



USER GUIDE

Trimble® NetR9™ GNSS Reference Receiver



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Trimble® NetR9™ GNSS Reference Receiver

Version 4.15
Revision A
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Corporate Office

Survey Business Area
Trimble Navigation Limited
Survey Business Area
5475 Kellenburger Road
Dayton, Ohio 45424-1099
USA

800-538-7800 (toll free in USA)
+1-937-245-5600 Phone
+1-937-233-9004 Fax
www.trimble.com

Email: trimble_support@trimble.com

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Release Notice

This is the January 2010 release (Revision A) of the NetR9 GNSS reference receiver User Guide. It applies to version 4.15 of the NetR9 GNSS reference receiver firmware.

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- proof of purchase
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- an explanation of the problem.

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WARRANTIES ARE OBTAINED FROM THE LOCAL DISTRIBUTOR. IN SUCH CASE, PLEASE CONTACT YOUR TRIMBLE DEALER FOR APPLICABLE WARRANTY INFORMATION.

Registration

To receive information regarding updates and new products, please contact your local dealer or visit the Trimble website at www.trimble.com/register. Upon registration you may select the newsletter, upgrade or new product information you desire.

Notices

Class B Statement - Notice to Users. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes and modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commission rules.

Canada

This 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-310 and RSS-210. Cet appareil est conforme à la norme CNR-310 et CNR-210 du Canada.

Europe

This product is intended to be used in all EU member countries.

This product has been tested and found to comply with the requirements for a Class B device pursuant to European Council Directive 89/336/EEC on EMC, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA).

Contains Infineon radio module PBA 31307. These requirements are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential or commercial environment.



Australia and New Zealand

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



Taiwan - Battery Recycling Requirements

The product contains a removable Lithium-ion battery.



Taiwanese regulations require that waste batteries are recycled.

廢電池請回收

Directive 1999/5/EC

Hereby, Trimble Navigation, declares that the NetR9 GNSS Reference receiver is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

Notice to Our European Union Customers

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



Recycling in Europe: To recycle Trimble WEEE (Waste Electrical and Electronic Equipment, products that run on electrical power), Call +31 497 53 24 30, and ask for the "WEEE Associate". Or, mail a request for recycling instructions to:

Trimble Europe BV
c/o Menlo Worldwide Logistics
Meerheide 45
5521 DZ Eersel, NL

Declaration of Conformity

We, Trimble Navigation Limited,
935 Stewart Drive
PO Box 3642
Sunnyvale, CA 94088-3642
United States
+1-408-481-8000

declare under sole responsibility that the product:
NetR9

complies with Part 15 of FCC Rules.

Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

Safety Information

Before you use your Trimble® NetR9™ GNSS reference receiver, make sure that you have read and understood all safety requirements.

Regulations and safety

The receiver contains an internal radio-modem for communicating signals through Bluetooth® wireless technology or through an external data communications radio. Regulations regarding the use of the 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 NetR9 GNSS reference receiver, 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, see page 3](#).

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 as a result of its actions in General Docket 79-144 on 13 March 1986. Proper use of this radio modem results in exposure below government limits. The following precautions are recommended:

- **Do not** operate the transmitter when someone is 20 cm (7.8 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 is far below the FCC radio frequency exposure limits. Nevertheless, the wireless radio shall be used in such a manner that the Trimble receiver is 20 cm (7.9 inch) or further from the human body. The internal wireless radio operates within guidelines found in radio frequency safety standards and recommendations, which reflect the consensus of the scientific community. Trimble therefore believes the internal wireless radio is 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.

Battery safety



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.
-



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.
-

Power over Ethernet safety



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



WARNING – When this receiver is connected to a PoE connection, the DC voltage must be limited to no more than 57 V DC +0% under both normal and single fault conditions. If the recommended input voltage is exceeded, the receiver may present an electrical hazard.

DC power supply safety



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 location safety



WARNING – This receiver is not intended to be used in a wet location, or a location that may become wet, when it is powered by the PoE interface, or by the external DC power supply. Use the receiver in a wet location **only** when operating it on its own internal battery.



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.

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Introduction

In this chapter:

- About the receiver
- Related information
- Technical support
- Your comments

The *NetR9 GNSS Reference Receiver User Guide* describes how to set up and use the Trimble® NetR9™ GNSS reference receiver.

In this manual, “the receiver” refers to the NetR9 GNSS reference receiver unless otherwise stated.

Even if you have used other Global Navigation Satellite Systems (GNSS) products before, Trimble recommends that you spend some time reading this manual to learn about the special features of this product. If you are not familiar with GNSS, go to www.trimble.com for an interactive look at Trimble and GNSS.

About the receiver

The NetR9 GNSS reference receiver (“the receiver”) is a multiple-frequency GNSS receiver. It can track all GPS (L1/L2/L5) as well as GLONASS (L1/L2) signals.

You can use the front panel of the receiver or an office computer to configure the receiver, access files, and publish data files to a company Intranet or to the Internet. The receiver makes it easy for you to set up a powerful, flexible, and reliable reference station for continuous operation.

The receiver serves in all common geodetic reference receiver roles. It can be the main component in a Continuously Operating Reference Station (CORS), streaming data to Trimble GNSS Infrastructure software. It can also work well as a campaign receiver prior to permanent deployment. The receiver makes an excellent portable RTK base station with its internal battery. It also has specialized capabilities that make it an excellent reference receiver for scientific applications.

Related information

Sources of related information include the following:

- Release notes: The release notes describe new features of the product, information not included in the manuals, and any changes to the manuals. They are provided as a PDF file on the Trimble website.
- Trimble training courses: Consider a training course to help you use your GNSS system to its fullest potential.

For more information, go to www.trimble.com/training.html.

Technical support

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

If you need to contact Trimble technical support, complete the online inquiry form at www.trimble.com/support_form.asp.

Your comments

Your feedback about the supporting documentation helps us to improve it with each revision. Email your comments to ReaderFeedback@trimble.com.

Overview

In this chapter:

- Receiver framework
- Receiver services
- Receiver features
- Use and care
- Electronic interference
- COCOM limits
- Keypad and display
- Rear connectors

This chapter introduces the NetR9 GNSS reference receiver (“the receiver”). This receiver makes it easy to set up a powerful and reliable Continuously Operating Reference Station (CORS) or to collect data from temporary field locations.

The receiver is ideal for the following infrastructure applications:

- As part of a GNSS Infrastructure network in conjunction with Trimble GNSS Infrastructure software.
- As part of a permanent reference station with or without supporting software.
- A temporary field base station to broadcast RTK corrections and collect observations for postprocessing.
- As a scientific reference station collecting data for atmospheric or seismological studies.

Receiver framework

The receiver integrates the latest multi-frequency GNSS technology into a specialized processing and communications framework. The receiver can operate as a standalone reference station or it can be integrated into a scalable network.

With an Internet Protocol (IP) as the primary communications method, you can use public domain tools, such as a web browser and FTP client, to configure the receiver and access logged data files.

Note – All references to the Internet refer to either a Wide Area Network (WAN) or a Local Area Network (LAN) connection.

You can enforce multiple levels of security, from a completely open system that allows anonymous access to all features, to a secured system that requires a password protected login for configuration changes and/or file access.

Use the network management features to create a base configuration with a variety of operating modes. You can then enable those modes as necessary instead of switching the global state of the receiver from one mode to another. For example, you can configure a number of streaming services with different configurations (such as measurement intervals or smoothing controls) on different TCP or UDP ports. To activate one or more modes, open the connection to the specific port. This allows multiple clients to access any given streaming service.

These features and many more, shift the model of a GNSS receiver toward the concept of a "network appliance".

The network appliance concept

Traditionally, a GNSS receiver has one operator. That person is the only user of the receiver so they can change settings without affecting other users.

With the NetR9 GNSS reference receiver, an operator can configure a receiver once, and then make it available as a network appliance for general use by one or more users (or clients).

This network appliance concept lets you set up the receiver to provide one or more services that one or more users can access through a Local Area Network (LAN) or a Wide Area Network (WAN), such as the Internet. Once the receiver is set up, you need make only minimal changes, if any, to the receiver configuration.

When the receiver is operating as a network appliance, it provides services to all users attached to the receiver through the network.

Different streamed services may be configured on different ports, for example, with differing data rates or smoothing configurations. To obtain a service, the client has only to connect to a specific port. In this way, most users do not need to control the receiver. Changing global settings, such as masks, will affect all users of all services. However, the comprehensive set of controls that have been provided for streamed service and data logging configuration avoids global changes for the majority of applications.

The receiver provides the following standard configuration and data logging services:

Use...	To perform...
HTTP	all manual and automated configuration operations manual operations to manage the logged data file space
FTP	remote manual and/or automated operations to manage the logged data file space

Receiver services

The receiver can provide one or more streaming or query services over a RS-232 serial port or a TCP/IP port:

- Streaming service

Anyone with authorized access can obtain streamed information, such as GNSS measurements or RTCM corrections, without having to control or issue commands to the receiver. The client simply connects to the port that is streaming the required information. Normally the port should be set to Output only mode so multiple users can connect to receive correction data.

- Query service

This allows bi-directional communications between the receiver and another application. All ports act as query ports unless Output-only mode is selected. When Output-only mode is selected, it also means the receiver is more secure; especially if it is on the Internet. Multiple users can connect simultaneously to a single port as long as it is set to Output-only mode.

Multiple users can connect simultaneously to a single port as long as it is set to Output only mode.

Receiver features

- 440-channels
 - GPS: L1/L2/L2C/L5
 - GLONASS: L1 C/A and unencrypted P code, L2 C/A, and unencrypted P code
 - Galileo: GIOVE-A and GIOVE-B
 - SBAS: L1C/A and L5 supporting WAAS, EGNOS, and MSAS
 - L-Band: OmniSTAR VBS/HP/XP
- 8 GB on-board storage
- External USB drive support
- Integrated battery, provides over 15 hours operation

- Integrated display and keypad for system configuration without a controller
- Integrated Bluetooth wireless technology for cable-free configuration and operation
- Permanent/semi-permanent and mobile quick setup base station capability
- Easy-to-use Web-interface menu system for rapid configuration and status checking
- Ability to operate as a Rover Integrity receiver with Trimble Infrastructure software to allow monitoring of Trimble VRS™ network performance
- Rugged, weatherproof construction with an IP67 environmental rating
- -40 °C to +65 °C (-40 °F to +149 °F) operating temperature range
- 9.5 V to 28 V DC input power range, with over-voltage protection and configurable power-up and power-down settings
- Power over Ethernet (PoE) support
- Data files generated in T02, RINEX version 2.11, RINEX version 3.00, BINEX, and Google Earth files
- Tracking and storage rates of up to 50 Hz
- Eight independent data logging sessions with configurable memory pooling
- FTP and email push to allow uploading of logged data files to remote sites
- Email client to alert system users of any issues with the system
- Ethernet and reference station configuration through the front panel
- Multiple languages available through the Web interface and receiver front panel
- Ntrip (Networked Transport of RTCM via Internet Protocol) client/server/caster support

Use and care

This receiver can withstand the rough treatment and tough environment that typically occurs in CORS installation. However, it 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. For more information, see [Chapter 8, Specifications](#).

Electronic interference

High-power signals from a nearby radio or radar transmitter can overwhelm the receiver circuits. This does not harm the instrument, but it can prevent the receiver electronics from functioning correctly.

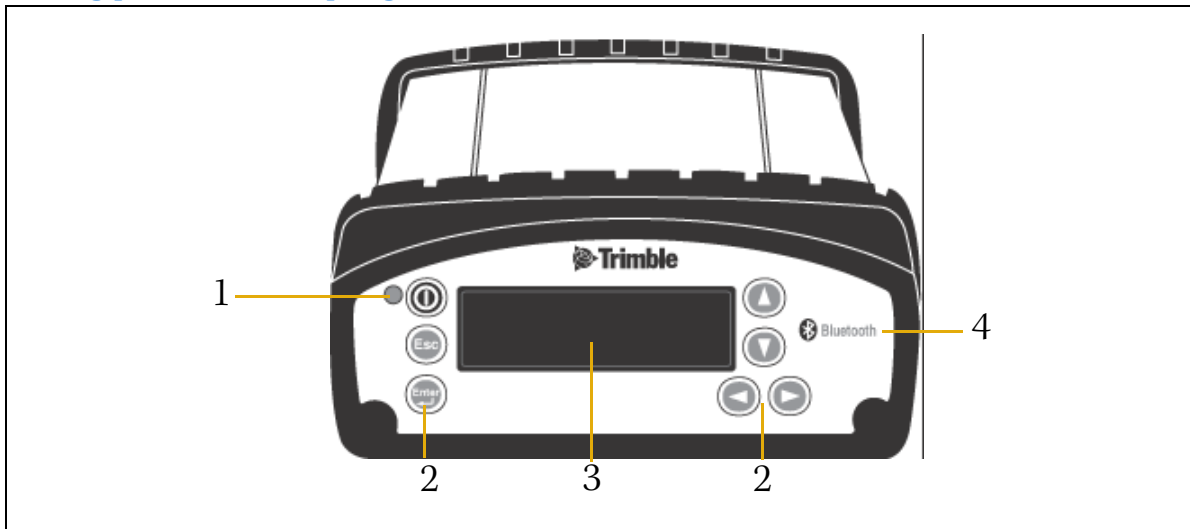
Avoid locating the receiver or antenna within 400 meters of powerful radar, television, or other transmitters or GNSS antennas. Low-power transmitters, such as those in cell phones and two-way radios, normally do not interfere with receiver operations.

COCOM limits

The U.S.A. Department of Commerce requires that all exportable GNSS products contain performance limitations so that they cannot be used in a manner that could threaten the security of the United States of America.

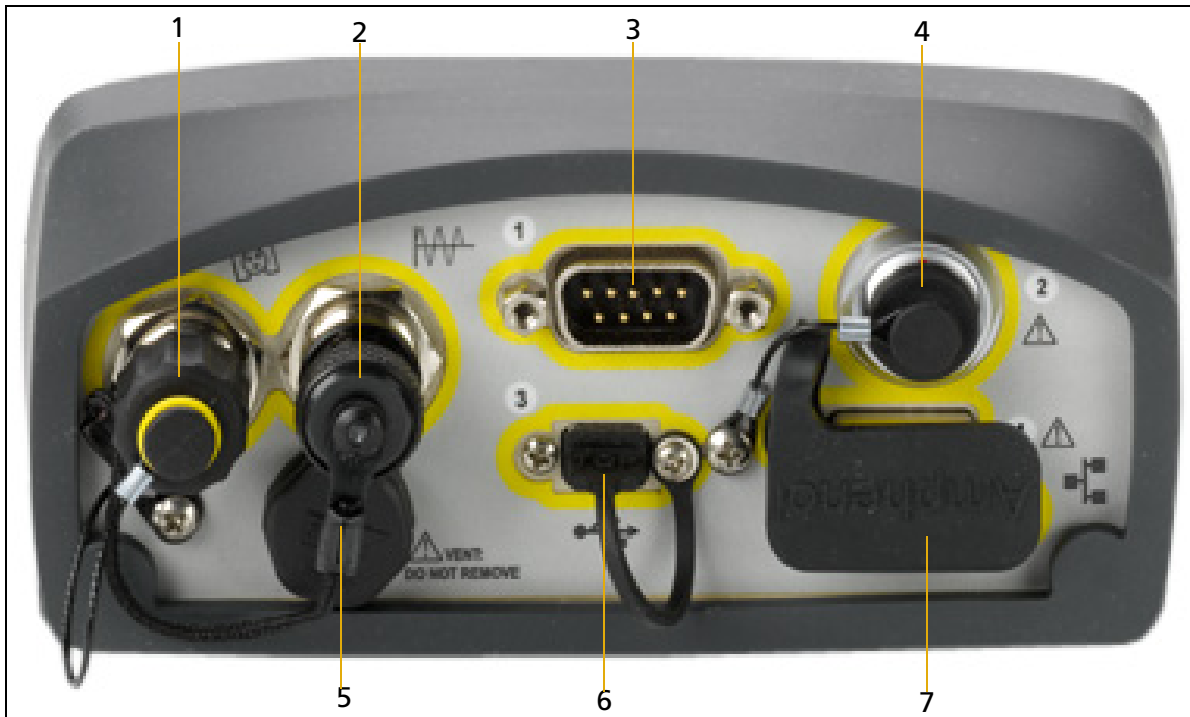
On the NetR9 GNSS reference receiver, immediate access to satellite measurements and navigation results is disabled when the receiver velocity is computed to be greater than 1000 knots, or its altitude is computed to be above 18 000 meters. The receiver GNSS subsystem resets until the COCOM situation clears. As a result, all logging and stream configurations stop until the GNSS subsystem is cleared.

Keypad and display



	Feature	Description
1	Power LED	Shows if the power is on or off.
2	Buttons	Use to turn on and turn off the receiver, and to configure it. See Button functions, page 32 .
3	Display	This Vacuum Fluorescent display enables you view the receiver operations the configuration settings. See Home screen, page 33 .
4	Bluetooth logo	Location of the Bluetooth antenna.

Rear connectors



	Connector type	Description
1	TNC	Connect to the GNSS antenna
2	BNC	10 MHz external frequency input
3	D9	Full 9-wire RS-232 serial port
4	Lemo (7-pin/O-shell) Port 2	<ul style="list-style-type: none"> Event input and 1 PPS output using cable (P/N 36451-02) Power from a Trimble AC/DC power supply 3-wire RS-232 serial communications using a 7-pin/O-shell Lemo cable (P/N 59044)
5	Vent plug	External venting plug for equalizing pressure
6	USB	Mini B 5-pin USB. <ul style="list-style-type: none"> Connect to external USB drive for external data logging. Connect the receiver to a computer to download files from the receiver (as an external device) to the computer.
7	RJ45 jack	10/100 Base-T Ethernet communications

Batteries and Power

In this chapter:

- External power
- Battery safety
- Battery performance
- Charging the battery
- Storing the battery
- Removing the battery

The NetR9 GNSS reference receiver uses an internal rechargeable Lithium-ion battery, which can be replaced only at an Authorized Trimble Service Center.

The receiver can also be powered by an external power source that is connected to either of the Lemo ports.

The operational time provided by the internal battery depends on the type of measurement and operating conditions. Typically, the internal battery provides up to 15 hours operation.

***Note** – All battery operational tests are carried out with new, fully-charged batteries at room temperature, tracking both GPS and GLONASS satellites while storing and streaming data at 1 Hz. Older batteries, at temperatures significantly higher or lower than room temperature, will have a reduced performance. Power consumption increases with an increasing number of actively tracked satellites and with increasing observation and storage rates.*

External power

The receiver uses an external power source in preference to its internal battery. If the receiver is not connected to an external power source, or if the external power supply fails, the internal battery is used.

The applied external power must offer between 9.5 V DC and 28 V DC and must be able to supply at least 5 W of power. The receiver's internal battery charges only when the external voltage is above 12 V DC. Trimble recommends that external supply voltage be above 12 V DC for long-term installations. This ensures that the internal battery is charged and ready to compensate for power supply disruptions.

While carrying out static measurements for postprocessed computations using the internal memory, if no external power is supplied and the internal battery is drained, the receiver shuts down. No data is lost; when power is restored, the receiver restarts in the same status as it was when power was lost.

If you prefer not to use the internal battery as an uninterruptable power supply, you can disable this feature in the Web user interface. For more information, see [Chapter 6, Configuring the Receiver: Other Than Keypad and Display](#).



WARNING – The external AC power adapter and its associated power cord and plug are not intended to be installed outdoors, nor in a wet location. 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.



WARNING – When you apply DC voltage to this product through the Lemo connector, the DC voltage must be limited to 28 V DC +0% under both normal and single fault conditions. This product may present an electrical hazard if the recommended input voltage is exceeded

Battery safety

The receiver is powered by a rechargeable internal Lithium-ion battery. Charge and use the battery only in strict accordance with the following instructions.



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.
-

Battery performance

To optimize battery performance and extend battery life:

- Fully charge all new batteries before use.
- Do not use at extreme temperatures. The receiver is designed to operate at -40 °C to +65 °C (-40 °F to +149 °F). However, operation at temperatures of less than 0 °C (32 °F) can cause a rapid drop in battery life.
- Do not allow a battery that is in storage to discharge to below 5 V.

Charging the battery

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

When connected to a suitable power source, the internal battery charges fully in 24 hours.



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 within the NetR9 receiver. The battery can only be removed by an authorized Trimble Service Center.
-

Storing the battery

If you must store a Lithium-ion battery for long periods, make sure that it is fully charged before it is stored, and that you charge it at least once every three months while it is stored.

Do not allow a battery that is in storage to discharge to below 5 V. A battery that reaches deep discharge level (5 V or less) cannot be recharged and must be replaced. (To protect a battery that is in use from deep discharge, the receiver switches power sources or stops drawing power when the battery pack discharges to 5.9 V.)

All batteries discharge over time when not in use, and they discharge faster in colder temperatures. Do not store the receiver at temperatures outside the range -40 °C to +70 °C (-40 °F to +158 °F).

The internal battery will only charge from an external power source that delivers more than 12 V, for example, an AC power adaptor. The receiver is supplied with a mains power supply unit that recharges the battery inside the receiver when it is connected through the adaptor to either of the Lemo ports. When you use the receiver in a long-term installation, Trimble recommends that you use this power supply or another that provides at least 12 V DC at all times to keep the internal battery charged. This will ensure that the internal battery provides an uninterrupted power supply that will keep the receiver operational for up to 15 hours after a power failure.

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

Removing the battery

The internal Lithium-ion battery may be removed *only* at an authorized Trimble Service Center. If the battery is removed at an unauthorized service center, the remaining warranty on the product will be void.

Setting Up the Receiver

In this chapter:

- Guidelines
- Connecting the receiver to an external device
- Installing the tripod clip

This chapter describes best practices for setting up the equipment, and outlines the precautions that you must take to protect the equipment. It also describes how to connect the receiver to external devices.

The antenna installation guidelines described here are the *minimum* standards. When installing a geodetic antenna to gather precise observation data, always follow recommended CORS installation practices to the greatest extent possible.

Guidelines

When you set up the receiver, follow these guidelines.

Environmental conditions

The receiver has a waterproof housing but you must take reasonable care to keep the unit dry.

To improve the performance and long-term reliability of the receiver, do not expose the receiver to extreme environmental conditions, such as:

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

Sources of electrical interference

Do not place the GNSS antenna near the following sources of electrical and magnetic noise:

- Gasoline engines (spark plugs)
- Televisions and computer monitors
- Alternators and generators
- Electric motors
- Equipment with DC-to-AC converters
- Fluorescent lights
- Switching power supplies
- Arc welding equipment

Uninterruptable power supply

Trimble recommends that you use an uninterruptible power supply (UPS) to power the receiver. The internal battery can also operate as a UPS for up to 15 hours. A UPS protects the equipment from power surges and spikes, and keeps the receiver running during short power outages.

Items operating with the receiver, such as an Ethernet switch, should also be on a UPS to provide uninterrupted operation.

For more information, contact your local Trimble dealer.

Lightning and surge protection

Trimble recommends that you install lightning protection equipment at permanent sites. All connections to the receiver should have surge protection. Typically, the minimum protection should include a surge protector in the antenna feed line, on the Ethernet connection between the receiver and the local area network, as well as on the receiver's power supply system. If serial devices are attached to the receiver, those serial connections should also be provided with surge protection. Also, protect any communications and power lines at building entry points. If you use other antennas, such as a radio modem that distributes real-time correction messages or a last-mile radio, install surge protection on those antenna feeds as well.

No surge protection devices can offer protection unless they are connected to an excellent ground using very low impedance conductors. Equipment damage caused by electrical surges occurs in many permanent installations even though surge protection is in place. Commonly, this is because the grounding system used was designed to protect against AC electrical hazards rather than to dissipate the sudden, high current surges caused by lightning. Please consult with a lightning protection expert or research the topic when planning permanent installations.

For more information, contact your local Trimble Infrastructure dealer, or go to the websites of surge protection and grounding system manufacturers. Trimble customers have reported good results when using products from the following manufacturers:

- Polyphaser (www.polyphaser.com)
- Huber and Suhner (www.hubersuhner.com)
- Harger (www.harger.com)
- Hyperlink Technologies (www.hyperlinktech.com)

Placing the antenna

The antenna location will have a significant effect on the quality of your NetR9 receiver's performance. In temporary developments it may not always be possible to set up on an ideal location with an excellent sky view. However, when installing a permanent station, be sure to plan the antenna location and mounting system carefully.

The general requirements for the antenna location and mount are:

- Clear sky from the zenith to the horizon to a 100 m (328 feet) radius, in all directions (360 degrees).
- Mounted 1.5 m (5 feet) above any nearby signal reflectors.
- Separation of at least 300 m (984 feet) from radio signal transmitters.
- Mount stability that is not influenced by thermal expansion, wind loading, or soil expansion/contraction.

For additional information on this topic, research the reference antenna installation guidelines published by the:

- US National Geodetic Survey
(http://www.ngs.noaa.gov/PUBS_LIB/CORS_guidelines.pdf)
- International GNSS Service
(<http://igscb.jpl.nasa.gov/network/guidelines/guidelines.html>)

Connecting the receiver to an external device

You can connect a NetR9 GNSS reference receiver to the following devices:

- GNSS antenna, page 28
- Dial-up modem, page 29
- Radio modem, page 29
- Meteorological or tilt sensor, page 29
- Other external devices, page 30

GNSS antenna

The receiver provides a TNC-type female connector for connecting to an antenna. The receiver is intended for use with a Zephyr Geodetic™ Model 2 antenna or a Trimble GNSS Choke Ring antenna.

Antenna cabling

Many permanent GPS installations have unique cabling requirements. Depending on the available infrastructure, you may need to mount the antenna a substantial distance from the receiver.

The receiver can withstand a loss of 12 dB between the antenna and the receiver. The degree of loss in a coaxial cable depends on the frequency of the signal passing through it. Some common types of cable are shown below.

Cable type	Maximum length for use without an inline amplifier
LMR-400	70 m (230 ft)
LMR-500	85 m (280 ft)
LMR-600	106 m (350 ft)
Heliax LDF4-50	165 m (540 ft)
Heliax LDF4.5-50	225 m (740 ft)

Dial-up modem

The receiver can make automated dial-out connections to an Internet service provider. To set up the receiver to do this, select *Network Configuration/PPP* in the Web interface.

You can set up a streaming service, such as RT17/RT27 raw GNSS data, CMR, or RTCM corrections over a serial port. When using a modem on the serial port, the modem itself must perform the auto-answer function.

Radio modem

You can connect the receiver to an external radio through the Lemo ports or the 9-pin serial port, whether or not the Ethernet port is in use. Trimble radios are supplied with the required cables to connect to the Lemo ports. The receiver supports the following Trimble base radios:

- TRIMMARK™ 3 (firmware 1.26 or later)
- Trimble HPB450
- Trimble PDL450

To use an external radio with the receiver, you must have an external power source for the radio. Use the configuration program for the external radio to configure it separately.

To configure the receiver for RTK operation, do the following:

1. Enable the RTCM or CMR RTK corrector stream on the selected serial port.
2. Use the receiver front panel or the Web user interface to set the reference station coordinates and broadcast ID.

Meteorological or tilt sensor

You can connect an external meteorological or tilt sensor to any of the three available serial ports on the receiver.

The sensor responds to a request for information. The request and the response are time tagged and are entered into the receiver's stored files and streamed observation data.

Note – *The sensor's serial configuration must include 8 data bits. Some sensors default to 7 data bits, which is incompatible with the NetR9 GNSS reference receiver.*

Supported sensors include the following:

- Paroscientific Met3, Met3A, Met4, and Met4A
- Vaisala PTU300
- Applied Geomechanics D700 and MD900 series

Use the *I/O Configuration / Port Configuration* menu to enter the serial port settings and control commands for a meteorological or tilt sensor.

Other external devices

For all other external devices, connect to a suitable communications port and then configure that port for the connected device.

Installing the tripod clip

For campaign operations or temporary base installations, you can use a tripod clip instead of the standard mounting base:

1. Remove the standard mounting base by unscrewing the four bottom screws that are located beneath the rubber end cap trim.
2. Use the two provided screws to attach the tripod clip to the two holes located at the bottom of the front panel of the receiver.

Configuring the Receiver: Keypad and Display








In this chapter:

- Button functions
- Power button operations
- Home screen
- Status screens
- Setting up the receiver as a base station
- Setting up the receiver as part of an Ethernet configuration
- Setting up the receiver to log data


The NetR9 GNSS reference receiver features a front panel user interface with a keypad and a two-line alphanumeric display (see [page 19](#)). This interface enables you to configure many of the receiver's features without using an external controller or computer.

Button functions

Use the buttons on the front panel to turn on or turn off the receiver and to check or change the receiver settings.

Button	Name	Function
	Power	Turn on or turn off the receiver. To turn off the receiver, hold down for two seconds.
	Escape	Return to the previous screen or cancel changes you make on a screen.
	Enter	Advance to the next screen or accept changes you make on a screen.
	Up	Move the cursor between multiple fields on a screen, or make changes.
	Down	Move the cursor between multiple fields on a screen, or make changes.
	Left	Move the cursor between characters in an editable field.
	Right	Move the cursor between characters in an editable field. Initiate edit mode for the current field.

Power button operations

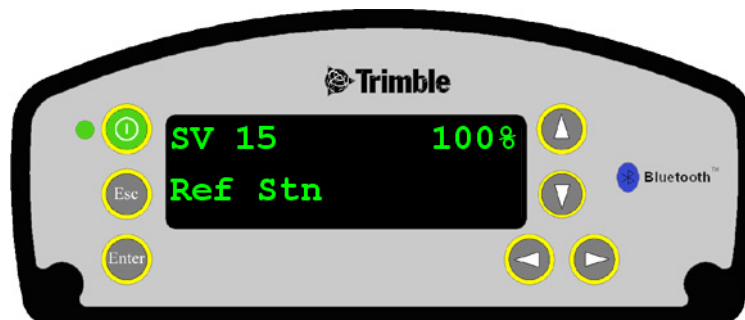
To...	Hold the power button down for...	Notes
Turn off the receiver	2 seconds	The display shows a countdown timer. When the display goes blank, release the power button.
Clear the almanac, ephemeris, and SV information	15 seconds	The display shows a countdown timer. When the display goes blank, continue to hold the power button. The display shows another countdown timer while clearing the almanac and ephemeris. When the counter reaches 0, release the power button
Reset the receiver to its factory defaults and the default application file	35 seconds	The display shows a countdown timer. When the display goes blank, continue to hold the power button. The display shows another countdown timer while clearing the almanac and ephemeris. When the counter reaches 0, continue to hold the power button. The display shows another countdown timer while resetting the receiver. When the counter reaches 0, release the power button.
Force the receiver to turn off.	At least 60 seconds	 CAUTION – All data stored in the receiver is lost when the receiver is forced to turn off. If the previous methods do not work, use this method to force the receiver to turn off. When the power LED turns off, release the power button.


Home screen

This is the main receiver screen. The receiver always returns to this screen if any other screen is left idle for 60 seconds.



The Home screen shows:

- The number of satellites being tracked.
- The internal battery power remaining.
- The current operation mode.
- If the receiver is logging data. If logging is enabled, the operating mode field shows **Logging** every three seconds.



As a power-saving feature, the front panel goes dark after a short period of inactivity. If the display is not lit and the receiver is on, press  to reactivate the display. If required, you can disable this power-saving feature in the Web interface.


Status screens








To review the receiver's current settings in the status screens, press  or  in the Home screen. The status screens show the following information:

- Position solution
- CMR and RTCM IDs
- Base name and code
- Latitude, longitude, and height
- Antenna type
- Antenna height and measurement point
- Receiver firmware version and date
- Receiver serial number
- Current IP address
- Current subnet mask

Setting up the receiver as a base station








Use the keypad to set up the receiver for Ethernet configuration and for real-time outputs to operate as a base station (also known as a reference station).

Follow the “step-by-step” configuration method to ensure that all appropriate settings are reviewed and set. Press  to move between configuration steps.








1. From the Home screen, press  to move to the next screen.
The Operation Mode screen appears. Use this screen to configure the reference station setup, Ethernet configuration, system setup, or to view the SV (satellite) status.
As reference station setup is the default, press  to move to the next screen.
The Base Station screen appears. Use this screen to select if the receiver is going to use a “Here” position or if the current coordinates in the receiver will be edited.
2. Do one of the following:
 - Press  to edit the current position.
Edit Current begins to flash. This indicates that you can now edit this setting.
Press  to change to **New Base (Here)**. Press  to accept the change.
The current coordinates that the receiver is using will be used as the base station coordinates.
 - Continue to the next step and then manually enter the coordinates. Press  again.
3. Press  to continue to the next screen.

Changing the name and description of the base station

In the Base Name screen:








1. Press  to edit the name of the base station. The name can be up to 16 characters.
2. Press  or  to select the character to edit and then press  or  to change it.
3. When finished, press  to accept the change.
4. Press  to move to the next screen.

In the Base Code screen:








1. Press  to edit the code (description) of the base station.
2. Press  or  to select the character to edit and then press  or  to change it.
3. When finished, press .
4. Press  to move to the next screen.

Setting the reference latitude, longitude, and height of the base station








In the Base Latitude screen:

1. Press  to edit the reference latitude of the base station.
2. Press  or  to select the character to edit and then press  or  to change it.
3. When finished, press .
4. Press  to move to the next screen.

In the Base Longitude screen:






1. Press  to edit the reference longitude of the base station.
2. Press  or  to select the character to edit and then press  or  to change it.
3. When finished, press .
4. Press  to move to the next screen.

In the Point Height screen:






1. Press  to edit the ellipsoidal height of the base station.
2. Press  or  to select the character to edit and then press  or  to change it.
3. When finished, press .
4. Press  to move to the next screen.

Measuring and changing the antenna height








In the Antenna Type screen:

1. Press  to select the type of antenna used with the receiver.
2. Press  or  to select an antenna type.
3. When finished, press .
4. Press  to move to the next screen.









In the Measure To screen:

1. Press  to select how the antenna height is measured.
2. Press  or  to select a measurement method.
3. When finished, press .
4. Press  to move to the next screen.

In the Antenna Height screen:











1. Press  to edit the antenna height.
2. Press  or  to select the character to edit and then press  or  to change it.
3. When finished, press .
4. Press  to move to the next screen.

Outputting corrections

1. Press  to edit the name of the port that will output corrections.
2. Press  or  to select the port (1, 2, or 3).
3. When finished, press .
4. Press  to select the *Format* field and then press  to edit this field.
5. Press  until the required format choices flashes
6. Press  to move to the next screen.









Data logging



In the Logging screen:

1. Once you configure the output corrections, press  to set up internal logging on the receiver.
2. Press  or  to select the logging rate.
3. Press .
4. Press  to select files and then press  to edit them.
5. Press  or  to select the appropriate length of time to log data for.
6. When finished, press .
7. Press  to move to the next screen.

Outputting observations


In the RT27 screen:















1. Once you configure data logging, press  to set up RT27 message output from the receiver.
2. Press  or  to select the output port.
3. Press .
4. Press  to move the cursor to the output rate then press  to edit it.
5. Press  or  to select the rate at which RT27 message will be output.

6. When finished, press .
7. Press  to move to the next screen.








The Home screen appears: Base station setup is complete.

Setting up the receiver as part of an Ethernet configuration

1. From the Home screen, press .

In the Operation Mode screen that appears, select if you want to configure the base station setup, Ethernet configuration, or system setup, or view the SV status.
2. As reference station setup is the default, press  so that the Ref Stn Setup message flashes.
3. Press  to select Ethernet configuration.
4. Press  twice to edit the configuration. The DHCP menu appears.
5. Press  to select the type of IP address to set up.
6. Press  or  to move through the options. You can choose either Enabled (the default) or Static IP address to program the Ethernet manually.
7. When finished, press .
8. Press  to move to the next screen. The IP address appears.
9. Press  to edit the IP address.
10. Press  or  to select the number to edit and then press  or  to change.
11. When finished, press .

Note – Editing starts from the right.

12. Press  to move to the next screen. The gateway appears.
13. Press  to edit the default gateway address.
14. Press  or  to select the number to edit and then press  or  to change.
15. When finished, press .

Note – Editing starts from the right.

16. Press  to move to the next screen.












The Home screen appears: Ethernet setup is complete.

Note – If you change the IP address, you must restart the receiver for the changes to take effect.

You can also use the keypad to configure the system setup or to view the satellite (SV) status using the same process described in this chapter.





Setting up the receiver to log data

The receiver supports up to five independent data logging sessions. You can use the front panel to **configure** the Default session parameters but you can only **activate** the other four sessions from the front panel: you must first **configure** them through the web interface.






1. From the Home screen, press . The Operation Mode screen appears.
2. As reference station setup is the default, press  repeatedly to move through the menu choices until **Logging** appears. This is where you edit the settings for the Default logging session.
3. Do one of the following:
 - Press  to edit the default session logging rate. Press  or  to select the required rate and then press .
 - Press  to move to the logging rate field. Press  to edit the logging rate and the press  to select a rate.
4. To store the new settings, press .
5. Press  to move to the next screen.

Enabling a logging session

In the Logging Session screen:

1. Press  to change the session to be enabled.
2. Press  or  to move among the session names.
3. When the required session name appears, press  to enable editing.

Note – If you have not set up an additional session using the web interface, you will only be able to select the "Default" session. Additionally, external USB logging is only configurable via the web interface.

4. Press  to move to the On/Off field.
5. Press  to edit the setting.
6. Press  to change the setting to the required state.
7. When finished, press .
8. Press  to move to the next screen.

Configuring the Receiver: Other Than Keypad and Display

In this chapter:

- Configuring the Ethernet settings
- Configuring through a web browser

You can configure the NetR9 GNSS reference receiver to perform a wide variety of functions. This chapter describes the configuration methods other than the front panel display, and explains when and why each method is used.

The WinFlash utility described in this chapter is used primarily to update the receiver firmware and to configure the Ethernet settings in the receiver.

Configuring the Ethernet settings

The receiver Ethernet port connects to an Ethernet network, through which you can access, configure, and monitor the receiver. No serial cable connection to the receiver is necessary.

The receiver has the following Ethernet settings:

- IP setup: Static or DHCP
- IP address
- Netmask
- Broadcast
- Gateway
- DNS address
- HTTP port


The default setting for the HTTP port is 80: This port is not assigned by the network. HTTP port 80 is the standard port for web servers and enables you to connect to the receiver by entering only the receiver's IP address in a web browser.

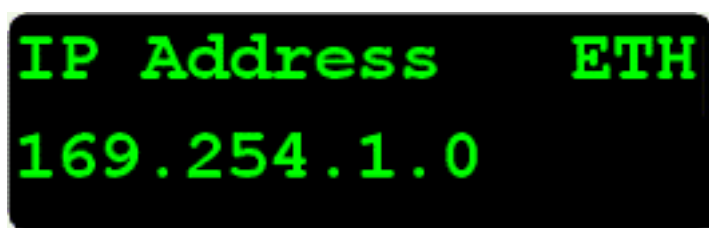
For example, using port 80: **http://169.254.1.0**

If the receiver is set to use a port other than 80, you must enter the IP address followed by the port number in a web browser.

For example, port 4000: **http://169.254.1.0:4000**

The default setting of the receiver is to use DHCP. This enables the receiver to automatically obtain an IP address, Netmask, Broadcast, Gateway, and DNS address from the network.

When a receiver is connected to a network using DHCP, the network assigns the receiver an IP address. To verify this address, open the Home screen and then press 



If your network installation requires the receiver to be configured with a static IP address, you can configure the Ethernet settings through the front panel (see [Chapter 5, Configuring the Receiver: Keypad and Display](#)), through a web server, or by using the WinFlash utility. To use a web server, the receiver must be connected to a network and have a valid Ethernet configuration.

Configuring using the WinFlash utility

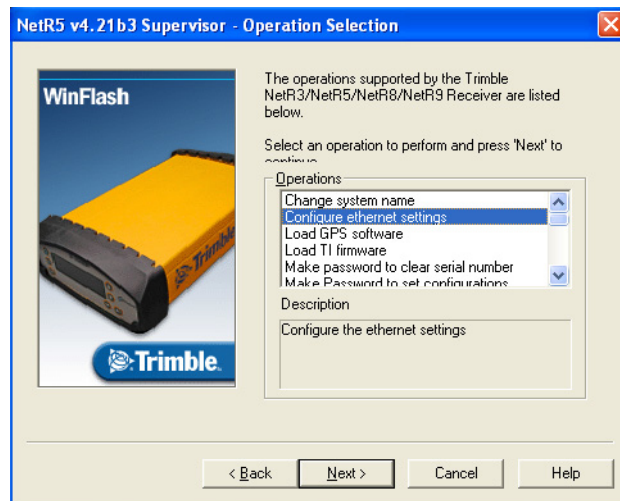
To use the WinFlash utility to configure Ethernet settings for a receiver that is to be connected to a network that requires static IP addresses:

1. Contact the network administrator for the correct settings for the receiver.
2. Use the serial cable provided with the receiver to connect the receiver to a computer running the WinFlash utility.
3. Turn on the receiver.
4. On the computer, start the WinFlash utility.
5. From the *Device Configuration* screen:
 - a. From the *Device type* list, select *Trimble NetR3/NetR5/NetR8/NetR9 Receiver*.
 - b. From the *PC serial port* list, select the appropriate serial port:

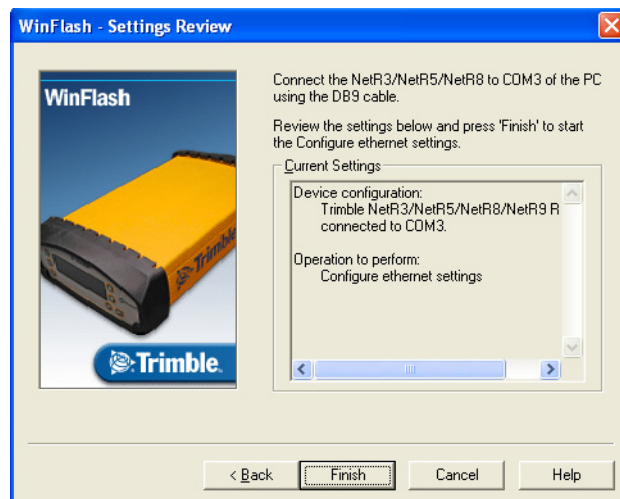


-
-
-
-
- c. Click **Next**.

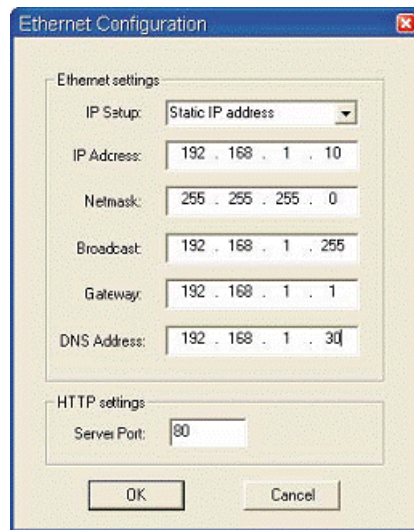
6. From the *Operation Selection* screen, select *Configure Ethernet settings* and then click **Next**:



7. From the *Settings Review* screen, click **Finish**:



Once the WinFlash utility connects to the receiver, the *Ethernet Configuration* dialog appears:



8. Enter the network settings and then click **OK**:

The Broadcast setting is the IP address that is used to broadcast to all devices on the subnet. This is usually the highest address (usually 255) in the subnet.

Configuring through a web browser

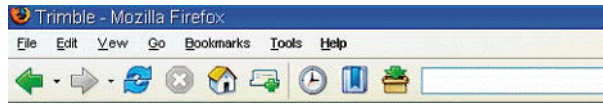
Supported browsers are:

- Mozilla Firefox version 3.0
- Microsoft Internet Explorer® version 7.0

Note – *Internet Explorer version 8.0 may not operate correctly if you select the Use Standards Mode option in that browser software.*

To connect to the receiver through a web browser:

1. Enter the IP address of the receiver into the address bar of the web browser:



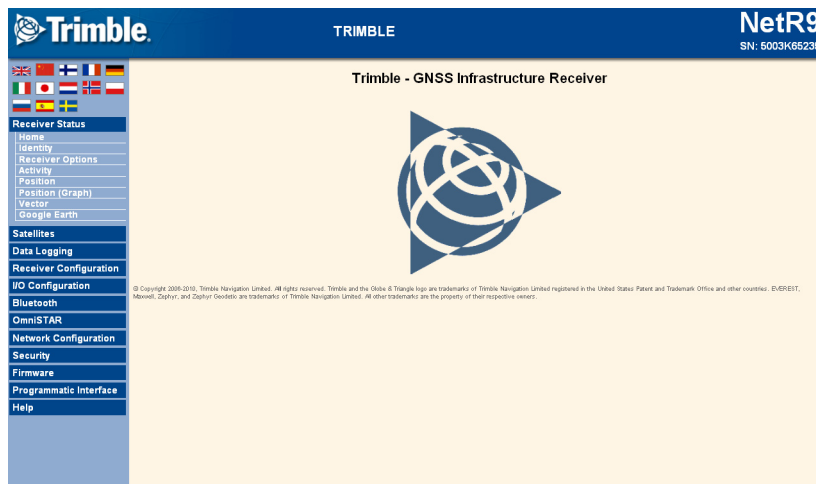
2. If security is enabled on the receiver (by default, it is disabled), the web browser prompts you to enter a username and password:



The default login values for the receiver are:

- User Name: admin
 - Password: password
3. If you cannot connect to the receiver, the password for the root account may have been changed, or a different account may be being used. Contact your receiver administrator for the appropriate login information.

Once you are logged in, the welcome page appears:



Changing the settings

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 to monitor receiver performance.

This section describes each configuration menu.

To view the web interface in another language, click the corresponding country flag. The following languages are available:

English	Chinese	German
Russian	French	Spanish
Japanese	Dutch	Norwegian
Polish	Swedish	Italian

Receiver Status menu

This 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
Home
Identity
Receiver Options
Activity
Position
Position (Graph)
Vector
Google Earth

- Identity

Shows a list of unique receiver items, including the Ethernet MAC address and the Bluetooth MAC address. It also lists variable items, including the current Ethernet IP address and the firmware version:

Receiver Status - Identity

System Name:	Trimble
Serial Number:	5003K65235
Ethernet MAC Address:	00:60:35:0D:E2:06
Ethernet IP:	10.1.95.100
DNS Resolved Name:	NONE
Bluetooth MAC Address:	00:03:19:05:67:88
Firmware Version:	0.16 - 4.15
Firmware Date:	2010-03-23
Monitor Version:	4.18
Hardware Version:	2.2

System Name:

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- Receiver Options

Lists the installed options and limits of the receiver platform. In addition, this page shows the current firmware warranty date and enables you to upload new codes to the receiver so that you can enter new firmware warranty date codes

Receiver Status - Options

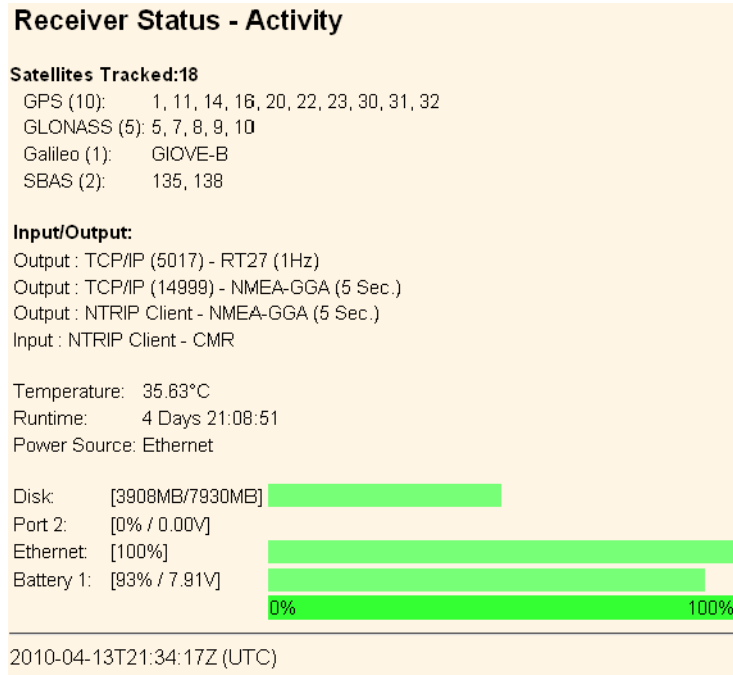
Option	Installed	Option	Installed	Option	Installed
L2 Tracking	X	L2C	X	L5 Tracking	X
GLONASS	X	GIOVE	X	Galileo	
Everest	X	Maximum Observable Rate	50Hz	VRS	X
HTTPS	X	OmniSTAR-HP	X	CMR Input	X
No Static CMR Input		CMR Output	X	No Static CMR Output	
CMRx Input	X	CMRx Output	X	RTCM Input	X
RTCM Output	X	RTK Baseline Length Limit	1.0km	NMEA	X
Binary Outputs	X	Data Logging	X	Event Markers	X
Bluetooth	X	Transmit		Advanced RTCM Output	X
USB Hard Drive	X	Programmatic Interface	X	Enable 1PPS	X

Firmware Warranty Date: 2011-07-01

Option Code:

- Activity

Lists several important items to help you understand how the receiver is being used and its current operating condition. Items include the identities of currently tracked satellites, files being logged, data streams being input and output, the receiver's internal temperature, how long the receiver has been operational, power source voltages, and the state of the internal battery. With this information, it is easy to tell exactly what functions the receiver is performing:



- Position

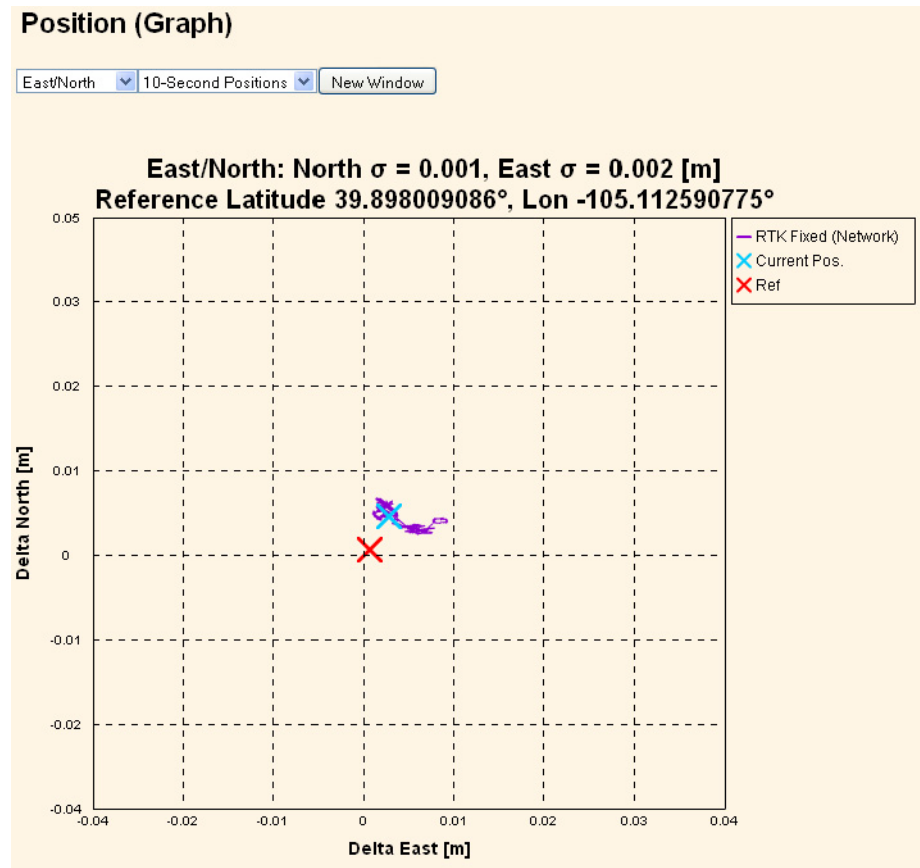
Shows all relevant information about the receiver's position solution. If the receiver is operating as a reference station, this information may be of minimal concern. However, if the receiver is acting as a Rover Integrity Monitor, this menu provides all the information needed to assess the quality of the receiver's RTK position and therefore, the quality of network correctors:

Receiver Status - Position

<p>Position: Lat : 39° 53' 52.83279" N Lon : 105° 8' 45.32658" W Hgt : 1685.972 [m] Type : RTK Fixed Datum : WGS-84</p> <p>Position Solution Detail: Position Dimension : 3D Position Type : Phase Diff Motion Info : Static Augmentation : GPS+GLN RTK Solution : Normal RTK Init : Fixed RTK Mode : Low Latency RTK Network Mode : Network Age of Corrections : 0.3 [Sec.] Height Mode : Normal</p>	<p>Satellites Used:10 GPS(8): 11, 14, 16, 20, 23, 30, 31, 32 GLONASS(2): 8, 10</p> <p>Satellites Tracked:17 GPS (9): 1, 11, 14, 16, 20, 23, 30, 31, 32 GLONASS (5): 5, 7, 8, 9, 10 Galileo (1): GIOVE-B SBAS (2): 135, 138</p> <p>Receiver Clock: GPS Week: 1579 GPS Seconds: 251585 Offset: 0.00000 [msec] Drift: 0.00028 [ppm]</p> <p>Multi-System Clock Offsets: Master Clock System: GPS GLONASS Offset: 376.1 [ns] GIOVE-B Offset: 128.9 [ns] GLONASS Drift: 0.115 [ns/s] GIOVE-B Drift: -0.013 [ns/s]</p>	<p>Velocity: East : 0.00 [m/s] North : 0.00 [m/s] Up : 0.00 [m/s]</p> <p>1-Sigma Estimates East : 0 North : 0 Up : 0 Semi Major Axis : 0 Semi Minor Axis : 0 Orientation :</p> <p>Dilutions of Preci: PDOP : 1.5 HDOP : 0.8 VDOP : 1.2 TDOP : 0.7</p>
--	--	---

- Position (Graph)

Graphically shows the receiver's position and fix status. These plots show the values of Height, East, North, East/North, and PDOP/# SVs. The operator can choose from 10-second or high-rate updates:



- Vector

Provides information on the vector between the NetR9 GNSS reference receiver and its RTK reference station.

- Google Earth

Enables you to request a Google Earth position marker file for the reference receiver position. You can easily import this KMZ file into Google Earth for that software to show the receiver's location on a map or aerial view.

Satellites menu

Use the *Satellites* menu to view satellite tracking details and enable/disable GPS, GLONASS, Galileo, and SBAS (WAAS/EGNOS/MSAS) satellites. These menus include tabular and graphical displays to provide all required information on satellite tracking status.

Satellites
General
Tracking (Table)
Tracking (Graph)
Tracking (SkyPlot)
GPS Enable/Disable
GLN Enable/Disable
SBAS Enable/Disable
Galileo Enable/Disable
Satellite Almanacs
Predicted Elevation
Predicted Constellation
Current Constellation
Ground Track

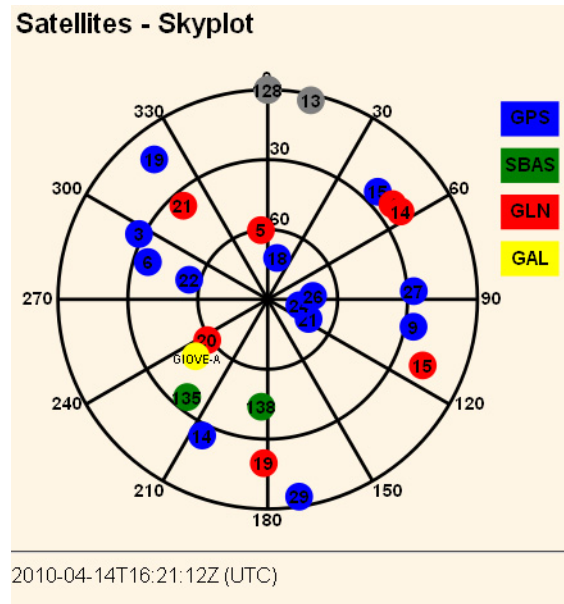
- General

Provides an overview of the satellite tracking status:

Satellites - General Information	
Satellites Tracked:24	
GPS (13):	3, 6, 9, 14, 15, 18, 19, 21, 22, 24, 26, 27, 29
GLONASS (8):	4, 5, 13, 14, 15, 19, 20, 21
Galileo (1):	GIOVE-A
SBAS (2):	135, 138
Total Satellites in GPS Constellation:31	
Healthy(30):	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30
Unhealthy(1):	1
Ignore Health(32):	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32
Total Satellites in GLONASS Constellation:21	
Healthy(21):	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24
Ignore Health(24):	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24
Total Satellites in Galileo Constellation:2	
Unhealthy(1):	GIOVE-A
Ignore Health(2):	GIOVE-A, GIOVE-B
2010-04-14T16:08:29Z (UTC)	

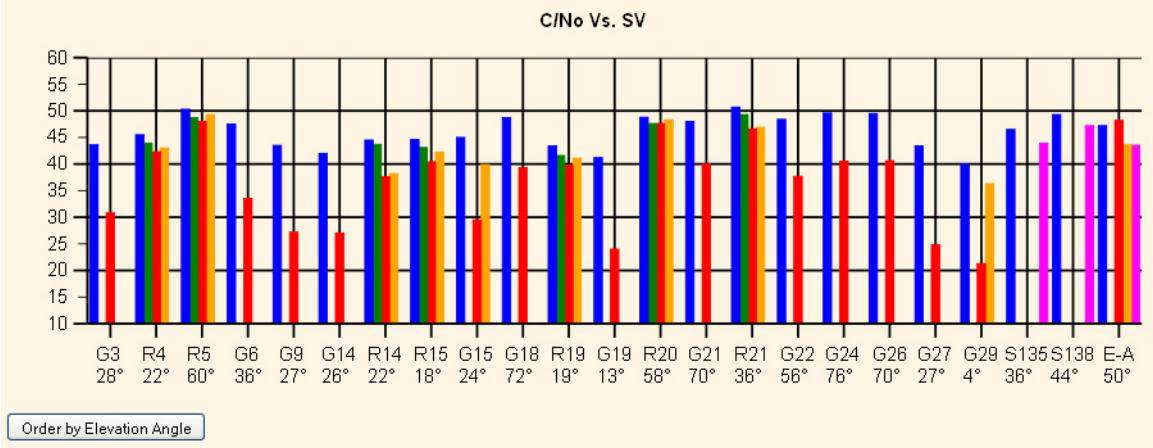
- Tracking: Skyplot and Graph

The following figures are examples of the Skyplot and Graph pages:



Satellites - Tracking Information

- L1 C/A / BOC
- L1 P
- L2 E/P or E5-AltBOC
- L2 C/C/A or E5B
- L5 / E5A

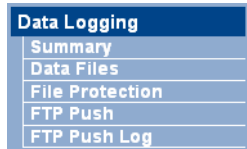


You can also:

- Manually disable satellite tracking.
- Download the latest broadcast ephemeris.
- View various constellation coverages.

Data Logging menu

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



- Summary

Shows the files that are currently being stored, including their schedules, names, whether they are using memory pooling, and in which directory they are stored:

Data Logging

File System	Size	Available	49%	Auto Delete	
/Internal	7.744 GB	3.816 GB	49%	<input type="checkbox"/>	Format
/External	119.46 MB	115.32 MB	97%	<input checked="" type="checkbox"/>	

Session	Schedule	Status	Enable
DEFAULT Measurements 0.02 Sec. Positions 0.02 Sec.	Continuous 60 Min.	Disabled	<input type="checkbox"/>
24hrG_G Measurements 0.1 Sec. Positions 0.02 Sec.	Continuous 60 Min.	Disabled	<input type="checkbox"/>
extPool Measurements 0.1 Sec. Positions 1 Sec.	Continuous 60 Min.	Logging /Internal/Trim104rF.T02	<input checked="" type="checkbox"/>
intPool Measurements 0.1 Sec. Positions 1 Sec.	Continuous 60 Min.	Disabled	<input type="checkbox"/>
1sec Measurements 1 Sec. Positions 1 Sec.	Continuous 60 Min.	Logging /Internal/1sec/2010/04/14/ 5003K65235201004141700B.T02	<input checked="" type="checkbox"/>
1nodop Measurements 0.02 Sec. Positions 0.02 Sec.	Continuous 60 Min.	Disabled	<input type="checkbox"/>
High_HZ Measurements 0.02 Sec. Positions 0.02 Sec.	Continuous 60 Min.	Logging /Internal/High_HZ/2010/04/14/ 5003K65235201004141700W.T02	<input checked="" type="checkbox"/>
12345 Measurements 0.02 Sec. Positions 0.02 Sec.	Continuous 60 Min.	Disabled	<input type="checkbox"/>

- To edit a logging session, double-click the session name.

- To create a new session, click **New Session**. The *Data Logging Configuration* screen appears:

Data Logging Configuration

Session Name: 1sec
 Enable:
 Schedule: Continuous
 Duration: 60 Minutes

Measurement Interval: 1 Sec.
 Smooth Pseudorange:
 Smooth Phase:
 Include Doppler:
 Position Interval: 1 Sec.
 Log Received Corrections:

File System: /Internal
 Path Style: Session/Date
 Name Style: #####YYMMDDhhmm
 Suffix: B
 Pool: Off

FTP Push: Convert: **None (FTP T01/T02 files)**
 Email Push: Convert: **None (FTP T01/T02 files)**
 Email To:

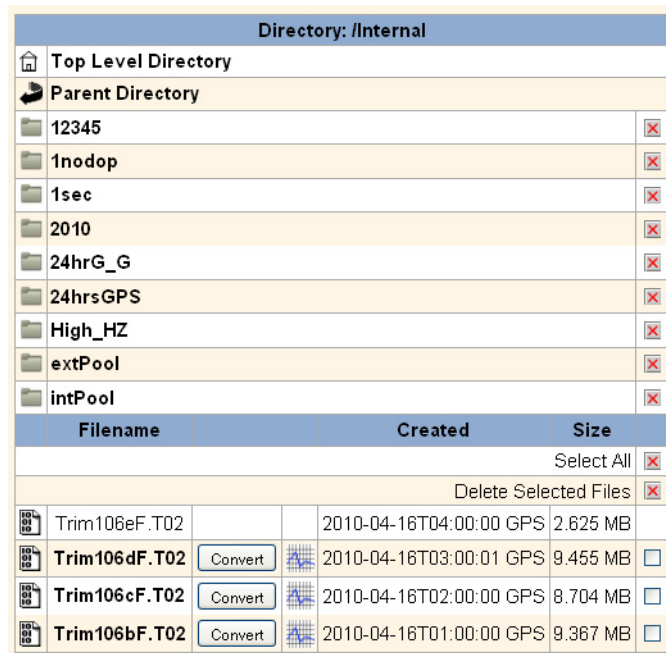
None (FTP T01/T02 files)
 T01/T02 file & Zipped V3.00 RINEX (Observable & Ephemeris)
 T01/T02 file & Zipped V2.11 RINEX (Observable & Ephemeris)
 Google Earth - Lines
 Google Earth - Lines and Points
 Zipped V3.00 RINEX (Observable & Ephemeris)
 Zipped V3.00 Hatanaka RINEX (Observable & Ephemeris)
Zipped V2.11 RINEX (Observable & Ephemeris)
 Zipped V2.11 Hatanaka RINEX (Observable & Ephemeris)
 V3.00 RINEX (Observable & Ephemeris)
 V3.00 Hatanaka RINEX (Observable & Ephemeris)
 V2.11 RINEX (Observable & Ephemeris)
 V2.11 Hatanaka RINEX (Observable & Ephemeris)
 BINEX

OK Delete Cancel

In this screen, you can set all logging parameters, and determine whether the session files will be affected by the FTP Push, Email Push, and any format conversions.

- Data Files

View, download, graph, and/or convert the files currently stored on the receiver:



- To download a file, double-click the file name or its icon and then follow the standard procedures to complete the download.
- To select a group of files for download, select the check box to the right of the required file names before double-clicking to start the download. To select all files, click **Select All**.
- To delete files, select the check box to the right of all files to be deleted and then click **Delete Selected Files**.

The following file naming options are available in the receiver:

Name style	Description
####JJJx	Last four digits of the receiver serial number 3-digit Julian calendar day alphabetic session identifier
#####YYYYMMDDhhmm	Receiver serial number 4-digit year 2-digit month 2-digit day 2-digit hour 2-digit minute of file start
SystJJJh	4-character system identifier 3-digit Julian calendar day Single letter hour of day identifier

Name style	Description
SystJJHm	4-character system identifier 3-digit Julian calendar day Single letter hour of day identifier 2-digit minute of the hour of file start
YYMMDDhh	2-digit year 2-digit month 2-digit day 2-digit hour of file start
YYMMDDhhmm	2-digit year 2-digit month 2-digit day 2-digit hour 2-digit minute of file start
SystemYYYYMMDDHHmm	System name 4-digit year 2-digit month 2-digit day 2-digit hour Minutes

- File Protection

Use this screen 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, which ensures that this data is available for later study:

File Protection

Enable:

Protect Before Events: Minutes

Protect After Events: Minutes

To remove protected data from the system memory, you must manually delete it.

- FTP Push

Use this screen to configure the receiver to push stored files to the FTP server of your choice. Only files that are configured to use FTP push are transmitted:

FTP Push

Server Address:

Username:

Password:

Verify Password:

Remote Directory:

Path Style:

Rename:

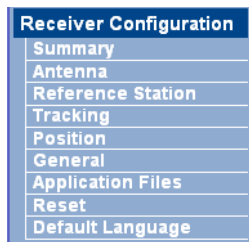
Transfer mode:

- FTP Push Log

Shows the status of all FTP Push operations.

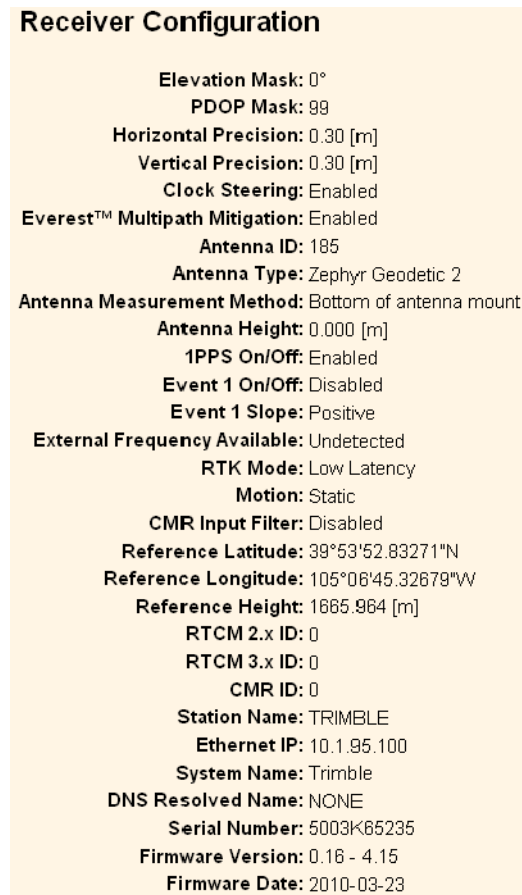
Receiver Configuration menu

Use this menu to configure settings such as elevation mask and PDOP mask, the antenna type and height, the reference station position, and the reference station name and code:



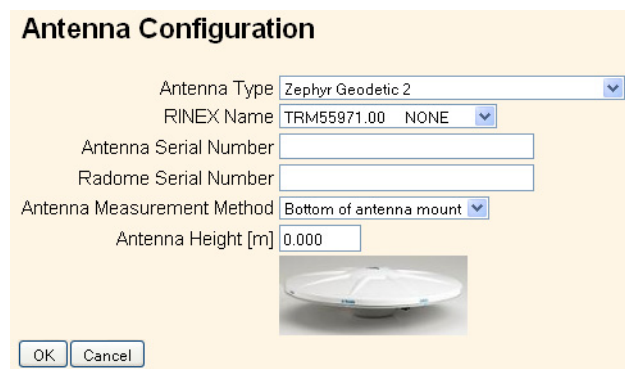
- Summary

Gives an overview of the status of many of the important configuration items:



- Antenna

Use this screen to configure all of the items relating to the GNSS antenna. You must enter the correct values for all antenna-related fields, as the choices you make significantly affect the accuracy for logged data and broadcast RTK correctors:



- Reference Station

Use this screen to configure settings such as the station coordinates and the broadcast station identifiers. You must enter accurate information in these fields, as this data significantly affects the accuracy of logged data files and broadcast RTK correctors:

Reference Station

Reference Latitude: ° ' " N S

Reference Longitude: ° ' " E W

Reference Height: [m]

Load Current Position

CMR ID:

RTCM 2.x ID:

RTCM 3.x ID:

Station Name:

Station Code:

- Tracking

Use this screen to determine whether Everest™ technology and clock steering are used. This screen also enables you to select which signals relating to particular satellites are to be stored:

Tracking

Elevation Mask: °

Everest™

Clock Steering

Type	Signal	Enable	Options
GPS	L2 - Legacy	<input checked="" type="checkbox"/>	L2 - CS and Legacy
GPS	L2 - CS	<input checked="" type="checkbox"/>	CM + CL
GPS	L5	<input checked="" type="checkbox"/>	I + Q
SBAS	L1 - C/A	<input checked="" type="checkbox"/>	
SBAS	L5	<input checked="" type="checkbox"/>	
GLONASS	L1 - C/A	<input checked="" type="checkbox"/>	
GLONASS	L1 - P	<input checked="" type="checkbox"/>	
GLONASS	L2 - C/A(M)	<input checked="" type="checkbox"/>	
GLONASS	L2 - P	<input checked="" type="checkbox"/>	L2 - C/A(M) and P
GALILEO	E1	<input checked="" type="checkbox"/>	
GALILEO	E5 - A	<input checked="" type="checkbox"/>	
GALILEO	E5 - B	<input checked="" type="checkbox"/>	
GALILEO	E5 - AltBOC	<input checked="" type="checkbox"/>	

- Position

Use this screen to configure settings relating to using the receiver as a Rover Integrity Monitor:

Position

PDOP Mask

RTK Mode Motion

CMR Input Filter

RTCM Input Filter

RTCM 2 Type 31 Input GLONASS Datum

Horizontal Precision [m]

Vertical Precision [m]

DGNSS Age of Correction:

GPS [Sec.]

GLONASS [Sec.]

- General

Use this screen to:

- Determine whether event signals and an external frequency source will be used.
- Choose to output a one-pulse-per-second signal (1 PPS).
- Disable the use of the internal battery as an uninterruptable power supply.
- Enable Power over Ethernet.
- Configure power on and shutdown voltages.
- Configure VFD settings.

General

Event 1 On/Off Event 1 Slope

External Frequency [No Source Detected]

Internal Battery UPS

1PPS On/Off

Power Over Ethernet Ethernet Battery Charging

Power On Voltage Volts. Range: 10.8V-15.0V. Default: 15.0V

Shutdown Voltage
 Volts. Range: 9.5V-15.0V. Default: 10.5V

VFD Configuration

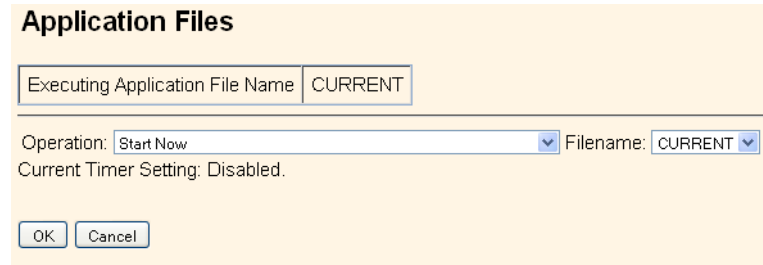
VFD Power Saver

VFD Brightness

VFD Rotation

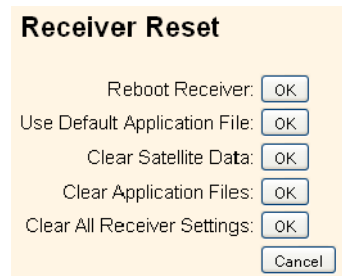
- Application Files

Use this screen to configure all of the settings that make up an application file, to save that file, and to select an application file for use:



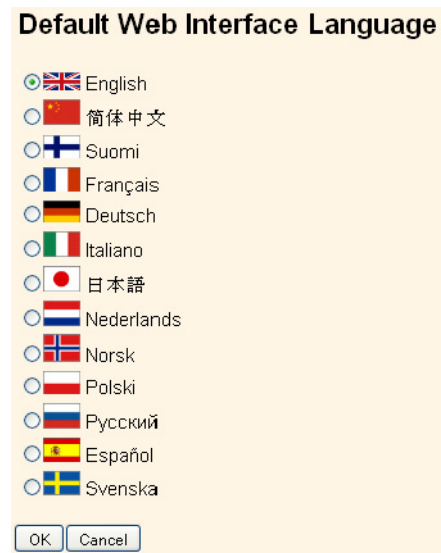
- Reset

Use this screen to completely or partially reset the receiver:



- Default Language

Use this screen to select the language that the receiver uses when it starts:



I/O Configuration menu

Use the *I/O Configuration* menu to set up all receiver outputs and inputs. The receiver can output CMR, RTCM, NMEA, GSOF, RT17, RT27, or BINEX messages, on TCP/IP, UDP, serial, or Bluetooth ports.

The following figure shows an example of the screen that appears when you select *I/O Configuration / Port Summary*:

I/O Configuration				
Type	Port	Input	Output	
TCP/IP	5017	-	RT27(1Hz)	
TCP/IP	5018	-	-	
UDP	9750	-	-	
TCP/IP	14999	-	NMEA-GGA(5 Sec.)	
TCP/IP	28001	-	-	
TCP/IP	28002	-	-	
NTRIP Client	155.63.159.60:28004/VRS_CM Rx	CMR	NMEA-GGA(5 Sec.)	
NTRIP Server	-	-	-	
NTRIP Caster 1	2101	-	-	
NTRIP Caster 2	2102	-	-	
NTRIP Caster 3	2103	-	-	
Serial	Serial 1 (38.4K-8N1)	-	-	
Serial	Serial 2 (38.4K-8N1)	-	-	
Bluetooth	1	-	-	
Bluetooth	2	-	-	
Bluetooth	3	-	-	
USB	-	-	-	

You can use the receiver USB port to access the receiver in USB Device mode. This enables you to cable your computer to the receiver and then browse the receiver internal memory as an external USB device. USB drivers are available from www.trimble.com.

- Bluetooth menu

Use this menu to configure Bluetooth settings. The following figure shows an example of the screen that appears when you select *Bluetooth/Info*:

Bluetooth Info	
Module Info	Infineon UniStone HW: v2.4; FW: v1.0.5
Stack Version	1.21:1.2
Local Name	NetR9, 5003K65235: Trimble
Bluetooth MAC Address	00:03:19:05:67:88
Discoverable	False
Pin Code	0000

OmniSTAR menu

Use this menu to configure OmniSTAR settings.

The following figure shows an example of the screen that appears when you select *OmniSTAR/Summary*:

OmniSTAR Summary	
Signal Source	Demodulator
SV name	Auto/MSVCN
Frequency [MHz]	1557.8350
Bit Rate [Hz]	1200
Setting	Auto
Mode	Tracking
SNR (Eb/No)	8.53
Total messages	5
Bad messages	0
Total unique word bits	384
Bad unique word bits	0
Total Viterbi symbols	48768
Corrected Viterbi symbols	4
Estimated BER	1.81164e-05
I/Q ratio	4.23136
Unique words with bit errors	0

Network Configuration menu

Use this menu to configure Ethernet settings, PPP, Routing Table, Email Client, Email Alerts, HTTP/HTTPS port, Proxy, FTP port, NTP ports and settings, VFD (Virtual Front Display), and discovery port settings of the receiver.

The VFD port enables you to use the Remote Control application to view the receiver and navigate it through a mock display and keypad interface. To enable this function, select *Network Configuration / VFD*.

A viewing utility is available on www.trimble.com.

The receiver can notify a system administrator by sending alerts (about general status changes in the receiver), and warning messages (about problems), to a specified email address. This requires the use of an SMTP server. To find out how to connect the receiver to the server, contact your network administrator.

The following figure shows an example of the screen that appears when you select *Network Configuration / Ethernet*:

Ethernet Configuration

Stored settings

IP Setup: Static IP ▾

IP Address: 10 . 1 . 95 . 100

Netmask: 255 . 255 . 254 . 0

Broadcast: 10 . 1 . 95 . 255

Gateway: 10 . 1 . 94 . 1

Force DNS Address:

DNS Address: 10 . 1 . 80 . 24

DNS Domain: am.trimblecorp.net

Hostname: trim5003K65235

MTU: 1500

Change Configuration

Renew DHCP

Current settings

IP Setup: Static IP

IP Address: 10.1.95.100

Netmask: 255.255.254.0

Broadcast: 10.1.95.255

Gateway: 10.1.94.1

Force DNS Address: Yes

DNS Address: 10.1.80.24

DNS Domain: am.trimblecorp.net

Hostname: trim5003K65235

MTU: 1500

Security menu

Use this menu to configure the login accounts for all users who will be permitted to configure the receiver through a web browser. Each account consists of a username, password, and permissions. Administrators can use this feature to limit access to other users. By default, security is **disabled** to make it easier to configure the receiver. However, Trimble encourages administrators to **enable** security to avoid unwanted changes. If security is enabled with anonymous access, it allows users to browse the receiver settings but they cannot make changes.

The following figure shows an example of the screen that appears when you select *Security/Configuration*:

Security Configuration

Security: Enabled with Anonymous Access ▾

Anonymous User: File Download
 File Delete

Delete?	Username	Edit User	File Download	File Delete	Receiver Config	NTripCaster	
	admin	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input type="checkbox"/>	TRMB	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="button" value="Update"/>
<input type="checkbox"/>	Rover1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="button" value="Update"/>
<input type="checkbox"/>	Rover2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="button" value="Update"/>
<input type="checkbox"/>	Downloads	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="Update"/>
<input type="checkbox"/>	Manager	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="button" value="Update"/>

Add User

Username:

Password:

Verify Password:

Edit User	File Download	File Delete	Receiver Config	NTripCaster
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Firmware menu

Use this menu to verify the current firmware and to 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.

The following figure shows an example of the screen that appears when you select *Firmware*:

Install New Firmware

Firmware Warranty Date: 2011-07-01
 Active Firmware Version: 0.16 - 4.15
 Active Firmware Date: 2010-03-23
 Active Firmware Checksum: a3de9939

Status: Idle

Programmatic Interface menu

Use this menu to show, set, and command configurations. The interface allows simple HTTP scripting for browser use or for integration into other web-capable platforms. For more information on supported commands and command structure, see [Appendix D, Programmatic Interface](#).

The following figure shows an example of the screen that appears when you select *Programmatic Interface*:

Programmatic Interface

Send AutoSubmit

Response Mode: Text XML

Status
 Configuration 1
 Firmware
 Satellites
 Configuration 2
 I/O

Status Commands

Show SerialNumber Returns the Serial Number for this GPS 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 voltage on all power or battery inputs.

Show Temperature Returns the internal temperature of the GPS Receiver

Show Commands Returns a list of supported commands (XML mode only)

Default Settings and Application Files

In this chapter:

- Default receiver settings

Most of the receiver settings are stored in application files. The default application file, `Default.cfg`, is stored permanently in the receiver, and contains the factory default settings for the NetR9 GNSS reference receiver.

Whenever the receiver is reset to its factory defaults, the current settings (stored in the current application file, `Current.cfg`) are reset to the values in the default application file.

The NetR9 GNSS reference receiver extends the use of application files to allow simplified receiver setting duplication in multiple receivers. This is sometimes referred to as ***receiver cloning*** and is very useful when preparing a large group of receivers for a field data collection campaign.

Default receiver settings

These settings are defined in the default application file.

Function		Factory default values
SV Enable		All SVs enabled
General controls	Elevation mask	0°
	PDOP mask	99
	RTK positioning mode	Low latency
	Motion	Static
Lemo port	Baud rate	38,400
	Format	8-None-1
	Flow contro	None
D9 port	Baud rate	38,400
	Format	8-None-1
	Flow contro	None
Input setup	Station	Any
NMEA/ASCII (all supported messages)		All ports off
Streamed output		All ports off
RT17/RT27/Binary		All ports off
Reference position	Latitude	0°
	Longitude	0°
	Altitude	0.00HAE (Height Above Ellipsoid)
Antenna	Type	Zephyr Geodetic Model 2
	Height (True vertical)	0.00 m
	Measurement method	True vertical

Resetting the receiver to factory defaults

Press  for 35 seconds.

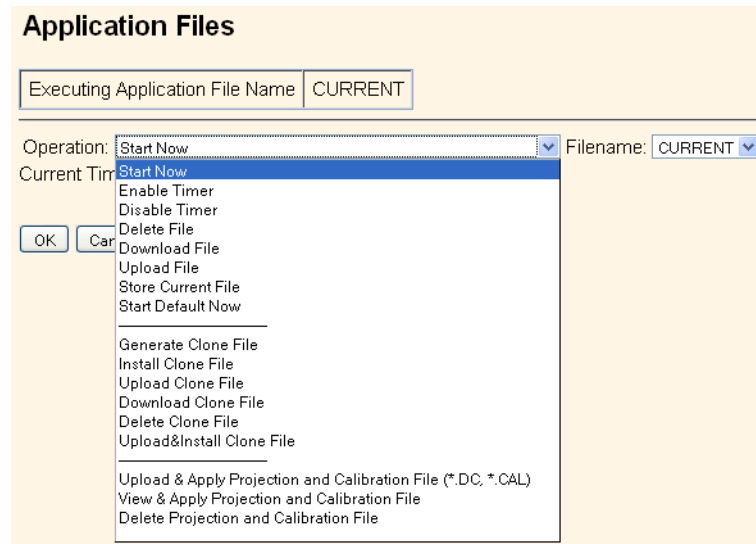
Using application files to duplicate receiver settings

The NetR9 GNSS reference receiver allows the extensive use of application files in order to retain a unique receiver configuration. With this receiver, you can create an application file that includes most of the receiver's unique configuration settings. You can then copy that application file onto one or more other NetR9 GNSS reference receivers (the *target*) to quickly configure them to match the first receiver (the *source*).

For settings that are not stored in an application file, there are also *clone* files, which enable you to capture all of the settings not included in the application file. You can copy the clone file and the application file onto one or more other NetR9 GNSS reference receivers (the *target*) to give them the exact configuration as the first receiver (the *source*). This is called *receiver configuration cloning* or *cloning*. Receiver cloning greatly reduces the time required to prepare a large group of receivers for field operations.

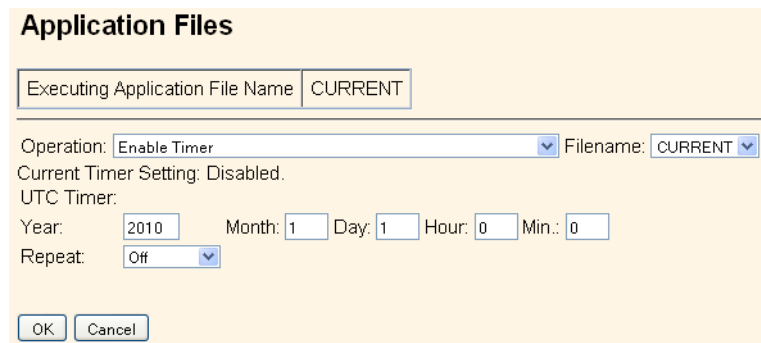
Select *Receiver Configuration/Application Files* to access the required tools to use these features. There are two variable fields:

- *Filename*: Enter a unique name for a stored configuration file.
- *Operation*: Select a particular operation from a drop-down list.



The available operations are as follows:

Operation	Description
Start Now	Applies the selected application file.
Enable Timer	Determines at what time and date the receiver will automatically power-up (wake up) and at what interval it will automatically power-up thereafter.
Disable Timer	Overrides all previously configured power-up timer settings.
Delete File	Deletes the currently selected application file.
Download File	Allows you to download the currently selected application file to your browsing computer.
Upload File	Allows you to store an application file including all current custom settings under a new name.
Store Current File	Returns the receiver to factory default settings.



Operation	Description
Generate Clone File	<p>Allows you to create a named xml file including the receiver configuration items of your choice.</p> <div data-bbox="469 356 1299 882" data-label="Image"> </div>
Install Clone File	Tells the receiver to accept the clone file settings in a particular file.
Upload Clone File	Allows you to move a clone file from your browsing computer to the target receiver.
Download Clone File	Allows you to move a clone file from the receiver to your browsing computer.
Delete Clone File	Allows you to delete a clone file stored on the receiver.
Upload&Install Clone File	Sends a clone file to the target receiver while telling the receiver to accept and apply these settings.

The following generated Clone file selections are available:

When you select this generated clone file...	The system ...
Clone Security Configuration	<p>Clones all security settings on the source receiver. See the Security menu.</p> <ul style="list-style-type: none"> All system users with Username, Password, and access settings. Security status: <ul style="list-style-type: none"> Enable Enable with Anonymous Access Disable
Clone IP Port and I/O Streams Configuration	<p>Clones all Input/Output stream configurations from the source receiver. See the I/O Configuration menu.</p> <ul style="list-style-type: none"> TCP/IP Port NTRIPClient NTRIPServer NTRIPCasters Serial ports Bluetooth ports: If the <i>Maintain configuration when connection dropped</i> switch is set. <p>Note – The source receiver clone files will not overwrite any ports currently configured on the target receiver.</p>

When you select this generated clone file...	The system ...
Clone Ethernet Boot Configuration	<p>Clones all Ethernet settings of the source receiver. See the Network Configuration/Ethernet menu.</p> <ul style="list-style-type: none"> • IP Setup <ul style="list-style-type: none"> - DHCP - Static IP • IP Address • Netmask • Broadcast • Gateway • Force DNS Address switch • DNS Address • DNS Domain
Clone HTTP Configuration	<p>Note – If the source receiver has a static IP address, you may need to edit the static IP address of the target receiver after the clone file is passed to that target.</p> <p>Clones all HTTP and HTTPS settings of the source receiver. See the Network Configuration/HTTP menu.</p> <ul style="list-style-type: none"> • HTTP Enable switch • HTTP Server Port • HTTPS Secure Enable switch • HTTPS Secure Port • Certificate Information
Clone Email Alert, FTP, NTP Server Configuration	<p>Clones all Email Alert controls, all FTP/FTP Push controls and NTPServer settings.</p> <p><i>Email alerts</i></p> <ul style="list-style-type: none"> • Enable switch • Authorization required switch • SMTP Server • SMTP Port • From Email Address • Any Alert switches <p>You must enter the email address to which the email is to be sent, login, and the email password.</p> <p><i>FTP</i></p> <ul style="list-style-type: none"> • FTP Server Enable switch • FTP Server Port • FTP Push Controls <ul style="list-style-type: none"> - FTP Server Address - Remote Directory (at server) - Path Style - Rename setting <p>You must enter the username and password.</p> <p><i>NTP server</i></p> <ul style="list-style-type: none"> • External Time Servers • NTP Port • Enable switch

When you select this generated clone file...	The system ...
Clone Data Logger Configuration	Clones all configured Data Logging Sessions from the source receiver. <ul style="list-style-type: none">• Session Name• Enable switch• Schedule setting• Duration• Measurement Interval• Smoothing settings• Position Interval• File System setting• Path and Name Style• Pool setting• FTP/Email Push switch
Clone Ephemeris and Almanac expediting Data	Clones all Ephemeris and Almanac data from the source receiver for SV tracking of target receiver(s). <ul style="list-style-type: none">• GPS Satellites - SV1~SV32• SBAS Satellites - SV120~SV138• GLONASS SV1~SV24• Galileo GIOVE A and GIOVE B• NAV Chan 0~11• SBAS for correction• WAAS Ephemeris and Iono Bands• Position• UTC• Almanac Health

When you select this generated clone file...	The system ...
Clone Miscellaneous (Everything Else)	<ul style="list-style-type: none"> • Position Controls <ul style="list-style-type: none"> - Elevation Mask - PDOP Mask - RTK Mode - Motion - Precisions • General Controls <ul style="list-style-type: none"> - Event On/Off and Slope - External Frequency - Internal Battery UPS setting - 1PPS On/Off - Power Over Ethernet Enabled/Disabled - Ethernet Battery Charging setting - Shutdown Voltage settings - VFD Configuration - VFD Power Saver setting • Tracking Controls <ul style="list-style-type: none"> - Everest setting - Clock Steering setting - Signal Enable switches and Options • Antenna Settings <ul style="list-style-type: none"> - Antenna Type - Measurement Method - Antenna Height • Reference Station settings <ul style="list-style-type: none"> - Latitude/Longitude/Height - CMR ID - RTCM 2.x/3.x ID - Station Name - Station Code • Bluetooth Controls • OmniSTAR Configuration <ul style="list-style-type: none"> - External OmniSTAR Data - Internal OmniSTAR Demodulator - SV Name - Seed with RTK setting - NAD83>ITRF Transformation switch

Specifications

In this chapter:

- General
- Physical
- Electrical
- Communication

This chapter describes the specifications for the NetR9 GNSS reference receiver.

Specifications are subject to change without notice.

General

Feature	Specification
Keyboard and display	Vacuum Fluorescent Display (VFD), 16 characters by 2 rows Escape and Enter key for menu navigation 4 arrow keys (up, down, left, right) to scroll options and for data entry
Receiver type	GNSS reference receiver
Antenna type	Zephyr Geodetic Model 2 or Trimble GNSS Choke Ring antenna preferred. Other models supported.

Physical

Feature	Specification
Dimensions	26.5 cm x 13.0 cm x 5.5 cm (10.43 in x 5.12 in x 2.16 in)
Weight	1.75 kg (3.85 lb)
Temperature ¹	
• Operating	-40 °C to +65 °C (-40 °F to +149 °F)
• Storage	-40 °C to +80 °C (-40 °F to +176 °F)
Humidity	100% condensing
Ingress protection	Tested to IP67; waterproof for temporary immersion to a depth of 1 m (3.28 ft); dustproof
Shock and vibration	Designed to survive a 1 m (3.28 ft) drop onto a hard surface.
• Shock: non-operating	Survival to 75 g, 6 mS
• Shock: operating	Survival to 25 g, 10 msec, saw-tooth
• Vibration	10 Hz to 300 Hz 0.04 g ² / Hz; 300 Hz to 1000 Hz -6 dB/Octave
Tracking	<ul style="list-style-type: none"> • Two advanced Trimble Maxwell™ 6 GNSS chipsets for a total of 440_channels • Trimble EVEREST multipath signal rejection • Trimble R-Track™ technology • High precision multiple correlator for GNSS pseudorange measurements • Unfiltered, unsmoothed pseudorange measurements data for low noise, low multipath error, low time domain correlation and high dynamic response • Very low noise GNSS carrier phase measurements with <1 mm precision in a 1 Hz bandwidth • Signal-to-noise ratios reported in dB-Hz • Proven Trimble low elevation tracking technology • Current satellite signals tracked simultaneously: <ul style="list-style-type: none"> - GPS: L1 C/A, L2C, L2E (Trimble method for tracking L2P), L5 - GLONASS: L1 C/A and unencrypted P code, L2 C/A1 and unencrypted P code - Galileo GIOVE-A and GIOVE-B - SBAS: L1 C/A, L5 supporting WAAS, EGNOS and MSAS - L-Band OmniSTAR VBS, HP and XP

Feature	Specification
Code Differential GNSS Positioning²	
• Horizontal	0.25 m + 1 ppm RMS
• Vertical	0.50 m + 1 ppm RMS
• WAAS differential positioning ³	Typically, <5 m 3DRMS
Static GNSS Surveying²	
Baseline <30 km	
• Horizontal	3 mm + 0.1 ppm RMS
• Vertical	4 mm + 0.4 ppm RMS
Baseline >30 km	
• Horizontal	4 mm + 0 ppm RMS
• Vertical	9 mm + 0 ppm RMS
Real Time Kinematic Surveying^{2, 4}	
Single Baseline <30 km	
• Horizontal	8 mm + 1 ppm RMS
• Vertical	15 mm + 1 ppm RMS
Networked RTK ⁵	
• Horizontal	8 mm + 0.5 ppm RMS
• Vertical	15 mm + 0.5 ppm RMS
Initialization time	Typically <10 seconds
Initialization reliability	Typically >99.9%
<ol style="list-style-type: none"> 1. The internal battery will operate from -20 °C to +50 °C (-4 °F to +122 °F). The internal battery charger will operate from 0 °C to 40 °C (32 °F to 104 °F). 2. Accuracy may be subject to degradation by multipath interference, obstructions, satellite geometry and atmospheric conditions. Always follow recommended survey practices. 3. Depends on WAAS/EGNOS system performance. 4. NetR9 limited to 1,000 m RTK baseline length. 5. Networked RTK PPM values are referenced to the closest physical base station. 	

Electrical

Feature	Specification
Power	
Internal	<p>Integrated internal battery 7.4 V, 7800 mA-hr, Lithium-ion</p> <p>Internal battery can operate as a UPS in the event of external power source outage</p> <p>Internal battery will charge from external power source when input voltage is >12 V or via Power over Ethernet supply</p>
External	<p>Power input on Lemo 7P05 has a user-defined cut off threshold of 9.5 V or higher.</p> <p>Power source supply (Internal / External) is hot swap capable in the event of power source removal or cut-off</p> <p>Power input on Lemo ports is 9.5 V DC to 28 V DC external power input with over-voltage protection</p> <p>Receiver will auto power on when connected to external power of a user-defined voltage. The default value is 15 V.</p>
Power over Ethernet	Requires a Class 3 Ethernet power supply.
Power consumption	3.8 W nominal, dependent upon user settings.
Reference station operation time on internal battery	Up to 15 hours.
Regulatory	<p>RoHS</p> <p>China RoHS</p> <p>FCC Part 15.247 FCC certifications</p> <p>Class B Device FCC Part 15 and ICES-003 compliance</p> <p>RSS-310 and RSS-210 Industry Canada compliance</p> <p>CE mark compliance</p> <p>C-Tick mark compliance</p> <p>UN ST/SG/AC.10.11/Rev. 3, Amend. 1 (Li-Ion battery)</p> <p>UN ST/SG/AC.10/27/Add. 2 (Li-Ion battery)</p> <p>WEEE</p>

Communication

Feature	Specification
Communications	
<ul style="list-style-type: none"> • Port 1 (D9 male) • Port 2 (OS 7P Lemo) • Port 3 (USB) • RJ45 Jack • Bluetooth 	<p>Full 9-wire RS-232</p> <p>3-wire RS-232, 1PPS output, event input, DC power input</p> <p>5 pin Mini-B USB, operates in Device or Host modes</p> <p>Ethernet, PoE</p> <p>Fully integrated, fully sealed 2.4 GHz Bluetooth wireless technology.</p> <p>Note – Bluetooth type approvals are country-specific. For more information, contact your local Trimble office or representative.</p>
Receiver position update rate	1 Hz, 2 Hz, 5 Hz, 10 Hz, 20 Hz, and 50 Hz positioning
Data Input and Output	CMR, CMR+™, CMRx, RTCM 2.1, 2.3, 2.3, 3.0, 3.1
Outputs	NMEA, GSOE, RT17, RT27, BINEX

NMEA-0183 Output

In this appendix:

- NMEA-0183 message overview
- Common message elements
- NMEA messages

This appendix describes the formats of the subset of NMEA-0183 messages that are available for output by the receivers.

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

NMEA-0183 message 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, and shows the page that contains detailed information about each message.

Message	Function	Page
ADV	Position and Satellite information for RTK network operations	82
GGA	Time, position, and fix related data	83
GSA	GPS DOP and active satellites	84
GST	Position error statistics	84
GSV	Number of SVs in view, PRN, elevation, azimuth, and SNR	85
HDT	Heading from True North	85
PTNL,AVR	Time, yaw, tilt, range, mode, PDOP, and number of SVs for Moving Baseline RTK	86
PTNL,GGK	Time, position, position type and DOP values	86
PTNL,PJK	Local coordinate position output	87
PTNL,VGK	Time, locator vector, type and DOP values	88
PTNL,VHD	Heading Information	89
RMC	Position, Velocity, and Time	89
ROT	Rate of turn	90
VTG	Actual track made good and speed over ground	90
ZDA	UTC day, month, and year, and local time zone offset	91

- 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). Only to be used 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. Only to be used 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. You should clear this check box to conform to the NMEA standard message length of 82 characters. However, if you do, the precision of the position and altitude data is reduced by truncating the number of decimal places.

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

Below is an example of a simple message with a message ID (*\$GPGGA*), followed by 13 fields and a checksum value:

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

Message values

NMEA messages that the receiver generates contains the following values.

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.cc*, where:

- *hh* is hours, from 00 through 23
- *mm* is minutes

- *ss* is seconds
- *cc* is hundredths of seconds

NMEA messages

When NMEA-0183 output is enabled, the following messages can be generated.

ADV Position and Satellite information for RTK network operations

An example of the ADV message string is shown below, with a description of the message fields. The messages alternate between subtype 110 and 120.

```
$PGPPADV,110,39.88113582,-105.07838455,1614.125*1M
```

ADV subtype 110 message fields

Field	Meaning
0	message ID \$PPGPADV
1	Message sub-type 110
2	Latitude
3	Longitude
4	Ellipsoid height
6	Elevation of second satellite, in degrees, 90° maximum
7	Azimuth of second satellite, degrees from True North, 000° through 359°
8	The checksum data, always begins with *

```
$PGPPADV,120,21,76.82,68.51,29,20.66,317.47,28,52.38,276.81,22,42.26,198.96*5D
```

ADV subtype 120 message fields

Field	Meaning
0	message ID \$PPGPADV
1	Message sub-type 120
2	First SV PRN number
3	Elevation of first satellite, in degrees, 90° maximum
4	Azimuth of first satellite, degrees from True North, 000° through 359°
5	Second SV PRN number
6	Elevation of second satellite, in degrees, 90° maximum
7	Azimuth of second satellite, degrees from True North, 000° through 359°
8	The checksum data, always begins with *

GGA Time, Position, and Fix Related Data

An example of the GGA message string is shown below, with a description of the message fields.

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

Field	Meaning
0	message ID \$GPGGA
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	GPS Quality indicator: 0: Fix not valid 1: GPS fix 2: Differential GPS fix 4: Real Time Kinematic, fixed integers 5: Real Time Kinematic, float integers
7	Number of SVs in use, range from 00 through 12
8	HDOP
9	Orthometric height (MSL reference)
10	M: unit of measure for orthometric height is meters
11	Geoid separation
12	M: geoid separation is 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, ranging from 0000 through 1023. A null field when any reference station ID is selected and no corrections are received.
15	The checksum data, always begins with *

GSA GPS DOP and active satellites

An example of the GSA message string is shown below, with a description of the message fields.

```
$GPGSA,<1>,<2>,<3>,<3>,,,,,<3>,<3>,<3>,<4>,<5>,<6>*<7><CR><LF>
```

Field	Meaning
0	message ID \$GPGSA
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, of satellite used in solution, up to 12 transmitted
4	PDOP-Position dilution of precision, 0.5 through 99.9
5	HDOP-Horizontal dilution of precision, 0.5 through 99.9
6	VDOP-Vertical dilution of precision, 0.5 through 99.9
7	The checksum data, always begins with *

GST Position Error Statistics

An example of the GST message string is shown below, with a description of the message fields.

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

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 *

GSV **Satellite Information**

The GSV message string identifies the number of SVs in view, the PRN numbers, elevations, azimuths, and SNR values. An example of the GSV message string is shown below, with a description of the message fields.

```
$GPGSV,4,1,13,02,02,213,,03,-3,000,,11,00,121,,14,13,172,05*67
```

Field	Meaning
0	message ID \$GPGSV
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, 00–99 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 *

HDT **Heading from True North**

The HDT string is shown below, with a description of the message fields.

```
$GPHDT,123.456,T*00
```

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 *

PTNL,AVR

Time, Yaw, Tilt, Range for Moving Baseline RTK

The PTNL,AVR message string is shown below, with a description of the message fields.

```
$PTNL,AVR,181059.6,+149.4688,Yaw,+0.0134,Tilt,,,60.191,3,2.5,6*00
```

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

PTNL,GGK

Time, Position, Position Type, DOP

An example of the PTNL,GGK message string is shown below, with a description of the message fields.

```
$PTNL,GGK,172814.00,071296,3723.46587704,N,12202.26957864,W,3,06,1.7,EHT-6.777,M*48
```

Field	Meaning
0	message ID \$PTNL,GGA
1	UTC of position fix
2	Date
3	Latitude
4	Direction of latitude: N: North S: South
5	Longitude

Field	Meaning
6	Direction of Longitude: E: East W: West
7	GPS Quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 2: Differential, floating carrier phase integer-based solution, RTK(float) 3: Differential, fixed carrier phase integer-based solution, RTK(fixed) 4: Differential, code phase only solution (DGPS). Also, OmniSTAR XP/HP converging 5: SBAS solution – WAAS, EGNOS 6: RTK Float 3D in a VRS/Network. Also OmniSTAR XP/HP converged 7: RTK Fixed 3D in a VRS/Network 8: RTK Float 2D in a VRS/Network
8	Number of satellites in fix
9	DOP of fix
10	Ellipsoidal height of fix
11	M: ellipsoidal height is measured in meters
12	The checksum data, always begins with *

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

PTNL,PJK

Local Coordinate Position Output

An example of the PTNL,PJK message string is shown below, with a description of the message fields.

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

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

Field	Meaning
7	GPS Quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 2: Differential, floating carrier phase integer-based solution, RTK(float) 3: Differential, fixed carrier phase integer-based solution, RTK(fixed) 4: Differential, code phase only solution (DGPS). Also, OmniSTAR XP/HP converging 5: SBAS solution – WAAS, EGNOS 6: RTK Float 3D in a VRS/Network. Also OmniSTAR XP/HP converged 7: RTK Fixed 3D in a VRS/Network 8: RTK Float 2D in a VRS/Network
8	Number of satellites in fix
9	DOP of fix
10	Ellipsoidal height of fix
11	M: ellipsoidal 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.

PTNL,VGK

Vector Information

An example of the PTNL,VGK message string is shown below, with a description of the message fields.

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

Field	Meaning
0	message ID \$PTNL,VGK
1	UTC of vector in hhmmss.ss format
2	Date in mmddyy format
3	East component of vector, in meters
4	North component of vector, in meters
5	Up component of vector, in meters
6	GPS Quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 2: Differential, floating carrier phase integer-based solution, RTK(float) 3: Differential, fixed carrier phase integer-based solution, RTK(fixed) 4: Differential, code phase only solution (DGPS). Also, OmniSTAR XP/HP converging 5: SBAS solution – WAAS, EGNOS 6: RTK Float 3D in a VRS/Network. Also OmniSTAR XP/HP converged 7: RTK Fixed 3D in a VRS/Network 8: RTK Float 2D in a VRS/Network
7	Number of satellites if fix solution
8	DOP of fix

Field	Meaning
9	M: Vector components are in meters
10	The checksum data, always begins with *

PTNL,VHD

Heading Information

An example of the PTNL,VHD message string is shown below, with a description of the message fields.

```
$PTNL,VHD,030556.00,093098,187.718,-22.138,-76.929,-
5.015,0.033,0.006,3,07,2,4,M*22
```

Field	Meaning
0	message ID \$PTNL,VHD
1	UTC of position in hhmmss.ss format
2	Date in mmddyy format
3	Azimuth
4	Δ Azimuth/ Δ Time
5	Vertical Angle
6	Δ Vertical/ Δ Time
7	Range
8	Δ Range/ Δ Time
9	GPS Quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 2: Differential, floating carrier phase integer-based solution, RTK(float) 3: Differential, fixed carrier phase integer-based solution, RTK(fixed) 4: Differential, code phase only solution (DGPS). Also, OmniSTAR XP/HP converging 5: SBAS solution – WAAS, EGNOS 6: RTK Float 3D in a VRS/Network. Also OmniSTAR XP/HP converged 7: RTK Fixed 3D in a VRS/Network 8: RTK Float 2D in a VRS/Network
10	Number of satellites used in solution
11	PDOP
12	The checksum data, always begins with *

RMC

Position, Velocity, and Time

The RMC string is shown below, with a description of the message fields.

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

Field	Meaning
0	message ID \$GPRMC
1	UTC of position fix

Field	Meaning
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 *

ROT Rate and Direction of Turn

The ROT string is shown below, with a description of the message fields.

```
$GPROT,35.6,A*4E
```

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 *

VTG Speed Over Ground or Track Made Good and Speed Over Ground

An example of the VTG message string is shown below, with a description of the message fields.

```
$GPVTG,,T,,M,0.00,N,0.00,K*4E
```

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	The checksum data, always begins with *

ZDA UTC Day, Month, And Year, and Local Time Zone Offset

An example of the ZDA message string is shown below, with a description of the message fields.

```
$GPZDA,172809,12,07,1996,00,00*45
```

Field	Meaning
0	message ID \$GPZDA
1	UTC
2	Day, ranging between 01 and 31
3	Month, ranging between 01 and 12
4	Year
5	Local time zone offset from GMT, ranging from 00 through ± 13 hours
6	Local time zone offset from GMT, ranging from 00 through 59 minutes
7	The checksum data, always begins with *

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

Upgrading the Receiver Firmware

In this appendix:

- The WinFlash utility
- Upgrading the receiver firmware
- Forcing the receiver into Monitor mode

The receiver is supplied with the latest version of the receiver firmware already installed. If a later version of the firmware becomes available, use the WinFlash utility to upgrade the firmware on your receiver.

Firmware updates are available for download from the Trimble website. Go to www.trimble.com/Support and select the link to the receiver that you need updates for and then click Downloads. Running the WinFlash installer installs the appropriate files to your hard drive.

You can also upgrade the receiver through the web interface. The firmware file required to upgrade the receiver through the Web interface is located in

C:\Program Files\Trimble\WinFlash\Firmware.
The file type required is the format `wm_vxxx.img` where xxx represents the version of firmware.

The WinFlash utility

The WinFlash utility communicates with Trimble products to perform various functions including:

- installing software, firmware, and option upgrades
- running diagnostics (for example, retrieving configuration information)
- configuring radios

For more information, online help is also available when using the WinFlash utility.

Note – *The WinFlash utility runs on Microsoft Windows® XP operating systems.*

Installing the WinFlash utility

You can download the WinFlash utility from the Trimble website. This self-extracting executable guides you through the software installation process.

Upgrading the receiver firmware

1. Start the WinFlash utility. The *Device Configuration* screen appears.
2. From the *Device type* list, select your receiver.
3. From the *PC serial port* field, select the serial (COM) port on the computer that the receiver is connected to and then click **Next**.

The *Operation Selection* screen appears. The *Operations* list shows all of the supported operations for the selected device. A description of the selected operation is shown in the *Description* field.

4. Select *Load GPS software* and then click **Next**.

The *GPS Software Selection* window appears. This screen prompts you to select the software that you want to install on the receiver.

5. From the *Available Software* list, select the latest version and then click **Next**.

The *Settings Review* window appears. This screen prompts you to connect the receiver, suggests a connection method, and then lists the receiver configuration and selected operation.

6. If all is correct, click **Finish**.

Based on the selections shown above, the *Software Upgrade* window appears and shows the status of the operation (for example, **Establishing communication with <your receiver>. Please wait.**).




7. Click **OK**.

The *Software Upgrade* window appears again and states that the operation was completed successfully.

8. To select another operation, click **Menu**; to quit, click **Exit**.
If you click **Exit**, the system prompts you to confirm.
9. Click **OK**.

Forcing the receiver into Monitor mode

If the receiver will not go into Monitor mode to load new firmware, complete the following steps:

1. Turn off the receiver.
2. Press and hold  while turning on the receiver.
3. Continue to hold the  button as the display shows the countdown timer.
4. Once the display shows **Remote Monitor Active:1**, release the  button.
5. The receiver is forced into Monitor mode and you can load the new firmware.

Troubleshooting

In this appendix:




- Receiver issues

Use this appendix to identify and solve common problems that may occur with the receiver.

Please read this section before you contact Technical Support.

Receiver issues

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

Issue	Possible cause	Solution
The receiver does not turn on.	External power is too low.	Check the charge on the external battery and, if applicable, check the fuse.
	Internal power is too low.	Check the charge on the internal battery.
	External power is not properly connected.	Check that the Lemo connector is seated correctly and that the cable is secured to the receiver. Check for broken or bent pins in the connector.
	Faulty power cable.	Check that you are using the correct cable for the port/battery. Check that the correct battery is connected to a particular port. Check pinouts with a multimeter to ensure internal wiring is intact.
Receiver does not log data.	Insufficient memory.	Delete old files. Do one of the following: <ul style="list-style-type: none"> Press  for 35 seconds. Use the delete and purge functions in the <i>Data Logging</i> menu of the web interface.
	The receiver is tracking fewer than four satellites.	Wait until the receiver display shows that more than four satellites are being tracked.
	The internal memory needs to be reformatted	Press  for 35 seconds.
The receiver is not responding.	Receiver needs a soft reset.	Turn off the receiver and then turn it back on again.
	Receiver needs a full reset.	Press  for 35 seconds.
The reference station receiver is not broadcasting	Port settings between reference receiver and radio are incorrect.	Check the port settings for the receiver by using the front panel or the Web interface. Check that the radio ports are correctly set up.
	Faulty cable between receiver and radio.	Try a different cable. Examine the ports for missing pins. Use a multimeter to check pinouts.
	No power to radio.	If the radio has its own power supply, check the charge and connections.
Rover receiver is not receiving radio.	The base station receiver is not broadcasting.	See the issue, The base station receiver is not broadcasting. above.
	Incorrect over air baud rates between reference and rover.	Connect to the rover receiver radio, and make sure that it has the same setting as the reference receiver.
	Incorrect port settings between roving external radio and receiver.	If the radio is receiving data and the receiver is not getting radio communications, use the SCS900 software to check that the port settings are correct.
	The radio antenna cable and GNSS antenna cable are mixed up.	Make sure that the external radio antenna cable is connected between the TNC connector marked RADIO and the radio antenna.

Issue	Possible cause	Solution
The receiver is not receiving satellite signals	The GNSS antenna cable is loose.	Make sure that the GNSS antenna cable is tightly seated in the antenna connection on the GNSS antenna.
	The cable is damaged.	Check the cable for any signs of damage. A damaged cable can inhibit signal detection from the antenna at the receiver.
	The GNSS antenna is not in clear line of sight to the sky.	<ul style="list-style-type: none"> • Make sure that the GNSS antenna is located with a clear view of the sky. • Restart the receiver as a last resort (turn off and then turn it on again).

Programmatic Interface

In this appendix:

- Overview
- Format of programmatic commands
- Uploading files
- Responses to commands
- Using programmatic commands
- Using Curl
- Using Perl
- Other techniques
- Programmatic commands

This appendix describes the Programmatic Interface which is a method of remotely controlling a Trimble GNSS receiver using easily generated text-based commands. This interface exists in parallel to the Graphical User Interface (GUI) that is accessible through the HTTP and HTTPS ports of the receiver. The GUI interface uses HTML web pages to provide visual, point-and-click access to all information and controls on the system. It is designed to be interactive with the user, and is not well suited for automating remote control tasks. The Programmatic Interface provides a matching functionality using a more machine friendly method. It accepts easily generated, text-based commands as requests to the GNSS receiver. The GNSS receiver responds with simple, plain-text answers that are easily interpreted by an automatic process.

Overview

Programmatic commands are submitted to the GNSS receiver using the same TCP/IP channels used by the GUI-browser interface. They both use the HTTP or HTTPS protocol to submit CGI requests encoded in URLs. Response documents are then returned to the remote computer using the same channels. The only differences between GUI requests and Programmatic requests are the exact URLs used and the types of responses returned.

Secure operations using the Programmatic Interface are available in two ways:

- The interface can be accessed through the HTTPS protocol, which encrypts all transactions. This prevents anyone from observing the interactions. Note that the commands can be accessed over the unencrypted HTTP port as well, which is not encrypted.
- The second level of security is provided by the HTTP Security mechanism. All programmatic commands are handled through the web server inside the GNSS Receiver. This security has three levels:

State	Access
Disabled	Any user can execute any programmatic command.
Enabled	A valid user account must be supplied with each Programmatic Interface request. The capabilities for that account may limit the types of requests that the user can make.
Enabled With Anonymous Access	Many commands can be executed without providing a username and account. These would be primarily "show" commands that will not alter the configuration of the system. The capabilities of the anonymous user can be customized to include file download and file deletion. However, Programmatic Commands beyond that limited scope are not allowed unless an authorized account name and password are used.

***Note** – By default, HTTP Security is **not enabled**. You must set Enabled or Enabled-With-Anonymous-Access restrictions before accounts and passwords will be required for the Programmatic Interface. See sample code later in this document for examples of how you can encode your requests when a Security mode is enabled.*

Format of programmatic commands

Programmatic commands are formatted as if they were URL CGI requests. For example, <http://NETR9-17332/prog/enable?session&name=HiRate>.

Variable	Description
http:	The protocol to use, either 'http:' or 'https:'
//NETR9-7332 or //10.1.150.72	The name or IP address of the GNSS receiver that is the target of the command. Must be preceded by two slashes, '//'. In this example, the Verb is 'enable'.
/prog	Indicator to the GNSS receiver web server that this is a programmatic request. This triggers the command parser to interpret the command.
/enable	The Verb. This is the action requested. Verbs can be one of: <ul style="list-style-type: none"> • Show • Set • Reset • Enable • Disable • Delete • Download • Upload
?session	This is an Object type on which the action is to be performed. Objects can be: <ul style="list-style-type: none"> • A state or characteristic of the system, such as the Serial Number. • A function control, such as ElevationMask or data logging Session. • A file object, like a logged data file, or a firmware file.
&name=HiRate	In this example, the Object is a data logging Session. A parameter that picks one of several objects, or describes characteristics that qualify the command request. In this sample, the 'name' parameter gives the name of the specific data logging Session that is to be enabled. Parameters are usually in the form paramname=value. Multiple parameters can be given for a single command. They all must be separated by an ampersand (&).

The general command format is:

<http://SystemName/prog/Verb?Object¶m=value¶m=value...>

In most of this document, parts of that format are ommitted. For clarity commands are shown as:

Verb Object param=value param=value ...

As far as is possible, Verbs, Objects, parameter names, and parameter values are not case sensitive. That is, you can use any combination of upper and lower case characters, anywhere in the commands. The exceptions are items such as SystemName, file names, session names, account names, passwords, and so on. These exceptions are called out in the parameter descriptions for each command.

Command parameters are in the form `paramname=value`. The value is a string of characters, usually a number or a single word. A few parameter values can contain multiple items concatenated into a single string, often with punctuation. For example, some parameters allow a comma-separated list like this:

Set GpsSatControls disable=5,8,23

In such cases, the parameter listing in the command description shows the acceptable formats.

Some parameters define an arbitrary string of characters that can include spaces, ampersands, or other punctuation character. These characters may cause problems when encoded in URLs. It is best to express them as "%xx" values, where 'xx' is the hexadecimal equivalent of the ASCII character. Common values that need encoding are:

Hex	ASCII
%20	Space
%25	Percent (%)
%26	Ampersand (&)
%3F	QuestionMark (?)

Most other characters do not require encoding but, if in doubt, you can do so.

Uploading files

A small number of commands are used to transfer a file from an external computer into the GNSS receiver. These commands all use the verb `Upload`. The process for uploading a file is more complex than a simple URL/CGI submission. Instead of an http GET request, you use a POST request. Programming with `Upload` commands requires special techniques. See the following examples in [Using Curl, page 108](#), [Using Perl, page 109](#), and [Firmware commands, page 113](#).

Responses to commands

Programmatic Interface requests trigger a response from the GNSS receiver. The response is usually a plain-text ASCII document that is returned using the HTTP or HTTPS protocol. The response can take one of several forms:

- [Single line data response, page 105](#)
- [Multi-line data response, page 105](#)
- [Single line action response: OK, page 106](#)
- [A single line error message, page 106](#)
- [Binary file response, page 107](#)

Single line data response

These are usually the result of Show commands, where the data returned is simple enough to fit on a single text line. For example, the response to command **Show SerialNumber** is:

```
SerialNumber sn=1234A56789
```

Single-line responses can be arbitrary text, but most often they are similar to a Set command format, showing an object name with parameters. For example, **Show GpsSatControls** returns:

```
GpsSatControls enable=all disable=5,6 ignoreHealth=7
```

This string is exactly what you must be append to the Set verb, in order to restore the controls to the current state.

Multi-line data response

Some responses are too long to be returned in a single line of text. In this case, the response is spread over multiple lines, with leading and trailing lines that frame the data. Both framing lines start with '<' and end with '>'. Between the two characters, text shows which command was used to trigger the response. For example, the **Show Sessions** command produces a response like this:

```
<Show Sessions>
```

```
Session name=CORSA enable=yes schedule=Continuous ....
```

```
Session name=CORSB enable=no schedule=Continuous....
```

```
Session name=CORSC enable=no schedule=Continuous ....
```

```
<end of Show Sessions>
```

Schematically, the multi-line format takes the form:

```
<Verb Object Parameters>
```

```
Zero or more lines of ASCII data
```

```
<end of Verb Object Parameters>
```

Note –

- A multi-line response may have zero lines of data inside the frame.
- There is no way of determining the length of the response other than counting lines until the end-of-response line is found.
- Any command that can return a multi-line response will always do so, even if the information could fit in a single line response.

Single line action response: OK

All commands that use a verb other than **Show** attempt to initiate an action as well as returning some data. The response to these commands indicates two things:

- Whether the command succeeded
- What the results of the action were

Successful execution of the command is always shown by a response line that starts with **OK:**. This is followed, on the same line, by descriptive text indicating what action was taken.

Often the descriptive text takes the form of the response from a corresponding Show command that shows the new state of the object being controlled. For example, the command **Set Pps enable=yes slope=positive** returns

OK: PPS enable=yes slope=positive

Some commands allow partial parameter lists, and then use defaults for the unspecified values. In these cases, the **OK** response always shows the complete list of settings that the affected object now has.

In other cases the descriptive text shows an appropriate description of what action was taken. For example:

Delete IoPort port=TcpPort5066

OK: IoPort TcpPort5066 is deleted.

Reset GnssData

OK: Clearing GnssData and restarting system.

A single line error message

If the command parser has difficulty understanding or implementing a command, it responds with a single line error message that shows why the command was rejected or why it failed to execute. For example:

Show

ERROR: Invalid command 'Show'

Shw System

ERROR: Invalid verb 'Shw'

Show Serial

ERROR: Unknown command : 'show?serial'

Show SerialNumber

SerialNumber sn=60350239BF

Enable Session name=testing

ERROR: No Session 'testing' exists.

Set multipathReject enable=maybe

ERROR: Invalid Yes/No Argument : set?multipathreject&enable=maybe

Binary file response

Some commands return a non-ASCII response, in the form of an 'application/octet-stream' binary document. This is used only by the Download File command. Receiving such a document may require special processing.

Using programmatic commands

In order 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 Browser-GUI 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, which include the following information:

- The required 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 in the form:

http://SystemName/prog/Verb?Object¶m=value¶m=value...

If any parameter values have special characters in them, such as 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, use the CGI transmission tool to send a **GET** request that contains the encoded command to the target GNSS receiver. The receiver responds 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 this process is the case of uploading a file to the GNSS receiver. Upload commands use a **POST** request instead of **GET**. For more information, see [Uploading files, page 104](#).

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://NetR9.Trimble.com/prog/show?serialNumber'  
SerialNumber sn=60350239BF  
$ curl 'http://NetR9.Trimble.com/prog/show?gpstime'  
GpsTime gpsweek=1244 weekseconds=437597  
$ curl 'http://NetR9.Trimble.com/prog/badcommand?abc'  
ERROR: invalid verb 'badcommand'  
$ curl 'http://NetR9.Trimble.com/prog/set?elevationmask&mask=10'  
OK: ElevationMask mask=10  
$ curl 'http://NetR9.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>
```

You can assemble multiple Curl commands into a shell script to implement a basic form of remote control.

If the GNSS receiver has security enabled, you need an account name and password to use the programmatic interface commands. Curl accepts these in a '-u' command line argument. For example:

```
$ curl -u admin:adminpw 'http://NetR9.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://NetR9/prog/download?file&path=$path/$name" > $name  
$
```

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 ends 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://NetR9/prog/upload?firmwareFile' -F firmwareFile=@$f
```

That command uploads a new firmware image file to the GNSS receiver, and triggers an installation of the new firmware.

Using Perl

Perl is a powerful scripting language. The language comes with numerous library packages that allow it 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 web access in Perl. On a Linux system, 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 more complex than just redirecting a `get()` request to a file, mainly because 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 $req = HTTP::Request->new(GET=>
    "http://NetR9/prog/download?file&path=$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. 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

You can use other methods to transmit the Programmatic Commands to the target system. For example, you could write C or C++ programs to directly open socket connections to the GNSS receiver and then directly transmit the requests over those channels. This is moderately advanced programming and the details are beyond the scope of this document.

Programmatic commands

Below is a complete list of the Action-Object commands accepted by the programmatic interface. Click an individual command to go to the specific information on that command.

- [Status commands, page 111](#)
- [Satellite commands, page 111](#)
- [Configuration commands, page 112](#)
- [Input/Output commands, page 112](#)
- [Firmware commands, page 113](#)

Status commands

All of these commands display some information from the GNSS receiver. The information can be a static item, such as a serial number, or dynamic, such as 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.

Command	Description
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
Show ReferenceFrequency	Returns the current source for the 10MHz reference clock.
Set ReferenceFrequency	Modifies the source for the 10MHz reference clock.
Show ElevationMask	Returns the current Elevation Mask control setting.
Set ElevationMask	Modifies the Elevation Mask control setting.
Show PdupMask	Returns the current PDOP Mask control setting.
Set PdupMask	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, and so on:

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.

Command	Description
PortParameters	Port specification parameters.
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

Glossary

almanac	<p>A file that contains orbit information on all the satellites, clock corrections, and atmospheric delay parameters. The almanac is transmitted by a GPS satellite to a GPS receiver, where it facilitates rapid acquisition of GPS signals when you start collecting data, or when you have lost track of satellites and are trying to regain GPS signals.</p> <p>The orbit information is a subset of the ephemeris / ephemerides data.</p>
base station	<p>Also called <i>reference station</i>. A base station in construction, 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 GPS observations are collected over a period of time, for subsequent postprocessing to obtain the most accurate position for the location.</p>
BINEX	<p>Binary EXchange format. BINEX is an operational binary format standard for GPS/GLONASS/SBAS research purposes. It has been designed to grow and allow encapsulation of all (or most) of the information currently allowed for in a range of other formats.</p>
broadcast server	<p>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.</p>
carrier	<p>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.</p>
carrier frequency	<p>The frequency of the unmodulated fundamental output of a radio transmitter. The GPS L1 carrier frequency is 1575.42 MHz.</p>
carrier phase	<p>The time taken for the L1 or L2 carrier signal generated by the satellite to reach the GPS receiver. Measuring the number of carrier waves between the satellite and receiver is a very accurate method of calculating the distance between them.</p>
cellular modems	<p>A wireless adaptor that connects a laptop computer to a cellular phone system for data transfer. Cellular modems, which contain their own antennas, plug into a PC Card slot or into the USB port of the computer and are available for a variety of wireless data services such as GPRS.</p>
CMR CMR+	<p>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.</p>
covariance	<p>The mean value.</p>

datum	<p>Also called <i>geodetic datum</i>. 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.</p> <p>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.</p> <p>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).</p> <p>All GPS coordinates are based on the WGS-84 datum surface.</p>
deep discharge	<p>Withdrawal of all electrical energy to the end-point voltage before the cell or battery is recharged.</p>
DGPS	<p>See real-time differential GPS.</p>
differential correction	<p>Differential correction is the process of correcting GPS 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.</p> <p>Differential correction can be done in real-time, or after the data has been collected by postprocessing.</p>
differential GPS	<p>See real-time differential GPS.</p>
DOP	<p>Dilution of Precision. A measure of the quality of GPS 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 accuracy is greater. When satellites are close together in the sky, the DOP is higher and GPS positions may contain a greater level of error.</p> <p>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 accuracy of horizontal measurements (latitude and longitude) and vertical measurements respectively. PDOP is related to HDOP and VDOP as follows: $PDOP^2 = HDOP^2 + VDOP^2$</p>
dual-frequency GPS	<p>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.</p>
EGNOS	<p>European Geostationary Navigation Overlay Service. A satellite-based augmentation system (SBAS) that provides a free-to-air differential correction service for GPS. EGNOS is the European equivalent of WAAS, which is available in the United States.</p>
elevation mask	<p>The angle below which the receiver will not track satellites. Normally set to 10 degrees to avoid interference problems caused by buildings and trees, and multipath errors.</p>
ellipsoid	<p>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.</p>
ephemeris / ephemerides	<p>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.</p>

epoch	The measurement interval of a GPS 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/breaklines, or boundaries/areas.
firmware	The program inside the receiver that controls receiver operations and hardware.
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.
GSOFF	General Serial Output Format. A Trimble proprietary message format.
HDOP	Horizontal Dilution of Precision. HDOP is a DOP value that indicates the accuracy 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).
L1	The primary L-band carrier used by GPS satellites to transmit satellite data.
L2	The secondary L-band carrier used by GPS satellites to transmit satellite data.
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.
MSAS	MTSAT Satellite-Based Augmentation System. A satellite-based augmentation system (SBAS) that provides a free-to-air differential correction service for GPS. MSAS is the Japanese equivalent of WAAS , which is available in the United States.
multi-frequency GPS	A type of receiver that uses multiple carrier phase measurements (L1 , L2 , and L5) from different satellite frequencies.
multipath	Interference, similar to ghosts on a television screen, that occurs when GPS signals arrive at an antenna having traversed different paths. The signal traversing the longer path yields a larger pseudorange estimate and increases the error. Multiple paths can arise from reflections off the ground or off structures near the antenna.
NMEA	National Marine Electronics Association. NMEA 0183 defines the standard for interfacing marine electronic navigational devices. This standard defines a number of 'strings' referred to as NMEA strings that contain navigational details such as positions. Most Trimble GPS receivers can output positions as NMEA strings.
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 GPS systems are accurate to within a meter or so, OmniSTAR with XP is accurate in 3D to better than 30 cm.

PDOP	<p>Position Dilution of Precision. PDOP is a DOP value that indicates the accuracy of three-dimensional measurements. Other DOP values include VDOP (vertical DOP) and HDOP (Horizontal Dilution of Precision).</p> <p>Using a maximum PDOP value is ideal for situations where both vertical and horizontal precision are important.</p>
postprocessing	<p>Postprocessing is the processing of satellite data after it has been collected, in order to eliminate error. This involves using computer software to compare data from the rover with data collected at the base station.</p>
real-time differential GPS	<p>Also known as <i>real-time differential correction</i> or <i>DGPS</i>. 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.</p> <p>Most real-time differential correction methods apply corrections to code phase positions. RTK uses carrier phase measurements.</p> <p>While DGPS is a generic term, its common interpretation is that it entails the use of single-frequency code phase data sent from a GPS base station to a rover GPS receiver to provide sub-meter position accuracy. The rover receiver can be at a long range (greater than 100 kms (62 miles)) from the base station.</p>
reference station	<p>See base station.</p>
rover	<p>A rover is any mobile GPS receiver that is used to collect or update data in the field, typically at an unknown location.</p>
Roving mode	<p>Roving mode applies to the use of a rover receiver to collect data, stakeout, or control earthmoving machinery in real time using RTK techniques.</p>
RTCM	<p>Radio Technical Commission for Maritime Services. A commission established to define a differential data link for the real-time differential correction of roving GPS receivers. There are three versions of RTCM correction messages. All Trimble GPS 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.</p>
RTK	<p>real-time kinematic. A real-time differential GPS method that uses carrier phase measurements for greater accuracy.</p>
SBAS	<p>Satellite-Based Augmentation System. SBAS is based on differential GPS, but applies to wide area (WAAS/EGNOS and MSAS) networks of reference stations. Corrections and additional information are broadcast via geostationary satellites.</p>
signal-to-noise ratio	<p>SNR. The signal strength of a satellite is a measure of the information content of the signal, relative to the signal's noise. The typical SNR of a satellite at 30° elevation is between 47 and 50 dBHz. The quality of a GPS position is degraded if the SNR of one or more satellites in the constellation falls below 39.</p>
skyplot	<p>The satellite skyplot confirms reception of a differentially corrected GPS signal and displays the number of satellites tracked by the GPS receiver, as well as their relative positions.</p>
SNR	<p>See signal-to-noise ratio.</p>
UTC	<p>Universal Time Coordinated. A time standard based on local solar mean time at the Greenwich meridian.</p>

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- VRS** Virtual Reference Station. A VRS system consists of GNSS hardware, software, and communication links. It uses data from a network of reference 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 reference station data to model systematic errors (such as ionospheric noise) at the rover position. It then sends [RTCM](#) or [CMR](#) 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 GPS 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 GPS receiver, exactly like a GPS 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.

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NORTH AMERICA

Trimble Engineering
& Construction Group
5475 Kellenburger Road
Dayton, Ohio 45424-1099 • USA
800-538-7800 (Toll Free)
+1-937-245-5154 Phone
+1-937-233-9441 Fax

EUROPE

Trimble Germany GmbH
Am Prime Parc 11
65479 Raunheim • GERMANY
+49-6142-2100-0 Phone
+49-6142-2100-550 Fax

ASIA-PACIFIC

Trimble Navigation
Singapore Pty Limited
80 Marine Parade Road
#22-06, Parkway Parade
Singapore 449269 • SINGAPORE
+65-6348-2212 Phone
+65-6348-2232 Fax



www.trimble.com