.

Waste Electrical and Electronic Equipment (WEEE)

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

People's Republic of China

Hazardous Substance Information for Chinese RoHS

产品中有毒有害物质或元素的名称及含量 (Name and Contents of Toxic and Hazardous Substances or Elements in Products)						
制品 P/N (Product PN) 10950-00	有害物质 (Hazardous Substance)					
零件名称 (Part Name)	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr6+)	多溴联苯 (PBB)	多溴联苯醚 (PBDE)
线缆 (Cables)	O	O	O	O	O	O
内部接线 (Internal Wiring)	O	O	O	O	O	O
液晶显示 (LCD Display)	O	O	O	O	O	O
按键盘 (Keypad)	O	O	O	O	O	O
供电器 (Power Supply)	O	O	O	O	O	O
印刷电路板装配 (Printed Circuit Board Assembly)	X	O	O	O	O	O
无线电模組 (Radio Module)	O	O	O	O	O	O
金属外壳 (Metal Enclosure)	O	O	O	O	O	O
硬件 (Hardware)	O	O	O	O	O	O
螺母，螺栓，螺丝，垫圈，紧固件 (Nuts, bolts, screws, washers, fasteners)	O	O	O	O	O	O
密封垫 (Gasket)	O	O	O	O	O	O
润滑油 (Grease)	O	O	O	O	O	O

本表格依据 SJ/T 11364 的规定编制。

O = 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572规定的限量要求以下。

X = 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572规定的限量要求。

制造日期代码信息
(Manufacturing Date Code Information)

日期代码编码的格式為10位数: AABBXDDDDD
例如- 4732D000167
AA = 年= 1960+AA 。例: 1960 +47 = 2007 年
BB = 星期= 制造于该年的第几星期。例: 产品生产于2007年的第32星期

产品Mfg 日期 另一个代码编码格式
日期代码编码的格式为10位数: XXXYWZZZAA
例如- 3507J750AA
XXX=制造于该年的第几天 。Y = 年。例: 7 = 2007 年
例: 产品生产于2007年的第350天

产品期间不包括这个项目。

TRIMBLE INC.

LIMITED WARRANTY TERMS AND CONDITIONS

Trimble Inc.
935 Stewart Drive
Sunnyvale, California 94085
United States of America

PRODUCT LIMITED WARRANTY

Subject to the following terms and conditions, Trimble Inc. ("Trimble") warrants that for a period of one (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. If accompanied by a separate end user license agreement (“EULA”), use of any such software will be subject to the terms of such end user license agreement (including any differing limited warranty terms, exclusions, and limitations), which shall control over the terms and conditions set forth in this limited warranty.

SOFTWARE FIXES

During the limited warranty period you will be entitled to receive such Fixes to the Product software that Trimble releases and makes commercially available and for which it does not charge separately, subject to the procedures for delivery to purchasers of Trimble products generally. If you have purchased the Product from a Trimble Authorized dealer rather than from Trimble directly, Trimble may, at its option, forward the software Fix to the Trimble Authorized dealer for final distribution to you. Minor Updates, Major Upgrades, new products, or substantially new software releases, as identified by Trimble, are expressly excluded from this update process and limited warranty. Receipt of software Fixes or other enhancements shall not serve to extend the limited warranty period.

For purposes of this warranty the following definitions shall apply: (1) “Fix(es)” means an error correction or other update created to fix a previous software version that does not substantially conform to its Trimble specifications; (2) “Minor Update” occurs when enhancements are made to current features in a software program; and (3) “Major Upgrade” occurs when significant new features are added to software, or when a new product containing new features replaces the further development of a current product line. Trimble reserves the right to determine, in its sole discretion, what constitutes a Fix, Minor Update, or Major Upgrade.

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 local Trimble Authorized dealer. Alternatively, you may contact Trimble to request warranty service by emailing your request to repair_services@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
- an explanation of the problem

The customer service representative may need additional information from you depending on the nature of the problem. Any expenses incurred in the making of a claim under this warranty will be borne by you.

Version 1.00
Revision E
July 2018
P/N 56504-00

Trimble

WARRANTY EXCLUSIONS AND DISCLAIMER

This Product limited warranty shall only apply in the event and to the extent that (a) 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; (b) 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 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 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.

THE FOREGOING LIMITED WARRANTY TERMS STATE TRIMBLE'S ENTIRE LIABILITY, AND YOUR EXCLUSIVE REMEDIES, RELATING TO THE TRIMBLE PRODUCT UNDER THIS LIMITED WARRANTY. EXCEPT AS OTHERWISE EXPRESSLY PROVIDED HEREIN, THE PRODUCT AND ACCOMPANYING DOCUMENTATION AND MATERIALS ARE PROVIDED "AS-IS" AND WITHOUT EXPRESS OR IMPLIED WARRANTY OF ANY KIND, BY EITHER TRIMBLE OR ANYONE WHO HAS BEEN INVOLVED IN ITS CREATION, PRODUCTION, INSTALLATION, OR DISTRIBUTION, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OR GUARANTEES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, TITLE, AND NONINFRINGEMENT. THE STATED EXPRESS WARRANTIES ARE IN LIEU OF ALL OBLIGATIONS OR LIABILITIES ON THE PART OF TRIMBLE ARISING OUT OF, OR IN CONNECTION WITH, ANY PRODUCT. BECAUSE SOME STATES AND JURISDICTIONS DO NOT ALLOW LIMITATIONS ON DURATION OR THE EXCLUSION OF AN IMPLIED WARRANTY, THE ABOVE LIMITATION MAY NOT APPLY OR FULLY APPLY TO YOU.

LIMITATION OF LIABILITY

TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, TRIMBLE'S ENTIRE LIABILITY UNDER ANY PROVISION HEREIN SHALL BE LIMITED TO THE AMOUNT PAID BY YOU FOR THE PRODUCT AND IN NO EVENT SHALL TRIMBLE OR ITS

SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGE WHATSOEVER UNDER ANY CIRCUMSTANCE OR LEGAL THEORY RELATING IN ANYWAY TO THE PRODUCTS, SOFTWARE AND ACCOMPANYING DOCUMENTATION AND MATERIALS, (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF DATA, OR ANY OTHER PECUNIARY LOSS), REGARDLESS OF WHETHER TRIMBLE HAS BEEN ADVISED OF THE POSSIBILITY OF ANY SUCH LOSS AND REGARDLESS OF THE COURSE OF DEALING WHICH DEVELOPS OR HAS DEVELOPED BETWEEN YOU AND TRIMBLE. BECAUSE SOME STATES AND JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, THE ABOVE LIMITATION MAY NOT APPLY OR FULLY APPLY TO YOU.

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 TRIMBLE AUTHORIZED DEALER FROM WHOM THE PRODUCTS ARE ACQUIRED. IN SUCH A CASE, PLEASE CONTACT YOUR LOCAL TRIMBLE AUTHORIZED DEALER FOR APPLICABLE WARRANTY INFORMATION.

OFFICIAL LANGUAGE

THE OFFICIAL LANGUAGE OF THESE TERMS AND CONDITIONS IS ENGLISH. IN THE EVENT OF A CONFLICT BETWEEN ENGLISH AND OTHER LANGUAGE VERSIONS, THE ENGLISH LANGUAGE SHALL CONTROL.

THE AUSTRALIAN CONSUMER LAW

Our goods come with guarantees that cannot be excluded under the Australian Consumer Law. You are entitled to a replacement or refund for a major failure and for compensation for any other reasonably foreseeable loss or damage. You are also entitled to have the goods repaired or replaced if the goods fail to be of acceptable quality and the failure does not amount to a major failure.

Trimble's warranty (set out above) is in addition to any mandatory rights and remedies that you may have under the Australian Consumer Law.

REGISTRATION

To receive information regarding updates and new products, please contact your local Trimble Authorized Distribution Partner or visit the Trimble website at https://mytrimbleprotected.com/customer. Upon registration you may select the newsletter, upgrade, or new product information you desire.

Safety Information

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

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

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

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

Use and care

This product is designed to withstand the rough treatment and tough environment that typically occurs in reference receiver 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.

Regulations and safety

The receiver contains an internal radio-model for communicating signals through Bluetooth wireless technology or through an external data communications radio. Regulations regarding the use of 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 dealer.

Before operating a Trimble receiver with an external modem, determine if authorization or a license to operate the unit is required in your country. It is the responsibility of the end user to obtain an operator's permit or license for the receiver for the location or country of use.

For FCC regulations, see Notices.

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.

Exposure to radio frequency radiation

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. See *FCC OET Bulletin No. 56, Evaluating Compliance With FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields*.

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

- *DO NOT* operate the transmitter when someone is within 28 cm (11 inches) of the antenna.
- *DO NOT* operate the transmitter unless all RF connectors are secure and any open connectors are correctly terminated.
- *DO NOT* operate the equipment near electrical blasting caps or in an explosive atmosphere
- All equipment must be correctly grounded according to Trimble installation instructions for safe operation.
- All equipment should be serviced only by a qualified technician.

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 25 cm (9.84 inches) 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 25 cm (9.8 inches) between yourself and the radiating antenna.
- Do not co-locate the antenna with any other transmitting device.

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

Battery safety

The rechargeable Lithium-ion battery is supplied at 30% or less of its capacity. Charge the battery completely before using it for the first time. If the battery has been stored for longer than three months, charge it before use.

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

- Do not charge or use the battery if it appears to be damaged or leaking.
- Charge the Lithium-ion battery only in a Trimble product that is specified to charge it. Be sure to follow all instructions that are provided with the battery charger.
- Discontinue charging a battery that gives off extreme heat or a burning odor.
- Use the battery only in Trimble equipment that is specified to use it.
- Use the battery only for its intended use and according to the instructions in the product documentation.

⚠ 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.

Storing the Lithium-ion battery

Do not store batteries in the receiver or in the external charger for an extended period of time unless power is applied.

Keep all batteries on continuous charge when not in use for an extended period of time. You can keep batteries on charge indefinitely without damage to the batteries.

DC power supply

⚠ WARNING – When DC voltage is applied to this receiver through connectors 2 or 3 (Lemo connectors), the DC voltage must be limited to no more than 28 V DC +0% under both normal and single fault conditions. If the recommended input voltage is exceeded, the receiver may present an electrical hazard.

Wet locations

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

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

⚠ WARNING – Do not power the receiver through external power when operating in a wet environment or an environment that may become wet. The power input connections must be sheltered.

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 over Ethernet

⚠ WARNING – When this product is connected to a Power over Ethernet connection, the source of the Ethernet power must meet IEEE 802.11af, and its DC output (Ethernet power source) must be completely isolated from earth ground (floating), or a shock hazard may exist.

⚠ WARNING – When this product is connected to a PoE connection, the DC voltage must be limited to 57 V DC +0% under both normal and single fault conditions. This product may present an electrical hazard if the recommended input voltage is exceeded.

Contents

1

Getting Started

Introduction

The Alloy GNSS reference receiver can be used for the following infrastructure and site development applications:

- CORS base for the Trimble Pivot™ software or other software applications
- Radio or cellular RTK or DGNSS base
- Simultaneous TCP/IP, UDP/IP, or serial output of corrections
- Campaign rover receiver

The Alloy receiver incorporates a GNSS receiver and up to two internal batteries with GNSS and Wi-Fi antenna connections. A 4-line OLED display enables monitoring of satellite tracking, data logging status, Wi-Fi, and power.

In addition to its obvious reference station functionality, the Alloy receiver can be used as a RTK rover or as a static rover typically used in campaign survey projects. The receiver can record GNSS data to the receiver's internal memory and download to a computer using the serial (cable or Bluetooth), Ethernet or Wi-Fi connections.

The receiver can be configured in the following ways:

- The front panel display in normal or reverse mode
- Connection via the web interface over Ethernet or Wi-Fi
- Connection via the Mobile web interface over Wi-Fi to a mobile phone
- Use an application file. To edit an application file, use the web interface. See Receiver Configuration – Application Files.

Alloy features

The Alloy GNSS reference receiver has the following features:

- Robust, lightweight design – 1.75 kg (3.85 lb) (GNSS receiver and batteries)
- Can be used as a rover, base station, or as both a rover and a base station.
- Trimble xFill™ RTK service is already installed.
- Trimble RTX worldwide corrections
- Advanced Trimble dual Maxwell™ 7 GNSS chipset provide 672 channels for simultaneous satellite tracking of GPS, QZSS, GLONASS, Galileo, BeiDou, and IRNSS satellites
- Trimble EVEREST Plus™ multipath signal rejection
- Trimble 360 receiver technology
- High-precision multiple correlator for GNSS pseudorange measurements
- Spectrum Analyzer to troubleshoot GNSS jamming
- Enhanced security option

  The California Consumer Privacy Act (CCPA) is a new data privacy law, effective from 1 January 2020. The law is intended to enhance privacy rights and consumer protection for residents of California, United States. It requires manufacturers of devices that connect "directly or indirectly" to the Internet to equip the devices with "reasonable" security features. The law requires that depending on the nature and purpose of the device, if a device can be accessed outside a local area network then the password for the device needs to either be unique for each device OR force the user of the device to set their own password. Although the law is currently specific to California, Trimble has chosen to implement the changes to all affected devices shipped from Trimble before 1 January 2020.

  For more information, see Logging in.

  Bluetooth security has been modified for enhanced security. For more information, see Bluetooth Configuration.
- Unfiltered, unsmoothed pseudorange measurements data for low noise, low multipath error, low-time domain correlation and high-dynamic response
- Very low noise GNSS carrier phase measurements with <1 mm precision in a 1 Hz bandwith
- Signal-to-noise ratio reported in dB-Hz
- Proven Trimble low elevation tracking technology

- Proprietary Receiver Autonomous Integrity Monitor (RAIM) system to detect and reject degraded signals to improve position quality
- Up to two internal, hot swappable, smart Lithium-ion batteries
- Bluetooth® wireless technology and Wi-Fi for cable-free, no-hassle, base or rover operation.
- Advanced four-line reversible front panel display with Power button, Enter, Escape, and navigation arrow keys for control and monitoring
- 20 Hz standard output rate, upgradable to 50 or 100 Hz
- Seamless connection to the Trimble Pivot™ software
- Can operate as an autonomous base with corrections supplied via NTRIP, direct socket connections, or via external radio
- Full data logging functionality with HTTP or FTP download capabilities
- FTP push functionality supported
- File format conversion support for HTTP downloads
- Can act as an Network Time Protocol server
- Built-in Dynamic DNS client support
- HTTP or HTTPS web interface access is supported.
- Built-in multi-language support for the web interface
- Operates within a VRS network or IBSS for conventional base station-free rover capability
- GPS (including GPS Block IIIA) and GLONASS supported as standard, upgradeable to receive Galileo, BeiDou, QZSS, and/or IRNSS

  NOTE – The Alloy receiver now supports the new GPS Block IIIA L1C signal. Please note that GPS III satellites are still launching and are not fully operational. The L1C signal frequency is 1575.42 MHz. The Alloy receiver requires a new option code to track the L1C signal. To obtain an upgrade code for the L1C signal, please contact Trimble Support (RTNS_Support@trimble.com) with the serial numbers of your Alloy receivers.

NOTE – The Alloy receiver can track the new signals that are part of the third-generation of Beidou satellites:

- *B1C - 1575.42 MHz.*
- *B2A - 1176.45 MHz.*
- *B2B - 1207 MHz. Not currently supported in the Pivot software.*

The Alloy receiver includes an updated pseudorange to extend the tracking from 37 to 63 BeiDou satellites with an extended almanac. The Beidou tracking option is required for this improvement. If you already have the Beidou upgrade for the Alloy receiver, please contact support (RTNS_Support@Trimble.com) to get a new key to track the B1C; B2A is already supported.

- Five SBAS channels
- 8 GB memory standard, upgradeable to 24 GB
- RoHS compliant
- Anti-spoofing feature

2

Receiver Web Interface

This section of the user guide provides a detailed overview of the web interface.

Web interface menus

Use the web interface to configure the receiver settings.

Supported languages

The web interface is available in the following languages:

- English (en)
- Chinese (zh)
- Dutch (nl)
- Finnish (fi)
- French (fr)
- German (de)
- Italian (it)
- Japanese (ja)
- Norwegian (n)
- Polish (pl)
- Portuguese (pt)
- Russian (ru)
- Spanish (es)
- Swedish (sv)

Use the **Receiver Configuration** / **Default Language** setting to select the default language for your use.

The web interface shows the configuration menus on the left of the browser window, and the settings on the right. Each configuration menu contains related submenus to configure the receiver and monitor receiver performance.

Supported browsers

For PCs and laptops, current versions of these HTML browsers are supported:

- Google Chrome (recommended)
- Mozilla Firefox
- Microsoft Internet Explorer for Windows operating systems
- Opera
- Apple Safari

Receiver Status menu

The **Receiver Status** menu provides a quick link to review the receiver's available options, current firmware version, IP address, temperature, runtime, satellites tracked, current outputs, available memory, position information, and more.

Receiver Status – Activity

This page shows general information about the current state of the receiver:

Satellites Tracked – Shows a list of all the satellites that the receiver is currently tracking. The number of satellites being tracked depends on controls specified on the Satellites and Receiver Configuration pages. This list contains the GPS, GLONASS, OmniSTAR, and SBAS satellite IDs that are being tracked.

Input/Output – A list of all input and output activity currently enabled in the receiver.

Temperature – Displays the internal temperature of the receiver. This value is typically 10 °C higher than the ambient temperature.

Runtime – Displays the current uptime of the receiver. The runtime value is reset to zero when you restart the Trimble receiver.

Disk – If the Data Logging option is installed, the current availability of the internal memory will be shown.

Wireless Connections – Displays a list of wireless connections and their status, the list may include Wi-Fi Access Point, Wi-Fi Client and Bluetooth PAN if available and connected.

Bluetooth PAN (Personal Area Network) profile. When a device is paired to the Trimble receiver using Bluetooth wireless technology and the Access Point service is connected, the device can open the receiver web interface on this IP. The default address is 192.168.143.1

Receiver Status – Position

This page shows general information about the current position solution derived from satellite measurements. This information includes:

Position – Shows the current position solution.

- Lat – Latitude in degrees, minutes, and seconds.
- Lon – Longitude in degrees, minutes, and seconds.
- Hgt – Height above the ellipsoid to the Antenna Phase Center in meters.

> ⚠ CAUTION – The position output by the receiver is the Antenna Phase Center position. You may want to reduce this position to a reference position elsewhere. If so, you should account for any tilt of the antenna in such a reduction. The settings for the Antenna Measurement Method and Antenna Height are not applied to this output.

- Type – Current position type.
  - Old – No updated position available.
  - Autonomous – Position has no satellite corrections applied.
  - Code Diff – Code differential solution – typically a single-frequency solution.
  - Phase Diff – Carrier phase differential solution (also known as Real-Time Kinematic (RTK) solution), typically a dual-frequency solution.
  - OmniSTAR VBS – Position using OmniSTAR VBS satellite-based correction service.
  - OmniSTAR XP – Position using OmniSTAR XP satellite-based correction service.
  - OmniSTAR HP – Position using OmniSTAR HP satellite-based correction service.
  - OmniSTAR HP+G2 – Position using OmniSTAR HP and G2 satellite-based correction service.
  - CDGP – Position using the Canadian DGPS corrections.
  - SBAS+ – Position using the SBAS Plus corrections.
  - SBAS – Position using SBAS corrections.
  - GVBS – Position using the clocks and orbits information from RTX corrections to augment the autonomous solution.
  - RTK and RTK Location – Carrier phase double difference position correction service.
  - RTX – Position using Trimble CenterPoint RTX satellite-based or IP correction service.

  - **xFill** – Position using Trimble xFill RTK augmentation service (5 minute duration limit).
  - **xFill-RTX** – Position using Trimble xFill RTK augmentation service with unlimited duration. Service requires a CenterPoint RTX subscription.
- **Precision** – Displays the precision capability of the receiver.
- **Datum** – Displays the datum that the position is referenced to.
- **Velocity** – Shows the apparent velocity of the receiver derived from the difference of the current position relative to the previous position.
  - **North** – The apparent velocity in the grid north direction, in meters per second.
  - **East** – The apparent velocity in the grid east direction, in meters per second.
  - **Up** – The apparent velocity in the vertical direction, in meters per second.

  NOTE – A stationary receiver shows some velocity due to minor differences in the position solution each time it is computed. The receiver must be moving for these values to be meaningful for anything other than general status information.

Position Solution Detail – Shows the following information:

- **Position Dimension** –
  - **Clock Only** – Accurate time is computed.
  - **1D** – Vertical position only is being computed.
  - **2D** – Horizontal position only computed.
  - **3D** – Horizontal and Vertical position computed.
- **Motion Info** – Only available for an RTK position solution.
  - **Roving** – Antenna can be in motion or static. Also known as Kinematic.
  - **Static** – Antenna is known to be static. This does provide some improvement in accuracy for RTK applications. When the receiver is in static mode, the antenna should not move at all.
- **Augmentation** – Shows which constellations are used in the position solution.
  - **GPS** – GPS satellites.
  - **GLN** – GLONASS satellites.
  - **BDS** – BeiDou satellites.
  - **GAL** – Galileo satellites.
  - **SBAS** – Satellite Based Augmentation Systems such as:
    - WAAS (North America)
    - EGNOS (Europe)

    - IRNSS (India)
  - QZSS – Quazi Zenith Satellite System (Japan).
  - IRNSS – Indian Regional Navigation Satellite System (India).
- RTK Solution – Only available for an RTK position solution.
  - Normal – Normal dual-frequency RTK solution.
  - L1 Only – Solution uses L1 frequency only.
- RTK Init – Only available for an RTK position solution.
- RTK Mode – Only available for an RTK position solution.
  - Synchronized – Position updates are synchronized with the appropriate CMR input, which is subject to the latency of the transport (radio).
  - Low Latency – Base measurements are predicted so that position updates are generated with only minimal latency (20 ms).
  - N/A– Non-RTK position.
- RTK Network Mode – Only available for an RTK position solution.
  - Single Base Line – Single RTK base station.
  - Network – Such as the Trimble VRS Network.
  - Global – Such as the Trimble RTX global correction service.
- Age of Corrections – If differential corrections are being used, the age of the differential corrections, in seconds, at the time of the shown position fix.
- SBAS PRN – If the receiver is in SBAS mode (WAAS/EGNOS/ etc), this shows which of the tracked SBAS satellites the receiver is using corrections from to generate the corrected position.
- Height Mode –
  - Normal – Not constrained by height input.
  - Constrained Height – An external height constraint for the antenna position. The receiver will produce a height value within the constraints provided by the external application.
- xFill Status –
  - Running – xFill is in operation. The Web interface displays xFill in the position type instead of RTK position type. If xFill runs for more than five minutes, this xFill status will display the **Ready** status while position type will no longer be xFill.

- **Ready** – The offset between the RTK datum and the xFill datum has been determined and the receiver can go to xFill positioning if the RTK position is ever lost. It shows **Ready** even if your receiver does not have xFill installed, but is tracking the RTX satellite
- **Not Ready** – The offset between the receivers RTK datum and the xFill datum has not yet been determined. It typically takes 10 minutes of concurrent RTK positioning and tracking of the RTX satellite for this to go to the Ready status. It can also mean the xFill satellite is not being tracked or the OmniSTAR tracking has been selected.
- **Not Available** – That means the receiver is not capable of offering this service

- **Correction Controls** –
  - **Off** – There are no user-defined correction controls.
  - **On** – User-defined correction controls are active.

Satellites Used – Shows the list of satellites used in the current position solution. Satellites may be tracked by the receiver but not used in the position solution. Satellites may not be used if no ephemeris available, measurements do not meet the receiver's quality requirements, or differential correction data is not available.

Satellites Tracked – Shows the list of all satellites being tracked by the receiver. Some of the satellites tracked may not be used in the position solution. The number of satellites tracked by each antenna is shown in brackets.

Receiver Clock – Shows information about the receiver clock performance.

- **GPS Week** – Current GPS week. Incremental number of weeks, starting at 0 hour UTC on the date January 6, 1980.
- **GPS Seconds** – Current time in GPS seconds. Incremental number of seconds, starting at 0 hour UTC on the date January 6, 1980.
- **Offset** – The difference between the current time as reported by the clock and the time derived from the GPS position solution.
- **Drift** – The rate at which the receiver clock is drifting from the time derived from the GPS position solution.

Multi-system clock offsets – Shows information about the time differences between the clocks used by different satellite systems.

- **Master Clock System** – The satellite system clock being used by the receiver.
- **GLONASS Offset** – The offset between the master clock and the GLONASS clock when GLONASS satellites are being tracked.

- **Galileo Offset** – The offset between the master clock and the Galileo clock when Galileo satellites are being tracked.
- **BeiDou Offset** – The offset between the master clock and the BeiDou clock is changing when BeiDou satellites are being tracked.
- **GLONASS Drift** – The rate at which the offset between the master clock and the GLONASS clock is changing when GLONASS satellites are being tracked.
- **Galileo Drift** – The rate at which the offset between the master clock and the Galileo clock is changing when Galileo satellites are being tracked.
- **BeiDou Drift** – The rate at which the offset between the master clock and the BeiDou clock is changing when BeiDou satellites are being tracked.
- **IRNSS Drift** – The rate at which the offset between the master clock and the IRNSS clock is changing when IRNSS satellites are being tracked.

Dilutions of Precision – Shows information about the strength of the satellite constellation with respect to a specific position attribute. The various DOPs take into account the location of each satellite relative to other satellites in the constellation, as well as their location relative to the receiver. Low DOP values indicate a higher probability of precision (lower precision dilution).

- **PDOP** – Position DOP, indicates the strength of the satellite constellation for general position precision.
- **HDOP** – Horizontal DOP, indicates the strength of the satellite constellation for horizontal position precision.
- **VDOP** – Vertical DOP, indicates the strength of the satellite constellation for vertical position precision.
- **TDOP** – Time DOP, indicates the strength of the satellite constellation for determining time and the clock offset.

Error Estimates (1-Sigma) – Shows the variation of the current position with a 68% confidence.

- **North** – The apparent variation of the receiver position in the grid north direction, in meters.
- **East** – The apparent variation of the receiver position in the grid east direction, in meters.
- **Up** – The apparent variation of the receiver position in the vertical direction, in meters.
- **Semi Major Axis** – The semi major axis of the error ellipse.
- **Semi Minor Axis** – The semi minor axis of the error ellipse.
- **Orientation** – The orientation of the major axis of the error ellipse.

Current Date/Time – At the very bottom of the Position page the current UTC date and time is displayed in the format YYYY-MM-DDTHH:MM:SSZ (UTC).

Position (Graph)

The graph(s) provide historical position information for the receiver, showing the selected data source over time.

Data Source – East, North, Height, East/North, Horizontal, PDOP/SVs, Age of Corrections, Heading, MSS (OmniSTAR.)

Data Rate – Determines which data buffer is used. The receiver has two buffers, both buffers are volatile so reset if the receiver is restarted.

- 10 Second Positions – The "10 Second" buffer contains data for up to the last 24 hours at 10 second intervals. The graphs displayed update every 10 seconds as new data is sent from the receiver to the browser.
- High Rate Positions – The "High Rate" buffer is 5,000 elements long and contains the last 5,000 positions the receiver computed. The time-span depends on the position rate of the receiver. Once the graph is drawn, data is sent from the receiver to the browser at the position rate, so the graphs update in real time only, subject to network and browser latencies.

New Window – When you click this, the graph is drawn on its own in a new window. The URL can be wrapped in an iFrame, which can be used in the Trimble Connected Community™ or other applications.

NOTE – You need version 9 or 10 of the Adobe Flash Plugin installed. As all the graphics handling is done in the browser using Adobe Flash Player, the load on the receiver is minimal.

Other Operations

- Zoom-in – Click in the graph area, hold down the mouse and then define the area you want to zoom into. Release the mouse. The plot zooms in to the selected area.
- Zoom-out – Right-click. From the shortcut menu, choose to zoom to the previous zoom level, zoom to the original view, or zoom out by a factor of 2. You can do this numerous times to make the graph canvas larger than the original view. The keyboard shortcuts are: **p**-previous, **r**-reset view, and **o**-zoom out by a factor of 2.
- Print – Right-click. A shortcut menu appears. Print the graph to a printer.
- Save as PNG – Saves the graph as a PNG file.

Data Handling – If you do not change the data view and the browser does not redraw the view, new data is added to the graph without a redraw. If a redraw is done for any reason, only data cached by the browser is re-drawn. The browser has an 18,000 point historical buffer of points it will attempt to redraw. When the buffer is full, old points are dropped.

Symbol key – The cyan-colored cross shows the current position. The red-colored cross shows the receiver's reference position. If no reference position is present, then the red cross does not appear.

Receiver Status – Vector

This page shows the RTK vector information. The RTK vector information is available only when the Trimble receiver is receiving RTK corrections from a static RTK base. The vector information includes:

Vector – The RTK vector between the base and rover antennas. The RTK information is only displayed if the receiver is receiving valid RTK correction data.

- North – The apparent vector in the local geodetic north direction, given in meters.
- East – The apparent vector in the local geodetic east direction, given in meters.
- Up – The apparent vector in the local geodetic up direction, given in meters to the Antenna Phase Center (APC).
- Range – The length of the vector from the APC of the Base antenna to the APC of the Rover antenna, given in meters.

Position – The current position solution in the satellite reference system of the position antenna.

- Lat – Latitude in degrees, minutes, and seconds.
- Lon – Longitude in degrees, minutes, and seconds.
- Hgt – Height above the Antenna Phase Center in meters.

⚠ CAUTION – The position output by the receiver is the Antenna Phase Center position. You may want to reduce this position to a reference position elsewhere. If so, you should account for any tilt of the antenna in such a reduction. The settings for the Antenna Measurement Method and Antenna Height are not applied to this output.

- Type – Current GNSS solution type.
- Datum – Displays the datum that the position is referenced to.

Base Position – Geographic location, height and name of the current moving base and the age of the corrections (the age of corrections are at the time of the Web page update).

Satellites Used – The list of satellites used by the position antenna (POS) for the current position solution.

Base SVs – A list of the satellites used by the base to generate corrections.

Error Estimates (1-Sigma) – The variation of the current position with a 68% confidence.

- Internal – Refers to the position of the Vector antenna of a dual-antenna receiver .
- External – Refers to the position of the Position antenna of a dual-antenna receiver .
- North – The apparent variation of the receiver position in the geodetic north direction, given in meters.

- **East** – The apparent variation of the receiver position in the geodetic east direction, given in meters.
- **Up** – The apparent variation of the receiver position in the geodetic up direction, given in meters.
- **Semi Major Axis** – The semi Major Axis of the apparent variation of the receiver position error ellipse.
- **Semi Minor Axis** – The semi Major Axis of the apparent variation of the receiver position error ellipse.
- **Orientation** – The orientation of the major axis of the error ellipse.

Dilutions of Precision –Information about the strength of the satellite constellation with respect to a specific position attribute. The various Dilution of Precision (DOP) values take into account the location of each satellite relative to other satellites in the constellation, as well as their location relative to the receiver. Low DOP values indicate a higher probability of precision.

- **PDOP** – (Position DOP). Indicates the strength of the satellite constellation for general position precision.
- **HDOP** – (Horizontal DOP). Indicates the strength of the satellite constellation for horizontal position precision.
- **VDOP** – (Vertical DOP). Indicates the strength of the satellite constellation for vertical position precision.
- **TDOP** – (Time DOP). Indicates the strength of the satellite constellation for determining time and the clock offset.

Link Quality – The ID and quality of the correction transmissions.

- **Correction Controls** – User-defined correction controls are either On or Off.

Google Map

This page shows the Trimble receiver plotted on Google Maps in Satellite view mode. Your computer must be connected to the Internet for this feature to work.

Refresh Interval – Sets the refresh rate of the map, which is useful if the receiver is moving and you want to track its location.

Google Earth

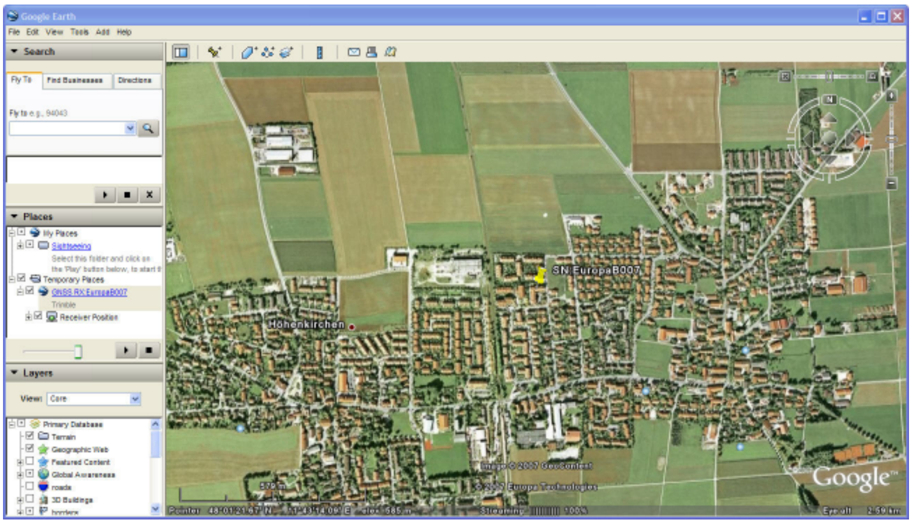
To use this feature, you must have Google Earth 4.1 or later installed. To download Google Earth, go to http://earth.google.com/download-earth.html.

Use the Google Earth menu to open Google Earth through a link in the receiver. This sets up a network link between the receiver and Google Earth. Google Earth shows the current position of the receiver; this is refreshed every 30 seconds.

To open Google Earth, click and then click **OK**. When Google Earth opens, you will see a placemarker showing the current position of the receiver.

NOTE – If you have security enabled, enter your username and password for the receiver's web interface into the Google Earth login box.

Once the data has loaded into Google Earth, it should look similar to the following screen. The point name shown is the serial number of the receiver:



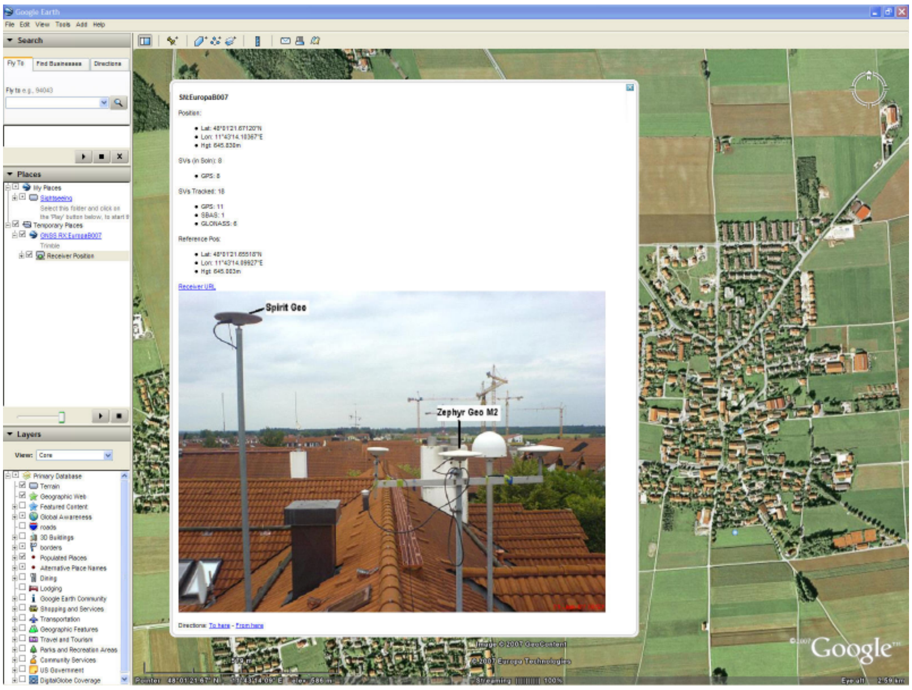
Every 30 seconds, the position of the placemarker updates with the current position of the receiver. Click the placemarker in Google Earth to view information about the current position and the number of satellites tracked.

The receiver provides you with the option of sending up to approximately 200 bytes of HTML to the placemarker (shown when you click the placemarker). This information must be well-formed HTML and can be used to provide links to other web pages and/or an image of the receiver.

NOTE – Version 4.10 of Google Earth does not allow you to use iframes. An example is shown of what could be added to the HTML field in the receiver, where "myServer" is a web server:

<img width="500" src='http://myServer/AntennaLocation.png'></img>

Then, when you click the placemarker it also downloads and shows "AntennaLocation.png", as shown in the following graphic. Approximately every 30 seconds the placemarker disappears as Google Earth refreshes to show the receiver's position.



Receiver Status – Identity

This page shows information about the identity of the Trimble receiver.

Receiver Type – Shows the receiver model.

System Name – Provides a way to distinguish between receivers. In the System Name field at the bottom of the screen, enter a logical name to identify the receiver such as "Rxr".

Serial Number – Shows the serial number of the Trimble receiver. This number is unique for the receiver model, so a combination of serial number and model is unique across all Trimble receivers. This is the most reliable way to identify a specific receiver.

Ethernet MAC Address – Shows the Ethernet MAC (Media Access Control) Address, which is an Ethernet hardware address that uniquely identifies each device on a network. The Trimble receiver has a unique address and you can use it to distinguish between multiple receivers on a network.

Ethernet IP – Shows the Ethernet IP address assigned to the receiver. This address is used to connect to the receiver using the Ethernet port. This address may be static, or it may change over time (DHCP), depending on the Ethernet configuration of the receiver.

DNS Address – Shows the IP address of the DNS server.

Secondary DNS Address – Shows the IP address of the secondary DNS server.

DNS resolved name – Shows the DNS (Domain Name System) name, which is an alternate way of addressing the receiver on the network. The name is used as an alias for the Ethernet IP. It is a combination of the System Name and Domain, which are specified using the Ethernet configuration menu and the WinFlash utility.

Zeroconf/mDNS address – Shows the address used for the hardware when Zero Configuration service discovery (mDNS/DNS-SD) is enabled and in use.

Bluetooth MAC Address – Shows the Bluetooth hardware address that uniquely identifies each device of a network. The Trimble receiver has a unique address and can be used to distinguish between multiple receivers on a network.

Bluetooth PAN IP Address – Shows the IP address used by the Network Access Point (NAP) service of the Bluetooth PAN (Personal area Network) profile. When a device is paired to the Trimble receiver using Bluetooth wireless technology and the Access Point service is connected, the device can open the receiver web interface on this IP. The default address is 192.168.143.1.

Firmware Version – Identifies the current software version running on the Trimble receiver. Usually this will be the same as the Core Engine version unless some additional functionality has been added that is independent of the core receiver operation.

Core Engine Version – Identifies the current core software running on the Trimble receiver. This information is used to determine if more recent firmware is available from Trimble, and also to identify the firmware if you need to contact Trimble Support. Receiver firmware is loaded using the Install New Firmware menu.

Firmware Date – Identifies the date that the current software running on the Trimble receiver was released.

RTK Version – Identifies the current version of the RTK engine. Used for troubleshooting with technical support

RTX Version – Identifies the current version of the RTX engine. Used for troubleshooting with technical support.

Monitor Version – Identifies the current monitor version on the Trimble receiver.

Antenna Database Version – Identifies the current Antenna database version installed on the Trimble receiver.

Hardware Version – Identifies the hardware version of the receiver.

Receiver Status – Options Summary

This page shows which functionality the Trimble receiver has enabled.

Firmware Warranty Date – The date on which support for this receiver expires. Any firmware that is dated earlier than this may be installed on the receiver. For firmware patches, the Firmware Warranty Date may be earlier than the Firmware Date. To purchase an extended warranty for the receiver, contact your local Trimble dealer.

Precision Capability

Precision Capability – Defines the precision capabilities of the receiver in Base mode and Rover mode.

Not Activated – The receiver needs to be activated using an upgrade code. This is usually completed by the Trimble Dealer or SITECH before delivery to the customer.

Off – The receiver does not have this function installed. Ask your dealer if an upgrade is available.

Base – RTK – The base receiver can transmit CMR/RTCM corrections.

Rover – Precise RTK – The rover receiver is capable of positioning at survey precisions (sub-centimeter).

Rover – Limited – The rover receiver is capable of positioning to the installed precision, e.g., 10/10 indicates it can position to 10 cm (RMS) horizontal and 10 cm (RMS) vertical. The actual precision depends on the correction source used.

Frequency

The total number of frequencies the receiver is capable of tracking. GNSS satellite constellations are capable of transmitting at three frequencies.

Single Frequency Tracking – The receiver can track a single frequency.

Dual Frequency Tracking – The receiver can track dual frequencies.

Triple Frequency Tracking – The receiver can track triple frequencies.

Constellation

Lists the GNSS satellite constellations tracking capability installed/enabled on the receiver.

GPS – The receiver can track the GPS satellite constellation. GPS frequencies available are L1-C/A, L2E, L2C, and L5.

SBAS – The receiver can track all SBAS GNSS augmentation satellites. SBAS frequencies available are L1-C/A and L5.

GLONASS – The receiver can track the GLONASS satellite constellation. GLONASS frequencies available are L1-C/A, L1P, L2-C/A, and L3.

Galileo – The receiver can track the Galileo satellite constellation. GLONASS frequencies available are E1, E5-A, E5-B, and E5-AltBOC.

IRNSS – The receiver can track the IRNSS satellite constellation. IRNSS frequencies available are L5-C/A and S1-C/A.

BeiDou – The receiver can track the BeiDou satellite constellation. BeiDou frequencies available are B1 and B2.

QZSS – The receiver can track the Quasi-Zenith Satellite System available in Japan. QZSS frequencies available are L1-C/A, L1-SAIF, L1C, L2C, and L5.

Rover Tracking Capabilities		
Options		Signal Tracking
Frequency	Constellation	
Single	GPS	L1
	GLONASS	L1
	Galileo	E1
	QZSS	L1 SAIF, L1C, L1CA
	SBAS	L1
	BeiDou	B1
	IRNSS	L5-C/A
Dual	GPS	L1, L2, L2C
	GLONASS	L1, L2
	Galileo	E1, E5B
	QZSS	L1 SAIF, L1C, L1CA, L2C
	SBAS	L1
	BeiDou	B1, B2
	IRNSS	L5-C/A, S1-C/A
Triple	GPS	L1, L2, L2C, L5
	GLONASS	L1, L2, L5
	Galileo	E1, E5a, E5B, altBOC, E6
	QZSS	L1 SAIF, L1C, L1CA, L2C, L5, LEX
	SBAS	L1, L5
	BeiDou	B1, B2, B3

Correction Services

Commercial GNSS augmentation services available for use on the receiver. Most of these services require a paid subscription through Trimble Positioning Services.

RTX – The receiver can track Trimble CenterPoint RTX correction services. A CenterPoint RTX subscription is required to perform RTX surveying or to use unlimited xFill services. The table displays the date of expiry of your subscription. A date in the past represents there is not a valid subscription installed.

OmniSTAR – The receiver can track the listed OmniSTAR multi frequency services (HP, XP, G2, G4, G2+, G4+) which can be used for positioning if the subscription is current.

OmniSTAR HP/XP – The receiver can track OmniSTAR-HP and OmniSTAR-XP signals.

OmniSTAR HP – The receiver can track the OmniSTAR-HP, OmniSTAR-XP, and OmniSTAR VBS signals.

OmniSTAR VBS – The receiver can track OmniSTAR VBS signals.

Maximum Measurement Rate

The maximum rate at which observable data (measurements) can be logged.

Communication

The available wireless communications installed on the receiver.

Bluetooth – The receiver can use Bluetooth wireless technology for communications.

Wi-Fi – Indicates the receiver supports Wi-Fi in Access Point (AP) mode and Client modes.

Additional Features

Binary Outputs – Enables the receiver to output raw GPS and optional GLONASS data in a Trimble proprietary format for use with datalogging.

Data Logging – The receiver can log raw GNSS data to internal memory. Also displayed is the total available memory in the receiver.

Option Code – Enter an option code supplied by Trimble and then click **Install Option**. Option codes are used to enable new functionality in the receiver.

Receiver Status – Option Detail

This page can be used for a more detailed summary of the receiver options when communicating with Trimble Support. Some of these options are explained below.

L2 Tracking – The receiver is capable of tracking the GPS L2 signal (often referred to as L2E).

L2C – The receiver is capable of tracking the Civilian code on the GPS L2 signal (also referred to as L2CS).

L5 Tracking – The receiver is capable of tracking the GPS L5 signal.

Everest – The receiver is capable of using the Everest Multipath Mitigation technology.

HTTPS – The receiver can support a secure HTTP link, with encryption limited to a 56-bit encryption.

NOTE – By default, Mozilla Firefox does not support this low-grade encryption. To turn on the SSL 3.0 encryption, select the Encryption tab in the Advanced Options of Firefox.

Spectrum Analyzer

An explanation of what a spectrum analyzer does is available here.

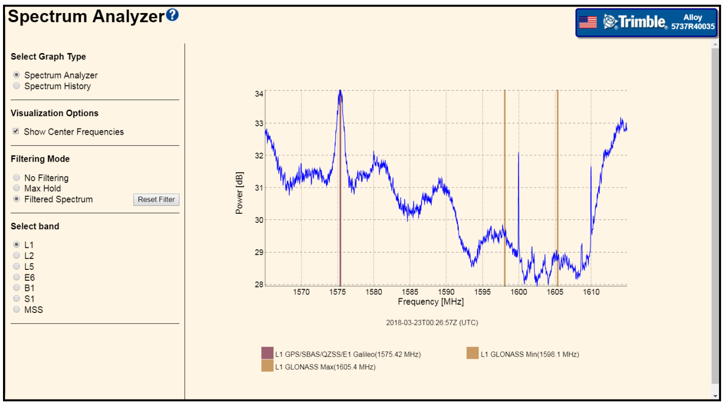
Features:

- Can monitor all seven GNSS bands
- Monitors continuously in the background
- Can playback previous days' data in waterfall or filtered format
- Can display real-time data in waterfall, filtered, peak hold, or unfiltered formats
- Does not affect the current Alloy functions such as logging, corrections generation, or observables streaming

NOTE – As of version 5.37, the Alloy spectrum analyzer has several improvements: faster update rates up to 5 Hz are supported; y-axis display (power in dB) scaling has been improved; the FFT (Fast Fourier Transform) can better detect more external pulse interference with reduced noise without requiring filtering. T04 files can save analyzed logs of the spectrum analyzer.

TIP – To view the history of the spectrum analyzer, you must enable data logging in the T04 format.

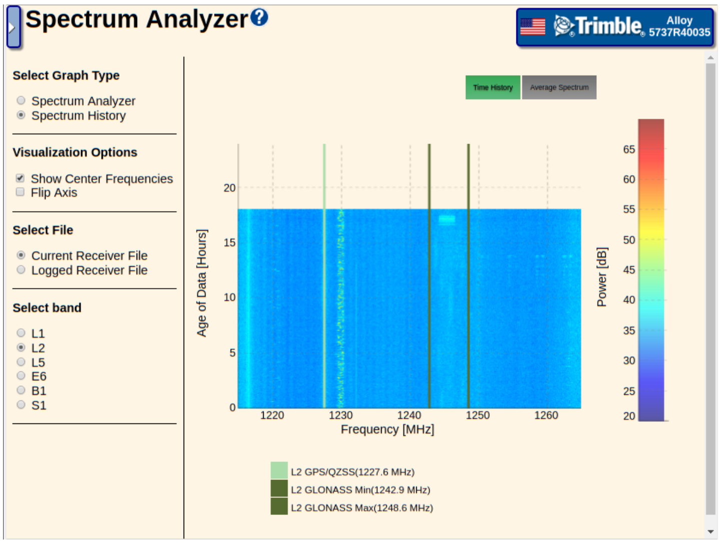
To open the Spectrum Analyzer, select **Receiver Status / Spectrum Analyzer**. The following screen appears:



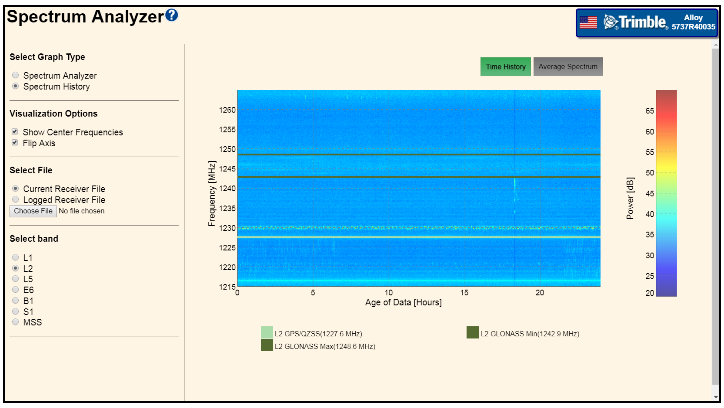
The screen is divided into the following sections:

- Select Graph Type
- Visualization Options
- Filtering Mode
- Select band
- The main graph window

Select Graph Type – You can select between an amplitude-verses-frequency (in dB) or a time-verses-frequency in waterfall format. The waterfall format also contains amplitude information presented as colors:



In the waterfall format, the Visualization Options allow for the axis to be flipped so that the frequency is on the Y axis and time is on the X axis as shown below. The amplitude of the signal is represented by colors corresponding to the coded scale on the right.



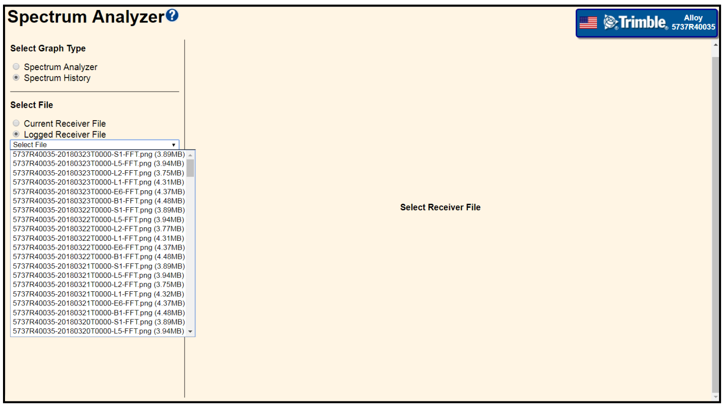
While in Spectrum Analyzer mode there is only a single Visualization Option, which is to toggle on or off the center frequencies of the associated GNSS signals. While in Spectrum History mode, an additional Visualization Option of **Flip Axis** is present.

Select File – This option is present ***only*** in the Spectrum History mode. It enables you to choose between the current day's data, including the near real-time observations or the previous days' data. An example of the previous days' data that is available is shown below. The files are organized by day and by frequency band.

The amount of history file held in the receiver depends on the amount of available memory in the receiver. Typically, the receiver can store about three months of FFT 'png' files, however; if the user memory becomes full (due to the user not enabling the Auto-Delete function) the spectrum analyzer will not be able to store any files until some user memory is released.

NOTE – The auto-delete and management of the spectrum analyzer historical files is automatic; you cannot adjust this. It does not in any way affect user T02/T04 files.

In the **Spectrum History** mode, the display can be set to Time History or Average Spectrum. The Average Spectrum mode is similar to the Filtered Spectrum when in Spectrum Analyzer mode as described below.



When in Spectrum Analyzer mode there are three selections available for the filtering mode:

- No Filtering
- Max Hold
- Filtered Spectrum

No Filtering – In this mode, the spectrum analyzer passes the raw data sampled to the display. This is useful for attempting to catch transient type signals such as radars.

Max Hold – In this mode, the spectrum analyzer uses the unfiltered dataset but allows any samples that exceed the maximum to be displayed. This is again useful to catch transient type signals but is of no use to measure the duration or repetition rate of the transient signals.

Filtered Select File – The default mode of the display. It uses low pass data-filtering to filter the FFT data to display. If you click **Reset Filter**, these data-filters are cleared and the data will initially resemble the No Filtering mode until the filter values are rebuilt.

Select File – Select which frequency band to display:

Band	Start	Stop	BW	Center	Signals
L1	1.5650 GHz	1.6150 GHz	50.0000 MHz	1.5900 GHz	L1 GPS/SBAS/QZSS/E1 Galileo (1575.42 MHz)

Band	Start	Stop	BW	Center	Signals
					L1 GLONASS Min (1598.1 MHz) L1 GLONASS Max (1605.4 MHz)
L2	1.2150 GHz	1.2650 GHz	50.0000 MHz	1.2400 GHz	L2 GPS/QZSS (1227.6 MHz) L2 GLONASS Min (1242.9 MHz) L2 GLONASS Max (1248.6 MHz)
L5	1.1650 GHz	1.2150 GHz	50.0000 MHz	1.1900 GHz	L5 GPS/QZSS/SBAS/IRNSS/E5A Galileo (1176.45 MHz) E5B Galileo/B2 BeiDou-II (1207.6 MHz) E5 AltBOC Galileo (1191.795 MHz) G3 GLONASS CDMA (1202.025 MHz)
E6	1.2550 GHz	1.3050 GHz	50.0000 MHz	1.2800 GHz	E6 Galileo/LEX QZSS (1278.75 MHz) B3 BeiDou-II (1268.52 MHz)
B1	1.5250 GHz	1.5750 GHz	50.0000 MHz	1.5500 GHz	B1 BeiDou-II (1561.098 MHz)
S1	2.4780 GHz	2.5280 GHz	50.0000 MHz	2.5030 GHz	IRNSS S BAND (2492.028 MHz)
MSS	1.525 GHz	1559 MHz	50.0000 KHz		MSS - The MSS spectrum start/stop are changed depending on the MSS downlink that the receiver is set to track. The receiver can receive MSS signals anywhere in the 1525 - 1559 MHz MSS band; only a

Band	Start	Stop	BW	Center	Signals
					50 KHz spectrum is shown around the desired signal.

The L1-S1 bands are all 50 MHz wide while the MSS band is 50 KHz wide. The bands are individually observable in the following modes:

- Near real-time filtered
- Near real-time maximum hold
- Near real-time unfiltered
- Near real-time in waterfall format
- Historical in averaging format
- Historical in waterfall format (not supported for MSS)

Graph manipulations

The following mouse control manipulations are supported in the amplitude verses frequency and time verses frequency (water fall) displays:

- Readout of signal level and frequency via mouse hovering (amplitude vs. frequency)
- Readout of signal level, frequency and time via mouse hovering (time vs. frequency)
- Frequency axis expansion (magnification)
- Amplitude axis expansion (magnification)
- Time axis expansion (magnification)

To magnify whatever is on the Y axis:

1. Place the mouse on the desired area of the graph.
2. Press down the left mouse button and hold it while dragging the mouse *vertically up or down* as required. A shadow of the area to be magnified will be displayed.
3. Release the left mouse button. The area is now magnified.
4. To return to the default display, place the mouse anywhere on the graph and double-click the left mouse button.

To magnify whatever is on the X axis:

1. Place the mouse on the desired area of the graph.
2. Press down the left mouse button and hold it while dragging the mouse *horizontally left or right* as required. A shadow of the area to be magnified will be displayed.
3. Release the left mouse button, the area is now magnified.

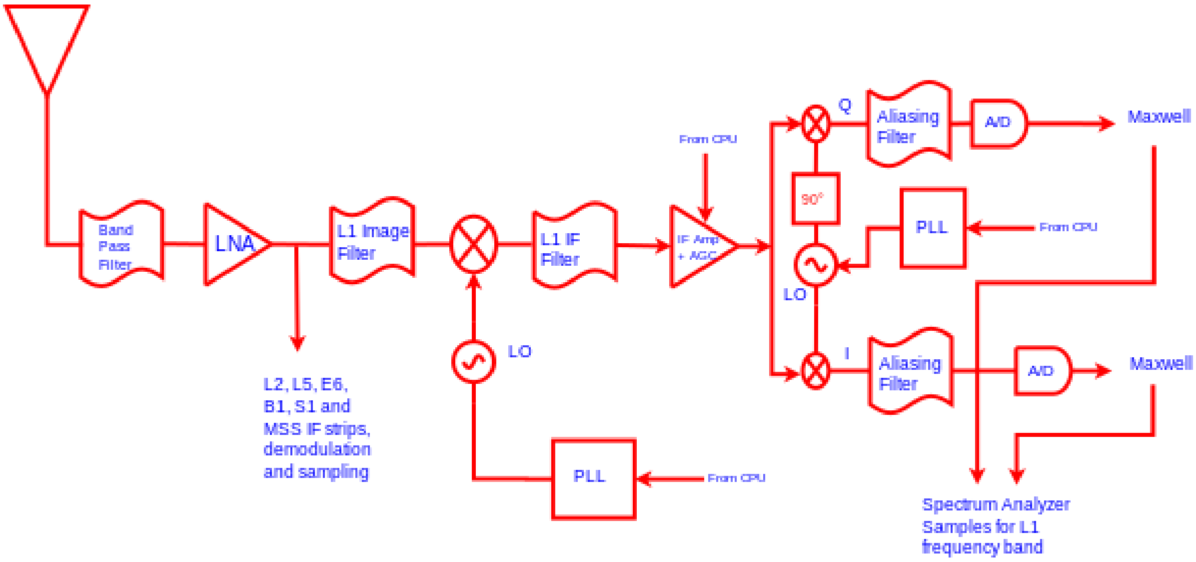
4. To return to the default display, place the mouse anywhere on the graph, double-click the left mouse button, the graph will return to default.

To read the signal strength and frequency (and the time if in waterfall mode) directly off the cursor position on the graph:

1. Place the mouse on the desired part of the spectrum analyzer graph.
2. Read the frequency and amplitude (and the time if in waterfall mode) off the dark display box above the left side of the graph.
3. The signal strength and amplitude also work if the graph has been magnified.

Signal derivation

The various signal bands are all processed in a similar manner. The L1 band processing is shown in this example:



Down conversion and IF processing are done before the In-phase and Quadrature-phase demodulation. The outputs of the I/Q demodulation are fed into an aliasing filters before sampling at the A/Ds. The outputs of the A/D units are fed to the Maxwell ASICs for correlation and onward processing by the system CPU. A small sampling from the Maxwell ASICs (~1% of all total samples) is used by the system to produce the spectrum analyzer display. It is this technique of using only a subset of the sampled data that allows the receiver to maintain normal operation while simultaneously performing the spectrum analyzer function.

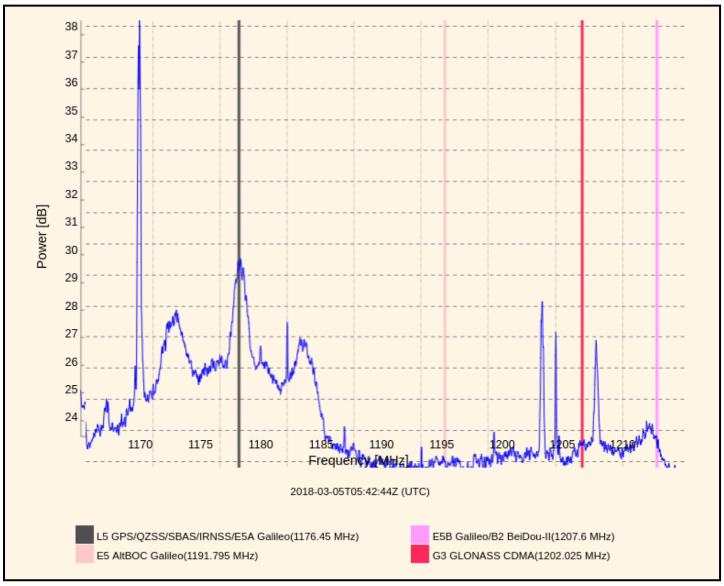
Spectrum Analyzer uses

The spectrum analyzer is meant as a site evaluation tool in addition to other tools such as teqc (see www.unavco.org/software/data-processing/teqc/teqc.html). The spectrum analyzer is meant as a compliment to these tools and not a replacement.

Example screens

Example 1

This example shows the L5 frequency band located in the Trimble Singapore office. Notice some of the frequency spikes. The table beneath lists the local airports in the vicinity (within ~50 miles) with their associated VOR and DME(TACAN) frequencies. Pay particular attention to the DME(TACAN) transmit frequency.



Site	VOR channel	DME Rx channel	DME Tx channel	Visible (~dB)
SaintJon	113.50 MHz	1,106 MHz	1,169 MHz	+38.5
Tekong	116.50 MHz	1,136 MHz	1,199 MHz	+28.2
Seletar	115.10 MHz	1,122 MHz	1,185 MHz	+23.5
Batam	116.00 MHz	1,131 MHz	1,194 MHz	No
Johor	112.70 MHz	1,098 MHz	1,161 MHz	Out of band
Bintan	114.80 MHz	1,119 MHz	1,182 MHz	No

While some of the signals shown in the above example can be identified, many cannot:

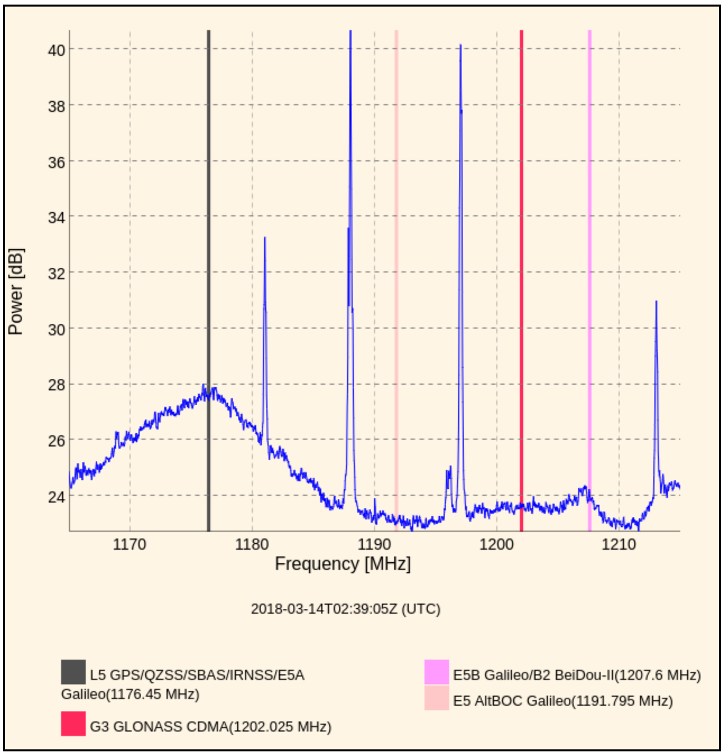
- There are narrow band signals at the following frequencies: 1,180 MHz, 1,184 MHz, 1,190 MHz, 1,195.5 MHz, 1,200 MHz, and 1,203 MHz. These signals cannot be identified.
- There are wide band signals at the following frequencies: 1,172 MHz, 1,176.50 MHz (very near to L5), and 1,181,5 MHz.

These signals will be discussed in a later section.

Example 2

This example shows the L5 band in Westminster CO, USA. The table shows the local VOR and DME (TACAN) frequencies for the Westminster CO vicinity. The only Westminster signal that is unidentified is a small band at a level of 25dB at a center frequency of approximately 1,195MHz.

Unlike the Singapore L5 plot there is not obvious band of frequencies at L5 but the Westminster plot shows a curious triangle shape centered on the L5 center frequency. More on this topic in a later section.



Site	VOR channel	DME Rx channel	DME Tx channel	Visible (~dB)
Mile High	114.70 MHz	1,118 MHz	1,181 MHz	+33.0
Denver	117.90 MHz	1,150 MHz	1,213 MHz	+31.0
Falcon	116.30 MHz	1,134 MHz	1,197 MHz	+40.0
Jeffco	115.40 MHz	1,125 MHz	1,188 MHz	+41.0
Gill	114.20 MHz	1,113 MHz	1,176 MHz	No

Additional signals to take note of are the amateur radio satellite uplink band from 1240 - 1300 MHz. There can also be amateur radio terrestrial digital TV experimentation inside this BW.

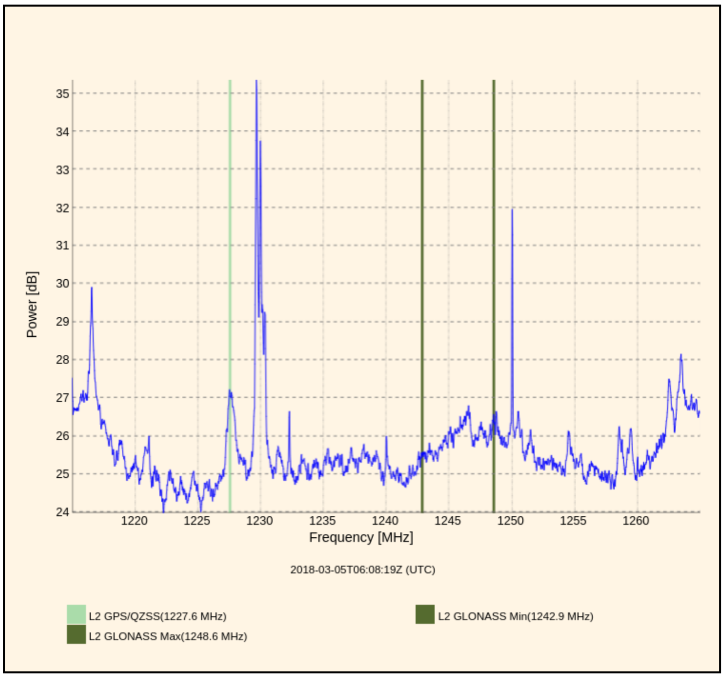
Example screen with interference

This example shows the "Filtered Spectrum" of the frequency band of L2 in Singapore with signal interference on GPS L2. GPS L2 is experiencing multiple cycle slips during most epochs.

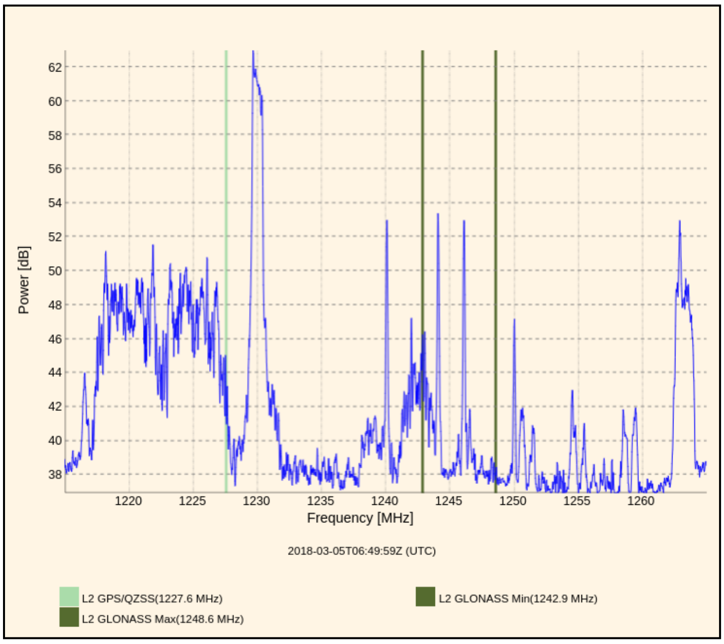
The example shows various signals:

- There are narrow band signals at 1,250 MHz and 1,232.5 MHz.
- There are wide band signals at 1,217 MHz, 1,227.6 MHz, and 1,230 MHz.
- The 1,227.6 MHz signal, while in band for GPS L2, does not seem large enough to cause a problem, more on this is a later section.

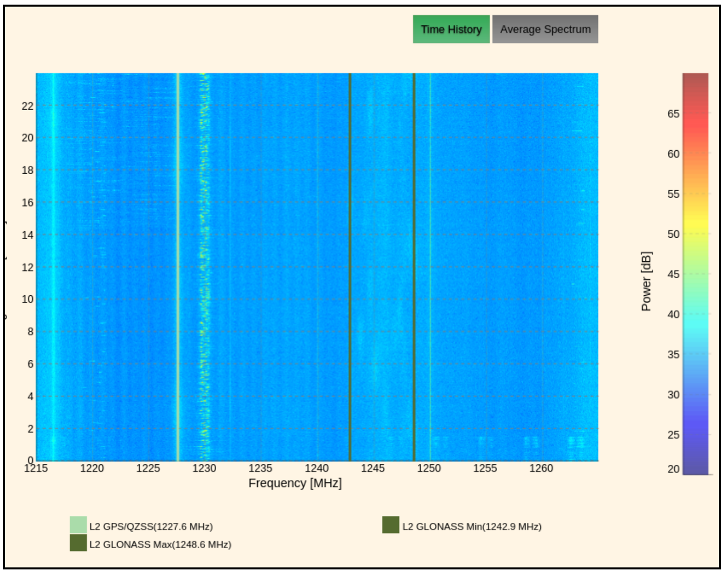
Switching from filtering mode to "Max Hold" shows a very different display:



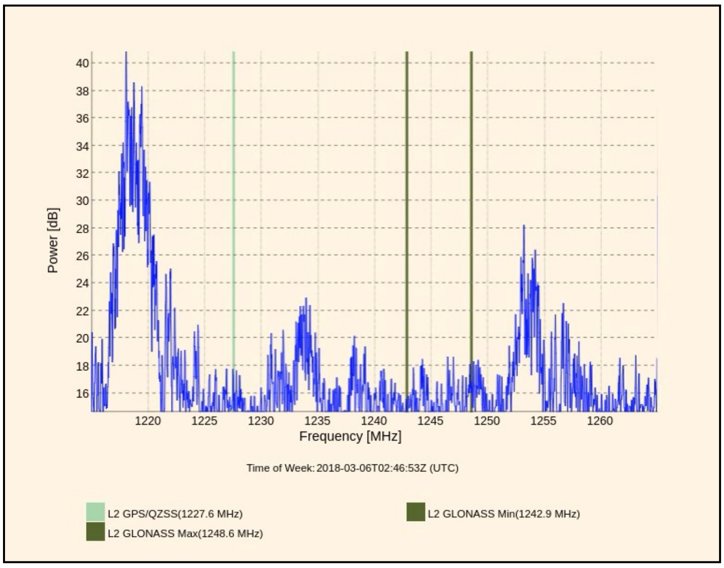
With the filtering mode in "Max Hold" a large wideband signal appears from ~1,217 - 1,27 MHz. This very well could be causing the cycle slips on GPS L2:

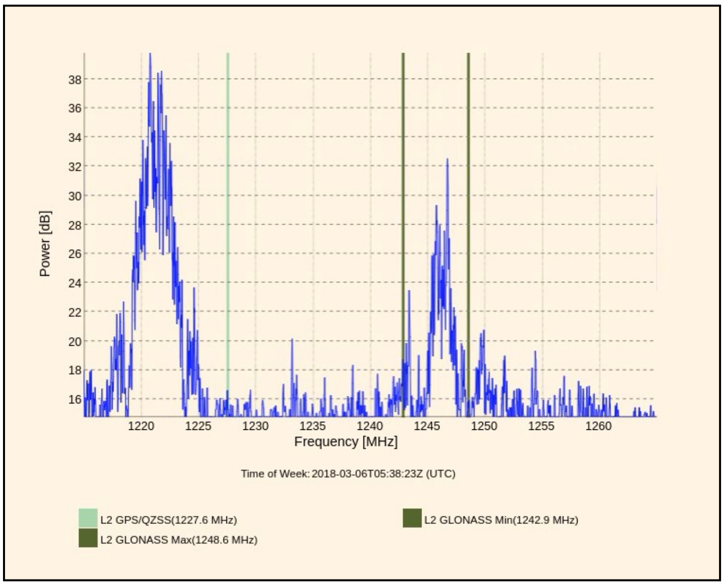


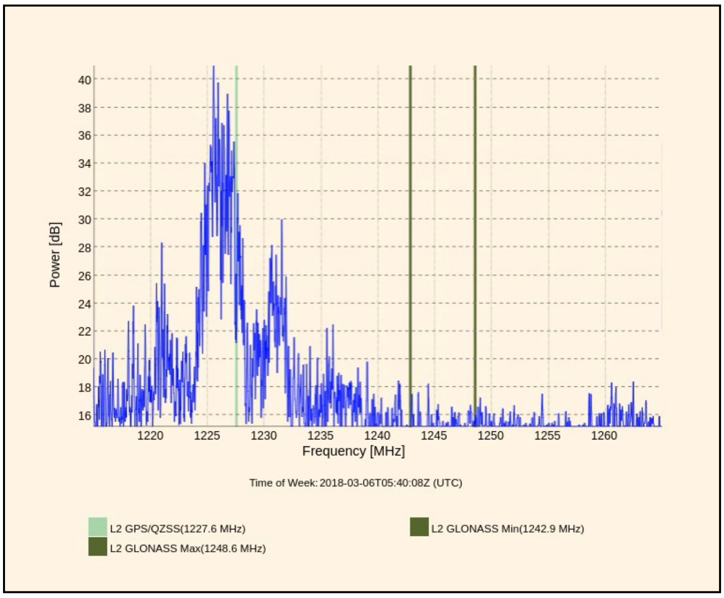
A look at the Spectrum History in the figure below shows only the signals at 1,230 MHz and the smaller one at 1,228 MHz. The wide band interference at ~1,217 - 1,27 MHz does not show up because it appears to be averaged out. This indicates that it is some sort of transient signal that gets averaged out of the waterfall and filtered display. The most likely type of signal that would behave this way is radar.



The spectrum analyzer was then placed in "No Filtering" mode and a screen recording application was used to record to video the spectrum analyzer display for approximately 3 minutes. The following figures were taken from this recording.


Power [dB]
Frequency [MHz]
Time of Week: 2018-03-06T02:46:53Z (UTC)
L2 GPS/QZSS(1227.6 MHz)
L2 GLONASS Min(1242.9 MHz)
L2 GLONASS Max(1248.6 MHz)


Power [dB]
Frequency [MHz]
Time of Week: 2018-03-06T05:38:23Z (UTC)
L2 GPS/QZSS(1227.6 MHz)
L2 GLONASS Min(1242.9 MHz)
L2 GLONASS Max(1248.6 MHz)



The sequence of screen captures shown above shows the radar pulse from ~1,170 - 1,130 MHz. Note each screen captures shows only a portion of the pulse and not the entire pulse. This behavior is normal due to the 1% sample set that the spectrum analyzer has to work with.

Visibility of GNSS bands

In some cases it is possible to see the GNSS bands in the spectrum analyzer, but this comes with a few caveats.

The noise, per unit BW, as computed from Boltzmann's Constant and ambient temperature is:

$$N_0 = kT = 1.38 \times 10^{-23} \times 290 = 4.0 \times 10^{-21} J$$

Converting this value to dBm:

$$N_0 dB/Hz = 10 \times log_{10} \frac{N_0}{10^{-3}} = -174 dBm/Hz$$

This value tells us that the noise floor is -174 dBm/Hz. To find the actual noise floor of a particular signal the BW of that signal must be added (in dB) to the -174 dBm value. The noise floor for various GNSS signals is given in the following table along with the minimum expected signal level at the earth's surface of that particular signal.

Signal	Center Freq (MHz)	BW (MHz)	Noise Floor (dBm)	Expected Minimum Signal Level (dBm)
GPS L1 C/A	1575.42	2.046	-111.0	-128.5
GPS L1C BOC	1575.42	2.046	-111.0	-127.0
GPS L1 P(Y)	1575.42	20.46	-100.9	-131.5
GLL E1 OS	1575.42	4.092	-107.9	-127.0
QZSS L1SAIF	1575.42	2.046	-111.0	-131.0
QZSS L1 C/A	1575.42	2.046	-111.0	-128.5
QZSS L1 BOC	1575.42	4.092	-107.9	-127.0
SBAS	1575.42	2.046	-111.0	-131.5
GPS L2 CM+CL	1227.60	1.023	-114.0	-134.5 - 131.5
GPS L2 P(Y)	1227.60	20.46	-100.9	-130.0-134.5
QZSS L2 CM+CL	1227.60	1.023	-114.0	-130.0
GPS L5 I+Q	1176.45	20.46	-100.9	-127.9
QZSS L5 I+Q	1176.45	20.46	-100.9	-127.9
GLL E5a I+Q	1176.45	20.46	-100.9	-125.0
IRNSS L5 C/A	1176.45	2.046	-111.0	-129.0
IRNSS L5 R-BOC	1176.45	4.092	-107.9	-125.0
SBAS L5	1176.45	2.046	-111.0	-131.5
GLN L1	1598.1-1605.4	1.023	-114.0	-131.0
GLN L2	1242.9-1248.6	1.023	-114.0	-127.0
GLL E5b	1207.6	20.46	-100.9	-125.0
GLL E6 D+P	1278.75	10.23	-104.0	-125.0
GLL E6 BOC	1278.75	20.46	-100.9	-125.0
QZSS LEX	1278.75	10.23	-104.0	-125.7

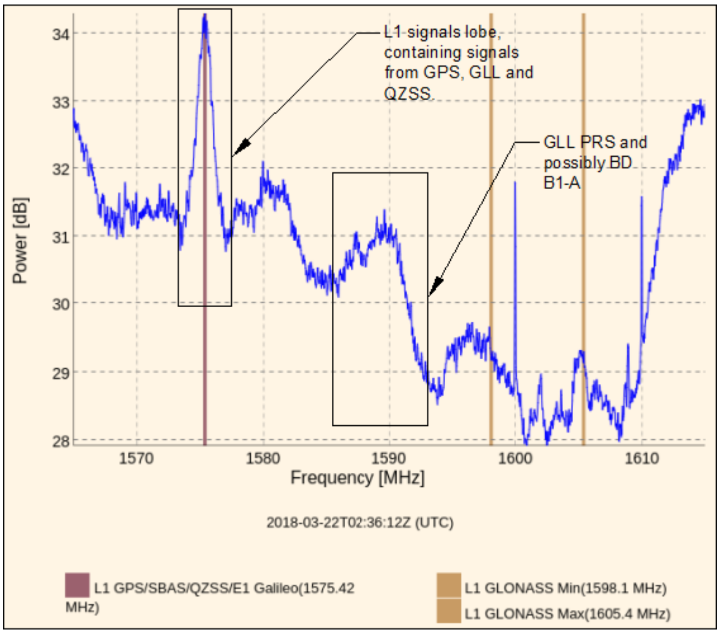
Signal	Center Freq (MHz)	BW (MHz)	Noise Floor (dBm)	Expected Minimum Signal Level (dBm)
BD B3 I+Q	1268.52	20.46	-100.9	-133.0
BD B2 I	1207.14	4.092	-107.9	-133.0
BD B2 Q	1207.14	20.46	-100.9	-133.0
BD B1 I+Q	1561.098+ 1589.742	4.092	-107.9	-133

For all SV signals listed above, the minimum expected reception level at earth's surface is below the ambient noise floor, which means that signal will not be visible on a spectrum analyzer. This reasoning holds only for individual satellites, not for multiple SVs using the same channels. In general, SV signals will be visible on the spectrum analyzer if the following conditions are met:

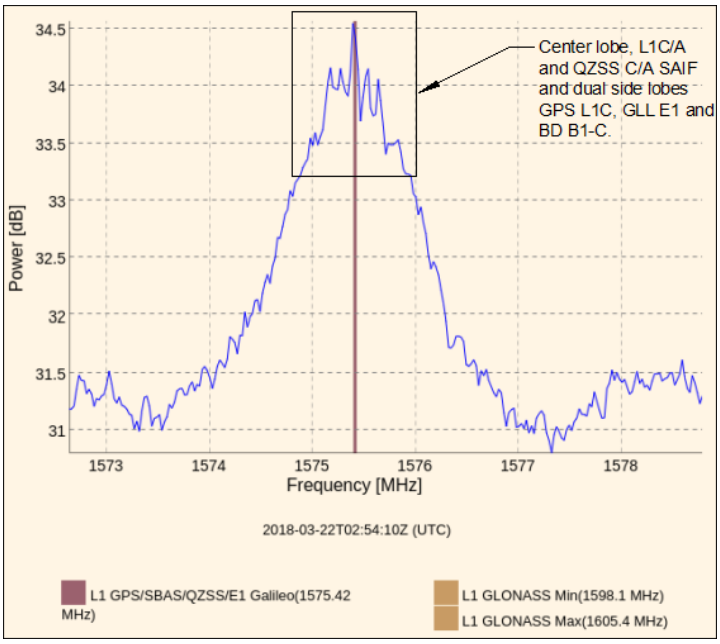
- The SV BW of the lobe in question is less than or equal to 4.092 MHz
- There are multiple SVs using that same signal in view
- In most cases the actual ground level received signal strength is several dB higher than the published minimum

Multiple SVs using the same band width has the effect of raising the noise floor in the same geometry as the signal envelope of that particular band width. If enough SVs are present, this envelope will rise out of the noise.

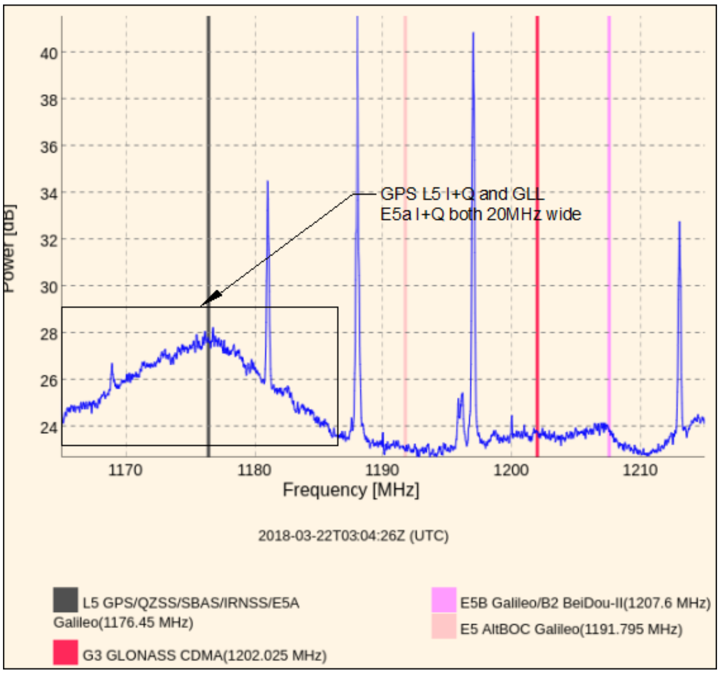
As an example, consider this figure with an annotated display of L1 frequencies in Singapore:



This figure shows the expanded view of the main L1 lobe from the figure above:



This figure shows the L5 lobe as seen in Westminster CO. As this display is from Westminster USA, no QZSS or URNSS signals are present meaning the GPS and GLL on their own are able to rise above the noise, which is interesting considering the signals are 20.46 MHz wide. GPS and GLL have both I + Q signals.

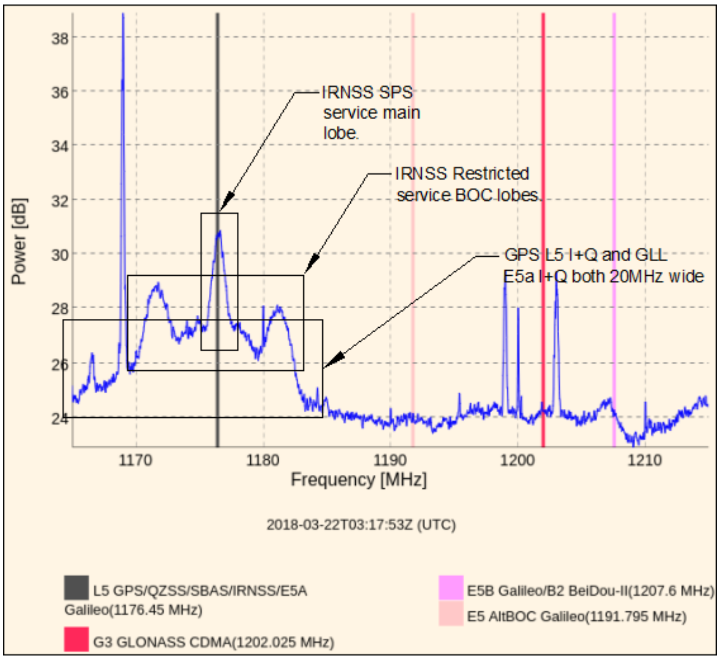


The same L5 display from Singapore shows something slightly different. The annotations on the next figure show the following:

- The main lobe of L5 GPS and GLL E5a I+ Q, which is the same as in Westminster CO
- The main lobe of L5 QZSS I+Q which is the same as the GPS GLL signals
- The main SPS lobe of the IRNSS signals which are not visible in Westminster CO
- The main lobes of the restricted IRNSS BOC lobes also not visible in Westminster CO

Notice how in the previous figure and the next figure nothing appears visible for E5B, E5 BOC and G3 GLL. There are several reasons for this:

- The spreading of the signal is over 20 MHz
- There are not enough SVs to raise this large BW above the noise floor



IRNSS SPS service main lobe.
IRNSS Restricted service BOC lobes.
GPS L5 I+Q and GLL E5a I+Q both 20MHz wide
Power [dB]
Frequency [MHz]
2018-03-22T03:17:53Z (UTC)
L5 GPS/QZSS/SBAS/IRNSS/E5A Galileo(1176.45 MHz)
G3 GLONASS CDMA(1202.025 MHz)
E5B Galileo/B2 BeiDou-II(1207.6 MHz)
E5 AltBOC Galileo(1191.795 MHz)

About the Spectrum Analyzer

A spectrum analyzer is a device that displays electronic signals on a screen. The screen is organized with the x-axis as frequency and the y-axis as power, typically in units of dBm (decibels referenced to 1 mW). A spectrum analyzer is similar in function to an oscilloscope, however with an oscilloscope, the x-axis is time and the y-axis is voltage.

So why is a spectrum analyzer necessary? This question is best answered by viewing an example waveform as an oscilloscope would see it and then show what a spectrum analyzer would show.

Consider the following three example signals:

1. *1.0 * sin(1,884,955.6t) volts*
2. *2.2 * sin(3,141,592.7t) volts*
3. *1.75 * sin(2,733,185.6t) volts*

The argument inside the brackets of the above signals is the radian frequency and is known as  which is given by 2πf. As such, the frequencies for the above signals are 300 Khz, 500 Khz, and 435 Khz respectively. In this example we will drive all three of these signals directly into the 50 Ω input of a spectrum analyzer and use a 10 MΩ input impedance scope probe to measure the resultant voltage at the spectrum analyzer input. What would be shown on the scope is the thick purple line shown below in Figure 1:

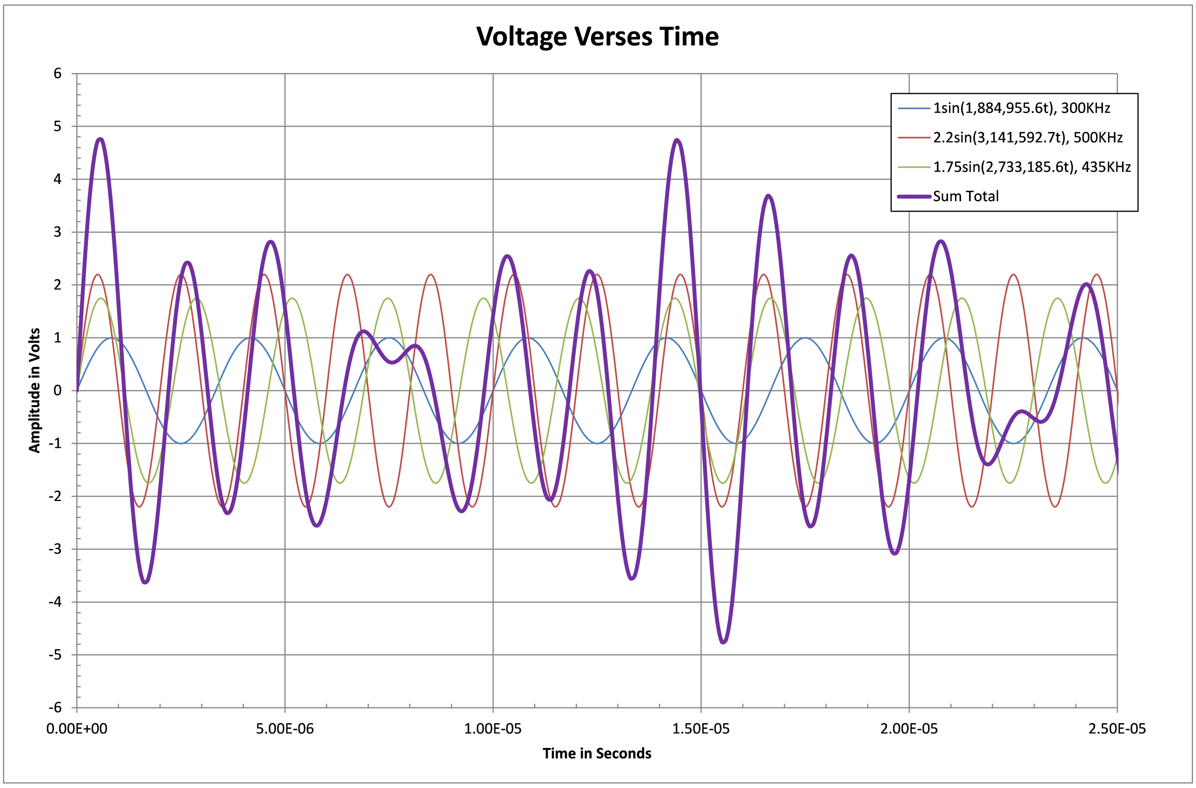


Figure 1

The blue, green, and red curves are the example signals as given above but they will not be visible on a real scope as they are, only the superposition sum of the three signals will be shown on the scope which is the thick purple curve. This thick purple curve shows no evidence of the original signals that comprise it. An observer would not know the frequency or amplitudes of the component signals that the purple curve is made of.

The display that a spectrum analyzer would show of the same thick purple curve from Figure 1, is shown in Figure 2:

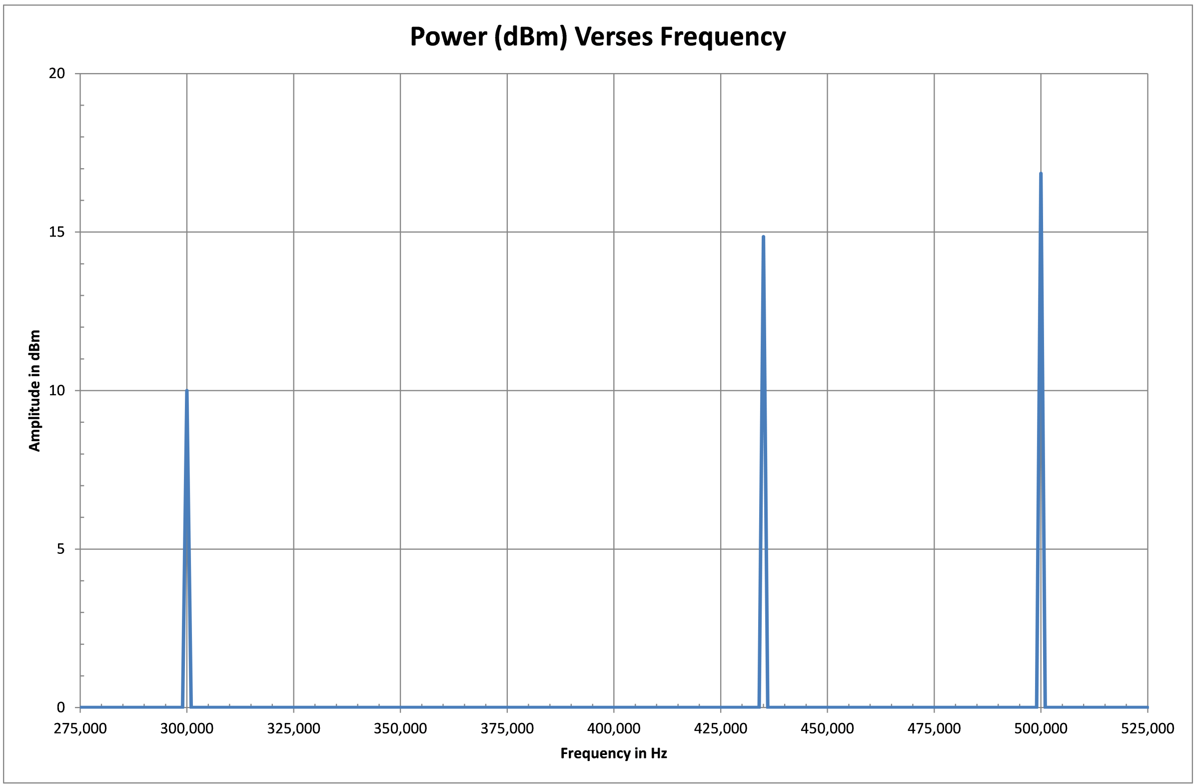


Figure 2

Unlike Figure 1, the horizontal scale on the spectrum analyzer is frequency and not time. The y-axis of the spectrum analyzer shows power in units of dBm whereas Figure 1 shows voltage. Figure 2 clearly shows the three signals' amplitudes and frequency when driven into a 50 Ω load.

Spectrum Analyzer Amplitudes verses an Oscilloscope

The apparent difference in amplitudes shown in Figures 1 and 2 can be confusing. To illustrate that the signals in Figure 2 are actually the original example signals, the first signal will be looked at. Signal one has a peak voltage of 1 Vp. To compute the power this will have to be converted to a rms value which is 0.707*Vp or 0.707 Vrms. The voltage is being driven into a 50 Ω load (which is actually the spectrum analyzer input). To compute the power dissipated by this load, the rms voltage must be squared and this square divided by the resistance (50 Ω) which yields 10 mW. This 10 mW must then be converted to dBm by first dividing by 1 mW (resulting in a value of 10), taking the base 10 log (resulting value of 1) and then multiplying by 10. This yields a result of 10 dBm which is exactly what is shown in Figure 2 at 300 Khz.

Spectrum Analyzer summary:

- Shows amplitudes in dBm not volts
- Shows amplitudes verses frequency not time
- Shows the amplitudes referenced to 50 Ω

Satellites menu

Use the **Satellites** menu to view satellite tracking details and enable/disable GNSS and SBAS satellites.

Satellites – General Information

This page shows overview information about the satellites being tracked and the overall satellite constellation. The information on this display is updated every five seconds.

Tracked – Shows the total count and PRN numbers of the satellites currently being tracked; the display includes GPS, QZSS, SBAS, RTX/OmniSTAR, and the optional GLONASS, Galileo, or BeiDou systems.

Constellation – Shows how many satellites are currently in orbit for the named constellation, and which, if any, are Unhealthy. This information comes from the most recent data transmitted in satellite almanacs.

Ignore Health – Shows how many satellites have been selected by the user to be tracked even if they are currently thought to be unhealthy. Typically, unhealthy satellites will not be tracked, measured, or used in position calculations.

Trimble has a free GNSS Planning Online tool at www.trimble.com/GNSSPlanningOnline.

Tracking (Table, Graph, and Skyplot)

Table

This table shows information about the satellites that are currently being tracked. To sort the table based on column values, click the header at the top of the column.

The table is organized into tabs for each constellation for ease of viewing or can be viewed together using the **ALL** tab.

If the background color of a given satellite is red, the satellite is unhealthy. Data from unhealthy satellites is logged but is not used in the position solution.

If the background color of a given satellite on the table is orange, the receiver's RAIM (Receiver Autonomous Integrity Monitoring) algorithm has either detected a problem with the satellite or, if you are tracking SBAS, the corrections indicate there is an integrity problem with the satellite. In either case, the satellite is not used in the position solution.

If the background color of a given satellite on the table is blue, the satellite is tracked, but not yet fully phase locked, so it is not yet available for use in RTK. This typically occurs very briefly when a satellite is first acquired or when the environment is hostile to GNSS.

SV – The numeric identifier of the satellite tracked on the channel.

Type – Indicates if the satellite is GPS, GLONASS, Galileo, BeiDou, QZSS, SBAS (WAAS, EGNOS, MSAS) or MSS (OmniSTAR).

Elev [Deg] – The elevation of the satellite, in degrees above the horizon.

Azim [Deg] – The azimuth (direction) of the satellite, in degrees clockwise from True North.

L1-C/No [dB-Hz] / L2-C/No [dB-Hz] / L5-C/No [dB-Hz] – The signal-to-noise ratio of the satellite on either the L1, L2, or L5 frequency. Scaled to a 1 Hertz bandwidth. The SNRs are available for both Position antenna 1 (POS) and Vector antenna 2 (VECT) for dual-antenna systems.

L1 – The signal being tracked in the L1 frequency band (1525 to 1614 MHz for each satellite.

L2 – The signal being tracked in the L2 frequency band (1217 to 1257 MHz) for each satellite.

L5 – The signal being tracked in the L5 frequency band (1164 to 1214 MHz) for each satellite.

IODE (**Issue of Data Ephemeris**) – The numeric identifier for the latest ephemeris data collected from this satellite.

URA [m] (**User Range Accuracy**) – The satellite's estimate of the accuracy of its ranging signals, in meters.

Type – Indicates which satellite model or generation is being tracked (if known).

Satellites – Tracking (Graph)

This graph shows information about the satellites that are currently tracked.

To view the graphs, you need Scalable Vector Graphic (SVG) support. SVG is available for download from ADOBE as a browser plug-in. Download and install the Adobe SVG plug-in from the Adobe website (www.adobe.com/svg/viewer/install/) if it is not enabled in your browser.

The graph can be sorted based on the ***satellite ID*** or the ***elevation angle***. To change the ordering sequence, click **Order by** below the graph.

Type – Apply a filter by selecting or deselecting the type of satellite and tracked signal displayed. For dual-antenna systems, you can select both the position and vector antenna frequencies.

SV – The numeric identifier of the satellite tracked on the channel with a prefix to identify the constellation.

C/No – The SNR of the satellite on the selected frequencies; scaled to a 1 Hz bandwidth.

Elev [Deg] – The elevation of the satellite, in degrees above the horizon is shown on the horizontal scale below the SV.

Satellites – Tracking (Skyplot)

This plot shows the locations of the satellites that are currently being tracked centered on the receiver's antenna location.

To view the graphs, you need Scalable Vector Graphic (SVG) support. SVG is available for download from ADOBE as a browser plug-in. Download and install the Adobe SVG plug-in from the Adobe website (www.adobe.com/svg/viewer/install/) if it is not enabled in your browser.

The numbers on the outermost circle indicate the azimuth angle values.

The numbers on each of the inner circles indicate the elevation angle values.

The color of the satellites signify its tracked constellation:

- Blue – Tracking GPS satellite
- Red – Tracking GLONASS
- Dark Green – Tracking an QZSS satellite
- Light Blue – Tracking an MSS (OmniSTAR/RTX) satellite
- Green – Tracking SBAS satellite
- Yellow – Tracking GIOVE or Galileo satellites
- Purple – Tracking BeiDou GNSS Satellites
- Navy Blue – Tracking IRNSS Satellites
- Gray – Satellite is above elevation mask but it is not yet being tracked

A bold pink ring around the satellite indicates it is being used in the current position solution.

Constellation tabs

A separate tab is available for each tracked constellation.

Use these settings to show and to control which satellites are enabled or are set to ignore bad health status. Each satellite has two check boxes associated with it. These check boxes control how the receiver treats each satellite.

An overall option to turn all tracking for each constellation on or off is available on the Receiver Configuration - Tracking page.

SV – The numeric identifier of the satellite.

Enable – If the **Enable** check box is selected, the receiver uses the satellite in positioning and places the measurements from that satellite in logged data files, as long as the satellite is reported to be healthy, or as long as the **Ignore Health** check box is checked.

If the **Enable** check box is not selected, the receiver does not use the satellite in positioning, and does not place the measurements in logged data files, regardless of the reported health or the state of the **Ignore Health** check box. It is not recommended that satellites be explicitly disabled.

Ignore Health – The receiver does not normally track satellites that are considered unhealthy. However, if the **Ignore Health** check box is selected for a satellite, then the receiver tracks that satellite ***even*** if it is considered unhealthy. Measurements from that satellite are used in all outputs such as logged measurements, logged ephemeris files, and in any other output that gives raw measurement values. Regardless of this setting, unhealthy satellites are never used to calculate the position of the receiver. Trimble recommends that you ***do not*** track unhealthy satellites in normal (non-scientific) applications.

Use the **Enable All** and **Disable All** buttons as a quick way to turn on or off the use of all satellites if several have been disabled.

Satellite Almanacs

This page enables you to download the current receiver almanac. Click on the Download link. The file can then be imported into the Trimble Planning software.

This software is available as a free download from www.trimble.com/GNSSPlanningOnline/#/Settings.

Predicted Satellite Elevation Angle

Use this page to view the predicted elevation angle of a particular satellite.

To view the graphs, you need Scalable Vector Graphic (SVG) support. SVG is available for download from ADOBE as a browser plug-in. Download and install the Adobe SVG plug-in from the Adobe website (www.adobe.com/svg/viewer/install/) if it is not enabled in your browser.

Satellite Type and Satellite ID – Select a satellite that you want to view:

- The GPS selection is available for all receivers.
- The other constellations are available only if the receiver is tracking them.
- Satellite numbers shown in red are unhealthy satellites.

For more information, see GPS Satellite Enable/Disable.

Use Receiver Position – Select this check box to view the elevation angle of the predicted satellite for the receiver's current position.

Select Position from a list – This option becomes available once you clear the Use Receiver Position check box. This enables you to select a major city from the list. To view the predicted satellite elevation angle for a particular location, clear the check box. Fields then appear where you can enter the location's latitude and longitude.

Predicted Number of Satellites

Use this page to view the predicted number of satellites available per constellation from a specific location for the next 24 hour period.

To view the graphs, you need Scalable Vector Graphic (SVG) support. SVG is available for download from ADOBE as a browser plug-in. Download and install the Adobe SVG plug-in from the Adobe website (www.adobe.com/svg/viewer/install/) if it is not enabled in your browser.

Ignore Health – Select this check box to view both healthy and unhealthy satellites. By default, this check box is cleared as the receiver does not normally track satellites that are considered unhealthy. For more information, see Satellite Enable/DisableSatellite Enable/Disable.

Elevation Mask – Select this check box to view the predicted satellite constellation for the elevation angle mask at the receiver's current position.

Use Receiver Position – Select this check box to view the satellite constellation for the receiver's current position.

Select Position from a list – This option becomes available once you clear the Use Receiver Position check box. This enables you to select a major city from the list. To view the predicted satellite constellation for a particular location, clear the check box. Fields then appear where you can enter the location's latitude and longitude.

Current Satellite Constellation

Use this page to view the current position of the entire constellation of satellites. The labels show the point on the earth directly beneath the satellite.

To view the graph, you need SVG support.

- Green circles – Visible satellites
- Blue – GPS satellites
- Purple – SBAS satellites
- Red – GLONASS satellites
- Orange – Galileo satellites
- Green – BeiDou satellites
- Magneta – QZSS satellites
- Turquoise – IRNSS satellites
- Yellow dot – Current receiver position

Use this page to view an orbit of a given satellite projected onto the earth. The graph shows the current position of the satellite and the time (in UTC format) that it will pass over various locations.

To view the graph, you need SVG support.

Select the Satellite Type from the list of available constellations and the satellite ID:

- The current location of the selected satellite above the earth is shown by in red.
- The UTC hour is shown for each location along the orbit.
- The current Receiver position is shown as a yellow dot.
- The satellite is visible from the Receiver position when the orbit is green.
- The satellite is not visible from the Receiver position when the orbit is blue.

Rise/Set (Table)

This table provides the UTC time at which the satellites currently being tracked by the receiver will rise above and set below the selected elevation mask at the selected location.

Ignore Health – Select this check box to view both healthy and unhealthy satellites in the predictions.

Elevation Mask – Enter the minimum elevation that you want to compute the satellites rise/set times. The rise and set times are based on when the satellites meets this criteria.

Use Receiver Position – Select this check box to use the current receiver latitude/longitude to compute rise/set times.

Select Position from a list – This option becomes available once you clear the **Use Receiver Position** check box. This enables you to select a major city from the list. To view the rise/set times for a particular location, clear the check box. Fields then appear where you can enter the location's latitude and longitude.

Click **Update** to show the predictions based on the data selected.

Rise/Set (Graph)

This graphic provides the UTC time at which the satellites currently being tracked by the receiver will rise above and set below the selected elevation mask at the selected location.

Satellite Type – Select the type of satellites to view the rise and set times from.

Ignore Health – Select this check box to view both healthy and unhealthy satellites in the predictions.

Elevation Mask – Enter the preferred minimum elevation to compute the satellites rise/set times. The rise and set times are based on when the satellites meets this criteria.

Use Receiver Position – Select this check box to use the current receiver latitude/longitude to compute rise/set times.

Select Position from a List – Select this check box to select positions from the main cities. Clear this check box to enter a latitude and longitude of the preferred position to get predictions from.

Update – Click **Update** to show the predictions based on the data selected.

Data Logging menu

Use the **Data Logging** menu to set up the receiver to log static GNSS data. You can also configure settings such as observable rate, position rate, continuous logging, continuous logging rate, and whether to auto delete old files if memory is low.

Data Logging – Summary

Data logging refers to the process of collecting GNSS measurements, positions, and other information into data files. The collected information can be downloaded into another system for postprocessing. Data logging is activated by creating and starting “sessions”. A session describes the types and storage intervals for logged information, the scheduled time and duration of logging, the file system, the file naming convention, and other attributes.

The receiver provides ***12 concurrent independent sessions with dedicated memory pooling*** capabilities.

This screen provides a summary of current data logging settings for the receiver.

The page shows two tables:

- The first table describes the status of one or two file systems.
- The second table describes the status of the session.

File System – Shows the starting path to a file system:

- /Internal (built-in Flash memory)
- /External (removable Flash memory)

Click on the file system path to switch the page to view the data files information at the top of that file system.

Size – The maximum storage space available, in megabytes (MB).

Available – The amount of storage space that is available for new files. This is shown in megabytes (MB) and as a percent of the maximum size.

Auto Delete – If this check box is selected, the receiver automatically delete files when the available space drops below 500 Kbytes. The receiver deletes the oldest files first. If this check box is not selected, all data logging stops whenever there is insufficient available space for new data to be logged. Changes take effect immediately after you select the check box.

Format button – Take care when using the **Format** button. The format button formats the file system on the flash memory in the receiver to allow data logging. The receiver is shipped with the flash memory formatted. The flash memory should ***only be formatted***

when you or a support representative suspects the file system on the flash memory is corrupt. ***All files on the receiver are erased during a file system format***.

Session – This field shows the GNSS Measurements and Position storage intervals and a Configure button. Click Configure to open the Data Logging Configuration page to view and edit the complete session configuration.

Schedule – Shows the type of schedule configured for the session. See *Data Logging* / *Configuration* / schedule.

Status – Shows the current status of the session. If the session is actively logging data, then the pathname of the file is shown. Other information may be shown, depending on the session configuration. Click the name of an active file to switch to the Data Files page showing the directory containing that file.

Enable – Select this check box to immediately enable the session. Depending on the session's schedule mode, logging might not start immediately. If you clear the check box on an active session, you are asked to confirm that you want to stop the session.

Data Logging – Configuration

Use these settings to configure the data logging settings.

Session Name – This field displays the name of the session as DEFAULT. You cannot change it.

Enable – Select this check box to enable the session to operate after you tap OK.

Schedule – Each session logs data for starting at specific times, for a specified duration:

- Always – This mode causes the session to log data whenever it is selected. A single file is produced. Logging only stops when the available file system space drops to zero or when the session is disabled.
- Manual – Logging starts when the session is first enabled and continues for the specified duration. A single file is produced.
- Once – Logging starts at a specified date and time and continues for the specified duration.
- Daily – Logging starts each day at the specified time and continues for the specified duration. A new file is produced each day.
- Continuous – Logging produces a continuous sequence of files of the given duration. Individual logging sessions starts at times that match the duration. For example, 2 hour files would start at 00:00, 02:00, 04:00, ... 20:00, 22:00, and repeats this schedule every day.

Start Date – This field becomes available when you select Once as the Schedule mode. Select the Year, Month, and Day when the session should start logging.

Start Time – This field becomes available when you select Once or Daily as the Schedule mode. Enter the time of day (HH:MM) when logging should start.

Duration – Available for all schedule modes except "Always". Specifies the amount of time, in minutes, for each logged file.

Measurement Interval – Select the interval between logged GNSS measurement records.

Smooth Pseudorange – Select this check box to smooth pseudorange values in GNSS measurement records to reduce random fluctuations.

Smooth Phase – Select this check box to smooth carrier phase measurements in GNSS measurement records to reduce random fluctuations. This feature is only available for Measurement Intervals of 1 second and longer.

Smoothing includes primary and secondary satellite signals.

Position Interval – Select the interval between logged position records.

Log Received Corrections – The correction stream being used for positioning will be logged.

Log Raw Nav Data– Logs the raw 50 bps data sent from the satellite.

Log SBAS Data– Logs the SBAS (Satelite Based Augmentation System) data messages.

File System – Select the file system to be used for this session. On some systems, only a single choice is available.

Path Style – Select one of several directory structures for the created files:

- **Flat** – Files are all created at the top-level directory of the selected file system. No subdirectories are used.

  NOTE – Some file systems (like USB memory sticks or CompactFlash cards) have limitations on the number of files that can be created in a top-level directory. If a large number of files will be created, do not use path style Flat.

- **Date** – Files are stored in a structure of the form /Internal/YYYY/MM/DD/filename.T01. The date chosen corresponds to the expected start time of the session.
- **Date/Session** – Files are stored in a structure of the form /Internal/YYYY/MM/DD/SessName/filename.T01. The actual name of the session (up to eight characters) is used as part of the path.
- **Session/Date** – Files are stored in a structure of the form /Internal/SessName/YYYY/MM/DD/filename.T01. The actual name of the session (up to eight characters) is used as part of the path.

Name Style – Select a filename style. The file has a filename extension of T01.

- **####JJJx** – Creates an 8 character name consisting of the last four digits of the serial number (####), followed by:

  x is an index character that steps from 0 to 9 and then from A to Z.

- **##########YYYYMMDDhhmm** – Creates a 22-character name consisting of the full 10-digit serial number (##########), followed by:

  4-digit year (YYYY)

  2-digit month (MM, 01 = January)

  2-digit day-of-month (DD, 01 = first day of month)

  2-digit hour (00 to 23)

  2-digit minute (00 to 59)

  The time encoded is the theoretical start time when the file will be created. Typically, this is the start time of the session. However, if a scheduled file starts later than its scheduled time (for example, due to a power failure), the file will still be named as if it actually started on time.

- SITEJJJh – NGS style for long durations. Only available for continuous logging sessions with durations that are exact 60 minute multiples. Creates an 8 character name where SITE is the last four characters of the Station Name entered on the Reference Station page, followed by:

  JJJ is the Julian Day of Year (001 for 01 Jan)

  h is an hour indicator character that steps from a to y (a = 00:00, b = 01:00, ..., y = 23:00)

- SITEJJJhmm – NGS style for short durations. Only available for continuous logging sessions. Creates a 10 character name where SITE is the last four characters of the Station Name entered on the Reference Station page, followed by:

  JJJ is the Julian Day of Year (001 for 01 Jan)

  h is an hour indicator character that steps from a to y (a == 00:00, b = 01:00, ..., y = 23:00)

  mm is a 2-digit minute indicator (00 to 59)

- YYMMDDHH – IGS style for long durations. Only available for continuous logging sessions with durations that are exact 60 minute multiples. Creates an 8 character name encoding the date and time of the file creation time, where:

  YY is the last two characters of the year.

  MM is the two digit month number, 01 = January.

  DD is the two digit day-of-month number.

  HH is the two digit hour within day, 00 to 23.

- YYMMDDHHmm – IGS style for short durations. Only available for continuous logging sessions. Creates a 10-character name encoding the date and time of the file creation time, where:

  YY is the last two characters of the year.

  MM is the two digit month number, 01 = January.

  DD is the two digit day-of-month number.

  HH is the two digit hour within day, 00 to 23.

  mm is the two digit minute within the hour, 00 to 59.

- FTP Push – If enabled, then at every rollover period, the receiver sends the logged data files to a predefined FTP server.

NOTE – Files that are pushed in this manner are always expanded to the filename format ##########YYYYMMDDhhmm unless they are already in that format. Any suffix character on the name is not changed.

- Email Push – If enabled, then at every rollover period, the receiver sends the logged data files to a predefined email address.
- Convert – A variety of conversions from the binary T01/T02 files to other formats is available for the FTP and Email Push features. These conversions include RINEX, BINEX, and Google Earth (KLM). See Data FilesData Files.

Data Logging – Data Files

Use the first table to navigate around the file system. The top row shows the path to the directory you are viewing. Click that path to refresh the page to show any recent changes. The rows below that enable you to move upward or downward in the directory structure.

To go to the top of the file system structure, click the **Home** icon or **Top Level Directory**.

To go up one level, click **Parent Directory**. Any subdirectories are shown by name. Click them to view.

The page shows any data files. Each file shows the filename, created date and time, and size. To download the file, click the file icon or filename. Each file has a check box that you can use to select it for deletion; To select all of the shown files for deletion, click the icon next to the **Select All** button. To delete the files, click the icon next to the **Delete Selected Files** button and then click **OK** to confirm the deletion.

To delete ***all*** files within the subdirectory, click X on the subdirectory and then click **OK** to confirm the deletion.

A file that is actively being written appears in the list, but cannot be downloaded or selected for deletion. Typically, the name is not shown in bold and the Delete check box does not appear.

Graph (icon) – The Graph function opens the Position (Graph) and plots the Height, East, North or East/North data from the position records of the T02 or T04 files.

For more information, see Position (Graph).

Convert – Click **Convert** to convert the raw data logged in a T02 or T04 file to a number of different formats including RINEX, BINEX, and Google Earth (KML).

RINEX Conversion – T02 and T04 files are more compact than RINEX files and hold more information. Use the RINEX converter if you require an industry standard file format. The converter does a data conversion on-the-fly when the user requests a RINEX download. As this is done in a single pass and there is no way to predict the size of the file, the one limitation is the size of the file is unknown on download as the web interface only displays the T02/T04 file length. This does not violate FTP/HTTP download standards.

The receiver supports the download of RINEX, Hatanaka RINEX, gzipped versions of RINEX and Hatanaka RINEX, and the GPS, GLONASS, and Galileo ephemeris in RINEX format.

You can also set the RINEX version. Trimble currently supports version 2.11, 2.12 with QZSS, 3.00, 3.02, 3.03, and 3.04. The receiver's FTP server also supports a convert on download. As the size is not known, it is not given in the directory listing.

Data Logging – Power Saving

This function is intended for remote long term deployments where power supply conservation is paramount.

When the **Power Off When Not Logging** check box is selected, the system will shut down three minutes after a scheduled logging session has completed. At the next manual power up, you have three minutes to either turn off this feature or schedule a new data logging session before the system powers down again.

When selected, the receiver will power down to a very low power setting when not actively logging. The receiver will wake up 1 minute before the next scheduled logging session to prepare itself to log data. Once the session is complete, it will again power down.

Once this setting is enabled, you can also then enable the **Periodic Wakeup** function, which is useful, for example, if schedule connections to the receiver are required at a specific time during the day. This functionality is in addition to the data logging power saving function. This Periodic Wakeup function has the following settings:

Duration – The time that the receiver will stay powered on.

Interval – The interval over which the power up will occur relative to the start of the GPS day.

Data Logging – File Protection

Use the **File Protection** screen to configure the protection of stored data files when an event signal is received. This feature allows important data to be protected from the standard memory pool automatic deletion function. The idea is that an event input from an external sensor, such as a seismic detector, will protect data from automatic deletion for a time period before and after the event. This ensures that this data is available for later study.

You must manually delete protected data to remove it from the system memory.

Data Logging – Data Files

Use the first table to navigate around the file system. The top row shows the path to the directory you are viewing. Click that path to refresh the page to show any recent changes. The rows below that enable you to move upward or downward in the directory structure.

To go to the top of the file system structure, click the **Home** icon or **Top Level Directory**.

To go up one level, click **Parent Directory**. Any subdirectories are shown by name. Click them to view.

The page shows any data files. Each file shows the filename, created date and time, and size. To download the file, click the file icon or filename. Each file has a check box that you can use to select it for deletion; To select all of the shown files for deletion, click the icon next to the **Select All** button. To delete the files, click the icon next to the **Delete Selected Files** button and then click **OK** to confirm the deletion.

To delete ***all*** files within the subdirectory, click X on the subdirectory and then click **OK** to confirm the deletion.

A file that is actively being written appears in the list, but cannot be downloaded or selected for deletion. Typically, the name is not shown in bold and the Delete check box does not appear.

Graph (icon) – The Graph function opens the Position (Graph) and plots the Height, East, North or East/North data from the position records of the T02 or T04 files.

For more information, see Position (Graph).

Convert – Click **Convert** to convert the raw data logged in a T02 or T04 file to a number of different formats including RINEX, BINEX, and Google Earth (KML).

RINEX Conversion – T02 and T04 files are more compact than RINEX files and hold more information. Use the RINEX converter if you require an industry standard file format. The converter does a data conversion on-the-fly when the user requests a RINEX download. As this is done in a single pass and there is no way to predict the size of the file, the one limitation is the size of the file is unknown on download as the web interface only displays the T02/T04 file length. This does not violate FTP/HTTP download standards.

The receiver supports the download of RINEX, Hatanaka RINEX, gzipped versions of RINEX and Hatanaka RINEX, and the GPS, GLONASS, and Galileo ephemeris in RINEX format.

You can also set the RINEX version. Trimble currently supports version 2.11, 2.12 with QZSS, 3.00, 3.02, 3.03, and 3.04. The receiver's FTP server also supports a convert on download. As the size is not known, it is not given in the directory listing.

Data Logging – FTP Push

The FTP Push feature allows logged data files to be automatically copied using FTP to a user-specified server. The logged data files are copied to the server as soon as the data file is closed.

Server Address – Enter the address of the server in which the data is to be copied to. Enter the address either as a numeric IP address or a valid DNS address. For example, ftp.trimble.com.

Username – Enter the (case sensitive) username required to log into the server.

Password – Enter the (case sensitive) password required to log into the server.

Verify Password – Re-enter the password required to log into the server.

When choosing an FTP Server password, remember the following limits:

- 60 characters for the server address
- 12 characters for the user name
- 15 characters for the password
- 60 characters for the remote directory

Delay – When the file roles instead of pushing the data immediately, the push is delayed by "delay" minutes. If there are a number of receivers on the same network all FTP-pushing, each receiver should have a unique delay to avoid overloading the network by all the receivers trying to FTP-push at the same time.

Remote Directory – The remote directory is the directory structure that the FTP Push should follow to write the data.

Example: \Data_Files\Trimble\

Path Style – Select one of two directory structures for the created files:

- **Flat** – Files are all created at the top-level directory of the selected file system. No subdirectories are used.

NOTE – This can result in a large number of files in a single directory, which can cause slow responses when listing directories, etc.

NOTE – Some file systems have limitations on the number of files that can be created in a top-level directory. You should not use this path style if a large number of files will be created.

- **Type/YYY/DDD/site** – Files will be stored in a structure of the form /type/YYYY/DDD/site/filename.T01. The site is the station name. The date chosen corresponds to the expected start time of the session.
- **RefData.YY/Month.MMM/Day.DD** – Files will be stored in a structure of the form /RefData.YY/Month.MMM/Day.DD.

Rename – Select one of two options:

- **No** – This leaves the file name format as previously selected when using FTP Push.
- **##########YYYYMMDDhhmm**: Creates a twenty-two character name consisting of:
  - The full ten-digit serial number (##########)
  - The four-digit year (YYYY)
  - A two-digit month (MM, 01 = January)
  - A two-digit day-of-month (DD, 01=first day of month)
  - A two-digit hour (00 to 23)
  - A two-digit minute (00 to 59)

  The time encoded is the theoretical start time when the file would be created. Typically, it is the start time of the session. However, if a scheduled file starts later than its scheduled time (for example, due to a power failure), then the file will be named as if it actually started on time.

Transfer Mode

- **Passive with fallback to Active** – This is the default setting. Trimble recommends that you select this option.
- **Passive** – The client sends a PASV command to the server and then receives an IP address and port number. The client uses these to open the data connection to the server. Use this option in situations where the client is behind a firewall and cannot accept incoming TCP connections.
- **Active** – The client sends the server, the IP address and port number on which the client will listen, and the server initiates the TCP connection.
- **SFTP** – The default port will automatically switch to Port 22 (user editable). After entering the connection details and clicking **Test** to perform a test of the connection, the algorithm and fingerprint provided by the remote server will be displayed, and the **Verify** check box is enabled but remains unchecked. You must select the **Verify** check box to enable remote host verification during transfers; otherwise the key submitted by the remote host will always be accepted.

  NOTE – You are encouraged to use HTTPS connections in combination with SFTP for secure transmission of all credentials. Also, it is strongly recommend that you enable Email Alerts on the receiver to be notified if a transfer fails due to a new fingerprint being used by the remote FTP server.

  NOTE – When you click Test at the bottom of the screen, the receiver attempts to connect to the server and publishes a test file to verify that the information is correctly entered. When you click

Test, a file called Hi.txt is pushed to the server. To push logged files, you must enable FTP Push on the Logging Setup page.

NOTE – Data Files are only pushed when a data logging file is closed.

Example – FTP Push *.T02 files to a Trimble Connected Community filespace.

Use **TCC Explorer** to create a folder within your Organisations filespace.

/TCC/<orgname>/<filespace's shortname>

Configure your Data Logging session, enable the **FTP Push** function and select the file convention as **None (FTP T01/T02 files)**.

Configure the **FTP Push** with the following settings:

Server Address – www.myconnectedsite.com

Username – <tccusername>.<tccorgname>

Password – <tccpassword>

Verify Password – <tccpassword>

Remote Directory – /TCC/<orgname>/<filespace's shortname>

Leave all other settings as default.

Click **Test** to check the settings.

Data Logging – FTP Push Log

The FTP Push Log provides a summary of the FTP transfers attempted by the receiver.

Time – Indicates when the receiver attempted to transfer a logged data file to a server.

Status – Indicates if the FTP transfer was successful or if it failed. Successful transfers are indicated by the text “OK”.

Local File Name – Displays the name of the logged data file that the receiver attempted to transfer to a server.

Receiver Configuration menu

Use the **Receiver Configuration** menu to configure such settings as elevation mask and PDOP mask, the reference station position.

Receiver Configuration – Summary

This page displays the current settings of the receiver.

Select **Receiver Configuration / Summary**.

Elevation Mask – The elevation mask below which the receiver will not track satellites.

PDOP Mask – The value for PDOP above which the calculation of new positions is suspended until the PDOP falls below the mask value again.

Horizontal Precision – The required horizontal precision that you set to determine when the horizontal quality indicator on the receiver display switches from flashing (precision threshold not met) to not flashing (precision threshold met). It also determines when an OmniSTAR solution has initialized.

Vertical Precision – The required vertical precision that you set. This threshold determines when the vertical quality indicator on the receiver display switches from flashing (precision threshold not met) to not flashing (precision threshold met).

Clock Steering – When enabled, the receiver clock is steered to GPS system time rather than periodically introducing 1 ms steps and constraining the clock to ± 0.5 ms.

EVEREST™ Multipath Mitigation – Trimble proprietary multipath mitigation algorithm. Enabled by default.

Signal Tracking Bandwidth – Can be Wide or Narrow. The default is Narrow.

Antenna ID – A numeric representation of the selected antenna type being used with the receiver.

Antenna Type – The selected antenna type being used with the receiver.

Antenna Measurement Method – The selected antenna measurement method being used with the receiver.

Antenna Height – The height of the antenna reference point.

1PPS On/Off – Indicates if the 1PPS output has been enabled.

Event 1 On/Off – Indicates whether the Event input has been enabled.

Event 1 Slope – Indicates the selected slope for the Event Input.

External Frequency Available – Indicates if an external frequency input signal has been detected.

RTK Mode – Indicates if the receiver is in a synchronized or low latency RTK mode.

Receiver Motion – Indicates if the receiver is set to operate as a static or kinematic receiver. This mode determines if the unit is Static or Moving for base station applications and MSS (RTX or OmniSTAR) initialization.

RTK Engine Motion – Follows the Receiver Motion setting.

CMR Input Filter – Shows whether or not CMR corrections are being used from a specific base station.

Reference Latitude – The WGS-84 reference station latitude.

Reference Longitude – The WGS-84 reference station longitude.

Reference Height – The WGS-84 reference station ellipsoid height.

RTCM 2.x ID – A unique identifier for the RTCM messages. Can be any value from 0 through 1023.

RTCM 3.x ID – A unique identifier for the RTCM messages. Can be any value from 0 through 4095.

CMR ID – A unique identifier for the CMR message. Can be any value between 0 through 31.

Station Name – The sixteen-character name of the reference station.

Ethernet IP – The Ethernet IP address of the receiver.

System Name – The unique system name for the receiver.

DNS Resolved Name – The name returned by the DNS system.

Serial Number – The serial number of the receiver.

Firmware Version – The version of the firmware currently installed in the receiver.

Firmware Date – The production date of the firmware currently installed in the receiver.

Antenna Configuration / Position Antenna / Vector Antenna

Use these settings to define the antenna being used by the receiver.

Antenna Type – Select the type of antenna being used with the receiver. The antenna serial number is automatically shown for the GNSS smart antenna. Setting this field will automatically set the RINEX Name in the following field.

RINEX Name – Allows the selection of the type of antenna being used with the receiver using the RINEX name of the antenna rather than the Trimble name for the antenna. Setting this field will automatically set the antenna type in the preceding field.

Antenna Serial Number – Enter the serial number of the antenna being used.

Radome Serial Number – Enter the serial number of the radome enclosure.

Antenna Measurement Method – Select how the antenna height is being measured.

Antenna Height [m] – Enter the measured height of the antenna. This is typically measured from a ground marker or the mounting point of the antenna.

Gain Amplification – Enable Gain Amplification if the sum of the antenna gain and the total cable loss is less than 38 dB. For example, if the antenna gain is 30 dB and the cable loss is 8 dB, then the sum is 30-8=22 dB (cable loss is negative) of gain. In this case, enable the Gain Amplification. Trimble antennas have an antenna gain of 50 dB and a maximum suggested cable loss of 12 dB for a total of 38 dB system gain, so the Gain Amplification should be set to Disabled. If a Trimble antenna is used with a very long cable run that has, for example, a 20 dB loss, then the system gain is only 30 dB, so Gain Amplification should be Enabled.

Apply Antenna Correction to – When the RTCM V3 check box is selected, the Base antenna is set to a "Null Antenna" and no antenna model parameters are sent to the rover receiver. When using Trimble receivers exclusively, Trimble recommends that you select the check box. In some case, when using a third-party rover receiver, the check box should be left cleared and the antenna model parameters are sent to the rover. To determine the settings for this parameter, check with the third-party manufacturer.

NOTE – If available, an image of the selected antenna is displayed, so that you can confirm that you have selected the correct antenna.

L1 antenna phase center offsets for each antenna type

Antenna name	P/N	Bottom of antenna mount (cm)
GA510	55550-00	7.54
GA530	44530-00	7.83
GA810	99810-00	7.23

Antenna name	P/N	Bottom of antenna mount (cm)
GA830	48830-00	8.85
Micro-centered L1/L2	33429-00	6.25
Micro-centered L1/L2 w/GP		
Rugged Micro-centered w/13 Inch GP	36569-00	5.00
Zephyr	39105-00	4.60
Zephyr Geodetic	41249-00	5.33
Zephyr Model 2	77970-00	8.43
	55970-00	
	57970-00	
Zephyr Geodetic 2	77971-00	8.55
	55971-00	
	57971-00	
Z Plus	57200-00	4.60
Zephyr Model 2 Rugged	65212-00	9.73
Zephyr 3 Base	115000-10	6.52
Zephyr 3 Rover	105000-10	6.17

Antenna Query

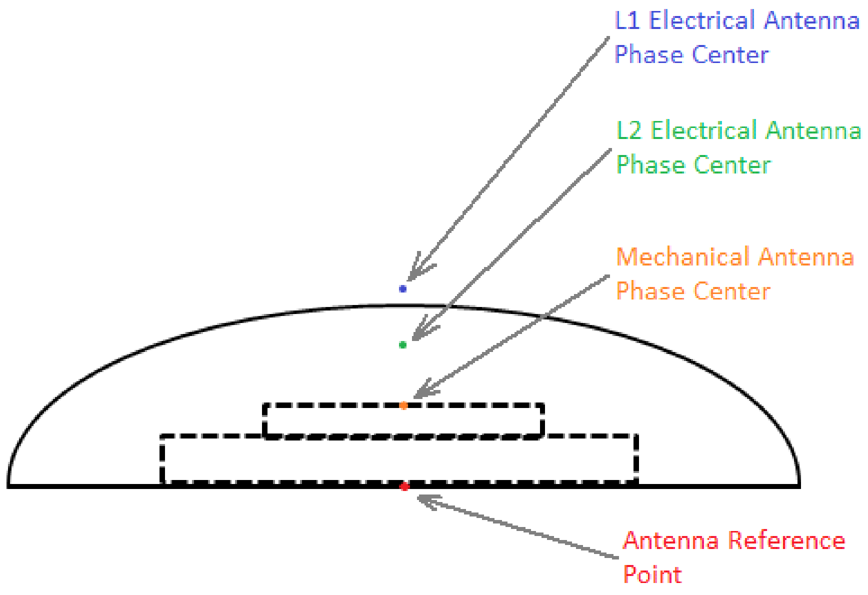
Click **Antenna Query** to interrogate a supported antenna for its model and serial number. This is currently an unsupported feature.

Understanding antenna phase center offsets

See Antenna Phase Centers.

Antenna Phase Centers

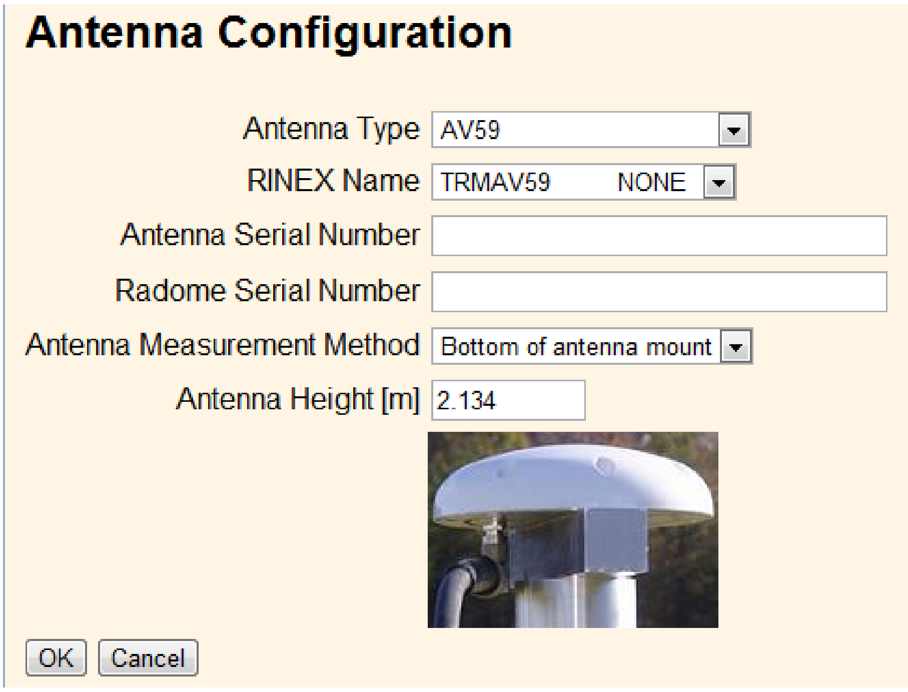
To understand Antenna Phase Centers (APC) and Antenna Reference Points (ARP), let's begin with a diagram of an antenna:



The ARP is typically the point on the centerline of the antenna at the mounting surface. Above the ARP is the Mechanical Antenna Phase Center, this is the physical point on the surface of the antenna element where the Antenna Phase Center electronics reside. The actual Antenna Phase Centers for L1 and L2 frequencies are points (or clouds) in space, typically above the Mechanical Antenna Phase Center.

The GNSS receiver reduces all of the measurements at the L1 and L2 Antenna Phase Centers to the Mechanical Antenna Phase Center. The GNSS receiver outputs the coordinates for the Mechanical Antenna Phase Center in all of its output measurements. If you wish to further reduce the output coordinates (for example, reduce them to the ARP), you must do this reduction in your software applications, taking into account factors such as tilt of the antenna.

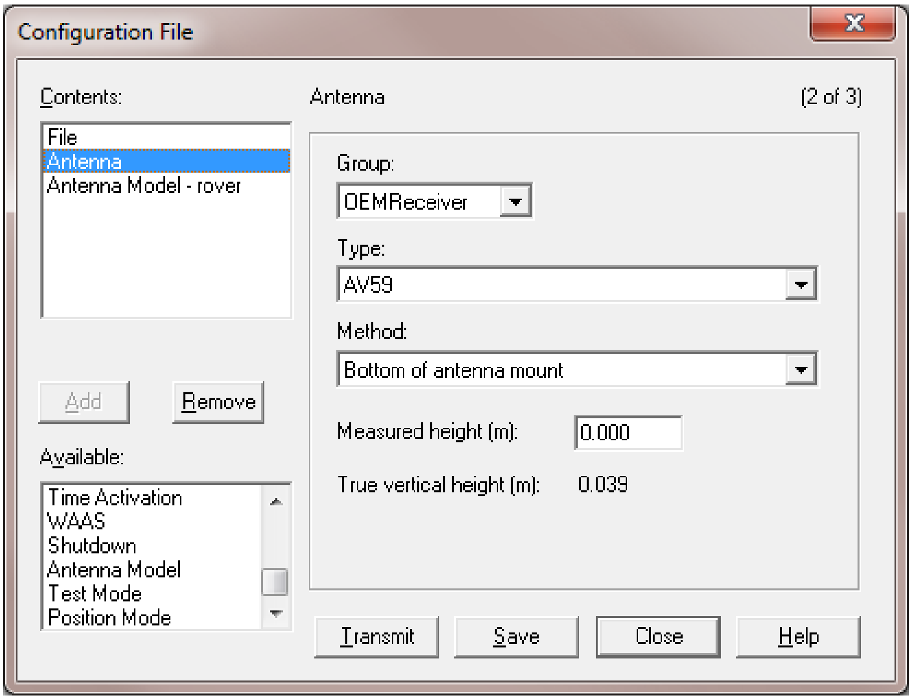
The GNSS receiver has an interface to setup the antenna type, antenna height, and antenna measurement method. The entered antenna height and antenna measurement method values are only applied when setting the GNSS receiver up as a base station, since the CMR or RTCM correction message outputs the coordinate of the base stations' Mechanical Antenna Phase Center. However, typically only the coordinates of the ground station which the antenna is setup over are known. Entering the antenna height and antenna measurement method enables the software to calculate the height of the Mechanical Antenna Phase Center above the ground station.



When the **Antenna Type** field is set, the value of the **RINEX Name** field is automatically set, and vice-versa.

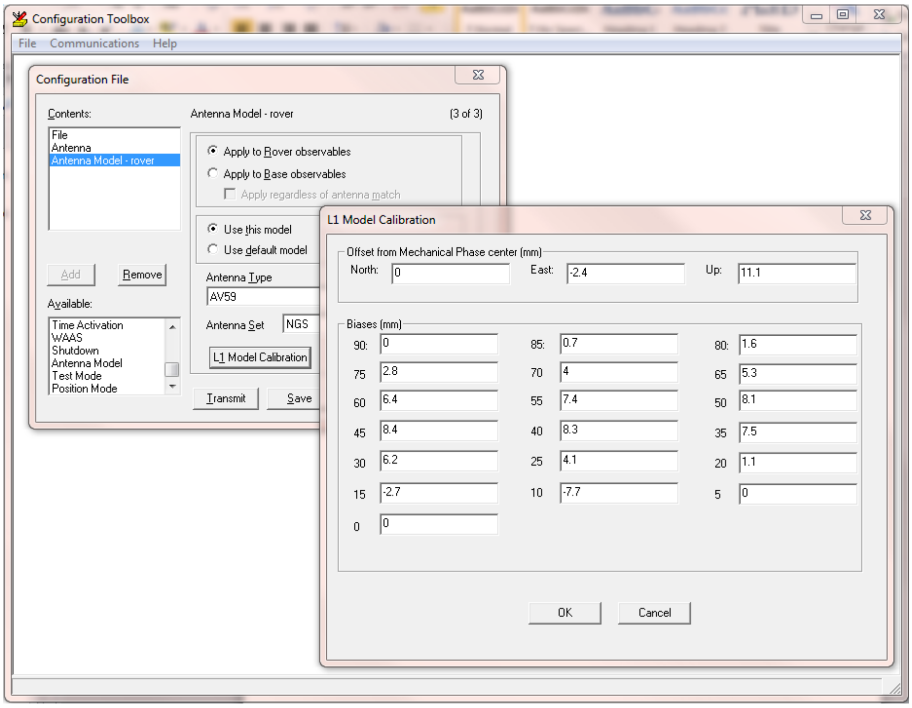
Setting the proper antenna type slightly improves the accuracy of the GNSS receiver, since the L1 and L2 Antenna Phase Center offsets are known and accounted for. In addition, the antenna model accounts for elevation-dependent biases of the antenna, so that the satellite tracking is corrected at various elevation angles.

If you want to know the offsets between the Antenna Reference Point and the various Antenna Phase Centers, Trimble recommends using the Configuration Toolbox software. In the Configuration Toolbox software, you can add the **Antenna** page and then select the antenna type:



If you select "Bottom of antenna mount" in the **Method** field, the **True vertical height** field shows the distance between the Antenna Reference Point and the Mechanical Antenna Phase Center.

If you want to understand the location of the L1 and L2 Antenna Phase Centers with respect to the Mechanical Antenna Phase Center, add the **Antenna Model** page and then select the antenna type. Click the **L1 Model Calibration** or **L2 Model Calibration** button to view the offsets and the elevation-dependent tracking biases:



These antenna calibrations are automatically used by the receiver when the correct antenna type is selected. You only need to add the **Antenna Model** page if you want to override the antenna models. Trimble recommends using the default antenna models. To download the most recent antenna models, go to www.trimble.com/trimbleconfiguration_ts.asp.

Receiver Configuration – Reference Station

Use these settings to set the position of the receiver and the ID of the data for use in RTCM and CMR output.

Select **Receiver Configuration** / **Reference Station**.

CMR ID – Enter a station ID for CMR corrections generated by the receiver (0 through 31).

RTCM 2.x ID – Enter a station ID for RTCM 2.x corrections generated by the receiver (0 through 1023).

RTCM 3.x ID – Enter a station ID for RTCM 3 corrections generated by the receiver (0 through 4095).

Station Name – Enter a name for the reference station (up to 16 characters).

Station Code – Enter a description for the reference station (up to 16 characters).

Reference Station Coordinate Type – Select a coordinate type using the *Cartesian* or *Geographical* options.

- **Cartesian (ECEF)** – An XYZ Cartesian Earth Centered Earth Fixed (ECEF) coordinate system is a coordinate system with the origin at the center of the Earth (as defined by a reference ellipsoid). The Z-axis coincides with the minor axis of the reference ellipsoid. The X-axis runs from the origin through a point on the equatorial plane at the zero meridian. The Y-axis is perpendicular to the X-axis on the equatorial plane. The coordinate of your reference station is defined in the plane of the X, Y and Z axis.
- **Geographical** – The "latitude" (abbreviation: Lat., φ, or phi) of a point on the Earth's surface is the angle between the equatorial plane and the straight line that passes through that point and is normal to the surface of a reference ellipsoid that approximates the shape of the Earth. This line passes a few kilometers away from the center of the Earth except at the poles and the equator where it passes through the center of the Earth. Lines joining points of the same latitude trace circles on the surface of the Earth called parallels, as they are parallel to the equator and to each other. The north pole is 90° N; the south pole is 90° S. The 0° parallel of latitude is designated the equator, the fundamental plane of all geographic coordinate systems. The equator divides the globe into Northern and Southern hemispheres.

  The "longitude" (abbreviation: Long., λ, or lambda) of a point on the Earth's surface is the angle east or west from a reference meridian to another meridian that passes through that point. All meridians are halves of great ellipses (often improperly called great circles), which converge at the North and South Poles.

  A line, which was intended to pass through the Royal Observatory, Greenwich (a suburb of London, UK), was chosen as the international zero-longitude reference line, the *prime meridian*. Places to the east are in the Eastern hemisphere, and places to the west are in the Western hemisphere.

Reference Station Coordinates – Enter the reference station coordinate using the coordinate type selected.

- Cartesian –
  - Reference X – Enter the X coordinate of the reference station in meters (+/-). Enter using the WGS-84 reference frame only.
  - Reference Y – Enter the Y coordinate of the reference station in meters (+/-). Enter using the WGS-84 reference frame only.
  - Reference Z – Enter the Z coordinate of the reference station in meters (+/-). Enter using the WGS-84 reference frame only.
- Geographical –
  - Reference Latitude – Enter the latitude of the reference station in degrees, minutes, seconds, and north or south hemisphere. Enter a WGS-84 position only.
  - Reference Longitude – Enter the longitude of the reference station in degrees, minutes, seconds, and east or west hemisphere. Enter a WGS-84 position only.
  - Reference Height – Enter the ellipsoidal height of the reference station in meters. Enter a WGS-84 height only. The Antenna Phase Center must be directly vertically above the station.

Here – Click Here to load the current position of the receiver as the reference station position.

Position Averaging – Select either Cartesian or Geographical reference frame.

- Current Position – The current position in the selected reference frame.
- Average Position – The average position in the selected reference frame.

Reset Average – Click to reset the position averaging to zero and restart.

Auto Average – *The Auto Average feature is only available in the Web interface*. Select this check box to set the averaging time (between 20 and 600 seconds), then click OK to begin auto averaging. An error message warning that the current reference position is “far away from current position” appears; accept this (click OK) since the auto average position will be loaded as the reference station position when the auto average operation is complete. When performing an “auto-average”, if the receiver position solution type changes, the auto-average starts from the beginning of the defined time period.

If the auto-average feature is running, the Here, Average, and Reset Average buttons are grayed out until the auto-average is complete. The auto-average can be canceled at any time.

Receiver Configuration – Tracking

Elevation Mask – Enter the elevation, in degrees, below which the receiver will not track satellites.

EVEREST™ Mutipath Mitigation – Trimble proprietary multipath mitigation algorithm. Enabled by default.

Clock Steering – When enabled, the receiver clock is steered to GPS system time rather than periodically introducing 1 ms steps and constraining the clock to ± 0.5 ms. Enabled by default.

Type	Signal	Description
GPS	L1C	Enable or disable the tracking of the L1C signal by the receiver. *NOTE – The Alloy receiver now supports the new GPS Block IIIA L1C signal. Please note that GPS III satellites are still launching and are not fully operational. The L1C signal frequency is 1575.42 MHz. The Alloy receiver requires a new option code to track the L1C signal. To obtain an upgrade code for the L1C signal, please contact Trimble Support (RTNS_Support@trimble.com) with the serial numbers of your Alloy receivers.*
	L2	Set which information of the L2 signal the receiver is to observe.
	L2 – Legacy	The receiver will track the full cycle carrier phase of the L2 signal. CS code will not be tracked even if available.
	L2CS with Legacy fallback	The receiver will track the CS code on the L2 signal if available. If CS code is not available, the receiver will track full cycle carrier phase in Legacy mode.
	L2CS with Legacy	The receiver will track both CS and Legacy code simultaneously.
	L2 – CS	The receiver will track the CS code on the L2 signal if available. If CS code is not available, the receiver tracks full cycle carrier phase in Legacy mode.
	L2CS – CM/CL	The receiver will track both the CM and CL code broadcast by the satellite simultaneously. Trimble recommends that you use this setting.
	L2CS – CL	The receiver will track only the CL code broadcast by the satellite.

Type	Signal	Description
	GPS L5	If L5 is installed, this menu item is displayed. If selected, it allows tracking of the L5 signal. Set which code the receiver is to track on the L5 signal: L5 – Q – The receiver will track only the Q code broadcast by the satellite. L5 – I + Q – The receiver will track both the I and Q code broadcast by the satellite simultaneously. Trimble recommends that you use this setting.
SBAS	L1 - C/A	Enable or disable the tracking of the L1 C/A signal transmitted from SBAS satellites such as WAAS.
	L5	Enable or disable the tracking of the L5 C/A signal transmitted from SBAS satellites such as WAAS.
GLONASS	L1	Enable or disable the tracking of GLONASS signals by the receiver.
	CA and P	The receiver will simultaneously track both the CA and P code of the GLONASS satellite if both are selected. This is the recommended setting.
	L2	Select from the following options: Disable, L2- C/A(M), L2-P. L2-P is the recommended setting.
	L3	Enable or disable the tracking of the GLONASS L3 signal by the receiver. If you enable GLONASS L3, please select either the Data + Pilot or Pilot option. DATA – Carries the navigation message . Pilot – GNSS channels transmit PRN codes without navigation data (without data modulation) . Data+Pilot: Uses combination of both data and pilot codes.

Type	Signal	Description
GALILEO	E1	Enable or disable the tracking of GALILEO signals by the receiver.
	E5-A	Enable or disable the tracking of the GALILEO E5-A signal by the receiver.
	E5-B	Enable or disable the tracking of the GALILEO E5-B signal by the receiver.
	E5-AltBOC	Enable or disable the tracking of the GALILEO E5-AltBOC signal by the receiver.
BeiDou	B1	Enable or disable the tracking of the BeiDou B1 signal by the receiver.
	B1C	Enable or disable the tracking of the BeiDou B1C signal by the receiver. *NOTE – The Alloy receiver can track the new signals that are part of the third-generation of Beidou satellites:* • *B1C - 1575.42 MHz.* • *B2A - 1176.45 MHz.* • *B2B - 1207 MHz. Not currently supported in the Pivot software.* *The Alloy receiver includes an updated pseudorange to extend the tracking from 37 to 63 BeiDou satellites with an extended almanac. The Beidou tracking option is required for this improvement. If you already have the Beidou upgrade for the Alloy receiver, please contact support (RTNS_Support@Trimble.com) to get a new key to track the B1C; B2A is already supported.*
	B2	Enable or disable the tracking of the BeiDou B2 signal by the receiver.
	B2A	Enable or disable the tracking of the BeiDou B2A signal by the receiver.
	B3	Enable or disable the tracking of the BeiDou B3 signal by the receiver.
QZSS	L1-CA	Enable or disable the tracking of the QZSS L1-CA signal by the receiver. The default setting is Enabled.
	L1 - SAIF	Enable or disable the tracking of the QZSS L1-SAIF signal by the receiver. This signal is only of use for SBAS operation when in the Japan territory. The default setting is Disabled.
	L1 - C	Enable or disable the tracking of the QZSS L1-C signal by the receiver.

Type	Signal	Description
		The default setting is Disabled.
	L2 - C	Enable or disable the tracking of the QZSS L2-C signal by the receiver. The default setting is Enabled.
	LEX	Enable or disable the tracking of the QZSS LEX signal by the receiver. The default setting is Disabled.
IRNSS	L5-CA	Enable or disable the tracking of the IRNSS L5-CA signal by the receiver. The default setting is Disabled.
	S1-C/A	Enable or disable the tracking of the ITNSS S1-CA signal by the receiver. The default setting is Disabled.

Receiver Configuration – Correction Controls

Select **Receiver Configuration** / **Correction Controls**.

Use these settings to manage the use of incoming RTK and DGNSS correction streams. If the receiver is receiving more than one correction stream or the same stream on different channels (such as radio, serial port, and Ethernet), predetermined criteria can be entered to set the preferred correction stream. Additional user-defined fallback settings can also be added.

The receiver always attempts to use the most precise positioning solution by using the following correction types in order:

1. RTK.
2. OmniSTAR XP/HP/G2.
3. Differential (DGPS, DGNSS).
4. OmniSTAR VBS.
5. Beacon DGPS.
6. SBAS.
7. Autonomous.

The correction streams are grouped into three categories according to how they will be processed:

- RTK
- DGNSS
- OmniSTAR

If there are multiple correction streams within any one of the three categories, the selection is made by the following rules in order:

1. Use the CMR Input Filter and RTCM Input Filter.
2. Use the user-defined Correction Controls.
3. If the category is RTK, use CMRx over CMR+™ over RTCM 3 over RTCM 2 (RTK).
4. If streams are of the same types, use the lowest Reference Station ID.
5. If the sources are identical, remain with the currently used channel.

CMR Input Filter – Select this check box to use CMR corrections from a single specific base station. In the ID field, enter a base station ID between 0 through 31.

RTCM Input Filter – Select this check box to use RTCM corrections from a single specific base station. In the ID field, enter a base station ID between 0 through 1023.

RTK – Use this control to use the rules manager to select which RTK service will be used based on user-defined criteria. By default, it is set to **Any Channel** with the option to **Reject All Channels** instead.

To select a channel based on user-defined criteria, click the Add Channel button (**+**). To add additional fallback channels and criteria, click the Add Channel button (**+**) next to the **Else** field.

Use the **Change Channel** drop-down list to select an I/O port as the primary correction source, and the **Else** field to select either the Any Channel or Reject All Channels option if the primary source is unavailable (or does not meet the specified criteria).

Once the you have selected a primary correction source, click the Add Qualifier button (**+** on the right of the source) to select the **Choose Qualifier** option to specify when the primary source will be rejected.

Qualifiers can be set either by:

- Correction Age (user-specified period in seconds after the selected channel stops getting a valid correction stream before switching to the next source). Note: This is not the same as the DGNSS Age of corrections.)
- Base ID (user-specified from 0 through 9999)

To remove rules for channels and qualifiers, click the red **X** button next to the item to remove.

For example:

> Serial 2 / Modem 1 where Correction Age ≤ 20 seconds
> Else
> Radio where Base ID = 37
> Else
> Reject All Channels

DGNSS – Use this control to use the rules manager to select which DGNSS service will be used based on user-defined criteria in the same manner as RTK (see above).

RTX Controls – Controls the enabling and disabling of the RTX-based functions in the receiver.

- **Disable RTX** – Disables any use of CenterPoint RTX, if the receiver has a current subscription.
- **Disable xFill** – Disables the use of xFill to 'fill in' for up to 5 minutes when RTK corrections drop out.
- **Disable GVBS**– Disables the use of clock and orbit information from the RTX corrections to augment the autonomous solution.

Receiver Configuration – Position

Use this page to set receiver position-related settings.

Select **Receiver Configuration / Position**.

PDOP Mask – Use the PDOP mask to enter the value for PDOP above which the calculation of new positions is suspended until the PDOP falls below the mask value again.

NOTE – This applies only to the calculation of position solutions. It does not affect the logging or streaming of GNSS measurements.

RTK Mode – Set the RTK Mode to Synchronous or Low Latency.

- **Synchronous** – The rover receiver must wait until the base station measurements are received before computing a baseline vector. Therefore, the latency of the synchronous position depends on the data link delay. A synchronous RTK solution yields the highest precision possible but is subject to latency. This mode is suitable for static and low-dynamic positioning.
- **Low Latency** – Provides a slightly lower precision solution than Synchronous mode but with a constant low latency, typically 20 msec. This mode is ideal for high-dynamic positioning where latency is an issue.

RTCM 2 Type 31 Input GLONASS Datum – If receiving RTCM 2 corrections from a GLONASS source, you can select the datum (PZ90 or PZ90.02) that they are based on.

Autonomous/Differential Engine – By default, the Kalman filter is on and results in higher quality position solution for autonomous or DGPS solutions when compared with a Least Squares solution. The Kalman selection works substantially better than a Least Squares solution in a mobile vehicle when there are frequent satellite signal dropouts around bridges or high buildings, and gives improved performance around forested areas.

A Kalman solution uses the time history of the position and velocity it has created, whereas a Least Squares option does not use the time history. Trimble recommends using the Kalman filter for most operations. Select Least Squares for non linear movement such as on a suction cutter dredge.

To enable anti-spoofing on the Alloy receiver, please ensure that the Kalman filter is turned on.

Signal Tracking Bandwidth – Allows for a DSP (Digital Signal Processor) selection for Wide or Narrow band tracking. The default is Wide band.

- **Wide** – Used for high-dynamic applications to allow the signal tracking to compensate for a higher rate of change in the Doppler frequency caused by antenna movement.
- **Narrow** – Used in low-dynamic applications where only relatively small changes in Doppler frequency are expected from antenna movement. Narrow bandwidth signal

tracking allows less noise to pass through the filter to improve low-dynamic positioning with better accuracy.

Receiver Motion (Dynamic Model) – Select the Kinematic option when the receiver is in motion. Select the Static option if the receiver is not in motion.

Horizontal Precision – The required horizontal precision that you set to determine when the horizontal quality indicator on the receiver display switches from flashing (precision threshold not met) to not flashing (precision threshold met). It also determines when an OmniSTAR solution has initialized.

Vertical Precision – The required vertical precision that you set. This threshold determines when the vertical quality indicator on the receiver display switches from flashing (precision threshold not met) to not flashing (precision threshold met).

RTK Propagation Limit – Sets the length of time that the low-latency RTK solution will propagate before it drops out of RTK (into DGNSS).

DGNSS Age of corrections – Defines the maximum age of the DGPS corrections, in seconds, for each constellation. When this maximum age is exceeded, the corrections are not used in the position solution.

ITRF Realization (2014) –

Epoch – The default is Fixed. Fixed means ITRF2014 (2005.0 Epoch). If Current is selected, then the Latitude, Longitude and Height are determined on the ITRF2014 reference frame for the current date. For example, 31 January 2017 will be the 2017.08 Epoch. Up until 23 March 2017, the RTX was on ITRF2008.

Apply ITRF Transformation to – RTX selection is the default setting. If None is selected, the RTX position is still computed on the ITRF2014.

ITRF Epoch – This field cannot be edited and shows you that when Fixed Epoch is selected, then the 2005.0 Epoch is used.

Tectonic Plate – When the Fixed Epoch default setting is used, the receiver uses its position and automatically determines which tectonic plate it is on. The Auto setting is default. If the drop-down menu is opened, the selected plate and the four closest plates to the receiver position are listed. The Fixed epoch allows you to select another adjacent tectonic plate.

Recalculate – Click this button to force the current position of the receiver to be used to recalculate the selection of the correct tectonic plate. This button can be used when the Tectonic Plate is set to Auto. Other than at receiver power on, the receiver firmware does not continuously update the Plate selection if Auto is selected.

Click OK to apply the changed settings to the receiver.

Receiver Configuration – Position Monitoring

Use this page to monitor the reference station itself so you can be alerted if the antenna falls over, is moved, and so forth. Enter a position (latitude, longitude, and height) to monitor against, and set up alarms if the threshold is passed.

You can define the acceptable movement of various positioning modes (autonomous, DGPS, RTK, SBAS, RTX, etc.). A Trimble ALLOY GNSS REFERENCE RECEIVER can both receive corrections and determine a real-time position as well as take the reference position and generate corrections for transmission.

You can also define the amount of time to wait before an alarm is issued. Usually email alerts are configured and sent, but there is also a graphical warning on the web interface. For more information, see Network Configuration – E-Mail Alerts.

This information includes:

Enable – Select this check box to enable position monitoring.

You can manually define the input position to monitor against. It does not have to be the base station reference position—it can be on another datum such as the ITRF2014.

Reference Latitude – Enter the current latitude in degrees, minutes, and seconds.

Reference Longitude – Enter the current longitude in degrees, minutes, and seconds.

Reference Height – Enter the height above the ellipsoid in meters.

Here – Use the current position to enter the position monitoring position.

Use Reference Station Position – Use the current reference station position to enter the position monitoring position.

Force reference station position – Always use the reference station position for the position monitoring position.

Suspend CMR/RTCM output if the monitor position is out of tolerance – Avoid unexpected results by suspending CMR/RTCM output if the monitored position is out of tolerance.

Alert Delay – Delay to generate an alert after an event is detected.

Position Type – A row that is highlighted in green indicates the solution type currently being used. If a position moves outside of the defined tolerance, the receiver sends an email alert, and posts a reminder at the top of the web interface to check the position. The current position mode is also highlighted in red. Once the condition clears itself, another email is sent confirming that the position is okay, and the receiver posts a note at the top of the web interface to let you know that an event has occurred and that the administrator needs to clear it. The offending position type is highlighted in yellow.

- Autonomous – Position has no satellite corrections applied.
- SBAS – Position using SBAS corrections.

- VBS – Position using OmniSTAR VBS satellite-based correction service.
- RTK – Position using a Trimble Real-Time Kinematic (RTK) solution.
- DGPS – Code phase differential solution using RTCM correction.
- HP – Position using OmniSTAR HP satellite-based correction service.
- XP – Position using OmniSTAR XP satellite-based correction service.
- G2 – Position using OmniSTAR HP and G2 satellite-based correction service.
- RTX – Position using RTX satellite-based correction service.

Receiver Configuration – General

Use this page to set the general receiver settings.

Enable Shared Port – Sets the shared port on the receiver to be an additional serial port, a CAN bus, or a second Event Marker.

Event 1 On/Off – Enable or disable the first event marker function of the receiver.

Event 1 Slope – Sets the first event marker to have a Positive (rising) slope or Negative (falling) slope.

External Frequency – Select if an external 10 MHz frequency source is used if detected by the receiver.

⚠ WARNING – Setting 1PPS may yield inaccurate results when the receiver is not tracking enough satellites to set time.

When enabled, the pulse is available on pin 4 of the Port 4 Lemo port.

1PPS Always On – Output the 1PPS pulse even if there are no SVs received and there is bi-GPS time.

Battery Charging Mode –

- When ON or OFF – Providing all voltage thresholds are met, charge the receiver's internal batteries whether the receiver is ON or OFF.
- When OFF – Providing all voltage thresholds are met, charge the receiver's internal batteries only when the receiver is OFF.
- When ON – Providing all voltage thresholds are met, charge the receiver's internal batteries only when the receiver is ON.
- Never – Disable charging of the receiver's internal batteries.

Battery Charging Voltage –

- Default – The receiver's internal batteries will change so long as the supply voltage is greater than 11.8 V DC.
- Programmable – Battery Charging Minimum – User settable from 10.8-15.0 V DC.

Power Over Ethernet –

- Enable – Enable the PoE supply for the receiver.
- Disable – Disable the PoE supply for the receiver.

Ethernet Battery Charging –

- **Enable** – Charge the receiver's internal batteries when the receiver is powered via PoE.
- **Disable** – If the receiver is powered via PoE, ***do not*** change the receiver's internal batteries.

Power on Voltage –

- **Port 3** – The voltage at which the receiver will power on if powered from port 3. The range is 10.8-15.0 V DC. The default is 11.8 V.
- **Port 4** – The voltage at which the receiver will power on if powered from port 4. The range is 10.8-15.0 V DC. The default is 11.8 V.

NOTE – If both port 3 and port 4 have power supplied, the receiver will choose the higher of the two supplies.

Shutdown Voltage –

- **Disable** – No automatic shutdown is enabled regardless of the supply voltage levels.
- **Enable** –
  - Port 3 – Voltage at which the receiver will shutdown. The range is 9.5-15.0 V DC. The default is 10.5 V DC.
  - Port 4 – Voltage at which the receiver will shutdown. The range is 10.0-15.0 V DC. The default 10.5 V DC.

NOTE – Since the receiver will choose the higher of two input voltages, if both port 3 and port 4 have voltage supplied, the receiver will shut down at the higher of the two shutdown voltages.

Front Panel Display

Brightness – Sets the brightness of the front panel display as a percentage of the maximum. The available settings are 13%, 25%, 38%, 50%, 63%, 75%, 88%, and 100%.

Rotation – Rotate the front panel display and the menu controls 180 degrees.

Power Saver –

- **Auto** – If external power to the receiver is removed, the display will go into power saving mode meaning the display will not be visible until a button is pressed.
- **Enable** – The displays turns off 60 seconds after the last button is pressed.
- **Disable** – The display always remain on.

Configuration –

- **Enable** – Allow the front panel controls to be used to make changes to the configuration of the receiver.

- **Disable** – Do not allow the front panel controls to be used to make changes to the configuration of the receiver. If disabled, the operator must use the web interface, serial ports etc to configure the receiver.

Back Lighting – Enable or disable the front panel display backlight.

Receiver Configuration – Application Files

Use these settings to configure and activate application files for the receiver.

The receiver can generate application files, which you can then download.

You can configure and activate Clone files, which include the information included in Application files as well as the optional IP (Internet, Network) and Ephemeris settings. The application files are typically used to duplicate the settings from a master receiver to multiple receivers in the field.

NOTE – Installing a Clone file on a receiver with I/O settings configured, ***does not*** *disable or replace the I/O settings currently in the receiver. A Clone file only adds I/O configurations; it does not disable or replace them.*

Calibration and Projection information in the Trimble DC or CAL files can be imported to enable the receiver to output site or map projection coordinates in the relevant output messages such as NMEA PJK.

Executing App. File Name – The display box at the top of this page shows which application file is currently running, for example:

Executing App. File Name ALPHA1

Operation – Select one of the following:

- Start Now – Select an application file and then click **OK** to start the application file.
- Enable Timer – Prompts you for a date and time, in UTC format, to start the selected application file.
  - Repeat – Enables you to define how often the application file is reapplied.

  For example, create an application file called START so that CMR output start at 7 am, and repeats every 24 hours. Also create an application file called STOP so that CMR outputs are not sent after 7 pm, and repeat this every 24 hours.

  NOTE – Enter the date and time in UTC format.
- Disable Timer – Disables the presently enabled Timer function for application files.
- Delete File – Deletes the application file that was selected from the Filename list.
- Download File – Exports the application file from the receiver to an external directory. It prompts you to name the file.
- Upload File – Imports an application file from an external directory to the receiver. It prompts you to browse for the file and, if required, rename it.
- Store Current File – Stores the current application file receiver settings to the non-volatile RAM of the receiver. It prompts you to name the file.
- Start Default Now – Activates the factory default application file immediately.

- **Generate Clone File** – Generates an XML file. When you select this option, a filename field appears. Enter the preferred name to assign to the clone file. There are also prompts to generate various settings that are not included in application files.
- **Install Clone File** – Prompts you to install a clone file from a list of XML files.
- **Upload Clone File** – Imports a clone file from an external folder to the receiver. It prompts you to browse for the file and, if required, rename it.
- **Download Clone File** – Exports the application file from the receiver to an external folder with an option to compress it with GZIP.
- **Delete Clone File** – Deletes the clone file that was selected in the Filename list.
- **Upload & Install clone file** – Imports and installs a clone file from an external folder to the receiver. It prompts you to browse for the file and, if required, rename it before installation. In addition, an option to install a static address from the clone file is available.
- **Upload & Apply Projection and Calibration file** – Select this when there is a preferred DC or CAL file to upload into the receiver. The DC or CAL files are available from the Trimble Business Center software and other Trimble devices and utilities. When they are loaded into the receiver, map projection or site coordinates can be output in the form of North, Easting, and Elevation values.

For example, if a valid DC or Projection file is loaded, the NMEA PJK message outputs NEE.

Once this item is selected, the **Select File** menu prompts you to browse for a file with a DC or CAL file extension. Click **OK** to load the selected file.

- **View & Apply Projection and Calibration file** – Select this and the file that was previously loaded into the receiver. The map projection and calibration data (if in the file) appear. Click **OK**.
- **Delete Projection and Calibration file** – Select this and the adjacent file to remove the file and its parameters from the receiver. Once you click **OK**, any NEE outputs using this data will no longer output NEE values.

Filename – Select the application file on which to apply the operation. It is recommended that you use a name that clearly defines what the application file is to be used for.

Current Timer Setting – Displays Enabled or Disabled to reflect current timer setting configured in the **Operation** field above.

Receiver Configuration – Reset

Reboot Receiver – Select this option to restart the receiver. All data and settings are kept.

Use Default Application file – Select this option to reset the receiver to its factory default settings. The satellite ephemeris and almanac data and all logged data files are kept. The receiver does not restart.

Clear Satellite Data – The satellite ephemeris and almanac data is cleared, and the receiver restarts.

Clear Application Files – Select this option for the receiver to perform the two operations above and also clear any application files resident in non-volatile memory. The receiver restarts. All Ethernet network settings are kept.

Clear All Receiver Settings – Select this option for the receiver to perform the three operations above and also clear all Ethernet network settings. The receiver restarts.

AutoReboot Timer – Indicates the receiver can restart at given times specified by the reboot settings. The AutoReboot Timer also provides a method to recover from the unlikely occurrence that an Alloy receiver cannot communicate without a forced system restart.

Cycle Power – If this option is selected, the receiver will cycle power during the auto-reboot process with the duration selected in the Timeout field. Indicates the receiver can restart at given times specified by the reboot settings. The AutoReboot Timer also provides a method to recover from the unlikely occurrence that an Alloy receiver cannot communicate without a forced system restart.

Receiver Configuration – Default Language

Use this menu to select the default language of the web interface. The receiver language setting is contained in the web browser cache. To see the language change, clear the browser cache or open a new browser.

Select **Receiver Configuration** / **Default Language**.

To change the language, click the option next to the corresponding country flag.

I/O Configuration menu

Use the **I/O Configuration** menu to set up all outputs of the receiver. Depending on the receiver's specification it may output CMR, RTCM, RTCM-REPEAT, RT17/RT27, NMEA, GSOF messages on a variety of ports including TCP/IP, NTRIP, UDP, serial ports.

I/O Configuration – Port Summary

This page provides a summary of input and output ports available to the receiver.

To edit the settings, click on the port type. The opens where you can edit the configuration settings for that port.

Type – Indicates what types of inputs/outputs are available.

- **TCP/IP** (Transmission Control Protocol/Internet Protocol) – A connection over an IP network.
- **UDP** (User Datagram Protocol) – A connection over an IP network.
- **IBSS/NTRIP Client 1, 2, 3** – A connection to IBSS or an NTRIP Caster for receiving correction data.
- **IBSS/NTRIP Server 1, 2, 3** – A connection to IBSS or an NTRIP Caster for sending correction data.
- **NTRIP Caster 1, 2, 3** – Allows up to ten users (NTRIP Clients) per port to request single base correction data.
- **Serial** – An RS-232 connection.
- **USB** (Universal Serial Bus) – A connection over USB.

NOTE – NTRIP is Networked Transport of RTCM via Internet Protocol. IBSS is Internet Base Station Service.

Port – Which port the input/output is being transferred on.

- **TCP/IP or UDP** – The port number will be displayed.
- **IBSS/NTRIP Client** – The type of the service and the name of the base station or Mountpoint it is connected to.
- **IBSS/NTRIP Server** – The type of the service and the name of the base station or Mountpoint being sent to the NTRIP Caster.
- **Serial** – Serial ports will indicate the receiver connector, baud rate, data bits, parity, and stop bits settings of the port.
- **USB** – No port will be displayed.

Input – The type of input that is received on the port. The correction stream input currently being used in the position solution will be shown in bold text.

Output – The type of output that is sent on the port.

Connection Colors – The color of the connection provides additional status information.

- Green – Indicates an active connection from another device on that port.
- Yellow – Indicates a connection is having problems or is not functioning properly.
- Red – Indicates no connection from another device on that port.
- No highlight – The serial port connections are not highlighted since it is not possible to distinguish if there is a connection from another device.
- **Bold** – Indicates that this correction stream input is currently being used for the position solution.

I/O Configuration – Port Configuration

Use these settings to set up the receiver inputs and outputs.

Port Selection

- **Port** – The first drop-down list displays which type of port is available for configuration.
- **Output Type** – The second drop-down list displays which output type is sent out of each port.

One of the following output groups appears with configuration settings, depending on the option that you select in the drop-down list at the top of the page:

- CMR
- RTCM
- REPEAT-RTCM
- NMEA
- RT17/RT27
- BINEX
- GSOF
- OMNISTAR
- 1PPS
- MET-TILT

Select one of the following options:

- TCP/IP 5017
- TCP/IP 5018
- Add TCP/IP or UDP Port
- IBSS/NTRIP Client
- IBSS/NTRIP Server
- NTRIP Caster 1
- NTRIP Caster 2
- NTRIP Caster 3
- Serial 1
- Serial 2
- Serial 3
- Serial 4

- Bluetooth 1
- Bluetooth 2
- Bluetooth 3
- USB

TCP/IP 5017 and TCP/IP 5018

By default, these ports are available. However, these can be changed to add or remove other ports.

Client – Select this check box to enter a Remote IP and port. This enables the receiver to initiate a connection to the remote server. This can be used when the receiver is behind a network firewall or has a dynamic IP address.

Output Only/ Allow Multiple TCP/IP Connections – Select this check box to configure the receiver so that it can broadcast to multiple simultaneous remotes. The remotes are unable to send data back to the receiver. Trimble strongly recommends this setting for all ports without a two-way data requirement. If this is not enabled, remotes can reconfigure the receiver.

UDP Mode – Select this check box to use UDP (User Datagram Protocol) instead of TCP. You can edit a UDP timeout. By default, it is set to 60 seconds.

- **UDP Broadcast Transmit** – Selecting this option will allow the broadcast of data (e.g., CMRx) to any devices on the same local network by using the IP broadcast address of 255.255.255.255.
- **UDP Broadcast Receive** – Selecting this option will allow the receipt of data (e.g., CMRx) from a UDP Broadcast Transmit device on the same local network.

Authenticate, set password – Select this check box so that all incoming connections are required to enter a password to authenticate the connection. This is not NTRIP authentication.

Add TCP/IP or UDP Port

Select this option to add a new TCP/IP port to the receiver.

UDP Mode – Select this check box to use UDP (User Datagram Protocol) instead of TCP.

Local Port# – Select the port number that is to be used and then click **Add** to create the configuration.

Depending on the option that you select in the drop-down list at the top of the page, the options for configuration changes:

- CMR
- RTCM

- REPEAT-RTCM
- NMEA
- RT17/RT27
- BINEX
- GSOF
- OMNISTAR
- 1PPS
- MET-TILT

IBSS/NTRIP Client

This option allows correction data to be received securely from an NTRIP Caster. The NTRIP source may be:

- A Trimble VRS Network
- A Trimble NTRIP Caster
- The Trimble Internet Base Station Service (IBSS)
- Another NTRIP compliant correction source

NTRIP version 2 is supported in firmware version 4.14 and later.

Status – Indicates the current status of the NTRIP connection:

Status	Meaning
Init	NTRIP Client disabled.
Up and Connected	NTRIP Client is connected to a source of corrections and receiving data.
Invalid Mountpoint	NTRIP error 404 returned from NTRIP Caster.
Invalid Username or Password	NTRIP error 401 returned from NTRIP Caster.
Failed to connect to remote NTRIP Caster	Connection failed due to an Internet-related issue.
No GNSS data from Caster	NTRIP error 503 returned from NTRIP Caster. No data available from the NTRIP Caster.
Unexpected internal error	NTRIP Caster internal error.
Incorrect NTRIP Caster response	NTRIP error 602 returned from NTRIP Caster.

Status	Meaning
No output stream is configured	NTRIP error 604 returned from NTRIP Caster.
Connection in progress	The NTRIP Client is in the process of connecting to the NTRIP Caster.
Unknown Ntrip Status	The status is not one of those listed above.

Enable – Select to enable NTRIP Client.

IBSS Mode – Checking this mode provides a simplified interface for IBSS:

- TCC Organization – Enter the TCC Organization name.
- TCC Device ID – The Device ID is generated by the receiver.
- TCC Password – Enter the TCC password provided by your Organization's TCC administrator.
- Base Name – Enter the name of the base station preferred as the source of your corrections if known, or select from the list using the Get Base Name list button.
- Get Base Name List – Use this button to obtain a list of available IBSS base stations for selection. The list is ordered with the closest at the top of the list and includes the distance from your current location in km.

NTRIP Caster HTTP:// – The address and port of the NTRIP Caster that the receiver will connect to in order to receive correction data.

Enable SSL/TLS – Select this check box to enable the SSL or TLS protocol. This check box is for either IBSS or regular NTRIP connections.

Authenticate NTRIP Caster – This check box appears if the **Enable SSL/TLS** check box is selected. It uses a hard-coded CA certificate. (Not present for non-IBSS NTRIP.)

User Name – Enter the username required to log on to the server.

Password – Enter the password required to log on to the server.

Verify Password – Re-enter the password required to log on to the server.

Mount Point – Enter name of the correction stream to which you are connecting on the NTRIP Caster if known, or select from the list using the Get Mount Points button.

Get Mount Points – Use this button to obtain a list of available IBSS base stations for selection. The list is ordered with the closest at the top of the list and includes the distance from the receiver's current position in km.

IBSS/NTRIP Server

This option enables the receiver to connect to IBSS or an NTRIP Caster to send correction data securely across the internet.

Status – Indicates the current status of the NTRIP connection:

Status	Meaning
Init	NTRIP Server disabled.
Up and Connected	NTRIP Server is connected to an NTRIP Caster and sending correction data.
Invalid Mountpoint	NTRIP error 404 returned from NTRIP Caster.
Invalid Username or Password	NTRIP error 401 returned from NTRIP Caster.
Failed to connect to remote NTRIP Caster	Connection failed due to an Internet-related issue.
No GNSS data from Caster	NTRIP error 503 returned from NTRIP Caster. No data available from the NTRIP Caster.
Unexpected internal error	NTRIP Caster internal error.
Incorrect NTRIP Caster response	NTRIP error 602 returned from NTRIP Caster.
Rejected by remote Caster due to mount point in use	NTRIP error 603 returned from NTRIP Caster.
No output stream is configured	NTRIP error 604 returned from NTRIP Caster.
Connection in progress	The NTRIP Server is in the process of connecting to the NTRIP Caster.
Unknown Ntrip Status	The status is not one of those listed above.

Enable – Select this check box to enable NTRIP Server.

NTRIP Version – NTRIP Server supports either NTRIP version 1 or 2.

NTRIP Caster http:// – The address and port of the NTRIP Caster that the receiver will connect to in order to send or receive data.

Enable SSL/TLS – Select this check box to enable the SSL or TLS protocol. This check box is for either IBSS or regular NTRIP connections.

Mount Point – The name of the correction stream the receiver is supplying to the NTRIP Caster.

Username – Enter the username required to log on to the server.

Password – Enter the password required to log on to the server.

Verify Password – Re-enter the password required to log on to the server.

Identifier – The unique identifier for the receiver (NTRIP Server) supplying the correction stream.

Country – An optional identifier to help distinguish which country the NTRIP Server is in.

Network – An optional identifier to help distinguish which network the NTRIP Server is a part of.

Select the correction type to output:

- CMR
- RTCM
- OMNISTAR

NTRIP Caster

There are three NTRIP Caster ports available. For each port, a maximum of 10 users can request data, which means that a total of 30 users can simultaneously request data.

Enable – Select this check box to enable this NTRIP Caster port.

Port – Source Port number of the caster host.

Enable SSL/TLS – Select this check box to enable the SSL or TLS protocol.

Identifier – The unique identifier for the NTRIP Caster.

Country – Enter the character country code, for example USA, DE.

Mount Point – Enter the name of the output stream, such as its type. Users must enter this name to connect to the port.

Authentication – This is set to Basic so you will require a login username and password.

Generator – Set to Trimble.

Fee – Set to no fee per connection. There is no billing model in this receiver.

NMEA Required – Set to No as this is a single base solution.

Mount Point – Enter the name of the receiver, such as its location. This name is required by the users.

Select one source of corrections:

When the factory defaults are applied the three NTRIP Caster ports will be automatically configured to output CMRx on port 2101, CMR on port 2102 and RTCMv2.1 on port 2103.

- CMR
- RTCM

- RT17/RT27
- OMNISTAR

Serial 1-4

Serial Port Setup – Set the appropriate baud rate, parity, and flow control for the port.

One of the following groups appears, depending on the option that you select in the drop-down list at the top of the page:

- CMR
- RTCM
- REPEAT-RTCM
- NMEA
- RT17/RT27
- BINEX
- GSOF
- OMNISTAR
- 1PPS
- MET-TILT

Bluetooth Port

You can stream any available data over a Bluetooth connection.

Maintain configuration when connection dropped – Select this for the receiver to maintain the output configuration on the selected Bluetooth port when the wireless link is dropped. The output resumes when the wireless link is re-established.

One of the following groups appears, depending on the option that you select in the drop-down list at the top of the page:

USB

USB Port – Data can be streamed over an available USB connection.

Depending on the option selected in the drop-down list at the top of the page, the options for configuration changes:

- CMR
- RTCM
- REPEAT-RTCM
- NMEA

- RT17/RT27
- BINEX
- GSOF
- OMNISTAR
- 1PPS

CMR

The following fields appear when CMR is selected from the list at the top of the page.

CMR – Select which CMR corrections will be output on this port. If transmitting CMRx messages, ensure that all rovers and machines have firmware that will accept CMRx. CMRx was introduced in receiver firmware version 4.0.

Delay – Select the time delay for the CMR output. This is used in multi-base applications.

REPEAT-RTCM

This feature allows an external source of RTCM corrections to be repeated to another port. The external source can be OmniSTAR VBS (if installed).

The following fields appear when you select REPEAT - RTCM from the list at the top of the page.

Use VBS as source – Select this check box to use the decoded OmniSTAR VBS service to populate an RTCM DGPS correction stream. The RTCM DGPS correction stream can be output on Ethernet, Serial, or USB ports. This output is available when the receiver is in any operating mode and can also be selected from the front panel Port menu. Only available when a valid OmniSTAR VBS subscription is loaded in receiver that supports OmniSTAR.

RTCM

The following fields appear when you select RTCM from the list at the top of the page.

Enable/Disable – Select if RTCM output is to be enabled on this port.

Version – Select which version of RTCM message will be output on this port. (Use version 2.X to transmit a version of RTCM that is compatible when multiple rovers are being used and they are not all compatible with the same version of RTCM message. That is, one rover might only support version 2.1 and the other requires version 2.3.)

RTCM version 3 is available when the base station is used by a mixed fleet of RTK receivers from a number of manufacturers. RTCM version 3 is more efficient, handles GLONASS, and is more suitable for networked RTK than version 2.x. If the GLONASS option is installed in the base station (receiver firmware version 4.13 and later), then both GPS and GLONASS measurements are output.

Bandwidth limit – This option is available once RTCM version 3 is selected. If the radio link used has a known maximum data throughput rate, then enter that value into this field in bytes per second. The receiver will then logically reduce the number of satellite messages so that maximum rate is not exceeded.

Type – Select which type of RTCM message will be output on this port.

NMEA

The following fields appear when NMEA is selected from the list at the top of the page.

NMEA Messages – Select which NMEA messages will be output on this port.

Standard – Select which standard to use for the compliant messages.

- *NMEA* – Output messages comply the National Marine Electronics Association (NMEA) 0183 Standard for Interfacing Marine Electronic Devices, Version 4.0, November 1, 2008. This is the default selection.
- *IEC61162-1:2010/NMEA 0183 V4.10* – Output messages will comply with the International Electrotechnical Commission (IEC) 61162-1, Edition 4 2010-11.

Variations from standard

Report max DQI=2 NMEA GGA string – When enabled, the Quality Indicator field in the GGA output message will never be greater than 2 (Differential GPS). Use this only with legacy systems that do not fully support the NMEA standard.

Report max correction age 9 sec in NMEA GGA string – When enabled, the Age of differential data field in the GGA message will never be greater than 9 sec. Use this only with legacy systems that do not fully support the NMEA standard.

Report extended information in NMEA GGA and RMC strings – By default, this check box is enabled to provide high precision position data in the NMEA messages. Clear this check box to conform to the NMEA standard message length of 82 characters.

Report GST message always as GPGST – When enabled, the NMEA talker ID will always be $GP for the GST message no matter what constellation is being tracked. This is required for some legacy systems using this NMEA output which have not yet been updated to follow the NMEA standard. By default this will be disabled.

Report legacy talker ID – When enabled, this forces the following sentences to always use "GP" as the talker ID: GGA, MSS, DTM, GLL, HDT, RMC, ROT, VTG, and ZDA.

RT17/RT27

The RT17/RT27 option is only available when the Binary Outputs option is installed in the receiver.

The following fields appear when RT17/RT27 is selected from the list at the top of the page.

Epoch Interval – This defines the rate at which the RT17/RT27 messages are output. Check boxes are provided to enable the output of measurements and/or positions.

Measurements – Select this check box to output raw observables.

Positions – Select this check box to output position measurements.

Concise – Select this check box to output a more compact message containing the raw observables. This should always be enabled.

R-T Flag – Select this check box to output IODE values and cycle-slip counts.

Ephemeris – Select this check box to output the satellite ephemeris when received.

Send Raw GPS Data – Select this check box to output the raw data extracted from the satellites.

Multi-System Support – Select this check box to output the GPS L5 and GLONASS observables.

Smooth Pseudorange – Enable Pseudorange smoothing.

Smooth Phase – Enable Phase smoothing.

Send Raw WAAS Data – Select this box to output the raw data extracted from the SBAS satellites.

BINEX

The following fields appear when you select BINEX from the list at the top of the page.

Observable Rate – Select the output rate for the raw observables.

Smooth Pseudorange – Enable Pseudorange smoothing.

Smooth Phase – Enable Phase smoothing.

GSOF

The following fields appear when you select GSOF (General Survey Output Format) message from the list at the top of the page.

GSOF Messages – Select which GSOF messages will be output on this port.

OmniSTAR

DATA for OmniSTAR – Enables the demodulated OmniSTAR data output on this port. This output can then be used as an External OmniSTAR input on a non-Trimble OmniSTAR-capable receiver that has a valid and appropriate OmniSTAR subscription.

DATA for Trimble – Enables the demodulated OmniSTAR data output on this port. This output is the same raw data as above with a TRIMCOMM wrapper (0xC4) to support use as an External OmniSTAR input on a Trimble receiver. The receiver must have a valid and appropriate OmniSTAR subscription.

DEBUG – Enables/Disables DEBUG OmniSTAR output on this port.

1PPS Time Tag

The following fields appear when you select 1PPS Time Tag from the list at the top of the page.

1PPS Time Tag – Enables the ASCII Time tags. The time tag provides the UTC time of the 1PPS pulse and is output approximately 800 milliseconds before the pulse.

To enable the 1PPS pulse, see Receiver Configuration – General, page 111.

Met-Tilt

This setting is used to support meteorological and tilt sensors. This option is available only with serial ports. It allows up to six different fields that allow serial poll type commands to be sent to MET or TILT sensors. The responses are recorded in the receiver's internal memory. If a RINEX file is generated from the associated T02 file, the appropriate and associated *.met and/or *.05m files will be generated.

Serial port 2, when set to MET-TILT, has a power output option that can supply up to 3.6 W @12 V DC from pin 9 of serial port 2.

Bluetooth menu

Use the **Bluetooth** menu to configure the receiver to connect to other devices that use Bluetooth wireless technology. These devices can be used to configure the receiver or receive corrections.

Bluetooth – Info

Module Info – This is the model of the Bluetooth module used in the receiver.

Stack Version – The stack version is the Trimble firmware version of the Bluetooth module used in the receiver.

Local Name – The name of the device that appears when it is discovered by another Bluetooth-enabled device. Made up of the Receiver Model name, Serial number, and System Name. See Identity Information.

Bluetooth MAC Address – The Bluetooth MAC (Media Access Control) address of the Bluetooth module used in the receiver.

Discoverable – Set this field to True or False. When this field is set to True, the receiver will be shown when it is discovered by another Bluetooth-enabled device. If this field is set to False, the receiver is not shown in the discovery list.

Pin Code – The password that is required to pair the receiver with another Bluetooth-enabled device.

Bluetooth – Configuration

Pairing Timer – For receivers with firmware version 5.44 or later and that have the Enhanced Security option installed, when the receiver is turned on, an 18-hour pairing timer starts. During this time the Bluetooth module is discoverable by external devices. After the countdown has elapsed, or after a device is paired with the receiver, the Bluetooth module is no longer discoverable.

While the timer is active, the Bluetooth Info menu will show that the module is discoverable.

To manually start the timer, click **Start Now**. Alternatively, to restart the timer without accessing the web interface, turn the receiver off and then back on.

Discoverable – Set this field to True or False. When this field is set to True, the receiver will be shown when it is discovered by another Bluetooth-enabled device. If this field is set to False, the receiver is not shown in the discovery list.

Pin Code – The password that is required to pair the Trimble receiver with another Bluetooth-enabled device. The pin code is user-defined and should consist of at least four numbers.

Bluetooth PAN IP Address – The default is 192.168.143.1. However if there is a conflict, the 143 subnet can be changed.

Click **OK** to apply any changed settings to the Trimble receiver.

Bluetooth Inquiry and Remote Connection

Use this screen to search for nearby Bluetooth-enabled devices.

A Bluetooth port can be used to transport most outputs available on the receiver to and from another Bluetooth device such as a controller, laptop, or another receiver.

Max. devices to find – Limits the inquiry search to information only for the number of devices specified.

Perform New Inquiry – Click this button to put the receiver into a discovery mode and to search for nearby Bluetooth-enabled devices.

Number of new devices found – Displays the number of Bluetooth-enabled devices that are discovered. The devices will only be displayed once a search is made.

Add Bluetooth address to inquiry results table – Instead of doing a manual search, manually enter the MAC address of the Bluetooth device being searched for (if known).

Number of remote devices – Shows the number of devices currently paired with the receiver. When a device is paired to the Trimble receiver using Bluetooth wireless technology and the Access Point service is connected, the Bluetooth PAN connection is listed here. The default address is 192.168.143.1.

The search results will appear in a table showing the MAC Address and Local Name of each device.

Device	Address	Name	Remote Services
1 Save	00:04:76:c9:0e:93	NZC-BWILSON	Update
2 Save	00:80:37:24:34:19	SPS851, 4938K63745: SPS851	Update
3 Save	00:80:37:27:1b:5c	SPS851, 9999K00059: Heading	Update

Save – Click **Save** to save this device so that it remains in the table when you search for more devices.

Update – Click **Update** to show the Remote Services for a specific device.

Remote/Local – The services available at each end of the Bluetooth wireless connection are listed. The Remote services are on the connected device, the Local services are on the receiver.

2 Save	00:80:37:24:34:19	SPS851, 4938K63745: SPS851	Update COM1 Bluetooth 1 Connect

Connect – Select the Remote Service to connect to and the Local Service to connect from and then click **Connect**. Once connected, another table appears below the remote device table showing details of the connected remote devices.

Number of remote devices: 1

Port	Address	RFCOMM Channel	Name	Connected	Reconnect at startup
Bluetooth 1	00:80:37:24:34:19	1	SPS851, 4938K63745: SPS851	Yes Disconnect	No Reconnect at startup

Reconnect at startup and **Disconnect** buttons can be used to toggle these settings. The reconnect function allows the connection to be re-established without any user intervention when the receiver is rebooted.

MSS Corrections menu

The receiver can receive Trimble CenterPoint RTX and OmniSTAR corrections.

For information on OmniSTAR services or to contact support, go to www.omnistar.com.

MSS – Summary

This page provides a summary of the Mobile Satellite Services (MSS) information.

Service – Displays the Mobile Satellite service currently being used.

Setting – Displays the Mobile Satellite service setting currently being used.

Signal Source – Displays the source of the OmniSTAR signal, which can either be from the internal RTX/OmniSTAR demodulator or from an external source through a serial, TCP/IP, or Bluetooth port.

SV name – Displays the name of the RTX/OmniSTAR satellite currently being tracked. "Auto" indicates that the satellite was selected based on geographical location.

Frequency (MHz) – Displays the frequency that the RTX/OmniSTAR satellite that is currently tracked is broadcasting on.

Bit rate (Hz) – Display the rate at which the tracked RTX/OmniSTAR data is modulated to the carrier wave.

Mode – Indicates if the internal demodulator is currently tracking an RTX/OmniSTAR satellite, or if external OmniSTAR data is being received from another source.

SNR [dB-Hz] – Displays the signal-to-noise ratio of the signal being tracked.

Total messages – Displays the total number of messages received from the RTX/OmniSTAR satellite.

Bad messages – Displays the number of RTX/OmniSTAR messages that the receiver has distinguished as not usable.

Link % – Displays the packet success rate. 100% indicates that no packets have been dropped

Age of Corrections [sec] – Displays the age of corrections in seconds.

Status – The **RTX Status** field reflects if the receiver is being used in a zone that is restricted to Trimble RTX™ correction services. Only available when RTX is enabled.

0 is Unknown

1 is Not Restricted (for land based applications)

2 is Restricted

MSS Configuration

Use this page to configure the receiver to track MSS (RTX/OmniSTAR) satellites.

NOTE – There must be a valid subscription on the receiver before it can use RTX/OmniSTAR data for positioning.

MSS Service – Select either **Off**, **RTX/xFill**, or **OmniSTAR**.

If **RTX/xFill** is selected, the following options are available:

SV name – Select which RTX satellite is to be tracked by the receiver. If you do not know the appropriate satellite name, select Auto so that the receiver scans for the satellite whose spot beam is closest to your current location. If the required SV Name does not appear in the list, select Custom and then enter the Frequency and Bit rate of the required satellite.

*NOTE – When **RTX/xFill** has been selected, the default datum will be ITRF2014 (fixed on 2005.0 Epoch). This can be changed to either the Fixed (2005 Epoch) or a Current epoch in the* *Receiver Configuration – Position* *menu.*

If **OmniSTAR** is selected, the following options are available:

Preferred Source of Data – When the OmniSTAR service has been selected, then select either External or Internal. If the receiver is configured below to use both internal and external data, it uses the preferred source when both are available:

- **Internal** – The OmniSTAR data is derived from the L-Band signal received via an appropriate antenna (for example, GA810).
- **External** – The OmniSTAR data is derived from an external source such as an NTRIP Client over an Internet connection.

External OmniSTAR Data – Set the receiver to use an external OmniSTAR data stream if available on an Ethernet, NTRIP, serial, Bluetooth, or USB port and then use one of the following modes:

- **Don't Use** – Do not use an external source of OmniSTAR data.
- **Auto** – Tracking is enabled and, if more than one external OmniSTAR service is available, the most precise mode is used.
- **Selecting specific services** – The following specific services are available for selection if the receiver has an appropriate valid subscription. Selecting one of these modes restricts the receiver from using other external OmniSTAR services:
  - HP Only
  - G2 Only

  - HP+G2
  - HP+XP
  - XP Only
  - VBS Only

Internal OmniSTAR Demodulator – Set the internal OmniSTAR demodulator to the required mode.

- **Off** – OmniSTAR tracking is disabled.
- **Auto** – Provides the best solution based on the error estimates. This delays the transition to OmniSTAR HP until the HP solution reports it is better than the VBS solution.

  NOTE – Be careful how you treat VBS; in some locations it is in NAD-83. By default, the receiver provides NAD-83 VBS (in the USA) positions and ITRF2014 for HP. However, you can configure the receiver to transform the NAD-83 VBS positions to ITRF by selecting the following check box.
- **Selecting specific services** – The following specific services are available if the receiver has an appropriate valid subscription. Selecting one of these modes restricts the receiver from using other internal OmniSTAR services:
  - HP Only
  - G2 Only
  - HP+G2
  - HP+XP
  - XP Only
  - VBS Only

SV Name – Select which OmniSTAR satellite is to be tracked by the receiver. If you do not know the appropriate OmniSTAR satellite name, select Auto so that the receiver scans for the OmniSTAR satellite whose spot beam is closest to your current location. If the required SV Name does not appear in the list, select Custom and then enter the Frequency and Bit rate of the required satellite.

NOTE – The SV Name list is automatically updated by OmniSTAR broadcasts, which contain the satellite name and ID, and coverage area. If this information is not currently available from OmniSTAR, the list may be incomplete or out of date. If this occurs, the SV Name Auto option may not select the most appropriate spot beam; instead you should select the Custom option.

Max Data Outage – This setting applies only to OmniSTAR corrections (not RTX corrections). If the OmniSTAR signal has been lost for the amount of time set in this field, the receiver discards the HP/XP/G2 position or the VBS correction. For OmniSTAR VBS, even though it discards the correction, the firmware still generates VBS positions until the time set in the DGNSS Age of Correction field also expires.

Seed with RTK – Select this option if the primary positioning mode is RTK and you need to use the OmniSTAR solution for short RTK outages. The OmniSTAR engine is seeded with the current RTK Fixed position at a 1 Hz rate. If an RTK Fixed position solution becomes unavailable, the OmniSTAR HP position solution will be used until it is restored. The RTK position is transformed into the OmniSTAR HP datum by using the Datum Offset parameters. You can manually enter the Datum Offset parameters or have them measured using the Siteworks or SCS900 Site Controller software.

NAD83 - ITRF Transformation – In North America, the OmniSTAR VBS datum is NAD-83, all other OmniSTAR services use the ITRF datum. Enable this feature to transform the VBS positions from NAD-83 to ITRF datum.

NOTE – When CenterPoint RTX has been selected as the Internal OmniSTAR Demodulator, the default datum will be ITRF2014 (fixed on 2005.0 Epoch), so the NAD83 – ITRF Transformation feature is unavailable. However, for CenterPoint RTX, either the Fixed (2005 Epoch) or a Current epoch can be selected in the *Receiver Configuration – Position, page 107* *menu.*

RTX or OmniSTAR – MSS Subscription

This page provides information about the MSS (RTX, xFill, OmniSTAR) subscription.

If the receiver is connected to an MSS-capable antenna with RTX or OmniSTAR reception, then subscriptions can be activated remotely.

If RTX/xFill was selected in the **MSS Configuration** page, then the following subscription information is displayed:

RTX Subscription – The start and end date of any current subscription.

xFill Subscription – The start and end date of any current subscription.

RTX Version – The currently installed version of RTX.

Serial Number – The serial number required when applying for an RTX subscription.

If OmniSTAR was selected in the **MSS Configuration** page, then the following subscription information is displayed:

HP/XP or VBS Expiration Date UTC – Shows when the current OmniSTAR subscriptions will expire. The receivers do not ship with an active subscription. Contact OmniSTAR for a subscription activation.

HP/XP Engine Mode – When the receiver has a valid subscription, the engine mode indicates which services are available.

HP/XP or VBS Firmware Version – Displays the current version of the OmniSTAR firmware that is loaded in the receiver.

Serial Number – The serial number is either a 7-digit or a 10-digit number, for example, 1475389 or 1010012017.

NOTE – When ordering a subscription from OmniSTAR, you must refer to this serial number. Please do not send the serial number (for example, 5221F12345) of the actual receiver.

OmniSTAR – Status

Use this page to monitor the status of the RTX/OmniSTAR satellite, subscriptions, and solution.

OmniSTAR Configuration

Provides the current OmniSTAR configuration settings.

External Data Mode – The mode setting set in the OmniSTAR Configuration page.

- Don't Use – OmniSTAR off.
- Auto – OmniSTAR auto tracking mode. When an HP or XP solution is available, output an HP or XP solution. When an HP or XP solution is not available but a VBS solution is available, output VBS solution.
- HP+G2 – OmniSTAR HP and G2 mode.
- G2 Only – OmniSTAR G2 mode.
- HP+XP – OmniSTAR HP and XP mode.
- HP Only – OmniSTAR HP only mode.
- XP Only – OmniSTAR XP only mode.
- VBS Only – OmniSTAR VBS only mode.

Internal Data Mode – The mode setting set in the OmniSTAR Configuration page.

- Off – OmniSTAR off.
- Auto – OmniSTAR auto tracking mode. When an HP or XP solution is available, output an HP or XP solution. When an HP or XP solution is not available, but a VBS solution is available, output VBS solution.
- HP+G2 – OmniSTAR HP and G2 mode.
- G2 Only – OmniSTAR G2 mode.
- HP+XP – OmniSTAR HP and XP mode.
- HP Only – OmniSTAR HP only mode.
- XP Only – OmniSTAR XP only mode.
- VBS Only – OmniSTAR VBS only mode.
- RTX – RTX only mode.

Internal HP/XP Link ID – The configured HP/XP satellite ID used by the internal demodulator.

Internal HP/XP Link Name – The configured HP/XP satellite name used by the internal demodulator.

Internal VBS Satellite Link ID – The configured VBS satellite ID used by the internal demodulator.

Internal VBS Satellite Link Name – The configured VBS satellite name used by the internal demodulator.

Custom Frequency [MHz] – Manually entered OmniSTAR signal frequency stored for Custom mode.

Custom Bit Rate [Hz] – Manually entered OmniSTAR bit rate stored for Custom mode.

HP/XP Library Status

Provides information relating to the HP/XP Library (software supplied by OmniSTAR used to decode and process the OmniSTAR signal). This is also referred to as the OmniSTAR Engine.

Internal Library – The current status of the HP/XP Library. It can be Active or Not Active.

Engine – The mode used by the library. It can be HP, XP, G2, HP+G2, HP+XP, or Unknown.

Subscription Start/Expiry – OmniSTAR HP/XP subscription start and expiry dates. OmniSTAR services cannot be used without a valid OmniSTAR Subscription for the appropriate service.

Subscribed Engine – The OmniSTAR subscribed service currently in use by the OmniSTAR library.

Horizontal Precision [m] – A user-defined horizontal 3-sigma precision tolerance for the receiver, which is also used to determine when the OmniSTAR solution has converged. To edit this value, go to **Receiver Configuration** / **Masks**.

Vertical Precision [m] – a user-defined vertical 3-sigma precision tolerance for the receiver, which is also used to determine when the OmniSTAR solution has converged. To edit this value, go to Receiver Configuration / Masks.

Receiver Motion – The current motion setting for the receiver. It can be Kinematic (Moving) or Static. OmniSTAR initialization time can be reduced by correctly setting the receiver motion. To change this setting, go to **Receiver Configuration** / **Advanced Settings**.

OmniSTAR Motion – The motion of the GNSS antenna as determined by the OmniSTAR Library. It can be Static, Kinematic (Moving), or Unknown.

Seed with Last known Pos – If enabled, the Last Known position stored in the receiver when it was last turned off is used to seed the OmniSTAR Library. Seeding is a method of speeding up the initialization process by telling the OmniSTAR Library the location of the GNSS antenna. The Last Known Position function can be used when a vehicle-mounted system is parked overnight and is powered down and powered up without the vehicle having moved. (This function can only be configured by application software.)

Seed with Fixed RTK Pos – If enabled, and if the receiver is in Kinematic mode and computing valid Fixed RTK positions, the OmniSTAR Library is continually seeded with Fixed RTK positions. If in Static mode, the OmniSTAR library is seeded with the first computed Fixed RTK position only. This function enables the OmniSTAR HP/XP Library to continue to provide a precise positioning solution for short periods when an RTK solution is not available because of a radio drop-out or other interference. To enable this feature, go to **OmniSTAR** / Configuration.

Seed Quality –

- **Unknown** – There is no seed available. The receiver does not have an SBAS or OmniSTAR VBS position.
- **Valid, source unknown** – There is a valid seed available but the source is unknown.
- **Invalid, low confidence level** – When using the last known position for seeding, if the last known position from the previous session has a low confidence level, it will be rejected. One of the causes of low confidence level is a high velocity associated with the position, suggesting that the receiver was moving when it was powered down.
- **Invalid, high variance, source unknown** – When static seeding, either the horizontal or the vertical variance of the seed position is higher than the precision thresholds configured in the receiver.
- **Invalid, wrong location** – When static seeding, a check is made to verify if the antenna is on the correct point by comparing the seed position with the current position. The ECEF XYZ of the current position must be within tolerance (5 m for SBAS, 3 m for OmniSTAR VBS) of the seed position; otherwise it is rejected.
- **Invalid, receiver does not have threshold** – Retrieving the precision threshold from the receiver failed. There is no threshold value to compare to the seed's variance. (This should not happen, because the receiver has default threshold value.)
- **Invalid, no seed found** – When Seed with Last Known Position is active, but the receiver does not have the seed position from the previous session.
- **Invalid, SBAS with high variance** – The SBAS position is higher than the receiver's precision threshold values.
- **Invalid, VBS with high variance** – The VBS position is higher than the receiver's precision threshold values.
- **Valid, SBAS** – The SBAS position is a valid seed.
- **Valid, OmniSTAR VBS** – The VBS position is a valid seed.
- **Valid, Fixed RTK** – The Fixed RTK position is a valid seed.
- **Valid, Last Known Pos** – The last known position is a valid seed.
- **Valid, User Defined** – The user-defined known position is a valid seed.

VBS Library status

Internal Library – The current status of the VBS Library. It can be Active or Not Active.

Subscription Start/Expiry – OmniSTAR VBS subscription start and expiry dates. OmniSTAR services cannot be used without a valid OmniSTAR subscription for the appropriate service. For more information on the current subscription and how to subscribe, go to OmniSTAR Subscription.

Last Known Position

The WGS-84 geographical position and quality of the Last Known position stored in the receiver when it was last turned off.

Datum Offset

The WGS-84 geographical offset between two datums. It can be the difference between the site datum and another datum such as ITRF00 (used by OmniSTAR) as measured using the SCS Site Controller software, or it can be input manually on the **OmniSTAR** / Configuration page. This offset needs to be defined before OmniSTAR Known point initializations, RTK Seeding, or other functions involving different datums are carried out.

NMEA Encryption

This is not supported.

L-Band Beam Status

Provides information relating to the currently-tracked RTX/OmniSTAR signal (spot beam).

Signal Source

- **Demodulator** – The receiver is using the RTX/OmniSTAR data from the internal demodulator.
- **External** – The receiver is using the RTX/OmniSTAR data from an external source through a serial, Ethernet, or NTRIP port.
- **Off** – RTX/OmniSTAR data is not being used.

Tracking Mode

- **Off** – OmniSTAR signal tracking is off.
- **Search** – Initializing – Searching for RTX/OmniSTAR satellite, initializing.
- **Searching** – Searching for RTX/OmniSTAR satellite, running.
- **Track** – Initializing – Found RTX/OmniSTAR satellite, tracking initialization.
- **Full Tracking** – Found RTX/OmniSTAR satellite, verifying data stream.

- **Full Tracking (Service)** – Fully tracking RTX/OmniSTAR satellite and using the service indicated in the brackets.

Satellite Link ID – ID of the RTX/OmniSTAR satellite link.

Satellite Link Name – Name of the RTX/OmniSTAR satellite link.

Frequency [MHz] – Frequency of the RTX/OmniSTAR signal.

Bit Rate – Bit rate of the RTX/OmniSTAR signal.

Eb/No [dB] – Signal strength.

C/No [dB-Hz] – Signal-to-Noise ratio (SNR) of RTX/OmniSTAR signal.

Network Configuration menu

Use the **Network Configuration** menu to configure Ethernet settings, email alerts, PPP connection, HTTP port, and FTP port settings of the receiver. For more information, see Configuring Ethernet settings.

Network Configuration – Summary

These settings display the current receiver Internet configuration.

DHCP Status – Indicates if DHCP is on or off. If DHCP is on, the receiver is automatically assigned an IP address from the network.

The receiver can recover its IP address when in DHCP mode whenever it is connected to a DHCP server that is temporarily unavailable. If the receiver is connected to a DHCP server which is then not available and its "lease" has expired, the receiver switches to IP address 169.254.1.XXX. Every 60 seconds, the receiver tries to reconnect to the DHCP server to obtain a new IP address. This is useful when the receiver "drops off" the DHCP server and does not require a manual power cycle.

Ethernet IP – Displays the current Ethernet IP address of the receiver.

DNS Address – Displays the IP address of the current Domain Name Server.

Secondary DNS Address – Displays the IP address of the Secondary Domain Name Server

FTP Push – Indicates if FTP Push is on or off.

HTTP Server Port – Displays the port on which the web server is currently running. The default HTTP port is 80.

Network Address Translation – Displays whether NAT is Enabled or Disabled.

If **PPP** is enabled, the following information is displayed:

PPP Port – Displays the port on which the PPP connection is established.

PPP State – Indicates if a PPP connection is currently established.

PPP Local Address – Displays the IP address of the receiver on the PPP connection.

PPP Remote Address – Displays the IP address of the device that the receiver is connected to on the PPP connection. The receiver assigns this address to the connecting device on connection.

If **Data Logging and FTP Push** are both enabled, the following information is displayed:

FTP Push Server – Displays the server address that files will be pushed to.

Network Configuration – Ethernet Configuration

Use these settings to change the Ethernet configuration of the receiver.

IP Setup – Set the receiver to obtain an IP address using DHCP (Dynamic Host Configuration Protocol) or a Static IP.

IP Address – Enter a static IP address for the receiver to use when connected to a network. This field cannot be edited when using DHCP.

Netmask – Enter the netmask for the network that the receiver will be connected to. This field cannot be edited when using DHCP.

Broadcast – The broadcast address is for informational purposes. This address allows packets to be sent to all devices on a network. This field cannot be edited when using DHCP.

Gateway – Enter the Gateway IP address for the network that the receiver will be connected to. This is typically the Local Area Network IP address of the router that links the receiver to the Internet. This field cannot be edited when using DHCP.

Hostname – Enter a name for the device. This name can be used to connect to the receiver over a network when DHCP is enabled and the IP address of the receiver is unknown.

MTU – Maximum Transmission Unit. The greatest amount of data or "packet" size that can be transferred in one physical frame on a network. The default is 1,500 bytes and is common for Ethernet and dial-up links.

NOTE – The suggested smallest MTU is 576. When MTU is set a value less than 576, networking activity is not guaranteed to work.

Change Configuration – Click to view the stored settings and reset the receiver any changes to take effect. If you do not want to change the current settings, click any other page.

Renew DHCP – DHCP renew is automatically done, but you can also do it manually by clicking this button. Also, click this button to renew the DHCP settings if the server has restarted.

Current Settings – Displays the current network configuration.

Lease time – Lease time is assigned by the DHCP server; you cannot change it. This is for information only to let you know how long before the lease is due to expire. The receiver system automatically renews the lease before its expiration.

Network Configuration – DNS Configuration

Use this page if you need to set your special DNS IP address.

If the receiver I/O configuration is using any domain name (such as “ntrip1.trimblehh.com”), the receiver needs to resolve the domain name string to an IP address; the DNS server serves that purpose. Many systems, such as the Microsoft Windows operating system, have two DNS IP addresses; primary DNS and secondary DNS. If the primary DNS cannot be reached, the secondary DNS is used. If the secondary DNS also fails, then the domain name cannot be resolved and the system cannot reach the specified address.

Usually when a receiver is configured in DHCP mode, the DHCP server assigns an IP address to the receiver along with a DNS IP address (both primary and secondary DNS). By default, the receiver uses the DHCP assigned DNS address. You do not have to do anything on this settings page unless you do not want to use the assigned DNS IP address.

If the receiver is configured as static mode, you must configure the DNS address in addition to the Ethernet Configuration page where you configure the IP address, Netmask, Broadcast, Gateway, hostname, and MTU settings.

The DNS address will be changed accordingly when the default interface is changed. For example, when using PPP over internal/external GPRS modem, the default interface is set to PPP over GPRS modem, and the PPP server will assign its special DNS address to the connection. The system will obtain a DNS address from the PPP connection unless it is “forced”. When PPP is disconnected, the DNS address will be changed back to the Ethernet DNS address. The priority of DNS addresses and default route is:

1. PPP over GPRS connection.
2. Ethernet.
3. Other PPPs.
4. Wi-Fi connection.

DNS Address – Displays the current DNS address.

Secondary DNS Address – Displays the secondary DNS address.

Force DNS Address – When you select this check box, you can enter a specific DNS Server IP address and DNS Domain Name. After you click **Change Configuration**, this DNS IP address and DNS Domain Name is used in the system. If this check box is selected, the system uses the supplied DNS address and ignores any DNS address assigned by an DHCP server or PPP server. Whether you have Ethernet or PPP, the DNS IP address is forced.

DNS Address – Enter the DNS (Domain Name Server) address for the network that the receiver will connect to. This field cannot be edited when using DHCP. In DHCP mode, the

DNS Address is sent to the receiver and is unique for each customer's LAN. If you require a static IP setup, this DNS address will have to be obtained by an system administrator.

Sec DNS Addr – Enter the Secondary DNS (Domain Name Server) address for the network that the receiver will connect to.

DNS Domain – Enter the DNS domain for the network that the receiver will connect to. This field cannot be edited when using DHCP. The DNS Domain name also comes from the DHCP server and is mainly used by mDNS and UPnP.

Change Configuration – When this is button is clicked, these new settings will be applied for the static configuration. Any static settings will be over written if the system goes to factory defaults (DHCP). If the **Force DNS Address** check box is not selected and the **Change Configuration** button is clicked, then the provided DNS will be set to the system once, but it will not be forced and in the DHCP case the next DHCP renew will overwrite the DNS addresses that you just set.

Network Configuration – PPP

Use these settings to change the receiver PPP (Point-to-Point Protocol) configuration, which is used to make Internet connections through a wired serial connection.

Port – Indicates which port the PPP connection is to be established on.

State – Indicates if a PPP connection is currently connected.

Auto Restart – Select this check box to have the receiver automatically re-establish the PPP connection if it is dropped.

Startup script type – Select a startup script for the receiver. The script is sent to the PPP CHAP (Challenge Handshake Authentication Protocol) program so that user names and passwords can be checked.

- No Startup Script – Does not run CHAP before PPP is established.
- Windows script – Serves the Microsoft Windows XP “clientclient” handshaking mechanism.
- GPRS script – Only available when a GSM/GPRS modem is connected to the receiver and is detected. The initstring and dialstring, user name and password, and possibly CPIN in “Advanced settings” will be used in CHAP.
- External modem script – Select this option when a circuit-switched or packet-switched modem is connected to the receiver.

Enable CPIN Check – This check box becomes available when you select the External modem script option from the Startup script type list. Checks and verifies that the CPIN defined in the Advanced Settings is valid for the SIM being used in the external modem.

Use External Modem Default – This check box becomes available when you select the External modem script option from the Startup script type list. When this check box is selected, the dial string uses “ATD*99#” and will not use any value set in the init string. The “ATD*99#” dial string forces the PPP to use the external modem’s default settings, which the receiver does not know.

Use Int/Dial string - This check box becomes available when you select either the GPRS script option or the External modem script option from the Startup script type list. When this check box is selected, you can manually enter the Modem Init string and the Modem Dial string as supplied by the carrier.

- Modem Init. String – Enter the initialization string required by the modem. This string contains APN information. By default, it is the Windows “clientclient”. However, for the GSM/GPRS Modem port, the Init String is similar to the following example:

  - **For T-Mobile**: AT+CGDCONT=2,"IP","internet2.voicestream.com"
  - **For Cingular**: AT+CGDCONT=2,"IP","WAP.CINGULAR"
- **Modem Dial String** – Enter the dial string required by the modem. Normally, you use the default setting "ATD*99***2#" where 2 in this string is matched with the 2 in "Modem Init String".

Use Trimble APN Database – This check box becomes available when you select either the GPRS script option or the External modem script option from the Startup script type list. The receiver firmware contains a database of known carriers with associated Modem Init and Modem Dial strings, which you can select by Country, Provider, and Service plan. This database is updated with new carrier information at each firmware release.

Access Point Name – The APN can be entered manually or generated by using the Trimble APN Database.

CID - Caller Identification. Should be in the range (1-2). The default is 2.

Username – Enter the username (if required) to log on to the carrier network that the modem connects to.

Password – Enter the password (if required) to log on to the carrier network that the modem connects to.

Verify Password – Re-enter the password (if required).

See advanced settings – Select this check box to view and change advanced settings.

Default Local Address – Enter the IP address that is assigned to the receiver when a PPP connection is established.

Default Remote Address – Enter the IP address that is assigned to the remote device when a PPP connection is established.

DNS Address – Enter the default DNS IP Address.

Refuse PAP – By default, this check box is not selected. If it is selected, no PAP (Password Authentication Protocol) is enforced in the system.

Refuse CHAP – By default, this check box is not selected. If it is selected, the system does not use CHAP (Challenge Handshake Authentication Protocol).

Enable ACCM negotiation – ACCM (Asynchronous Control Character Map) is one of the LCP-negotiated options within the CONFREQ frame. ACCM sets the character escape sequences, which tells the port to ignore specified control characters within the data stream. If the router at the other end of the connection does not support ACCM negotiation, the port is forced to use FFFFFFFF. By default, this check box is selected.

Enable ACCM configuration – ACCM Configuration is one of options in PPP LCP layer, and allows LCP Configure-Ack to do ACCM mapping. By default, this check box is not selected.

Max idle time [minutes] – The PPP connection is dropped after this length of idle time.

Max connect time [minutes] – The PPP connection is dropped after this amount of connection time. If it is set to 0, the maximum connection time is not limited. That is, there is an infinite connection time.

CPIN – SIM PIN (Personal Identification Number). The GSM/GPRS Modem has a SIM card. For some European countries, before dialing, a PIN is required for the modem. The CPIN has a value of 4 to 8 digits, if required. If a user tries to make a PPP connection before the SIM PIN code is confirmed, it refuses the “ATD” command with an error. However, after three unsuccessful attempts to enter the PIN, the PUK (Personal Unblocking Key) is required to force the user to enter a new PIN code.

Verify CPIN – Re-enter the SIM PIN code to verify the digits entered in the CPIN field.

Save – Saves the configuration into the receiver's Application File (Appfile) without attempting to make a PPP connection.

Connect – Starts the PPP connection based on the above configuration and saves any changes to the receiver's Appfile.

Disconnect – Disconnects any PPP connection.

Go Back To Defaults – Sets the port configuration to its default settings.

Network Configuration – Routing Table

Use these settings to connect to a sub-network, such as behind a gateway, or to add static routes to a network. This page is for advanced users.

IP Filtering

Enables you to specify one or more ranges of IP addresses with which the receiver can communicate. When IP Filtering is enabled, all communication with out-of-range IP addresses will be suppressed.

For example: Setting up a single IP range with:

> IP Address: 192.168.1.0
>
> Bits:Netmask: 24:255.255.255.0

specifies that all IP addresses between 192.168.1.0 and 192.168.1.255 can communicate with the GNSS receiver and connections with all other external address will be suppressed.

Network Configuration – E-Mail Client

Use these settings to configure the receiver to use a specific email client which can be used to send E-Mail Alerts regarding the status of the receiver.

NOTE – The email server needs to support SMTP without encryption.

E-Mail Authorization Required – Select this check box if the e-mail server requires authorization.

SMTP Server – Enter the SMTP (outgoing mail server) address that the e-mail will be sent from.

SMTP Port – Enter the SMTP port that the receiver connects to on the e-mail server. The most common SMTP Port is 25.

From E-Mail Address – Enter an address from which the e-mail will be sent.

E-Mail Login Name – Enter the login name (if required) that is required to send an e-mail on the SMTP server listed above.

E-Mail Login Password – Enter the login password (if required) that is required to send an e-mail on the SMTP server listed above.

Verify Password – Re-enter the login password.

Network Configuration – E-Mail Alerts

Use these settings to configure the receiver to send e-mail to a specified address with detailed information regarding the state of the receiver.

NOTE – You must first configure the E-Mail Client.

Enable – Select this check box to enable e-mail alerts.

To E-Mail Address – Enter the address that the email will be sent to. (Only one email address is supported).

Selection Boxes – Select which events will cause the receiver to send an email.

*NOTE – To check if all e-mail alert settings are correct and to send a test e-mail, click **Test**.*

Network Configuration – HTTP

Use this page to change the HTTP port, enable HTTP Secure (HTTPS) operation, and optionally change the default HTTPS port from 443 to a different value.

HTTP Enable – Enter the port number for the HTTP server. The default is port 80.

By default, the receiver supports unencrypted HTTP traffic through port 80. Encrypted web interface access can then be performed from a client browser by entering a receiver URL starting with “https://” followed by the IP address or the DNS-supported name by which the receiver IP is known.

If the HTTPS port has been changed from the default value of 443, then a colon (:) followed by that port must be appended to the URL.

EXAMPLE – If HTTPS is running on port 8443 on a receiver at IP 10.20.30.40, the URL for encrypted web interface access would be “https://10.20.30.40:8443”.

If an HTTPS certificate has not been installed through the SSL Certificates page, a default self-signed certificate is used but will never be trusted by a web browser. The browser will caution the user not to proceed to the receiver web interface, and you must enable access as an exception. If an HTTPS certificate is installed, it, too, will not be trusted by a web browser unless the following conditions are met. The root CA certificate and any intermediate CA certificates are installed on the web client computer in the “trusted” certificate stores. The “common name” specified in the HTTPS certificate Subject field matches the name in the URL used to access the receiver.

HTTP Server Port – Enter the port number for the HTTP server. The default is port 80.

HTTP Secure Enable – Enter a port number (the default is 443) and update your port forwarding rules (if applicable). You can then access the secure port by using the "https://" extension.

These settings are only available if the HTTPS option is installed. See Receiver Status – Option Detail.

The receiver can support a secure HTTP link, with encryption limited to a 56-bit encryption.

NOTE – By default, Mozilla Firefox does not support this low-grade encryption. Turn on the security.ssl3.rsa_1024_rc4_56_sha option by going to about:config in Firefox.

Network Configuration – Proxy

Use these settings to configure the proxy settings for the receiver.

Enable HTTP proxy – If the receiver is on a network that uses a proxy server, or if you find the NTRIP service or the Firmware Upgrade Check feature is not functioning, then select this check box.

HTTP proxy – Contact your network administrator to get this value.

HTTP proxy port – Contact your network administrator to get this value.

NOTE – Enter the server name and IP address without adding the protocol in front. That is, enter /companyx.com, not http://companyx.com.

Network Configuration – SSL Certificates

When the HTTPS+Certs option is enabled (see Receiver Status – Option Detail, page 45) in a Trimble GNSS receiver, the **SSL Certificate Upload** page can be used to install one or more of three types of certificates.

NOTE – Only PEM (base64 ASCII) format certificates can be installed. Both the HTTPS and CLIENT certificates must include the associated private key in ASCII/PEM format, and that key must be unencrypted.

When a web browser connects to a web server supporting HTTPS, that server sends the certificate installed for server authentication. Any valid certificate can be used, but for a browser client to automatically accept that certificate, two conditions must be met.

- All CA certificates in the chain from the root CA through all intermediate CAs used must be available. The root CA certificate must always be installed on the client host in the "trusted root CA store". However, any intermediate CA certificates in the chain may either be installed on the client host as trusted or included in the set of certificates sent by the web server.
- The Subject common name (CN) on the certificate must match the name by which the host is identified in the browser URL.

Upload Certificate

Type –

- **SSL CA** – One or more root and/or intermediate CA certificates used to authenticate the remote NTRIP Caster when the **Enable SSL/TLS** and the **Authenticate NTRIPCaster** check boxes are selected for an NTRIP Client or NTRIP Server operation.

  All CA certificates in the chain from the root CA through the last intermediate CA used to sign the remote NTRIP Caster HTTPS certificate must be installed on the receiver to enable authentication of the NTRIP Caster certificate. Note that the CA certificate required for IBSS authentication is pre-installed and need not be installed by the user. See IBSS/NTRIP Client, page 122 or IBSS/NTRIP Server.
- **SSL Client** – Certificate used to authenticate the GNSS receiver when the **Enable SSL/TLS** and the **Send Client Certificate** check boxes are selected for NTRIP Server operation. The Client certificate will be provided by the operator of the NTRIP Caster to which data is being sent. The intended purpose of the certificate must include "client authentication". See IBSS/NTRIP Server.
- **HTTPS Server** – Certificate sent by the receiver when the web interface is accessed using the HTTP Secure (HTTPS) protocol. Any user-installed HTTPS certificate must

have “server authentication” enabled in its intended purpose. See Network Configuration – HTTP

Secure Socket Layers (SSL) information

HTTPS - None or HTTPS

The following features become available when the HTTPS option is set to either **None** or **HTTPS**.

NTRIP Client or Server. See IBSS/NTRIP Client, page 122 and IBSS/NTRIP Server.

- **Enable SSL/TLS** check box for either IBSS or regular NTRIP connections.
- If the **Enable SSL/TLS** check box is selected for an IBSS connection, the **Authenticate NTRIP Caster** check box appears. It uses a hard-coded CA certificate. (Not present for non-IBSS NTRIP.)

NTRIP Caster. See NTRIP Caster.

- The **Enable SSL/TLS** check box appears.

HTTPS - HTTPS+Cert

The following features become available when the HTTPS option is set to **HTTPS+Cert**.

SSL Certificates web page. See Network Configuration – SSL Certificates.

This web page enables you to install HTTPS, CLIENT, or CA certificates.

NTRIP Client. See IBSS/NTRIP Client, page 122.

- The **Authenticate NTRIP Caster** check box appears for standard NTRIP connections, but it is only enabled when at least one CA certificate is installed.

NTRIP Server. See IBSS/NTRIP Server.

- The **Authenticate NTRIP Caster** check box appears for standard NTRIP connections, but it is only enabled when at least one CA certificate is installed.
- The **Send Client Certificate** check box appears, but it is only enabled when a CLIENT certificate is installed.

NTRIP Caster.

- No functionality is added by the **HTTPS+Cert** option.

Network Configuration – FTP

Use these settings to configure the FTP Server settings for the receiver.

FTP Server Enable – Select this check box to enable the receiver to act as an FTP (File Transfer Protocol) server. If security is disabled, then anyone has access. To restrict access you must enable security. Once enabled, the access settings are controlled by the File Download and File Delete settings for a particular user. To set this up, see Security Configuration.

FTP Server Port – Enter the port on which the FTP Server will run. The default port is 21.

NTP Configuration

Use these settings to configure the NTP (Network Time Protocol) Client settings for the receiver.

Client

External Time Servers – Enter the IP address or DNS address and port of the NTP server that the receiver will connect to. This allows the receiver to synchronize the internal receiver clock to an Internet time source, which can improve satellite acquisition if the receiver was powered off for a long period of time. The receiver is preconfigured with three default time servers.

Enable NTP Client – Select this check box if you require the receiver to be an NTP client. Use this feature to synchronize the receiver time using an external time source.

Server

Enable NTP server – Select this check box if you require the receiver to be an NTP server. Use this feature to synchronize devices on a network, for example, other computers. This is useful on an offshore installation when an external NTP time server is not available and other devices on the network cannot access the 1PPS, but they are on a local network (wired or wireless) and require time synchronization.

Reference clock offset – If an accurate absolute time service is required, then the delay caused by the length of the antenna cable needs to be determined and entered as nanoseconds delay.

DDNS Configuration

Use these settings to set up a Dynamic DNS (DDNS) Client in the receiver.

The main reason for setting up a DDSN Client is to solve the problem of the base station using the NTRIP Caster function to make a correction stream available directly from its router, or a cell phone changing its IP address as determined by the service provider. When this occurs, rover systems can no longer connect to and use this source of Internet corrections. This DDNS feature can be used when your router does not have an inbuilt DDNS Client or when you are using a cell phone at the base station in which the IP address is randomly changing.

DDNS is often used in conjunction with NTrip Caster in the role of an Internet-capable base station. Before setting up the DDNS, do the following:

- Set up the base station NTrip Caster parameters.
- Set up an account on a free DDNS Server such as at DynDNS (www.dyndns.com).

Last Update Time – The time period since the last successful update was made. The format is dd (days) hh (hours) mm (minutes) ss (seconds). The field is updated every 5 seconds and starts again after a “forced update period” occurs.

Update Status – This field shows one of the following:

Status Message	Meaning
Good	The update was successful.
Invalid Remote Address	The DDNS Server IP address cannot be resolved.
TCP/IP connect() failed	The connect() due to the device is behind a NAT (Network Address Translation or Network Address Translator) or a firewall.
TCP/IP send() or rcv () failed	The send or receive failed.
Invalid Response from IP Check Server	The response from the IP Check Server is not expected.
Invalid Response from DNS Server	The response from the DNS server is not expected.
Internet error	Other errors occurred in the implementation.

Enable – Select this check box to enable the DDNS feature.

Server ID – Select from a list of common DDNS servers, for example, www.dyndns.com. The dyndns.org dynamic setting is used when your Internet connection has a public routable

IP address. This is probably the most common setting. For information about the Custom setting, go to www.dyndns.com.

The receiver supports the following DDNS servers:

- dyndns.com
- freedns.afraid.org
- zoneedit.com
- no-ip.com

Client Name – Enter an existing URL, for example, SiteAlphaBase.dyndns.org.

User Name and Password – Enter the name and password that you chose when you set up your DDNS Server account.

Forced Update Period – The receiver automatically updates the DNS information within 120 seconds (2 minutes) of the IP address changing. You can also specify a time frequency for the receiver to update DNS information at, even if the information has not changed. This is the “Forced Update Period”. The minimum Forced Update Period is 5 minutes; the default is 40320 minutes (28 days).

Click **OK** to apply the changed settings to the receiver.

TIP – You can set up an alert, so that an email is sent to you if the DDNS update process fails. Select **Network Configuration** / **E-Mail Alerts** and then select the *Alert when DDNS update failed* check box.

Zero Configuration / Universal Plug and Play

This feature enables a computer on the same subnet as the receiver to discover the IP address of the receiver and then discover what services and ports the receiver has enabled. The computer client can then access data files, configure the receiver, connect to NMEA/CMR streams, send CMR streams to the receiver, and so on.

It enables users with no networking experience to connect directly to the receiver without having to know or enter an IP address.

Use Bonjour or uPnP on your local computer.

Enable Zeroconf service discovery (mDNS/DNS-SD) – This is enabled, by default, and enables computers on the subnet using Bonjour to discover this receiver.

For Windows, download Bonjour For Windows (http://support.apple.com/downloads/Bonjour_for_Windows). When you open Internet Explorer or Safari, a new icon appears that lets you browse for devices. Click on the Bonjour devices; it scans the network and shows all the GNSS devices on the subnet.

The local name string applied to the receiver is the following:

Product Name, Serial Number: System Name

Where:

Product Name is the name of the product.

Serial Number is the Trimble 10-character serial number.

System Name - Entered using either the WinFlash utility or the web interface.

For other browsers and operating systems:

- *After* installing Bonjour for Windows, you can install BonjourFoxy for Firefox browser support.
- For Linux, install avahi and do "avahi-browse -a".
- In Mac OSX, Bonjour is installed as standard.

Bonjour also enables the receiver to advertise other services it has today. Trimble advertises HTTP and FTP, if the services are enabled.

Enable UPnP service discovery – By default, this check box is selected. It enables computers on the subnet using Universal Plug and Play to discover this receiver.

A similar technology to Bonjour is UPnP, however it does not provide as much functionality as Bonjour (you cannot advertise FTP, NTP, and so forth, but you can advertise that the receiver is a web server).

While Microsoft has included this as part of their Windows operating systems, it is not integrated as cleanly into Internet Explorer as it is in Bonjour; there are also no known Firefox plugins that support UPnP. However, the Microsoft Windows API does give programmatic access to UPnP (search the MSDN documentation). From version 4.12 firmware, the receiver implements UPnP. To connect to the receiver, without knowing the IP address, using this technology under Windows XP open "My Network Places". If you have UPnP discovery enabled, you see a list of receivers. If you do not see the list, and you know there are receivers with this functionality enabled on your subnet, make sure that you have select the Show UPnP ... option.

Forward HTTP – The Forward options relate to UPnP and routers/firewalls.

Use these options if you place a receiver behind your router/firewall at a site office and you need to access the receiver from another location (anywhere besides the site office). If you select this check box, then the receivers performs a UPnP search for a router and automatically tries to forward the HTTP port externally. If it succeeds, you should be able to point your web browser to the IP address listed next to the "Internet Gateway Device IP".

NOTE – You must have UPnP enabled on your site office firewall/router. By default, some routers are UPnP enabled. However, some require you to enable it using the router web interface.

For a diagram of a setup that might want port forwarding, see www.knoxscape.com/Upnp/NAT.htm. The article also shows how to manually configure port forwarding on a LinkSys router (Note – The configuration differs between routers.)

Forward FTP – Is the same as the Forward HTTP check box except for your FTP port.

Forward IO – Select one of the following options:

- None – Do not forward any I/O ports through the local firewall/router.
- Output-only – Forward all server I/O ports marked "Output only/Allow multiple connections" and NTRIP caster ports.
- All – Forward all server I/O ports and NTRIP caster ports.

Wi-Fi menu

Use the **Wi-Fi** menu to configure the Wi-Fi access mode and access point, so that using a Wi-Fi enabled device such as a smartphone, you can access the web interface of a Trimble ALLOY GNSS receiver.

Wi-Fi Status

Current Wi-Fi Mode – Access point and/or client mode.

Wi-Fi Client Status:

RSSI – The received signal strength shown numerically in brackets and graphically as bars (a maximum of five).

Hardware Status – The current status of the Wi-Fi hardware in the receiver.

Region Code – The Wi-Fi region code.

Client MAC Address – The Client MAC address.

IP Setup – Depends on the Access Point; it can be either DHCP (default) or Static IP.

Network Name (SSID) – The name (SSID) of the Access Point if the receiver is in Client mode and connected to a Wi-Fi network.

BSSID) – The MAC address (BSSID) of the Access Point if the receiver is in Client mode and connected to a Wi-Fi network.

IP Address) – The IP address of the receiver on the Wi-Fi network, if the receiver is in Client mode and connected to a Wi-Fi network. NOTE: Use this IP address to access the web interface of the receiver in a web browser running on any other device on the same network.

Netmask – The netmask of the Access Point if the receiver is in Client mode and connected to a Wi-Fi network.

Gateway – The IP address of the Access Point if the receiver is in Client mode and connected to a Wi-Fi network.

DNS Address – The IP address of the DNS Server for the Wi-Fi network, if the receiver is in Client mode and connected to a Wi-Fi network.

Access Point Status:

SSID – SSID stands for service set identifier, a 32-character unique identifier attached to the header of packets sent over a WLAN that acts as a password when a mobile device tries to connect to an Access Point. An SSID is also referred to as a network name as it identifies a wireless network.

BSSID – The MAC address of the wireless access point.

Encryption Type – Shows the current encryption type. The default is WEP64.

Broadcast SSID – Shows the current status. Either Enabled or Disabled.

Transmit Rate – Shows the default setting.

Channel Mode – Shows the default setting.

Channel Number – Shows the current channel number used.

Client inactivity timeout – The number of minutes of inactivity from a Client connection before it is dropped. The default is 30 minutes.

IP Address – This IP address can be used on an internet browser on a Wi-Fi device if the receiver is in access point mode. In most cases “GNSS” can be entered in the browser.

Netmask – Shows the default setting.

Association list – Shows which devices such as computers or receivers are connected to the receiver that is in access point mode.

Wi-Fi Client Configuration

Use these settings to set the client mode. The site should have at least one access point that this receiver can connect to. This allows:

- Satellite corrections to be sent to the "client" receiver
- Positions to be sent from the "client" receiver to the access point
- Access to the web interface of the "client" receiver from elsewhere on the network

Enable the Wi-Fi Client – Select this check box if the receiver is to be a client.

Static IP – When enabled, a static IP address can be allocated to the Wi-Fi Client to override the IP address allocated by DHCP from the network.

Stored Settings – This lists the SSID and Encryption Key for the Access Points that the Wi-Fi Client has been configured to connect to.

Scan for Networks – Click this button to search for nearby Wi-Fi Access Points. Once completed, a list of access points will be available for selection. Each access point will show SSID, encryption, and signal strength, for example, "Trimble Guest Network (Open, RSSI:197)".

Connect – Select an access point from the list and then click **Connect**.

SSID – SSID (Service Set Identifier). It is the name of the Access Point that the Wi-Fi Client is connecting to.

Encryption Key – The Pre-Shared Key (PSK) or Encryption Key configured on the Access Point that this client is connecting too.

Save – Click **Save** to save the current settings.

Access Point Configuration

Use these settings to modify the Wi-Fi Access Point settings. In most cases, the factory defaults will be suitable for most operations.

Enable the Wi-Fi Access Point – Select this check box to enable the Wi-Fi access point, so it will broadcast its SSID for users to log in to the web interface of the receiver. The access point mode is also set when the receiver is acting as a base station.

SSID – SSID stands for service set identifier, a 32-character unique identifier attached to the header of packets sent over a WLAN that acts as a password when a mobile device tries to connect to an access point. An SSID is also referred to as a network name as it identifies a wireless network.

- Factory Default SSID for the receiver.
- Trimble GNSS NNNN (last four Serial number digits) when a Rover or Rover/Base configuration is loaded.
- You can alter the SSID name using up to 32 characters.

Encryption Type – Either Open, WEP64, WEP128, WPA, or WPA2. The factory default is WEP64.

WPA Encryption Type – Select from TKIP or TKIP AES security when using WPA.

WPA2 Encryption Type – Available when encryption type WPA2 is selected. Select from AES, AES+TKIP and Mixed mode.

Encryption Key – The factory default is blank.

Broadcast SSID – Select this if you want devices, such as your computer to see the SSID name or untick it if you do not want mobile devices to see the SSID.

Show Advanced Settings – Select this check box to show the additional settings below for advanced users with IT knowledge.

Channel Number – By default, the receiver automatically sets the channel number. The range is 1 to 11.

DHCP IP Range – The receiver can be set to operate in one of three IP ranges (Class A = 10.0.0.0/255.255.255.0; Class B = 172.16.0.0/255.255.255.0; Class C = 192.168.0.0/255.255.255.0). In each address range, the Access Point has the static IP xxx.xxx.xxx.1. The default IP address range for the Access Point is 192.168.142.0/255.255.255.0 and has a default static IP address of 192.168.142.1, which cannot be changed.

Reserved IP Addresses – The receiver can be set to reserve static IP address for particular devices. This ensures that the Access Point assigns the same IP address when that device connects through Wi-Fi. Enter the MAC Address of your device and then assign an IP address within your DHCP IP range. The MAC Address of a connected Client, is shown in the Associations List under Wi-Fi Status. (See Wi-Fi Status, page 167).

***NOTE –** If the DHCP IP Range is changed, then all Client devices must be reconnected to the Access Point to receive an IP address in the new range.*

Security menu

Use the **Security** menu to configure the login accounts for all users who will be permitted to configure the receiver using a web browser. Each account consists of a username, password, and permissions. Administrators can use this feature to limit access to other users.

Security Summary

Use this page to review the current security settings of the receiver. The table on the page provides a summary of all users and their security privileges.

Security – There are three different types of security access for the receiver. Set this in the Security Configuration, page 174 page.

Limit NTRIP Caster Connections – There are two settings to control the maximum number of allowed simultaneous NTRIP Caster connections. Set this in the Security Configuration, page 174 page.

Current User – Displays the user name of the account that is currently logged into the receiver.

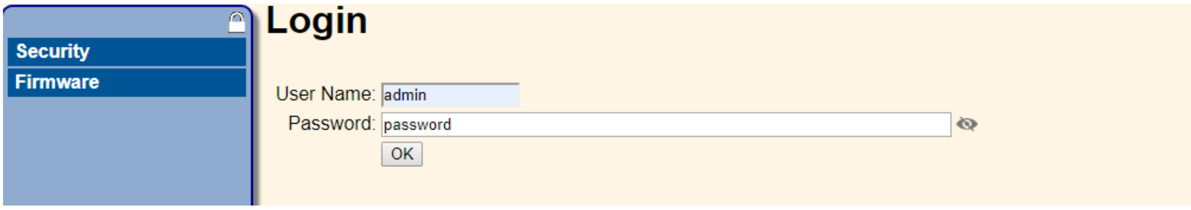
Login IP Address Range (non-admin) – Log in is allowed from any IP address or can be restricted to authentication-only from a LAN or WAN format IP address. Set this in the Security Configuration, page 174 page.

Logging in

Version 5.44 or later with the Enhanced Security (IoT) option installed

From firmware version 5.44 or later, the first time you access the receiver web interface you need to perform additional steps to set up a new password for the 'admin' login:

1. Connect to the receiver's Wi-Fi access point and open a web browser with the appropriate IP address to start the web interface. You will initially see that the list of menu options are limited to **Security** and **Firmware**:



2. When prompted, enter the default login username and password.

   The default username is **admin**.

   The default password is **password**.

3. The Initialize Security screen appears. You are prompted to enter a new password. Use a combination of upper and lowercase letters, numbers, and punctuation to obtain a "medium" or "strong" password; a "weak" password will be rejected. After verifying your new password, click **Update**.
4. ***Ensure that you remember the new password as it is no longer possible to clear this password without direct physical access to the receiver.*** For more information, see resetting your password.
5. If the receiver was set to factory defaults and Wi-Fi is supported on this device, the Access Point Configuration screen appears and you are asked to update the Wi-Fi access point settings. This provides you with an opportunity to review Wi-Fi encryption settings and adjust if necessary.
6. After completing first-time initialization, you can adjust the security settings on the Security Configuration, page 174 page. Refer to the help information for the **Login IP Address Range (non-admin)** setting.

For receivers without the Enhanced Security option installed

Select the **Log in** field and when prompted enter a username and password. To log out, return to this menu and click **Log out**.

The default username is **admin**.

The default password is **password**.

Security Configuration

Use these settings to configure the security settings of the Trimble receiver.

Security

- Enabled – Requires all users to log in to access the receiver.
- Enabled with Anonymous Access – Any user can access the receiver without logging in. If enabled, Anonymous users can be permitted to download and delete files. Users are required to log in when attempting to change any of the receiver settings.
- Disable – Any user can gain access to the receiver without logging in. All users have complete control of the receiver. (Not available with Enhanced Security).

Limit NTRIP Caster Connections – There are two settings to control the maximum number of allowed simultaneous NTRIP Caster connections. The 'admin' account never limits maximum connections. (Note that each NTRIP Caster supports up to ten simultaneous connections.)

- Enabled – The maximum number of connections allowed for each user-defined account is specified in the NTripCaster column.
- Disabled (default) – No limit is applied to any account.

Login IP Address Range (non-admin) – With Enhanced Security, log in is allowed from any IP address or can be restricted to authentication-only from a LAN or WAN format IP address. The 'admin' account always allows log in from any IP address and requires at least a medium strength password.

NOTE – First-time initialization of the "admin" account password is still required even if you are on a local network. The medium/strong requirement is maintained at all times for this account. The admin account can always authenticate from any IP address.

NOTE – An account with NTRIP Caster access can log in from any IP address at all times.

NOTE – Any account with only NTRIP Caster and/or File Download authorization is allowed to have a weak password at all times.

- Any IP (default) – A user can log into any account from any IP address (including the Internet), and the password for each account must be at least medium strength.
- LAN/WAN IP Only – Logging into user-defined accounts is only allowed from LAN/WAN IP addresses (not the Internet), but any strength password can be used for these accounts. You can create another account with the same authorizations as 'admin', for example, 'admin2' that uses any strength password and can only be accessed locally. The LAN/WAN IP address ranges are:

- 10.0.0.0 to 10.255.255.255
- 172.16.0.0 to 172.31.255.255
- 192.168.0.0 to 192.168.255.255
- 169.254.0.0 to 169.254.255.255

User Summary Table – The table provides a summary of all users and their security privileges. The privileges of the admin user cannot be changed and the admin user cannot be deleted. Only the password of the admin user can be changed.

Add User – Enter a username and password for a new user. To enable the privileges for the user, select the appropriate check boxes. To create a new user, click **Add User**. The security eye icon can be used to toggle viewing of the password characters. The Password line also shows the estimated password strength. With Enhanced Security, the password strength required depends on the **Login IP Address Range (non-admin)** setting.

Resetting passwords

Use these methods to change the password for the administrator or an existing user.

NOTE – The receiver must be reconfigured after it is reset. The reset does not affect any options that have been previously installed.

Changing the password of a user

From the Security menu, select **Change Password**.

Username – Enter the existing username for which the password is to be changed.

New Password – Enter the new password for the user.

Verify New Password – Re-enter the new password for the user.

Firmware menu

Use the **Firmware** menu to verify the current firmware and load new firmware to the receiver. You can upgrade firmware across a network or from a remote location without having to connect to the receiver with a serial cable.

Install new firmware

This page provides a summary of the firmware currently installed on the Trimble receiver. You can also use it to install new firmware on the receiver.

⚠ CAUTION – All data files are deleted when you install new firmware. Before you install the new firmware, ensure that you first download any data files to your computer.

Firmware Warranty Date – Indicates when the firmware support for the receiver will expire. Once the date shown has passed, the receiver will not install new firmware.

Active Firmware Version – Shows the version of firmware that is currently installed on the receiver.

Active Core Engine Version – Shows the core firmware version. Use this when reporting problems or issues to Trimble Support.

Active Firmware Release Date – Shows the date that the firmware currently installed on the receiver was produced.

Active Firmware Warranty Date – Shows the warranty date for the firmware currently installed on the receiver. This can be different to the Active Firmware Release Date. The firmware will only load into the receiver if this date is prior to the Firmware Warranty Date set in the receiver.

Active Firmware Checksum – Used by Trimble support to verify that the current firmware of the receiver is correctly installed.

Choose File – Click **Choose File** to locate new firmware on your computer to install on the receiver.

Install New Firmware – Begins the installation of the newly uploaded firmware to the receiver. Status updates are given at the bottom of the page during a new firmware installation.

Check for Firmware Upgrades

The receiver can automatically check for firmware upgrades from the Trimble website if this option is enabled (by default it is enabled).

If your network requires that you pass through a proxy server, you can configure the IP address of the server and the port through which the Internet is accessed from Network Configuration - Proxy.

Update Available – This field is visible if there is a more recent firmware version than the receiver has installed. If the receiver is under warranty support, select the **Firmware** / **Install** option to open the Install New Firmware page.

Programmatic Interface

Use the **Programmatic Interface** menu to show, set, and command configurations. The programmatic interface allows simple HTTP scripting for browser use or for integration into other web capable platforms. You can find below, additional information on supported commands and command structure.

How to use Programmatic Commands

To use the Programmatic Interface commands, the following must be available:

- A GNSS receiver on a TCP/IP link. This could be either an Ethernet connection or a PPP connection over a serial port.
- A computer that can send HTTP requests over the TCP/IP link to the GNSS receiver. This is assured if a web-browser can communicate using the GNSS receiver web interface.
- A programming tool that allows sending CGI requests, and receives the responses. On most Unix/Linux systems this can be satisfied with the command-line utilities perl or curl.

Programmatic commands have to be encoded as URL or CGI requests. This requires assembling several pieces of information.

- The desired protocol (http or https).
- The DNS name or IP address of the target system.
- The Verb, Object, and Parameters forming the command.

The URL will be of the form:

    http://SystemName/prog/Verb?Object&param=value&param=value...

If any parameter values have special characters in them, like spaces or ampersands, these must be encoded using %hex formatting. For example, each space must be replaced with the sequence %20.

Once the URL is determined, the CGI transmission tool is used to send a "GET" request, containing the encoded command, to the target GNSS Receiver. The GNSS Receiver will respond by sending back a document in one of the five response types. Almost all responses are simple ASCII text which can then be displayed or parsed as the application requires.

One exception to the previous paragraph is the case of uploading a file to the GNSS Receiver. Upload commands use a "POST" request instead of a "GET" request. See Uploading Files for details.

Using Curl

A simple method of testing out Programmatic commands is to manually feed the URLs into curl, a commonly available command line tool. Here is a sample Unix session that shows the usage.

```
$ curl 'http://Alloy.Trimble.com/prog/show?serialNumber'
SerialNumber sn=60350239BF

$ curl 'http://Alloy.Trimble.com/prog/show?gpstime'
GpsTime gpsweek=1244 weekseconds=437597

$ curl 'http://Alloy.Trimble.com/prog/badcommand?abc'
ERROR: invalid verb 'badcommand'

$ curl 'http://Alloy.Trimble.com/prog/set?elevationmask&mask=10'
OK: ElevationMask mask=10

$ curl 'http://Alloy.Trimble.com/prog/show?position'
<Show Position>
GpsWeek 1244
WeekSeconds 498154.0
Latitude 37.3891271874 deg
Longitude -122.0368443968 deg
Altitude -4.898 meters

....

<end of Show Position>
```

Multiple curl commands could be assembled into a shell script to implement a basic form of remote control.

If the GNSS receiver has security enabled, an account name and password is required to use the Programmatic Interface commands. Curl accepts these in a '-u' command line argument. For example:

```
$ curl -u admin:adminpw 'http://Alloy.trimble.com/prog/show?serialNumber'
SerialNumber sn=60350239BF
```

That submits the request, using account name 'admin' and password 'adminpw'.

Binary file downloads with Curl simply require directing the output to a file.

```
$ path=/Internal
$ name=60350239BF200906181935.T01
$ curl "http://Alloy/prog/download?file&path=$path/$name" > $name
$
```

Note that there is no command line response in this case. If an error occurred (for instance, if the file did not exist in the GNSS receiver) the message would end up in the file.

File upload commands require curl to format a POST request, with a binary attachment. Curl implements this with a -F option:

```
$ f=/tmp/fina_V401.timg
$ curl 'http://Alloy/prog/upload?firmwareFile' -F firmwareFile=@$f
```

That command would upload a new firmware image file to the GNSS receiver, and trigger an installation of the new firmware.

Using Perl

Perl is a powerful scripting language. The language comes with numerous library packages, which enables it to be used to automate many complex tasks. It is also available on most operating systems, which makes it good for cross-platform applications.

Perl can easily be used to control a GNSS Receiver using the Programmatic Interface commands. A simple method uses LWP - a Library for WWW access in Perl. On Linux, use man LWP for overview documentation. This is a powerful and complex package, which cannot be documented here. Some sample programs show the basic techniques needed. The first shows how to encode basic URL requests:

```
#!/usr/bin/perl -w
use strict;
use LWP::Simple;

print get( "http://fbtc/prog/show?systemname" ) ;
print get( "http://fbtc/prog/show?gpstime" ) ;
print get( "http://fbtc/prog/badCommand?abc" ) ;
print get( "http://fbtc/prog/set?elevationMask&mask=10" ) ;
print get( "http://fbtc/prog/show?position" ) ;
```

Running that program produces the following output:

```
SystemName name=NewName
GpsTime gpsweek=1244 weekseconds=498371
ERROR: Invalid verb 'badCommand'
OK: ElevationMask mask=10
<Show Position>
GpsWeek 1244
WeekSeconds 498373.2
Latitude 37.3891241306 deg
Longitude -122.0368464236 deg
Altitude -4.078 meters
```

```
....
<end of Show Position>
```

File downloads are a bit more complex than just redirecting a get() request to a file, mainly due to the fact that the files can be arbitrarily large. A more complex syntax allows Perl to download and put the results directly into a file.

```
#!/usr/bin/perl -w

use LWP::UserAgent;

my $f = '60350239BF200906181935.T01' ;
my $path = '/Internal' ;

my $ua = LWP::UserAgent->new ;

my $req = HTTP::Request->new(GET=>
    "http://Alloy/prog/download?file&path=$path/$f" ) ;

my $res = $ua->request( $req, $f ) ;
```

When this is run, the logged file on the GNSS receiver is copied to an identically named file in the local computer. Note that no text comes to standard output.

File uploads use a similar technique.

```
#!/usr/bin/perl -w

use strict ;
use HTTP::Request::Common qw(POST) ;
use LWP::UserAgent ;

print "OKAY\n" ;
my $fname = '/tmp/fina_V401.timg' ;
my $ua = LWP::UserAgent->new ;
my $command = 'http://fbtc/prog/Upload?FirmwareFile' ;
my $response = $ua->request( POST( $command ,

                        Content_Type => 'form-data',
                        Content => [ 'firmwareFile'
                                  => [ $fname ]
                             ]

                   )
              ) ;

print $response->content ;
```

Running that program produces:

OK: Failsafe Firmware Installation Started.

Other techniques

It is quite feasible to use other methods to transmit the Programmatic Commands to the target system. For example, C or C++ programs directly open socket connections to the GNSS receiver and directly transmit the requests over those channels. This is moderately advanced programming and the details are beyond the scope of this document.

List of Programmatic Commands

Below is a complete list of the Action-Object commands accepted by the programmatic interface. Clicking an individual command takes you to the specific information on that command.

- Status Commands
- Satellite Commands
- Configuration Commands
- I/O Commands
- Firmware Commands

Status commands

All of these commands display some information from the GNSS receiver. The information can be a static item, like a serial number, or something dynamic like the current time or receiver position.

Command	Description
Show SerialNumber	Returns the serial number of this GNSS receiver.
Show UtcTime	Returns the current UTC date and time.
Show GpsTime	Returns the current GPS week number and time.
Show Position	Returns the currently measured position and associated values.
Show Voltages	Returns the voltages on all power or battery inputs.
Show Temperature	Returns the internal temperature of the GNSS receiver.
Show Commands	Returns a list of all supported commands.

Satellite commands

These commands are associated with satellite tracking and data.

Command	Description
Show TrackingStatus	Returns information on all tracked satellites.
Show Tracking	Returns signal tracking settings.
Set Tracking	Modifies signal tracking settings.
Show GpsSatControls	Returns the Enable/Disable/IgnoreHealth settings for all GPS satellites values.
Set GpsSatControls	Modifies the Enable/Disable/IgnoreHealth settings for GPS satellites.
Show SbasSatControls	Returns the Enable/Disable/IgnoreHealth settings for all SBAS satellites.
Set SbasSatControls	Modifies the Enable/Disable/IgnoreHealth settings for SBAS satellites.
Show GlonassSatControls	Returns the Enable/Disable/IgnoreHealth settings for all GLONASS satellites.
Set GlonassSatControls	Modifies the Enable/Disable/IgnoreHealth settings for GLONASS satellites.
Show Ephemeris	Returns ephemeris data for a GNSS satellite.
Show Almanac	Returns the Almanac data for a GNSS satellite.
Show GpsHealth	Returns the health status of all GPS satellites.
Show GpsUtcData	Returns the UTC data decoded from GPS satellites.
Show GpsIonoData	Returns the Ionospheric Model data decoded from GPS satellites.
Reset GnssData	Clears all decoded GNSS Ephemeris and Almanac data.

Configuration commands

These commands show or modify the state of various of system functions.

Command	Description
Reset System	Restarts (reboots) the GNSS receiver.

Command	Description
Show ReferenceFrequency	Returns the current source for the 10 MHz reference clock.
Set ReferenceFrequency	Modifies the source for the 10 MHz reference clock.
Show ElevationMask	Returns the current Elevation Mask control setting.
Set ElevationMask	Modifies the Elevation Mask control setting.
Show PdopMask	Returns the current PDOP Mask control setting.
Set PdopMask	Modifies the PDOP Mask control setting.
Show ClockSteering	Returns the current Clock Steering control setting.
Set ClockSteering	Modifies the Clock Steering control setting.
Show MultipathReject	Returns the current Multipath Rejection control setting.
Set MultipathReject	Modifies the Multipath Rejection control setting.
Show PPS	Returns the current settings of the Pulse-Per-Second controls.
Set PPS	Modifies the settings of the Pulse-Per-Second controls.
Show AntennaTypes	Returns a list of supported antenna types.
Show Antenna Clears	Returns the current antenna specifications.
Set Antenna	Modifies the antenna specifications

Input/Output commands

These sections show how Input/Output ports are configured to stream data, etc.

Command	Description
Show IoPorts	Returns a list of all I/O ports and their settings
Show IoPort	Returns the settings for a single I/O port.
Set IoPort	Modifies the controls for an I/O port.
Delete IoPort	Removes a TCP/IP port definition.
Show RefStation	Returns the current Reference Station control settings.
Set RefStation	Modifies the Reference Station control settings.
PortParameters	Port specification parameters.

Command	Description
StreamParameters	Stream specification parameters.

Firmware commands

These commands are associated with updating firmware in the GNSS receiver.

Command	Description
Show FirmwareVersion	Returns the current running firmware version.
Show FirmwareWarranty	Returns the firmware warranty date set in the receiver.
Set FirmwareWarranty	Sends option code to update firmware warranty date.
Upload FirmwareFile	Loads new firmware file to receiver.

Help menu

The **Help** menu provides information for each of the receiver settings available in the web browser. The Help files are stored on the Trimble Internet site and updated between firmware releases.

Help

Here you can access the help files for the receiver. You can search for topics and browse the contents for the information you are looking for.

Alternatively, you can download the files to a local windows computer and view them using a web browser. See Help Location.

Help Location

Use the **Help Link** field to point to the location of the Help files.

The Help Link enables you to host the online Help on either a local computer or a LAN running a web server. This is useful if you use a computer to access the web interface, but you do not have a permanent Internet connection. Usually the help files are hosted on www.trimble.com. Various web servers can be used to host the help files. The following example explains how to use Apache:

1. Go to the Apache website at http://httpd.apache.org/.
2. Find the most recently released version. As of February 2010, this is version 2.2.14. Click on it and then install the "Win32 without crypto" version.
3. By default, Apache 2.2 uses the following location for the root of the web server content C:\Program Files\Apache Software Foundation\Apache2.2\htdocs.
4. For the English help in the Apache root directory, add a folder "en".
5. In the "en" folder, download and then unzip the receiver Help. From the **Contents** tab, select **Download Guides** / **Download Help (.zip file)**.
6. Open a browser on the computer that is running Apache. The help should now be located at http://localhost/en.
7. On the Help Location page, enter **localhost** in the **Help Link** field. The receiver web interface appends the prefix and the two character language code ("en" in this case) based on the language that the web interface is operating in.
8. Click **OK**. The help links are now serviced from the local computer. This computer does not need to be local and can be a computer on the local LAN. Instead of "localhost", enter the name or IP address of the machine that is running Apache.
9. When new firmware is released, ensure that you download the latest files and update the local help files.

3

Output Messages

This section includes information regarding output messages. The ASCII NMEA messages are detailed along with the binary GSOF messages.

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
DTM	Datum reference information
GBS	GNSS satellite fault detection (RAIM support)
GGA	Time, position, and fix related data
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
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

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

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: 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: 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

Field	Meaning
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 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

Field	Meaning
	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 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

Field	Meaning
	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
	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: MSS

The NMEA MSS message is supported by Trimble receivers capable of MSK (Beacon) reception.

Signal-to-noise ratio, signal strength, frequency, and bit rate from a MSK (Beacon) receiver

The format of the MSS message is:

$ --MSS, x.x,x.x,x.x,x.x,x*hh<CR><LF>

An example of the MSS message from a dual channel DGNSS receiver is:

$GPMSS,26.4,7.2,283.5,200,2*61

MSS message fields

Field	Meaning
0	Message ID $--MSS
1	Signal strength (SS), dB re: 1 uV/m
2	Signal-to-noise ratio (SNR), dB
3	Beacon frequency, 283.5 to 325.0 kHz
4	Beacon bit rate (25, 50, 100, 200) bits per second
5	Channel number (set equal to "1" or null for single-channel receivers)
6	The checksum data, always begins with *

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
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 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

Field	Meaning
	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,DG

L-band corrections and beacon signal strength and related information

This message, $PTNLDG, is a Trimble-created message. It outputs the L-band and beacon signal strength and other information.

Examples of the PTNL,DG message string are:

For beacon DG message: $PTNLDG,44.0,33.0,287.0,100,0,4,1,0,,,*3E

For L-band DG message: $PTNLDG,124.0,10.5,1557855.0,1200,2,4,0,3,,,*3C

DG message fields

Field	Meaning
0	Talker ID
1	Signal strength
2	SNR in db
3	Signal frequency in kHz
4	Bit rate
5	Channel number. For a beacon message, the system locks only to the primary channel. As a result, there is not more than one beacon message. The channel for beacon is 0 (so it matches the DSM 232 family of GPS receivers). For L-band messages, the channel number is 2 (so it matches the DSM 232 family of GPS receivers).
6	Tracking status: 0: Channel idle. 1: Wideband FFT search. 2: Searching for signal. 3: Channel has acquired signal. 4: Channel has locked onto signal. For beacon, this means valid RTCM has been received. For L-band, this means good data has been decoded. 5: Channel disabled.
8	Channel tracking performance indicator. For beacon, this is the word error rate, which is in percentage. For L-band, this is the time since the last sync, in tenths of seconds ranging from 0 through 255.

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

Field	Meaning
	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
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

Field	Meaning
	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:

Field	Meaning
	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
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 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

Field	Meaning
	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 207*.

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 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 207**.*

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 207*.

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.

GSOF Messages: Overview

These topics provide information on the General Serial Output Format (GSOF) messages. GSOF messages are a Trimble proprietary format and can be used to send information such as position and status to a third-party device.

This table summarizes the GSOF messages that the receiver supports. When GSOF output is enabled, the following messages can be generated:

Message	Function
Attitude Info	Attitude info
Base Position and Quality	Base station position and its quality
Battery/Memory Info	Receiver battery and memory status
Brief All SV Info	SV brief info (all satellite systems)
Brief SV Info	GPS SV brief info
Clock Info	Clock info
Delta ECEF	Earth-Centered, Earth-Fixed Delta position
Detail All SV	SV detailed info (all satellite systems)
Detail SV Info	GPS SV detailed info
DOP Info	PDOP info
ECEF Position	ECEF Position
L-Band Status Info	L-Band status info
Lat, Long, Ht	Latitude, longitude, height
Local ENU	Local zone north, east, and height - projection/calibration based
Local LLH	Local datum position
Multiple Page Detail All SV	Multiple Page All SV Detailed Info
Position Sigma	Position sigma info
Position Time	Position time
Position VCV	Position VCV info

Message	Function
Position Type Information	Position Type Information
Received Base	Received info about the base
Receiver Serial	Receiver serial number
TPlane ENU	Tangent Plane Delta
UTC	Current UTC time
Velocity	Velocity data

GSOF messages: General Serial Output Format

Report packet 40h structure (GENOUT)

Byte	Item	Type	Value	Meaning
0	STX	Char	02h	Start transmission
1	STATUS	Char	See Receiver status code	Receiver status code
2	PACKET TYPE	Char	40h	Report Packet 40h (GENOUT)
3	LENGTH	Char	00h–FAh	Data byte count
4	TRANSMISSION NUMBER	Char		Unique number assigned to a group of record packet pages. Prevents page mismatches when multiple sets of record packets exist in output stream.
5	PAGE INDEX	Char	00h–FFh	Index of current packet page.
6	MAX PAGE INDEX	Char	00h–FFh	Maximum index of last packet in one group of records.
One or more GSOF messages				
	Output record type	Char	01h	For example, Time (Type 1 Record)
	Record length	Char	0Ah	Bytes in record
Various fields depending on Output record type. There can be various records in one GENOUT packet. There could be multiple GENOUT packets per epoch. Records may be split over two consecutive packets.				
Length + 4	CHECKSUM	–	–	(Status + type + length + data bytes) modulo 256
Length + 5	ETX		03h	End transmission

Each message begins with a 4-byte header, followed by the bytes of data in each packet. The packet ends with a 2-byte trailer. Byte 3 is set to 0 (00h) when the packet contains no data. Most data is transmitted between the receiver and remote device in binary format.

Receiver Status code

Byte number	Description
Bit 0	Reserved
Bit 1	If set, low battery at the base station
Bit 2	Reserved
Bit 3	If set, receiver's kinematic state is currently set to 'Roving', otherwise 'static'
Bit 4–7	Reserved

GSOF messages: Reading binary values (Motorola format)

The receivers store numbers in Motorola format. The byte order of these numbers is the opposite of what personal computers (Intel format) expect. To supply or interpret binary numbers (8-byte DOUBLES, 4-byte LONGS, and 2-byte INTEGERS), the byte order of these values must be reversed. This section contains a detailed description of the Motorola format.

INTEGER data types

The INTEGER data types (CHAR, SHORT, and LONG) can be signed or unsigned. By default, they are unsigned. All integer data types use two's complement representation. The following table lists the integer data types:

Type	# of bits	Range of values (Signed)	Unsigned
Char	8	-128 to 127	0 to 255
Short	16	-32768 to 32767	0 to 65535
Long	32	–2147483648 to 2147483647	0 to 4294967295

FLOATING-POINT data types

Floating-point data types are stored in the IEEE SINGLE and DOUBLE precision formats. Both formats have a sign bit field, an exponent field, and a fraction field. The fields represent floating-point numbers in the following manner:

Floating-Point Number = <sign> 1.<fraction field> x 2(<exponent field> - bias)

Sign bit field

The sign bit field is the most significant bit of the floating-point number. The sign bit is 0 for positive numbers and 1 for negative numbers.

Fraction field

The fraction field contains the fractional part of a normalized number. Normalized numbers are greater than or equal to 1 and less than 2. Since all normalized numbers are of the form 1.XXXXXXXX, the 1 becomes implicit and is not stored in memory. The bits in the fraction field are the bits to the right of the binary point, and they represent negative powers of 2. For example:

0.011 (binary) = 2-2 + 2-3 = 0.25 + 0.125 = 0.375

Exponent field

The exponent field contains a biased exponent; that is, a constant bias is subtracted from the number in the exponent field to yield the actual exponent. (The bias makes negative exponents possible.)

If both the exponent field and the fraction field are zero, the floating-point number is zero.

NaN

A NaN (Not a Number) is a special value that is used when the result of an operation is undefined. For example, adding positive infinity to negative infinity results in a NaN.

FLOAT data type

The FLOAT data type is stored in the IEEE single-precision format which is 32 bits long. The most significant bit is the sign bit, the next 8 most significant bits are the exponent field, and the remaining 23 bits are the fraction field. The bias of the exponent is 127. The range of single-precision format values is from 1.18 x 10–38 to 3.4 x 1038. The floating-point number is precise to 6 decimal digits.

0 000 0000 0 000 0000 0000 0000 0000 0000 = 0.0
0 011 1111 1 000 0000 0000 0000 0000 0000 = 1.0
1 011 1111 1 011 0000 0000 0000 0000 0000 = -1.375
1 111 1111 1 111 1111 1111 1111 1111 1111 = NaN

DOUBLE

The DOUBLE data type is stored in the IEEE double-precision format which is 64 bits long. The most significant bit is the sign bit, the next 11 most significant bits are the exponent field, and the remaining 52 bits are the fractional field. The bias of the exponent is 1023. The range of single precision format values is from 2.23 × 10–308 to 1.8 × 10308. The floating-point number is precise to 15 decimal digits.

0 000 0000 0000 0000 0000 ... 0000 0000 0000 = 0.0
0 011 1111 1111 0000 0000 ... 0000 0000 0000 = 1.0
1 011 1111 1110 0110 0000 ... 0000 0000 0000 = -0.6875
1 111 1111 1111 1111 1111 ... 1111 1111 1111 = NaN

GSOF message overview: Flags

Position flags 1: Bit values

Bit	Meaning
0	New position. 0: No. 1: Yes.
1	Clock fix calculated for current position. 0: No. 1: Yes.
2	Horizontal coordinates calculated this position. 0: No. 1: Yes.
3	Height calculated this position. 0: No. 1: Yes.
4	Reserved. Always set.
5	Least squares position. 0: No. 1: Yes.
6	Reserved. Always clear.
7	Position uses filtered L1 pseudoranges. 0: No. 1: Yes.

Position flags 2: Bit values

Bit	Meaning
0	Differential position 0: Differential position is an autonomous or a WAAS solution. 1: Position is a differential solution.
1	Differential position method 0: Code 1: Phase including RTK, HP or XP OmniSTAR (VBS is not derived from Phase).
2	Differential position method 0: Code (DGPS) or a float position (RTK). Uncorrected position is Autonomous (if bit 0 = 0). 1: Position is fixed integer phase position (RTK). Uncorrected position is WAAS (if bit 0 = 0).
3	OmniSTAR solution. 0: Not active 1: OmniSTAR differential solution (including HP, XP, and VBS)
4	Position determined with static as a constraint. 0: No. 1: Yes.
5	Position is network RTK solution. 0: No. 1: Yes.
6	Position is Location RTK. 0: No. 1: Yes.

Bit	Meaning
7	Position is Beacon DGPS. 0: No. 1: Yes.

Flags: Bit values

Bit	Meaning
0	Time information (week and millisecond of week) validity 0: Not valid 1: Valid
1	UTC offset validity 0: Not valid 1: Valid

Velocity flags: Bit values

Bit	Meaning
0	Velocity data validity 0: Not valid 1: Valid
1	Velocity computation 0: Computed from Doppler 1: Computed from consecutive measurements
2–7	Reserved (set to zero)

SV flags 1: Bit values

Bit	Meaning
0	Satellite Above Horizon 0: No. 1: Yes.
1	Satellite Currently Assigned to a Channel (trying to track) 0: No. 1: Yes.
2	Satellite Currently Tracked on L1 Frequency. 0: No. 1: Yes.
3	Satellite Currently Tracked on L2 Frequency. 0: No. 1: Yes.
4	Satellite Reported at Base on L1 Frequency. 0: No. 1: Yes.
5	Satellite Reported at Base on L2 Frequency. 0: No. 1: Yes.
6	Satellite Used in Position. 0: No. 1: Yes.
7	Satellite Used in Current RTK Process (Search, Propagate, Fix Solution). 0: No. 1: Yes.

SV flags 2: Bit values

Bit	Meaning
0	Satellite Tracking P-Code on L1 Band. 0: No. 1: Yes.

Bit	Meaning
1	Satellite Tracking P-Code on L2 Band. 0: No. 1: Yes.
2–7	Reserved. Set to zero.

Attitude flags: Bit values

Bit	Meaning
0	Calibrated. 0: No. 1: Yes.
1	Pitch valid. 0: No. 1: Yes.
2	Yaw valid. 0: No. 1: Yes.
3	Roll valid. 0: No. 1: Yes.
4	Scalar valid. 0: No. 1: Yes.
5	COBRA system: Diagnostic valid; For non-COBRA system: Reserved
6	COBRA system: Slave static; For non-COBRA system: Reserved
7	COBRA system: Error stats valid; For non-COBRA system: Reserved

Attitude calculation flags: Bit values

Bit	Meaning
0	0: No position 1: Autonomous position 2: RTK/Float position 3: RTK/Fix position 4: DGPS position

GSOF message: Attitude

This message describes attitude information relating to the vector between the Heading antenna and the Moving Base antenna. It contains the following data:

- Tilt or vertical angle, in radians, from the Heading antenna to the Moving Base antenna relative to a horizontal plane through the Heading antenna
- Heading or yaw, in radians, relative to True North
- Range or slope distance between the Heading antenna and the Moving Base antenna

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

Attitude (Type 27 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	1Bh	Attitude information
1	Record length	Char		Bytes in record
2–5	GPS time	Long	msecs	GPS time in milliseconds of GPS week
6	Flags	Char	See Attitude flags	Flag bits indicating validity of attitude components
7	Number of SVs used	Char		Number of satellites used to calculate attitude
8	Calculation mode	Char	See Attitude calculation flags	Positioning mode
9	Reserved			Reserved (unused)
10–17	Pitch	Double	radians	The forward dive/climb angle
18–25	Yaw	Double	radians	Rotation about the vertical axis relative to True North (i.e. horizontal turn left or right)
26–33	Roll	Double	radians	Side-to-side roll angle
34–41	Master-Slave Range	Double	meters	Distance between master and slave antennas
42–43	PDOP	Short	0.1	Position Dilution of Precision of current position

Field	Item	Type	Value	Meaning
44-47	Pitch variance	Float	$radians^2$	Expected variance of error of the pitch estimate
48-51	Yaw variance	Float	$radians^2$	Expected variance of error of the yaw estimate
52-55	Roll Variance	Float	$radians^2$	Expected variance of error of the roll estimate
56-59	Pitch-Yaw Covariance	Float	$radians^2$	Expected covariance of errors of the pitch and yaw estimates
60-63	Pitch-Roll Covariance	Float	$radians^2$	Expected covariance of errors of the pitch and roll estimates
64-67	Yaw-Roll Covariance	Float	$radians^2$	Expected covariance of errors of the yaw and roll estimates
68-71	Master-Slave Range Variance	Float	$meters^2$	Expected variance of error of the master-slave range estimat

Subsequent elements are not implemented in firmware versions prior to GNSS version 4.20 firmware. The error stats valid flag is ***not*** set when these elements are implemented, because the error stats flag refers to specific position statistics, and not to the attitude statistics provided here. The presence of these additional elements should be detected based on the record length.

GSOF message: Base Position and Quality

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.

Base position and quality indicator (Type 41 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	01h	Position time output record
1	Record length	Char		Bytes in record
2–5	GPS time (ms)	Long	msecs	GPS time, in milliseconds, of GPS week
6–7	GPS week number	Short	number	GPS week count since January 1980
8–15	Latitude	Double	radians	The WGS-84 latitude, in radians, of the moving base antenna
16–23	Longitude	Double	radians	The WGS-84 longitude, in radians, of the moving base antenna
24–31	Height	Double	meters	The WGS-84 height, in meters, of the moving base antenna
32	Quality indicator	Char	number	The quality of the base station position: 0: Fix not available or invalid 1: Autonomous GPS fix 2: Differential SBAS or OmniSTAR VBS 4: RTK Fixed, xFill 5: OmniSTAR XP, OmniSTAR HP, CenterPoint RTX, Float RTK, or Location RTK

GSOF message: Battery/Memory Info

This message provides information relating to the receiver battery and memory. It contains the following data:

- Remaining battery power
- Remaining memory

Batt/Mem (Type 37 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	25h	
1	Record length	Char	0Ah	Bytes in record
2–3	Battery capacity	Unsigned short	percentage	Remaining battery capacity in percentage
4–11	Remaining memory	Double	hours	Estimated remaining data logging time in hours

GSOF message: Brief All SV Info

This message contains brief satellite information for all tracked satellites in all tracked satellite systems. It contains the following data:

- Number of satellites tracked
- The PRN number of each satellite
- The satellite system that the satellite belongs to
- Flags indicating satellite status

SV brief (Type 33 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	21h	Brief satellite information output record
1	Record length	Char		Bytes in record
2	Number of SVs	Char		Number of satellites included in record. ***NOTE –** Includes all tracked satellites, all satellites used in the position solution, and all satellites in view.*
The following bytes are repeated for the number of SVs:				
	PRN	Char		The PRN number of the satellite which the following flags refer to. This is the actual PRN number given by the SV (not ranged due to the SV system).
	SV System			The system that the SV belongs to. Valid values are: 0: GPS 1: SBAS 2: GLONASS 3: Galileo 4: QZSS 5: BeiDou 6–255: Reserved
	SV Flags 1	Char		SV Flags 1 indicates conditions relating to satellites: bit 0 Set: Above horizon

Field	Item	Type	Value	Meaning
				bit 1 Set: Currently assigned to a channel (trying to track) bit 2 Set: Currently tracked on L1/G1 frequency bit 3 Set: Currently tracked on L2/G2 frequency bit 4 Set: Reported at base on L1/G1 frequency bit 5 Set: Reported at base on L2/G2 frequency bit 6 Set: Used in current position bit 7 Set: Used in the current RTK solution
	SV Flags 2	Char		SV Flags 2 indicates conditions relating to satellites: If SV SYSTEM is GPS: bit 0 Set: Tracking P Code on L1/G1 bit 1 Set: Tracking P Code on L2 bit 2 Set: Tracking CS on L2 bit 3 Set: Tracking on L5 bits 4–7: RESERVED If SV SYSTEM is GLONASS: bit 0 Set: Tracking P Code on L1/G1 bit 1 Set: Tracking P Code on L2 bit 2 Set: GLONASS SV is "M" SV bit 3 Set: GLONASS SV is "K" SV bits 4–7: RESERVED If SV SYSTEM is Galileo: bit 0 Set: Tracking E1 bit 1 Set: Tracking E5A bit 2 Set: Tracking E5B bit 3 Set: Tracking E5AltBOC bits 4–7: RESERVED If SV SYSTEM is QZSS: bit 0 Set: Tracking L1 C/A

Field	Item	Type	Value	Meaning
				bit 1 Set: Tracking L1C BOC bit 2 Set: Tracking L1SAIF bit 3 Set: Tracking L2C bit 4 Set: Tracking L5 bits 5–7: RESERVED If SV SYSTEM is BeiDou: bit 0 Set: Tracking B1 bit 1 Set: Tracking B2 bit 2 Set: Tracking B3 bits 3–7: RESERVED else: bits 0–7: RESERVED

GSOF message: Brief SV Info

This message contains brief satellite information. It contains the following data:

- Number of satellites tracked
- The PRN number of each satellite
- Flags indicating satellite status

All SV brief (Type 13 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	0Dh	Brief satellite information output record
1	Record length	Char		Bytes in record
2	Number of SVs	Float	00h–18h	Number of satellites included in record. *NOTE – Includes all tracked satellites, all satellites used in the position solution, and all satellites in view.*
The following bytes are repeated for the number of SVs:				
	PRN	Char	01h–20h	Pseudorandom number of satellites (–32)
	SV Flags 1	Char	See SV flags: 1-bit values	First set of satellite status bits
	SV Flags 2	Char	See SV flags: 2-bit values	Second set of satellite status bits

GSOF message: Clock Info

This message describes the clock information. It contains the following data:

- Clock offset
- Frequency offset

Clock information (Type 10 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	0Ah	Clock information output record
1	Record length	Char		Bytes in record
2	Clock flags	Char	0, 1, or 2	Provides information related to the clock fix process. Defined values are: bit 0 SET: clock offset is valid bit 1 SET: frequency offset is valid bit 2 SET: receiver is in anywhere fix mode
3–10	Clock offset	Double	milliseconds	The current clock offset in milliseconds
11–18	Frequency offset	Double	ppm	The offset of the local oscillator from the nominal GPS L1 frequency in parts per million

GSOF message: UTC

This message describes current time information. It contains the following data:

- GPS time, in milliseconds of GPS week
- GPS week number
- GPS to UTC time offset, in seconds

UTC (Type 16 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	10h	
1	Record length	Char	09h	Bytes in record
2–5	GPS millisecond of week	Long	msecs	Time when packet is sent from the receiver, in GPS milliseconds of week
6–7	GPS week number	Short	number	Week number since the start of GPS time
8–9	UTC offset	Short	seconds	GPS to UTC time offset
10	Flags	Char	See Flags: Bit values	Flag bits indicating validity of Time and UTC offsets

GSOF message: ECEF DELTA

This message describes the ECEF Delta position. It contains the following data:

- Earth-Centered, Earth-Fixed X, Y, Z deltas between the rover and base position, in meters

ECEF Delta (Type 6 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	06h	Earth-Centered, Earth-Fixed (ECEF) Delta output record
1	Record length	Char	18h	Bytes in record
2–9	Delta X	Double	meters	ECEF X-axis delta between rover and basis station positions
10–17	Delta Y	Double	meters	ECEF Y-axis delta between rover and basis station positions
18–25	Delta Z	Double	meters	ECEF Z-axis delta between rover and basis station positions

GSOF message: All SV Detail

This message describes detailed satellite information for all tracked satellites in all tracked satellite systems. It contains the following data:

- Number of satellites tracked
- The PRN number of each satellite
- The satellite system that the satellite belongs to
- Flags indicating satellite status
- Elevation above horizon, in degrees
- Azimuth from True North, in degrees
- Signal-to-noise ratio (SNR) of first frequency
- Signal-to-noise ratio (SNR) of second frequency
- Signal-to-noise ratio (SNR) of third frequency

All SV detail (Type 34 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	22h	Detailed satellite information for all satellite systems output record.
1	Record length	Char	1 + 8 (number of SVs)	Bytes in record. This record will not exceed 255 bytes; satellites may be dropped from the output message if the length exceeds this. To ensure that output for all satellites is output, use the GSOF 30h "Multiple Page All SV Detail" message.
2	Number of SVs	Char		Number of satellites included in record. *NOTE – Includes all tracked satellites, all satellites used in the position solution, and all satellites in view.*
The following bytes are repeated for each SV:				
	PRN	Char		The PRN number of the satellite which the following flags refer to. This is the actual PRN number given by the SV (not ranged due to the SV system).
	SV System			The system that the SV belongs to. Valid values are: 0: GPS 1: SBAS

Field	Item	Type	Value	Meaning
				2: GLONASS 3: Galileo 4: QZSS 5: BeiDou 6–255: Reserved
	SV Flags1	Char		SV Flags 1 indicates conditions relating to satellites: bit 0 Set: Above horizon bit 1 Set: Currently assigned to a channel (trying to track) bit 2 Set: Currently tracked on L1/G1 frequency bit 3 Set: Currently tracked on L2/G2 frequency bit 4 Set: Reported at base on L1/G1 frequency bit 5 Set: Reported at base on L2/G2 frequency bit 6 Set: Used in current position bit 7 Set: Used in the current RTK solution
	SV Flags2	Char		SV Flags 2 is a bitmap variable that has the following values: If SV SYSTEM is GPS: bit 0 Set: Tracking P Code on L1/G1 bit 1 Set: Tracking P Code on L2 bit 2 Set: Tracking CS on L2 bit 3 Set: Tracking on L5 bits 4–7: RESERVED If SV SYSTEM is GLONASS: bit 0 Set: Tracking P Code on L1/G1 bit 1 Set: Tracking P Code on L2 bit 2 Set: GLONASS SV is "M" SV bit 3 Set: GLONASS SV is "K" SV bits 4–7: RESERVED

Field	Item	Type	Value	Meaning
				If SV SYSTEM is Galileo: bit 0 Set: Tracking E1 bit 1 Set: Tracking E5A bit 2 Set: Tracking E5B bit 3 Set: Tracking E5AltBOC bits 4–7: RESERVED If SV SYSTEM is QZSS: bit 0 Set: Tracking L1 C/A bit 1 Set: Tracking L1C BOC bit 2 Set: Tracking L1SAIF bit 3 Set: Tracking L2C bit 4 Set: Tracking L5 bits 5–7: RESERVED If SV SYSTEM is BeiDou: bit 0 Set: Tracking B1 bit 1 Set: Tracking B2 bit 2 Set: Tracking B3 bits 3–7: RESERVED else: bits 0–7: RESERVED
	Elevation	Char	Degrees	Angle of satellite above the horizon.
	Azimuth	Short	Degrees	Azimuth of satellite from True North.
	SNR first frequency	Char	dB * 4	Signal-to-noise ratio of first frequency (multiplied by 4)1[1] If GPS: L1 C/A SNR

[1]THe SNR L1 and SNR L2 items are set to zero for satellites that are not tracked on the current frequency.

Field	Item	Type	Value	Meaning
				If GLONASS: G1C or G1P SNR If Galileo: E1 SNR If BeiDou: B1 SNR
	SNR second frequency	Char	dB * 4	Signal-to-noise ratio of second frequency (multiplied by 4)1[1] If GPS: L2C or L2P SNR If GLONASS: G2C or G2P SNR If Galileo: E5 AltBoc SNR If BeiDou: B2 SNR
	SNR third frequency	Char	dB * 4	Signal-to-noise ratio of third frequency (multiplied by 4)1[1] If GPS: L5 SNR If GLONASS: G3 SNR If Galileo: E5A SNR if available, else E5B SNR if available If BeiDou: B3 SNR

[1] THe SNR L1 and SNR L2 items are set to zero for satellites that are not tracked on the current frequency.

[1] THe SNR L1 and SNR L2 items are set to zero for satellites that are not tracked on the current frequency.

GSOF message: GPS SV Detail

This message describes detailed satellite information. It contains the following data:

- Number of satellites tracked
- The PRN number of each satellite
- Flags indicating satellite status
- Elevation above horizon, in degrees
- Azimuth from True North, in degrees
- Signal-to-noise ratio (SNR) of L1 signal
- Signal-to-noise ratio (SNR) of L2 signal

SV detail (Type 14 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	0Eh	Detailed satellite information output record
1	Record length	Char	1 + 8 (number of SVs)	Bytes in record
2–9	Number of SVs	Char	00h-18h	Number of satellites included in record *NOTE – Includes all tracked satellites, all satellites used in the position solution, and all satellites in view.*
The following bytes are repeated for each SV:				
	PRN	Char	01h-20h	Pseudorandom number of satellites (1–32)
	Flags1	Char	See SV flags: 1-bit values	First set of satellite status bits
	Flags2	Char	See SV flags: 2-bit values	Second set of satellite status bits
	Elevation	Char	Degrees	Angle of satellite above the horizon
	Azimuth	Short	Degrees	Azimuth of satellite from True North
	SNR L1	Char	dB * 4	Signal-to-noise ratio of L1 signal (multiplied by

Field	Item	Type	Value	Meaning
				1[1]
	SNR L2	Char	dB * 4	Signal-to-noise ratio of L2 signal (multiplied by 4)1[1]

[1]THe SNR L1 and SNR L2 items are set to zero for satellites that are not tracked on the current frequency.
[1]THe SNR L1 and SNR L2 items are set to zero for satellites that are not tracked on the current frequency.

GSOF message: DOP

This message describes the DOP information. It contains the following data:

- PDOP
- HDOP
- VDOP
- TDOP

DOP (Type 9 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	09h	DOP information output record
1	Record length	Char	10h	Bytes in record
2–5	PDOP	Float		Positional Dilution of Precision
6–9	HDOP	Float		Horizontal Dilution of Precision
10–13	VDOP	Float		Vertical Dilution of Precision
14–17	TDOP	Float		Time Dilution of Precision

GSOF message: LLH

This message describes latitude, longitude, and height. It contains the following data:

- WGS-84 latitude and longitude, in radians
- WGS-84 height, in meters

Latitude, longitude, height (Type 2 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	02h	Latitude, longitude, and height output record
1	Record length	Char	18h	Bytes in record
2–9	Latitude	Double	radians	Latitude from WGS-84 datum
10–17	Longitude	Double	radians	Longitude from WGS-84 datum
18–25	Height	Double	meters	Height from WGS-84 datum

GSOF message: Local Zone Position

This message describes local site north, east, and vertical information. A site coordinate system such as a map projection or a site calibration must be loaded into the receiver for the message to output valid data. The message contains the following data:

Local ENU (Type 5 record)

Field	Item	Type	Value	Meaning
0	Output record type	Byte	05h	Local zone position
1	Record length	Byte	28h	Bytes in record
2–9	Local datum identifier	Char		ASCII string that identifies the coordinate datum
10–17	Local zone identifier	Char		ASCII string that identifies the coordinate zone
18–25	Local zone north (meters)	Double	meters	Local zone north coordinate
26–33	Local zone east (meters)	Double	meters	Local zone east coordinate
34–41	Local datum height	Double	meters	Height in the local datum

GSOF message: Local Datum Position

This message describes the local datum position. It contains the following data:

- local datum latitude and longitude in radians
- local datum height in meters

Local datum position (Type 4 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	04h	Local datum position output record
1	Record length	Char		Bytes in record
2–9	Local datum ID	Char		ASCII string that identifies the coordinate datum
10–17	Local datum latitude	Double	radians	Latitude of the local datum in radians
18–25	Local datum longitude	Double	radians	Longitude of the local datum in radians
26–33	Local datum height	Double	meters	Height of the local datum in meters

GSOF message: Position SIGMA

This message describes the Position Sigma information. It contains the following data:

- Position RMS
- Sigma east, in meters
- Sigma north, in meters
- Sigma up, in meters
- Covariance east-north
- Error Ellipse Semi-major axis, in meters
- Error Ellipse Semi-minor axis, in meters
- Orientation of Semi-major axis in degrees from True North
- Unit variance
- Number of epochs

NOTE – The Configuration Toolbox software incorrectly identifies this message subtype as "Error Covariance data".

Sigma (Type 12 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	0Ch	Position sigma information output record
1	Record length	Char	26h	Bytes in record
2–5	Position RMS	Float		Root mean square of position error calculated for over-determined positions
6–9	Sigma east	Float	meters	
10–13	Sigma north	Float	meters	
14–17	Covar. east-north	Float	number	Covariance east-north (dimensionless)
18–21	Sigma up	Float	meters	
22–25	Semi-major axis	Float	meters	Semi-major axis of error ellipse

Field	Item	Type	Value	Meaning
26–29	Semi-minor axis	Float	meters	Semi-minor axis of error ellipse
30–33	Orientation	Float	degrees	Orientation of semi-minor axis, clockwise from True North
34–37	Unit variance	Float		Valid only for over-determined solutions. Unit variance should approach 1.0 value. A value of less than 1.0 indicates that apriori variances are too pessimistic.
38–39	Number of epochs	Short	count	Number of measurement epochs used to compute the position. Could be greater than 1 for positions subjected to static constraint. Always 1 for kinematic.

GSOF message: Position TIME

This message describes position time information. It contains the following data:

- GPS time, in milliseconds of GPS week
- GPS week number
- Number of satellites used
- Initialization counter

Time (Type 1 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	01h	Position time output record
1	Record length	Char	0Ah	Bytes in record
2–5	GPS time (ms)	Long	msecs	GPS time, in milliseconds, of GPS week
6–7	GPS week number	Short	number	GPS week count since January 1980
8	Number of SVs used	Char	number	Number of satellites used to determine the position
9	Position Flags 1	Char	See Position flags: 1-bit values	Reports first set of position attribute flag values
10	Position Flags 2	Char	See Position flags: 2-bit values	Reports second set of position attribute flag values
11	Initialized number	Char	00h–FFh	Increments with each initialization (modulo 256)

GSOF message: Position VCV

This message describes the Position VCV information. It contains the following data:

- Position RMS
- VCV xx
- VCV xy
- VCV xz
- VCV yy
- VCV yz
- VCV zz
- Unit variance
- Number of epochs

NOTE – The Configuration Toolbox software incorrectly identifies this message subtype as "Position Statisitics".

Position VCV information (Type 11 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	0Bh	Earth-Centered, Earth-Fixed (ECEF) position output record.
1	Record length	Char		Bytes in record.
2–5	Position RMS	Float		The range residual RMS is the square root of the sum of the squares of the range residuals divided by the number of degrees of freedom in the solution.
6–9	VCV xx	Float		VCVxx through VCVzz is the variance-covariance matrix. This contains the positional components of the inverted normal matrix of the position solution in a ECEF WGS-84 reference.
10–13	VCV xy	Float		
14–17	VCV xz	Float		
18–21	VCV yy	Float		
22–25	VCV yz	Float		
26–29	VCV zz	Float		
30–33	Unit	Float		The unit variance of the position solution.

Field	Item	Type	Value	Meaning
	variance			
34–35	Number of epochs	Short		Indicates the number of measurements used to calculate the position. It may be greater than 1 for positions subjected to a STATIC constraint.

GSOF message: Received Base Info

This message describes received base information. It contains the following data:

- Flags indicating base message status
- Base name and ID
- Base latitude, longitude, and height

Received base info (Type 35 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	23h	Received base information output record
1	Record length	Char	1 + 8 (number of SVs)	Bytes in record
2	Flags	Char		Provides information about the base message. Valid values are: bits 0–2: Specify a version number for the message bit 3: If set, specifies that the base information given is valid bits 4–7: Reserved
3–10	Base name	Chars		The short base name received from the base. In the case of the base being RTCM (with no base name), the field is set to all 0s.
11–12	Base ID	Char		The ID number of the base being used. This field is big-endian, so the first byte will always be set to 0 if the base is a CMR base.
13–20	Base latitude	Double	radians	The WGS-84 latitude of the base in radians.
21–28	Base longitude	Double	radians	The WGS-84 longitude of the base in radians.
29–36	Base height	Double	meters	The WGS-84 height of the base in meters.

GSOF message: Receiver Serial Number

This message provides receiver serial number.

Receiver serial number (Type 15 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	0Fh	Receiver serial number output record
1	Record length	Char		Bytes in record
2–5	Serial number	Long		The full serial number of the receiver

NOTE – If the serial number of the receiver contains an alpha character this will be dropped. For example, a receiver with serial number 5033K44488 will be output as 503344488 (with the "K" removed).

GSOF message: Position Type

This message describes position time information. It contains the following data:

- Position type information
- Solution flags
- RTK condition
- Correction age
- Network flags

NOTE – This record may grow in the future. Apps should be coded so that they do not have problems if a larger record is encountered.

Position Type (Type 38 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char		Position time output record
1	Record length	Char		Bytes in record
2–5	Position Type Information			Output precisions, which is an empirical constant used to produce approximately a 99% confidence level or 3-sigma.
6	Solution Flags			Is a bitmap as follows: Bit 0: Solution is Wide Area/Network/VRS. Bit 1: RTK fix solution (clear: RTK float solution). Bit 2: Initialization Integrity Check bit. Bit 3: Initialization Integrity Check bit. Bits 4-7: (reserved).
7	RTK Condition			Is the same as bits 0..3 of 31h_RETPOS3 'RTK POSITION FLAGS'. Bits 0-3 values: 0: New Position computed. 1: Unable to obtain a synced pair from both stations. 2: Insufficient double difference measurements.

Field	Item	Type	Value	Meaning
				3: Reference position unavailable. 4: Failed integer verification with fixed solution. 5: Solution residual RMS exceeds predefined limit. 6: PDOP or RDOP exceeds (absolute positioning) PDOP mask.
8-11	Correction Age			Is the time in since the last differential measurement update in seconds. Same as in 31h_RETPOS3, GSOF_17, etc.
12	Network Flags			is the same as the 'NETWORK FLAGS' field in 31h_RETPOS3. Bit 0: New physical base station available. Bit reset after next command GETBASE, 34h. Bit 2,1: 0,0: RTCM v3 Network messages not available or unknown (RTCM3Net not operational). Bit 2,1: 0,1: Collecting RTCM v3 Network messages from beginning and have not received a complete cycle yet. Bit 2,1: 1,0: Completed a full cycle collection, but found the network message data insufficient to generate RTK network solutions. Bit 2,1: 1,1: RTCM v3 network RTK message collection completed and VRS observations epochs generated from V3 network messages. I.e. V3 network is up and running and in good shape. Bit 3: GeoFence option is enabled and unit is outside Geofence area. See also GeoFence, 4Bh RETOPT Bit 4: RTK Range limiting is enabled and unit is too far from the base (Range limit exceeded). Bit 5: RTK position MTG (mind-the-gap) flag. 1 = MTG position, 0 = Not MTG position. Bit 6: RTX position flag. 1 = RTX position, 0 = Not RTX position.

Field	Item	Type	Value	Meaning
				Bit 7: RTX/xFill link is down. 1 = link is down, 0 = don't care.
13	Network Flags2			Bit 0: xFill is ready to propagate RTK positions (or is already running).
14	Frame Flag (proposed)		number	This byte defines the reference frame and epoch of the reported position (proposed). 0: Unknown/Local (e.g. local site or not defined) 1: ITRF2014 Current epoch 2: ITRF2014 Epoch 2005.0 3: NAD83 2011 4: NAD83 CORS96
15–16	ITRF Epoch			
17	Techtonic Plate			
18–21	RTX STD SUB Minutes Left			
22	Pole Wobble Status Flag			
23–26	Pole Wobble Distance			

GSOF message: TPlane ENU

This message contains Tangent Plane Delta information. It contains the following data:

- North, East, and Up deltas of the vector from the base to the rover (in meters) projected onto a plane tangent to the WGS-84 ellipsoid at the base receiver.

NOTE – These records are output only if a valid DGPS/RTK solution is computed.

TPlane ENU (Type 7 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	07h	Tangent Plane Delta output record.
1	Record length	Char	18h	Bytes in record.
2–9	Delta east	Double	meters	East component of the vector from base station to rover, projected onto a plane tangent to the WGS-84 ellipsoid at the base station.
10–17	Delta north	Double	meters	North component of the vector from base station to rover, projected onto a plane tangent to the WGS-84 ellipsoid at the base station.
18–25	Delta up	Double	meters	Difference between ellipsoidal height of tangent plane at base station and a parallel plane passing through rover point.

GSOF message: Velocity

This message describes velocity information. It contains the following data:

- Horizontal velocity, in meters per second
- Vertical velocity, in meters per second
- Heading, in radians, referenced to WGS-84 True North

NOTE – The heading computation in this message is derived from consecutive positions. For heading using a moving baseline system, see *GSOF message: Attitude, page 231**.*

Velocity (Type 8 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	08h	Velocity data output record
1	Record length	Char	0Dh, 11D	Bytes in record
2	Velocity flags	Char	See Velocity flags: bit values	Velocity status flags
3–6	Speed	Float	Meters per second	Horizontal speed
7–10	Heading	Float	Radians	True north heading in the WGS-84 datum
11–14	Vertical velocity	Float	Meters per second	Vertical velocity

GSOF message: ECEF

This message describes the ECEF position. It contains the following data:

- Earth-Centered, Earth-Fixed X, Y, Z coordinates, in meters

ECEF position (Type 3 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	03h	Earth-Centered, Earth-Fixed (ECEF) position output record
1	Record length	Char	18h	Bytes in record
2–9	X	Double	meters	WGS-84 ECEF X-axis coordinate
10–17	Y	Double	meters	WGS-84 ECEF Y-axis coordinate
18–25	Z	Double	meters	WGS-84 ECEF X-axis coordinate

GSOF message: Multiple All SV Detailed Info

This message describes detailed satellite information for all tracked satellites in all tracked satellite systems. It contains the following data:

- Number of satellites tracked
- The PRN number of each satellite
- The satellite system that the satellite belongs to
- Flags indicating satellite status
- Elevation above horizon, in degrees
- Azimuth from True North, in degrees
- Signal-to-noise ratio (SNR) of L1 signal
- Signal-to-noise ratio (SNR) of L2 signal
- Signal-to-noise ratio (SNR) of L5 signal

All SV detail (Type 34 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char	48	Detailed satellite information for all satellite systems output record
1	Record length	Char	1 + 8 (number of SVs)	Bytes in record
2	Version Number	Char		The version for the current format.
Page info			Page number and total page. b0-b3 is the total page number, b4-b7 is the current page number. 0x12 means this message is 1 out of 2.	
	Number of SVs			The number of tracked satellites reported in this record.
	PRN	Char		The PRN number of the satellite which the following flags refer to. This is the actual PRN number given by the SV (not

Field	Item	Type	Value	Meaning
				ranged due to the SV system).
	SV System			The system that the SV belongs to. Valid values are: Bit 0: GPS Bit 1: SBAS Bit 2: GLONASS Bit 3: Galileo Bit 4: QZSS Bit 5: BeiDou Bits 6-9: Reserved Bit 10: OmniSTAR Bits 11–255: Reserved
	SV Flags1	Char		SV Flags 1 indicates conditions relating to satellites: Bit 0 SET: Above horizon Bit 1 SET: Currently assigned to a channel (trying to track) Bit 2 SET: Currently tracked on L1/G1 frequency Bit 3 SET: Currently tracked on L2/G2 frequency Bit 4 SET: Reported at base on L1/G1 frequency Bit 5 SET: Reported at base on L2/G2 frequency Bit 6 SET: Used in current position Bit 7 SET: Used in the current RTK solution
	SV Flags2	Char		SV Flags 2 is a bitmap variable that has the following values:

Field	Item	Type	Value	Meaning
				Bit 0 SET: Tracking P-Code on L1/G1 Bit 1 SET: Tracking P-Code on L2 If the SV is a GPS SV: Bit 2 SET: Tracking CS on L2 Bit 3 SET: Tracking L5 signal Bits 4–7: Reserved If the SV is a GLONASS SV: Bit 2 SET: GLONASS SV is "M" SV Bit 3 SET: GLONASS SV is "K" SV Bits 4–7: Reserved Else: Bits 2–7: Reserved If the SV is a Galileo SV: Bit 0 Set: Tracking P Code on E1 Bit 1 Set: Tracking P Code on E5A Bit 2 Set: Tracking P Code on E5B Bit 3 Set: Tracking P Code on E5AltBOC Bits 4-7: Reserved If the SV is a QZSS: Bit 0 Set: Tracking L1 C/A Bit 1 Set: Tracking L1C BOC Bit 2 Set: Tracking L1SAIF Bit 3 Set: Tracking L2C Bit 4 Set: Tracking L5 Bit 5 Set: Tracking LEX Bits 6-7: Reserved

Field	Item	Type	Value	Meaning
				Else: Bits 0-7: Reserved
	Elevation	Char	Degrees	Angle of satellite above the horizon
	Azimuth	Short	Degrees	Azimuth of satellite from True North
	SNR L1	Char	dB * 4	Signal-to-noise ratio of L1 signal (multiplied by 4)1[1] . Zero for SVs not tracked on this frequency. If GPS: L1C/A SNR If GLONASS: G1C or G1P SNR. If Galileo: E1 SNR. If Compass: B1 SNR.
	SNR L2	Char	dB * 4	Signal-to-noise ratio of L1 signal (multiplied by 4)1[1]. Zero for SVs not tracked on this frequency. If GPS: L2C or L2P SNR. If GLONASS: G2C or G2P SNR If Galileo: E5 AltBoc SNR. If Compass: B2 SNR.
	SNR L5	Char		If the SV is: GPS: then SNR L5 is the signal-to-noise ratio of the L5 signal (multiplied by 4). This is 0 for SVs not tracked on this frequency. GLONASS: then G1P SNR is the signal-to-noise ratio of the G1P signal (multiplied by 4). This is 0 for SVs not tracked on this

[1] THe SNR L1 and SNR L2 items are set to zero for satellites that are not tracked on the current frequency.

[1] THe SNR L1 and SNR L2 items are set to zero for satellites that are not tracked on the current frequency.

Field	Item	Type	Value	Meaning
				frequency. Galileo: then the value is E1 SNR or E5A SNR or E5B SNR or E5AltBOC SNR. Compass: B3 SNR. Else, this last byte is Reserved.

GSOF message: L-Band Status Information

This message describes the L-band status information.

L-Band status information (Type 40 record)

Field	Item	Type	Value	Meaning
0	Output record type	Char		L-band status information record
1	Record length	Char		Bytes in record
2	Satellite name	Char	string	The name of the L-band satellite the receiver is trying to track. There are two tracking modes: • In Auto mode, the receiver automatically picks a satellite to track and this field shows the name of the selected satellite. • In Custom mode, the first 5 characters of "Custom" is reported i.e., "Custo".
3	Satellite frequency	Char	MHz	The frequency of the tracked satellite, in MHz
4	Satellite bit rate	Char	Hz	The bit rate of the tracked satellite, in Hz
5	SNR	Char	dB-Hz	The SNR (C/No dB-Hz) value of the tracked satellite
6	HP/XP subscribed engine	Char		The subscribed engine in the HP/XP library: 0: XP 1: HP 2: G2 3: HP + G2 4: HP + XP 0xFF: Unknown
7	HP/XP library mode	Char		0: Library is inactive 1: Library is active.

Field	Item	Type	Value	Meaning
8	VBS library mode	Char		0: Library is inactive 1: Library is active.
9	Beam mode	Char		The mode of the L-band beam: 0: Off 1: FFT initializing 2: FFT running 3: Search initializing 4: Search running 5: Track initializing 6: Track searching 7: Tracking
10	OmniSTAR motion	Char		The motion state reported by the OmniSTAR library: 0: Dynamic 1: Static 2: OmniSTAR is not ready 0xFF: Unknown
11	3-sigma horizontal precision threshold	Char		Shows the configured 3-sigma horizontal precision threshold
12	3-sigma vertical precision threshold	Char		Shows the configured 3-sigma vertical precision threshold
13	NMEA encryption state	Char		0: Encryption is not applied to NMEA 1: Encryption is applied to NMEA
14	I/Q ratio	Char		Mean power in I and mean power in Q
15	Estimated bit error rate			
16	Total unique			Total unique words since the last search

Field	Item	Type	Value	Meaning
	words			
17	Total unique words with 1 or more bit errors			Total unique words with 1 or more bit errors since the last search
18	Total bad unique word bits			Total bad unique word bits since the last search
19	Total # of viterbi symbols			Total number of viterbi symbols since the last search. When the count reaches FFFFFF00 the count resets to 0.
20	# of corrected viterbi symbols			Number of corrected viterbi symbols since the last search. This count is reset along with the number of viterbi symbols.
21	# of bad messages			Number of bad messages since the last search. A bad message has a non-0 flush byte.
22	MEAS frequency valid flag			0: The MEAS frequency could be out by a significant amount 1: The MEAS frequency is accurate
23	MEAS frequency			Measured satellite frequency in Hz.

[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.

4

Receiver Dimensions, Cables, Connectors, and Accessories

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.

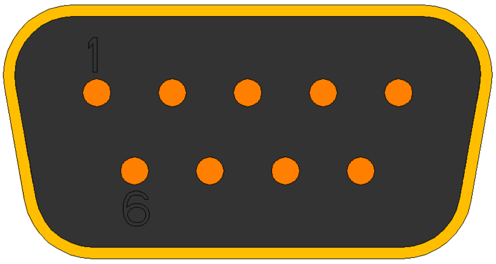
The receiver drawings are useful if you need to build mounting brackets and housings for the receiver.

The last section provides you with information on additional cables and accessories, environmental specifications, and installing lightning protection and guidelines for NEBS (Network Equipment Building Systems) compliance.

Pinout information for connectors

DB9 connector port 1

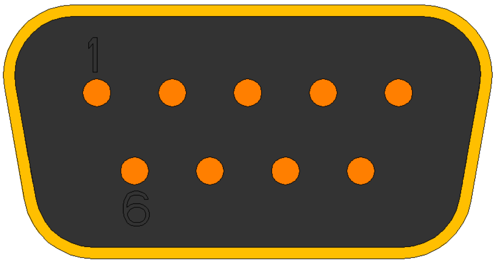
This is a 9-pin DTE 9-wire modem DB9 connector.



Pin	Usage
1	DCD
2	RS-232 serial data in (Rx)
3	RS-232 serial data out (Tx)
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

DB9 connector port 2

This is a 9-pin DTE 5-wire DB9 connector with MET sensor and 12 V DC output.

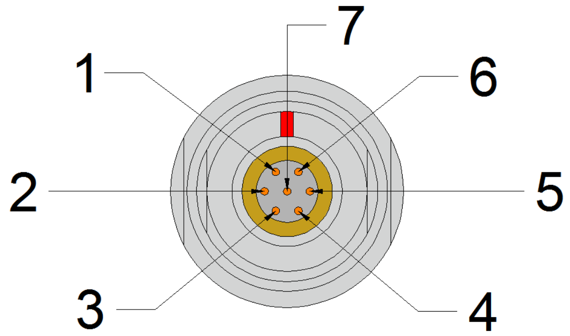


Pin	Usage
1	No connection
2	RS-232 serial data in
3	RS-232 serial data out
4	No connection
5	GND
6	No connection
7	RTS
8	CTS
9	12V_Out

The maximum power of the 12 V output is 3.6 W.

Lemo connectors (port 3 and 4)

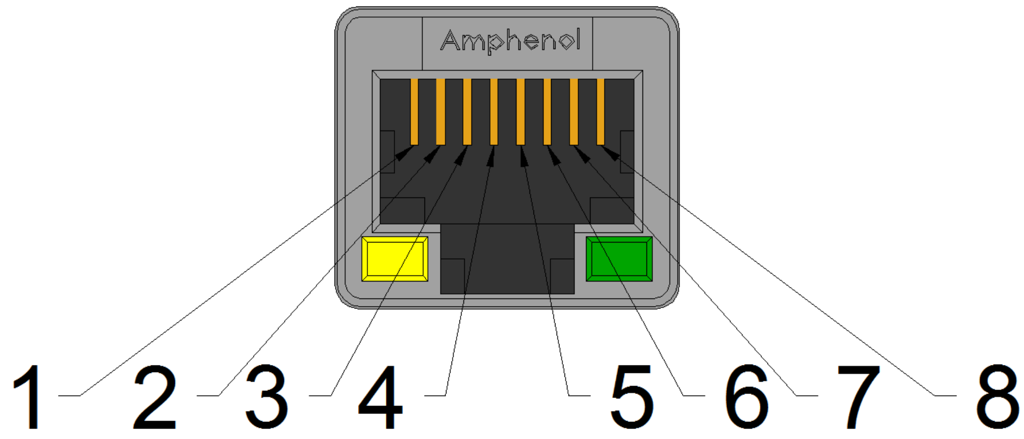
This is a 7-pin 0-shell Lemo connector.



Port 3		Port 4	
Pin	Usage	Pin	Usage
1	RS-232 signal GND	1	RS-232 signal GND
2	GND	2	GND
3	RS-232 serial data out	3	RS-232 serial data out
4	RTS	4	PPS (output)
5	CTS	5	Event (input)
6	DC power In	6	DC power In
7	RS-232 serial data in	7	RS-232 serial data in

RJ45 Ethernet connector

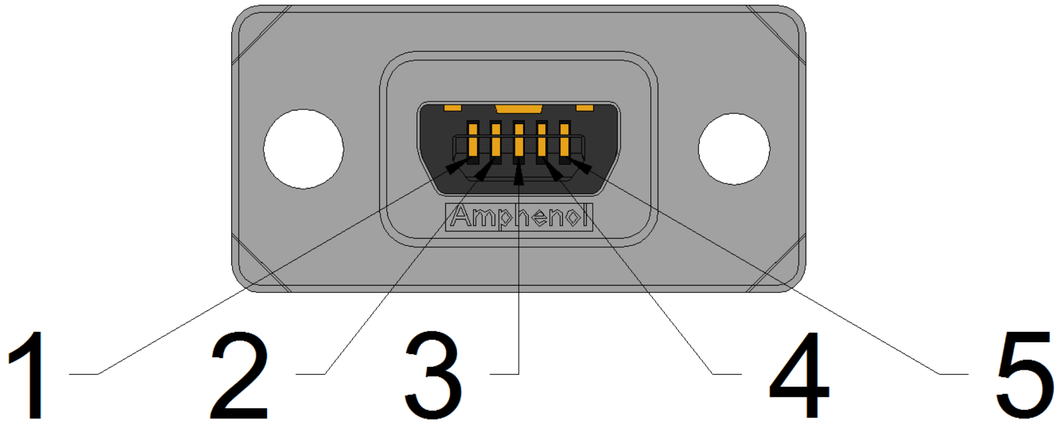
This is an 8-pin RJ45 connector.



Pin	Usage
1	R-, PoE Mode_A DC+
2	R+, PoE Mode_A DC+
3	T-, PoE Mode_A DC-
4	PoE Mode_B DC+
5	PoE Mode_B DC+
6	T+, PoE Mode_A DC-
7	PoE Mode_B DC-
8	PoE Mode_B DC-

USB Mini-B connector

This is a 5-pin USB mini-B connector.

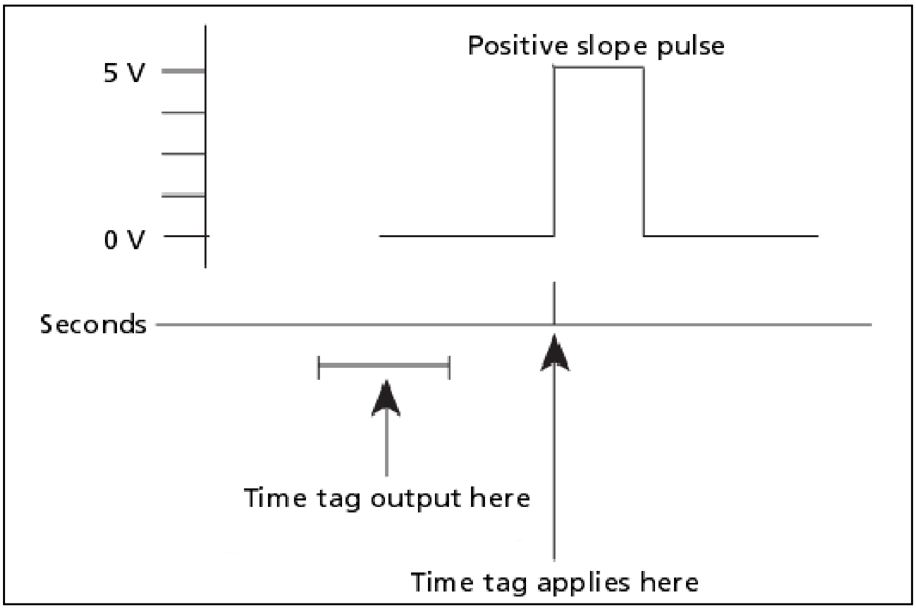


Pin	Usage
1	VCC (+5 V DC)
2	Data -
3	Data +
4	USB OTG ID
5	GND

1PPS and ASCII time tag

The receiver can output a 1 pulse-per-second (1PPS) time strobe and an associated time tag message. The time tags are output on a user-selected port.

The leading edge of the pulse coincides with the beginning of each UTC second. The pulse is driven between nominal levels of 0.0 V and 5.0 V (see the following figure). The leading edge is positive, rising from 0 V to 5 V.



The pulse is about 8 microseconds wide, with rise and fall times of about 100 nsec. Resolution is approximately 40 nsec, but the following antenna cable length limits accuracy to approximately ±1 microsecond. Each meter of cable adds a delay of about 2 nsec to satellite signals, and a corresponding delay in the 1PPS pulse.

1PPS is available on pin 4 of Lemo PORT 4.

Trimble P/N 36451-02 can be used as breakout box for the 1 PPS out and Event marker input.

Event marker input

Use event marker input to log a precise GNSS time tag whenever an externally generated pulse is received, such as one generated at the time of the shutter closing from a photogrammetric camera.

The event is triggered when the source pulse voltage transitions between 1.0 V DC and 2.0 V DC in less than 100 nsec. Trimble recommends that you use TTL level inputs, 0 - 5 V. You can configure the receiver to recognize either a positive (rising) or negative (falling) voltage as the leading edge of a pulse. The accuracy of the associated time tag recorded for an event is determined by the GPS accuracy (typically less than 1 µsec.).

The receiver records each event in the current data file. This record includes the port on which the event was received.

The maximum voltage on the event marker input is 6 V. Input impedance is 1 KΩ.

The Event Marker Input is available on pin 5 of Lemo PORT 4.

Trimble P/N 36451-02 can be used as breakout box for the 1PPS out and event marker input.

ASCII time tag

Each time tag is output about 0.5 second before the corresponding pulse. Time tags are in ASCII format on a user-selected serial port. The format of a time tag is:

```
UTC yy.mm.dd hh:mm:ss ab
```

Where:

Value	Description
UTC	Fixed text.
yy.mm.dd	Year, month, and date.
hh:mm:ss	Hour (on a 24-hour clock), minute, and second. The time is in UTC, not GPS.
a	An integer number representing the position-fix type: 1 = time only 2 = 1D & time 3 = currently unused 4 = 2D & time 5 = 3D & time
b	The number of GPS satellites being tracked.

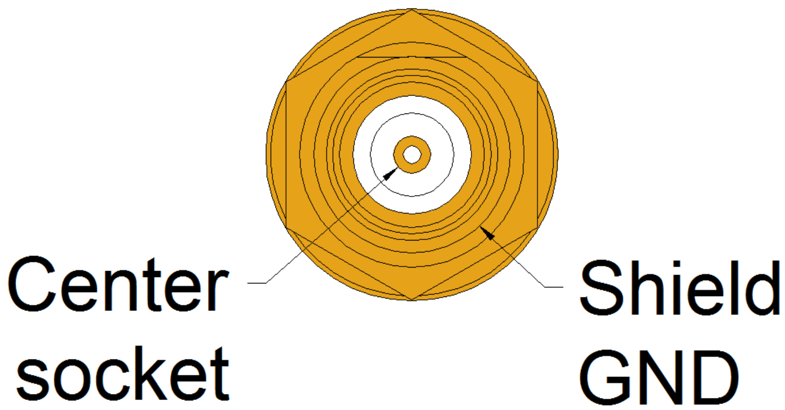
Each time tag is terminated by a carriage return, line feed sequence. A typical printout looks like:

```
UTC 02.12.21 20:21:16 56
UTC 02.12.21 20:21:17 56
UTC 02.12.21 20:21:18 56
```

NOTE – If the receiver is not tracking satellites, the time tag is based on the receiver clock. In this case, a and b are represented by "??". The time readings from the receiver clock are less accurate than time readings determined from the satellite signals.

TNC GNSS antenna connector

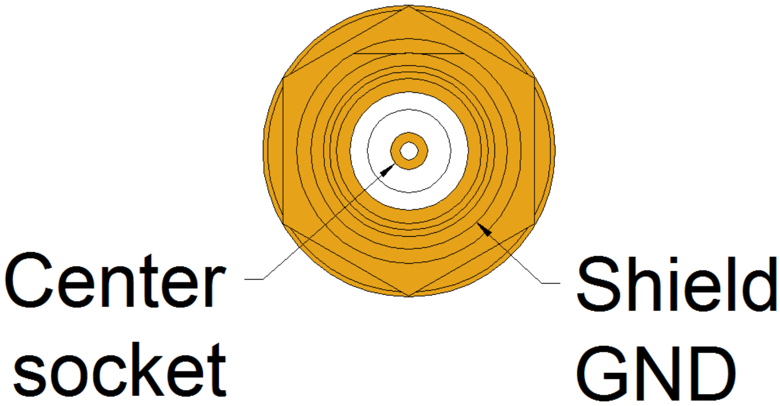
This is a TNC socket coaxial cable connector.



Pin	Usage
Center socket	Antenna supply voltage Antenna LNA setting: "Narrow Band" 7.5 V DC @100 mA max Antenna LNA setting: "Wide Band" 5.5 V DC @140 mA max
Shield	GND

BNC external frequency input connector

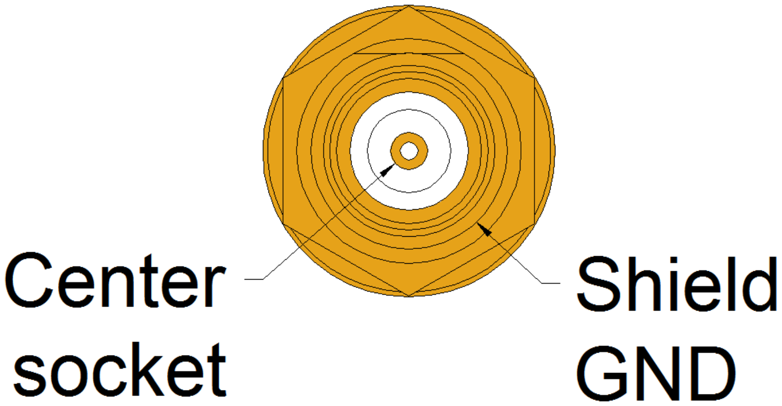
This is a BNC socket coaxial cable connector.



Pin	Usage
Center socket	10 MHz input signal: • Range, 0-+13 dBm (0.224 –1.0 V RMS into 50Ω), • Input impedance 50Ω @10 MHz, DC blocked, • Max input level +17 dBm, (1.58 V RMS into 50Ω), • Max input DC level, ±35 V DC.
Shield	GND

SMA-RP Wi-Fi connector

This is a SMA-RP (reversed polarity) plug coaxial cable connector.



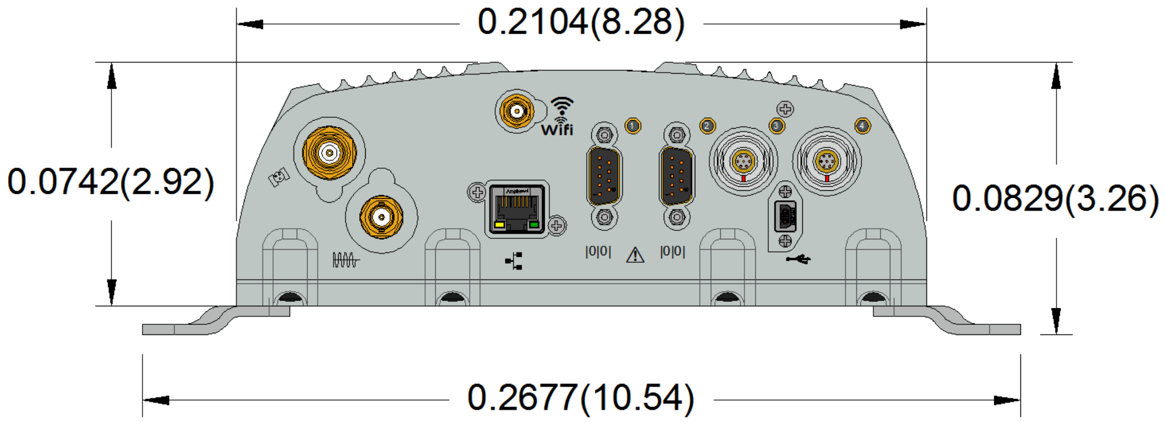
Pin	Usage
Center pin	Wi-Fi in/out Maximum output signal is +20 dBm or 100 mW into 50Ω
Shield	GND

Receiver dimensions

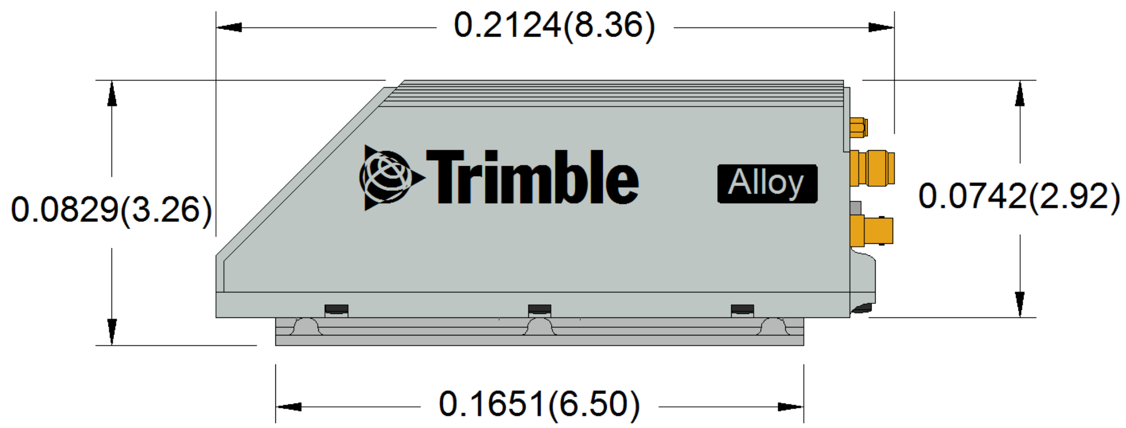
The drawings show the dimensions of the Alloy GNSS receiver. Refer to these drawings if you need to build mounting brackets and housings for the receiver.

The dimensions shown in these drawings are in inches. Dimensions in millimeters are shown in brackets.

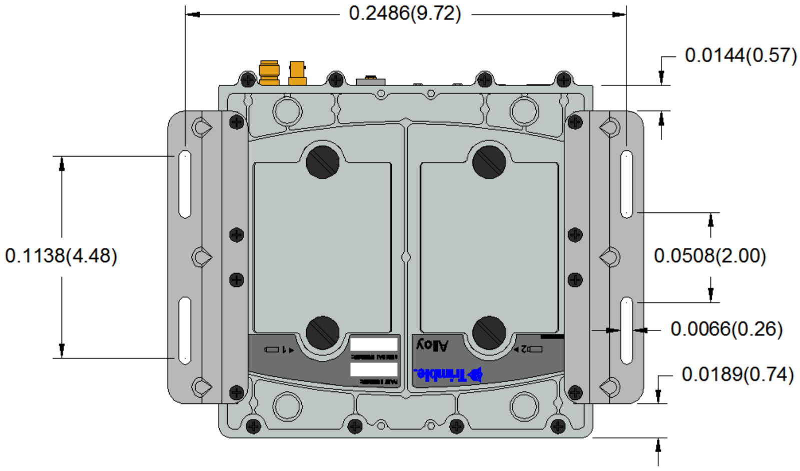
Back view



Side view



Bottom view


0.2486(9.72)
0.0144(0.57)
0.1138(4.48)
0.0508(2.00)
0.0066(0.26)
0.0189(0.74)
Alloy
Trimble.

Cables and accessories

- Power and data cable
- Event Marker/1 PPS cable
- Battery (P/N 109UPG-BATT)

Power and data cable

The following cable is available:

P/N 59044: Cable - 1.5m, DB9(F) Y to 0S/7P/M to Power Jack

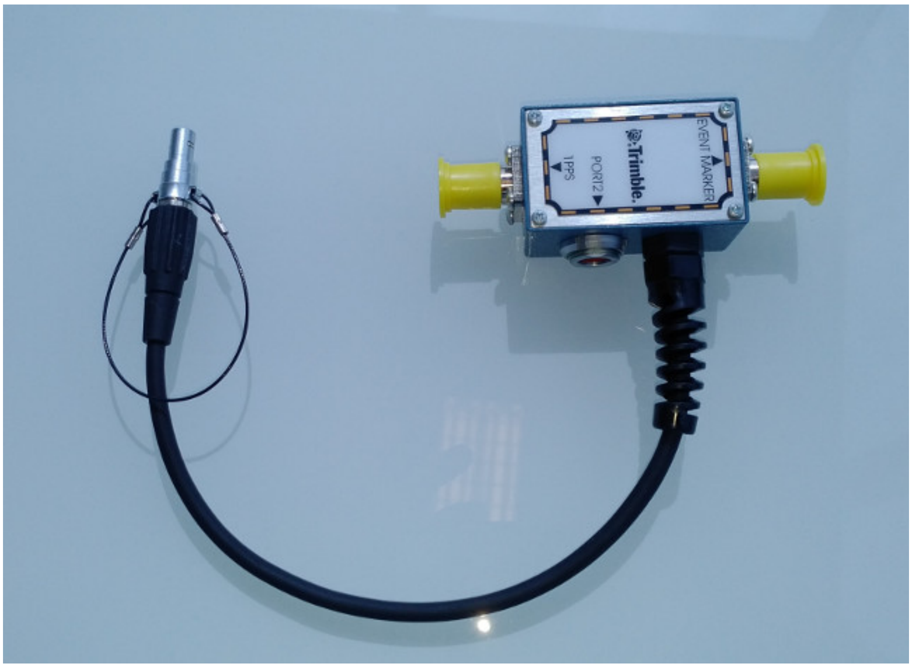
Used for power input to either of the port 3 or port 4 Lemo ports and data output.

Event Marker/1 PPS cable

The following cable is available:

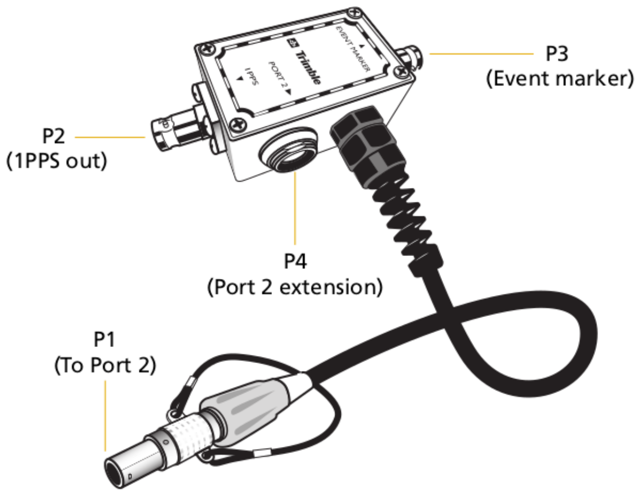
P/N 36451-02: Cable ASSY EVENT MARKER/1PPS

Used for power input to port 4, event marker in and 1 PPS output.



The event marker/1PPS cable provides a breakout box with two BNC (female) connectors for 1PPS input and event marker output.

Connect a device that accepts 1PPS output pulses to the BNC connector labeled 1PPS on the breakout box. Connect a device that outputs event marker pulses to the receiver, such as a photogrammetric camera, to the BNC connector labeled Event Marker on the breakout box.



In addition, the breakout box includes a Lemo 7-pin connector to extend serial communications and/or power on port 4. Because the BNC connectors are used to service the event marker and 1PPS features, pins 4 (1PPS) and 5 (Event Marker) are inactive on the Lemo connector.

For port 4 pinouts, see Lemo connectors (port 3 and 4).

The following pinouts are for the event marker/1PPS cable. The event marker/1PPS cable is used only with the receiver connector Port 4 (for event marker output).

Lemo port 4		Direction	P2: BNC-F connector 1PPS	P3: BNC-F connector (event marker)	P4: Lemo 7-pin port 4 extensions	
Pin	Usage		Pin	Pin	Pin	Usage
1	RS232 GND	←			1	RS232 GND
2	GND	→	GND (shield)	GND (shield)	2	GND
3	Data out	←			3	Data out
4	1 PPS	←	Center pin		4	No connection
5	Event marker	←→		Center pin	5	No connection
6	Pwr In +	→			6	Pwr In +
7	Data In	←			7	Data In

Battery (P/N 109UPG-BATT)

The Alloy receiver is shipped with one internal rechargeable Lithium-ion battery, but the receiver can fit two batteries. A second battery can be ordered from your Trimble dealer. Each battery provides six to seven hours GNSS operation. The battery run time depends on the usage of the receiver's tracking, logging, and other power consumption options; results will vary. The life of the battery also depends on its usage.

7.4 V, 3700 mAh, 27.3 Wh:

For safety information, see Battery safety.

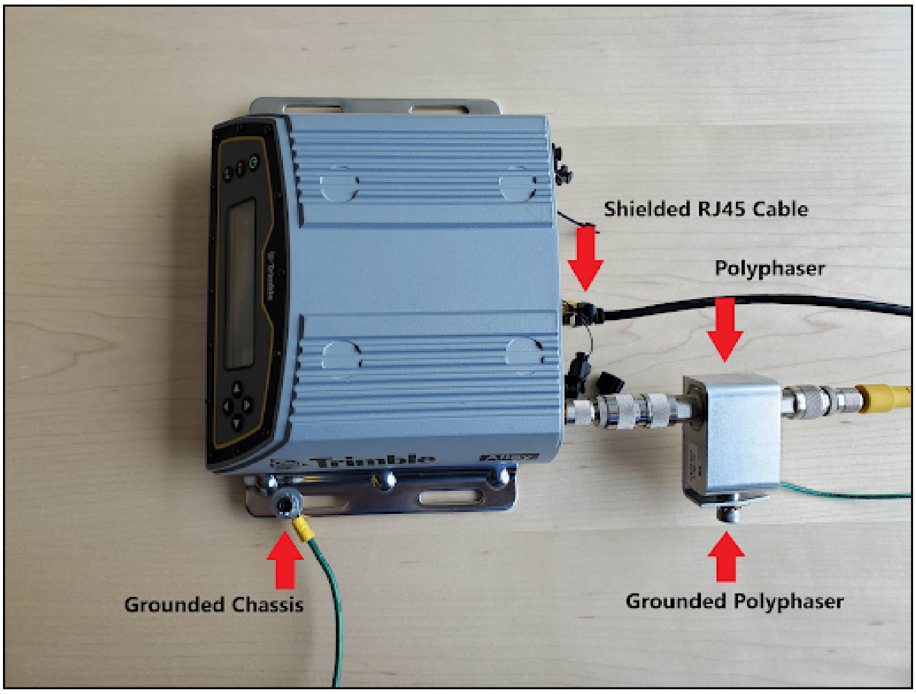
Environmental specifications

Trimble recommends using the Alloy receiver within the following environmental operating conditions.

Operating temperature	–40 °C to +65 °C (–40 °F to +149 °F) *NOTE – To protect the removable Lithium-ION batteries from extreme temperatures, the internal battery charger only charges batteries from –20 °C to +50 °C (–4 °F to +122 °F).*
Storage temperature	–40 °C to +80 °C (–40 °F to +176 °F)
Humidity	100% condensing
Shock	
Operating	40 g per MIL-STD-810G Table 5.16.6-VII
Non-operating	75 g per MIL-STD-810G Table 5.16.6-VII
	Designed to survive 1 m bench drop
Vibration	
Operating	MIL-STD-810G Fig. 5.14.6C-1 Category 4
Ingress protection	IP68 Certified per IEC-60529 - waterproof/dustproof (1 m submersion for 1 hr)

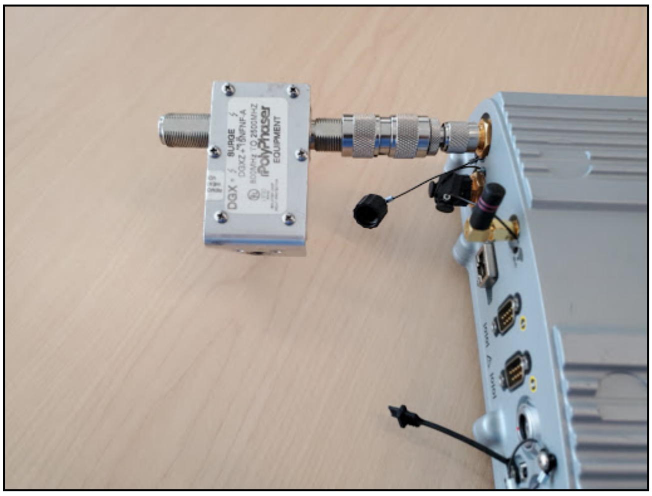
Lightning protection

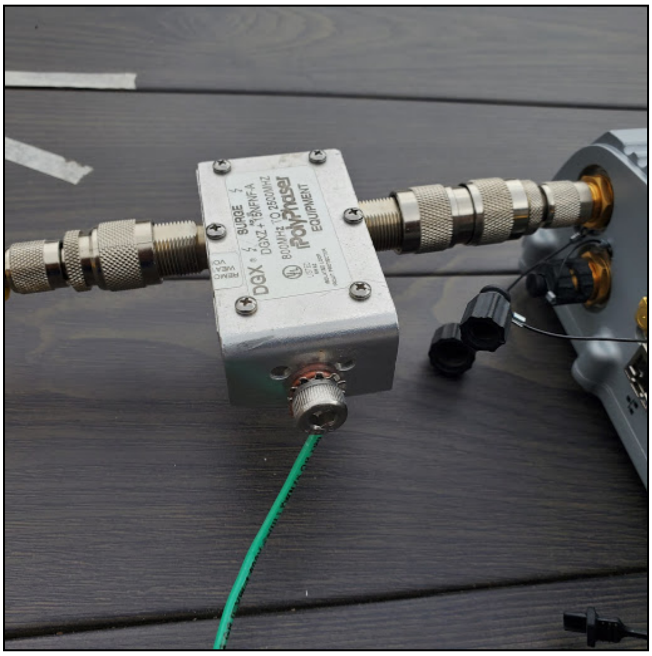
The Alloy receiver needs the following parts and areas to be grounded to prevent, or limit, the damage sustained from electrical surges and lightning strikes:



Trimble recommends installing lightning and surge protection equipment to protect GNSS receivers on all permanent sites as follows:

1. Install lightning protection for the GNSS antenna coaxial input. Trimble recommends P/N 187642 - Polyphaser DGXZ + 15NFNF-A. The SURGE side of the lightning suppressor *must* be connected to the cable going to the GNSS antenna. The EQUIPMENT-PROTECTION side connector *must* be connected to the GNSS receiver.

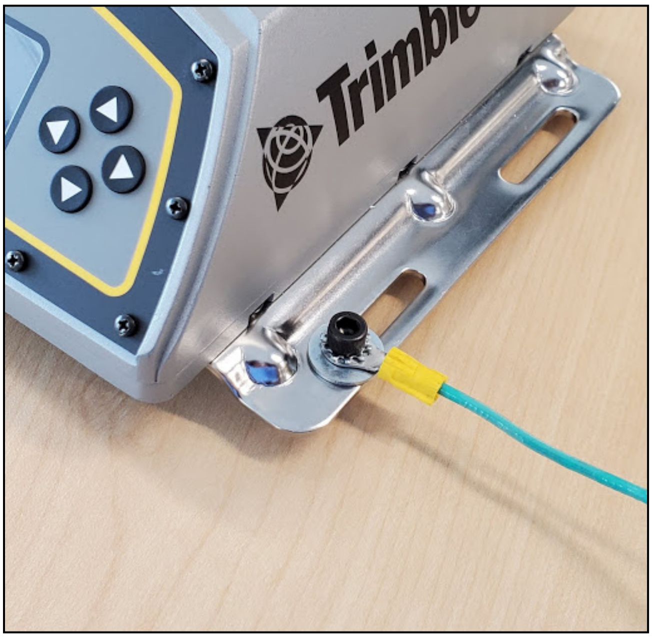




2. Connect the Polyphaser body to earth ground per the Polyphaser installation instructions.

3. To protect the Ethernet port from power surges and RF noise, ensure that you use a Shielded RJ45 cable:

4. The Alloy chassis needs to be grounded. The recommended grounding method is by connecting a grounded wire to a mounting screw and mounting rail. The receiver requires a ring terminal with a 14-AWG copper wire to secure to the primary ground, as shown:



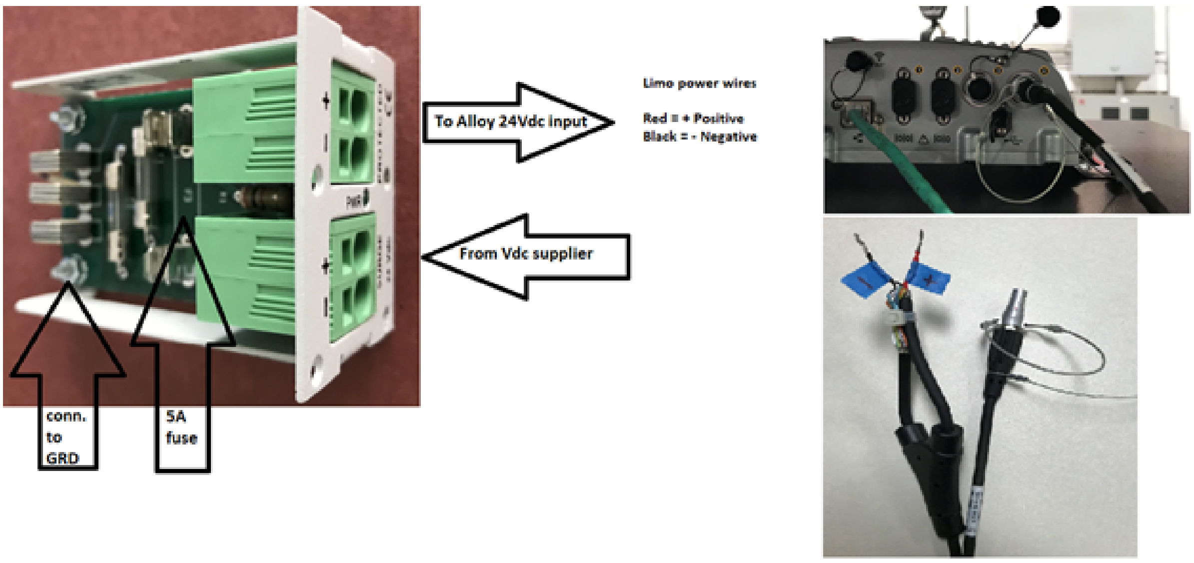
5. Trimble recommends installing a surge suppressor for the power line. If powering the Alloy receiver by DC voltage, the DC input requires additional surge protection input of 24 V DC (+/-). If you are using DC power, please see the NEBS recommendation on page 297.

NEBS (Network Equipment Building Systems)

If your receiver installation needs to follow the NEBS requirements and guidelines, please follow these guidelines to be NEBS compliant.

DC power supply surge protection

The Alloy lemo cable must be connected to a Transtector V DC power surge protector. Trimble recommends that in-line lightning arrestors are mounted on a low impedance ground at the point where the cable enters the building. The NEBS compliance is based on the following Transtector V DC power surge protector (P/N1000-1464) at www.transtector.com/dc-surge-protector-spd-cpx-indoor-module-1000-1464. See the following drawing for more information.



NOTE – The Alloy receiver can operate from +9.5 V DC to +28.0 V DC at a maximum current level of 4.7 A, the DC input is reverse polarity protected. Reversing polarity with 24 V DC options does not cause damage to the device.

NOTE – The power cable should be routed separately from the data (signal) cables.

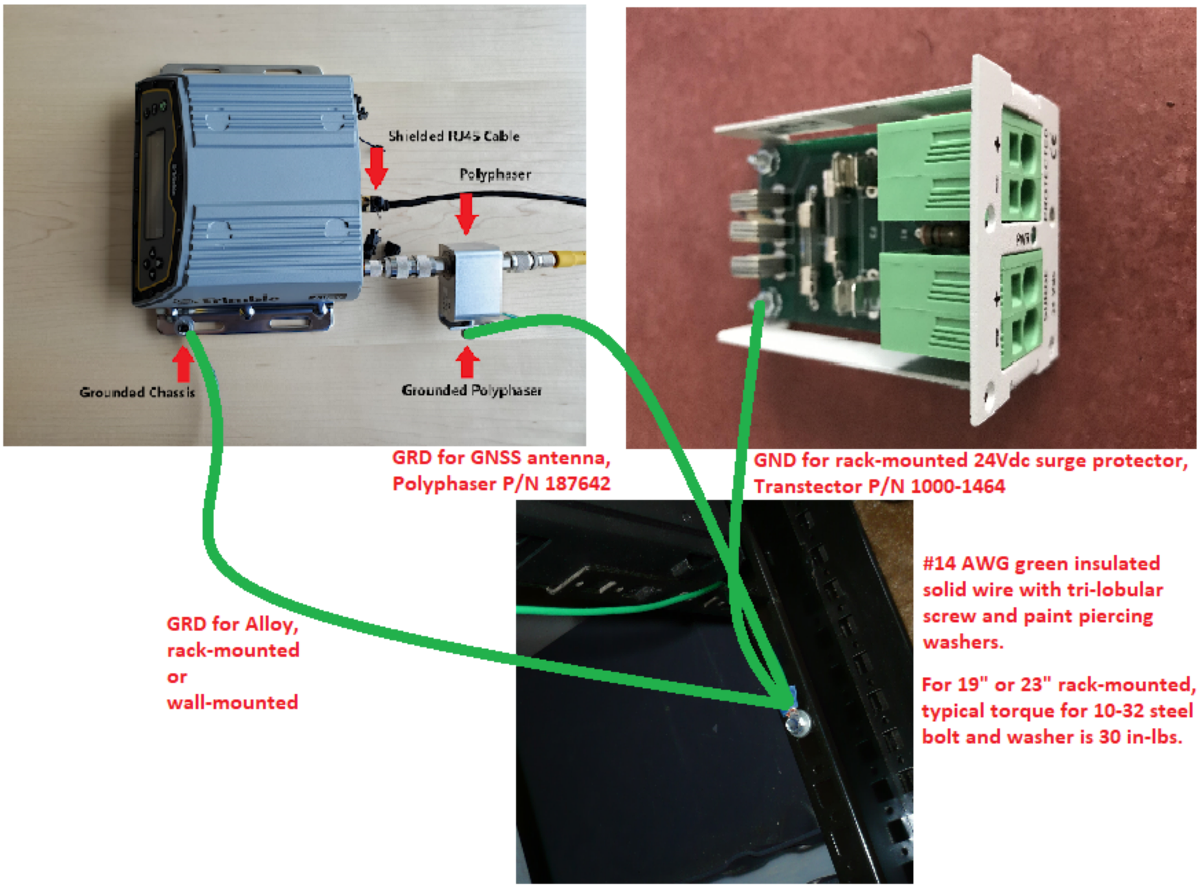
The intra-building ports of the equipment or sub-assembly are suitable for connection to intra-building or unexposed wiring or cabling-only of the intra-building port(s) of the equipment or sub-assembly. The intra-building ports ***must not*** be metallically connected to interfaces that connect to the OSP or its wiring. These interfaces are designed for use as intra-building interfaces only (Type 4 or 4a ports as described in *GR-1089: Electromagnetic Compatibility and Electrical Safety*) and require isolation from the exposed OSP cabling with the addition of primary protectors.

Grounding the Alloy receiver for NEBS compliance

The receiver must be grounded via a copper ground conductor, and the device must be installed and connected to the common bonding network (CBN). The receiver DC power returns need to be treated as DC-I (Isolated from Frame Ground). The receiver is suitable for connection to the CO and CPE. For security reasons, the receiver must be located in a restricted access location where only trained service personnel can access.

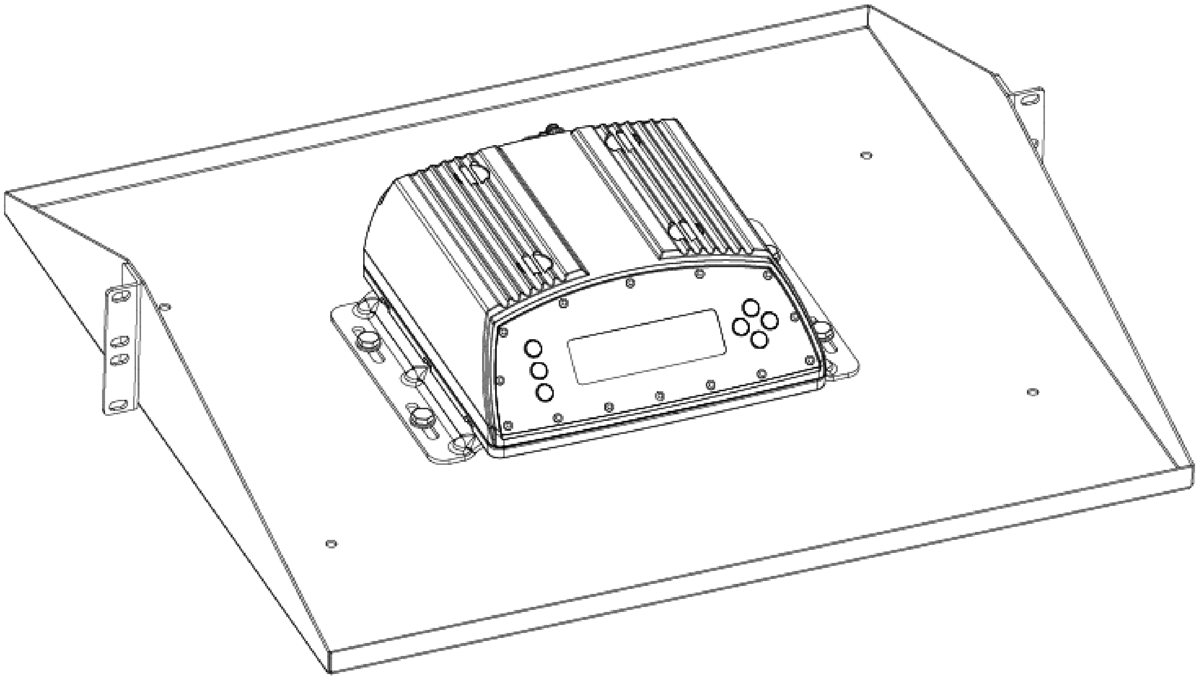
Before connections are made, all bare grounding connection points to the receiver must be cleaned and coated with an anti-oxidant solution. Trimble recommends the surfaces on the receiver that are unplated should be brought to a bright finish and treated with an anti-oxidant solution before a connection is made with the antenna cable, lemo cable, RJ45 cable, and any other required connections.

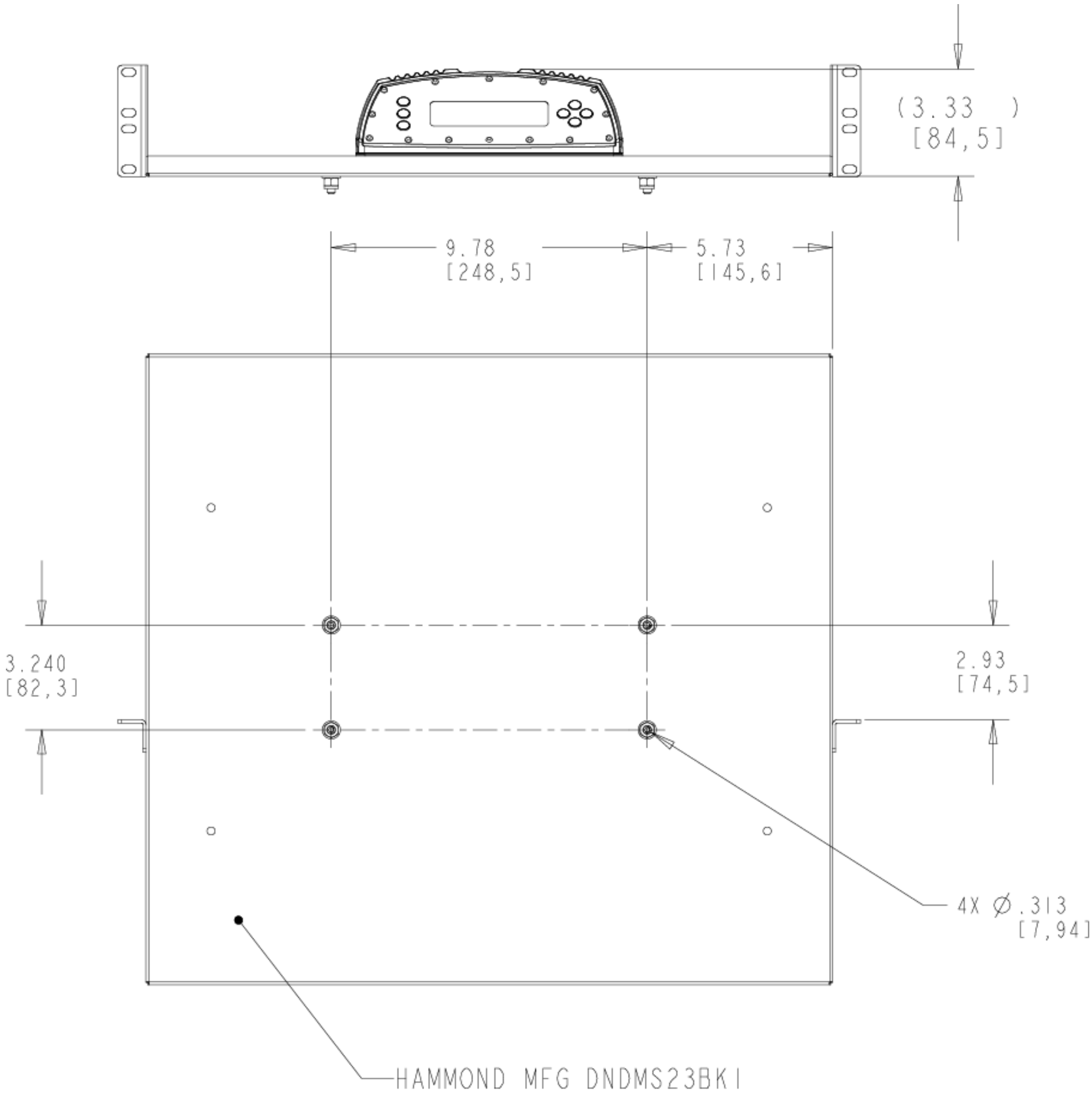
All non-conductive surfaces on the receiver will be removed from all threads and connection points to ensure electrical continuity. The GNSS antenna cable and RJ45 cable need to be inspected for breaks in the outer shield before installation.



Mounting the Alloy receiver to a rack for NEBS compliance

Trimble recommends that the receiver is either wall-mounted or rack-mounted to decrease the chances of the receiver being harmed or out of commission during an earthquake or other disaster. Trimble recommends that the receiver is installed in an environmentally-controlled cabinet with an EIA standard 19-inch or 23-inch mounting rack, for example, www.rackmountsolutions.net/hammond-dndms23bk1-23-2u-centered-2-post-rack-shelf/.





Hardware	Quantity
1/2-20 x .75 or M6 x 18 hex head bolt stainless steel (A2)	4
1/4 or M6 flat washer stainless steel (A2)	8
1/4-20 or M6 nylon insert locking nut stainless steel (A2)	4

NOTE – Keep one rack-unit of space (1.75 in) empty above the device, which allows a small amount of convectional airflow. Forced airflow is not required.

5

Software Requirements

The Alloy receiver is compatible with the following Trimble software:

- Business Center software, version 4.10 or later
- Pivot™ platform, version 3.10.4 or later
- Trimble 4D Control™ software, version 4.6.3 or later

Glossary

1PPS	Pulse-per-second. Used in hardware timing. A pulse is generated in conjunction with a time stamp. This defines the instant when the time stamp is applicable.
Almanac	A file that contains orbit information on all the satellites, clock corrections, and atmospheric delay parameters. The almanac is transmitted by a GNSS satellite to a GNSS receiver, where it facilitates rapid acquisition of GNSS signals when you start collecting data, or when you have lost track of satellites and are trying to regain GNSS signals. The orbit information is a subset of the ephemeris/ephemerides data.
anti-spoofing	GNSS signal spoofing is an increasing concern. The latest Alloy firmware implements various mitigation techniques to detect and eliminate spoofing. The detection techniques are a combination of signal processing and navigation filter updates. If the receiver detects it is tracking a spoofed signal, it attempts to find the correct signal from the satellite and relock the channel. If it is unable to identify the correct signal, it sets the RAIM flag for the satellite in the streamed data observable data and eliminates it from the position solution. Disclaimer: While new GNSS anti-spoofing feature is a vast improvement, no anti-spoofing feature can guarantee full protection of spoofing or location hacking.
Base station	Also called *reference station*. In construction, a base station is a receiver placed at a known point on a jobsite that tracks the same satellites as an RTK rover, and provides a real-time differential correction message stream through radio to the rover, to obtain centimeter level positions on a continuous real-time basis. A base station can also be a part of a virtual reference station network, or a location at which GNSS observations are collected over a period of time, for subsequent postprocessing to obtain the most accurate position for the location.

BeiDou	The BeiDou Navigation Satellite System (also known as BDS) is a Chinese satellite navigation system. The first BeiDou system (known as BeiDou-1), consists of four satellites and has limited coverage and applications. It has been offering navigation services mainly for customers in China and from neighboring regions since 2000. The second generation of the system (known as BeiDou-2) consists of satellites in a combination of geostationary, inclined geosynchronous, and medium earth orbit configurations. It became operational with coverage of China in December 2011. However, the complete Interface Control Document (which specifies the satellite messages) was not released until December 2012. BeiDou-2 is a regional navigation service which offers services to customers in the Asia-Pacific region. The third generation of the system (known as Beidou-3) consists of 3 geostationary satellites, 3 geosynchronous, and 24 Medium Earth orbit (MEO) satellites. As of 2018, 15 Beidiou-3 satellites have been launched. The Chinese government plans on having Beidou-3 fully operational in 2020.
Broadcast server	An Internet server that manages authentication and password control for a network of VRS servers, and relays VRS corrections from the VRS server that you select.
Carrier	A radio wave having at least one characteristic (such as frequency, amplitude, or phase) that can be varied from a known reference value by modulation.
Carrier frequency	The frequency of the unmodulated fundamental output of a radio transmitter. The GPS L1 carrier frequency is 1575.42 MHz.
Carrier phase	Is the cumulative phase count of the GPS or GLONASS carrier signal at a given time.
Cellular modems	A wireless adapter that connects a laptop computer to a cellular phone system for data transfer. Cellular modems, which contain their own antennas, plug into a PC Card slot or into the USB port of the computer and are available for a variety of wireless data services such as GPRS.
Clock steering	When enabled, the receiver clock is steered to GPS system

	time rather than periodically introducing 1 ms steps and constraining the clock to ± 0.5 ms. Disabled by default; this setting does not affect performance.
CMR/CMR+	Compact Measurement Record. A real-time message format developed by Trimble for broadcasting corrections to other Trimble receivers. CMR is a more efficient alternative to RTCM.
CMRx	A real-time message format developed by Trimble for transmitting more satellite corrections resulting from more satellite signals, more constellations, and more satellites. Its compactness means more repeaters can be used on a site.
CMR ID	A unique identifier for the CMR message. It can be any value between 0 through 31.
CMR input filter	Shows whether or not CMR corrections are being used from a specific base station.
Code Diff	Code differential solution. Typically a single-frequency solution.
Constrained height	An external height constraint for the antenna position. The receiver will produce a height value within the constraints provided by the external application.
Covariance	A statistical measure of the variance of two random variables that are observed or measured in the same mean time period. This measure is equal to the product of the deviations of corresponding values of the two variables from their respective means.
Datum	Also called *geodetic datum*. A mathematical model designed to best fit the geoid, defined by the relationship between an ellipsoid and, a point on the topographic surface, established as the origin of the datum. World geodetic datums are typically defined by the size and shape of an ellipsoid and the relationship between the center of the ellipsoid and the center of the earth. Because the earth is not a perfect ellipsoid, any single datum will provide a better model in some locations than in others. Therefore, various datums have been established to suit particular regions. For example, maps in Europe are often based on the European datum of 1950 (ED-50). Maps in the United States

	are often based on the North American datum of 1927 (NAD-27) or 1983 (NAD-83). All GPS coordinates are based on the WGS-84 datum surface.
Deep discharge	Withdrawal of all electrical energy to the end-point voltage before the cell or battery is recharged.
DGPS	See real-time differential GPS.
Differential correction	Differential correction is the process of correcting GNSS data collected on a rover with data collected simultaneously at a base station. Because the base station is on a known location, any errors in data collected at the base station can be measured, and the necessary corrections applied to the rover data. Differential correction can be done in real-time, or after the data is collected by postprocessing.
Differential GPS	See real-time differential GPS.
DOP	Dilution of Precision. A measure of the quality of GNSS positions, based on the geometry of the satellites used to compute the positions. When satellites are widely spaced relative to each other, the DOP value is lower, and position precision is greater. When satellites are close together in the sky, the DOP is higher and GNSS positions may contain a greater level of error. PDOP (Position DOP) indicates the three-dimensional geometry of the satellites. Other DOP values include HDOP (Horizontal DOP) and VDOP (Vertical DOP), which indicate the precision of horizontal measurements (latitude and longitude) and vertical measurements respectively. PDOP is related to HDOP and VDOP as follows: $PDOP^2 = HDOP^2 + VDOP^2$.
Dual-frequency GPS	A type of receiver that uses both L1 and L2 signals from GPS satellites. A dual-frequency receiver can compute more precise position fixes over longer distances and under more adverse conditions because it compensates for ionospheric delays.
EGNOS	European Geostationary Navigation Overlay Service. A Satellite-Based Augmentation System (SBAS) that provides a free-to-air differential correction service for GNSS. EGNOS is

	the European equivalent of WAAS, which is available in the United States.
Elevation	The vertical distance from a geoid such as EGM96 to the antenna phase center. The geoid is sometimes referred to as Mean Sea Level.
Elevation mask	The angle below which the receiver will not track satellites. Normally set to 10 degrees to avoid interference problems caused by buildings and trees, atmospheric issues, and multipath errors.
Ellipsoid	An ellipsoid is the three-dimensional shape that is used as the basis for mathematically modeling the earth's surface. The ellipsoid is defined by the lengths of the minor and major axes. The earth's minor axis is the polar axis and the major axis is the equatorial axis.
EHT	Height above ellipsoid.
Ephemeris/ephemerides	A list of predicted (accurate) positions or locations of satellites as a function of time. A set of numerical parameters that can be used to determine a satellite's position. Available as broadcast ephemeris or as postprocessed precise ephemeris.
Epoch	The measurement interval of a GNSS receiver. The epoch varies according to the measurement type: for real-time measurement it is set at one second; for postprocessed measurement it can be set to a rate of between one second and one minute. For example, if data is measured every 15 seconds, loading data using 30-second epochs means loading every alternate measurement.
Feature	A feature is a physical object or event that has a location in the real world, which you want to collect position and/or descriptive information (attributes) about. Features can be classified as surface or non-surface features, and again as points, lines/break lines, or boundaries/areas.
Firmware	The program inside the receiver that controls receiver operations and hardware.
Galileo	Galileo is a GNSS system built by the European Union and the European Space Agency. It is complimentary to GPS and GLONASS.

Geoid	The geoid is the equipotential surface that would coincide with the mean ocean surface of the Earth. For a small site this can be approximated as an inclined plane above the Ellipsoid.
GHT	Height above geoid.
GLONASS	Global Orbiting Navigation Satellite System. GLONASS is a Soviet space-based navigation system comparable to the American GPS system. The operational system consists of 21 operational and 3 non-operational satellites in 3 orbit planes.
GNSS	Global Navigation Satellite System.
GPS	Global Positioning System. GPS is a space-based satellite navigation system, owned by the United States government, consisting of multiple satellites in six orbit planes.
GSOF	General Serial Output Format. A Trimble proprietary message format.
HDOP	Horizontal Dilution of Precision. HDOP is a DOP value that indicates the precision of horizontal measurements. Other DOP values include VDOP (vertical DOP) and PDOP (Position DOP). Using a maximum HDOP is ideal for situations where vertical precision is not particularly important, and your position yield would be decreased by the vertical component of the PDOP (for example, if you are collecting data under canopy).
Height	The vertical distance above the ellipsoid. The classic ellipsoid used in GPS is WGS-84.
IBSS	Internet Base Station Service. This Trimble service makes the setup of an Internet-capable receiver as simple as possible. The base station can be connected to the Internet (cable or wirelessly). To access the distribution server, the user enters a password into the receiver. To use the server, the user must have a Trimble Connected Community site license.
IRNSS	The Indian Regional Navigation Satellite System (IRNSS) with an operational name of NAVIC ("sailor" or "navigator" in Sanskrit, Hindi and many other Indian languages, which also stands for NAVigation with Indian Constellation) is an autonomous regional satellite navigation system that provides accurate real-time positioning and timing services

L1	The primary L-band carrier used by GPS and GLONASS satellites to transmit satellite data.
L2	The secondary L-band carrier used by GPS and GLONASS satellites to transmit satellite data.
L2C	A modernized code that allows significantly better ability to track the L2 frequency.
L5	The third L-band carrier used by GPS satellites to transmit satellite data. L5 will provide a higher power level than the other carriers. As a result, acquiring and tracking weak signals will be easier.
Mountpoint	Every single Ntrip Source needs a unique mountpoint on an Ntrip Caster. Before transmitting GNSS data to the Ntrip Caster, the Ntrip Server sends an assignment of the mountpoint.
MSAS	MTSAT Satellite-Based Augmentation System. A Satellite-Based Augmentation System (SBAS) that provides a free-to-air differential correction service for GNSS. MSAS is the Japanese equivalent of WAAS, which is available in the United States.
Multipath	Interference, similar to ghosts on an analog television screen that occurs when GNSS signals arrive at an antenna having traversed different paths. The signal traversing the longer path yields a larger pseudorange estimate and increases the error. Multiple paths can arise from reflections off the ground or off structures near the antenna.
NavIC (IRNSS)	Navigation with Indian Constellation. Previously the Indian Regional Navigation Satellite System. An autonomous regional satellite navigation system that covers India and surrounding areas.
NMEA	National Marine Electronics Association. NMEA 0183 defines the standard for interfacing marine electronic navigational devices. This standard defines a number of 'strings' referred to as NMEA strings that contain navigational details such as positions. Most Trimble GNSS receivers can output positions as NMEA strings.
Ntrip Protocol	Networked Transport of RTCM via Internet Protocol (Ntrip) is an application-level protocol that supports streaming Global

	Navigation Satellite System (GNSS) data over the Internet. Ntrip is a generic, stateless protocol based on the Hypertext Transfer Protocol (HTTP). The HTTP objects are extended to GNSS data streams.
Ntrip Caster	The Ntrip Caster is basically an HTTP server supporting a subset of HTTP request/response messages and adjusted to low-bandwidth streaming data. The Ntrip Caster accepts request messages on a single port from either the Ntrip Server or the Ntrip Client. Depending on these messages, the Ntrip Caster decides whether there is streaming data to receive or to send. Trimble Ntrip Caster integrates the Ntrip Server and the Ntrip Caster. This port is used only to accept requests from Ntrip Clients.
Ntrip Client	An Ntrip Client will be accepted by and receive data from an Ntrip Caster, if the Ntrip Client sends the correct request message (TCP/UDP connection to the specified Ntrip Caster IP and listening port).
Ntrip Server	The Ntrip Server is used to transfer GNSS data of an Ntrip Source to the Ntrip Caster. An Ntrip Server in its simplest setup is a computer program running on a PC that sends correction data of an Ntrip Source (for example, as received through the serial communication port from a GNSS receiver) to the Ntrip Caster. The Ntrip Server - Ntrip Caster communication extends HTTP by additional message formats and status codes.
Ntrip Source	The Ntrip Sources provide continuous GNSS data (for example, RTCM-104 corrections) as streaming data. A single source represents GNSS data referring to a specific location. Source description parameters are compiled in the source-table.
OmniSTAR	The OmniSTAR HP/XP service allows the use of new generation dual-frequency receivers with the OmniSTAR service. The HP/XP service does not rely on local reference stations for its signal, but utilizes a global satellite monitoring network. Additionally, while most current dual-frequency GNSS systems are accurate to within a meter or so, OmniSTAR with XP is accurate in 3D to better than 30 cm.

Orthometric elevation	The Orthometric Elevation is the height above the geoid (often termed the height above the 'Mean Sea Level').
PDOP	Position Dilution of Precision. PDOP is a DOP value that indicates the precision of three-dimensional measurements. Other DOP values include VDOP (vertical DOP) and HDOP (Horizontal Dilution of Precision). Using a maximum PDOP value is ideal for situations where both vertical and horizontal precision are important.
Postprocessing	Postprocessing is the processing of satellite data after it is collected, in order to eliminate error. This involves using computer software to compare data from the rover with data collected at the base station.
QZSS	Quasi-Zenith Satellite System. A Japanese regional GNSS, eventually consisting of three geosynchronous satellites over Japan.
Real-time differential GPS	Also known as *real-time differential correction* or *DGPS*. Real-time differential GPS is the process of correcting GPS data as you collect it. Corrections are calculated at a base station and then sent to the receiver through a radio link. As the rover receives the position it applies the corrections to give you a very accurate position in the field. Most real-time differential correction methods apply corrections to code phase positions. While DGPS is a generic term, its common interpretation is that it entails the use of single-frequency code phase data sent from a GNSS base station to a rover GNSS receiver to provide submeter position . The rover receiver can be at a long range (greater than 100 kms (62 miles)) from the base station.
Rover	A rover is any mobile GNSS receiver that is used to collect or update data in the field, typically at an unknown location.
Roving mode	Roving mode applies to the use of a rover receiver to collect data, stakeout, or control machinery in real time using RTK techniques.
RTCM	Radio Technical Commission for Maritime Services. A commission established to define a differential data link for the real-time differential correction of roving GNSS receivers.

	There are three versions of RTCM correction messages. All Trimble GNSS receivers use Version 2 protocol for single-frequency DGPS type corrections. Carrier phase corrections are available on Version 2, or on the newer Version 3 RTCM protocol, which is available on certain Trimble dual-frequency receivers. The Version 3 RTCM protocol is more compact but is not as widely supported as Version 2.
RTK	Real-time kinematic. A real-time differential GPS method that uses carrier phase measurements for greater .
SBAS	Satellite-Based Augmentation System. SBAS is based on differential GPS, but applies to wide area (WAAS, EGNOS, MSAS, and GAGAN) networks of reference stations. Corrections and additional information are broadcast using geostationary satellites.
Signal-to-noise ratio	SNR. The signal strength of a satellite is a measure of the information content of the signal, relative to the signal's noise. The typical SNR of a satellite at 30° elevation is between 47 and 50 dB-Hz.
skyplot	The satellite skyplot confirms reception of a differentially corrected GNSS signal and displays the number of satellites tracked by the GNSS receiver, as well as their relative positions.
SNR	See signal-to-noise ratio.
Source-table	The Ntrip Caster maintains a source-table containing information on available Ntrip Sources, networks of Ntrip Sources, and Ntrip Casters, to be sent to an Ntrip Client on request. Source-table records are dedicated to one of the following: • data STReams (record type STR) • CASters (record type CAS) • NETworks of data streams (record type NET) All Ntrip Clients must be able to decode record type STR. Decoding types CAS and NET is an optional feature. All data fields in the source-table records are separated using the semicolon character.
Triple-frequency GPS	A type of receiver that uses three carrier phase measurements (L1, L2, and L5).

UTC	Universal Time Coordinated. A time standard based on local solar mean time at the Greenwich meridian.
xFill	Trimble xFill® is a service that extends RTK positioning for several minutes when the RTK correction stream is temporarily unavailable. The Trimble xFill service improves field productivity by reducing downtime waiting to re-establish RTK corrections in black spots. It can even expand productivity by allowing short excursions into valleys and other locations where continuous correction messages were not previously possible. Proprietary Trimble xFill corrections are broadcast by satellite and are generally available globally where the GNSS constellations are also visible. It applies to any positioning task being performed with a single-base, Trimble Internet Base Station Service (IBSS), or VRS RTK correction source.
VRS	Virtual Reference Station. A VRS system consists of GNSS hardware, software, and communication links. It uses data from a network of base stations to provide corrections to each rover that are more accurate than corrections from a single base station. To start using VRS corrections, the rover sends its position to the VRS server. The VRS server uses the base station data to model systematic errors (such as ionospheric noise) at the rover position. It then sends RTCM correction messages back to the rover.
WAAS	Wide Area Augmentation System. WAAS was established by the Federal Aviation Administration (FAA) for flight and approach navigation for civil aviation. WAAS improves the accuracy and availability of the basic GNSS signals over its coverage area, which includes the continental United States and outlying parts of Canada and Mexico. The WAAS system provides correction data for visible satellites. Corrections are computed from ground station observations and then uploaded to two geostationary satellites. This data is then broadcast on the L1 frequency, and is tracked using a channel on the GNSS receiver, exactly like a GNSS satellite. Use WAAS when other correction sources are unavailable, to obtain greater accuracy than autonomous positions. For more information on WAAS, refer to the FAA website at

	http://gps.faa.gov. The EGNOS service is the European equivalent and MSAS is the Japanese equivalent of WAAS.
WGS-84	World Geodetic System 1984. Since January 1987, WGS-84 has superseded WGS-72 as the datum used by GPS. The WGS-84 datum is based on the ellipsoid of the same name.