

NetRS™ GPS Receiver

User Guide



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- 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.

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

STATEMENT ACCORDING FCC PART 15.21

Modifications not expressly approved by Trimble could void the user's authority to operate the equipment.

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EMC Emissions: BSEN 55022:1998 (W/A1:00) Class B

EMC Immunity: EN 55024:1998

Safety: EN 60950:2000

Mark First Applied: 03

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Introduction

Welcome to the *NetRS GPS Receiver User Guide*. This manual describes how to set up and use the Trimble® NetRS™ GPS receiver.

Even if you have used other Global Positioning System (GPS) 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 GPS, visit the Trimble website (www.trimble.com) for an interactive look at Trimble and GPS.

This publication assumes that you are familiar with the Microsoft® Windows® operating system and know how to use a mouse, select options from menus and dialogs, make selections from a list, and refer to online help.

About the NetRS

The NetRS receiver is a dual-frequency GPS receiver that runs on a Linux operating system and communicates mainly through local and wide area networks. You can operate the receiver as a stand-alone reference station or integrate it into a scalable network.

You will use an office computer to configure the receiver, access files, or publish data files to a company intranet or to the Internet.

The NetRS receiver makes it easy for you to set up a powerful, flexible, and reliable reference station for continuous operation.

Related Information

Sources of related information include the following:

- Release notes – the release notes describe new features of the product, information not included in the manuals, and any changes to the manuals.
- Trimble training courses – consider a training course to help you use your GPS system to its fullest potential. For more information, visit the Trimble website at www.trimble.com/support.html.

Technical Assistance

If you have a problem and cannot find the information you need in the product documentation, *contact your local dealer*.

If you need to contact Trimble technical support:

1. Go to the Trimble website (www.trimble.com).
2. Click the **Support** button at the top of the screen. The Support A–Z list of products appears.
3. Scroll to the bottom of the list.
4. Click the **submit an inquiry** link. A form appears.
5. Complete the form and then click **Send**.

Alternatively, you can send an e-mail to trimble_support@trimble.com

Your Comments

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

Overview

In this chapter:

- The Network Appliance Concept
- NetRS Services
- Use and Care
- Electronic Interference
- Security Threat (COCOM) Limits

This chapter introduces the NetRS GPS receiver. This receiver makes it easy to deploy a powerful, flexible, and reliable Continuously Operating Reference Station (CORS).

The NetRS receiver integrates the latest dual-frequency GPS technology into a Linux processing and communications framework that can operate as a stand-alone reference station or can be integrated into a scalable network.

Because Internet Protocol (IP) is 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** – In this manual, all references to the “Internet” mean either a wide area network (WAN) or a local area network (LAN) connection.*

The Linux framework provides a foundation that allows Trimble to extend and customize the system in ways which are not possible with a proprietary operating system. Native support for standardized interfaces means that you can use a variety of powerful commercial and public domain software to work with the NetRS receiver.

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:

- Store the configuration of one receiver to a file and restore it to the same receiver at a future date, or clone it to any other receiver in a network.

- Create a base configuration with a variety of operating modes. You can then enable those modes as necessary, rather than having to change the global state of the receiver from one mode to another. For example, you can configure a number of streaming services with different 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.
- Create multiple continuous logging session configurations and then enable them only when required.

These features, and many more, shift the model of a GPS receiver toward the concept of a “network appliance”.

The Network Appliance Concept

Traditionally, a GPS receiver has one user (operator). That person can change settings without affecting other users.

With the NetRS receiver, an operator can configure the receiver once, then make the receiver available, as a *network appliance*, for use by one or more other users (clients).

An operator can set up the receiver to provide one or more services that are accessible to one or more clients through the Internet. Once the receiver is deployed, the client need make only minimal changes, if any, to the receiver configuration.

When the receiver operates as a network appliance, it provides services to all clients who are attached to the receiver through the network.

Different streamed services can be configured on different ports. For example, the service configuration on one port can have different data rates or smoothing configurations from the service configuration on another port. To obtain a service, the client has only to connect to a specific port. In this way, most clients do not need to control the

receiver. Any changes the operator makes to global settings, such as masks, affects all clients 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 NetRS receiver provides the following standard configuration and data logging services:

Use ...	to perform ...
FTP	remote manual and/or automated operations to manage the logged data file space
HTTP	all manual and automated configuration operations
	manual operations to manage the logged data file space
HTTPS	the same functions as the HTTP link, except that all data that is sent between the office computer and the receiver is encrypted, which makes the link more secure.

NetRS Services

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

- Protocol service

A protocol service provides functionality over a two-way link. PPP enables IP communications over an RS-232 serial link; Trimcom is a binary protocol used by Trimble PC software applications; Met-Tilt provides sensor query and data logging.

- Streaming service

Any client with authorized access can obtain streamed information, such as GPS 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.

- Query service

No command is required; opening the TCP port triggers data transmission. A query service provides a single source for a specific information type, and returns it without affecting other continuous streams.

Multiple clients can connect simultaneously to a single streaming or query port.

The NetRS receiver supports the following services:

Service	Description	Type
PPP (Point to Point Protocol)	This service is the Internet standard for transmitting IP packets over serial lines. When you enable the serial port for PPP, you can run the NetRS web configuration interface over the serial port.	Protocol
Trimcom	This service supports a subset of the standard Trimble “Trimcom” binary communications protocol. Trimcom is used by Trimble software applications for configurable GPS data streaming and queries.	Protocol
RT17	This service can be configured to provide various combinations of real time GPS measurements, including phase, pseudorange, carrier-to-noise ratios, and other general information about each satellite that is tracked. “RT17” is also the real-time streamed GPS measurement information. It includes the same information that is stored in Type 17 records in T00 and DAT files This is the basic information used to produce GPS positions and corrections.	Streaming
BINEX	The BINEX service provides streamed GPS observables, satellite orbits, and various optional data about the site and receiver. For more information about the BINEX format, go to http://binex.unavco.org/ .	Streaming

Service	Description	Type
Met-Tilt	This service can be configured to send one or more device initialization and query strings on a regular basis to obtain measurements from external sensors. These sensors include those used to collect meteorological data and/or deformation data (where the tilt of the sensor is measured). Data from the Met or the Tilt sensor is included in any active RT17 or BINEX stream. Depending on whether you are logging or streaming data, all data is included in T00, BINEX, or RT17 format.	Protocol
RTCM	This RTCM (Radio Technical Commission for Maritime Services) service can be configured to send one or more RTCM SC-104 messages from the specified port.	Streaming
CMR/ CMR+	This service can be configured to provide real-time GPS measurements in Compact Measurement Record format, primarily for RTK applications that use CMR or CMR+.	Streaming
Ephemerides	This service provides a complete set of GPS ephemerides (orbits) each time an application connects to the selected port.	Query
Almanacs	This service provides a complete GPS almanac each time an application connects to the selected port.	Query
SV Status	This service provides a variety of information about the current GPS and WAAS/EGNOS constellation.	Query

Use and Care

The NetRS receiver is designed to withstand the treatment and 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 NetRS receiver outside the specified temperature range can damage it. For details, see Specifications, page 70.

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.

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

Security Threat (COCOM) Limits

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

Immediate access to satellite measurements and navigation results is disabled when the receiver velocity is computed to be greater than 1000 knots, or its altitude is computed to be above 18,000 meters (approximately 59,000 ft). The receiver GPS subsystem will reset until the security threat (COCOM) situation clears. As a result, all logging and stream configurations will stop until the GPS subsystem is cleared.

Features and Functions

In this chapter:

- Features of the Receiver
- Button Functions
- LED Functions

This chapter describes the physical features of the NetRS receiver. It also describes how to perform some basic receiver functions.

Features of the Receiver

All operating controls, ports, and connectors on the receiver are on the front or the rear panels, see Figure 3.1.



Figure 3.1 Receiver front and rear panels

Front panel

Figure 3.2 shows the features on the front panel. The following tables describe the features. For more information, see Button Functions, page 18 and LED Functions, page 22.

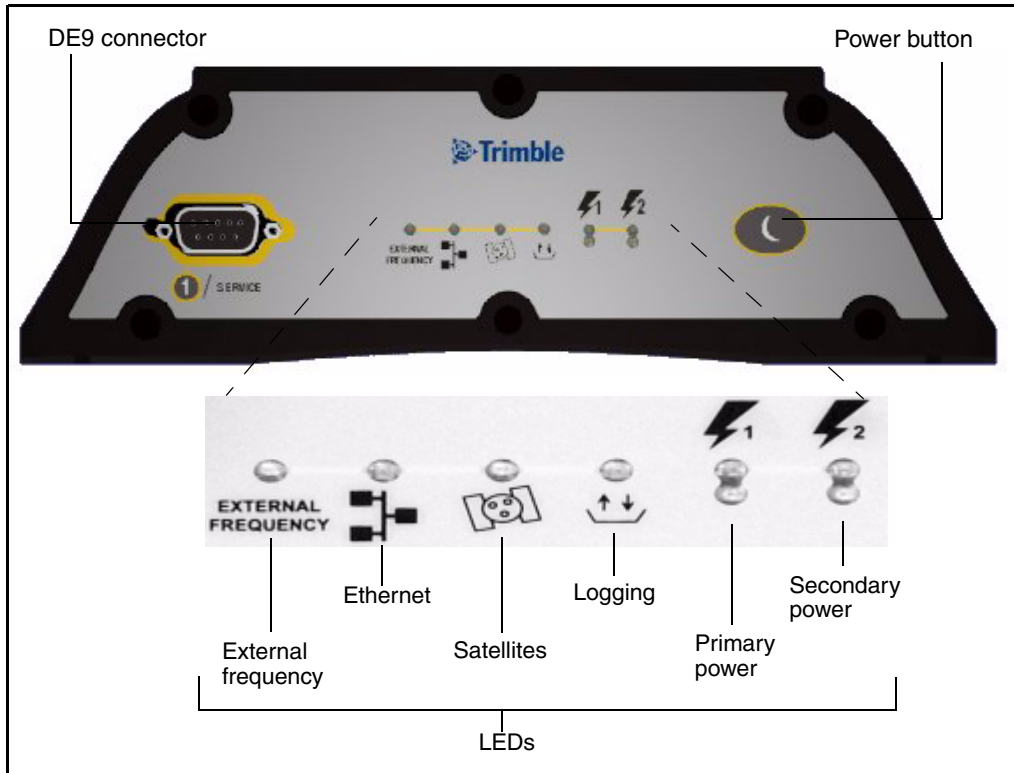


Figure 3.2 Front panel features

Feature	Description
DE9 port	Provides a service port for initial Ethernet address configuration and diagnostics. The service port uses a 3-wire connection with default parameters of 115,200 baud, 8-NONE-1. Linux diagnostics are available through this port during the boot and shutdown processes.
Power button	Controls the receiver power states

LED indicator	shows...
External frequency	external oscillator activity
Ethernet	Ethernet port activity
Satellites	satellite tracking status
Logging	logging status to the internal memory
Primary power	power status on the primary power port
Secondary power	power status on the secondary power port

Rear panel

Figure 3.3 shows the rear panel features. Serial ports can support RT-17 and BINEX data formats (to stream real-time GPS observables), and CMR and RTCM data formats (to stream RTK/differential corrections). Each port can also act as a PPP server for IP communications over a serial link.

All supported configuration, streaming, file transfer, and firmware update capabilities are supported over the Ethernet port or any serial port supporting IP communications using PPP.

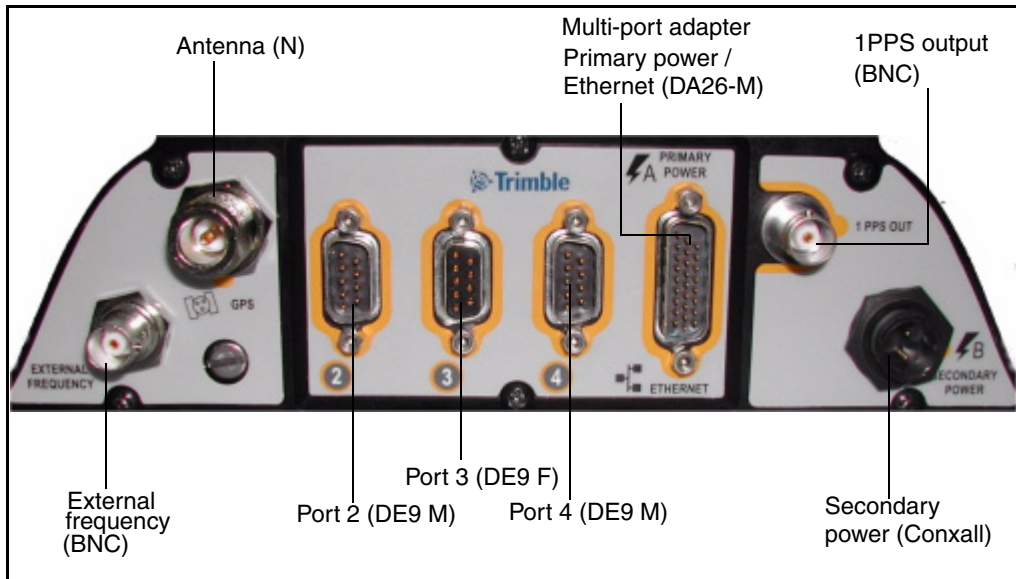


Figure 3.3 Rear panel features

Figure 3.4 shows the multi-port adapter in detail.

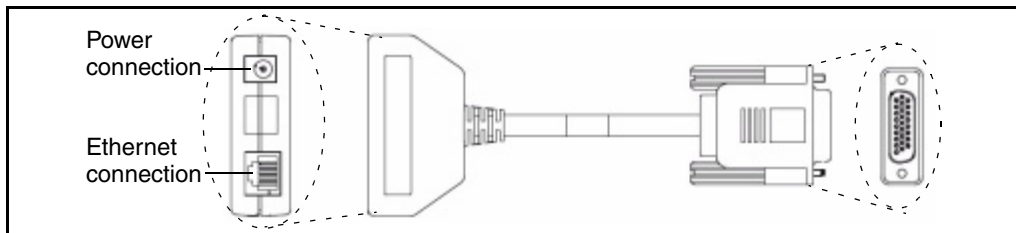


Figure 3.4 Multi-port adapter detail

Table 3.1 Rear panel features

Feature	Description
N connector	Connects to the GPS antenna.
Multi-port adapter (DA26 male port)	Primary power port – AC-to-DC power supply connects through an inline DC power jack. Ethernet port – connects to a 10Base-T network through an RJ45 jack.
BNC ports (two)	One PPS output. External frequency input.
DE9 male ports (two)	Connects to a DCE device, such as a modem or a terminal adapter.
DE9 female port	Connects to a DTE device, such as a computer.
<i>Note – The 3 rear panel ports include full 9-pin connections that provide all the signals required to support a modem or other communications device. A serial port can be configured for either direct or modem connections. A modem connection supports all the signals necessary for auto-answer operation using the Linux communication protocol, mgetty daemon. For more information, see Cables and Connectors, page 73.</i>	
2-pin Conxall connector	Secondary power port. Backup battery power connects through a DC power cable (P/N 48600).

Power ports

The NetRS receiver has two power ports:

- Primary – connects to the DA26 connector on the rear panel through an inline DC power jack on the multi-port adapter.

Intended for use only with the Trimble AC-to-DC power supply (P/N 48800-00).

- Secondary – connects to the 2-pin Conxall connector through the DC power cable with polarity indications (P/N 48600).

Intended for battery backup using a nominal 12.6 V lead acid battery system with any type of charging configuration.

Trimble recommends that you use a minimum 20 Amp-hour lead acid battery in backup power configurations. A 20 Amp-hour battery will provide over 60 hours of backup power, or about 30 hours with 50% derating, if the receiver and antenna are the only powered devices.

If you use an external low voltage disconnect (LVD), set the NetRS receiver shutdown voltage so that the LVD does not switch off while the receiver is powering down. Do one of the following:

- Set the shutdown voltage to at least 0.3 V *above* the LVD disconnect voltage. Trimble recommends this setting to enable the receiver to shut down normally.
- Set the shutdown voltage to at least 0.3 V *below* the LVD disconnect voltage.

A large capacity battery will provide longer backup time. Trimble does not recommend that you use a small capacity battery. Any battery charging system must match the selected battery size.



Caution – Do not exceed the power supply voltage specification. Use only AC power supply (P/N 48800-00) with the NetRS receiver.

Button Functions

The NetRS receiver has only one button, the **Power** button, which is on the front panel. The function of this button is to turn the receiver on (press the button once) and off (press and hold the button for two seconds). If you turn the receiver off using the **Power** button, the receiver will stay off, regardless of any alarm settings you may have made. To turn the receiver on again, you must use the **Power** button or remove and then reapply power to the receiver.

Power button operations

- When the receiver is switched on and operating, press the **Power** button for at least 2 seconds, but not more than 10 seconds, to switch the receiver off. All LEDs, except the Ethernet LED, turn off briefly when the receiver accepts the button press.
- When the receiver is off, press the **Power** button once to turn the receiver on.

The NetRS receiver requires time to start up and shut down. It can take from 75 seconds to 4 minutes to fully start up the Linux operating system, depending on the previous shut down conditions.

To turn off the receiver, press and hold the power button for two seconds. The shut down process normally takes between 20 seconds and 1 minute. During these operations, all the LEDs flash.

Once you have pressed the **Power** button, wait for the operation to complete before you press the button again.

Power saving mode

Use the power saving mode to set options that control whether the receiver remains on continuously or goes to sleep between data logging sessions. This feature is particularly useful for sites with intermittent power or where batteries are used and charging.

Sleep mode

In Sleep mode, the receiver switches to low power when there is no active data logging session. This allows for extended operation when the receiver is running on battery power.

Failsafe wakeup alarm

When the receiver is in Sleep mode, you cannot communicate with it until the receiver wakes up for the next scheduled session. To avoid problems if there is no future session defined, use the Failsafe wakeup alarm. This activates the receiver for a short period at specific times every day.

To control Sleep mode, select Data Logging and then set the following controls as required in the *Power Saving* screen or the *Status* screen:

- Shut down receiver between data logging sessions?
 - Select *Yes* for the receiver to go into the power saving mode when there are no active sessions. Once the receiver is in this mode, you cannot communicate with the receiver or use the browser interface until the receiver wakes up.
 - Select *No* to disable Sleep mode. The receiver remains active between sessions.
- Wake up periodically?
 - Select *Yes* for the receiver to wake from Sleep mode for a short time at one or more periodic intervals every day, regardless of the need for a data logging session. This option allow you to establish communications with a receiver when there is no data logging session scheduled.

Specify the duration of the wakeup alarm, and the interval between alarms, from a range of values. The wakeup times are always synchronized to the beginning of the UTC day. For example, if you specify an 8 hour interval, then a periodic wakeup alarm will occur every day at 00:00 UTC, 08:00 UTC, and 16:00 UTC.



Caution – If you turn off the Failsafe wakeup alarm, you may not be able to communicate with a remote receiver.

***Note** – If you press **Power** while the power saving mode is enabled and the receiver is in **Sleep mode**, the receiver temporarily turns on. If there is no session pending, the receiver continues to operate for five minutes, then automatically shuts down. If you visit the NetRS home page for the first time during such a “hold off” period, a dialog appears to warn that the receiver is scheduled to shut down after the hold off time.*

*If you press **Power** while the power saving mode is enabled and the receiver is **on**, power saving mode is disabled and the receiver turns off.*

Other power operations

- If you disconnect all power sources, the receiver shuts down. It automatically turns on again when you reconnect a power source of 12 V or more. The receiver may take longer to boot up when power is restored after a sudden power loss.
- The receiver turns on only if at least one of the power supplies supplies 12 V (or more) power.

However, when the receiver is on battery power, you can turn it off, or put it into Sleep mode, if the voltage is more than 11 V.

- When you use a standard AC power supply, or a battery that is providing at least 12 V (that is, charged to at least 40-50% of capacity), the **Power** button will always function as an on/off switch to boot up or shut down the receiver.

To erase the almanac and the ephemeris

You can erase the almanac and the ephemeris when they are out of date:

1. Press and hold down the **Power** button for 15 seconds. The External Frequency LED turns on.
2. Once you release the **Power** button, the almanac and ephemeris are erased.

To reset the receiver to factory defaults settings



Caution – The reset operation can take 5 to 10 minutes. Wait until the receiver has returned to normal operation before you press the Power button or disconnect receiver power. With the antenna connected, wait until the Satellite tracking LED blinks to indicate normal tracking. Alternatively, connect an office computer to the service port and wait until the diagnostics output displays Switching to runlevel: 5. The default IP addressing mode is DHCP. If the receiver is configured with a static IP address, resetting to factory defaults may cause the receiver IP address to change and result in loss of communications with the receiver over the Ethernet link.

1. With the receiver switched on, press and hold the **Power** button until the External Frequency LED turns on (at 15 seconds) and then turns off (at 30 seconds).
2. Once the External Frequency LED turns off, release the **Power** button.

The receiver performs a full reset. All parameters, including GPS orbit and tracking information, are restored to the factory default values.

LED Functions

The six LEDs on the front panel of the receiver indicate various operating conditions. An LED that is constantly lit or is flashing slowly usually indicates normal operation. An LED that is flashing quickly indicates a condition that may require attention. An LED that is unlit indicates that no operation is occurring. The possible LED states are:

LED state	Description
Flashing slowly	LED is on for ½ second and off for ½ second
Flash quickly	LED is on for 0.1 second every 0.2 seconds
Blinking	LED is on for 1 second every 5 seconds
Off	LED is not lit
On	LED is continuously lit

LED startup sequence

When the receiver switches on, all LEDs turn on for a few seconds, flash until the boot up process is complete, then operate normally.

The LED startup sequence shows if the receiver has started successfully. When you switch on the receiver, the LED startup sequence is:

1. All LEDs turn on briefly.
2. All LEDs turn off.
3. LEDs operate normally.

If the LEDs do not turn off, it means that the system has failed to start correctly.

Note – On startup, LEDs flash from 20 seconds to 4 minutes, depending on the cause of the previous shutdown. Receiver shutdown due to a sudden loss of power will force a data file system integrity

check the next time the receiver is turned on. The time required to perform the file system check will increase with the number of data files stored in receiver memory.

The LEDs operate as follows:

External frequency (orange)

LED state	Description
On	External frequency source is being used
Flashing slowly	External oscillator is being used
Off	No external frequency source

Ethernet (green)

LED state	Description
On	Ethernet port is on
Flashing quickly	Ethernet traffic is being received
Off	Ethernet port is off or disconnected

Satellite (amber)

LED state	Description
Flashing slowly	Tracking four or more satellites
Flashing quickly	Tracking fewer than four satellites
Off	Not tracking satellites

Logging (yellow)

Note – Normal operation for the NetRS receiver is continuous logging. There is no LED state to indicate the memory capacity.

LED state	Description
Flashing slowly	Logging data to the internal CompactFlash card
Off	Not logging data

Power management (green and amber)

Green Power LED	Description
On	Power source is healthy (12 V or more). The unit will always power on.
Flashing quickly	Power source is low (11 V–12 V). The unit will continue to operate, but will not wake up if in sleep mode.
Off	No power source.

Amber Power LED	Description
On	Power source is healthy but is not in use
Flashing quickly	Power source is low but is not in use
Off	No power source

LED flash patterns

Table 3.2 summarizes the LED flash patterns.

Table 3.2 LED flash patterns

Mode	External Frequency (orange)	Ethernet (green)	Satellite (amber)	Logging (yellow)	Power 1 (green / amber)	Power 2 (green / amber)
Receiver off (no power)	Off	Off	Off	Off	Off	Off
Receiver in Monitor mode	On	On	On	On	On	On
Receiver in Sleep mode	Off	Off	Off	Blinking	Off	Off
Receiver on primary Secondary power healthy Logging data	N/A	N/A	Flashing slowly	Flashing slowly	Green on	Amber on
Ethernet port on Receiving traffic Tracking satellites Power on Port 2 only	Off	On Flashes with traffic	Flashing slowly	N/A	Off	Green on
Primary power source on Secondary power supply low	N/A	N/A	N/A	N/A	Green on	Amber flashing quickly
Primary power source low Secondary power source available	N/A	N/A	N/A	N/A	Green flashing quickly	Amber on
Tracking four or more satellites	N/A	N/A	Flashing slowly	N/A	N/A	N/A
External frequency in use	Flashing slowly	N/A	N/A	N/A	N/A	N/A

Setting Up the Receiver

In this chapter:

- Setup Guidelines
- Connecting the Receiver to Other Devices

This chapter describes how to set up the NetRS receiver and how to connect the receiver to other devices.

Setup Guidelines

Consider the following guidelines when you set up the receiver.

Environmental conditions

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

To improve the receiver performance and long-term reliability, 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

Do not locate the GPS 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 supply power to the receiver. 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 and appropriate safety grounding. A static dissipater near the antenna can reduce the likelihood of a direct lightning strike. You should 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. To be compatible with the receiver voltage output, the antennas should allow 8 V DC to pass through.

For more information, contact your local Trimble dealer, or go to the following websites:

- <http://www.hubersuhner.com/>
- <http://www.polyphaser.com/>

Mounting the receiver

Figure 4.1 shows the layout and dimensions of the mounting holes on the base of the receiver.

When you mount the receiver on a vertical surface, use four #10 or M5 threaded fasteners. Thread the fasteners into a solid surface, such as half-inch plywood or an equivalent solid structure. Make sure the fasteners are tightly inserted.

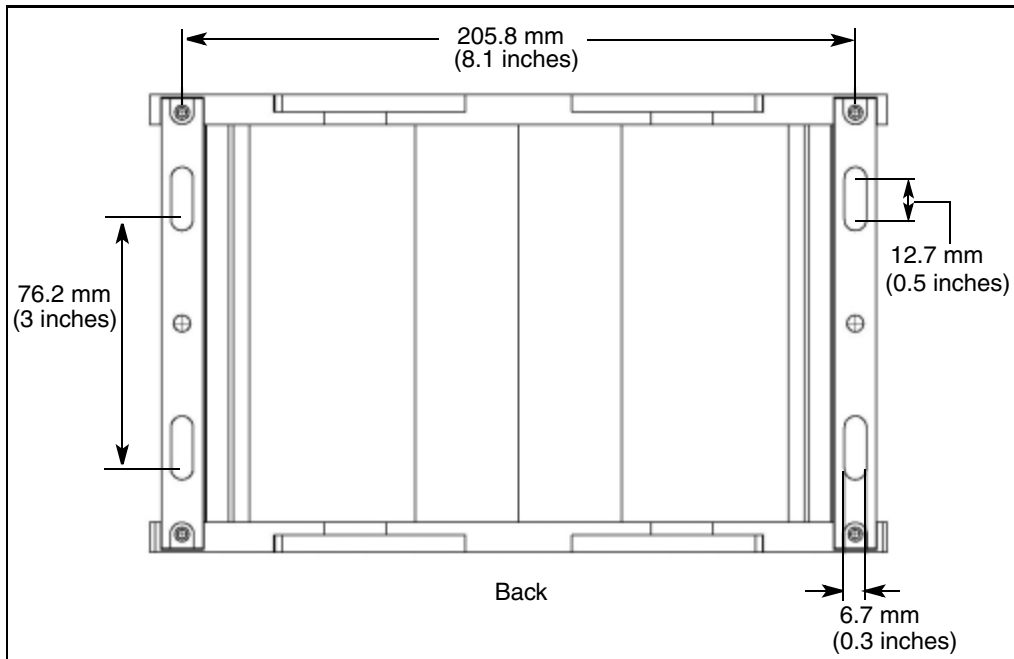


Figure 4.1 Receiver mounting holes

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 position.

Figure 4.2 shows a suitable place for an antenna. 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.

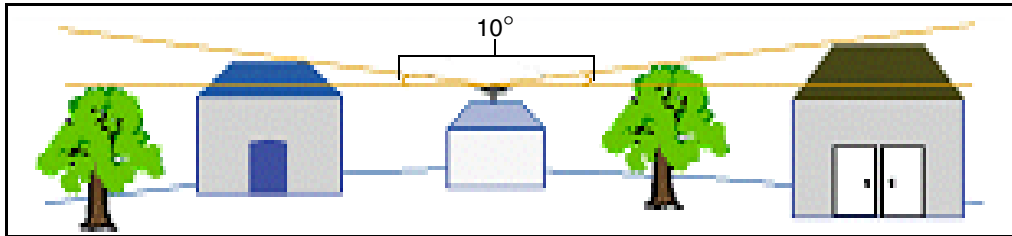


Figure 4.2 Antenna placement

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 Other Devices

This section describes how to connect the NetRS receiver to external devices.

Antenna

The receiver provides an N-type female connector for connecting to an antenna. The receiver is intended for use with a Zephyr™ Geodetic or Choke Ring antenna. However, you can use it with any Trimble geodetic antenna.

Antenna cabling

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

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

The following table lists some common types of cable and the maximum length you can use before you need an inline amplifier (P/N 33411-00) for GPS frequencies.

Cable type	Maximum length for use without inline amplifier
RG-214	30 m
LMR-400	55 m
LMR-500	70 m
LMR-600	85 m
Heliac LDF4/50	105 m
Heliac.LDF4.5/40	140 m

Met-Tilt sensors

You can connect the NetRS receiver to an external meteorological (Met) or Tilt sensor.

The receiver supports only one direct Met-Tilt sensor connection. For multiple sensors, the solution is to daisy chain. For more information see Daisy chaining devices, page 33. The sensor responds to a request for information, and the query and response are time tagged and stored in any T00 or BINEX file being logged, or transmitted in an RT17 or BINEX data stream. You can connect a Met or Tilt sensor to any RS-232 serial port.

Instruments which can collect meteorological data include:

- Paroscientific MET3 and MET3a (www.paroscientific.com)
- Vaisala PTU200GPS and PTU200GPSMIK (www.vaisala.com)

Instruments which can collect tilt data include:

- Applied Geomechanics D700 and MD900 series (www.geomechanics.com)

Daisy chaining devices

Typically, when you need to collect meteorological and tilt sensor data, you can connect both devices to one RS-232 serial port.

To do this, use custom cabling where the transmit data (TXD) RS-232 line from one sensor is connected to the receive data (RXD) RS-232 line of the next sensor.

The receiver sends a command to the first device in the chain. Each device responds to a specific address. If the command is addressed to the device, the device sends a measurement response to the next device in the chain. If the command is not addressed to that device, the command is transmitted without modification, and the next device may process it. The receiver receives and logs the response from the last device in the chain.

For more information, see *Configuring Met-Tilt sensors*, page 47.

Dial-up modems and terminal adapters

The NetRS receiver provides auto-answer support for a dial-up modem or a terminal adapter connection as a PPP server. You can configure the modem, or the receiver can program the AT setup strings. The receiver can also make automated dial out connections to an Internet service provider using PPP dial out.

Note – This option only supports a 24/7 continuous connection for streaming connections. For more information, refer to the Help.

For full control, a modem must be connected to one of the serial ports on the rear panel. Typically, this would be port 2 or port 4, which provide connectors for a DCE device.

You can access and control the receiver over a PPP link. You can also set up a streaming service, such as Trimcom, CMR RTK, or RTCM RTK corrections on a serial port. For a streaming service, the modem must perform the auto-answer function.

For more information, see *Dial-up modem, radio modem, or terminal adapter*, page 45.

Radio modems

The most common data link for Real-Time Kinematic (RTK) surveying is a radio. You can connect the receiver to an external radio through one of the four serial ports, whether or not the Ethernet port is in use. Typically, use one of the DE9 male ports on the rear panel.

The NetRS receiver supports the following Trimble base radios:

- TRIMMARK™ 3
- TRIMMARK IIe
- PDL450
- TRIMTALK™ 450S

To use an external radio with the NetRS receiver, you need an external power source for the radio. Use the external radio's configuration program to configure the radio modem separately.

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

- Enable the RTCM or CMR RTK corrections stream on the selected serial port.
- Set the reference station coordinates and broadcast ID.

For more information, see Chapter 5, Configuring the Receiver.

External frequency reference

Use a BNC cable to connect to an external frequency reference. The receiver directly supports a 10 MHz external frequency reference.

An external reference must provide the reference signal with an amplitude in the range +6 to +13 dBm, and a frequency tolerance within +/- 5 ppm over temperature and time.

You can also use one of the following external off-the-shelf adapters to support a 5 MHz or a 20 MHz external reference source with a +7 to +13 dBm input range:

- 5 MHz: Wenzel LNHD HF DOUBLER
(Wenzel P/N 601-10726 Rev. A)
- 20 MHz: Wenzel LNFDN FREQUENCY DIVIDER
(Wenzel P/N LNFDN-2-20-10-1-10)

Configuring the Receiver

In this chapter:

- Setting up Communications
- Configuring the Receiver Through a Web Browser
- Configuring the Receiver for Connected Devices
- Updating the Receiver Firmware

The NetRS receiver typically communicates through a network such as the Internet. To configure the receiver, access files, and update the receiver firmware, you must create an IP-based link to the receiver.

This chapter describes how to connect the receiver to a network, configure the receiver through the HTTP web interface, configure the receiver for a connected device, and install new firmware.

Setting up Communications

Connect the receiver to a network or host computer through one of the following:

- The Ethernet (10Base-T) port

Use a CAT5 cable to connect the receiver to a network hub or switch. Alternatively, use a crossover cable to connect directly to the receiver from a host computer.

- A PPP connection from a serial port

For more information, see *Setting Up a PPP Connection*, page 83.

The NetRS ethernet port supports 10Base-T full duplex and auto-negotiation. The system automatically configures to the highest interoperable performance mode. Possible modes and configurations are as follows:

Ethernet port mode	System configuration
1: 10Base-T full duplex	NetRS receiver and End port devices support auto-negotiation End port device is configured for full duplex
2: 10Base-T half duplex	NetRS receiver and End port devices support auto-negotiation End port device is configured for half duplex
3: 10Base-T half duplex	The NetRS receiver supports auto-negotiation End port device does not support auto-negotiation or There is no ethernet port connected

***Note** – Do not configure a NetRS receiver in mode 3 where the End port device does **not** support auto-negotiation but the receiver is configured for “full duplex” instead of “half duplex”. If you do, you may encounter Ethernet data overflows and system problems.*

1. To configure initial parameters for a hub- or switch-based connection, use Port 1 on the receiver front panel.
2. To complete the configuration, access the web-based configuration pages.

Configuring the Ethernet connection

To configure a 10Base-T connection, you need the following:

- A terminal emulator on the host computer that you will use to configure the receiver.
- One of the following:

- A static IP address, default gateway, and netmask for a static configuration.

If you use a crossover cable for the connection, then you can use any address that does not conflict with the IP address and default gateway address of the connected host.

- A DHCP server on the network.
- A 10Base-T network connection and a CAT5 cable.

Connect through a port on a network hub or switch that is also connected to the host computer that you will use to configure the receiver.

Alternatively, use a crossover cable to connect directly to the host computer.

To define a static IP address for the device or to obtain network-assigned DHCP parameters:

1. Use a standard RS-232 cable to connect a computer host to the receiver service port.
2. Configure a terminal emulator program (for example, Hyperterminal for the Windows operating system) for a 115,200 baud 8-N-1 connection with no hardware flow control.

If you use Hyperterminal:

- a. Click **Disconnect**.
- b. To set the parameters, select *File / Configure* and then click **Configure**.
- c. Change the communication values and then click **Connect**.



Tip – You may also want to enable the terminal emulator to capture text for future review.

3. Connect or supply power to the receiver. If the receiver is already turned on, turn it off and then on again.

As the receiver starts, it emits diagnostic information through the service port. For example, Figure 5.1 on page 39 shows the summary sequence that appears when you define a static IP address configuration.

4. When the message Do you want to change Ethernet Configuration? appears, enter **yes**.
5. Enter the new mode, static IP address, default gateway address, and netmask. Press **Enter**.

The new values appear in the summary followed by the message Accept New Configuration?.

6. If the new values are correct, enter **yes**.

```
Current Ethernet Port Configuration:
MAC address: 00:60:35:00:C3:12
Mode: dhcp
IP: 0.0.0.0
Netmask: 255.255.255.0
Gateway: 0.0.0.0
Do you want to change Ethernet Configuration? (yes/no)[no]: yes
-----

New Mode (static/dhcp): static
New static IP Address [0.0.0.0]: 10.1.80.74
New Gateway Address [0.0.0.0]: 10.1.80.1
New Netmask [255.255.255.0]: 255.255.254.0
-----

New Configuration
Mode: static IP
IP: 10.1.80.74
Gateway: 10.1.80.1
Netmask: 255.255.254.0
Accept New Configuration? (yes/no)[yes]: yes
-----

Accepted - Updating configuration files
Applying new Network configuration
```

Figure 5.1 Ethernet port configuration sequence

***Note** – If you do not have a pre-assigned static IP address but you do have DHCP services on your network, you can enter **dhcp** as the Ethernet address mode. To obtain the automatically assigned IP address, monitor the service port output as the receiver boots up.*

Changing the Ethernet configuration

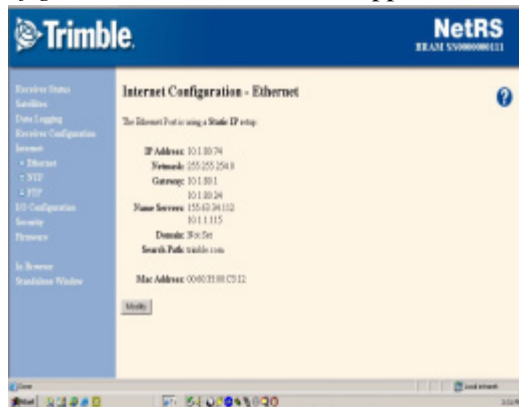
After you configure the receiver as described in the previous section, you can change the Ethernet address configuration or add Domain Name System (DNS) information (the IP address of one or more DNS servers, a domain name, and a domain search path). You can make these changes from the Ethernet configuration screen.

Once you have the receiver IP address, open the required web pages and complete the network configuration as follows:

1. From a host computer with a network connection to the receiver, open a web browser, such as Internet Explorer or Netscape.
2. In the URL address field of the browser enter **http://**, followed by the IP address of the NetRS receiver. For example, to access the receiver web server home page for the configuration in Figure 5.1, enter **http://10.1.80.74**.

Note – You must configure your web browser to bypass any proxy server in use for the connection to the NetRS receiver.

3. From the NetRS main menu, select *Internet*. The *Internet Configuration – Ethernet* screen appears:



4. Click **Modify**. In the *Ethernet Configuration* screen that appears, change the existing IP address configuration or enter DNS information as required.

Configuring the Receiver Through a Web Browser

This section briefly describes the interface that you use when you access the receiver through a web browser. You can configure the receiver through the Ethernet port or through a serial port that provides a PPP link to the receiver.

Web-based menu


The following table briefly describes options in the NetRS web-based menu system. For more information, refer to the NetRS Help. To access the help, click .

Table 5.1 Web-based menu options

Main menu option	Use the sub-menu screens to ...
Receiver Status	<p>View basic parameters, such as system name, IP address, and firmware version.</p> <p>Modify the system name.</p> <p>View a list of the SVs being tracked, files being logged, a list of currently active streams, power supply voltages, and the receiver internal temperature.</p> <p>View the currently computed GPS position, DOP, and clock offset.</p>
Satellites	<p>View a summary of current satellite activity.</p> <p>View a detailed table of current satellite activity.</p> <p>Enable or disable individual satellites.</p> <p>Control and configure the receiver for WAAS.</p> <p>View a text version of the almanac, ephemeris, UTC time, and ionospheric model data broadcast by GPS satellites.</p>
Data Logging	<p>View and manage logging sessions.</p> <p>Manage file space through the Automatic File Deletion mode.</p> <p>Shut down the receiver between sessions.</p> <p>Set the wakeup alarm.</p> <p>View logged data files.</p> <p>Access and download logged files.</p> <p>For more information, see Chapter 6, Logging and Managing Data.</p>

Table 5.1 Web-based menu options (continued)

Main menu option	Use the sub-menu screens to ...
Receiver Configuration	Access global receiver controls, including antenna settings, clock steering, multipath control, masks, and 1 PPS. Enable the external reference. Manage and apply receiver configuration files. Copy a configuration from one receiver to another. Restore the configuration of a receiver. Configure a voltage threshold for automated receiver shutdown in case of low battery power. Clear all GPS almanac or ephemeris information. Reset (restart) the receiver.

Table 5.1 Web-based menu options (continued)

Main menu option	Use the sub-menu screens to ...
Internet	<p>Configure the Ethernet connection.</p> <p>Configure the MTU value to limit the maximum packet size sent over the network by the NetRS receiver. Where network communications are slow or there is significant data loss it may be better to decrease this value.</p> <p>Enable/Disable the HTTP and/or HTTPS ports.</p> <p>Select alternative HTTP/HTTPS ports. HTTPS sends encrypted data from the browser client to the receiver, which makes HTTPS more secure than HTTP, especially if the receiver is not installed behind a network firewall.</p> <p>Setup IP filtering to allow access only from specified IP addresses.</p> <p>Limit access to the receiver by specifying a range of IP addresses that are authorized to connect to the receiver. The receiver will not respond to attempts to connect from a non-specified IP address.</p> <p><i>Note – You must specify valid IP addresses. If the specified IP addresses do not match at least one of those used to connect to the NetRS receiver, you will not be able to communicate with the receiver.</i></p> <p>Configure FTP access policies, including passwords for named FTP accounts.</p> <p>Change, or enable and disable, the default FTP ports.</p> <p>Control access for anonymous FTP, named account data files, and system files (for firmware upgrades).</p> <p>Configure the receiver for one or more NTP servers.</p> <p>Send notification messages to selected computers on a network with information about the available services and the ports on which those services are enabled.</p> <p>For more information on FTP access for logging data, see Chapter 6, Logging and Managing Data.</p> <p>For more information on FTP access for updating the firmware, see Updating the Receiver Firmware, page 49.</p>

Table 5.1 Web-based menu options (continued)

Main menu option	Use the sub-menu screens to ...
I/O Configuration	<p>Control serial port and TCP/UDP/REP port configurations and services (including PPP, GPS data streaming, and RTK correction services).</p> <p>Define the precise station position, station ID, and the station name used for RTK correction streams.</p> <p>Set up the client authentication password to secure the datastreams for use only by authorized personnel.</p> <p>Port advertising so the receiver can advertise to a specified IP address what services it offers and on which ports.</p> <p>PPP Dialout can be used to dial out to an ISP (Internet Service Provider) to initiate a connection directly from the receiver.</p> <p>For more information, see <i>Configuring the GPSBase or GPSNet software</i>, page 48.</p>
Security	<p>Control web-based access to the receiver. Access levels include System Controls (IP and firmware modification), GPS Controls (GPS tracking and data logging access), and File Access (restricts web-based access to internally logged files).</p>
Firmware	<p>Upload and install new receiver firmware and additional extended warranties.</p>
In Browser / Standalone Window	<p>Control the appearance of the browser window. The <i>In Browser</i> and <i>Standalone Window</i> options do not relate to the operation of the NetRS receiver. The default mode is <i>In Browser</i>, where all screens include browser menus and toolbars.</p> <p>If you prefer to have more screen area available to view and manipulate the NetRS web pages, select <i>Standalone Window</i>. A new window appears with menus and toolbars hidden. You can close the <i>Standalone Window</i> and return to the default view when you want to.</p>

Configuring the Receiver for Connected Devices

This section describes how to configure the receiver to operate with different types of external devices.

Dial-up modem, radio modem, or terminal adapter

You can use a dial-up modem, a radio modem, or a terminal adapter (TA) to support PPP access to full receiver services or access to a fixed raw data stream, such as RT17 GPS data or RTK corrections.

Typically, you would connect a modem or TA to a DE9 male port on the rear panel.

Note – The front panel DE9 female port provides only a 3-wire connection, so flow control is not available through this port.

Make sure that you identify the configuration settings required for the external device. These include the DCE baud rate and hardware flow control. Consider the following issues when you define modem or TA configuration strings:

- A radio-modem must be fully pre-configured.
- If the modem or TA is to be used for a PPP connection, you can preconfigure the modem or you can enter the setup strings in the configuration page. See *Configuring a modem or terminal adapter*, page 46.
- To configure the modem to Auto-answer mode, you can do one of the following:
 - Select *Direct* connection type.
 - Select *Modem* connection type to allow the receiver to manage auto-answer. See Step 6 below.
- If you are using a modem or a TA for RT17 data or RTK correction streaming, then you must do all of the following:
 - Fully configure the modem before you connect it to the receiver.

- Enable Auto-answer mode in the modem.
- Use hardware flow control.
- Program the modem to use RTS to hold off data when there is no active connection.

Note – For flow control, always use a rear panel DE9 port.

Configuring a modem or terminal adapter

1. From the NetRS main menu, select *I/O Configuration*.
2. Select the serial port to configure.
3. If you are using a PPP server connection, select *PPP*:
4. Select the baud, parity, and flow control.
5. If required when configuring the PPP service, enter the local and remote IP addresses.
6. Select the required connection option:
 - *Modem* – to enable the receiver to manage the auto-answer operation. Use this option for a PPP connection.
 - *Direct* – if the modem is configured for auto-answer.
7. If you are providing RT17, RTCM, or CMR data:
 - a. Select the required service.
 - b. Enter the appropriate port and define the service parameters.

When you configure RTCM or CMR RTK corrections, configure the ports as described in RTCM or CMR corrections, page 49.

Configuring Met-Tilt sensors

All communication with Met-Tilt external sensors is by ASCII strings through a receiver serial port. The NetRS receiver supports the following forms of command strings to configure and query an external sensor:

- Initialization – The receiver sends an initialization string to the sensor at the beginning of every survey session. The string may include calibration parameters to configure the external sensor. In most cases, only device query operations are performed, and an initialization string is unnecessary.
- Query – The receiver sends a query string at a predefined interval for each device to request a new measurement. Each time the receiver sends a query string, the system assigns a GPS time tag and logs the measurement.

You can configure this service to send one or more initialization and repeat strings (up to a total of six strings) on a regular basis to obtain measurements from external sensors. These sensors include those used to collect meteorological data and/or deformation data (where the tilt of the sensor is measured). The time tag, query string, and the response from the sensor(s) are then stored in all Trimble T00 or BINEX files that are being logged in the receiver, and are also sent out through any ports that are configured for streaming RT17 or BINEX GPS measurements.

Configuring the receiver to use an external sensor

1. Select the *I/O Configuration*, then the *Port Configuration* screen and then select the *Met-Tilt* check box.
2. In the *Parameters for Met-Tilt* group, specify the command to send. You do not need to include a carriage return or new line character.

For example, a typical Met sensor command appears as:

```
*0100P9
```

3. From the *Schedule* drop-down list, select the interval at which to send the command.

Select *Once* to send the command once at the start of every data logging session.

If you specify query commands that occur at the same time, a delay of 10 seconds is added to each subsequent command to avoid possible conflict when sensors are connected serially.

Configuring the GPSBase or GPSNet software

You can configure the GPSBase or GPSNet software using a Trimcom or an RT17 service.

Trimble recommends that you use Trimcom to obtain full bidirectional communications with GPSNet, in preference to streamed RT17.

- Trimcom – Use only a TCP port through an Ethernet or a PPP link. For dial-up access, you must configure a PPP dial-up link, as described in *Configuring a modem or terminal adapter*, page 46.
- RT17 – Use a serial port or a TCP port.

A default Trimcom service is defined on port 5018. The default RT17 service is at 5017. To change this configuration:

1. From the *I/O Configuration* screen, select *Edit Port Setups*.
2. From the drop-down list, select *TCP Port 5018*. Click **Delete**.
3. To restore the service with a different port value, select *Create New TCP Port* from the *I/O Configuration* screen.

Note – There may be only one Trimcom service running.

4. Configure the parameters as required.

RTCM or CMR corrections

RTK corrections can stream to a serial port or through a TCP/IP port.

Before you create the service:

1. From the *I/O Configuration* screen, select *Reference Station*.
2. Enter the precise station coordinates and the station ID/name to be used.

To create an RTK service:

1. From the *I/O Configuration* screen, select the required serial port or select *Create New TCP Port*.
2. If you are creating a TCP/IP port, enter the port number.
3. Select and configure an RTCM or a CMR service.

For more information on RTCM and CMR options, refer to the online help.

Updating the Receiver Firmware

The firmware update release is a complete, self-installing, firmware package. It is assembled using the Red Hat Package Manager (RPM) for Linux.

If you are an eligible and registered customer, you will receive an e-mail when a firmware upgrade is available for the NetRS receiver. To obtain the firmware upgrade files, go to www.trimble.com.

Download the NetRS firmware to your computer, then use the web browser to install it on the NetRS receiver. Alternatively, log in as “adminFTP” and transfer the update through FTP. You can then install the new firmware over HTTP.

Downloading the firmware upgrade

1. In the advisory e-mail, click the URL link.

Alternatively, enter or paste the URL into the web browser address field.

2. If a download dialog appears, choose to save the file to your local hard disk.

The version number of the release is embedded in the file name. It represents a naming format that guarantees unique file names for subsequent firmware release packages. ***Do not change this file name.***

Uploading the firmware

1. From the NetRS main menu, select *Firmware / Upload*. A screen appears.
2. Click **Browse**. A dialog appears.
3. Find the RPM file that you downloaded to your system from the Trimble website.
4. Select the RPM file and then click **Upload**.

The full RPM file is approximately 12 MB in size. It may take more than 30 minutes to transfer across a slow link, such as a PPP link over a modem connection. From time to time, smaller releases will be available.

The system displays a dialog once the file is successfully transferred. If the transfer fails, an error message appears.

Installing the firmware upgrade

1. Click **Install** next to the firmware description.

Alternatively, click **Install** next to each firmware file line item at the top of the page.

2. In the confirmation pop-up that appears, click **OK** to begin.

While the upgrade is in progress, the screen is not available. The web browser may display an error dialog to advise that the web server is unavailable. Wait five minutes.

***Note** – To monitor the upgrade operation, connect to the front panel service port at 115200-8-N-1, using a terminal emulator such as Hyperterminal.*

The receiver reboots and installs the new firmware.

Once the receiver reboots ***again***, the upgraded firmware will be operational. Normal LED function resumes.

3. After several minutes, the screen times out. Click **Reconnect**.

Logging and Managing Data

In this chapter:

- Data Logging Sessions
- Data Format
- Naming Files
- Managing Files Through the Web Interface
- Managing Files Using FTP

Use the NetRS receiver to log data to the internal CompactFlash card. You can then access the data directly from the receiver, or publish it on a company intranet or on the Internet.

The CompactFlash card has the following approximate storage capacity for logged data files:

- 150 MB (256 MB card)
- 900 MB (1 GB card)

The following table shows in days the amount of data that you can store:

Card	Interval seconds	6 SVs	8 SVs	10 Svs
256 MB	0.1	2	1	1
	1.0	19	14	12
	5.0	74	57	46
	15.0	173	136	112
	30.0	291	237	200
1 GB	0.1	12	6	6
	1.0	114	84	82
	5.0	444	342	276
	15.0	1038	816	672
	30.0	1746	1422	1200

Data Logging Sessions

A data logging session is the process that creates a data file. To log information to a data file, you must first create a session, then enable the session. You can create multiple session definitions for different purposes. These sessions can simultaneously log different types of data on different schedules into separate files. Sessions can run automatically, using one of several scheduling modes.

A session runs automatically only if you have enabled a session. This allows you to define multiple sessions in the receiver, with independent characteristics, but run them only when required. For a Manual session, select the *Enable* check box to start or stop the session.

You can define one or more sessions, then enable some, all, or none of them. This allows you to define multiple modes of data logging in the receiver, then enable any particular mode(s) as required.

Note – Be sure to use a different session identifier for any session that will create files with the same start time as another session.

More than one session can be active at the same time. The receiver records a separate data stream for each session.

While there is no limit on the number of sessions you can create, you can have only eight sessions actively logging at any one time. If you define more than eight sessions, you can enable up to eight but you must disable all others.

The following table describes the available schedules.

Schedule	Description
Manual	Manually controlled start and stop time.
Once Only	Single session with a starting date, time, and duration. Creates a single file.
Daily	Repetitive session with a fixed time and duration every day. Creates a fixed-duration file each day.
Continuous Logging	Once started, this session runs continuously, 24 hours a day. Creates multiple files of the specified durations.

Continuous logging is the most common mode used for CORS operation.

Creating or editing a session

1. From the NetRS main menu, select *Data Logging*.
2. In the *Data Logging Status* screen, select *Create a New Session*, or *Edit Sessions*.
3. Configure the new session, or change an existing session, as required.

Enabling a session

To enable a session, select the *Data Logging* screen, then the *Status* screen and then select the *Enable* check box.

Disabling a session

To disable a session, clear the *Enable* check box.

Data Format

The T00 data format provides control over position and measurement logging rates and whether Code or Carrier phase smoothing is enabled.

The receiver can also log data in the UNAVCO BINEX format. For more information, go to <http://binex.unavco.org/>. You can enable carrier phase smoothing for BINEX files.

Naming Files

Filename are generated in the form:

StationIDYYYYMMDDHHmmS.ext

For example:

TNCO_NetRs200306052041b.t00

The elements in the filename are as follows:

Element	Description
StationID	The system name, as defined by the GPS network administrator
YYYY	The Julian calendar year
MM	The Julian calendar month
DD	The Julian calendar day
HH	The UTC hour when logging started
mm	The UTC minute when logging started
S	Any letter (a–z) that you define as a session identifier

Auto Delete

If you select the *Auto Delete* check box, the receiver automatically deletes the oldest logged files, as required, to make room for new files. If you clear the *Auto Delete* check box, the receiver stops logging data once the available file space is full. This option affects all files.

You can also set up session pools to define a maximum amount of memory to be used by each session.

If auto delete is...	when the pool is full...
Enabled	the oldest files are automatically overwritten
Disabled	the session stops logging data

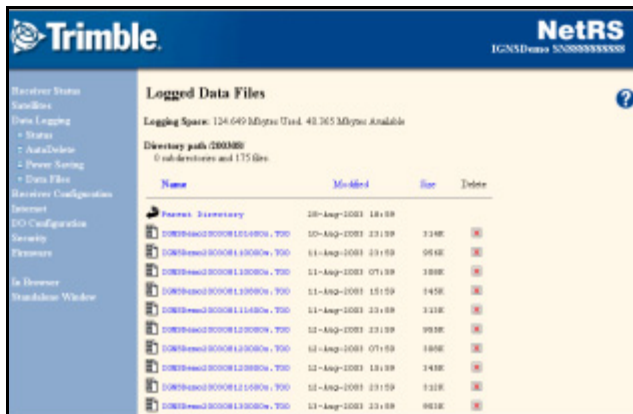
Each pool can have auto delete enabled or disabled.

Managing Files Through the Web Interface

Use the web browser interface to manage logged data files that have been recorded and are still stored on the NetRS CompactFlash card.

Storing files

Data that has been logged by the NetRS receiver is stored and organized into files in a directory (folder) tree structure. Select the *Data Logging* screen and then the *Logged Data Files* screen to view and manage these files:



The *Logged Data Files* screen displays one directory at a time, starting at the root directory (*/*). To navigate to another directory, click the directory name in the list.

To move up from the subdirectory toward the root directory, click the parent directory link.

Directory contents

Each directory title shows the directory path. This is followed by a table that shows the directory contents. All subdirectories are listed first, along with the date and time that the contents of that subdirectory

were last modified. Then, all of the data files are listed. Each list shows the name of the file, the date when it was last modified, and the file size in bytes.

***Note** – The modification time is **not** when the file was created. It refers to the most recent time when data was written to the file, which is usually the time that the data logging session ended.*

Sorting files

To sort the directory list, click a column heading. For example, click *Name* to sort the list by file or directory name, or click *Modified* to sort by the modification date, from earliest to latest. The selected column heading appears in bold. Click the column heading again to reverse the order of sorting. Regardless of the sorting method, all directories are listed first, followed by the data files.

Downloading files


To download a file to the computer running your web browser, click the icon or name of a data file. An *Open or Save* dialog appears. When prompted, enter the directory and file name. Once you click **OK** (or the equivalent button), the download begins. While downloading a file, the browser displays a progress dialog.

Deleting files

To delete a data file:

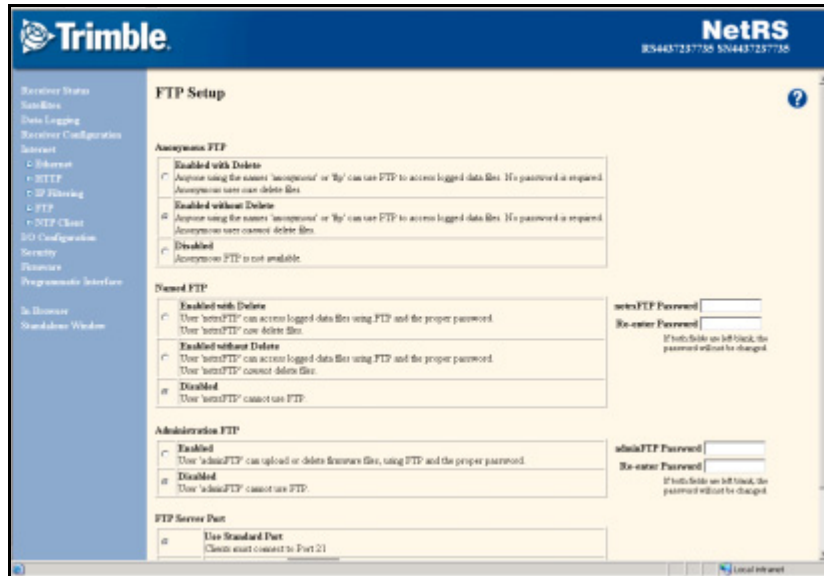
- Click  next to it.

To delete all files and subdirectories:

1. Go to the end of the file list.
2. Click  on the line “Delete ALL FILES AND SUBDIRECTORIES in this directory.”

Managing Files Using FTP

To list, download, or delete logged data files from the data logging memory, use any standard FTP client. NetRS FTP access must be enabled for the given function. Select the *Internet* screen and then the *FTP Setup* screen to define FTP access policies and passwords and to change the default FTP port:



For Anonymous and Named FTP, make sure that you enable or disable access to the File deletion option as required.

The receiver provides three options for FTP transfer:

- Anonymous FTP – log in as “anonymous” or “ftp”
- Named FTP – log in as “netrsFTP”
- Administration FTP – log in as “adminFTP”

Administration FTP (for the system administrator) is normally used only for installing and managing firmware. Trimble recommends that you do not manage logged data from this account. To access logged data through FTP, users or automated clients would normally use Anonymous FTP or Named FTP.

Files are created in subdirectories as specified for each session. Each session has a session identifier character. For more information, see Naming Files, page 56.

The directory naming options support moderate sized directories using the default YYYYMM naming scheme. They also support detailed directory structures using the day and/or session identifier. When you use this default scheme, you can navigate the FTP directory quickly and easily.

To access the files remotely through FTP, navigate the directory path to the required timeframe, then transfer and/or delete files as required. FTP sessions always start at the root of the logging hierarchy, under which you will find all directories with YYYYMM naming.

***Note** – You can transfer only those files that end in .T00 or .BNX. Any file opened for an active logging session will end in .T00.A or .BNX.A. Do not attempt to transfer those files.*

Real-Time Data and Services

In this chapter:

- Streamed Data Services
- Collecting Data as a Client

This chapter describes the streamed data services, and how a client can collect real-time GPS data.

Streamed Data Services

The NetRS receiver supports five streamed data services: RT17, Trimcom, BINEX, CMR (CMR+), and RTCM.

RT17

An RT17 service provides GPS observations, ephemerides, and other information, as defined for that service. When a client connects to the service, all data flow is from the receiver to the client.

An RT17 service can have any number of clients. The client can be considered “passive”, because it does not initiate the data stream and has no control over its content. The client cannot request any further information through the TCP connection.

You can configure the receiver for one or more of the Ephemerides, SV Flags, and Almanacs services on different TCP ports. To request updates to ephemeris and other information, a client of an RT17 service can open additional TCP sessions while the NetRS receiver receives and logs the primary RT17 data.

An RT17 service can be used if there are multiple clients requiring the same streamed data, or when a client is unfamiliar with the Trimcom protocol.

Trimcom

With the Trimcom service, the client uses a subset of the standard Trimble TRIMCOM™ binary communications interface to request ephemeris and time updates, and other data. The client must first enable an RT17 stream on this connection using Trimcom commands to control the data rate, and the rate and content of the data stream. The client can also send a query for additional information.

The Trimcom client must be “active” to enable the data stream. There can be only one Trimcom service defined on the receiver, and only one client can use this service at a time.

The Trimble GPSBase and GPSNet applications are the most common clients of the Trimcom service when active links are required. Alternatively, they may operate as a “passive” client to an RT17 stream.

BINEX

The BINEX service provides GPS observations, ephemerides, and other information that you select. For full information on each message type, go to the UNAVCO website at <http://binex.unavco.org/>.

CMR

The Trimble proprietary CMR service offers RTK users a compressed data format to work with when using RTK.

RTCM

The RTCM service (using format 2.1, 2.2, 2.3) is an alternative method for sending data to users in the field. It allows compatibility with non-Trimble rover receivers.

Collecting Data as a Client

To access GPS data from an RT17 or BINEX service, the client simply needs to know how to open a TCP connection to the receiver. The RT17 data is Trimble proprietary, while BINEX format description is open and described on the UNAVCO website.

To access GPS data from a Trimcom service, the client must know the binary commands used to enable data streaming. This service is intended primarily for use by GPSBase and GPSNet software. The Trimcom command set is a Trimble proprietary format.

Other System Information

In this chapter

- Default Settings
- Specifications
- Cables and Connectors
- 1PPS Output
- Deployment Issues
- NetRS Support Software
- Setting Up a PPP Connection

Default Settings

The following table shows the default settings for the NetRS GPS receiver:

Setting	Default value
Sysadmin password	netrs
Antenna	Type: 86 = Zephyr Geodetic SN00000000 Height: 0.00 meters Height method: Bottom of antenna mount
Clock steering	Enabled
Multipath reduction	Enabled
Elevation mask	0°
PDOP mask	7
One pulse per second output	Disabled Positive
Reference frequency	Using Internal Source External source NOT detected
GPS satellites	Disabled: None IgnoreHealth: None
WAAS	Disabled Enabled satellites: EGNOS-AOR-E, prn121, WAAS-AOR-W, prn123, prn124, prn125, prn126, prn127, prn128, MSAS-1, prn130, EGNOS-IOR, prn132, prn133, WAAS-POR, prn135, prn136, MSAS-2, prn138
Reference station	RTCM Identifier: 0 CMR Identifier: 0 Name: CREF0001 Description: Position: Lat: 00°00'00.0000" N X: 6378137.000 m Lon: 000°00'00.0000" E Y: 0.000 m Height: 0.000 meters Z: 0.000 m

Setting	Default value
Data logging	AutoDelete: Enabled Power Saving Mode: Disabled Enabled Sessions: <i>None</i>
Shutdown threshold voltage	10.68 V

Specifications

The following table shows the specifications for the NetRS GPS receiver:

Feature	Specification
System	Advanced Maxwell 5 custom chip R-track technology for L2C signal tracking capability High precision multiple correlator for L1 and L2 pseudo range measurements Unfiltered, unsmoothed pseudorange measurements data for low noise and low multipath error EVEREST™ multipath rejection (option to enable or disable) Very low noise L1 and L2 carrier phase measurements 12 channels L1 C/A code and carrier phase 12 channels L1/L2 P2 (derived under encryption) and full cycle carrier phase 1 channel WAAS / EGNOS support Clock steering Configuration cloning

Feature	Specification
Data storage	Memory: 1 GB CompactFlash card, 150 MB internal, 3400 hours of raw data observables based on recording data from 7 satellites at 15 sec epoch Multiple T00 and BINEX file logging Continuous logging sessions Query services (SV data, Ephemeris, Almanac)
Accuracy	Static: 5mm+1ppm horizontal RMS; 10mm+1ppm vertical RMS
Electrical	12 - 32 V DC external power input with over-voltage protection 2 Power ports – primary and secondary Remote power cycling through an IP command
Power consumption	Less than 3 Watts for receiver only 3.5 Watts with a Dorne & Margolin Choke Ring antenna 4.0 Watts with a Zephyr Geodetic
Size	22.8 cm W x 6.5 cm H x 14 cm D (9" W x 2.6" H x 5.5" D)
Weight	1.6 Kg (3.5 lbs.)
Environment	Operating temperature: -40 °C to +65 °C Storage temperature: -40 °C to +75 °C Waterproof to IPX5 Fully sealed from sand, dust, and moisture Humidity: 100% non-condensing
Shock	Shock tested to MIL-810-F Table 516.5-I to survive a 1 m (approximately 3 ft) drop onto hard surface
Vibration	MIL-810-F Figure 514 5c-17 vibration levels on each axis
Communication	4 standard DE9 RS-232 ports, including 3 with full modem control lines 1 RJ45 10Base-T Ethernet port All functions (web GUI access, FTP file transfer, RT17 streaming, and remote firmware upload) can be performed through the Ethernet port or a PPP connection over a serial link. At the same time, one or more serial ports can be used for local CMR or RTCM correction transmission, or a remote PPP dial-up through a modem. Basic configuration through the service port and Telnet
Positioning	1 Hz, 2 Hz, 5 Hz, and 10 Hz

Feature	Specification
Outputs	Internal logging (T00) (Intervals: 0.1, 0.2, 0.5, 1, 2, 5, 10, 15, 30, 60, 300, or 600 seconds) RT17 (Intervals: 0.1, 0.2, 0.5, 1, 2, 5, 10, 15, 30, 60, 300, or 600 seconds) BINEX (Intervals: 0.1, 0.2, 0.5, 1, 2, 5, 10, 15, 30, 60, 300, or 600 seconds) CMR, CMR+™, and RTCM 2.1 and 2.3 PPS Sensor I/O - Met-Tilt data logging for devices that support ASCII query/response
Inputs	10 MHz external frequency at +6 to +13 dBm with a +/- 5 ppm tolerance over temperature and time Sensor I/O – Met-Tilt data logging for devices that support ASCII query/response
Control software	HTML web browser (Internet Explorer v 5.0 or later and Netscape v 4.78 or later)
Network time	Network Time Protocol
Antenna option	1 antenna port that supports any Trimble survey antenna including the following recommended Trimble antennas: <ul style="list-style-type: none"> • Zephyr Geodetic • Dorne & Margolin Choke Ring

Cables and Connectors

This section contains pinout information for the NetRS receiver communication ports, connectors, and cables. You can use this information to prepare special cables for connecting the NetRS receiver to a device or instrument that is not supported by a standard or optional cable.

Ports

- Port 1 (Service) is on the front panel
- Ports 2, 3, and 4 are on the rear panel
- The combined Power/Ethernet port is on the rear panel

Cables and connectors

The following table describes the cables and connectors that are provided with the NetRS receiver:

Cable or connector	Part number	Description
Primary power / Ethernet	48164	DA26 to RJ45 and DC Jack
Ethernet cable	50150-00	2 m 10BASET CAT5
Secondary power	48600	2-pin Conxall to bare wires
1PPS	11517	BNC(M) to BNC(M)
Serial cable	19309-00	2 m DE9(M) to DE9(F)

Port pinouts

The following table describes the communication port pinouts:

Port 1 (F) DE9	Port 2 (M) DE9	Port 3 (F) DE9	Port 4 (M) DE9	Primary power / Ethernet (M) DA26
2 – TX (O)**	1 – DCD (I)	1 – DCD (O)	1 – DCD (I)	6 – GND
3 – RX (I)*	2 – RX (I)	2 – TX (O)	2 – RX (I)	7 – unused
5 – GND	3 – TX (O)	3 – RX (I)	3 – TX (O)	8 – unused
	4 – DTR (O)	4 – DSR (I)	4 – DTR (O)	10 – ET_GND (O) RJ45 Pin 4
	5 – GND	5 – GND	5 – GND	12 – TX(O)**
	6 – DSR (I)	6 – DTR (O)	6 – DSR (I)	13 – ET_GND (O) RJ45 Pin 5
	7 – RTS (O)	7 – CTS (I)	7 – RTS (O)	14 – ET_GND (O) RJ45 Pin 8
	8 – CTS (I)	8 – RTS (O)	8 – CTS (I)	15 – GND
	9 – RI (I)	9 – RI(O)	9 – RI (I)	16 – ET_RD_MINUS (I) RJ45 Pin 6
				17 – ET_TD_MINUS (O) RJ45 Pin 2
				19 – ET_LED (O)
				21 – RX(I)*

Port 1 (F) DE9	Port 2 (M) DE9	Port 3 (F) DE9	Port 4 (M) DE9	Primary power / Ethernet (M) DA26
				22 – ET_GND (O) RJ45 Pin 7
				23 – GND
				25 – ET_RD_PLUS (I) RJ45 Pin 3
				26 – ET_TD_PLUS (O) RJ45 Pin 1
Key				
(O)	Output (from the receiver)			
(I)	Input (to the receiver)			
*	Duplicate			
**	Duplicate			

1PPS Output

The NetRS GPS receiver can output a one pulse per second (1PPS) time strobe. The pulse is output from the 1PPS port through a BNC cable.

1PPS Pulse Definition

The leading edge of the pulse coincides with the beginning of each UTC second, as shown in Figure 8.1. The pulse is driven by an RS-422 driver between nominal levels of 0 V and 7.2 V. The leading edge is positive, rising from 0 V to 7.2 V.

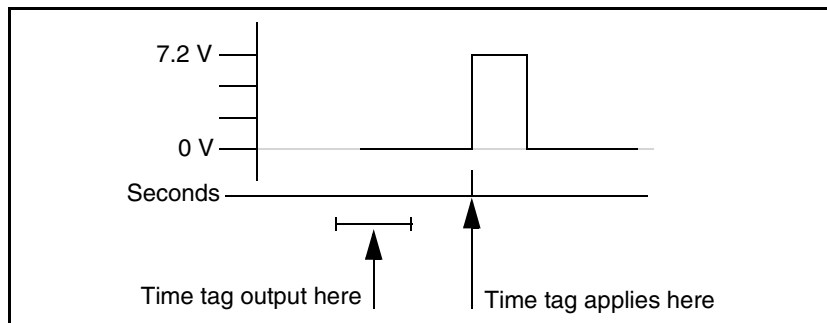


Figure 8.1 Time tag relation to 1PPS wave form

The pulse is approximately 8 μ sec wide, with rise and fall times of about 100 nsec. Resolution is approximately 40 nsec, but several external factors limit accuracy to approximately ± 1 μ sec:

- Position errors, especially with user-entered reference. Each meter of error can result in 3 nsec of error in the 1PPS pulse.
- Antenna cable length. Each meter of cable adds a delay of about 5 nsec to satellite signals, and a corresponding delay in the 1PPS pulse.

Deployment Issues

This section discusses issues related to deploying and operating a network of receivers on a continuous basis. Most of these issues relate to networks of any size, but some relate specifically to deploying large networks of tens or hundreds of receivers.

Planning

The NetRS receiver supports named configuration files that can be obtained from any given receiver and cloned to another receiver. Therefore, when you plan a network configuration, you should identify which elements are common to all the receivers in the network, and which elements are unique to individual receivers.

You can store any combination of the following parameters in a configuration file and then restore them to the same receiver or to a different one:

- I/O configurations (including serial, TCP, UDP, and REP port specifications)
- Reference station setup
- Antenna setup
- Data logging sessions (including all defined sessions, the AutoDelete function, and the power saving controls)
- Miscellaneous receiver controls (including masks, clock steering, multipath, 1PPS output, GPS satellite controls, and WAAS controls)
- External frequency source
- Ethernet setup controls
- FTP access controls
- Network Time Protocol (NTP)

- Security setup (including access controls and HTTP accounts)

Configuring from Factory Defaults

In general, you will initially configure the receiver manually. However, for a large network deployment, you could automatically configure the receiver from its factory defaults. To do this, choose one of the following approaches.

- Create an application that works with the service port and 10Base-T port to perform the initial IP address configuration. The application then configures the receiver using HTTP.
- Create an application that works through a PPP connection on a serial port to perform all configuration.

Automated configuration can be carried out entirely through the HTTP link.

To view the status of the receiver after it has been configured, save and then transfer a configuration file. To view a summary of global settings, select the *Receiver Configuration* screen and then select the *Summary* screen.

Monitoring Operation

To monitor GPS performance, you can:

- automatically retrieve standard GPS status information, such as SV tracking.
- analyze real-time data streams

To monitor system activity, you can:

- retrieve the real-time status of all logging and active streams on a receiver

Changing Modes

You can pre-configure and enable operational modes as necessary, and enable or disable internal logging modes through a single control.

You can pre-define streamed data services for a number of configurations. For example, you can provide services at different data rates. Once the data stream is defined, a client can select a service on a different port to effectively change the mode of real-time streamed data collection.

Changing the Configuration

To reliably change the configuration of one or more receivers, Trimble recommends that you use configuration files. You can verify a configuration change in a laboratory setting, then propagate it into the network where required.

For example, to automate security settings to periodically change passwords, manually enter a change for a remote system on a local receiver, then transmit it to all remote receivers.

If passwords are unique to each receiver, you can automatically create separate partial configurations for multiple receivers through a single receiver at the network operations center. You can then automatically transfer and apply the unique change to each receiver.

To verify the configuration of network receivers, create a configuration file on each receiver and then transfer it to the network operations center. Compare the latest configuration file with the previously transferred configuration file for that receiver. This way, you can monitor a remote receiver for any inadvertent changes.

NetRS Support Software

This section describes the data format conversion programs and the software utilities that are provided on the *NetRS GPS Receiver CD*.

Data Conversion

The following data format conversion programs are provided on the CD.

T00 to DAT file conversion

Program: runpkr00

This program converts internally logged T00 format files to the DAT format.

To print the file with full usage information, enter:

- runpkr00

To create a DAT file, enter:

- runpkr00 -dv *filename*.T00

To concatenate multiple consecutive continuously logged files (for example, when converting hourly files to a single 24 hour file), enter one of the following:

- runpkr00 -dv *filename1*.T00+*filename2*.T00+...
- runpkr00 -dv @*listfile* (Listfile contains a list of the T00 files to be converted, one filename per line.)

RT17 to DAT file conversion

Program: `rt172dat`

This program converts streamed RT17 data to the DAT format:

- Linux operating system:
`rt172dat < rt17filename > filename.dat 2> /dev/null`
- Windows operating system:
`rt172dat < rt17filename > filename.dat 2> null`

DAT to RINEX file conversion

Program: `dat2rin`

This program converts DAT format files that were created by `runpkr00` or `rt172dat` to the RINEX format.

The following example shows some of the basic usage for this program:

- `dat2rin -rrunby -oobserver -Aagency -aantennacode [@parmfile] filename.dat`

The values for *antennacode* are:

- G2 – D&M Choke Ring antenna
- GZ – Zephyr Geodetic antenna

The following example converts DAT files that were created from T00 files to a RINEX file for data collected with a D&M Choke Ring antenna and including L1 and L2 S/N values (`-s1` and `-s2` parameters):

- `dat2rin -rPBO -oPBO -APBO -aG2 -s1 -s2 filename.dat`

DAT files created from RT17 files do not contain as much meta information about the data collection. You must use a parameter file to specify header fields for which insufficient information is available in the DAT file. An example parameter file (`dat2rin.opt`) is provided. This

file includes full specification of the input and output file names, and all other controls and header fields required for PBO data collection. After editing this parameter file, the example dat2rin command is:

- dat2rin @dat2rin.opt

***Note** – A complete description of the operation of dat2rin is provided in the file Dat2rin.rtf in the Doc directory on the CD.*

Setting Up a PPP Connection

This section describes how to set up a direct Point-to-Point (PPP) connection for Linux and Windows operating systems.

Linux Operating System

To use PPP with the NetRS receiver as the server and the Linux operating system as the client:

1. Connect the serial port of the Linux machine to the NetRS serial port.
2. Run the following command (where ttyS0 is the serial port of the Linux system):

```
/usr/sbin/pppd ttyS0 115200 -detach
```

The Linux system responds with the following messages:

```
Using interface ppp0
Connect: ppp0 <--> /dev/ttyS0
Deflate (15) compression enabled
local IP address xxx.xxx.xxx.xxx
remote IP address xxx.xxx.xxx.xxx
```

The PPP connection is now established.

3. To verify the connection, ping the remote IP address.
4. To use this connection with a web browser, configure the browser so that it does not use a proxy server before connecting to the receiver.

Windows Operating System

Note – When you use PPP with the Windows operating system, you must create a connection, then configure it.

To use PPP with the NetRS receiver as the server and the Windows operating system as the client, do one of the following:

- To connect through ports 1 and 3, use a DCE adapter to assert the CD signal. Make sure that the adapter is wired as shown in Figure 8.2.

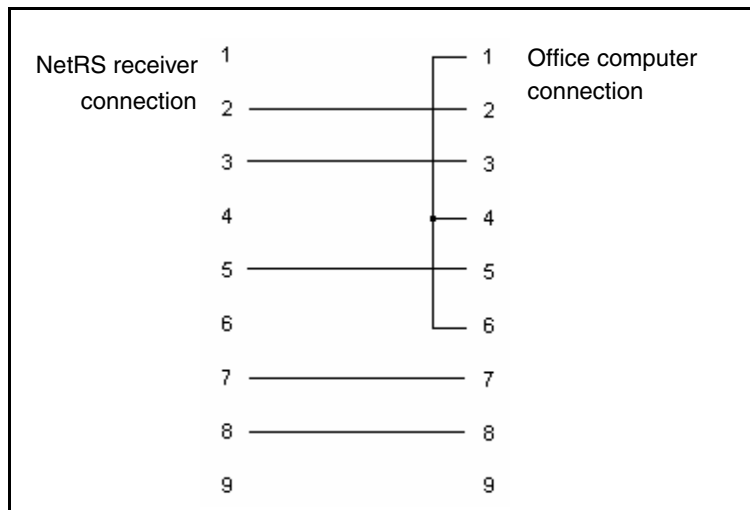


Figure 8.2 DCE adapter wiring

- For a direct cable link, connect through ports 2 and 4 using a null modem adapter. Make sure that the adapter is wired as shown in Cables and Connectors, page 73. If the connection times out while you are making the PPP link, verify that the null modem is correctly wired.

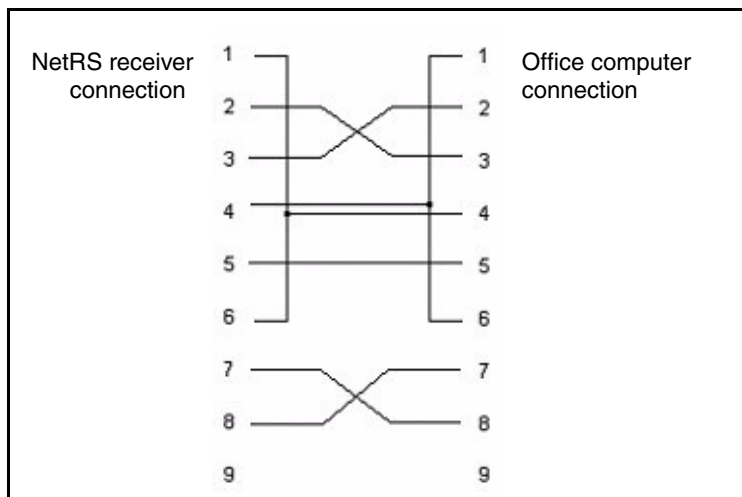


Figure 8.3 Null modem adapter wiring

Creating a PPP connection

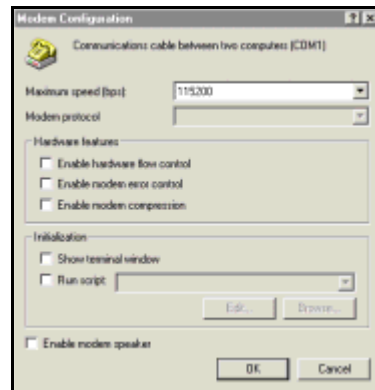
1. Click *Start / Settings / Network and Dial-up Connections / Make New Connection*.
The *Network Connection* wizard appears. After you select the required option in each wizard dialog, click **Next** to continue.
2. Select *Connect directly to another computer*.
3. Select *Guest*.
4. From the drop-down list, select the communication port you want to use. For example, Communications cable between two computers (COM1).
5. Select the required availability of this connection (*For all users* or *Only for myself*).
6. Enter a name for the connection. For example, **NetRS PPP on COM1**. Click **Finish**.

Configuring a PPP connection

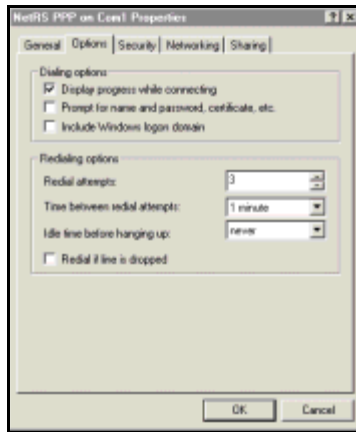
1. In the *Network and Dial-up Connections* dialog right-click the connection you just created, then select *Properties* from the menu. A dialog appears.:



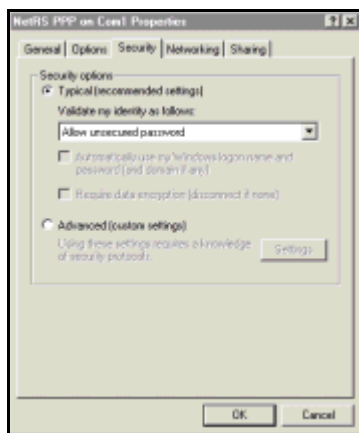
2. In the *General* tab, click **Configure**:
 - a. In the *Maximum speed (bps)* field, select 115200.
 - b. Clear the *Enable hardware flow control* check box. Click **OK**.



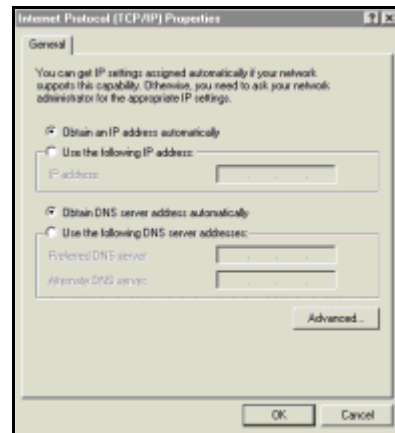
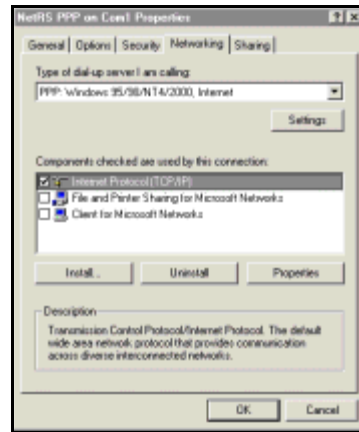
- In the *Options* tab, clear the *Prompt for name and password, certificate, etc.* check box.



- In the *Security* tab, select *Typical (recommended settings)*.

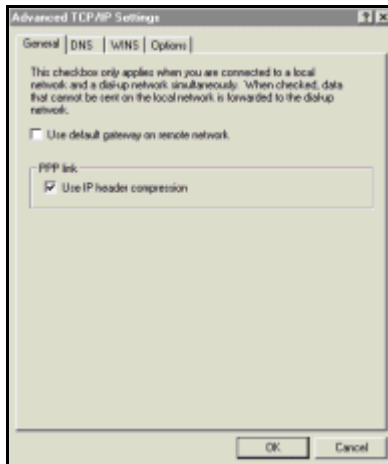


5. In the *Networking* tab:
 - a. In the *Type of dial-up server I am calling* field, make sure that *PPP* is selected.
 - b. In the *Components checked are used by this connection* group, clear the check boxes for *File and Printer Sharing for Microsoft Networks* and *Client for Microsoft Networks*.
 - c. Select *Internet Protocol (TCP/IP)* and then click **Properties**.
 - d. Make sure that the check boxes for *Obtain an IP address automatically* and *Obtain DNS server address automatically* are selected.



- e. Click **Advanced**. Clear the *Use default gateway on remote network* check box.

Make sure that the *Use IP header compression* check box is selected. Click **OK**.



6. Click **OK** in the other dialogs that appear.

Using the PPP connection

Once you have successfully configured the connection, the *Connecting* dialog appears to show that the system is dialing, verifying your username and password, and authenticating the connection. Once the system is connected, the dialog disappears and the dial-up networking icon appears in the system tray.

To view the current connection status, double-click the icon. In the dialog that appears, click the *Details* tab to view the Server (NetRS receiver) and Client (computer) IP addresses. With the Server IP address, you can access the receiver, using standard network tools like Ping, SSH, and the Web browser. For example, if the Server IP address is 192.168.143.1, start the Web browser, then enter **192.168.143.1** in the URL field.

Closing the PPP session

1. Double-click the dial-up networking icon.
2. Click **Disconnect**.

Re-connecting the PPP session

1. Click *Start / Settings / Network and Dial-up Connections*.
2. Select the connection that you previously created in *Creating a PPP connection*, page 85.

Note – *The Password dialog does not appear.*

The *Connecting* dialog appears, then closes when the connection is established.

Editing PPP connection properties

1. Select *Start / Settings / Control Panel*.
2. To edit the network connection properties:
 - a. Double-click *Network and Dial-up Connections*.
 - b. Right-click the connection to edit and then select *Properties*.
3. To edit the COM port settings, do one of the following:
 - Open the *Properties* dialog (see the previous step). Then click **Configure** in the *General* tab.
 - Double-click *Phone and Modem Options*. In the *Modems* tab, select the connection created in Step 4 on page 85. Click **Properties**.

Deleting a PPP connection

1. Select *Start / Settings / Control Panel*.
2. To delete a network connection:
 - a. Double-click *Networking and Dial-up Connections*.
 - b. Right-click the connection to delete, then select *Delete*.

This does not automatically delete the modem entry created for this connection.

3. To delete the modem entry:
 - a. Double-click *Phone and Modem Options*.
 - b. In the *Modems* tab, select the entry to delete, then click **Remove**.

Glossary

This section explains some GPS terms and some of the terms used in this manual.

.dat file	The Trimble standard storage format data file for GPS data.
almanac	A file that contains orbit information on all satellites, clock corrections, and atmospheric delay parameters. It is transmitted by a GPS satellite to a GPS receiver, where it facilitates rapid SV acquisition. It can be transferred from the receiver to the GPS processing software on an office computer, where it is then used to predict the best time to collect GPS data. The orbit information is a subset of the ephemeris data, with reduced precision. See also ephemeris.
antenna height	The height of a GPS APC above the point being observed. The uncorrected antenna height is measured from the observed point to a designated point on the antenna, then corrected to the true vertical, manually or automatically, in the software.
antenna phase center	Also called APC. The electronic center of the antenna. The APC often does not correspond to the physical center of the antenna. The radio signal is measured at the APC.
ASCII	American Standard Code for Information Interchange. An eight-bit code for character representation, (seven bits plus parity), used for serial communication.

base station	Also called reference station. A receiver (and antenna) that is set up at a known location specifically to collect data for differentially correcting rover files. The base station calculates the error for each satellite and, through differential correction, improves the accuracy of GPS positions collected at unknown locations by a roving GPS receiver.
baud	A unit of speed, used to describe serial communications data transfer speed from one binary digital device to another. Baud rate is generally one bit per second. See also bits per second.
bits per second	The number of bits sent or received each second. For example, a baud rate of 9600 means there is a data flow of 9600 bits each second. One character equals approximately 10 bits.
BNC (Bayonet Neill Concelman)	A BNC connector provides a secure, easy-to-use means of connecting shielded cables to electronic equipment.
C/A code	See Coarse Acquisition code.
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 difference between the carrier signal generated by the internal oscillator of a receiver and the carrier signal coming in from the satellite.
CMR (Compact Measurement Record)	A satellite measurement message that is broadcast by the base receiver and used by RTK surveys to calculate an accurate baseline vector from the base to the rover.

Coarse Acquisition code	Also called <i>C/A</i> code or civilian code. The pseudorandom noise (PRN) code, modulated onto a GPS L1 signal. This code helps the receiver to compute the distance from the satellite.
concatenate	To combine separate computer files so that they can be used as one file.
coordinate system	Any 3D reference frame that locates objects in space.
data message	A message included in the GPS signal that reports on the location and health of the satellites as well as any clock correction. It includes information about the health of other satellites as well as their approximate position.
DCE	Data Communications Equipment. The RS-232C interface that a modem or other similar communications device uses to exchange data with a computer.
Differential GPS	Also called DGPS or differential correction. The process of correcting GPS positions at an unknown location with data collected simultaneously at a known location (usually a base station).
DOP	Dilution of Precision. An indicator of the accuracy of a GPS position which takes account of each satellite's location relative to the other satellites in the constellation and their geometry in relation to the GPS receiver. A low DOP value indicates a higher probability of accuracy.
DTE	Data Terminal Equipment. The RS-232C interface that a computer uses to exchange data with a modem or other serial device.

dual-frequency	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.
elevation mask	The angle below which the receiver will not track satellites. Normally set to 13 degrees to avoid interference problems caused by buildings and trees, and multipath errors.
EGNOS	European Geostationary Navigation Overlay Service
ephemeris	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.
flow control	A means of coordinating two communicating devices so that one transmits data only when the other is prepared to receive it.
FTP	File Transfer Protocol. The standard, high-level protocol for transferring files from one network node to another using TCP/IP.
GPS network administrator	A user charged with maintaining a network of two or more receivers. This role includes functions such as initializing and maintaining communication configurations, managing user authentication and security, performing remote maintenance, and updating firmware.
GPS operator	A user who will change the configuration of the GPS data logging and streams service of one or more receivers.

GPS raw data	The data collected by a GPS receiver for the purpose of processing at a later time. It can be in the form of a .dat file (Trimble raw data file format) or a RINEX file.
GPS time	A measure of time used internally by the NAVSTAR system. GPS time is based on UTC, but does not add periodic “leap seconds” to correct for changes in the earth’s period of rotation.
ID	A unique identity number.
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.
main service	The service or service group selected in the equipment configuration.
multichannel receiver	A receiver containing many independent channels. Each channel tracks one satellite continuously.
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 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.
null modem	A RS-232 cable/connector with pins 2 and 3 reversed.

parity	A form of error checking, using a parity bit, that is used in binary digital data storage and transfer. Options for parity checking include Even, Odd, or None.
parity bit	An extra bit added to a group of bits. The parity bit can be a 0 or 1 value so that every byte will add up to an odd or even number (depending on whether odd or even parity is chosen).
position	The latitude, longitude, and altitude of a point. An estimate of error is often associated with a position.
post-processed client	A person (or a computer) who obtains data file(s) from one or more receivers on a systematic basis. This includes any server that mirrors or delivers data.
PPS (1PPS)	Pulse per second. An electrical pulse output by the receiver every second and used by external hardware for precision timing applications.
PRN (Pseudorandom number/noise)	A sequence of digital 1's and 0's that appear to be randomly distributed like noise, but that can be exactly reproduced. PRN codes have a low autocorrelation value for all delays or lags except when they are exactly coincident.
real-time client	A computer that obtains real-time data streams from one or more receivers and provides useful services based on that data. Clients include GPSBase, GPSNet, or VRS software, or any program that requires real-time data streams for operation.
Real-Time Kinematic (RTK)	A method of GPS surveying in real time, using short (stop-and-go) occupation, while maintaining lock on at least four satellites. This method requires a wireless data link between the base and rover receivers.

RINEX (Receiver Independent Exchange)	A set of standard definitions and formats to promote the free exchange of GPS data and to facilitate the use of data from any GPS receiver with any software package.
rover	Any mobile GPS receiver and field device collecting data in the field. A roving receiver's position can be differentially corrected relative to a stationary base GPS receiver.
RS-232 (Recommended Standard)	This was originally a nine-wire interface standard for teletype machines from the Electronics Industry Association. It is the standard for computer serial-port transfers.
RTCM	Radio Technical Commission for Maritime Services. The body responsible for defining and updating the RTCM SC-104 standard.
serial port	The communications port on a computer. This is also called the COM or RS-232 port. It is called serial because, although it has nine pins and many wires, the PC sends data on only one wire and receives data on one other wire.
service	Information provided by the receiver or a protocol that is used to exchange data between the receiver and an external device.
session	A period during which one or more GPS receivers log satellites and measure data.
tracking	The process of receiving and recognizing signals from a satellite.
UTC	Universal Time Coordinated. A time standard based on local solar mean time at the Greenwich meridian. See also GPS time.
WAAS	Wide Area Augmentation System.

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