GPS Pathfinder® Systems
Receiver Manual

Trimble™

GPS Pathfinder® Systems

Receiver Manual

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Trimble™

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– 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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2 Accuracy

3 Real-Time DGPS Components

About This Manual

Welcome to the *GPS Pathfinder Systems Receiver Manual*. This manual describes how to use Trimble's GPS Pathfinder® Pro XR, Pro XRS, and Power receivers.

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 our website for an interactive look at Trimble and GPS at:

- www.trimble.com

Related Information

Other sources of related information are:

- Release notes – the release notes describe new features of the product, information not included in the manuals, and any changes to the manuals.
- Update notes – there is a warranty activation sheet with this product. Send it in to automatically receive update notes containing important information about software and hardware changes. Contact your local Trimble Dealer for more information about the support agreement contracts for software and firmware, and an extended warranty program for hardware.
- ftp.trimble.com – use the Trimble FTP site to send files or to receive files such as software patches, utilities, service bulletins, and FAQs. Alternatively, access the FTP site from the Trimble website at www.trimble.com/support/support.htm.
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Document Conventions

The document conventions are as follows:

Convention	Definition
Italics	Identifies software menus, menu commands, dialog boxes, and the dialog box fields.
Helvetica Narrow	Represents messages printed on the screen.
Helvetica Bold	Identifies a software command button, or represents information that you must type in a software screen or window.
‘Select *Italics* / *Italics*’	Identifies the sequence of menus, commands, or dialog boxes that you must choose in order to reach a given screen.
Ctrl	Is an example of a hardware function key that you must press on a personal computer (PC). If you must press more than one of these at the same time, this is represented by a plus sign, for example, Ctrl+C.

CHAPTER

1

Overview

In this chapter:

- Introduction
- What is GPS?
- What is the GPS Pathfinder Pro XR receiver?
- What is the GPS Pathfinder Pro XRS receiver?
- What is the GPS Pathfinder Power receiver?
- What can the GPS Pathfinder Systems receivers do?
- Standard GPS Pathfinder Pro XR/XRS features
- Standard GPS Pathfinder Power features
- Antenna options

Introduction

The GPS Pathfinder® Systems receivers are Trimble's high-performance GPS receivers. They can be operated with one of the following controlling software systems as part of an effective GIS data collection and maintenance system:

- Trimble's Asset Surveyor® software running on the rugged TSC1™ data collector

  Note – *Version 5.20 or later is required for use with the GPS Pathfinder Power receiver.*

- Trimble's TerraSync™ software running on a user-supplied Microsoft Windows CE field device

  Note – *Version 1.20 or later is required for use with the GPS Pathfinder Power receiver.*

- Trimble's ASPEN® software running on a user-supplied notebook or pen computer (GPS Pathfinder Pro XR/XRS receiver only)

The GPS Pathfinder Systems receivers use integrated differential GPS to provide submeter position accuracy on a second-by-second basis. NMEA-0183 messages and raw measurements in TSIP (Trimble Standard Interface Protocol) are also available, offering optimal flexibility when interfacing with other instruments.

What is GPS?

The Global Positioning System (GPS) is a satellite-based positioning system operated by the U.S. Department of Defense (DoD). Over 24 operational NAVSTAR satellites orbit the earth every 12 hours, providing worldwide, all-weather, 24-hour time and position information. For more information about GPS concepts, refer to the *Mapping Systems General Reference*.

What is the GPS Pathfinder Pro XR Receiver?

The GPS Pathfinder Pro XR receiver includes a differential GPS receiver module and a fully automatic, dual-channel MSK beacon receiver module for receiving DGPS (Differential GPS) broadcasts conforming to the IALA (International Association of Lighthouse Authorities) standard. These components are packaged within a lightweight, rugged, weatherproof housing.

What is the GPS Pathfinder Pro XRS Receiver?

The GPS Pathfinder Pro XRS receiver is Trimble's most versatile real-time GPS mapping receiver in the GPS Pathfinder Systems family. By combining a GPS receiver, an MSK beacon differential receiver, and a satellite differential receiver in a single housing, the GPS Pathfinder Pro XRS receiver offers unsurpassed flexibility for choosing a source for real-time differential corrections. One receiver and antenna is all that is required for the flexibility of receiving GPS signals, MSK beacon differential corrections, and satellite differential corrections.

What is the GPS Pathfinder Power Receiver?

The GPS Pathfinder Power receiver combines high-performance GPS reception with real-time satellite differential capabilities in a small, lightweight, durable, waterproof housing. The unit integrates both the receiver and the antenna in the same housing, making it the most comfortable and lightweight receiver in the GPS Pathfinder Systems family.

What Can the GPS Pathfinder Systems Receivers Do?

The GPS Pathfinder Systems receivers, with Trimble controlling software, make an ideal system for all GIS data collection and maintenance projects. The system allows you to collect precise data for utility, urban, and natural resource databases. As the demand for accurate and up-to-date position and attribute information increases, the system allows you to update existing GIS data, ensuring that decisions made with the GIS are based upon the most accurate, current, and reliable data available.

The foundation of the GPS Pathfinder Systems receivers is precise GPS positioning technology. The GPS receivers feature 12 channels of continuous satellite tracking. Using differential GPS, the GPS Pathfinder Systems receivers deliver differentially corrected C/A code positions to submeter accuracy on a second-by-second basis under the most challenging operating conditions.

Integrated Beacon Receiver

The MSK beacon receiver is included in the GPS Pathfinder Pro XR/XRS receiver. It allows you free access to real-time solutions transmitted from DGPS radiobeacons operating in the MF (medium frequency) band from 283.5 kHz to 325 kHz. The integrated MSK beacon receiver is an advanced dual-channel radiobeacon receiver. It tracks broadcasts from DGPS radiobeacons conforming to the IALA Standard. The beacon receiver uses its *all-digital signal processing* techniques to track and demodulate signals from DGPS radiobeacons.

For an up-to-date list of beacon stations, visit the following Web page:

- http://www.trimble.com/gis/beacon/

Integrated Satellite Differential Receiver

The integrated satellite differential capability of the GPS Pathfinder Pro XRS and Power receivers decodes and uses satellite differential corrections to provide submeter position accuracy. To receive and decode these satellite signals, a subscription to a satellite differential correction service is required. The GPS Pathfinder Pro XRS and Power receivers support two satellite differential correction services. For information on obtaining a subscription, subscription rates, and satellite coverage maps, visit the following websites:

- www.omnistar.com
- www.racal-landstar.com

Once you have a subscription, you activate the service through an on-the-air signal or an encrypted activation message entered into the controlling software.

Satellite differential signals provide valid corrections over a large area. Integrated virtual reference/base station (VRS/VBS) technology permits the satellite corrections to be uniformly accurate over the entire satellite coverage area, without the degradation in accuracy associated with increasing distance from fixed reference stations.

Satellite differential signals are line-of-sight and can be blocked by mountains, buildings, or tree canopy. Wet canopy, from a heavy rain, reduces the signals even more. The same environmental factors that affect the GPS signal, such as radar and microwave transmitters, can interfere with the satellite signal. Power lines usually have no effect.

External Differential Correction Receiver

The GPS Pathfinder Systems receivers can also receive differential corrections from any external differential correction receiver that communicates in the standard RTCM SC-104 data format.

Standard GPS Pathfinder Pro XR/XRS Features

The GPS Pathfinder Pro XR/XRS receiver offers the following:

- 12-channel DGPS receiver with EVEREST™ multipath rejection technology, L1 C/A code tracking with carrier-phase smoothing, and instantaneous full-wavelength carrier-phase measurements
- Submeter MCORR400 accuracy—typically less than 50 cm RMS (assumes at least 5 satellites, PDOP less than 6, and corrections from a Trimble Reference Station (TRS™), 4000RS™, or Trimble Community Base Station with EVEREST multipath rejection technology)
- 1 Hz position and velocity update rate
- Velocity computations incorporate carrier-phase data
- Time to First Fix typically less than 30 seconds
- Two RS-232 serial ports
- NMEA-0183 output to external NMEA devices (supported messages are ALM, GGA, GLL, GSA, GSV, VTG, and ZDA)
- RTCM-SC 104 input from an external differential correction receiver
- TSIP protocol to/from the data collector
- Fully automatic and manual beacon operating modes, fast acquisition of differential beacon signals
- Immunity to MSK jamming signals, advanced techniques for combating atmospheric noise in the beacon receiver
- Integrated GPS/MSK beacon antenna
- User-upgradeable receiver firmware
- Receiver manual
- CE Mark compliance

Additional GPS Pathfinder Pro XRS Receiver Features

The GPS Pathfinder Pro XRS GPS/MSK/beacon/satellite differential receiver offers the items previously listed, and also:

- Integrated L-band satellite differential correction receiver
- Combined L1 GPS/beacon/satellite differential antenna

Standard GPS Pathfinder Power Features

The GPS Pathfinder Power receiver offers the following standard features:

- Integrated 12-channel L1 GPS receiver/antenna, C/A code tracking with carrier-phase smoothing, and full-wavelength carrier-phase measurements
- EVEREST multipath rejection technology

  Note – *If you have purchased part number 40888-85-ENG, this option is not installed. If you want to purchase the option upgrade for this functionality, contact your local dealer.*
- Submeter MCORR400 accuracy (assumes at least 5 satellites, PDOP less than 6, and corrections from a Trimble Reference Station (TRS), 4000RS, or Trimble Community Base Station with EVEREST multipath-rejection technology)
- 1 Hz position and velocity update
- Velocity computations incorporate carrier-phase data
- Time to First Fix typically less than 30 seconds
- Two RS-232 serial ports
- NMEA-0183 output to external NMEA devices (supported messages are ALM, GGA, GLL, GSA, GSV, VTG, and ZDA)
- RTCM-SC 104 input from an external differential correction receiver, for example the Beacon-on-a-Belt (BoB™) receiver
- TSIP Protocol to/from the data collector

- Integrated L-band satellite differential correction receiver
- Integrated L1 GPS/satellite differential antenna—this active antenna filters out unwanted signals and amplifies the L1 GPS and satellite differential signals
- User-upgradeable receiver firmware
- Receiver manual
- CE Mark compliance

Antenna Options

There are three antenna options for the GPS Pathfinder Systems receivers:

This antenna …	is used with this receiver …	See …
Integrated GPS/MSK beacon antenna	GPS Pathfinder Pro XR	page 9
Combined L1 GPS/beacon/ satellite differential antenna	GPS Pathfinder Pro XRS	page 10
Integrated L1 GPS/satellite differential antenna	GPS Pathfinder Power	page 11

Integrated GPS/MSK Beacon Antenna

The GPS Pathfinder Pro XR receiver's integrated GPS/MSK beacon antenna (part number 29653-00) features two antenna components:

- L1 GPS antenna

  This active antenna is designed to filter out unwanted signals and amplify the L1 GPS signal for transmission over the antenna cable to the receiver.

- MSK H-field loop beacon antenna

  This antenna features a pre-amplifier for filtering out signal interference such as AM radio broadcasts and noise from switching power supplies. After filtering, the pre-amplifier amplifies the MF signal for transmission over the same antenna cable to the beacon receiver.

The coaxial antenna cable also carries DC power to the pre-amplifier of both the L1 GPS and beacon antennas over the center conductor of the cable.

The L1 GPS antenna and a beacon antenna are integrated into a single antenna assembly, as shown in Figure 1.1. The antenna assembly is completely weatherproof and is designed to withstand harsh environmental conditions.

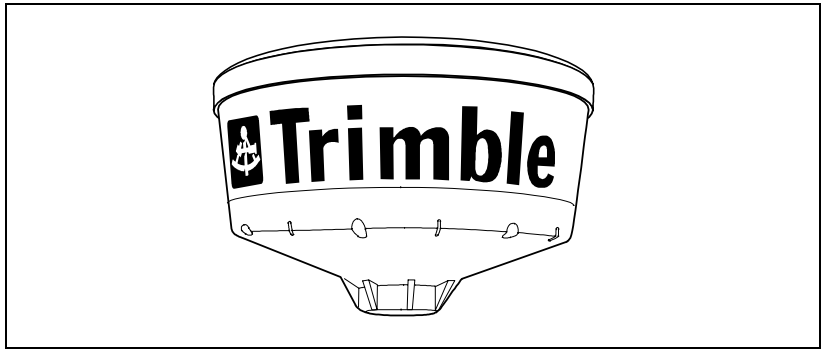


Figure 1.1 Integrated GPS/MSK beacon antenna (for the GPS Pathfinder Pro XR receiver)

Combined L1 GPS/Beacon/Satellite Differential Antenna

The GPS Pathfinder Pro XRS receiver's integrated L1 GPS/beacon/satellite differential antenna (part number 33580-50) features two antenna components:

- L1 GPS/satellite differential antenna

  This active antenna is designed to filter out unwanted signals and amplify the L1 GPS and satellite differential signals for transmission over the antenna cable to the receiver.

- MSK H-field loop beacon antenna

  This antenna features a pre-amplifier for filtering out signal interference such as AM radio broadcasts and noise from switching power supplies. After filtering, the pre-amplifier amplifies the MF signal for transmission over the same antenna cable to the beacon receiver.

The coaxial antenna cable also carries DC power to the pre-amplifier of both the L1 GPS/satellite differential and beacon antennas over the center conductor of the cable.

The antenna assembly integrates the L1 GPS/satellite differential antenna and a beacon antenna into a single antenna assembly, as shown in Figure 1.2. The antenna assembly is completely weatherproof and is designed to withstand harsh environmental conditions.

Figure 1.2 Combined L1 GPS/beacon/satellite differential antenna (for the GPS Pathfinder Pro XRS receiver)

Integrated L1 GPS/Satellite Differential Antenna

The GPS Pathfinder Power receiver's integrated L1 GPS/satellite differential antenna shares its housing with the GPS receiver. The active antenna filters out unwanted signals and amplifies the L1 GPS and satellite differential signals.

The combined GPS receiver and integrated L1 GPS/satellite differential antenna assembly (part number 38198-50) is shown in Figure 1.3. It is completely weatherproof and is designed to withstand harsh environmental conditions.

Figure 1.3 Integrated L1 GPS/satellite differential antenna (for the GPS Pathfinder Power receiver)

CHAPTER

2

Accuracy

In this chapter:

- Introduction
- Differential GPS positioning
- Factors affecting postprocessed DGPS accuracy
- Real-time DGPS accuracy

Introduction

The GPS Pathfinder Systems receivers calculate very accurate GPS positions on a second by second basis. After postprocessed differential correction, the horizontal accuracy of each position is better than 50 cm (RMS) + 1 part per million (ppm) times the distance between the base and the rover. For the GPS Pathfinder Power receiver, the horizontal accuracy is better than 1 m (RMS) + 1 ppm. Using real-time corrections, the accuracy of each position can be as good as submeter, but is subject to a number of operational conditions.

Note – *RMS means that approximately 68% of the positions are within the specified value.*

Differential GPS Positioning

Differential GPS (DGPS) requires two or more receivers. One receiver, called the reference station, is located at a known point to determine the GPS measurement errors and compute corrections to these errors. An unlimited number of mobile GPS Pathfinder Systems receivers, commonly called *rovers*, collect GPS data at unknown locations within the vicinity of the reference station. Errors common at both the reference and rover receivers are corrected with DGPS either in real time or during postprocessing.

Note – *For more information about GPS and DGPS, review the All About GPS tutorial on the Trimble website (www.trimble.com).*

The GPS Pathfinder Systems receivers, in combination with Trimble controlling software and the GPS Pathfinder Office software, provide three ways of obtaining submeter positions:

- Real-time DGPS
- Postprocessed DGPS
- Postprocessed real-time DGPS

The accuracy figures given in the sections below are obtained under the following conditions:

- Number of satellites used: ≥ 5
- PDOP: ≤ 6
- Signal-to-noise ratio: ≥ 6
- Satellite elevation mask: ≥ 15°
- Reference station receiver is a Trimble GPS Pathfinder Pro XR, Pro XRS, 4600 LS™, or Series 4000 GPS receiver, or equivalent.

Real-Time DGPS

When using real-time DGPS, the reference station broadcasts the correction values to the rovers within coverage range, through a transmitter such as a radiobeacon (beacon DGPS) or a satellite (satellite DGPS). The rover applies the corrections to its position in real time. With real-time DGPS, the data file collected at the rover includes the corrected DGPS position and the differential corrections. Collecting the differential corrections enables you to postprocess the real-time corrected positions later if required. For more information, see Postprocessed Real-Time (PPRT) DGPS, page 16.

The positions calculated by the GPS Pathfinder Systems receivers using real-time DGPS are of submeter accuracy + 2 ppm. If you use a provider of real-time DGPS that uses VRS/VBS techniques, there is no degradation associated with distance from reference station and the accuracy always stays at the submeter level (RMS).

Postprocessed DGPS

When real-time DGPS is not available, or is only available part of the time, you have to postprocess the autonomous GPS data in your rover file to obtain sufficient accuracy on your positions. When using postprocessed DGPS, the reference station stores the correction values in base data files on a computer.

Many reference station owners provide their base data to the community through the Internet or other means of communication. Often this means that you do not have to set up your own reference station for postprocessed DGPS, but can use an existing one. For a list of available reference stations, visit the Trimble website (www.trimble.com).

Postprocessed Real-Time (PPRT) DGPS

Postprocessed DGPS positions are generally more accurate than DGPS positions obtained in real time. If you are not satisfied with your real-time DGPS position accuracy, you can postprocess the real-time DGPS positions, provided that you have access to suitable reference station base data files.

The accuracy using PPRT DGPS is the same as for postprocessed DGPS (see previous section).

Factors Affecting Postprocessed DGPS Accuracy

The accuracy that you obtain after data collection depends on several factors, including:

- Number of visible satellites
- Multipath
- Distance between reference station and rover receivers
- Position Dilution of Precision (PDOP)
- Signal-to-noise ratio (SNR)
- Satellite elevations
- Occupation time at a point
- Receiver type at reference station
- Accuracy of the reference station position

In addition, the following conditions must be met to obtain submeter accuracy:

- Synchronized measurements are logged at the reference station.
- The logging interval for the roving receiver is the same as, or a multiple of, the logging interval at the reference station.
- The reference station uses the correct antenna.

For more information on GPS data accuracy, refer to Chapter 4 of the *Mapping Systems General Reference*.

Number of Visible Satellites

Generally, you need a minimum of four satellites to get a good position. If you have five or more satellites, accuracy increases by a small amount. You can obtain positions from only three satellites by supplying a height value manually. However, Trimble recommends that you do not use this method, as an inaccurate height can significantly reduce horizontal accuracy.

Use the Asset Surveyor or ASPEN software to configure the receiver to use a minimum of five satellites (Overdetermined 3D), four satellites (3D), or three satellites (2D).

Note – *The TerraSync software always uses a minimum of four satellites. You cannot configure this setting.*

When the number of visible satellites drops below the required number, the controlling software stops logging positions and displays the message Too few satellites.

Multipath

GPS signals are sometimes reflected off nearby objects, particularly metallic objects, creating false or erroneous results. This phenomenon is known as *multipath*. Severe multipath can induce position errors of many meters, while mild multipath may cause small, undetectable errors. Optimal accuracy is obtained by collecting data in an environment that is free of large reflective surfaces, like buildings and trees. The GPS Pathfinder Systems receiver's EVEREST multipath reduction option helps reduce the effects of multipath.

Note – *If you have purchased a GPS Pathfinder Power receiver with part number 40888-85-ENG, this option is not installed. If you want to purchase the option upgrade for this functionality, contact your local dealer.*

Distance Between Reference Station and Rover

When you postprocess GPS Pathfinder Pro XR/XRS data using the GPS Pathfinder Office Differential Correction utility, the horizontal accuracy of the positions received is 50 cm (RMS) at a 1 km base line (distance from reference station). Accuracy degrades by 1 ppm as the distance between reference station and rover increases. This means that 1 mm of degradation occurs for every kilometer between the reference station and rover. You must collect data within 500 km (310 miles) of your reference station to obtain submeter accuracy for the GPS Pathfinder Pro XR/XRS receiver.

PDOP

PDOP (Position Dilution of Precision) is a unitless measure of the current satellite geometry. It indicates when the most accurate results are provided. When satellites are spread around the sky, the PDOP value is low, and the computed position is more accurate. When the satellites are grouped closely together, the PDOP value is high, and the computed position is less accurate. The lower the PDOP value, the more accurate the GPS positions.

You can configure the PDOP mask so that if the PDOP exceeds the mask value, the controlling software stops logging positions. A PDOP mask of 6 is required for submeter accuracy.

SNR

SNR (signal-to-noise ratio) is a measure of the satellite signal strength relative to the background noise. A strong signal with low noise provides better accuracy. To compute positions with strong signals, the SNR mask should be set to 6 or more. In areas of dense canopy, the SNR mask can be lowered to 3. Although you may not achieve submeter accuracy, this provides the ability to collect GPS positions in marginal areas.

Elevation Mask

When a satellite is low on the horizon, the GPS signals must travel a great distance through the atmosphere, delaying reception by the receiver. You can minimize noisy data by adjusting the elevation mask. Satellites below the mask are excluded from the position computation. For best results, the recommended setting is 15°.

Warning – If the elevation mask is too low, the rover may use a satellite that the reference station cannot see. If this occurs, some data cannot be differentially corrected by postprocessing. To avoid this situation, make sure that the elevation mask is at least 5° higher than the reference station elevation.

Occupation Period

The GPS Pathfinder Systems receivers achieve the specified horizontal accuracy with a one-second occupation time.

Note – *To achieve higher levels of accuracy using a GPS Pathfinder Systems receiver, collect carrier-phase data and postprocess using the GPS Pathfinder Office software.*

Receiver Type

The following Trimble receiver models use Maxwell™ technology and, when used as the reference station, yield submeter accuracy with GPS Pathfinder Systems receivers:

- GPS Pathfinder Pro XRS
- GPS Pathfinder Pro XR
- GPS Pathfinder Pro XL
- 4700
- 4800
- 4600 LS Surveyor
- 4000 series
- DSM™ Reference Station

Warning – If the GPS receiver at the reference station has fewer than 12 channels, you may be unable to differentially correct some of your data. If the reference station is not capable of logging data from all of the satellites the rover is using, the data collected by the rover cannot be differentially corrected using postprocessing.

Accuracy of the Reference Station Position

Any inaccuracy in the reference station position is reflected in your rover position accuracy. For information on the accuracy of your local DGPS reference station coordinates, contact the provider of that particular service.

Synchronized Measurements

To obtain optimal accuracy from differential correction, the reference station must record reference data (or output differential corrections) from synchronized measurements. Synchronized measurements occur when the reference station receiver and rover receivers simultaneously make measurements to all the satellites they are tracking.

When you use one of the receivers listed in Receiver Type, page 20, as a reference station receiver, the data is always synchronized. When measurements are not synchronized, there is no equivalent reference station position measured at exactly the same time as the rover position. A simultaneous reference station position must be interpolated, which reduces accuracy.

Logging Intervals

Ideally, the logging interval at the reference station should be the same as the logging interval at the rover. For example, if the reference station is using a 5-second logging interval, the rover logging interval should be 5 seconds. The rover logging interval can also be a direct integer multiple of the interval at the reference station. For example, if the reference station is logging every 5 seconds, the rover can log every 10 seconds.

If the rover logging interval is not synchronized with the reference station, the accuracy of the GPS positions logged by the rover may not be submeter. This is because the reference station measurements must be interpolated to correct the roving receiver's measurements. For more information, see Synchronized Measurements, page 21.

If the synchronized measurement logging interval at the reference is 1 second, you can use any logging interval at the rover. However, this generates a large file at the reference station. If the computer or data collector at the reference station runs out of space, you cannot differentially correct any rover data collected after the base file ends.

When disk space is at a premium, the best option is a 5-second logging interval for synchronized measurement data at the reference station and a 5-second logging interval for positions at the rover. This is frequent enough to be practical at the rover and uses the default reference station logging interval, which results in base files that are not too large.

Table 2.1 gives examples of various reference station and rover intervals and their effect on accuracy. They are valid for both postprocessed and real-time corrections.

Table 2.1 Logging Interval Accuracy

Reference station interval (seconds)	Rover interval (seconds)	Base data interpolated?	Notes
1	1	No	Recommended for best accuracy.
5	5	No	Recommended if reference station disk space is at a premium.
1	3, or 5, or 6, etc.	No	The rover interval is a direct integer multiple of the reference station interval.
5	10	No	The rover interval is a direct integer multiple of the reference station interval.
5	1	Yes	Base data is interpolated at seconds 1, 2, 3, and 4. A slight degradation of accuracy occurs with interpolation. One in five of the rover positions is not interpolated.

Real-Time DGPS Accuracy

Real-time DGPS offers similar accuracies to postprocessed GPS. However, in addition to the factors discussed in Factors Affecting Postprocessed DGPS Accuracy, page 17, there are other factors that affect the accuracy of real-time DGPS positions. These factors include:

- Update rate of the corrections
- Corrections based on a different datum

Update Rate of the Corrections

The frequency, or rate, at which the RTCM differential correction messages are output from the reference station affects the accuracy of the GPS positions recorded by the roving receiver. The latency of the corrections (that is, the time it takes for up-to-date information to get from the reference station to the rover) also affects the rover position accuracy.

Datum of Corrections

Errors can occur if the reference stations use a datum other than WGS-84 as the basis for the DGPS corrections. The error introduced by using a reference station that transmits coordinates using a different datum is generally quite small. However, in some places the margin of error can be 5–10 meters. To avoid this type of error, you can set the controlling software to collect postprocessable real-time (PPRT) data.

CHAPTER

3

Real-Time DGPS Components

In this chapter:

- Introduction
- GPS Pathfinder Pro XR/XRS beacon components
- Real-Time DGPS beacon components
- Advanced DGPS system components
- MSK beacon receiver signal processing
- Worldwide DGPS beacon coverage
- Activating the OmniSTAR satellite differential service
- Activating the Racal-LandStar satellite differential service

Introduction

The GPS Pathfinder Systems receivers have integrated real-time DGPS, making it simple for you to collect or maintain your GPS data in real time. This chapter provides an introduction to the advanced operating characteristics of the MSK beacon component of the GPS Pathfinder Pro XR/XRS receiver. It also outlines the necessary steps to activate a satellite differential component of the GPS Pathfinder Pro XRS or Power receiver.

GPS Pathfinder Pro XR/XRS Beacon Components

The International Association of Lighthouse Authorities (IALA) has established a standard for modulating DGPS corrections in the RTCM SC-104 format on marine radiobeacon broadcasts using minimum shift keying (MSK) modulation.

The differential beacons are a subset of the large number of existing marine radiobeacons, which operate in the 283.5 to 325 kHz band. The MSK beacon component of the GPS Pathfinder Pro XR/XRS receiver is a radiobeacon receiver that tracks and demodulates differential beacon broadcasts conforming to the IALA standard.

Real-Time DGPS Beacon Components

Real-time DGPS beacons require the following three components for a complete system architecture (see Figure 3.1):

- DGPS reference station
- Broadcast site
- GPS/MSK beacon equipment

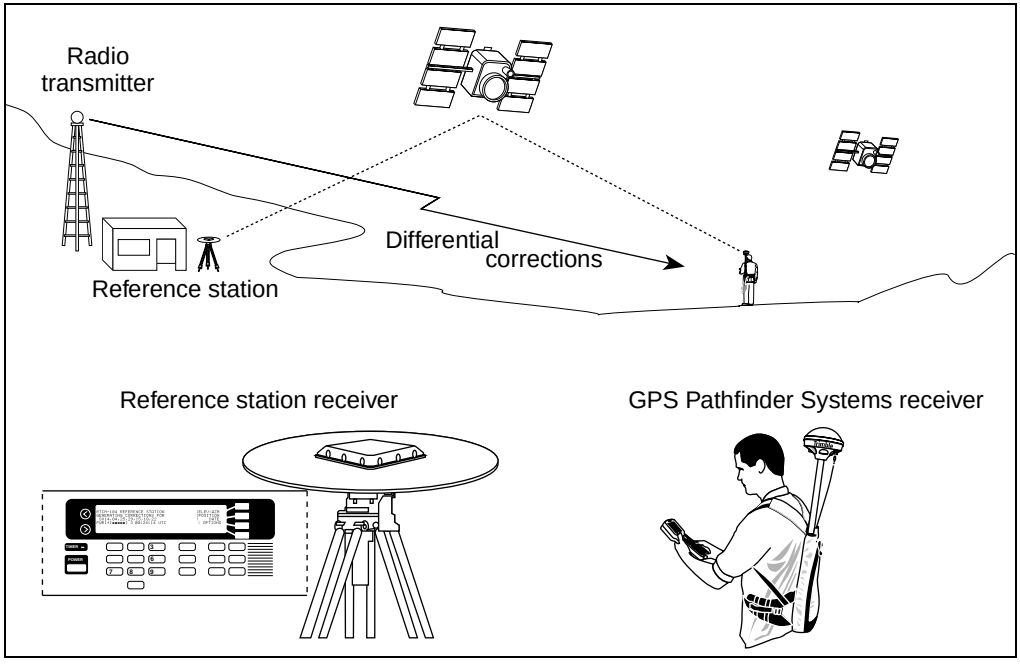


Figure 3.1 Components of a DGPS system

DGPS Reference Station

DGPS relies on GPS error corrections calculated by a reference station placed at a precisely known location. The reference station measures the ranges to each satellite and calculates the magnitude and rate of change of error in each measurement based on its known location.

Broadcast Site

A broadcast site is a radio beacon transmitting correction data in the 283.5 to 325 kHz band. The GPS error corrections from the reference station are modulated on the radio beacon broadcast using minimum shift keying (MSK) modulation.

GPS/MSK Beacon Equipment

The MSK beacon component of the GPS Pathfinder Pro XR/XRS receiver tracks and demodulates the DGPS broadcasts from differential beacons, and outputs the DGPS corrections to the GPS component in the industry standard RTCM SC-104 format. The GPS component of the GPS Pathfinder Pro XR/XRS receiver applies the DGPS corrections output from the MSK beacon component to achieve accurate position and velocity measurements.

Advanced DGPS System Components

In addition to the three DGPS components listed in Real-Time DGPS Beacon Components, page 26, a DGPS service can have advanced components:

- Integrity monitor
- Control station

Integrity Monitor

An integrity monitor is a precisely located GPS receiver and MSK beacon receiver that applies differential corrections. The differentially corrected position is compared to its known location to determine if the corrections broadcast from the reference station are within the preset tolerance.

Control Station

Some DGPS services maintain centralized control sites to administer the DGPS service elements.

MSK Beacon Receiver Signal Processing

MSK signal processing is broken down into five stages:

- MSK pre-filtering
- MSK automatic gain control
- MSK analog-to-digital conversion
- MSK digital signal processing
- MSK I/O processing

MSK Pre-Filtering

The MSK pre-filter rejects additional interference in the MF signal that was not attenuated by the pre-amplifier filter or was picked up by the antenna cable.

MSK Automatic Gain Control

This stage automatically amplifies the filtered MF signal to an optimal level for the analog-to-digital conversion stage.

MSK Analog-to-Digital Conversion

The analog MF signals are converted into digital signals for the digital signal processing stage. Unlike most other receivers, the MSK receiver uses a wide-band conversion. This technique improves acquisition performance by allowing a broader range of beacon signals to pass to the signal processing stage for evaluation. The wide-band technique also improves signal processing by eliminating the need for dedicated mixing stages that can generate non-linearities in the frequencies of interest.

In addition, the wide-band analog-to-digital conversion enables the use of special digital noise reduction techniques for handling impulse noise. This permits a highly adaptable and optimized response to impulse noise such as lightning.

MSK Digital Signal Processing

Controlled by proprietary processing algorithms, the MSK digital signal processor (DSP) digitally filters the wide-band sample, selects the best beacon signal, and passes the selected signal through a matched filter to the I/O processor. In addition, the DSP measures signal level, noise level, and frequency offset.

During the signal acquisition process, the DSP employs a 128-point FFT (Fast Fourier Transform) algorithm for evaluating the spectral content of the digitized signal. The FFT algorithm orders the beacon signals by relative strength. By filtering and squaring the signals before the FFT stage, the MSK modulation rate and the transmitter versus receiver frequency offset for a particular beacon may be determined. This signal processing technique permits rapid acquisition of the most powerful MSK signal and automatic identification of the modulation rate.

In tracking mode, the DSP rejects out-of-channel interference by selectively filtering the desired MSK signal. This technique allows the MSK receiver to track a weak differential beacon in the presence of much stronger signals from other radiobeacons. The DSP applies dual, low-noise, second-order, phase-locked loops for tracking the MSK carrier phase and symbol phase. The DSP coherently demodulates the MSK signal using a MSK matched filter. The matched filter offers optimal performance in a Gaussian noise environment. In addition, the DSP employs a proprietary noise cancellation technique for combating impulse noise.

MSK I/O Processing

The MSK I/O processor monitors the integrity of the data signal from the DSP, formats the RTCM SC-104 data messages, and outputs the data.

Worldwide DGPS Beacon Coverage

For an up-to-date list of beacon stations around the world, refer to the following Web page:

- http://www.trimble.com/gis/beacon/

Activating the OmniSTAR Satellite Differential Service

To activate the OmniSTAR satellite differential service, do the following:

1. Prepare the GPS Pathfinder Pro XRS or Power receiver:
   - Connect the controlling software to the receiver and begin tracking GPS satellites with a clear view of the sky.
   - Follow the directions in the software's user documentation to obtain the OmniSTAR ID for the receiver. Write the ID down.
2. Call OmniSTAR and give them:
   - your location (for example, Sunnyvale, California, USA)
   - the OmniSTAR ID that you obtained from the controlling software

   OmniSTAR gives you:
   - the OmniSTAR satellite and frequency for your local area
   - a 24-digit activation code

Note – *For phone numbers and further details on how to access the Fugro-OmniSTAR service, refer to the OmniSTAR booklet that accompanies your GPS Pathfinder Systems receiver, or visit the OmniSTAR website at www.omnistar.com.*

3. Follow the directions in the controlling software's user documentation to configure the receiver, so that it is ready to receive corrections from your regional OmniSTAR satellite.

Warning – Make sure that you enter the 24-digit code correctly. Typographic errors prevent successful activation.

4. Wait up to 45 minutes for the activation process to complete.

Note – *If the activation process does not complete within 45 minutes, call Fugro-OmniSTAR and report your problem.*

Note – *The 45 minute wait period is for activation only. Once activated, OmniSTAR corrections begin less than 10 seconds after configuring the receiver to receive them.*

Activating the Racal-LandStar Satellite Differential Service

To activate the Racal-LandStar satellite differential service, do the following:

1. Prepare the GPS Pathfinder Pro XRS or Power receiver:
   - Connect the controlling software to the receiver and begin tracking GPS satellites with a clear view of the sky.
   - Follow the directions in the software's user documentation to obtain the LandStar ID for the receiver. Write the ID down.
2. Call Racal-LandStar and give them:
   - your location (for example, Sunnyvale, California, USA)
   - the LandStar ID that you obtained from the controlling software

   Racal-LandStar gives you:
   - the LandStar satellite and frequency for your local area

Note – *For phone numbers and further details on how to access the Racal-LandStar service, refer to the LandStar booklet that accompanies your GPS Pathfinder Systems receiver, or visit the Racal-LandStar website at www.racal-landstar.com.*

3. Follow the directions in the controlling software's user documentation to configure the receiver, so that it is ready to receive the corrections from your regional Racal-LandStar satellite.
4. Wait up to 45 minutes for the activation process to complete.

Note – *If the activation process is not completed within 45 minutes, call Racal-LandStar and report your problem.*

Note – *The 45-minute wait period is for activation only. Once activated, Racal-LandStar corrections begin less than 10 seconds after configuring the receiver to receive them.*

CHAPTER

4

Equipment

In this chapter:

Introduction

This chapter outlines the various components of the GPS Pathfinder Systems receivers and shows how to connect your receiver and data collector to create a mapping system.

GPS Pathfinder Pro XR/XRS Front Panel

The GPS Pathfinder Pro XR/XRS receiver, shown in Figure 4.1, is mounted in a weatherproof housing.

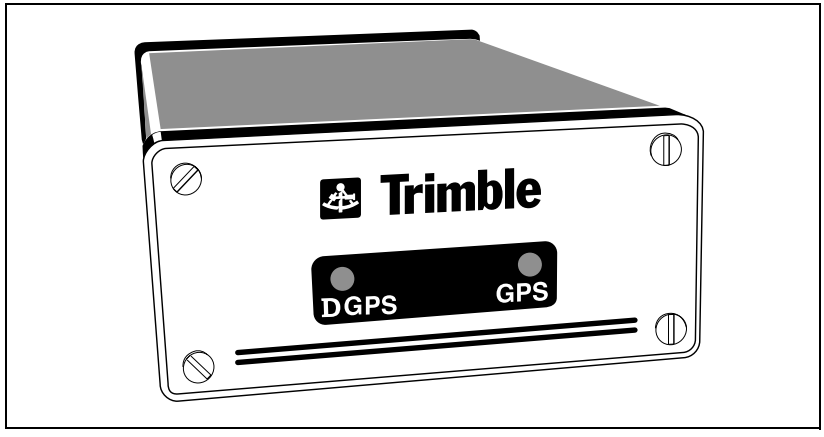


Figure 4.1 GPS Pathfinder Pro XR/XRS front panel

Status Lights

The two status lights on the front panel of the GPS Pathfinder Pro XR/XRS receiver provide the status information listed in Table 4.1.

Table 4.1 GPS Pathfinder Pro XR/XRS Status Lights

	GPS	DGPS
Off	Unit not powered up	Unit not powered up, or DGPS function is disabled
Flashing Yellow	Tracking satellites	Searching for DGPS signals from MSK radio beacon
Flashing Green		Searching for DGPS signals from satellite differential provider (Not applicable for Pro XR receiver)
Solid Yellow	Performing position fixes using autonomous GPS	Differential corrections are being received from MSK radio beacon
Solid Green	Performing position fixes using differential GPS	Differential corrections are being received from satellite differential provider (Not applicable for Pro XR receiver)

GPS Pathfinder Pro XR/XRS Back Panel

The GPS Pathfinder Pro XR/XRS receiver has two serial communications (RS232) ports and an antenna cable port. The serial communications ports, shown in Figure 4.2, are 12-pin male bulkhead connectors located on the back panel of the receiver.

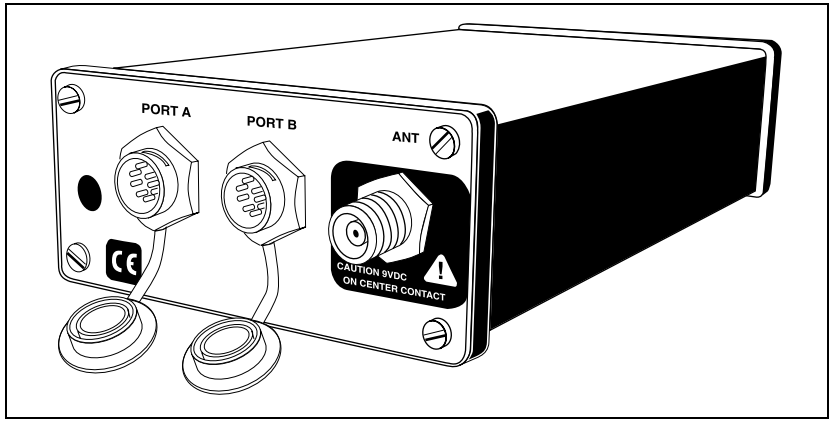


Figure 4.2 GPS Pathfinder Pro XR/XRS receiver back panel

Port A

Port A offers RS-232 communication standards. It is designed for NMEA-0183 output and RTCM input.

Port B

Port B also offers RS-232 communication standards. It is designed for two-way data flow, external sensor input, and power.

Antenna Port

The antenna connector is a TNC female connector located on the far right on the back panel of the GPS Pathfinder Pro XR/XRS receiver.

GPS Pathfinder Power Housing

Figure 4.3 shows the GPS Pathfinder Power receiver mounted in its weatherproof housing.

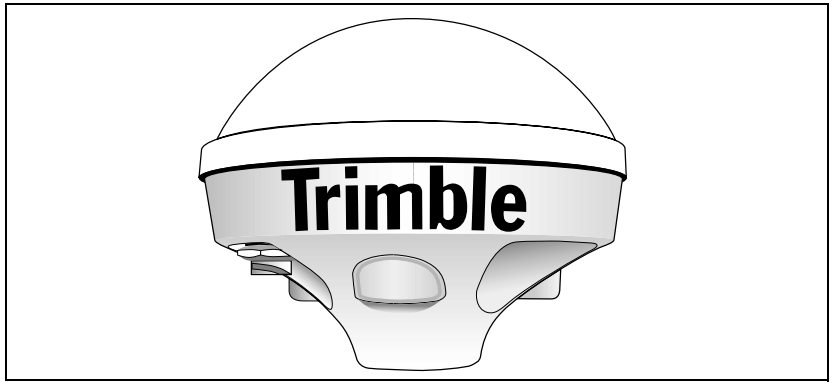


Figure 4.3 GPS Pathfinder Power housing

The GPS Pathfinder Power receiver has one physical port, as shown in Figure 4.4. This port combines two RS-232 serial communications ports (Port A and Port B), one 1 PPS port, and power input.

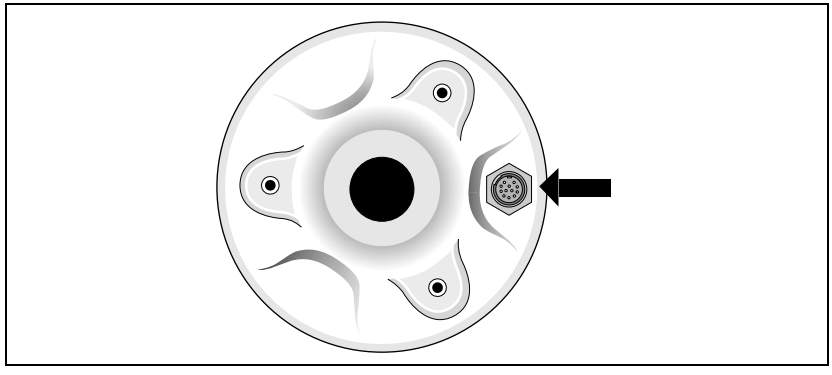


Figure 4.4 GPS Pathfinder Power port

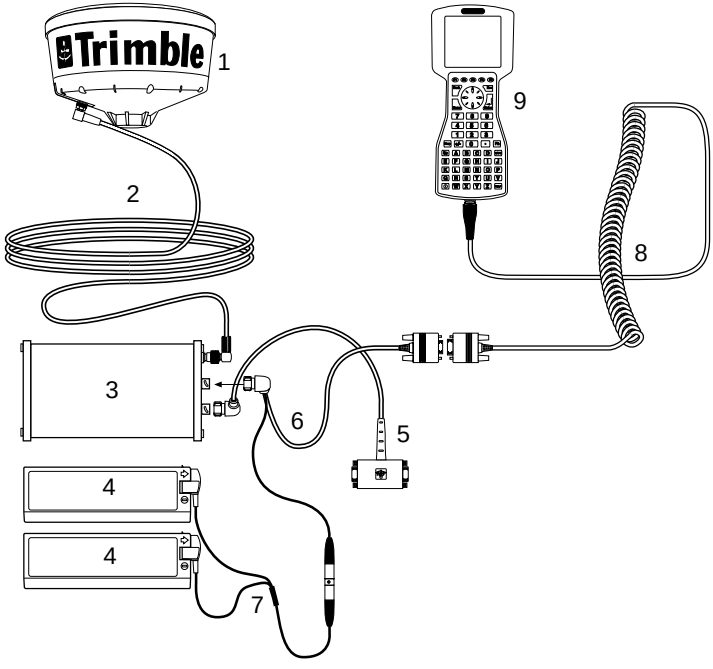
The port is a 12-pin male bulkhead connector:

- Port A is set by default to output NMEA-0183 messages and receive RTCM SC-104 correction data. The port can also be setup to communicate Trimble's format TSIP (Trimble Standard Interface Protocol).
- Port B is set by default to input and output TSIP messages.

You do not need to connect an antenna cable to this receiver, because the antenna and receiver are built into and connected within the same housing. For pinout information for the port, see Appendix B, Specifications.

GPS Pathfinder Pro XR Cabling

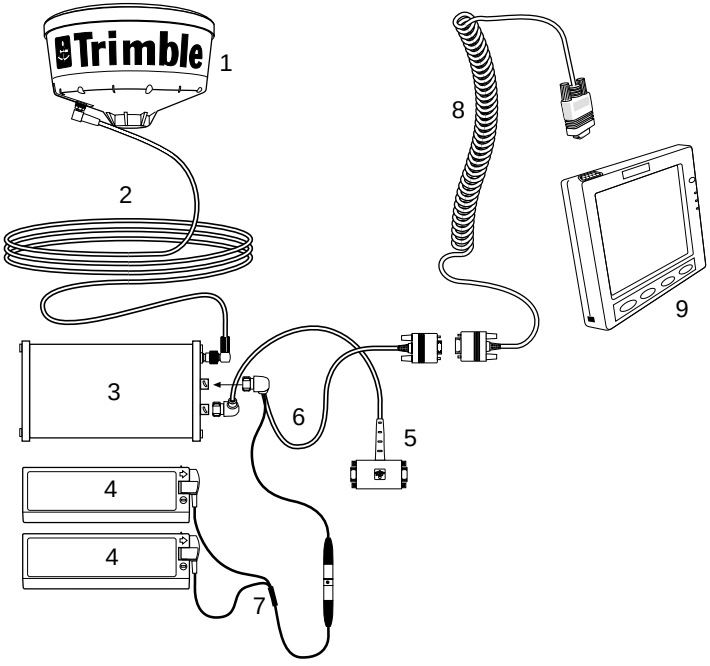
To use a GPS Pathfinder Pro XR receiver with a TSC1™ data collector, connect the system as shown in Figure 4.5.



1	P/N 29653-00	Integrated GPS/beacon antenna
2	P/N 22628	Antenna cable
3	P/N 38073-11	12-channel Pro XR receiver
4	P/N 17466	Camcorder batteries
5	P/N 30232-00	NMEA/RTCM cable
6	P/N 30231-00	Data/power cable
7	P/N 24333	Dual battery cable
8	P/N 32287-00	TSC1 data/ESP cable
9	P/N 29673-50	TSC1 data collector

Figure 4.5 GPS Pathfinder Pro XR receiver / TSC1 connection diagram

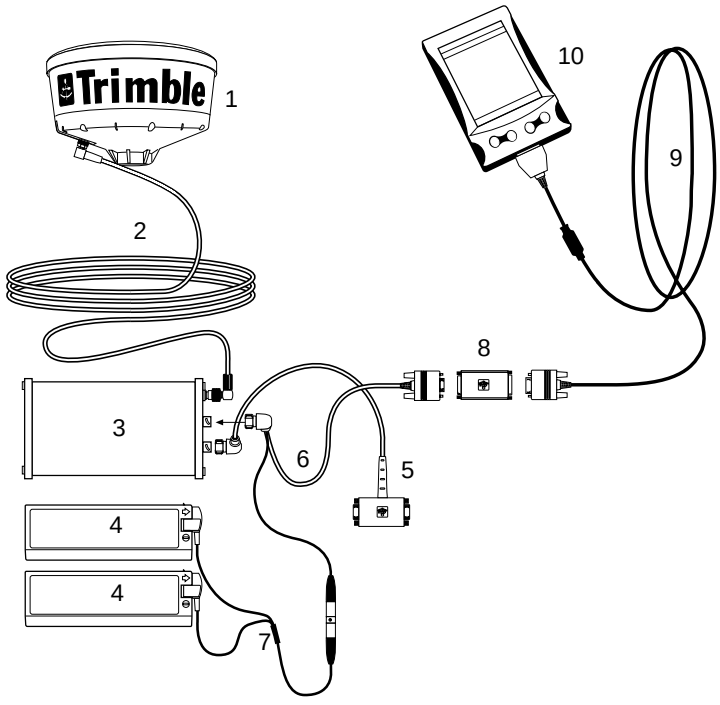
To use a GPS Pathfinder Pro XR receiver with a field device that has a standard serial port, connect the system as shown in Figure 4.6.



1	P/N 29653-00	Integrated GPS/beacon antenna
2	P/N 22628	Antenna cable
3	P/N 38073-11	12-channel Pro XR receiver
4	P/N 17466	Camcorder batteries
5	P/N 30232-00	NMEA/RTCM cable
6	P/N 30231-00	Data/power cable
7	P/N 24333	Dual battery cable
8	P/N 30236	Field device data cable
9	Field Device with standard serial port	

Figure 4.6 GPS Pathfinder Pro XR receiver / field device with standard serial port connection diagram

To use a GPS Pathfinder Pro XR receiver with a field device that has a customized serial port, connect the system as shown in Figure 4.7.

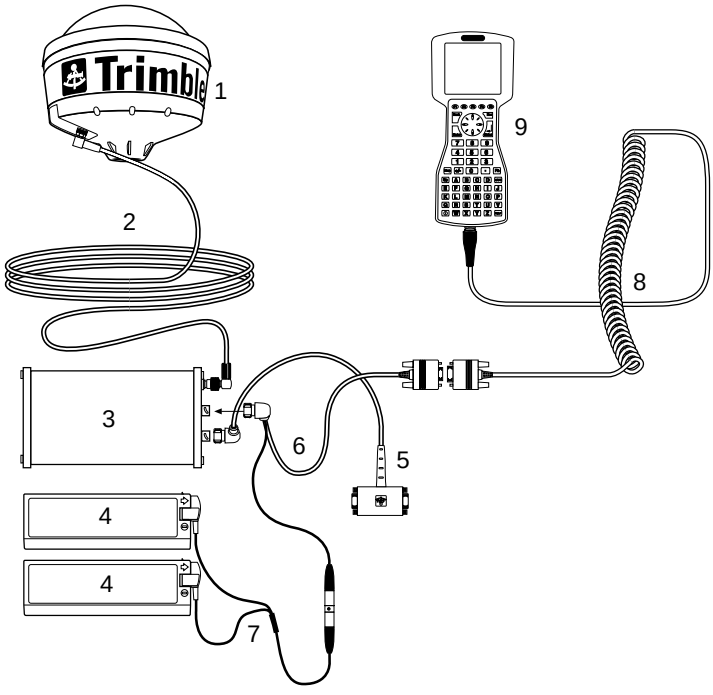


1	P/N 29653-00	Integrated GPS/beacon antenna
2	P/N 22628	Antenna cable
3	P/N 38073-11	12-channel Pro XR receiver
4	P/N 17466	Camcorder batteries
5	P/N 30232-00	NMEA/RTCM cable
6	P/N 30231-00	Data/power cable
7	P/N 24333	Dual battery cable
8	P/N 43197	Null modem adapter
9	Custom data cable	
10	Field device with custom serial port	

Figure 4.7 GPS Pathfinder Pro XR receiver / field device with custom serial port connection diagram

GPS Pathfinder Pro XRS Cabling

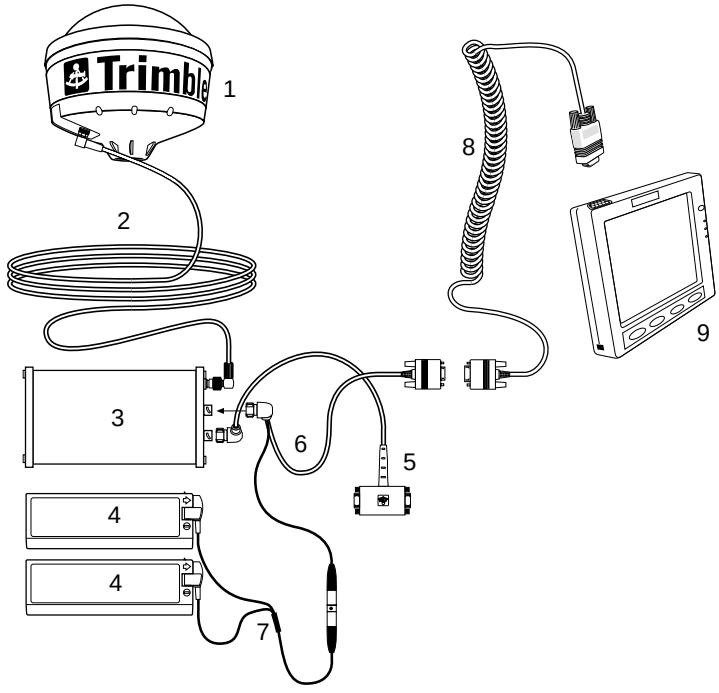
To use a GPS Pathfinder Pro XRS receiver with a TSC1 data collector, connect the system as shown in Figure 4.8.



1	P/N 33580-50	Combined L1 GPS/MSK beacon/ satellite differential antenna
2	P/N 22628	Antenna cable
3	P/N 33302-51	12-channel Pro XRS receiver
4	P/N 17466	Camcorder batteries
5	P/N 30232-00	NMEA/RTCM cable
6	P/N 30231-00	Data/power cable
7	P/N 24333	Dual battery cable
8	P/N 32287-00	TSC1 data/ESP cable
9	P/N 29673-50	TSC1 data collector

Figure 4.8 GPS Pathfinder Pro XRS receiver / TSC1 connection diagram

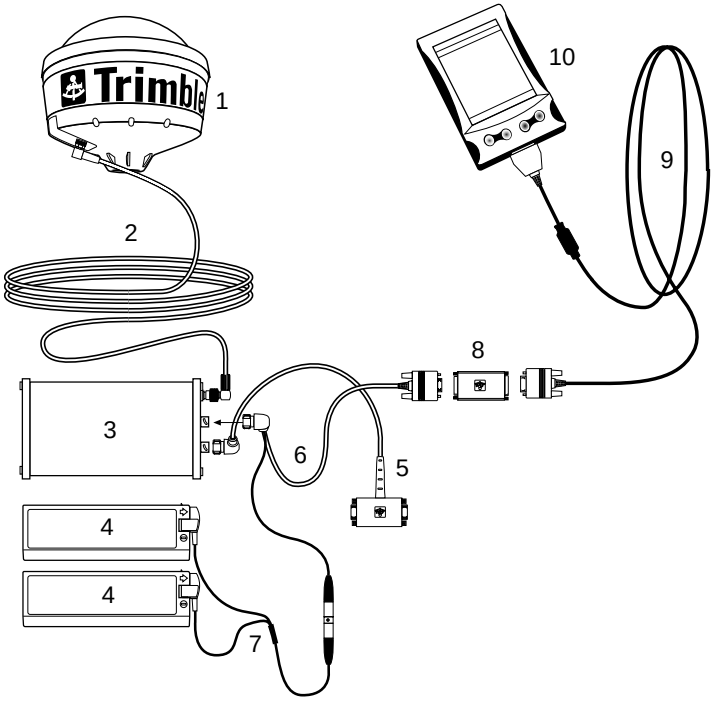
To use a GPS Pathfinder Pro XRS receiver with a field device that has a standard serial port, connect the system as shown in Figure 4.9.



1	P/N 33580-50	Combined L1 GPS/MSK beacon/ satellite differential antenna
2	P/N 22628	Antenna cable
3	P/N 33302-51	12-channel Pro XRS receiver
4	P/N 17466	Camcorder batteries
5	P/N 30232-00	NMEA/RTCM cable
6	P/N 30231-00	Data/power cable
7	P/N 24333	Dual battery cable
8	P/N 30236	Field device data cable
9	Field device with standard serial port	

Figure 4.9 GPS Pathfinder Pro XRS receiver / field device with standard serial port connection diagram

To use a GPS Pathfinder Pro XRS receiver with a field device that has a customized serial port, connect the system as shown in Figure 4.10.

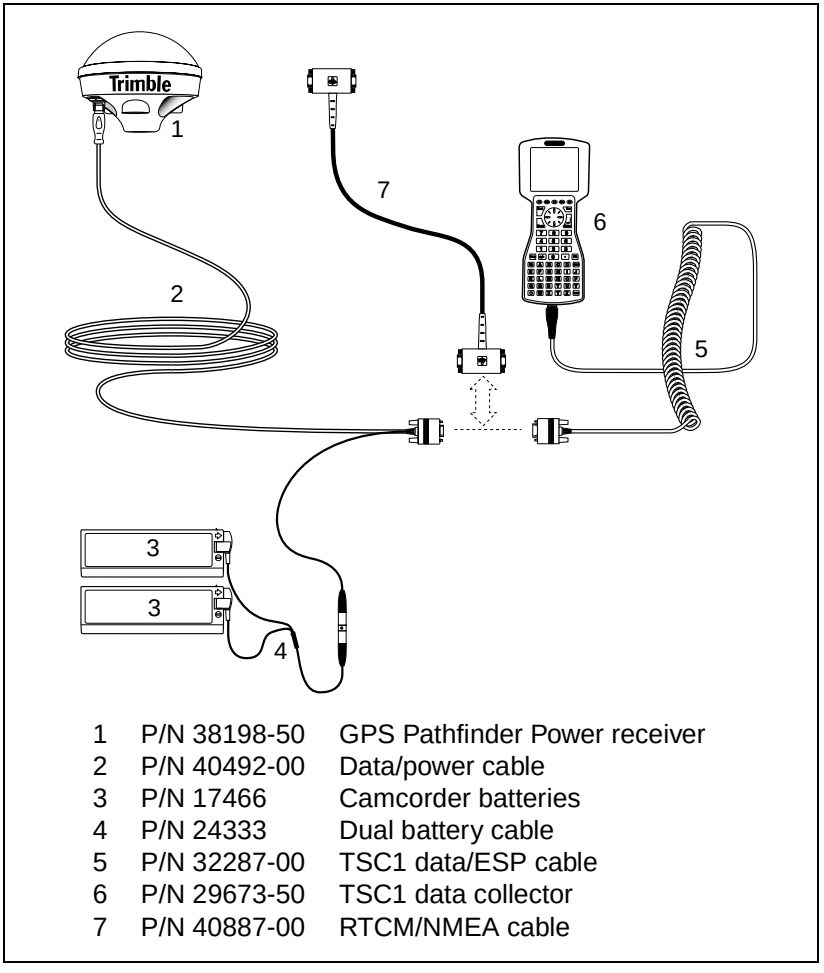


1	P/N 33580-50	Combined L1 GPS/MSK beacon/ satellite differential antenna
2	P/N 22628	Antenna cable
3	P/N 33302-51	12-channel Pro XRS receiver
4	P/N 17466	Camcorder batteries
5	P/N 30232-00	NMEA/RTCM cable
6	P/N 30231-00	Data/power cable
7	P/N 24333	Dual battery cable
8	P/N 43197	Null modem adapter
9	Custom data cable	
10	Field device with custom serial port	

Figure 4.10 GPS Pathfinder Pro XRS receiver / field device with custom serial port connection diagram

GPS Pathfinder Power Cabling

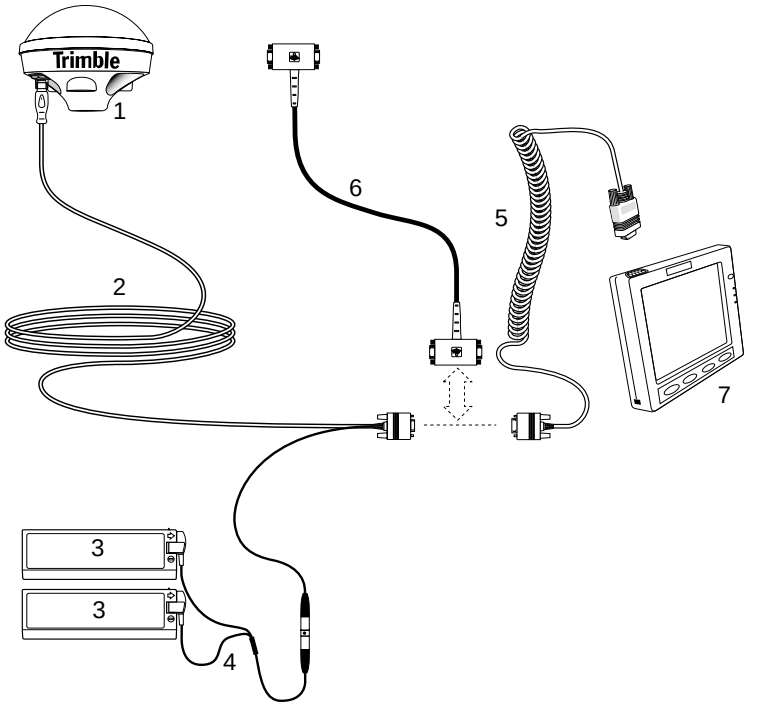
To use a GPS Pathfinder Power receiver with a TSC1 data collector, connect the system as shown in Figure 4.11. Use the RTCM/NMEA cable (part number 40887-00) only if you need to cable in RTCM corrections and/or output NMEA data from the receiver.



1	P/N 38198-50	GPS Pathfinder Power receiver
2	P/N 40492-00	Data/power cable
3	P/N 17466	Camcorder batteries
4	P/N 24333	Dual battery cable
5	P/N 32287-00	TSC1 data/ESP cable
6	P/N 29673-50	TSC1 data collector
7	P/N 40887-00	RTCM/NMEA cable

Figure 4.11 GPS Pathfinder Power receiver / TSC1 connection diagram

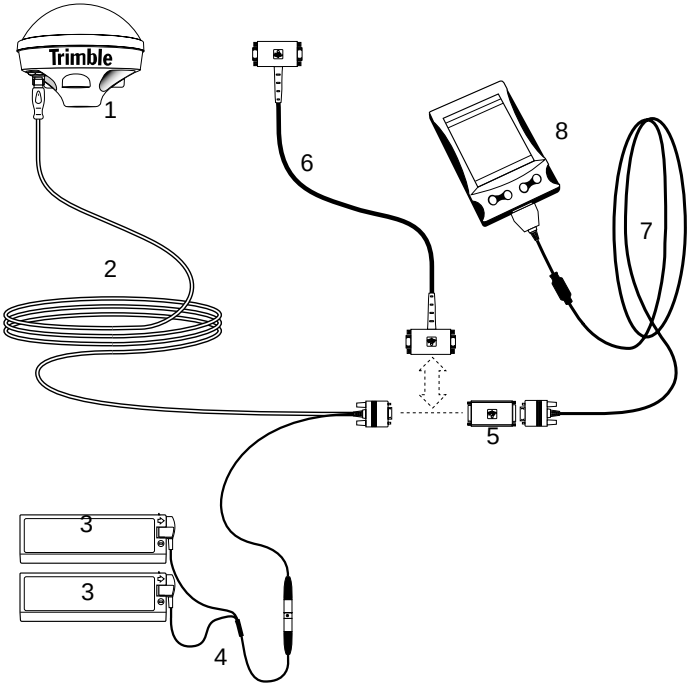
To use a GPS Pathfinder Power receiver with a field device that has a standard serial port, connect the system as shown in Figure 4.12. Use the RTCM/NMEA cable (part number 40887-00) only if you need to cable in RTCM corrections and/or output NMEA data from the receiver.



1	P/N 38198-50	GPS Pathfinder Power receiver
2	P/N 40492-00	Data/power cable
3	P/N 17466	Camcorder batteries
4	P/N 24333	Dual battery cable
5	P/N 45052	GPS Pathfinder Power field device data cable
6	P/N 40887-00	RTCM/NMEA cable
7	Field device with standard serial port	

Figure 4.12 GPS Pathfinder Power receiver / field device with standard serial port connection diagram

To use a GPS Pathfinder Power receiver with a field device that has a customized serial port, connect the system as shown in Figure 4.13. Use the RTCM/NMEA cable (part number 40887-00) only if you need to cable in RTCM corrections and/or output NMEA data from the receiver.



1	P/N 38198-50	GPS Pathfinder Power receiver
2	P/N 40492-00	Data/power cable
3	P/N 17466	Camcorder batteries
4	P/N 24333	Dual battery cable
5	P/N 43197	Null modem adapter
6	P/N 40887-00	RTCM/NMEA cable
7	Custom data cable	
8	Field device with custom serial port	

Figure 4.13 GPS Pathfinder Power receiver / field device with custom serial port connection diagram

Backpack

An ergonomic backpack is included with each GPS Pathfinder Systems receiver. Use this comfortable backpack to carry the receiver/antenna, batteries, and data collector in the field.

Loading GPS Pathfinder Pro XR/XRS Equipment into the Backpack

Figure 4.14 illustrates the features inside the backpack.

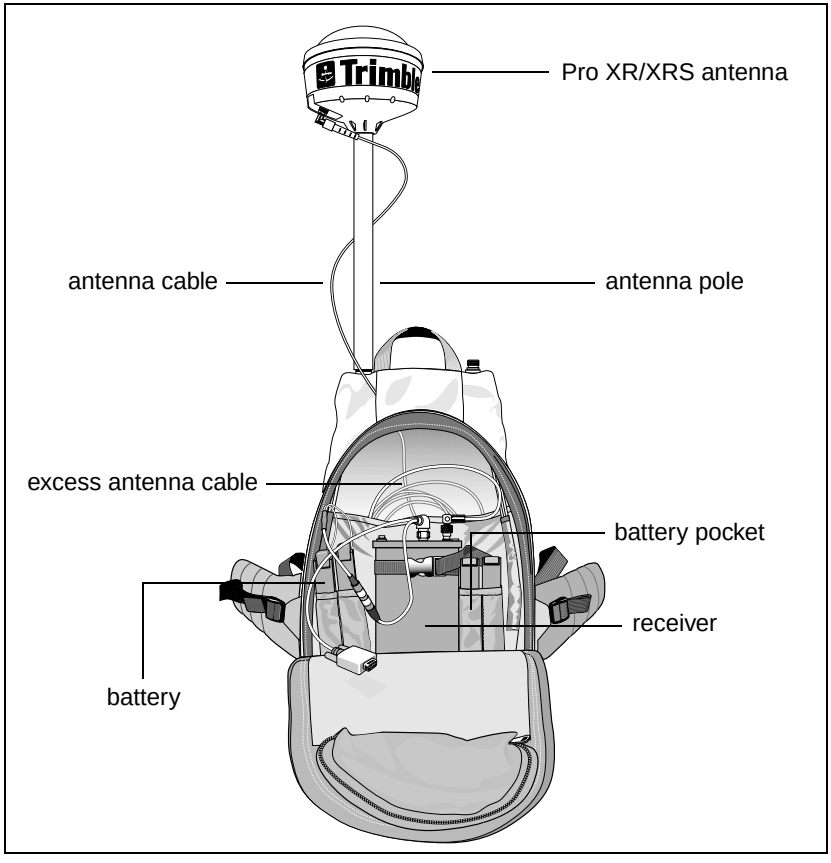


Figure 4.14 GPS Pathfinder Pro XR/XRS receiver in the backpack

To load the GPS equipment into the backpack, open the backpack and follow these steps:

1. Place the GPS Pathfinder Pro XR/XRS receiver in the center of the backpack, between the battery pockets. Position it with the back panel face up and clip the receiver in place with the retaining straps.
2. Attach the data/power cable (part number 30231-00) to receiver Port B.
3. Place two (or four, if needed) fully charged batteries in the backpack. One battery goes in each of the battery pockets, with the connector clips facing up, towards the front.
4. Clip the battery cable (part number 24333) to two batteries and connect the 3-pin connector to the data/power cable.

   The other two batteries act as spares if required.
5. Screw the antenna pole(s) onto one of the antenna mounts.

   The poles need to be high enough for the Pro XR/XRS antenna to be above your head.
6. Install the Pro XR/XRS antenna on top of the antenna pole.
7. Attach the antenna cable (part number 22628) to the port labeled “Ant” on the receiver.
8. Thread the other end of the antenna cable through the antenna cable outlets and attach it to the antenna.
9. Place the excess antenna cable in the device pocket.
10. From the outside of the backpack, insert the DE9 connector of the field device data cable through the data cable outlet.
11. Connect the DE9 connector on the receiver data/power cable (part number 30231-00) to the DE9 connector on the field device data cable.

    For more information, see GPS Pathfinder Pro XR Cabling, page 41, or GPS Pathfinder Pro XRS Cabling, page 44.

12. Pull the data cable through the cable retainer loops on the side of the backpack.
13. Connect the field device cable to the field device.
14. Close all compartments.

Loading GPS Pathfinder Power Equipment into the Backpack

Figure 4.15 illustrates the features inside the backpack.

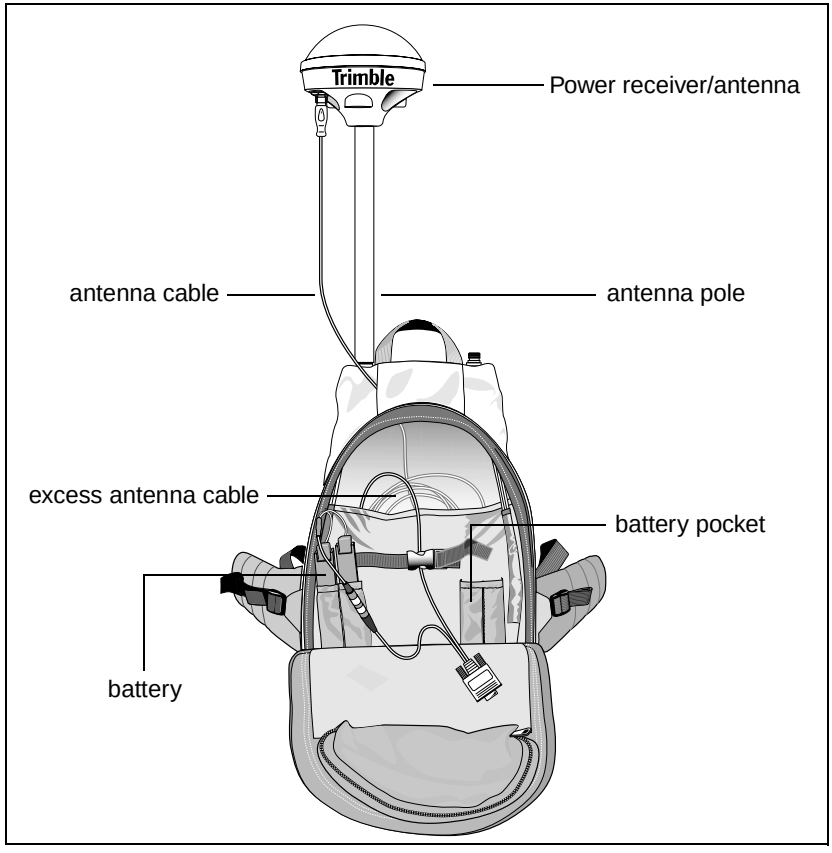


Figure 4.15 GPS Pathfinder Power receiver in the backpack

To load the GPS equipment into the backpack, open the backpack and follow these steps:

1. Place two fully charged batteries in the backpack. One battery goes in each of the battery pockets, with the connector clips facing up, towards the front.
2. Connect the battery cable (part number 24333) to the two batteries in the battery pockets.
3. Screw the antenna pole(s) onto one of the antenna mounts.

   The poles need to be high enough for the GPS Pathfinder Power receiver to be above your head.
4. Install the GPS Pathfinder Power receiver on top of the antenna pole.
5. From the outside of the backpack, insert the DE9 connector of the field device data cable through the data cable outlet.
6. Pull the cable through the data cable strain relief retainer and pull it tight.
7. Place the receiver data/power cable (part number 40492-00) in the sleeve pocket.
8. Pull its bulkhead cable connector out of the backpack through one of the antenna cable outlets.
9. Connect the bulkhead connector to the GPS Pathfinder Power receiver on top of the pole.
10. Connect the TA3 connector on the receiver data/power cable to battery cable (part number 24333). Place the excess cable in the sleeve pocket.

11. Connect the DE9 connector on the receiver data/power cable (part number 40492-00) to the DE9 connector on the field device data cable.

    For more information, see GPS Pathfinder Power Cabling, page 47.

    Alternatively, if you need to use the RTCM/NMEA cable (part number 40887-00), follow these steps instead:

    – Connect the DE9 connector on the receiver data/power cable (part number 40492-00) to the DE9 connector on the RTCM/NMEA cable (part number 40887-00) labeled “To Receiver”.

    – Connect the DE9 connector on the RTCM/NMEA cable labeled “To Data Logger” to the DE9 connector on the field device data cable.

      For more information, see GPS Pathfinder Power Cabling, page 47.

    – If required, connect the port of the RTCM/NMEA cable labeled “RTCM In” to the external differential correction receiver.

    – If required, connect the port of the RTCM/NMEA cable labeled “Data Out” to the device requiring NMEA.

12. Pull the data cable through the cable retainer loops on the side of the backpack.

13. Connect the field device cable to the field device.

14. Close all compartments.

Fitting the Backpack

Figure 4.16 illustrates the front and back views of the backpack.

Figure 4.16 Backpack adjustment front and back views

It is important that the Trimble backpack fits you for maximum comfort and efficiency. To optimize the fit of the backpack, follow these instructions:

1. Load the GPS equipment into the backpack (see Loading GPS Pathfinder Pro XR/XRS Equipment into the Backpack, page 50, or Loading GPS Pathfinder Power Equipment into the Backpack, page 52).
2. Loosen the hip belt, the stabilizer straps, and the shoulder straps.

3. Position the hip belt so that the top of the belt is at the same height as the top of your hip bone.
4. Tighten the hip belt until it is firmly around your hip.
5. Tighten the shoulder pads by pulling down on the shoulder pad adjustment straps.

   The straps should be firm but not cutting in under your arm.
6. Adjust the height of your chest strap to be positioned just below your collarbones.

   The chest strap helps to keep your backpack in the right place on your body and is also used to fine-tune the shoulder straps to the most comfortable position.

Note – *The harness is designed to follow your movements rather than resist them. However, you may want to minimize the backpack movement when balance is critical (for example, when climbing in rocky areas). To do this, tighten the side stabilizer straps.*

Caring for the Backpack

To maintain the durability of the Trimble backpack and protect its waterproofing:

- Clean it regularly with a soft brush and warm water to remove dirt and other foreign material.
- Dry the backpack thoroughly before storing it to avoid the risk of mildew.
- Store it in a well-ventilated, dry area away from direct sunlight or heat.

Warning – Do not use soap detergents or other solvents. These can attack and damage the fabrics. Do not machine-wash the backpack.

Optional Range Poles and Tripods

Range poles and tripods are very useful when collecting carrier-phase data. With a range pole or tripod you can measure the antenna height more accurately and hold the antenna still more easily than you can with an antenna mounted on the backpack.

Optional Vehicle Kit

The optional vehicle kit contains useful accessories for working in a car, boat, or plane, including:

- magnetic mount
- vehicle power cable
- quick-release for the antenna

APPENDIX

A

Upgrading Receiver Firmware

In this appendix:

- Introduction
- Downloading the firmware files
- Connecting the cables
- Upgrading the receiver firmware

Introduction

This appendix provides instructions for upgrading the firmware in the GPS Pathfinder Systems receivers. The procedure for upgrading the firmware is as follows:

1. Download the upgrade files.
2. Connect the receiver to a personal computer.
3. Upgrade the firmware from the personal computer, using the upgrade files.

Downloading the Firmware Files

You can download upgrade firmware files from Trimble's FTP site:

- ftp://ftp.trimble.com/pub/mapping/bin

To upgrade the firmware for this receiver …	download this file …
GPS Pathfinder Pro XR	XR_*nnn*.exe
GPS Pathfinder Pro XRS	XRS_*nnn*.exe
GPS Pathfinder Power	PPW_*nnn*.exe

The *nnn* in the filename represents the firmware version. For example, PPW_150.exe is the filename for version 1.50 of the GPS Pathfinder Power firmware. These files are self-extracting zip files. To extract the firmware file, run the downloaded executable file from DOS or Windows. The resulting unzipped file has the same name as the file you downloaded, but has an extension of .tnr.

You also need to download the latest version of the Trimble Flash Loader 100 software and install it on the computer. Download the file fl100*nnn*.exe, where *nnn* is the version number of the Flash Loader 100 software. To install the software, run the executable file from within Windows.

Note – *The Flash Loader version number has no relation to the GPS Pathfinder Systems receiver firmware version.*

Connecting the Cables

To connect a GPS Pathfinder Systems receiver to a personal computer, use the GPS receiver data/power cable (part number 40492-00 for the GPS Pathfinder Power receiver, or part number 30231-00 for the GPS Pathfinder Pro XR/XRS receiver):

1. Connect the AC power adapter (part number 31197) to the TA3 (male) connector on the GPS receiver data/power cable.
2. Connect the AC power adapter to a suitable AC power outlet.
3. Connect the DE-9 connector on the GPS receiver data/power cable to COM port 1 or COM port 2 on the computer.

The GPS receiver data/power cable must be connected to the receiver. A standard serial cable can extend the reach of the data/power cable to the computer.

Warning – Pin 9 of the DE-9 connector on the receiver data/power cable is powered by the receiver at 12 volts DC with 1 amp capability. Power is used to charge the battery in the TSC1 data collector, but is not necessary when upgrading the receiver firmware. Before connecting this pin to the computer, refer to the documentation for the computer.

Upgrading the Receiver Firmware

To perform the receiver firmware upgrade, use a personal computer with the Flash Loader 100 software installed and the appropriate .tnr file. For details on which files you need, see Downloading the Firmware Files, page 60.

To upgrade the receiver firmware:

1. On the computer, start the Flash Loader 100 software using one of the following methods:
   - Double-click the Flash Loader 100 desktop icon.
   - Select Flash Loader 100 from the Programs menu.

   By default, the software assumes that the receiver is connected to COM1 on your computer.

   To change this manually, select Options / Settings from the menu. Alternatively, click **Find Receiver** to let Flash Loader 100 determine which port the receiver is connected to.
2. Check the box labeled *Upload new firmware*.

   A standard *File Open* dialog appears.
3. Navigate to the folder where you downloaded the .tnr file from the Trimble FTP site. Select it and click **OK**.

   The software will take a few seconds to process this file.
4. Click **Proceed** to transfer the new firmware to the receiver.

   This may take several minutes.
5. When the process is complete, click the cross in the top right corner of the window to close the Flash Loader 100 program.

Warning – Do not turn off the computer or disconnect power to the receiver. Do not disconnect the cables between the computer and the receiver. Doing this will interrupt the update process.

APPENDIX

B

Specifications

In this appendix:

- Introduction
- Specifications
- Pinouts

Introduction

This appendix lists specifications for GPS Pathfinder Systems receivers and antennas, and pinouts for cables that are supplied with the receivers.

Specifications

Table B.1 lists specifications for the GPS Pathfinder Pro XR/XRS receiver.

Table B.1 GPS Pathfinder Pro XR/XRS receiver specifications

Parameter	Specification
General	Fully sealed, dustproof, waterproof, shock resistant
Update Rate	1 Hz
Time to First Fix	< 30 seconds, typical
Size	11.1 cm × 5.1 cm × 19.5 cm (4.4" × 2.0" × 7.7")
Weight	0.76 kg (1.68 lb)
Power	5 W (maximum)
Temperature	–30°C to 65°C (–22°F to 149°F) operating –40°C to 85°C (–40°F to 185°F) storage
Humidity	100% non-condensing

Table B.2 list specifications for the GPS Pathfinder Pro XR antenna.

Table B.2 Integrated GPS/beacon antenna specifications

Parameter	Specification
General	Right-hand, circular polarized; omnidirectional; hemispherical coverage
Size	15.5 cm diameter × 10.8 cm high (6.1" × 4.2")
Weight	0.49 kg (1.08 lb)
Temperature	–30°C to 65°C (–22°F to 149°F) operating –40°C to 85°C (–40°F to 185°F) storage
Humidity	100% fully sealed
Case	Dustproof, waterproof, shock resistant

Table B.3 lists specifications for the GPS Pathfinder Pro XRS antenna.

Table B.3 Combined L1 GPS/beacon/satellite differential antenna specifications

Parameter	Specification
General	Right-hand, circular polarized; omnidirectional; hemispherical coverage
Size	15.5 cm diameter × 14 cm high (6.1" × 5.5")
Weight	0.55 kg (1.2 lb)
Humidity	100% fully sealed
Case	Dustproof, waterproof, shock resistant

Table B.4 lists specifications for the GPS Pathfinder Power combined receiver and antenna.

Table B.4 GPS Pathfinder Power receiver specifications

Parameter	Specification
General	12-channel, L1/CA code tracking with carrier-phase filtered measurements Integrated GPS/L1 satellite differential receiver/antenna with optional EVEREST multipath-rejection technology upgrade
Casing	Fully sealed, dustproof, waterproof, shock resistant
Update Rate	1 Hz
Time to First Fix	< 30 seconds, typical
Size	15.5 cm diameter × 10.8 cm high (6.1" × 4.2")
Weight	0.52 kg (22 oz)
Power	3.1 W, 9 to 32 V
Temperature	–30°C to 65°C (–22°F to 149°F) operating –40°C to 85°C (–40°F to 185°F) storage
Humidity	100% fully sealed

Pinouts

Table B.5 lists the pinouts for the GPS Pathfinder Pro XR/XRS receiver's data/power cable.

Table B.5 Data/power cable pinout (part number 30231-00)

To GPS Pathfinder Pro XR/XRS receiver				Data Collector		Input Power		
Conn P1			**7 Cond Cbl #1**	**Conn P2 DE9-F**		**2 Conn Cbl #2**	**Conn P3 TA3-M**	
Event In	1	in	—	—		—	—	
TXD	2	out	Orange	2	RXD	—	—	
RXD	3	in	Red	3	TXD	—	—	
Chg Ctrl	4	in	Black	4	DTR	—	—	
Sig Gnd	5	in/out	Shield	5	Sig Gnd	—	—	
DSR	6	out	Yellow	6	DSR	—	—	
Pwr On	7	in	Brown	7	RTS	—	—	
CTS	8	out	Green	8	CTS	—	—	
Charge	9	out	Blue	9	RI	—	—	
V+ In	10	in	—	—		White	1	V+ In
V– In	11	in	—	—		Black	2	V– Out
PPS	12	—	—	—		—	—	

Table B.6 lists the pinouts for the GPS Pathfinder Power receiver's data/power cable.

Table B.6 Data/power cable pinout (part number 40492-00)

To GPS Pathfinder Power receiver			To Data Collector		Input Power	
Color Scheme	**P1 Conn ConXall-F**	**P1 Desc.**	**P2 Conn DE9-F**	**P2 Desc.**	**P3 Conn TA3-M**	**P3 Desc.**
Orange	2	Data Out Port A →	6			
Red	3	Data In Port A ←	8			
Yellow	6	Data Out Port B →	2			
Brown	7	Pwr on ←	7			
Green	8	Data In Port B ←	3			
Black	10	V+ In	9	V+ In	1(Wht)	V+ Out from battery
Blue	12	PPS →	1	PPS		
Shield	5,11	Sig Gnd, V– In	5, Body	Sig Gnd	2(Blk)	V– Out from battery
No Connect	1,4,9		4			

Table B.7 lists the pinouts for the GPS Pathfinder Pro XR/XRS receiver's NMEA/RTCM cable.

Table B.7 NMEA/RTCM cable pinout (part number 30232-00)

To GPS Pathfinder Pro XR/XRS receiver				NMEA/RTCM output connectors			
Conn P1			9 Cond Cbl #1	Conn P2 DE9-M		7 Conn Cbl #1	Conn P3 DE9-F	
Event In	1	in	—	—		—	—	
TX– (232)	2	out	—	—		Orange	2	TXD
RX– (232)	3	in	Red	2	RXD	—	—	
Chg Ctrl	4	in	—	—		Shield		
Sig Gnd	5	in/out	Shield	5	Sig Gnd	—	5	Sig Gnd
TX+ (422)	6	out	—	—		—		
Pwr On	7	in	—	—		—	—	
RX+ (422)	8	out	—	—		—	—	
Charge	9	out	Yellow	9	Pwr	—	—	
V+ In	10	in	—	—		—	—	
V– In	11	in	—	—		—	—	
PPS	12	—	—	—		Brown	4	DTR

Table B.8 lists the pinouts for the GPS Pathfinder Power receiver's NMEA/RTCM cable.

Table B.8 NMEA/RTCM cable pinout (part number 40887-00)

To GPS Pathfinder Power receiver's data/power cable (part number 40492-00)			To data collector cable	To NMEA device	To RTCM device
Color Scheme	**P1 Conn DE9-M**	**P1 Description**	**P2 Conn DE9-F**	**P3 Conn DE9-F**	**P4 Conn DE-M**
Blue	1	1 PPS →		4	
Black	2	Data In to data logger →	2		
Black	3	Data Out from data logger ←	3		
Shield	5	Sig Gnd ↔	5	5	5
Red	6	Data In to NMEA device →		2	
Black	7	Power On ←	7		
Black	8	Data Out from RTCM device ←			2
Green	9	V+ In ↔	9 (BLK)		9
No Connect	4		1,4,6,8	1,3,6,7,8,9	1,3,4,6,7,8

Table B.9 lists the pinouts for the TSC1 data cable.

Table B.9 TSC1 data cable pinout (part number 32287-00)

To GPS Pathfinder Pro XR, Pro XRS, or Power receiver cable			TSC1 data collector		
Conn P1 LEMO OB-M			7 Cond Cbl #1	Conn P2 DE9-M	
Charge	6	in	Black	9	Charge
RXD1	7	in	Red	2	RXD1
Pwr On	4	out	Blue	4	Chg Ctrl
Pwr On	4	out	White	7	Pwr On
TXD1	3	out	Brown	3	TXD1
Gnd	1.2	in/out	Shield	5	Sig Gnd
Charge	5	in	Green	8	RTS

Table B.10 lists the pinouts for the field device data cable.

Table B.10 Field device data cable pinout (part number 30236)

To GPS Pathfinder Pro XR, Pro XRS, or Power receiver			Field device		
Conn P1 DE9-F			7 Cond Cbl #1	Conn P2 DE9-M	
Event In	1	out	White	1	CD
TXD	2	in	Orange	2	RXD
RXD	3	out	Red	3	TXD
Chg Ctrl	4	out	Black	4	DTR
Sig Gnd	5	in/out	Shield	5	Sig Gnd
DSR	6	in	—	6	DSR
Pwr On	7	out	Brown	7	RTS
CTS	8	in	Green	8	CTS
Charge	9	in	Blue	9	RI

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Reader Comment Form

GPS Pathfinder Systems Receiver Manual **April 2001**
P/N: 40889-00-ENG **Revision: B**

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