

USER GUIDE

Trimble® NetR5™ GNSS Infrastructure Receiver



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Version 3.10
Revision A
March 2006



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This is the March 2006 release (Revision A) of the *NetR5 GNSS Infrastructure Receiver User Guide*. It applies to version 3.10 of the NetR5 GNSS Infrastructure receiver firmware.

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

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- proof of purchase
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- an explanation of the problem.

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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 NetR5 GNSS Infrastructure 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 products:
SPSx50 Modular GPS receiver, NetR5
comply with Part 15 of FCC Rules.

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

Safety Information

Before you use your Trimble® NetR5™ GNSS Infrastructure 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 NetR5 GNSS Infrastructure 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, page iii.

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 March 13, 1986.

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

- **DO NOT** operate the transmitter when someone is 20 cm (7.8 inches) of the antenna.
- **DO NOT** operate the transmitter unless all RF connectors are secure and any open connectors are properly terminated.
- **DO NOT** operate the equipment near electrical blasting caps or in an explosive atmosphere.
- All equipment must be properly grounded according to Trimble installation instructions for safe operation.
- All equipment should be serviced only by a qualified technician.

For 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 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.
-

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Introduction

Welcome to the *NetR5 GNSS Infrastructure Receiver User Guide*. This manual describes how to set up and use the Trimble® NetR5 GNSS Infrastructure receivers.

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, visit the Trimble website (www.trimble.com) for an interactive look at Trimble and GNSS.

About the NetR5 GNSS Infrastructure receivers

The NetR5 GNSS Infrastructure receiver is a multiple-frequency GNSS receiver. It can track all GPS signals (L1/L2/L5) as well as GLONASS (L1/L2). 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 NetR5 receiver makes it easy for you to set up a powerful, flexible, and reliable reference station for continuous operation.

The Trimble NetR5 is designed as a permanent reference station for use in a Trimble VRS™ (Virtual Reference Station) network. It can also operate as a single reference station either on its own or with Trimble GPSBase software. Additionally, it can be used as a temporary field base.

Related information

Sources of related information include the following:

- Help – The Web interface to the NetR5 receiver has built-in, context-sensitive help that lets you quickly find the information you need. Access it from the *Help* menu.
- 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 Survey and Infrastructure Receivers CD* as well as 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 the Trimble website at www.trimble.com/training.html.

Technical support

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

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. E-mail your comments to ReaderFeedback@trimble.com.

Receiver Overview

In this chapter:

- Receiver framework
- NetR5 receiver features
- Use and care
- Electronic interference
- COCOM limits
- Keypad and display
- Rear connectors

This chapter introduces the Trimble NetR5 GNSS Infrastructure receiver. This receiver makes it easy to set up a powerful, flexible, and reliable Continuously Operating Reference Station (CORS).

The NetR5 receiver is ideal for the following infrastructure applications:

- Use as part of a GNSS Infrastructure network with the GPSNet™ software
- Use as a permanent reference station with or without the Trimble GPSBase software
- Use as a temporary field reference station (in conjunction with a Trimble HPB450 or PDL450 radio)

Receiver framework

The NetR5 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 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 are intended to mean 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 NetR5 receiver, an operator can configure a receiver once, 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 has been provided for streamed service and data logging configuration avoids global changes for the majority of applications.

The NetR5 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

NetR5 services

The NetR5 receiver can provide one or more streaming or query services over a RS232 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.

NetR5 receiver features

The receiver provides the following features:

- 72-channel L1/L2/L2C/L5 GPS plus L1/L2 GLONASS receiver
- WAAS/EGNOS, and MSAS Satellite Based Augmentation (SBAS) compatibility
- Long- life integrated battery, typically 15 hours operation as a base station
- Integrated display and keypad for system configuration without a controller
- Integrated Bluetooth wireless technology for cable-free configuration and operation
- Small, lightweight design – 1.55 kg (3.42 lbs) with battery
- Permanent/semi-permanent and mobile quick setup base station capability
- Easy-to-use menu system for rapid configuration and status checking
- Ability to operate as a Rover Integrity receiver with the GPSNet software to allow monitoring of VRS network performance
- Two-line, 16-character VFD (Vacuum Fluorescent Display) display
- Rugged, weatherproof construction with an IP67 environmental rating
- -40°C to $+65^{\circ}\text{C}$ (-40°F to $+149^{\circ}\text{F}$) operating temperature range
- 9.5 V to 28 V DC input power range, with over-voltage protection

Reference station

- FTP push to allow uploading of logged data files to remote FTP sites
- E-mail client to alert system users of any issues with the system
- Ethernet and reference station configuration via the front panel
- Multiple languages available through the Web interface and receiver front panel
- Support for external USB hard drives and USB memory sticks to allow increased data logging capabilities
- Ntrip (Networked Transport of RTCM via Internet Protocol) client/server support to securely transfer data to and from an NtripCaster

Use and care

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



CAUTION – Operating or storing the receiver outside the specified temperature range can damage it. For more information, see Chapter 10, 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. 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. The following limitations are implemented on this product:

- Immediate access to satellite measurements and navigation results is disabled when the receiver velocity is computed to be greater than 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

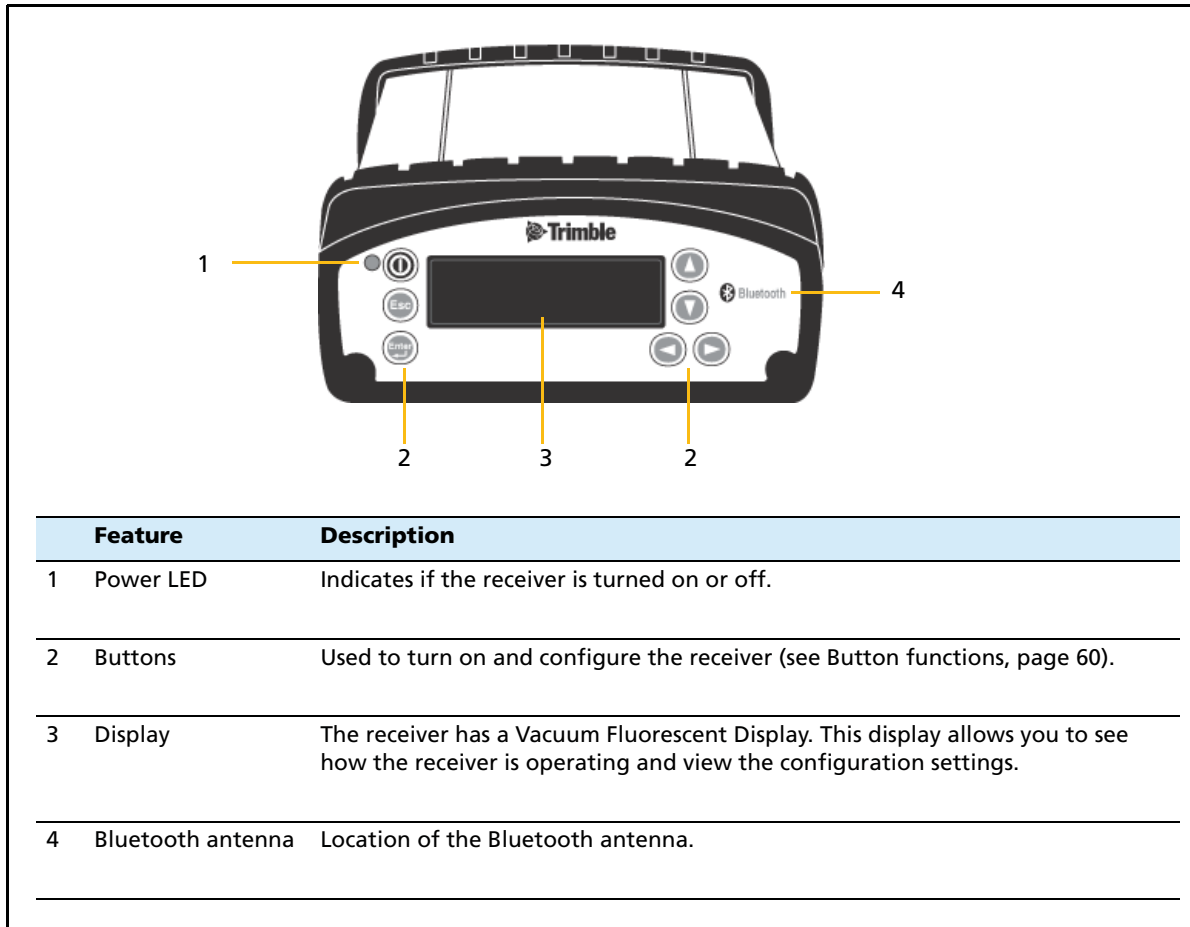


Figure 2.1 Front view of the NetR5 receiver

Rear connectors

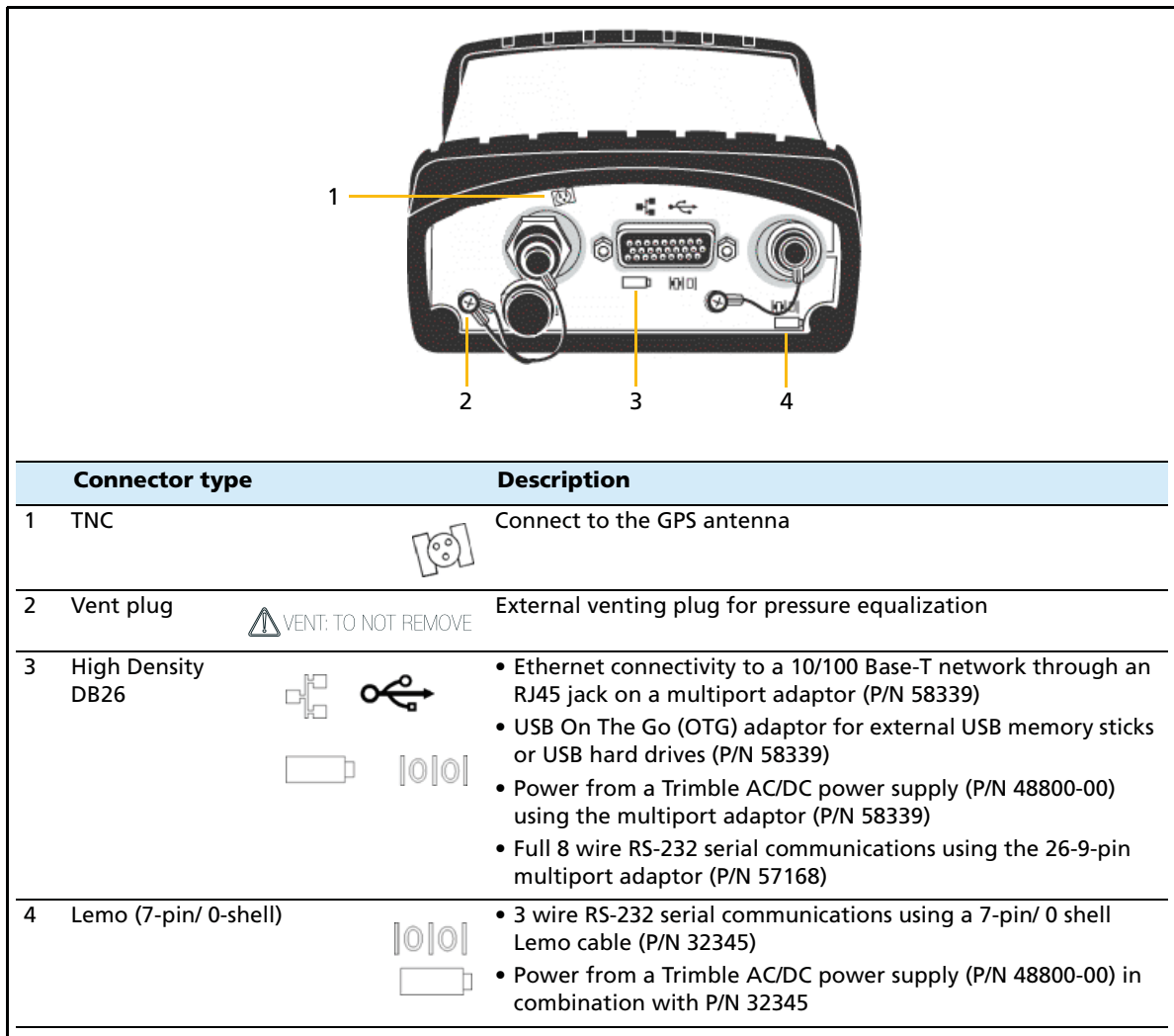


Figure 2.2 Rear view of the NetR5 receiver

Batteries and Power

In this chapter:

- External power
- Battery safety
- Battery performance
- Charging the Lithium-ion battery
- Storing the Lithium-ion battery
- Removing the rechargeable Lithium-ion battery

The NetR5 GNSS receiver 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 the Lemo or modem port.

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

***Note** – All battery operation tests are carried out with new, fully charged batteries at room temperature and full receiver configuration operational. Older batteries, at temperatures significantly higher or lower than room temperature, will have a reduced performance. Receivers operating with reduced configuration will have a higher performance.*

External power

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

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 and when power is restored, the receiver restarts in the same status as it was when power was lost.

Battery safety

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



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.
- Batteries perform best when they are not used at extreme temperatures. The receiver is designed to operate at $-40\text{ }^{\circ}\text{C}$ to $+65\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $+149\text{ }^{\circ}\text{F}$). However, operation at temperatures of less than $0\text{ }^{\circ}\text{C}$ ($32\text{ }^{\circ}\text{F}$) 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 Lithium-ion 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.

The internal battery charges fully in 8 hours when connected to a suitable power source.



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 with 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.
-

Storing the Lithium-ion 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 $+70^{\circ}\text{C}$ (-40°F to $+158^{\circ}\text{F}$).

The receiver has an internal Lithium-ion battery. The internal battery will only charge from an external power source that delivers more than 15 volts, 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 the modem port or the Lemo port. When you use the receiver on large projects, from a permanent or semi-permanent base station location in a site trailer, Trimble recommends that you use this power supply at all times to keep the internal battery charged. This provides an uninterrupted power supply and will keep the site 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 rechargeable Lithium-ion battery

The internal Lithium-ion battery should 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:

- Setup guidelines
- Connecting the receiver to external devices

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

Setup guidelines

When you set up the receiver, follow these guidelines.

Environmental conditions

The receiver has a waterproof housing. However, you should take reasonable care to keep the unit dry.

To improve the performance and long-term reliability of the receiver, avoid exposing 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

Avoid locating 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

Uninterruptible 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.

For more information, contact your local Trimble dealer.

Lightning protection

Trimble recommends that you install lightning protection equipment at permanent sites. Equipment should include a gas capsule lightning protector in the antenna feed line as well as appropriate safety grounding. A static dissipater near the antenna can reduce the likelihood of a direct lightning strike. Also, protect any communications

and power lines at building entry points. If you use other antennas or aerials, such as a radio modem that distributes real-time correction messages, consider protecting those antennas as well.

For more information, contact your local Trimble dealer, or go to the Huber and Suhner website at www.hubersuhner.com/hs-sup-search-prod-rf-emp-2g.

Placing the antenna

Before you mount the antenna for your reference station, you should plan the best location for the antenna, and how you will obtain accurate coordinates for that

Trimble recommends a site as free as possible from interference, where the antenna has a clear view of the sky and where there are no obstructions above 10° elevation. See Figure 4.1.

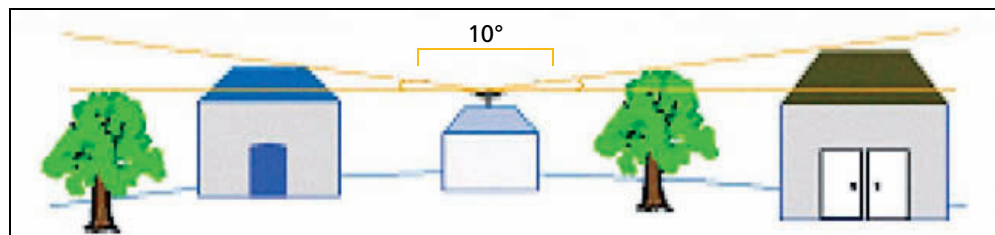


Figure 4.1 Suitable placement for an antenna

If there are obstructions above 10°, or large metallic objects nearby, the rover receiver may collect data from satellites that the reference station cannot track. This data cannot be used in rover DGPS or RTK solutions.

Connecting the receiver to external devices

You can connect a NetR5 receiver to the following devices:

- GNSS antenna
- Dial-up modems and terminal adaptors
- Radio modems

GNSS antenna

The NetR5 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; other Trimble geodetic antennas can also be used. You can use a Dorne Margolin Choke Ring, however it cannot reliably track L5 or GLONASS L1/L2 signals.

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 NetR5 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. The following table lists some common types of cable and the maximum length you can use before you need an inline amplifier .

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. LDF4.5/40	225 m (740 ft)

Dial-up modems and terminal adaptors

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

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 modems

You can connect the receiver to an external radio through the lemo port, whether or not the Ethernet port is in use. The Trimble radio is supplied with the required cables to connect to the lemo port.

The NetR5 receiver supports the following Trimble base radios:

- TRIMMARK™ 3 (firmware 1.26 or later)
- Trimble HPB450
- Trimble PDL450
- TRIMTALK™ 450S

To use an external radio with the receiver, you need an external power source for the radio. Configure the external radio separately, using the configuration program for the external radio.

To configure the NetR5 receiver for RTK operation, you must do all of the following:

- Enable the RTCM or CMR RTK corrections stream on the selected lemo port.
- Set the reference station coordinates and broadcast ID using the front panel of the receiver (refer to the *Trimble NetR5 GNSS Receiver Quick Start Guide*, P/N 58920-00-ENG) or the Web interface (*Receiver Configuration* menu).

Configuring the Receiver Using the 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


The receiver features a keypad and display (see page 22) so that you can configure the receiver without using a controller or computer.


Button functions

The NetR5 has seven buttons on the front panel to control the receiver. Use the buttons to turn the receiver on and off and to check or change the receiver settings.

Button	Name	Function
	Power	Turn on/off the receiver. To turn off the receiver, hold the power button for two seconds.
	Escape	Return to the previous screen or cancel changes being made on a screen.
	Enter	Advance to the next screen or accept changes made 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. This button also initiates edit mode for the current field.

Power button operations

Press the power button  to turn the receiver on and off. In addition, you can tap the power button to return to the Home screen, or hold down the Power button to perform the following operations:



To ...	Hold the  button for ...	Notes
turn off the receiver	two 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 show a countdown timer. When the display goes blank, continue to hold the power button. The display shows a countdown time to clear 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 show a countdown timer. When the display goes blank, continue to hold the power button. The display show a countdown to clear the almanac and ephemeris. When the counter reaches 0, continue to hold the power button. The display indicates a countdown to resetting the receiver. When the counter reaches 0, release the power button.
force the receiver to power down	at least 60 seconds	If the method above does not work, use this method to force the receiver to turn off. When the Power LED goes off, release the power button. Note – All data stored in the receiver is lost when the receiver is forced to power down.

Home screen

The Home screen is the main screen displayed on the NetR5 receiver. The receiver always returns to this screen if displaying any other screen and left idle for 60 seconds. The Home screen indicates:

- the number of satellites being tracked
- the internal battery power remaining
- the current mode configuration
- if the receiver is logging data
- if a USB memory device is being accessed


Status screens

The NetR5 receiver has several view-only status screens so you can review the receiver's current settings. To access these screens, press  or  when the Home screen is displayed. The status screens provide the following information:








- Position solution
- CMR and RTCM IDs
- Base name and code
- Latitude, longitude, and height
- Precision of current position
- Antenna type
- Antenna height
- Horizontal and vertical precision
- Receiver firmware version and date
- Receiver serial number
- Current IP address
- Current subnet mask
- Current gateway

Setting up the receiver as a base station

The NetR5 receiver can be set up for Ethernet configuration and for real-time outputs so that the receiver can be used as a base station (also known as a *reference station*). To set up the receiver as a base station, use the receiver keypad.















The receiver uses a “step-by-step” configuration method to ensure that all appropriate settings are reviewed and set. Press  to move between steps in the configuration process.

Configuring the receiver as a base station

1. From the Home screen, press  to move to the next screen.
The *Operation Mode* screen appears. Use this screen to configure the base station setup, Ethernet configuration, system setup, or to view the SV (satellite) status.
2. 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.
3. Do one of the following:
 - Press  to edit the current position
 - Continue to the next step and manually enter the coordinates. Press  again.
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.
4. Press  to move to the next screen.








Changing the name and description of the base station

The *Base Name* screen appears.








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. When finished, press  to accept the change.
3. Press  to move to the next screen.
The *Base Code* screen appears.
4. Press  to edit the code (description) of the base station.
5. Press  or  to select the character to edit and press  or  to change. When finished, press .
6. Press  to move to the next screen.

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








The *Base Latitude* screen appears.

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. When finished, press .
3. Press  to move to the next screen.

The *Base Longitude* screen appears.






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

The *Point Height* screen appears.






7. Press  to edit the ellipsoidal height of the base station.
8. Press  or  to select the character to edit and then press  or  to change. When finished, press .
9. Press  to move to the next screen.

Measuring and changing the antenna height








The *Antenna Type* screen appears.

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

The *Measured To* screen appears.






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

The *Antenna Height* screen appears.











7. Press  to edit the antenna height.
8. Press  or  to select the character to edit and then press  or  to change. When finished, press .
9. Press  to move to the next screen.

Outputting corrections











The *Output* screen appears.

1. Press  to edit the name of the port which will be used to output corrections.
2. Press  or  to select the port (Lemo or Modem). When finished, press .
3. Press  to move to the next screen.

The *Logging* screen appears.

4. Press  to set up internal logging on the receiver.
5. Press  or  to select the logging rate. Press  to accept. Press  to select Files. Press  to edit and press  or  to select the appropriate length of time to log data for. When finished, press .
6. Press  to move to the next screen.

The *RT27* screen appears.




7. Press  to set up RT27 message output from the receiver.
8. Press  or  to select the output port. Press  to accept. Press  to move the cursor to the output rate. Press  to edit and then press  or  to select the rate at which RT27 messages will be output. Press  to accept.
9. Press  to move to the next screen.

The Home screen appears. Base station setup is now complete.






Setting up the receiver as part of an Ethernet configuration

1. From the Home screen, press .






















The *Operation Mode* screen appears. Use this screen to select if you want to configure the base station setup, Ethernet configuration, or system setup, or to view the SV status.

2. As reference station setup is the default, press  so that the Ref Stn Setup message is flashing.
3. Press  to select Ethernet config.
4. Press  twice to edit the configuration.

The *DHCP* menu appears.

5. Press  to select the type of IP address to setup.
6. Press  or  to move through the options. You can choose either Enabled (the default) or Static IP address to program the Ethernet manually. When finished, press .
7. Press  to move to the next screen.

The IP address appears.

8. Press  to edit the IP address.
9. Press  or  to select the number to edit and then press  or  to change. When finished, press . Note: Editing starts from the right.
10. Press  to move to the next screen.
The subnet mask is shown.
11. Press  to edit the subnet mask address.
12. Press  or  to select the number to edit and then press  or  to change. When finished, press . Note: Editing starts from the right.
13. Press  to move to the next screen.
The gateway is shown.
14. Press  to edit the default gateway address.
15. Press  or  to select the number to edit and press  or  to change. When finished, press . Note: Editing starts from the right.
16. Press  to move to the next screen.
The Home screen appears. Ethernet setup is now complete.

Note – If you change the IP address, 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 as outlined in this chapter.

Configuring the Receiver Settings

In this chapter:

- Configuring Ethernet settings
- Configuring the NetR5 GNSS receiver using a web browser

You can configure the NetR5 receiver in a variety of ways. This chapter describes the different configuration methods, and explains when and why each method is used.

The external software detailed in this chapter is primarily used to update the receiver firmware and to set the Ethernet settings. In Chapter 5, the Ethernet configuration was detailed via the front panel. How to do this with WinFlash software is detailed here.

Configuring Ethernet settings

The receiver has an Ethernet port so that the receiver can connect to an Ethernet network. You can use the Ethernet network to 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

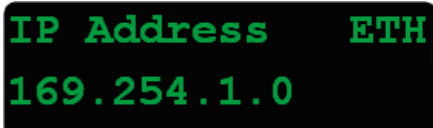
The default setting for the HTTP port is 80. The HTTP port is not assigned by the network. HTTP port 80 is the standard port for web servers. This allows you to connect to the receiver by entering only the IP address of the receiver in a web browser. If the receiver is set up to use a port other than 80, you will need to enter the IP address followed by the port number in a web browser.

Example of connecting to the receiver using port 80: `http://169.254.1.0`

Example of connecting to the receiver using port 4000: `http://169.254.1.0:4000`

The default setting of the receiver is to use DHCP. Using DHCP 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, an IP address is assigned to the receiver by the network. To verify the IP address of the receiver, select the up button from the keypad when the *Home* screen is displayed. The Ethernet IP address appears as shown.



The image shows a black rectangular display area with green text. The text is arranged in two lines. The first line contains the label 'IP Address' followed by 'ETH'. The second line contains the IP address '169.254.1.0'.

If your network installation requires the receiver to be configured with a static IP address, you can configure the Ethernet settings either using the front panel as described in the Chapter 5, Configuring the Receiver Using the Keypad and Display, via the web server or the WinFlash utility. The web server can be only used when the receiver is connected to a network and has a valid Ethernet configuration.

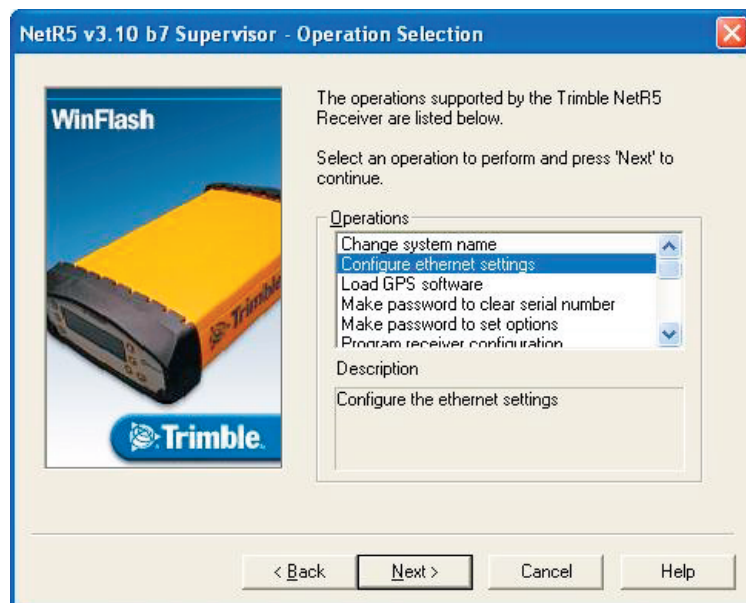
Use the WinFlash utility to configure the Ethernet settings of a receiver that is to be connected to a network that requires static IP addresses:

1. Contact the network administrator for the correct settings for the receiver.
2. Connect the receiver to a computer running the WinFlash utility using the serial cable provided with the receiver.
3. Turn on the receiver.

4. On the computer, start the WinFlash utility.
5. From the *Device Configuration* screen, select Trimble NetR5 Receiver. From the *PC serial port* list, select the appropriate PC serial port. Click **Next**:



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

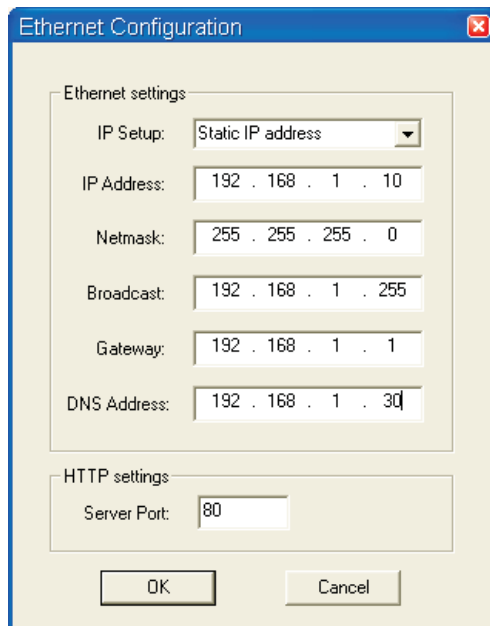


- From the *Settings Review* screen, click **Finish**:



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

- Enter the network settings in the *Ethernet Configuration* dialog. 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 the NetR5 GNSS receiver using a web browser

The receiver can be configured using the keypad and display, or a web browser. This section describes how to set up the receiver using a web browser.

Supported browsers

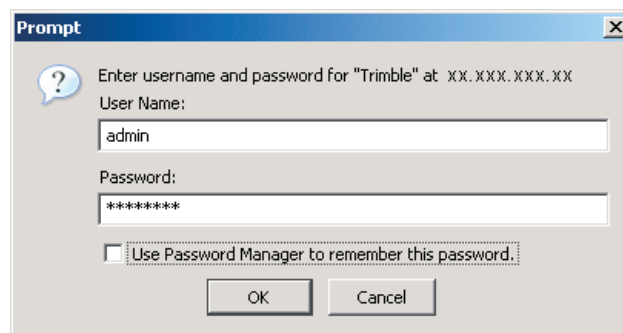
- Mozilla Firefox version 1.07 or later (version 1.50 is recommended for Windows, Macintosh, and Linux operating systems)
- Microsoft Internet Explorer version 6.00 or later for Windows operating systems

To connect to the receiver using a web browser:

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



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

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 web page (see Figure 6.1) appears.

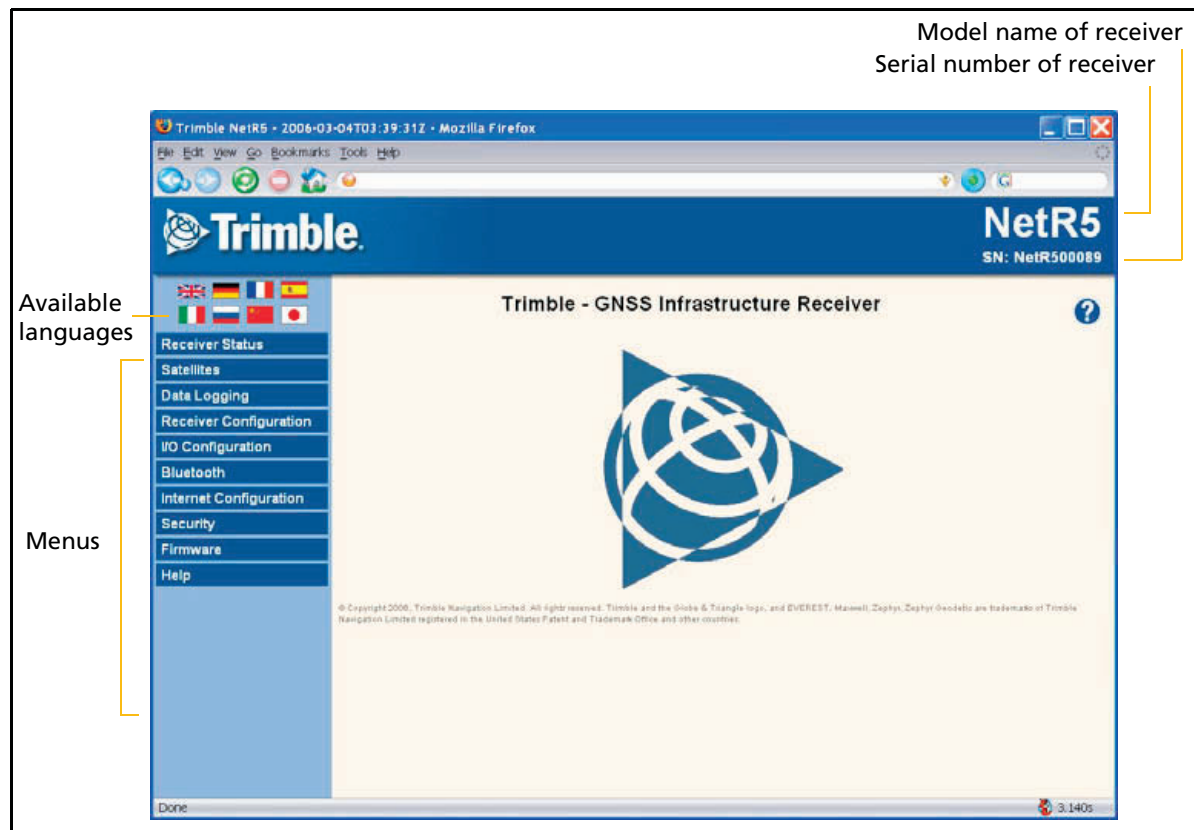


Figure 6.1 NetR5 receiver Home webpage

Changing the settings

Use the webpage to configure the receiver 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 monitor receiver performance.

A summary of each configuration menu is provided here. For more detailed information about each of the receiver settings, select the *Help* menu.

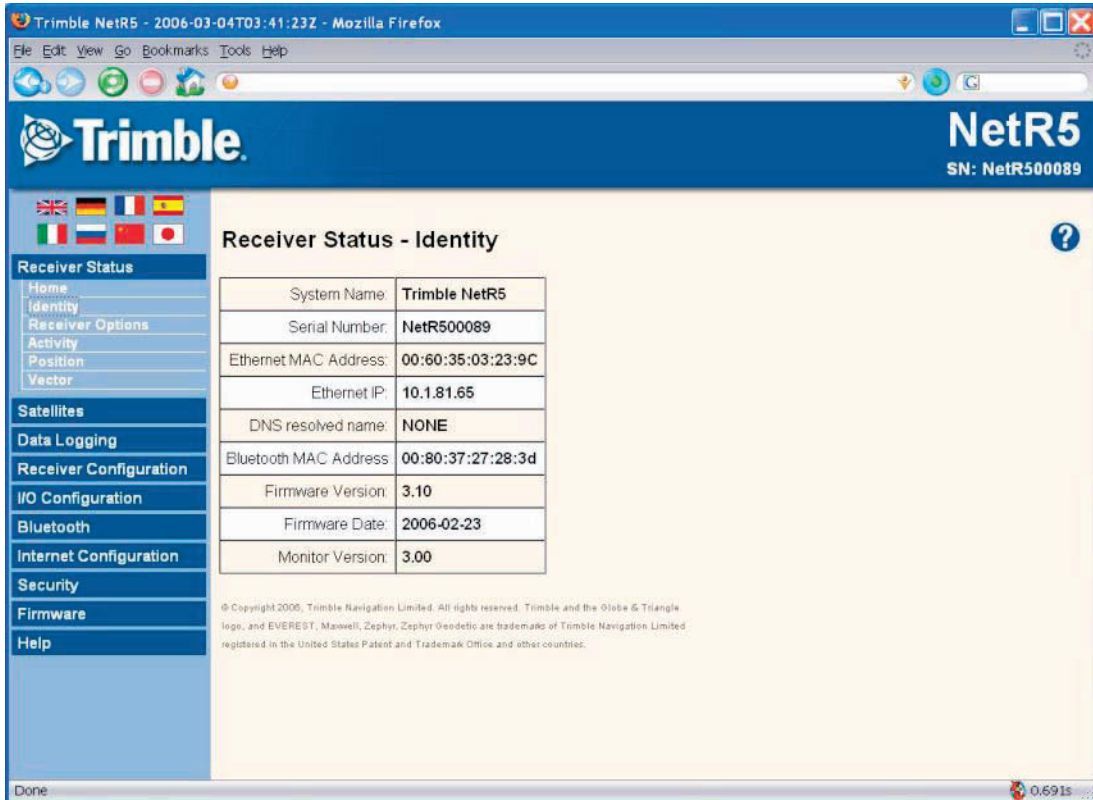
To display the web interface in another language, click the corresponding country flag. The web interface is available in the following languages:

- English
- German
- French
- Spanish
- Italian
- Russian
- Chinese
- Japanese

Receiver Status menu

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

This figure shows an example of the screen that appears when you select *Receiver Status / Identity*.



The screenshot shows a web browser window displaying the Trimble NetR5 interface. The page title is "Receiver Status - Identity". The interface includes a navigation menu on the left with options like Home, Identity, Receiver Options, Activity, Position, Vector, Satellites, Data Logging, Receiver Configuration, I/O Configuration, Bluetooth, Internet Configuration, Security, Firmware, and Help. The main content area displays a table of system information.

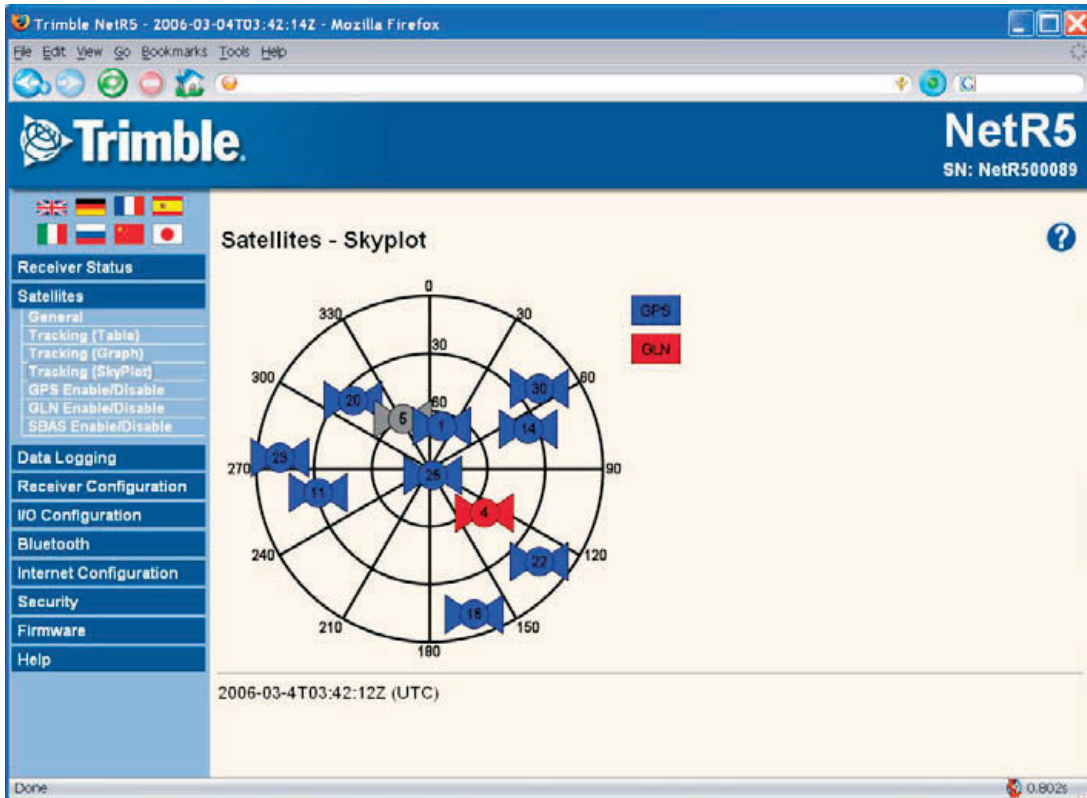
System Name:	Trimble NetR5
Serial Number:	NetR500089
Ethernet MAC Address:	00:60:35:03:23:9C
Ethernet IP:	10.1.81.65
DNS resolved name:	NONE
Bluetooth MAC Address:	00:80:37:27:28:3d
Firmware Version:	3.10
Firmware Date:	2006-02-23
Monitor Version:	3.00

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Satellites menu

Use the *Satellites* menu to view satellite tracking details and enable/disable GPS, GLONASS, and SBAS (WAAS/EGNOS, and MSAS) satellites.

This figure shows an example of the screen that appears when you select *Satellite / Tracking (Sky Plot)*.

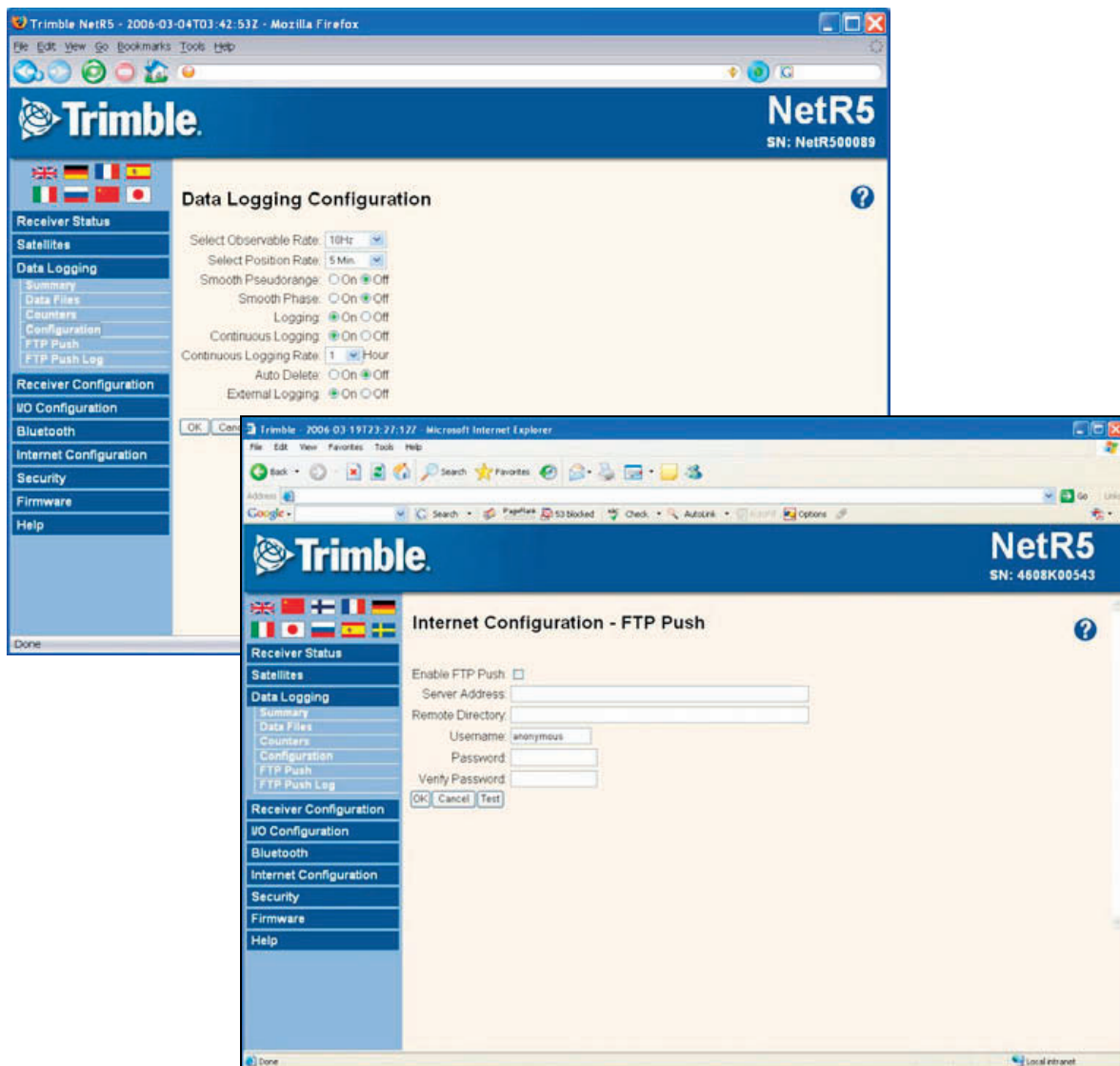


Data Logging menu

Use the *Data Logging* menu to set up the receiver to log static GPS data. 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. If an external USB hard drive or USB memory stick is connected, you can choose the External Logging option. This option allows you to logs more data for extended periods of time, if the internal memory of the receiver is not sufficient. Note that the external drives need to be formatted as FAT32; NTFS formatting is not supported. For information on supported and tested brands, refer to the *Trimble NetR5 GNSS Infrastructure Release Notes*.

The receiver can also send locally stored files (whether internally or on an external drive) to an FTP server.

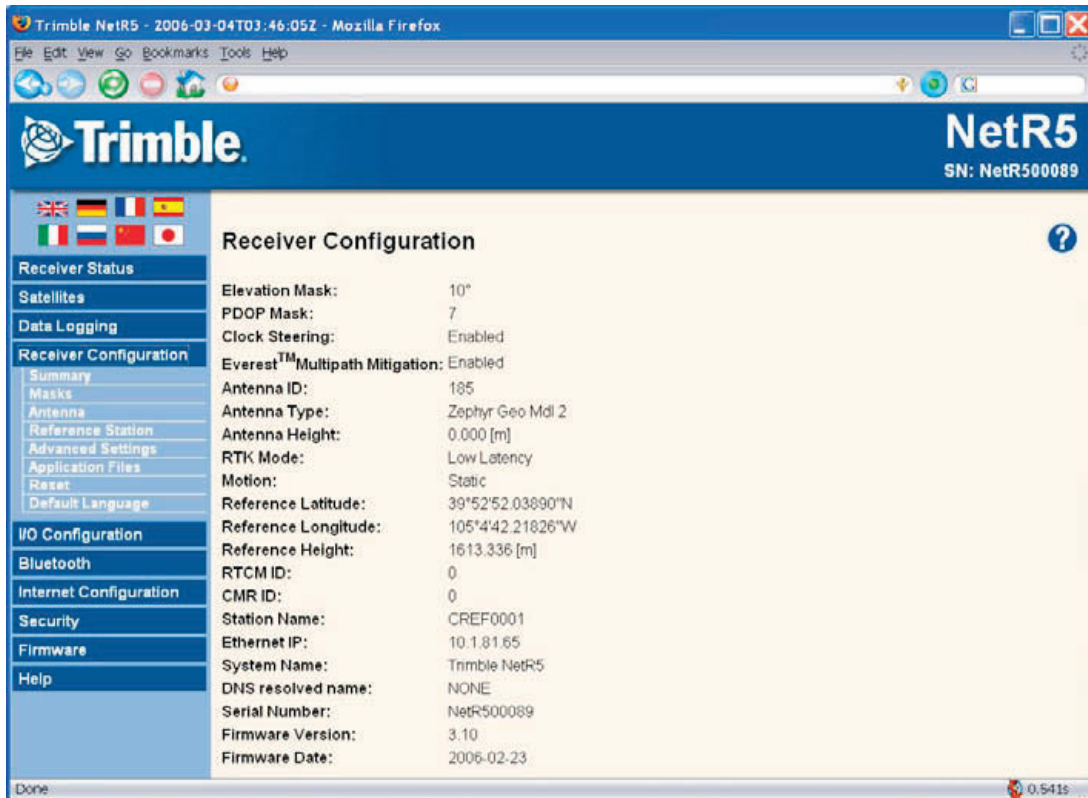
This figure shows an example of the screens that appears when you select *Data Logging / Configuration* and *Data Logging / FTP Push*.



Receiver Configuration menu

Use the *Receiver Configuration* 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.

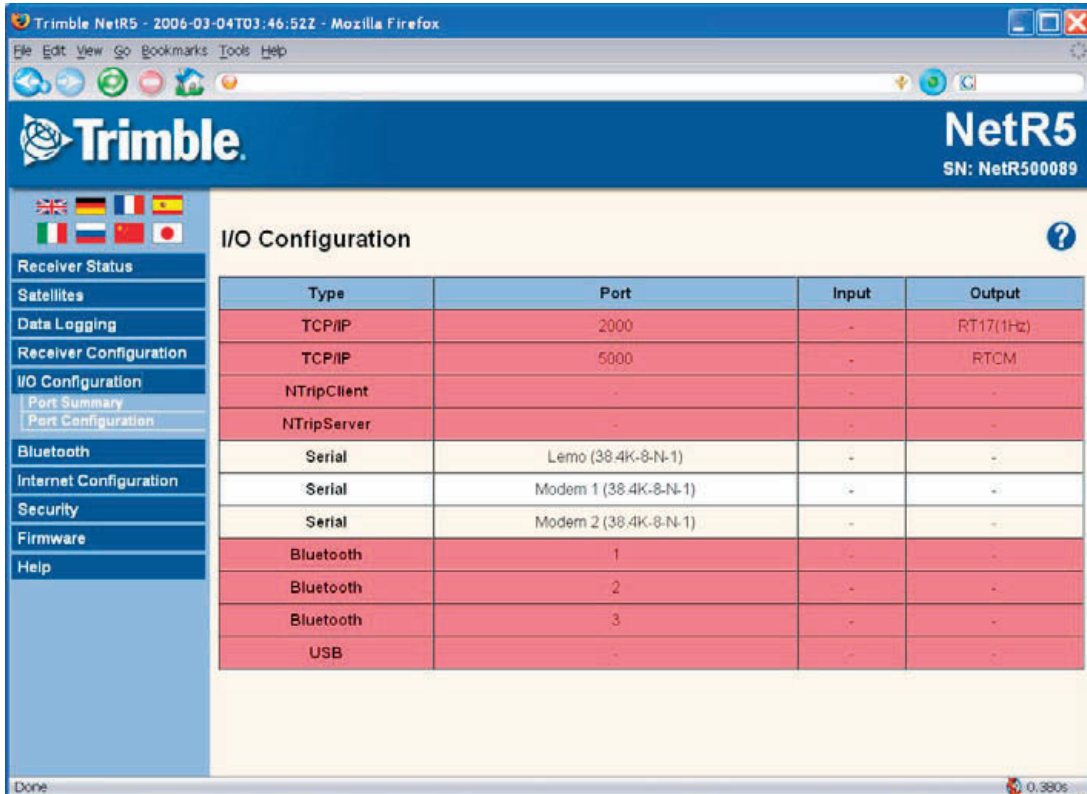
This figure shows an example of the screen that appears when you select *Receiver Configuration / Summary*.



I/O Configuration menu

Use the *I/O Configuration* menu to set up all outputs of the receiver. The receiver can output CMR, RTCM, NMEA, GSOF, RT17, RT27 (indicated by Multi-system support), or BINEX messages. These messages can be output on TCP/IP, UDP, serial, or Bluetooth.

This figure shows an example of the screen that appears when you select *I/O Configuration / Port Summary*.



The screenshot shows the Trimble NetR5 web interface in a Mozilla Firefox browser window. The page title is "Trimble NetR5 - 2006-03-04T03:46:52Z - Mozilla Firefox". The interface features the Trimble logo and "NetR5 SN: NetR500089" in the top right. A navigation menu on the left includes options like Receiver Status, Satellites, Data Logging, Receiver Configuration, I/O Configuration (selected), Bluetooth, Internet Configuration, Security, Firmware, and Help. The main content area is titled "I/O Configuration" and contains a table with the following data:

Type	Port	Input	Output
TCP/IP	2000	-	RT17(1Hz)
TCP/IP	5000	-	RTCM
NTripClient	-	-	-
NTripServer	-	-	-
Serial	Lemo (38.4K-8-N-1)	-	-
Serial	Modem 1 (38.4K-8-N-1)	-	-
Serial	Modem 2 (38.4K-8-N-1)	-	-
Bluetooth	1	-	-
Bluetooth	2	-	-
Bluetooth	3	-	-
USB	-	-	-

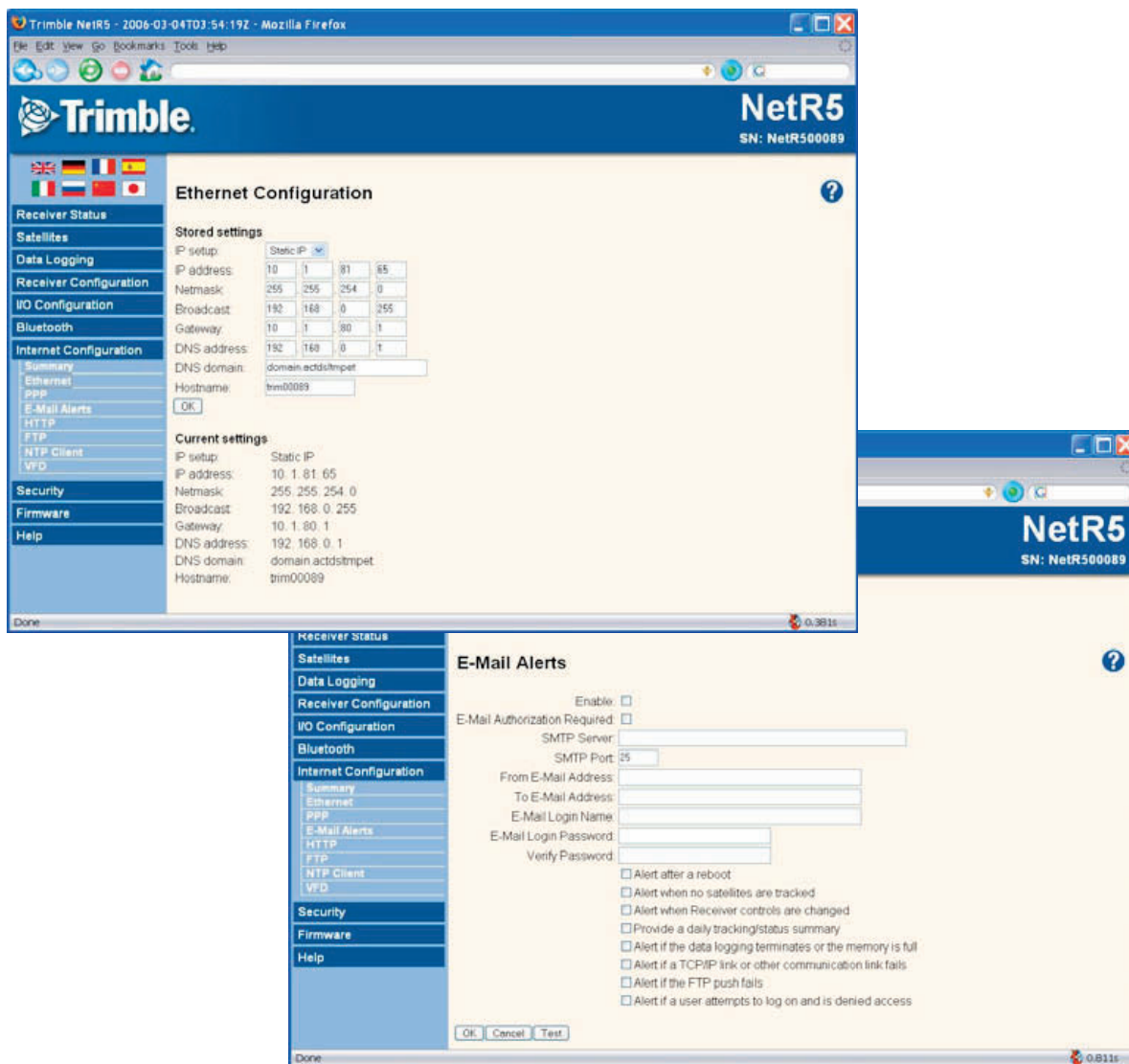
Internet Configuration menu

Use the *Internet Configuration* menu to configure Ethernet settings, e-mail alerts, PPP connection, HTTP port, FTP port, and VFD port settings of the receiver.

The VFD port allows you to use the NetR5 Remote Control application to view and navigate the receiver through a mock display and keypad interface. To allow the NetR5 Remote Control to connect to the receiver, select *Internet Configuration / VFD* to enable the VFD port. A viewing utility is available on the *Trimble Survey and Infrastructure Receivers CD* under NetR5 utilities.

The receiver can notify a system administrator by sending alerts about general status changes in the receiver as well as warning messages in case of problems to a specified e-mail address. This requires the use of an SMTP server. To find out how to connect the receiver to the server, contact your network administrator.

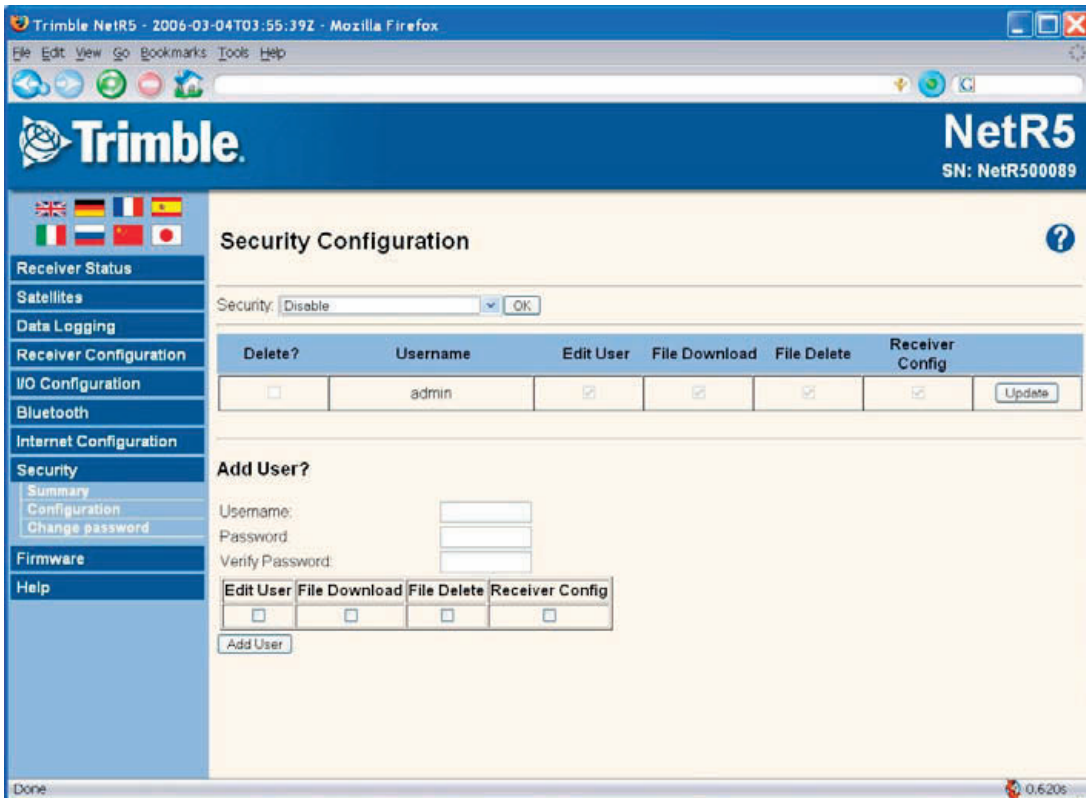
This figure shows an example of the screen that appears when you select *Internet Configuration / Ethernet* and *Internet Configuration / E-Mail Alerts*.



Security menu

Use the *Security* menu to configure the login accounts for all users who will be permitted to configure the receiver using a web browser. Each account consists of a username, password, and permissions. Administrators can use this feature to limit access to other users. 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.

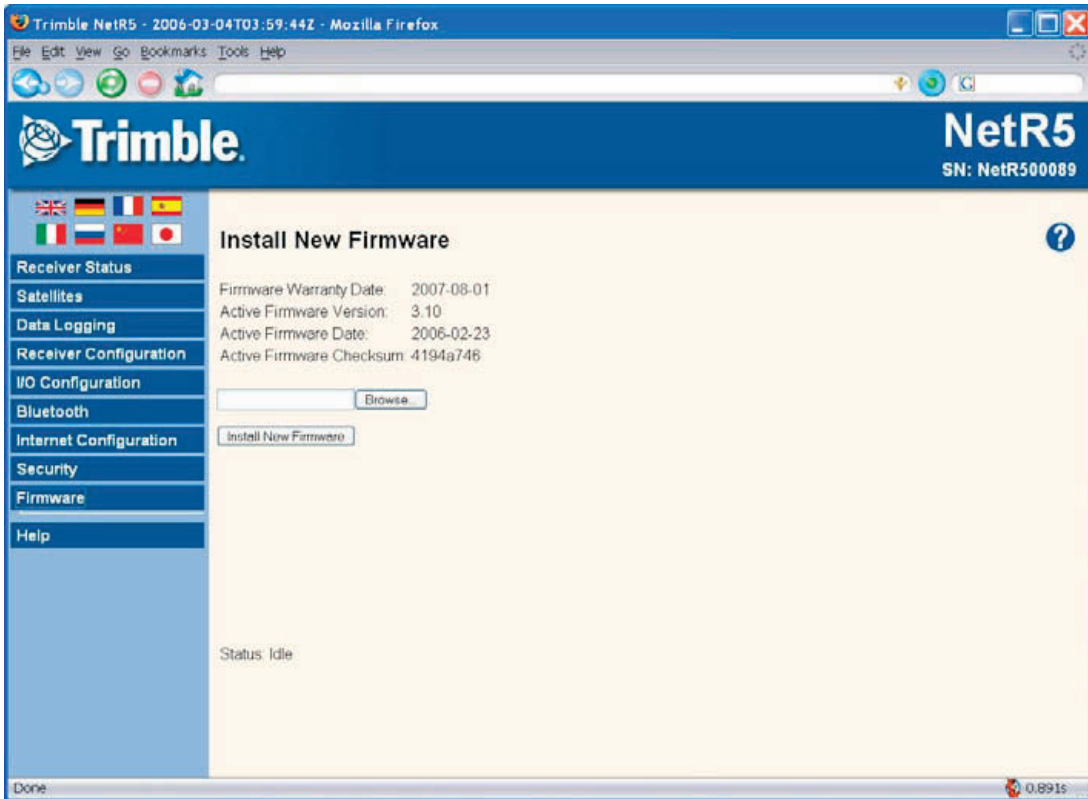
This figure shows an example of the screen that appears when you select *Security / Configuration*.



Firmware menu

Use the *Firmware* menu to verify the current firmware and load new firmware to the receiver. You can upgrade firmware across a network or from a remote location without having to connect to the receiver with a serial cable.

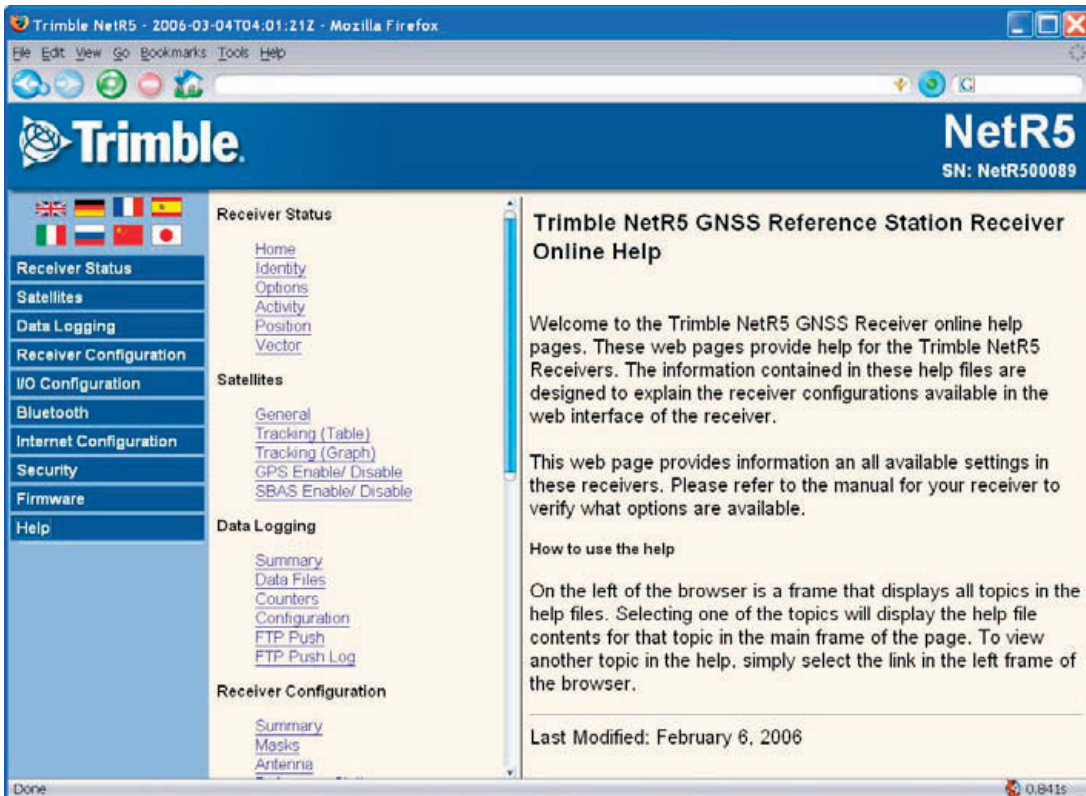
This figure shows an example of the screen that appears when you select *Firmware*.



Help Menu

The *Help* menu provides information on each of the receiver settings available in a web browser. Selecting the *Help* menu opens new windows. Select the section of the Help that you want to view. The Help files are stored on the Trimble Internet site and are updated between firmware releases. If you do not have access to the Internet, there is also a copy of the receiver Help files on the *Trimble Survey and Infrastructure Receivers CD*. (This copy shows the Help files as they were when the CD was published).

This figure shows an example of the screen that appears when you select *Help*.



Default Settings

In this chapter:

- Default receiver settings
- Resetting the receiver to factory defaults
- Data Logging option

All 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 NetR5. 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.

Default receiver settings

These settings are defined in the default application file.

Function	Factory default
SV Enable	All SVs enabled
General Controls:	Elevation mask
	PDOP mask
	RTK positioning mode
	Motion
Lemo Port:	Baud rate
	Format
	Flow control
Modem Port:	Baud rate
	Format
	Flow control
Input Setup:	Station
NMEA/ASCII (all supported messages)	All ports Off
Streamed output	All types Off
	Offset = 00
RT17/RT27/Binary	All ports Off
Reference position:	Latitude
	Longitude
	Altitude
Antenna:	Type
	Height (true vertical)
	Measurement method

Resetting the receiver to factory defaults

To reset the receiver to its factory defaults, press  for 35 seconds.

Data Logging option

By default, the Data Logging option is turned off. If you choose to log data using a GNSS receiver, you must enable the option and acquire suitable postprocessing software, such as the Trimble Geomatics Office software. For more information, please contact your Trimble dealer.

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

Specifications

In this chapter:

- General specifications
- Physical specifications
- Electrical specifications
- Communication specifications

This chapter details the specifications for the NetR5 receiver.

Specifications are subject to change without notice.

General specifications

Feature	Specification
Keyboard and display	VFD display 16 characters by 2 rows Escape and Enter key for menu navigation 4 arrow keys (up, down, left, right) for option scrolls and data entry
Receiver type	Modular GNSS receiver
Antenna type	Zephyr Geodetic Model 2 Also supports legacy antennas Zephyr™, Zephyr Geodetic, Dorne Margolin Choke ring. Note – Legacy antennas are not supported for L5 and GLONASS satellite tracking.

Physical specifications

Feature	Specification
Dimensions (LxWxH)	24 cm (9.4 in) x 12 cm (4.7 in) x 5 cm (1.9 in) including connectors
Weight	1.55 kg (3.42 lbs) receiver with internal battery and no radio
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
Waterproof	IP67 for submersion to depth of 1 m (3.28 ft)
Shock and vibration	Tested and meets the following environmental standards:
Shock, non operating	MIL-STD-810F, Fig.514.5C-17
Shock, operating	To 40 G, 10 msec, saw-tooth
Vibration	MIL-STD-810F, FIG.514.5C-17
Measurements	<ul style="list-style-type: none"> • Advanced Trimble Maxwell™ Custom GNSS chip • L2C Civil signal and L5 signal for GPS modernization • Very low noise L1, L2, and L5 carrier phase measurements with <1 mm precision in a 1 Hz bandwidth • Proven Trimble low elevation tracking technology • 72 Channels L1 C/A Code, L2C, L5C, L1/L2/L5 Full Cycle Carrier, GLONASS L1/L2 • WAAS/EGNOS, and MSAS
Code differential GPS positioning ²	
Horizontal accuracy	±(0.25 m + 1 ppm) RMS
Vertical accuracy	±(0.50 m + 1 ppm) RMS
WAAS/EGNOS, and MSAS	
Horizontal accuracy ³	Typically <1 m (3.28 ft)
Vertical accuracy ²	Typically <5 m (16.40 ft)
Real Time Kinematic (RTK) positioning ⁴	
Horizontal	±(10 mm + 1 ppm) RMS, ± (0.38 in +1 ppm) RMS
Vertical	±(20 mm + 1 ppm) RMS, ± (0.78 in +1 ppm) RMS
Initialization reliability ⁵	Typically >99.9%

¹ Receiver will operate normally to -40 °C.

² Accuracy and reliability may be subject to anomalies such as multipath, obstructions, satellite geometry, and atmospheric conditions. Always follow recommended practices.

³ Depends on WAAS/EGNOS, and MSAS system performance.

⁴ Only for use with the GPSNet software in conjunction with rover integrity module.

⁵ May be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.

Electrical specifications

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 >15 V</p>
External	<p>Integrated charging circuitry</p> <p>Power input on Lemo 7P05 has a cut off threshold of 10.5 V</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 modem port is 9.5 V to 28 V DC external power input with over-voltage protection</p> <p>Receiver will auto power on when connected to external power of 15 V or greater</p>
Power consumption	4.8 W average
Reference station operation times on internal battery	Up to 15 hours
Certification	<p>Part 15.247 FCC certifications</p> <p>Class B Device FCC Part 15 and ICES-003 certifications</p> <p>RSS-310 and RSS-210 Industry Canada certifications</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 specifications

Feature	Specification
Communications	
Port 1 (7-pin 05 Lemo)	3-wire RS-232 CAN
Port 2 (DSub 26-pin)	Full RS-232 (via multi-port adaptor) 3-wire RS-232 USB (On the Go) Ethernet
Bluetooth	Fully integrated, fully sealed 2.4 GHz Bluetooth ¹
External GSM/GPRS, cellular phone support	Supported for direct dial and Internet-based VRS correction streams Cellular phone or GSM/GPRS modem inside TSC2™ controller
Receiver position update rate	1 Hz, 2 Hz, 5 Hz, 10 Hz, and 20 Hz positioning (varies by receiver model)
Data Input and Output	CMR, CMR+™, RTCM 2.0, RTCM 2.1, RTCM 2.3, RTCM 3.0
Outputs	NMEA, GSOF, RT17, RT27, BINEX

¹ Bluetooth type approvals are country specific. Contact your local Trimble office or representative for more information.

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	62
GGA	Time, position, and fix related data	63
GSA	GPS DOP and active satellites	64
GST	Position error statistics	65
GSV	Number of SVs in view, PRN, elevation, azimuth, and SNR	66
HDT	Heading from True North	67
PTNL,AVR	Time, yaw, tilt, range, mode, PDOP, and number of SVs for Moving Baseline RTK	68
PTNL,GGK	Time, position, position type and DOP values	69
PTNL,PJK	Local coordinate position output	70
PTNL,VGK	Time, locator vector, type and DOP values	71
PTNL,VHD	Heading Information	72
RMC	Position, Velocity, and Time	73
ROT	Rate of turn	74
VTG	Actual track made good and speed over ground	75
ZDA	UTC day, month, and year, and local time zone offset	76

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. Table A.1 and Table A.2 describe the message fields. The messages alternate between subtype 110 and 120.

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

Table A.1 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
```

Table A.2 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. Table A.3 describes 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
```

Table A.3 GGA message fields

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. Table A.4 describes the message fields.

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

Table A.4 GSA message fields

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. Table A.5 describes the message fields.

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

Table A.5 GST message fields

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

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. Table A.6 describes the message fields.

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

Table A.6 GSV message fields

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, and Table A.7 describes the message fields.

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

Table A.7 Heading from true north fields

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

PTNL,AVR

Time, Yaw, Tilt, Range for Moving Baseline RTK

The PTNL,AVR message string is shown below, and Table A.8 describes the message fields.

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

Table A.8 AVR message fields

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

PTNL,GGK**Time, Position, Position Type, DOP**

An example of the PTNL,GGK message string is shown below. Table A.9 describes the message fields.

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

Table A.9 PTNL,GGK message fields

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
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. Table A.10 describes the message fields.

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

Table A.10 PTNL,PJK message fields

Field	Meaning
0	message ID \$PTNL,PJK
1	UTC of position fix
2	Date
3	Northing, in meters
4	Direction of Northing will always be N (North)
5	Easting, in meters
6	Direction of Easting will always be E (East)
7	GPS Quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 2: 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. Table A.11 describes the message fields.

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

Table A.11 PTNL,VGK message fields

Field	Meaning
0	message ID \$PTNL,VGK
1	UTC of vector in hhmmss.ss format
2	Date in mmddyy format
3	East component of vector, in meters
4	North component of vector, in meters
5	Up component of vector, in meters
6	GPS Quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 2: 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
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. Table A.12 describes 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
```

Table A.12 PTNL,VHD message fields

Field	Meaning
0	message ID \$PTNL,VHD
1	UTC of position in hhmmss.ss format
2	Date in mmdyy 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, and Table A.13 describes the message fields.

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

Table A.13 GPRMC message fields

Field	Meaning
0	message ID \$GPRMC
1	UTC of position fix
2	Status A=active or V=void
3	Latitude
4	Longitude
5	Speed over the ground in knots
6	Track angle in degrees (True)
7	Date
8	Magnetic variation in degrees
9	The checksum data, always begins with *

ROT Rate and Direction of Turn

The ROT string is shown below, and Table A.14 describes the message fields.

\$GPROT,35.6,A*4E

Table A.14 ROT message fields

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

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

An example of the VTG message string is shown below. Table A.15 describes the message fields.

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

Table A.15 VTG message fields

Field	Meaning
0	message ID \$GPVTG
1	Track made good (degrees true)
2	T: track made good is relative to true north
3	Track made good (degrees magnetic)
4	M: track made good is relative to magnetic north
5	Speed, in knots
6	N: speed is measured in knots
7	Speed over ground in kilometers/hour (kph)
8	K: speed over ground is measured in kph
9	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. Table A.16 describes the message fields.

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

Table A.16 ZDA message fields

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

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

Real-Time Data and Services

In this appendix:

- RT17/RT27 Streamed Data service

The RT17 Streamed Data service and the RT27 Stream Data service (also referred to as *Multi-system support*) are Trimble proprietary formats. They are available for use with the GPSBase and GPSNet 2.5 software.

The RT17 stream only contains GPS L1/L2 and L2C information. For L5 and GLONASS L1/L2 support, the RT27 Streamed Data service must be enabled. If you are configuring outputs using the front panel of the receiver, only RT27 can be selected. To select the RT17 Streamed Data service or to override the stream data settings in the receiver, use the Web interface.

RT17/RT27 Streamed Data service

An RT17/RT27 service provides GNSS observations, ephemerides, and other information, as defined for that service. When the GPSNet/GPSBase software connects to the port, the software can configure the receiver.

***Note** – If you are familiar with the NetRS GPS receiver, this means a TRIMCOMM™ port is no longer required for bi-directional communications. If the connection is required to be passive, it is possible to set Output only mode when configuring the port.*

Using the keypad and display to configure RT27 outputs

You can configure RT27 output during the base and rover setup using the keypad and display. See Chapter 5, Configuring the Receiver Using the Keypad and Display.

Using the web interface to configure RT17/RT27 outputs

You can configure RT17/RT27 output using the *I/O Configuration* menu of the web interface of the receiver. Configure the stream to allow multiple client connections on a single port, or restrict the stream to a single client connection. To allow only authorized connections on the port, protect the output stream by requiring a password.

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 to 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 NetR5 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 95, 98, Windows NT®, 2000, Me, or XP operating systems.*

Installing the WinFlash utility

You can install the WinFlash utility from the *Trimble Survey and Infrastructure Receivers CD*, or from the Trimble website.

To install the WinFlash utility from the CD:

1. Insert the disk into the CD drive on your computer.
2. From the main menu select *Install individual software packages*.
3. Select *Install WinFlash*.
4. Follow the on-screen instructions.

The WinFlash utility guides you through the firmware upgrade process, as described below. For more information, refer to the *WinFlash Help*.

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.
4. 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.

5. 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.

6. 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.

7. 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.**).

8. Click **OK**.

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




9. To select another operation, click **Menu**; to quit, click **Exit**.

If you click **Exit**, the system prompts you to confirm.

10. 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 or 26-pin adaptor 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 (see above) 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.

Issue	Possible cause	Solution
Rover receiver is not receiving radio.	The base station receiver is not broadcasting.	See the issue, The reference 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.
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).

Glossary

almanac	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. The orbit information is a subset of the ephemeris / ephemerides data.
AutoBase	AutoBase technology uses the position of the receiver to automatically select the correct base station; allowing for one button press operation of a base station. It shortens setup time associated with repeated daily base station setups at the same location on jobsites.
base station	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.
BINEX	BIInary 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.
broadcast server	An Internet server that manages authentication and password control for a network of VRS servers, and relays VRS corrections from the VRS server that you select.
carrier	A radio wave having at least one characteristic (such as frequency, amplitude, or phase) that can be varied from a known reference value by modulation.
carrier frequency	The frequency of the unmodulated fundamental output of a radio transmitter. The GPS L1 carrier frequency is 1575.42 MHz.
carrier phase	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.
cellular modems	A wireless adaptor that connects a laptop computer to a cellular phone system for data transfer. Cellular modems, which contain their own antennas, plug into a PC Card slot or into the USB port of the computer and are available for a variety of wireless data services such as GPRS.
CMR CMR+	Compact Measurement Record. A real-time message format developed by Trimble for broadcasting corrections to other Trimble receivers. CMR is a more efficient alternative to RTCM.
covariance	The mean value.

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>

- 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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