TOPCON

GR-3

Operator's Manual

TOPCON
POSITIONING SYSTEMS

GR-3
Operator's Manual

Part Number 7010-0736

Rev A

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ECO#2808

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Preface

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Manual Conventions

This manual uses the following conventions:

Example	Description
File ▸ Exit	Click the **File** menu and click **Exit**.
Connection	Indicates the name of a dialog box or screen.
Frequency	Indicates a field on a dialog box or screen, or a tab within a dialog box or screen.
Enter	Press or click the button or key labeled **Enter**.

NOTE	Further information to note about the configuration, maintenance, or setup of a system.
TIP	Supplementary information that can help you configure, maintain, or set up a system.
NOTICE	Supplementary information that can have an affect on system operation, system performance, measurements, or personal safety.
CAUTION	Notification that an action has the potential to adversely affect system operation, system performance, data integrity, or personal health.
WARNING	Notification that an action *will* result in system damage, loss of data, loss of warranty, or personal injury.

DANGER Under no circumstances should this action be performed.

Notes:

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Introduction

The GR-3 receiver is a multi-frequency, GPS+ receiver built to be the most advanced and compact receiver for the surveying market. The receiver is a multi-function, multi-purpose receiver intended for precision markets. Precision markets means markets for equipment, subsystems, components and software for surveying, construction, commercial mapping, civil engineering, precision agriculture and land-based construction and agriculture machine control, photogrammetry mapping, hydrographic and any use reasonably related to the foregoing.

The GR-3 can receive and processes multiple signal types (including the latest GPS L2C, GPS L5, GLONASS C/A L2, and GALILEO signals) improving the accuracy and reliability of your survey points and positions, especially under difficult jobsite conditions. The multi-frequency and GPS+ features of the receiver combine to provide a positioning system accurate for any survey. Several other features, including multipath mitigation, provide under-canopy and low signal strength reception. The receiver provides the functionality, accuracy, availability, and integrity needed for fast and easy data collection.
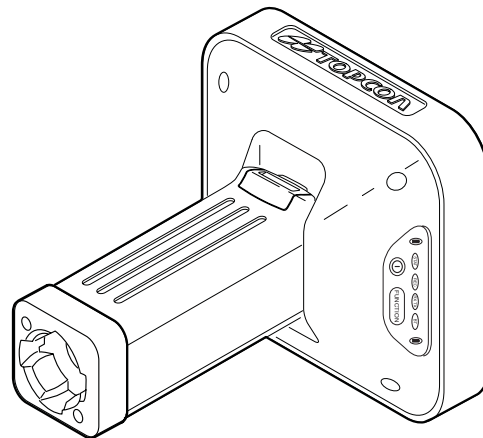
Figure 1-1. GR-3 Receiver

Principles of Operation

Surveying with the right GPS receiver can provide users accurate and precise positioning, a requirement for any surveying project.

This section gives an overview of existing and proposed Global Navigation Satellite Systems (GNSS) and receiver functions to help you understand and apply basic operating principles, allowing you to get the most out of your receiver.

GNSS Overview

Currently, the following three global navigation satellite systems (GNSS) offer line-of-site radio navigation and positioning, velocity, and time services on a global, all-weather scale to any user equipped with a GNSS tracking receiver on or near the Earth's surface:

- GPS – the Global Positioning System maintained and operated by the United States Department of Defense. For information on the status of this system, visit the US Naval Observatory website (http://tycho.usno.navy.mil/) or the US Coast Guard website (http://www.navcen.uscg.gov/).

- GLONASS – the Global Navigation Satellite System maintained and operated by the Russian Federation Ministry of Defense. For information on the status of this system, visit the Coordinational Scientific Information Center website (http://www.glonass-center.ru/frame_e.html).

- GALILEO – an upcoming global positioning system maintained and operated by Galileo Industries, a joint venture of several European space agencies/companies working closely with the European Space Agency. Unlike GPS and GLONASS, this is a civil endeavor and is currently in the development and validation stage. For information on the status of this system, visit the Galileo Industries website (http://www.galileo-industries.net).

Despite numerous technical differences in the implementation of these systems, satellite positioning systems have three essential components:

- Space – GPS, GLONASS, and GALILEO satellites orbit approximately 12,000 nautical miles above Earth and are equipped with a clock and radio. These satellites broadcast ranging signals and various digital information (ephemerides, almanacs, time&frequency corrections, etc.).

- Control – Ground stations located around the Earth that monitor the satellites and upload data, including clock corrections and new ephemerides (satellite positions as a function of time), to ensure the satellites transmit data properly.

- User – The community and military that use GNSS receivers to calculate positions.

Calculating Absolute Positions

When calculating an absolute position, a stationary or moving receiver determines its three-dimensional position with respect to the origin of an Earth-Center Earth-Fixed coordinate system. To calculate this position, the receiver measures the distance (called pseudo-ranges) between it and at least four satellites. The measured pseudo-ranges are corrected for clock differences (receiver and satellites) and signal propagation delays due to atmospheric effects. The positions of the satellites are computed from the ephemeris data transmitted to the receiver in navigation messages. When using a single satellite system, the minimum number of satellites needed to compute a position is four. In a mixed satellite scenario (GPS, GLONASS, GALILEO), the receiver must lock onto five or more satellites to account for the different time scales used in these systems and to obtain an absolute position.

Calculating Differential Positions

DGPS, or Differential GPS, is a relative positioning technique where the measurements from two or more remote receivers are combined and processed using sophisticated algorithms to calculate the receivers' relative coordinates with high accuracy.

DGPS accommodates various implementation techniques that can be classified according to the following criteria:

- The type of GNSS measurements used, either code-phase differential measurements or carrier-phase differential measurements

- If real-time or post-mission results required

  Real-time applications can be further divided according to the source of differential data and communication link used.

With DGPS in its most traditional approach, one receiver is placed at a known, surveyed location and is referred to as the reference receiver or base station. Another receiver is placed at an unknown location and is referred to as the remote receiver or rover. The reference station collects the code-phase and carrier-phase measurements from each GNSS satellite in view.

- For real-time applications, these measurements and the reference station coordinates are then built up to the industry standard RTCM—or various proprietary standards established for transmitting differential data—and broadcast to the remote receiver(s) using a data communication link. The remote receiver applies the transmitted measurement information to its observed measurements of the same satellites.

- For post-mission applications, the simultaneous measurements from reference and rover stations are normally recorded to the receiver's internal memory (not sent over communication link). Later, the data are downloaded to computer, combined, and processed.

  Using this technique, the spatially correlated errors—such as satellite orbital errors, ionospheric errors, and tropospheric errors—can be significantly reduced, thus improving the position solution accuracy.

A number of differential positioning implementations exist, including post-processing surveying, real-time kinematic surveying, maritime radio beacons, geostationary satellites (as with the OmniSTAR service), and satellite based augmentation systems (WAAS, EGNOS, MSAS).

The real-time kinematic (RTK) method is the most precise method of real-time surveying. RTK requires at least two receivers collecting navigation data and communication data link between the receivers. One of the receivers is usually at a known location (Base) and the other is at an unknown location (Rover). The Base receiver collects carrier phase measurements, generates RTK corrections, and sends this data to the Rover receiver. The Rover processes this transmitted data with its own carrier phase observations to compute its relative position with high accuracy, achieving an RTK accuracy of up to 1 cm horizontal and 1.5 cm vertical.

Essential Components for Quality Surveying

Achieving quality position results requires the following elements:

- Accuracy – The accuracy of a position primarily depends upon the satellite geometry (Geometric Dilution of Precision, or GDOP) and the measurement (ranging) errors.

  – Differential positioning (DGPS and RTK) strongly mitigates atmospheric and orbital errors, and counteracts Selective Availability (SA) signals the US Department of Defense transmits with GPS signals.

  – The more satellites in view, the stronger the signal, the lower the DOP number, the higher positioning accuracy.

- Availability – The availability of satellites affects the calculation of valid positions. The more visible satellites available, the more valid and accurate the position. Natural and man-made objects can block, interrupt, and distort signals, lowering the number of available satellites and adversely affecting signal reception.

- Integrity – Fault tolerance allows a position to have greater integrity, increasing accuracy. Several factors combine to provide fault tolerance, including:
  – Receiver Autonomous Integrity Monitoring (RAIM) detects faulty GNSS satellites and removes them from the position calculation.
  – Five or more visible satellites for only GPS or only GLONASS; six or more satellites for mixed scenarios.
  – Satellite Based Augmentation Systems (WAAS, EGNOS, etc.) creates and transmit, along with DGPS corrections, data integrity information (for example, satellite health warnings).
  – Current ephemerides and almanacs.

Conclusion

This overview simply outlines the basics of satellite positioning. For more detailed information, visit the TPS website.

Receiver Overview

When power is turned on and the receiver self-test completes, the receiver's 72 channels initialize and begin tracking visible satellites. Each of the receiver's channels can be used to track any one of the GPS, GLONASS, or GALILEO signals. The number of channels available allows the receiver to track all visible global positioning satellites at any time and location.

An internal GPS+ antenna equipped with a low noise amplifier (LNA) and the receiver's radio frequency (RF) device are connected with a coaxial cable. The wide-band signal received is down-converted, filtered, digitized, and assigned to different channels. The receiver processor controls the process of signal tracking.

Once the signal is locked in the channel, it is demodulated and necessary signal parameters (carrier and code phases) are measured. Also, broadcast navigation data are retrieved from the navigation frame.

After the receiver locks on to four or more satellites, its absolute position in WGS-84 and the time offset between the receiver clock and GPS time are computed. This information and the measurement data can be stored in the optional MMC or SD card[1] and downloaded later onto a computer, then processed using a post-processing software package. When the receiver operates in RTK mode, raw data measurements can also be recorded into the receiver's internal memory. This allows the operator to double check real-time results obtained in the field.

Depending on your options, capabilities of the receiver include:

- Multipath reduction
- Satellite based augmentation systems (WAAS, EGNOS, etc.)
- Adjustable phase locked loop (PLL) and delay lock loop (DLL) parameters
- Dual- or multi-frequency modes, including static, kinematic, real-time kinematic (RTK), and differential GPS (DGPS) survey modes (DGPS modes include static, kinematic, and RTK)
- Auto data logging
- Setting different mask angles
- Setting different survey parameters
- Static or dynamic modes

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1. MMC = multi-media card; SD = secure digital

Getting Acquainted

The GR-3 is a 72-channel GPS receiver with external, detachable batteries, two data ports, an interface for controlling and viewing data logging, external memory card slot, an internal radio modem, a Bluetooth® wireless technology module, and an optional GSM/GPRS module.

Batteries

The GR-3 receiver comes equipped with two detachable, rechargeable batteries (Figure 1-2) for powering the receiver.
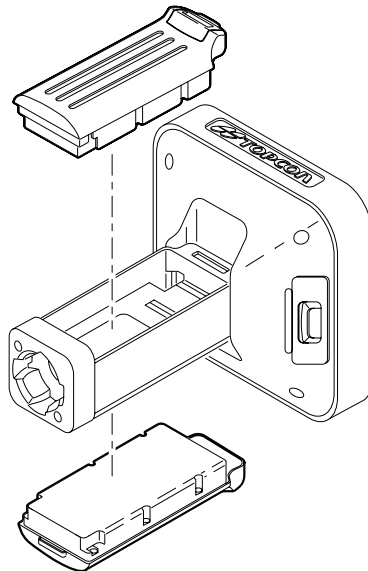
Figure 1-2. GR-3 Batteries

The receiver draws power from one battery at a time before switching to the second battery. Each detachable battery can provide up to between 4h30m and 8h30m (approximate) of operation, depending on the mode of the receiver.

The battery charging cradle (Figure 1-3) connects to a standard power outlet using the power adapter cable and power cable/power supply unit. When connected to a power outlet, the batteries will be

fully charged in approximately six hours. The batteries should run at no less than 80% capacity after 500 charging cycles. These batteries do not need to be drained before recharging.

The charger has two ports, one button, and three LEDs.

* The two ports connect the charger to either a receiver or an external power source. The ports charge or drain the batteries simultaneously.

* The STATUS button activates the battery LEDs.

  Press **STATUS** to display the amount of charge for the corresponding battery.

* The two battery LEDs display the percentage of charge in the attached battery.

  – Green: indicates greater than 85% charge.

  – Orange: indicates an intermediate charge.

  – Red: indicates less than 15% charge.

* The power LED lights up when the charger is connected to an external power source; such as an electrical outlet or another power source (12 volt battery).
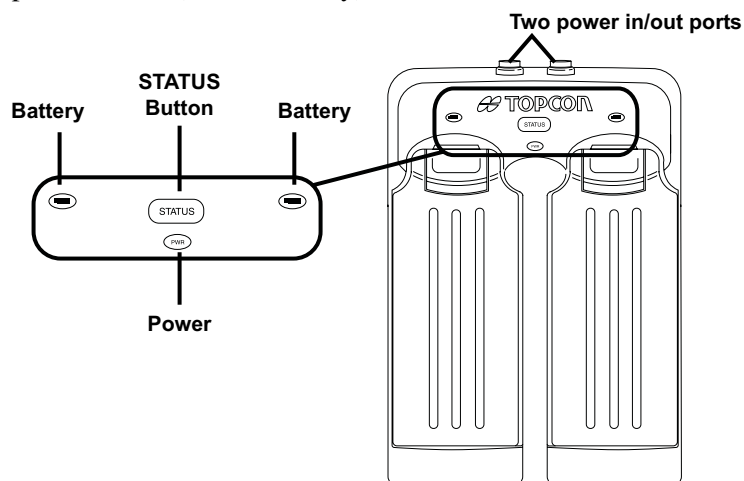
Figure 1-3. Battery Charger with Batteries

The battery charger can also be attached to a tripod, belt, or RTK pole to provide external power to the base station or rover.

The AA battery shell (Figure 1-4) holds four AA batteries to provide an easily portable backup power source for the receiver. Due to variances in AA battery capacity, and the mode of the receiver and type of modem, the amount of time the receiver is powered will vary.
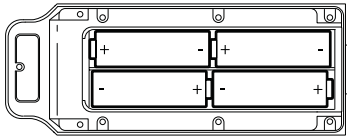
Figure 1-4. AA Battery Shell (Open)

⚠ CAUTION
Do not use rechargeable AA batteries.
Do not use the AA battery shell when the radio modem is in transmitter mode.

GR-3 Receiver

The GR-3 receiver's advanced design reduces the number of cable required for operation, allowing you to survey more reliably and efficiently. The casing allocates space for two removable, rechargeable batteries, SD/MMC and SIM card slots, a Bluetooth wireless technology module, a multi-system receiver board, and a radio modem communications board.

The GR-3 comes in one of the following configurations:

- with an FH915 Plus TX/RX/RP[1] radio modem
- with an FH915 Plus TX/RX/RP radio modem and a GSM/GPRS module
- without a radio modem

Other features include two data ports, a power port, and a MINTER for viewing status and controlling data input/output.

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1. RP = repeater

MINTER

The MINTER is the receiver's minimum interface used to display and control data input and output (Figure 1-5).

The battery LEDs display the power status for each battery:

- Green – indicates greater than 85% charge.
- Orange – indicates an intermediate charge.
- Red – indicates less than 15% charge.

The STAT LED displays the status of tracked satellites.

- Red blink – receiver is on, but no satellites being tracked.
- Green blink – receiver is on and tracking satellites; one blink per tracked GPS satellite.
- Orange blink – receiver is on and tracking satellites; one blink per tracked GLONASS satellite.
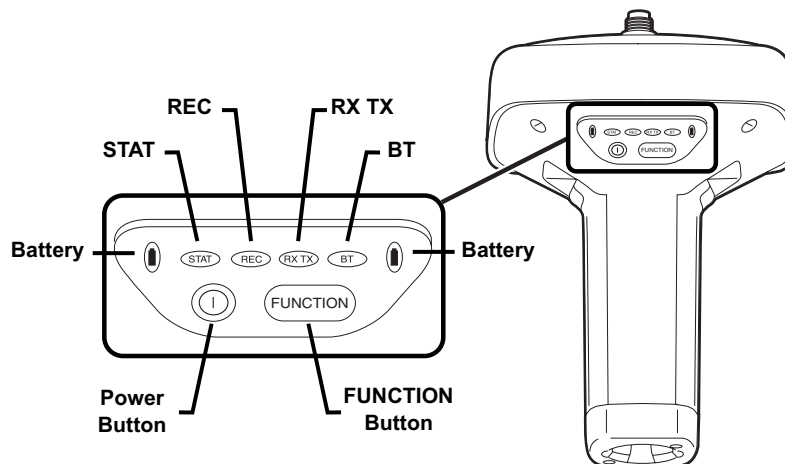

Figure 1-5. GR-3 MINTER

The REC LED displays the data recording status. See "The FUNCTION button" on page 1-13 for more information on REC LED behavior when using the FUNCTION button.

* Green blinks – each blink indicates that data is being written to the SD/MMC card.

* Solid Orange – indicates the receiver is changing modes.

* Orange blinks – indicates that the receiver is checking its internal file system (after clearing the NVRAM or loading new firmware). During this operation, the file system is not accessible for CDU (control display unit) applications or for data recording. This operation may require from fractions of a second to several minutes, depending on the circumstances and the amount of internal memory.

* Solid Red – indicates a fault condition with the receiver (no more memory, no SD/MMC card inserted, a hardware problem, or an improper OAF).

Table 1-2 on page 1-14 describes the REC LED status when using the FUNCTION button.

The RX TX LED displays the status of the modem. Table 1-1 describes the LED colors and patterns for the different modems available for the GR-3 receiver.

Table 1-1. RX TX LED Indications

FH915 Plus Modem	• No light – modem is turned off.
	• Green flashes – modem is in receiver mode.
	• Solid Green – a radio link has been established; modem is ready to receiver data.
	• Solid Green plus Red flashes – modem is receiver data.
	• Solid Red – modem is in transmitter mode.
	• Red flashes – a fault condition has been detected. Check the condition of the radio modem's antenna to ensure it is undamaged, and is connected properly and securely. Also make sure nothing interrupts the signal.
	• Red flashes plus Green flashes – modem is in command mode.

Table 1-1. RX TX LED Indications (Continued)

GSM/GPRS	• Solid Orange (Red and Green) – the modem is initializing. • Green flashes – the modem is on, registered on the network, and is waiting for incoming calls (Slave mode). • Solid Red – a connection has been established. • Green flashes – the modem is in direct control mode (Daisy Chain). • Orange flashes – an error has occurred (initialization error, wrong PIN code, etc.).

The BT LED indicates the level of activity at the Bluetooth wireless technology communication link:

- Blue flashes – the Bluetooth module is on but no connection is established.
- Solid blue light – the Bluetooth module is on and a connection has been established.
- No light – the Bluetooth module is off.

The power button turns the receiver on and off.

The FUNCTION button switches the receiver between information modes and post-processing modes, starts/stops data recording, and changes the baud rate of the serial port to 9600. See "MINTER Operation" on page 4-7 for more information. Table 1-2 on page 1-14 describes the REC LED status when using the FUNCTION button.

Table 1-2. FUNCTION Button Operations and REC LED Status

FUNCTION Key	REC LED	Status
When data recording is off, and the FUNCTION key is...		
Not pressed	No light	No data recording.
	Orange blink	Internal file system test in progress.
	Red	No free memory; hardware problem with data recording. No SD/MMC card.
Pressed for < 1 second	If FUNCTION key mode is "LED blink mode switch"	
	Orange	Release to change information mode.
	If FUNCTION key mode is "Occupation mode switch"	
	Orange	No function.
Pressed for 1–5 seconds	If FUNCTION key mode is "LED blink mode switch"	
	Green	Release to start data recording (post-processing occupation mode undefined).
	If FUNCTION key mode is "Occupation mode switch"	
	Green	Release to start recording (Kinematic or Static post-processing occupation mode)
Pressed for 5–8 seconds	Red	Release to turn serial port A baud rate to 9600 bps.
Pressed for > 8 seconds	No light	No function.

Table 1-2. FUNCTION Button Operations and REC LED Status (Continued)

FUNCTION Key	REC LED	Status
When data recording is on, and the FUNCTION key is...		
Not pressed	Red	No free memory; hardware problem with data recording.
	If FUNCTION key mode is "LED blink mode switch"	
	Green	Data recording started (post-processing occupation mode undefined).
	If FUNCTION key mode is Occupation mode switch	
	Green	Data recording started (Kinematic post-processing occupation mode).
	Orange	Data recording started (Static post-processing occupation mode).
Pressed for < 1 second	If FUNCTION key mode is "LED blink mode switch"	
	Orange	Release to change information mode.
	If FUNCTION key mode is "Occupation mode switch"	
	Orange	Release to toggle between Static and Kinematic post-processing modes.
Pressed for 1–5 seconds	No light	Release to stop data recording.
Pressed for 5–8 seconds	Red	Release to turn serial port A baud rate to 9600 bps.
Pressed for > 8 seconds	No light	No function (data recording still on).

Data and Power Ports

The GR-3 has the following three ports (Figure 1-6):

- USB – rimmed in yellow; used for high-speed data transfer and communication between the receiver and an external device.

  The body of the connector on the corresponding cable is yellow.

- Serial – rimmed in black; used for communication between the receiver and an external device.

  The body of the connector on the corresponding cable is black.

- Power – rimmed in red; used to connect the receiver to an external power source. This port can also be used to charge the batteries.

  The body of the connector on the corresponding cable is red.
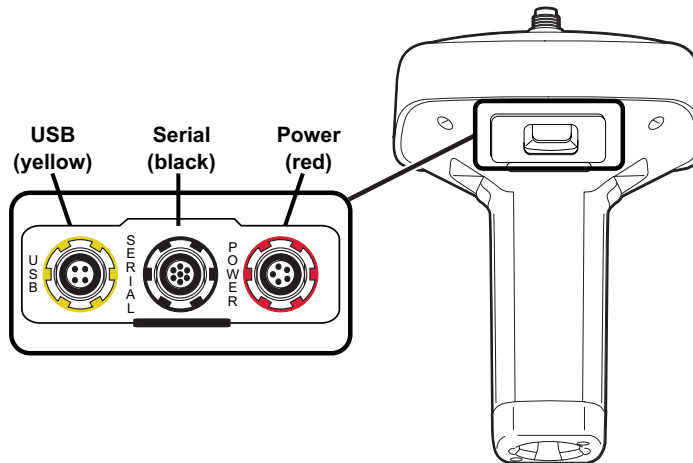
Figure 1-6. GR-3 Ports

External Radio Antenna Connector

The SS antenna connects to the external antenna connector on the
GR-3 radome (Figure 1-7). The SS/GSM antenna uses a reverse
polarity TNC connection.

**External
Antenna
Connector**
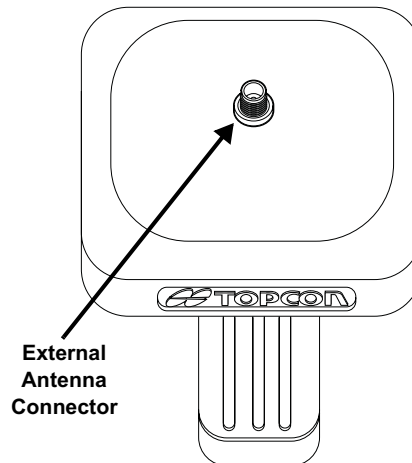
Figure 1-7. GR-3 Radome and External Antenna Connector

Connector

The bottom connector (Figure 1-8) connects the receiver to either a
standard 5/8" thread pole/adapter or the quick disconnect (see "The
quick disconnect adapter" on page 1-21 for details).

**Bottom Connector
for Standard Setups**

Figure 1-8. GR-3 Quick Connector

SD/MMC and SIM Card Slots

The SD/MMC[1] and SIM card slots reside under the batteries near the base of the dome.

The SD/MMC card slot is located to the left of the MINTER inside the battery pocket (Figure 1-9) and connects an optional SD/MMC card to the receiver board to provide memory. Once installed, the SD/MMC card usually remains inside the receiver. The data that r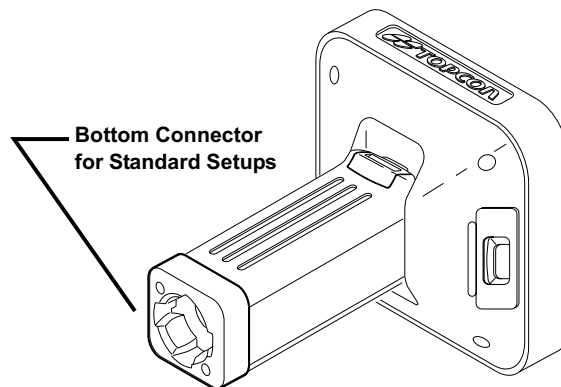esides on the SD/MMC card can be accessed via the USB or serial port, or Bluetooth wireless technology. A secure digital card can be purchased at your local computer supply store.

The SIM card slot is located to the right of the MINTER inside the battery pocket and allows a standard SIM card to be installed in the receiver. Once installed, the SIM card provides a unique identification for the receiver's GSM module and enables the receiver's GSM functionality based on the subscribed services (the receiver board accesses the GSM module which accesses the SIM card). The SIM card usually remains inside the receiver. The GSM module with the SIM card installed can be accessed via Modem-TPS for configuration purposes. A SIM card can be purchased from your local cellular provider.
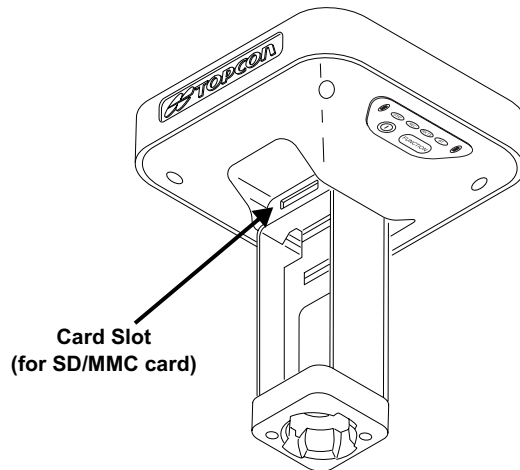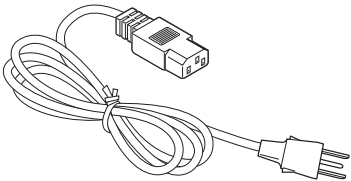

Card Slot
(for SD/MMC card)

Figure 1-9. GR-3 Card Slot Example
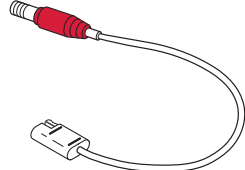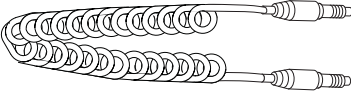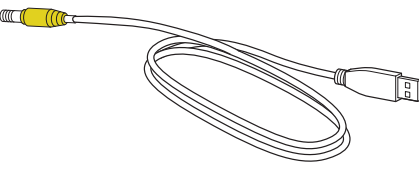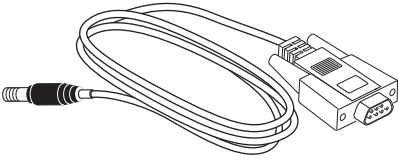
1. MMC = multi-media card; SD = secure digital

Cables

The GR-3 package includes standard communication and power cables for configuring the receiver and providing a power source to the receiver. Table 1-3 lists the cables included in the GR-3 package.

Table 1-3. GR-3 Package Cables

Cable Description	Cable Illustration
Power cable Connects the power supply unit to a grounded outlet. U.S. p/n 14-008052-01 Europe p/n 14-008054-01 Australia p/n 14-008053-01	
Receiver power/charging cable Connects the receiver and the power supply unit via SAE connectors for battery charging. Body of connector is red. p/n 14-008016-03	
Cradle-to-receiver charging cable Connects the receiver to the charging cradle for external power. p/n 14-008072-01 (1.5m long) p/n 14-008072-02 (0.5 m long)	
USB cable Connects the receiver to an external device (controller or computer) for high-speed data transfer and receiver configuration. Body of connector is yellow. p/n 14-008070-01	
Serial cable Connects the receiver to an external device (controller or computer) for data transfer and receiver configuration. Body of connector is black. p/n 14-008005-02	

Other Accessories

Along with the following accessories, the GR-3 package includes a 128 MB SD memory card, 3-meter measuring tape, an adjustable range pole, and a cable bag.

The Power Supply unit (p/n 22-034101-01) charges the internal batteries when connected to a grounded outlet (Figure 1-10). This unit converts the alternating current (AC) normally supplied from an electrical outlet to a direct current (DC) used to charge the batteries and/or power the receiver.

⚠️ **CAUTION**	The power supply unit should only be used for charging the batteries. Do not use as a power source during surveying.

The power supply unit can be connected to the charging cradle or directly to the receiver. For details, see the power related sections in Chapter 2.
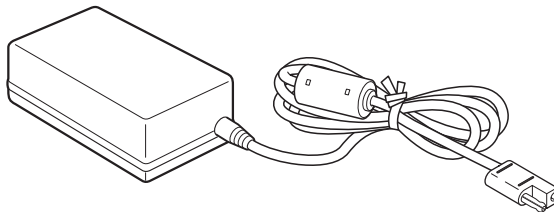
Figure 1-10. Power Supply Unit

The modem antenna Spread Spectrum includes support for a GSM modem (Figure 1-11 on page 1-20). The Spread Spectrum antenna is a reverse polarity TNC RF connection (p/n 30-030012-01).

SS/GSM Antenna
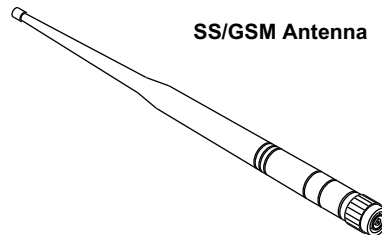
Figure 1-11. Modem Antenna

The universal tribrach and tribrach adapter (p/n 22-006008-01 and p/n 22-006009-011) are used to level the tripod and secure the receiver or antenna to the tripod (Figure 1-12).
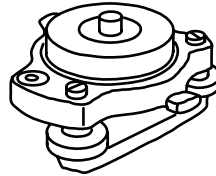
Figure 1-12. Universal Tribrach and Tribrach Adapter

The quick disconnect adapter (p/n 02-850905-01) connects to the range pole for the receiver to slip into the top. Using the side clips, the receiver can be quickly connected to/disconnected from the range pole (Figure 1-13).

Figure 1-13. Quick Disconnect

For more details on the accessories and package options available for the GR-3, contact your local Topcon dealer.

Optional Accessories

Topcon offers a wide variety of accessories especially designed to extend your job reliability and efficiency. For more details on the optional accessories available for the GR-3, contact your local Topcon dealer.

The precision tribrach adapter (Figure 1-14) is used to precisely center, align, and level the tripod over a point. The horizontal spacer (p/n 60419) inserts into the precision tribrach and allows the receiver to sit securely on the precision tribrach.
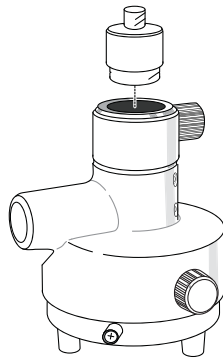
Figure 1-14. Precision Tribrach Adapter and Horizontal Spacer

A hand-held controller (Figure 1-15) allows the GR-3 Base and Rover systems to be configured and monitored directly in the field. TopSURV (field data collection software) and CE-CDU (receiver configuration and monitoring software) can be used on Topcon controllers to configure and manage the receiver.
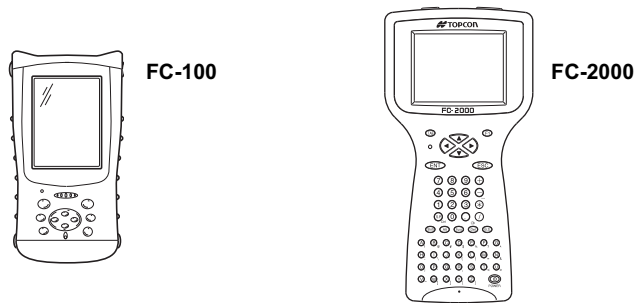
Figure 1-15. Hand-held Controller Examples

The ODU-to-alligator clips cable (p/n 14-008097-01LF) connects the charging cradle or receiver to an auxiliary battery for powering the receiver during survey operations (Figure 1-13).
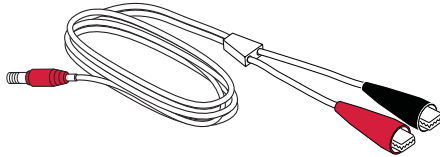
Figure 1-16. Auxiliary Power Cable – ODU-to-Alligator Clips

Option Authorization File (OAF)

Topcon Positioning Systems issues an Option Authorization File (OAF) to enable the specific options that customers purchase. An Option Authorization File allows customers to customize and configure the receiver according to particular needs, thus only purchasing those options needed.

Typically, all receivers ship with a temporary OAF that allows it to be used for a predetermined period of time. When the receiver is purchased, a new OAF permanently activates desired, purchased options. Receiver options remain intact when clearing the NVRAM or resetting the receiver.

The OAF enables the following kinds of functions. For a complete list of available options and details, visit the TPS website or consult your TPS dealer.

- Type of signal (standard L1; optional L2, L5 GPS, GLONASS, GALILEO)
- External SD memory card
- Update rate standard 1Hz (optional 5, 10, or 20Hz)
- RTK at 1Hz, 5Hz, 10Hz, and 20Hz
- RTCM/CMR Input/Output
- Advanced multipath reduction
- Wide Area Augmentation System (WAAS)
- Receiver Autonomous Integrity Monitoring (RAIM)

Notes:

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Pre-survey Preparation

Before beginning to survey with the GR-3 receiver, the following software needs to be installed and configurations need to be applied:

☐ Install receiver configuration software

See "Installing Topcon Software" on page 2-2.

☐ Optional: install SD card and/or SIM card

See "Installing the Optional SD and SIM Cards" on page 2-7.

☐ Charge the batteries

See "Charging the Batteries" on page 2-9.

☐ Enable power source settings (either attached or external)

See "Power Management" on page 2-10 and "Powering the Receiver" on page 2-14.

☐ Configure the Bluetooth wireless technology module

See "Bluetooth Module Configuration" on page 2-22.

☐ Collect almanacs and ephemerides (after first-time configuration activities as described in Chapter 3)

See "Collecting Almanacs and Ephemerides" on page 2-26.

This chapter also discusses connecting batteries to the receiver, connecting the receiver and a computer, and powering the receiver using different sources.

Installing Topcon Software

The Topcon GPS+ CD includes the following software programs used for configuring and maintaining the receiver. This software is also available on the TPS website to registered users.

- PC-CDU Lite
  ver. 2.1.15 or newer
- BTCONF
  ver. 1.2 or newer

- Modem-TPS
  ver. 2.0 or newer
- FLoader
  ver 1.0.07 or newer

If installing the program(s) from the GPS+ CD, insert the CD into the computer's CD-ROM drive. If downloading the program(s) from the website, extract the program's files into a folder on your hard drive.

The following sections describe installing this software, and other sections throughout the manual describe using this software with the receiver.

Installing PC-CDU

PC-CDU™ is a comprehensive Windows® software product designed for controlling GPS+ receivers developed by Topcon Positioning Systems. PC-CDU uses the GPS Receiver Interface Language (GRIL) to configure various receiver settings and diagnose receiver performance.

The PC-CDU software exists in two versions: a full-functionality version called PC-CDU MS and a reduced-functionality version called PC-CDU Lite. PC-CDU Lite is available for free on the Topcon website or the GPS+ CD.

Computer requirements for PC-CDU are: Windows® 98 or newer and an RS-232C or USB port, or Bluetooth capable. Use PC-CDU version 2.1.15 or newer to correctly configure the receiver.

> NOTICE Refer to the *PC-CDU Reference Manual* for full details on installing and using PC-CDU.

1. Create a PC-CDU folder on your hard drive and place the compressed PC-CDU zip file (retrieved from either the website or the GPS+ CD) in this folder.

2. Navigate to the PC-CDU folder and double-click the **PC-CDU zip file**.

3. Extract the PCCDU.EXE and associated *.dll file to the PC-CDU folder (Figure 2-1).

4. Create a shortcut on the computer's desktop for quick access to PC-CDU (Figure 2-1).
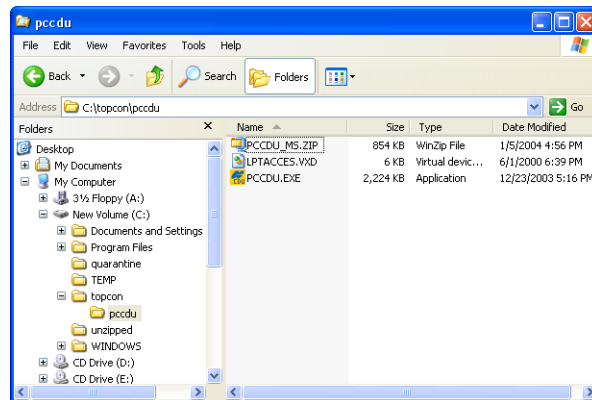
Figure 2-1. Extract Program and Create Shortcut

To uninstall PC-CDU, navigate to the location of the *.exe file. Select the file and press **Delete**.

Installing Modem-TPS

Modem-TPS is a configuration program for the radio modem board inside the receiver. Modem-TPS is available from the TPS website or on the GPS+ CD.

Computer requirements for Modem-TPS are: Windows® 98 or newer and an RS-232C port or Bluetooth wireless technology. Use Modem-TPS version 2.0 or newer to correctly configure the receiver.

1. Navigate to the location of the Modem-TPS program and double-click the **Setup.exe icon**.

2.   Keep the default installation location or select a new location. Click **Finish** (Figure 2-2).
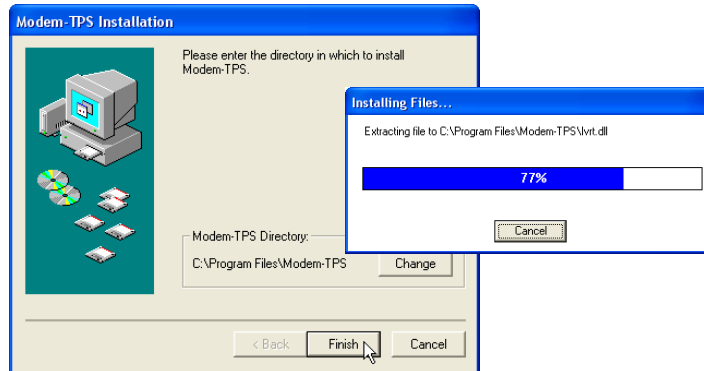
Figure 2-2. Select Modem-TPS Installation Location and Install

3.   Click **OK** to complete the installation (Figure 2-3).

4.   If desired, create a shortcut on the computer's desktop for quick access to Modem-TPS (Figure 2-3).
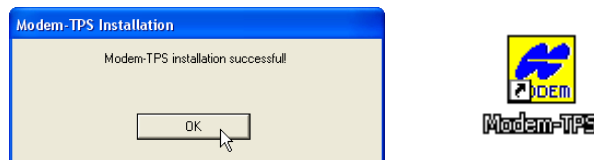
Figure 2-3. Installation Complete and Shortcut

To uninstall Modem-TPS, use the Start menu on your computer:

Click **Start ▸ Programs ▸ Modem-TPS ▸ Uninstall Modem-TPS**, and click **Yes** at the prompt. Then click **OK** when the uninstall completes.

Installing BTCONF

BTCONF is configuration program for the Bluetooth wireless technology module inside the receiver. BTCONF is available from the TPS website or on the GPS+ CD.

Computer requirements for BTCONF are: Windows® 98 or newer and an RS-232C port or Bluetooth wireless technology. Use BTCONF version 1.2 or newer to correctly configure the receiver.

1. Create a BTCONF folder on your hard drive and place the compressed BTCONF zip file (retrieved from either the website or the GPS+ CD) in this folder.

2. Navigate to the BTCONF folder and double-click the **BTCONF zip file**.

3. Extract the btconf.exe to the BTCONF folder.

4. Create a shortcut on the computer's desktop for quick access to BTCONF (Figure 2-4).

Figure 2-4. Extract Program and Create Shortcut

To uninstall BTCONF, navigate to the location of the *.exe file. Select the file and press **Delete**.

Each time you run BTCONF and configure the Bluetooth module, BTCONF saves the settings in a file (btconf.ini). BTCONF automatically updates the file each time you make changes to the Bluetooth module's settings.

> To maintain unique Bluetooth module settings for different purposes, keep copies of BTCONF in separate folders.

Installing FLoader

FLoader is a firmware loading program for the power board, GPS module, and modem board inside the receiver. FLoader is available from the TPS website or on the GPS+ CD.

Computer requirements for FLoader are: Windows® 98 or newer and an RS-232C port or Bluetooth wireless technology. Use FLoader version 1.0.07 or newer to correctly configure the receiver.

1. Create an FLoader folder on your hard drive and place the compressed FLoader zip file (retrieved from either the website or the GPS+ CD) in this folder.

2. Navigate to the FLoader folder and double-click the **FLoader zip file**.

3. Extract the FLoader.exe to the FLoader folder (Figure 2-5).

4. Create a shortcut on the computer's desktop for quick access to FLoader (Figure 2-5).
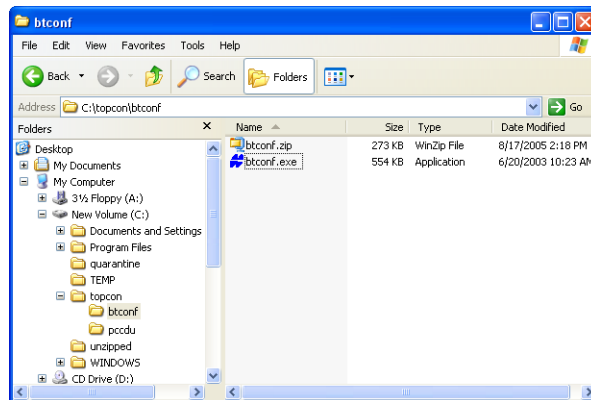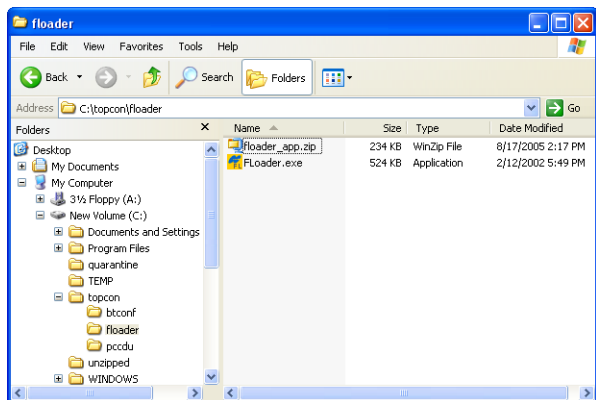

Figure 2-5. Extract Program and Create Shortcut

To uninstall FLoader, navigate to the location of the *.exe file. Select the file and press **Delete**.

Installing the Optional SD and SIM Cards

Behind each detachable battery is a slot for the optional SD card or the optional SIM card. The SD card provides memory space in which to save logged data; the SIM card provides telephony communication for data transfer between two GSM-capable receivers. The SD card can be purchased at your local computer store; the SIM card can be purchased at your local cellular phone supply store. The receiver currently supports an SD card with up to 1GB capacity.

Once installed, the card(s) generally remains installed. The card can then be accessed via the receiver board using a data port or Bluetooth wireless technology.

To install the SD card (Figure 2-6):

1. Ensure the receiver is turned off.
2. Remove the battery to the left of the MINTER.
3. Carefully insert the SD card, label side down, into the SD card slot located at the top of the battery pocket.
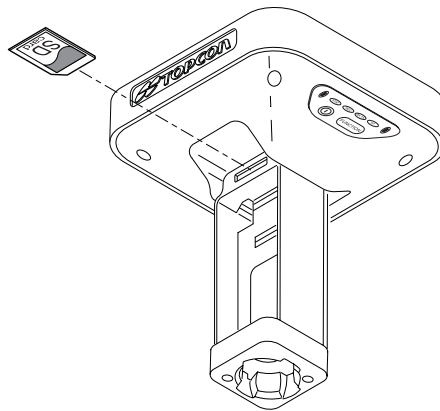
Figure 2-6. Install SD Card

⚠ CAUTION	Do not remove the card if the receiver is powered on. Damage to data may result from improper removal of the card.

Once the receiver is turned on, the receiver board will detect the SD card and it will be ready to use as needed.

To install the SIM card (Figure 2-7):

The SIM card must support Circuit Switched Data to communicate directly between receivers. The SIM card must have GPRS support to communicate with a GPS Network IP address.

> **NOTICE** Both the Base and Rover receivers must have a SIM card installed (supporting Circuit Switched Data) and have subscriptions to the same service provider for proper communication.

1. Ensure the receiver is turned off.
2. Remove the battery to the right of the MINTER.
3. If needed, snap the SIM card into its holder.
4. Carefully insert the holder, label side down, into the SIM card slot located at the top of the battery pocket.
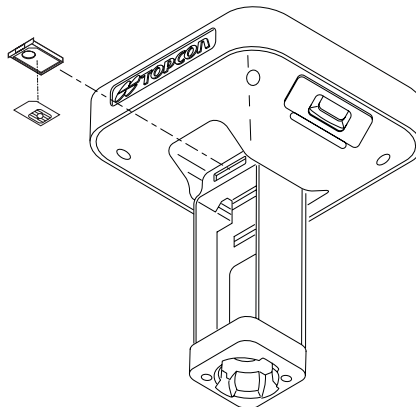
Figure 2-7. Install SIM Card

Once the receiver is turned on, the receiver board will detect the SIM card and it will be ready to use as needed.

Charging the Batteries

Before beginning to work, fully charge the batteries for maximum operating time (Figure 2-8 on page 2-10).

- If the batteries are attached to the charging cradle, an approximately 6-hour charge cycle will fully charge the batteries; the batteries will charge simultaneously.
- If the batteries are attached to the GR-3, an approximately 6-hour charge cycle will fully charge the batteries; the batteries will charge simultaneously.

The batteries can not be overcharged.

> **NOTE** The batteries are shipped from the factory without power. Fully charge the batteries before surveying.

Each detachable battery can provide up to between 4.5 and 8.5 hours (approximate, at room temperature) of operation, depending on the mode of the receiver.

> **TIP** If the batteries are attached to the receiver, connect the power adapter cable to the receiver's power port to charge the batteries. The batteries will charge simultaneously.

1. Remove the batteries from the receiver and insert them into the charging cradle.
2. Connect the power cable to the power supply unit.
3. Connect the SAE connectors on the power adapter cable and power supply unit.
4. Connect the power adapter cable to one of the ports on the charging cradle (either port will charge both/either battery).
5. Plug the power supply to an available outlet. Leave for approximately 6 hours to fully charge the batteries.
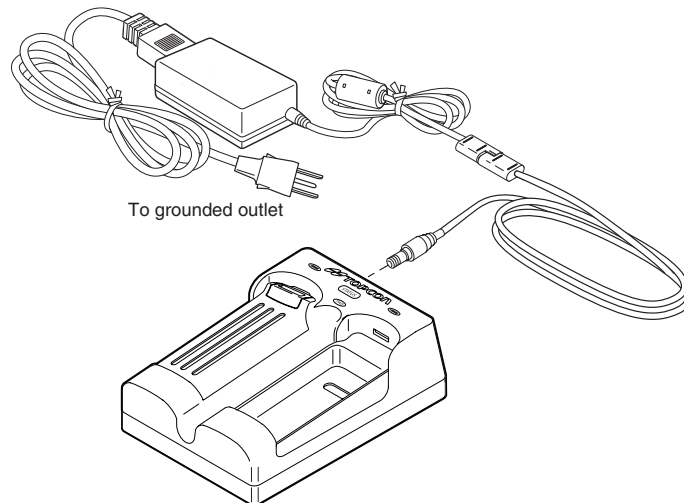
Figure 2-8. Insert Batteries in Charger and Connect to Outlet

The Li-Ion batteries used in the battery packs should run at no less than 80% capacity after 500 charging cycles. These batteries do not need to be drained before recharging.

Power Management

Topcon's PC-CDU software provides an interface for various configuration, monitoring, and management functions for the receiver.

For power management of the receiver, PC-CDU enables the power source, enables the charging mode, and displays the current voltage for the batteries.

1. Connect your receiver and computer. See "Connecting the Receiver and a Computer" on page 2-19 for this procedure.

2. Once connected, click **Configuration ▸ Receiver**.

Figure 2-10. Select Charger Mode

5. Select the *Turn on/off Slots* drop-down list to set power output on internal slots (Figure 2-11).

   • On – slot C is powered if the receiver is turned on

   • Off – internal slot will not be powered even if the receiver is turned on

   • Always – internal slot will be powered even if the receiver is turned off
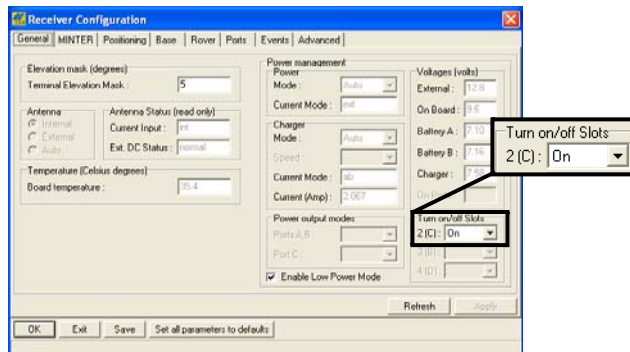
Figure 2-11. Select Power Output Modes – Ports and Slots

6. View the *Voltages* information (Figure 2-12 on page 2-13).

   • External – displays the external power supply's voltage

   • On Board – displays the voltage drawn by the receiver board

   • Battery A – displays the voltage of battery A

   • Battery B – displays the voltage of battery B

* Charger – displays the charger's output voltage during battery charging
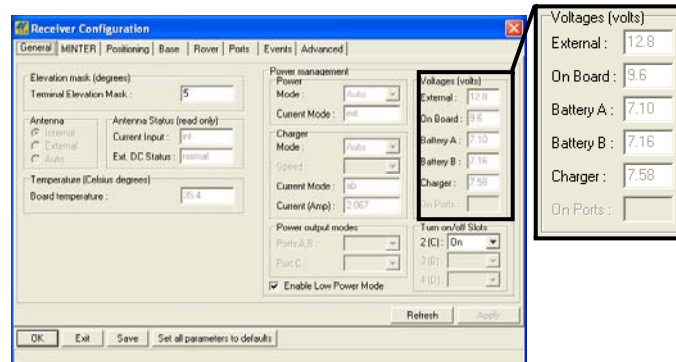
Figure 2-12. View Voltages Information

7. Select and check the *Enable Low Power Mode* check box to put the receiver's processor into low power consumption mode (Figure 2-13).
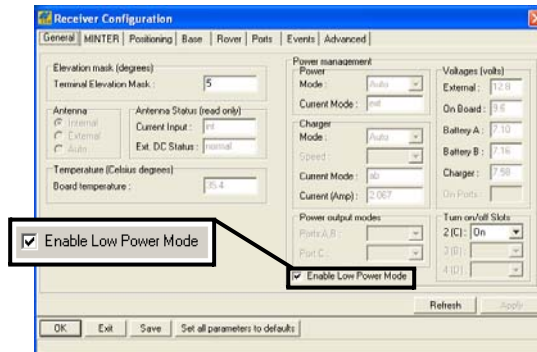
Figure 2-13. Enable and Apply Power Settings

8. Click **Apply**.

Powering the Receiver

When powered from the internal batteries, the receiver will constantly switch from one battery to the other, maintaining a difference of 0.4 V between the batteries.

To check the status of the internal batteries, view the BATT LED or check the status using available Topcon software.

- Check the BATT LEDs for battery status.
    - A green light indicates greater than 85% charge.
    - An orange light indicates an intermediate charge.
    - A red light indicates less than 15% charge.
- Do one of the following using PC-CDU:
    - Click on **Configuration ▶ Receiver** to view battery voltages on the *Receiver Configuration* screen.
    - Click on **Help ▶ About** to view battery voltages on the *About PC-CDU* screen.

Using the Detachable Batteries

The GR-3 receiver comes with two detachable, rechargeable batteries and an AA battery shell. Each battery can provide up to between 4.5 and 8.5 (approximate) hours of operation at room temperature, depending on the mode of the receiver and the capacity of the battery.

Table 2-1. Estimated Operating Times Using Two Fully-charged Batteries

Using the Detachable Batteries Receiver conditions: Bluetooth = on; 10-12 SV tracked; room temperature	
Modem off	17 hours
915+ modem in receive only mode	13 hours
915+ modem in 250mW transmission mode	11 hours
915+ modem in 1W transmission mode	9 hours
Using the Battery Shells and AA batteries Receiver conditions: Bluetooth = on; 10–12 SV tracked	
Modem off	2.5 hours

To attach the batteries (Figure 2-14):

1. With the battery slightly tipped, place the bottom of the battery into the bottom of the battery pocket.

2. Gently push the top of the battery into the battery pocket until it snaps into place. Make sure that the clip at the top of the battery completely snaps into place.
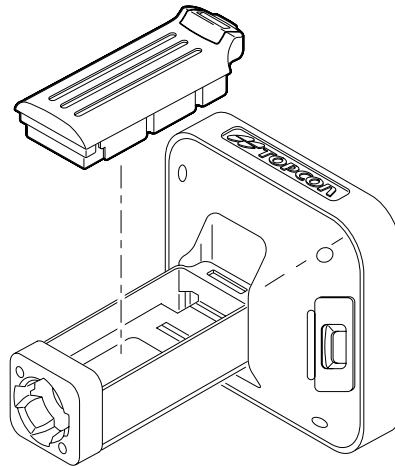
Figure 2-14. Insert the GR-3 Batteries

To detach the batteries:

Using the clip at the top of the battery, gently pull down and out to detach the battery from the receiver (Figure 2-15).
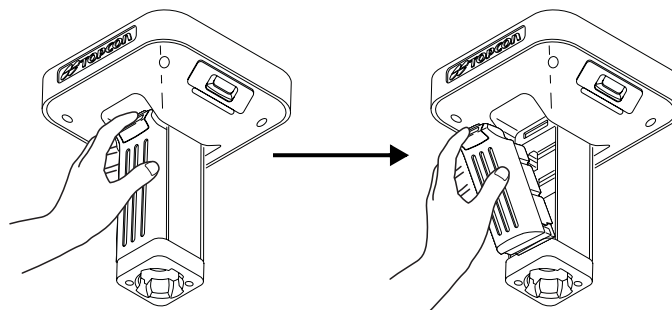
Figure 2-15. Detach the GR-3 Batteries

To assemble the AA battery shell (Figure 2-16):

> ⚠️ **CAUTION**
>
> Do not use rechargeable AA batteries.
> Do not use the AA battery shell when the radio modem is in transmitter mode.

1. Slide the back cover of the AA battery shell down and lift off.

2. Insert four AA batteries as shown on the inside of the shell (and in Figure 2-16 below).

    • The batteries on the left lay with the positive end towards the bottom of the shell.

    • The batteries on the right lay with the positive end towards the top of the shell.

3. Replace the back cover of the shell.
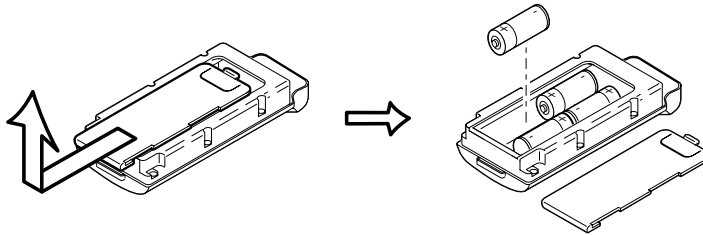
Figure 2-16. Remove Cover and Insert AA Batteries

4. Insert the AA battery shell into the battery pocket of the receiver as shown in "To attach the batteries" on page 2-15.

Using an Auxiliary Power Source

In addition to the attached batteries, the receiver connects to external batteries. External batteries allow you to continue using the receiver in case the internal batteries become discharged.

> **NOTE**
> The batteries in the charging cradle will not charge the internal/detachable batteries.
>
> The charging cradle is used to power the receiver.

To connect the receiver and the charging cradle (Figure 2-17):

The charging cradle with extra batteries hooks onto a tripod or belt for a convenient power supply for the receiver. The part number for the receiver-to-charger cradle cable is 14-008072-01 or 14-008072-02.

1. Connect one end of the cradle-to-receiver cable to the charging cradle.
2. Connect the other end to the power port on the receiver.

To recevier and charging cradle using receiver-to-charger cable
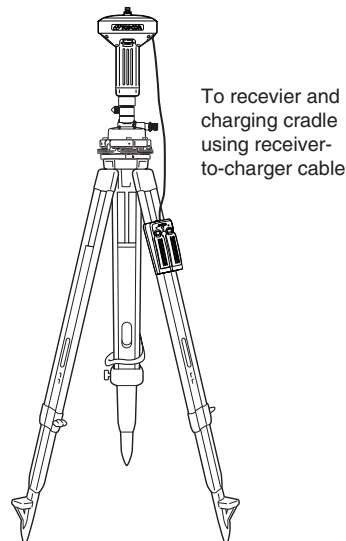
Figure 2-17. Connect the Charging Cradle and Receiver

To connect the receiver to an auxiliary battery (Figure 2-18):

Use the ODU-to-alligator clips cable (p/n 14-008097-01LF) to directly connect the auxiliary battery and the receiver's power port (without SAE).

> **NOTICE** When powering the receiver using external batteries, set the charger mode to Off. Otherwise, the detachable batteries will also charge, causing operation time to decrease. See "Power Management" on page 2-10 for more information on setting the charger mode.

1. Connect the ODU-to-alligator clips cable to a 12-volt battery.
2. Connect the ODU-to-alligator clips cable to the receiver's power port.
3. Turn on the receiver.

From receiver to auxiliary battery using ODU-to-alligator clips cable.
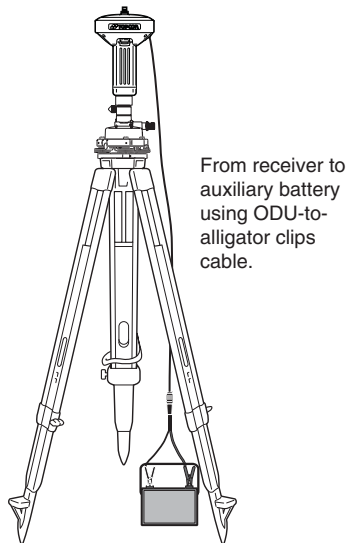
Figure 2-18. Connect an Auxiliary Battery and the Receiver

A single external 12 V, 2.3 A*h battery should run the receiver and modem for about 4.5 hours and the receiver for 6 hours.

Turning On/Off the Receiver

To turn ON the receiver, press and hold the **power** button until the LEDs briefly flash.

To turn OFF the receiver, press and hold the **power** key for more than one and less than four seconds (until both the STAT and the REC LEDs are off). This delay (about 1 second) will prevent the receiver from being turned off by mistake.

Connecting the Receiver and a Computer

Topcon's PC-CDU software provides an interface for various configuration, monitoring, and management functions for the receiver.

To configure, manage files, or maintain the receiver, connect the receiver and a computer using one of the following methods and start PC-CDU:

- a Bluetooth-enabled external device (computer/controller)
- an RS232 cable and a computer/controller
- a USB cable and a computer/controller with the TPS USB driver installed

Once you have established a connection between the receiver and the computer/controller, you will be able to configure the receiver and its components, send commands to the receiver, download files from the receiver's memory; as well as, upload new firmware using FLoader™, upload an OAF, and upload configuration files to a receiver.

Establishing a Wireless Connection

The GR-3 receiver contains Bluetooth wireless technology that allows file transfer and synchronization between the receiver and any other external device that supports Bluetooth wireless technology; for example, an FC-100, or a computer with USB-to-Bluetooth adapter or PCMCA-to-Bluetooth adapter installed.

> **NOTICE**
>
> Changing the receiver's Port D default settings will affect the Bluetooth link. The default settings for Port D are: 115200 bps, 8 data bits, 1 stop bit, no parity, and no handshaking.

The receiver and external device connection procedure varies slightly depending on the type of external device used. In general, the connection procedure is as follows.

> **NOTICE**
>
> Refer to your Bluetooth-enabled external device documentation for detailed connection information.

1. Turn on a Bluetooth-enabled external device and the receiver. The default external device mode is Master; the receiver's Bluetooth module mode is Slave.
2. Instruct the external device (Master) to search for the receiver (Slave).
3. Once the Master device detects the receiver, use the procedure described in the external device's documentation to connect it with the receiver.
4. Connect to the desired configuration software (PC-CDU, Modem-TPS, etc.) as described in the configuration sections.

If you cannot establish a connection, check that the receiver's slot three is enabled.

1. Connect your receiver and a computer using an RS232 cable or USB cable and PC-CDU as seen below.
2. Click **Configuration ▸ Receiver ▸ General**.
3. In the *Turn on/off Slots* area, ensure the *Slot 2* (C) check box is enabled.

Establishing an RS232 Cable Connection

1. Using the RS232 cable, connect the serial port of your computer (usually COM1) to the receiver's serial port.
2. Press the **power** buttons on the receiver and computer to turn them on.
3. Connect to the desired configuration software (PC-CDU, Modem-TPS, etc.) as described in the configuration sections.

Establishing a USB Connection

Make sure the computer has the TPS USB driver installed and that the USB option is enabled.

1. Using the USB cable, connect the USB port of your computer to the receiver's USB port.
2. Press the **power** buttons on the receiver and computer to turn them on.
3. Connect to the desired configuration software (PC-CDU) as described in the configuration sections.

Bluetooth Module Configuration

Use BTCONF, Topcon's Bluetooth module's configuration program, and your computer to:

- access the Bluetooth wireless technology module
- configure the Bluetooth module
- check or change the module's configuration

To access the Bluetooth wireless technology module, first download and install BTCONF, then connect your computer and the receiver and run the configuration program. See "Installing BTCONF" on page 2-4 for details.

Once you have BTCONF available, follow these steps to configure the Bluetooth module.

1. Using the RS232 cable, connect the serial port of your computer (usually COM1) to the receiver's serial port. If needed, turn on the receiver and computer.

2. Run the Bluetooth module configuration program (Figure 2-19).

   For BTCONF version and copyright information, click the **About** button.
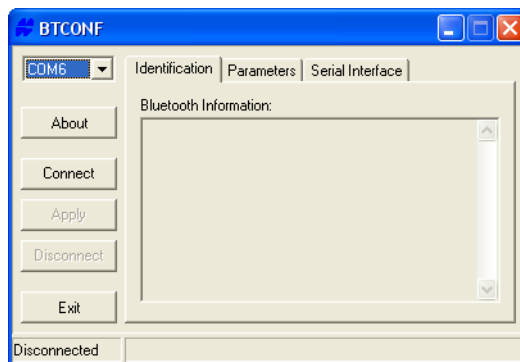
Figure 2-19. Bluetooth Module Configuration Main Screen

3. From the drop-down list in the upper left corner, select the computer serial port used for communication (Figure 2-20).

4. Click **Connect** to connect the computer and Bluetooth module.
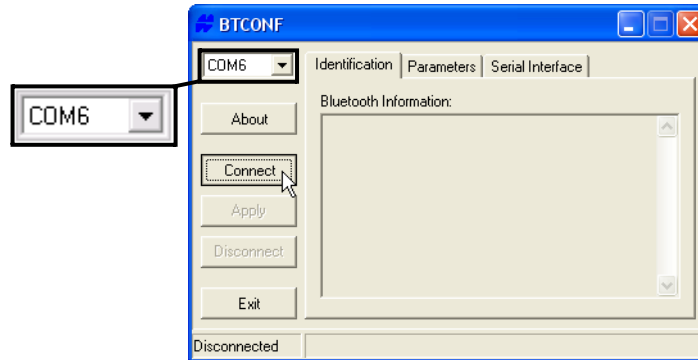
Figure 2-20. Select Communication Port and Click Connect

Once the receiver and computer connect through BTCONF, the *Identification* tab (Figure 2-21) displays the following information:

- Bluetooth name – the name of the Bluetooth module.
- Bluetooth address – the unique electronic address for the module.
- Firmware version – the current firmware version of the Bluetooth module.
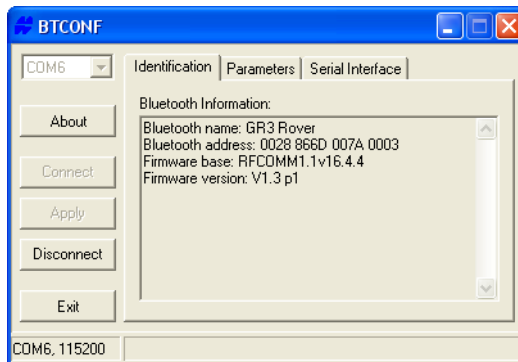
Figure 2-21. BTCONF Identification Tab

The COM port and baud rate display in the lower left corner.

5. Click the **Parameters** tab (Figure 2-22). The Parameters tab sets identifying and security information for your Bluetooth module. The security section allows you to set data security and unauthorized access parameters for the Bluetooth module.

6. Enter up to 14 characters to set a unique name for the Bluetooth module (Figure 2-22), and click **Apply**.
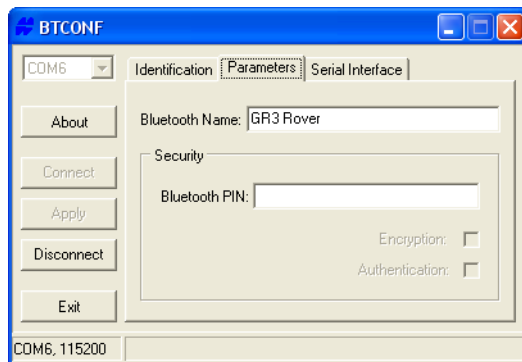
Figure 2-22. BTCONF Parameters Tab

7. To set security parameters (Figure 2-23 on page 2-25), enter and enable the following, then click **Apply**:

   • Bluetooth PIN – enter up to 16 characters to specify a personal identification number for the Bluetooth module.

   • Encryption – enable to have the Bluetooth module encrypt wirelessly sent data. To read encrypted data, the user must have the same PIN used in the device that sent the data.

   • Authentication – enable to require a PIN before two Bluetooth enabled devices (such as, the receiver and a computer) can establish a communication link. The two devices must use the same PIN.

NOTICE   If you do not need security settings, leave these parameters disabled.
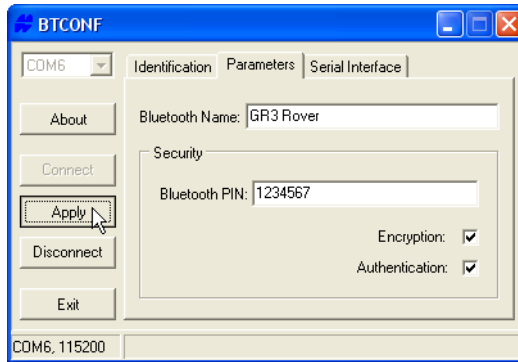
Figure 2-23. BTCONF Security Parameters

8. Click the **Serial Interface** tab (Figure 2-24). Enable Echo to display Bluetooth module replies and corresponding commands on the computer terminal. If needed, click **Apply**.

9. Click **Disconnect** then **Exit** to quit BTCONF.
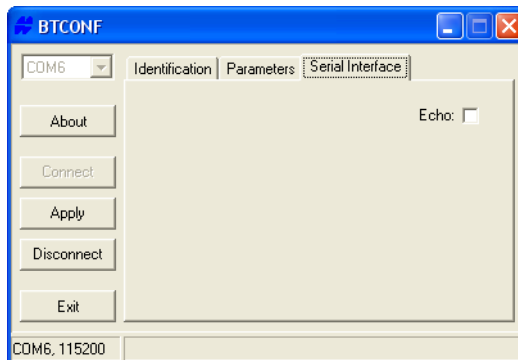
Figure 2-24. BTCONF Serial Interface Tab

Collecting Almanacs and Ephemerides

Each satellite broadcasts a navigation message that includes the ephemeris parameters of the satellite, the almanac, and various other information. The ephemeris parameters describe the orbital motion of the satellite and are used to predict its location/trajectory. The almanac gives the approximate orbit (course) for the transmitting satellite and all other satellites in the same system only.

- GPS and GLONASS satellites broadcast ephemeris data cyclically, with a period of 30 seconds.

- GPS satellites broadcast almanac data cyclically with a period of 12.5 minutes; GLONASS satellites broadcast almanac data cyclically with a period of 2.5 minutes.

If the receiver has an almanac, you can considerably reduce the time needed to search for and lock on to satellite signals.

The receiver regularly updates the almanac and ephemerides and stores the most recent versions in its Non-Volatile Random Access Memory (NVRAM).

1. Set up the receiver in a location with a clear view of the sky.

2. Turn on the receiver.

3. Wait for about 15 minutes while the receiver collects complete almanac and ephemeris data from the satellites.

> **NOTICE** If 15 minutes have passed and the receiver does not lock on to satellites, clear the NVRAM. See "Clearing the NVRAM" on page 5-13 for details.

You will need to collect or update the almanac and ephemerides under the following circumstances:

- If the receiver has been off for a long time.

- If the last known receiver position, stored in the NVRAM, is different from the present position by several hundred kilometers.

- After loading a new OAF.

- After loading new firmware.
- After clearing the NVRAM.
- Before surveying.

Notes:

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GR-3 Configuration

Both Base and Rover receivers must be configured according to the desired survey method.

- In applications where real-time positioning results are required, the Base receiver provides the correction information needed to properly calculate the location of the Rover receiver.

  A Base station is normally set up over a known point and collects GPS/GLONASS data from satellites. As the receiver picks up satellite data, it measures the carrier and code phases to accurately compute and verify its location. Then, the receiver transmits this information via radio (SS or GSM) to the Rover receiver.

- The Rover receiver applies correction information from the Base station to its current location to accurately calculate one or more points.

  Rovers are mobile GPS receivers on a survey pole or bipod that compares the information from the Base station to the data it logs from satellites and applies correction algorithms to accurately calculate a new point.

- In applications intended for post-processing, the receivers typically log code phase and/or carrier phase measurements separately from common satellites and during the same time interval. This data is then processed using post-processing software (for example, Topcon Tools).

When configuring receivers for RTK surveying, use the following checklist to ensure the receivers are properly set up.

☐ Perform pre-survey functions as described in Chapter 2.

☐ Configure one receiver as an RTK Base station and the other receiver as an RTK Rover. See "Configuring the Receiver" on page 3-10.

☐ Configure the communication data link for transmitting and receiving corrections.

    • For a Spread Spectrum modem, see "Configuring a Spread Spectrum Radio Modem" on page 3-3.

    • For a GSM/GPRS modem, see "Configuring a GSM Radio Modem" on page 3-7.

☐ Set up the Base receiver over a known point to begin collecting static observation data and transmitting corrections. Set up the Rover receiver to begin collecting RTK data. See "Receiver Setup" on page 4-1 for more information.

When configuring receivers for post-processing surveying, use the following checklist to ensure the receivers are properly set up.

☐ Perform pre-survey functions as described in Chapter 2.

☐ Configure one receiver as a Base station and the other receiver as a Rover. See "Configuring the Receiver" on page 3-10.

☐ Set up the Base receiver over a known point to begin collecting static observation data. Set up the Rover receiver to begin collecting static or kinematic observation data. See "Receiver Setup" on page 4-1 for more information.

Configuring the Radio Modem

Modem-TPS is Topcon's radio modem configuration utility for modems embedded in Topcon receivers. Modem-TPS provides the following functions:

- Connecting a computer to an integrated radio modem via a serial port or Bluetooth wireless technology.
- Displaying information about the radio modem installed in the receiver.
- Programming the radio modem's settings.

See the following sections for details on configuring the receiver with a Spread Spectrum or GSM radio modem using Modem-TPS.

> **NOTICE**
> Note that the SS radio and the GSM radio do not work simultaneously. Only one radio may be used at a time.

> **NOTICE**
> When finished configuring the radio modem, always disconnect from Modem-TPS before exiting to prevent conflicts with serial port management.

Topcon's configuration and surveying software, TopSURV or Pocket-3D, also have the ability to configure Topcon receivers. Refer to the TopSURV or Pocket-3D manuals for details.

Configuring a Spread Spectrum Radio Modem

For Topcon receivers, the integrated TPS FH915+ radio modem provides TX/RX spread spectrum communications between a Base and Rover. To configure a SS radio modem, have the following ready:

- Computer running Windows® 98 or newer
- Modem-TPS ver 2.0 or newer installed on the computer
- A serial cable (or Bluetooth wireless technology capabilities)

See "Configuring a GSM Radio Modem" to configure the GSM portion of a spread spectrum radio setup.

1. Connect the computer and receiver. Turn on the receiver.
2. Open Modem-TPS and select the COM port the receiver is connected to (Figure 3-1). Click **Connect**.
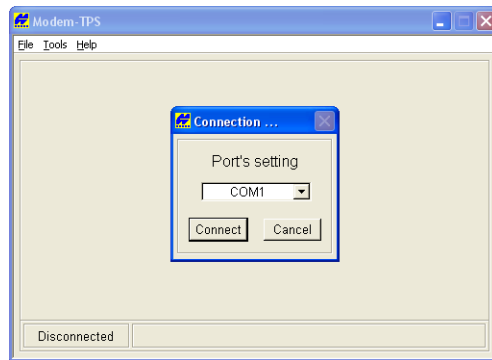
Figure 3-1. Connect to Modem-TPS

3. On the *Radio Link* tab, set the following parameters (Table 3-1) and click **Apply** (Figure 3-2 on page 3-6).

Table 3-1. Receiver Parameters for the Radio Link Tab

Parameter	Base Receiver	Rover Receiver
Protocol	Select either FH915 or FH915+ for the type of radio. • An FH915 radio modem can be configured as a transmitter or receiver. • An FH915+ radio modem can be configured as a transmitter, receiver, or repeater.	
Location	Select the country in which the receiver will be used. If selecting "Australia", the radio spectrum will be split in half for compatibility with the available spectrum. This feature is automatic and will be invisible to the user.	
Operation mode	Select Off if the radio is turned off; select Repeater if the radio modem includes a feature to boost the signal.	
	Select Transmitter.	Select Receiver.

Table 3-1. Receiver Parameters for the Radio Link Tab (Continued)

Parameter	Base Receiver	Rover Receiver
Output power	Select the transmission power for the radio modem.	n/a
Link rate For FH915+ protocol, the link rate is selected automatically.	Select the data transmission rate for the radio link. As opposed to a baud rate (the rate of data transfer through a serial cable interface), the link rate is the amount of data (measured in bits) the radio modem can transmit/receive over the air in a specified time period (measured in seconds). • 9600 – repeats data packet 3 times; packets are encoded to decrease the affects of interference. This provides max. data security, but reduces data throughput. • 12000 – repeats data packets 5 times; no encoding is applied. • 17000 – repeats data packets 3 times; no encoding applied. • 24000 – only uses encoding. • 51000 – uses no repeating or encoding. This provides max. data throughput, but reduces data communication reliability. For maximum efficiency, the data packet size transferred to the radio modem in a given time should be equal to or less than the link rate. Use Table 3-2 on page 3-5 to determine the link rate.
Channel	Assign a channel on which to transmit/receive data. Each channel uses a unique communication frequency, allowing up to five simultaneously transmitting radio modems, without interference, at the jobsite. • Use the same channel for both receiver in the same network. • Assign different channels to other networks.

Table 3-2. Link Rate vs. Baud Rate Comparison

Data packet size (in bits)	TX serial baud rate (bps)	Link rate (bps)	RX serial baud rate (bps)
0–9600	9600; 19200	9600[a];12000	9600; 19200; 38400; 57600
9600–12000	19200; 38400	12000[a]; 24000	19200; 38400; 57600
12000–17000	19200; 38400	17000[a]; 24000	19200; 38400; 57600
17000–24000	38400; 57600	24000	38400; 57600

Table 3-2. Link Rate vs. Baud Rate Comparison (Continued)

Data packet size (in bits)	TX serial baud rate (bps)	Link rate (bps)	RX serial baud rate (bps)
24000–51000	57600	51000	57600

a. Recommended link rate for this data packet size.

4. On the *Serial Interface* tab, select the following baud rate parameters and click **Apply** (Figure 3-2).

- *Baud Rate* – select a baud rate for the modem's serial port. The same rate must be used for the receiver and the modem.

- *RTS/CTS* – controls the flow of data between the receiver and modem. "On" enables handshaking/hardware flow control.

> **NOTICE**
>
> If the serial baud rate exceeds the link rate, enable hardware handshaking to prevent the radio link from overflowing, resulting in data loss.
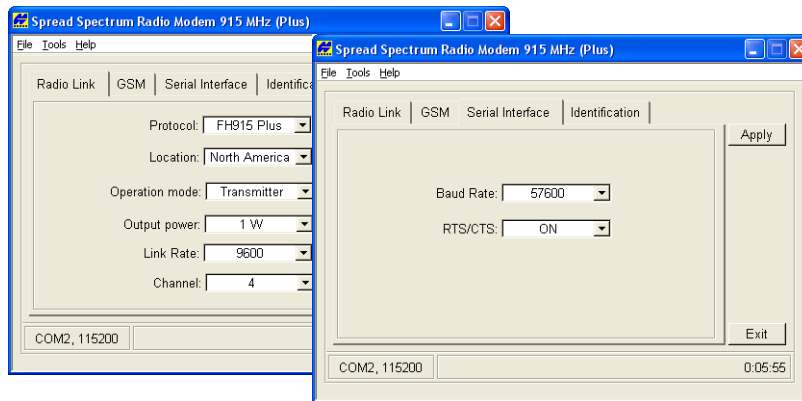
Figure 3-2. Apply Radio Link and Baud Rate Parameters

5. When finished, click **File ▶ Disconnect**.

Configuring a GSM Radio Modem

NOTICE   To comply with RF exposure requirements, maintain at least 25cm between the user and the radio modem.

For GR-3 receivers, the integrated TPS SS radio modem configured with a GSM module provides TX/RX GSM communications between a Base and Rover, or communication with a GPS network using IP based connections. To configure a GSM radio modem, have the following ready:

• Computer running Windows® 98 or newer

• Modem-TPS ver 2.0 or newer

• A serial cable (or Bluetooth wireless technology capabilities)

• The phone number of the base station

1. Connect the computer and receiver. Turn on the receiver.

2. Open Modem-TPS and select the COM port the receiver is connected to (Figure 3-3). Click **Connect**.
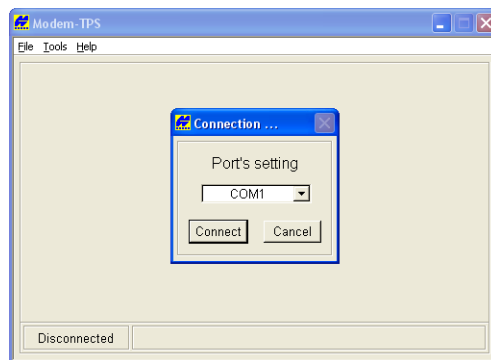
Figure 3-3. Connect to Modem-TPS

3. On the *GSM* tab, set the following parameters (Table 3-3 on page 3-8) and click **Apply** (Figure 3-4 on page 3-8).

    If some fields display "N/A", click **Refresh**.

Table 3-3. Receiver Parameters for the FCS Tab

Parameter	Base Receiver	Rover Receiver
Mode	Select Slave.	Select Master.
PIN	Enter a Personal Identification Number (PIN) if required.	
Dial	Leave blank.	Enter the phone number of the base GSM modem.
Send time	Enter a period of time in seconds in which the base/rover GSM modem will send a service word to the rover/base GSM modem. • This parameter is used to maintain reliable communication between a pair of modems and avoid unnecessary modem re-initialization. • To ensure reliable and secure modem communication, this parameter must be larger then the period for transmitting differential corrections. If the base and rover are both GR-3 receivers with internal GSM modems, set the *Send time* to zero (0).	
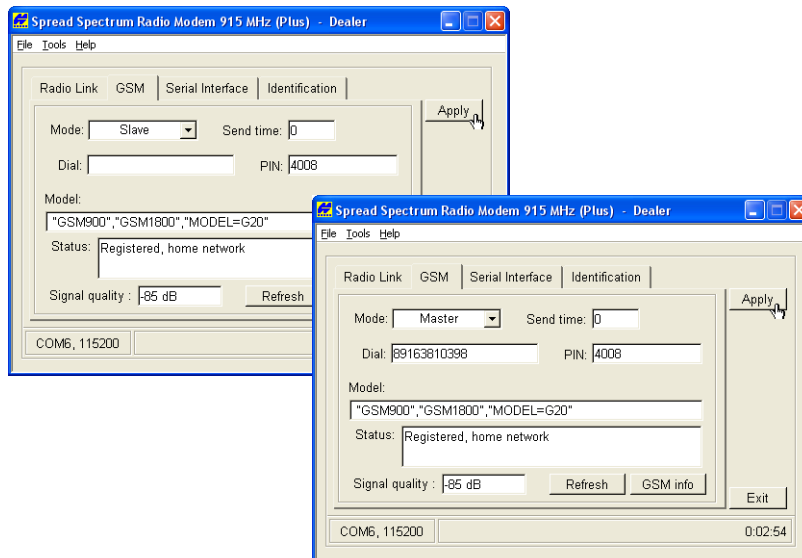
Figure 3-4. Select GSM Parameters for the Base and Rover

4. To view GSM modem information, click **GSM info** (Figure 3-5). Click **Quit** to return to the *GSM* tab.

   Signal quality is a reading of the strength of the GSM signal. The lower the number—the closer to zero—the better the signal quality. The minimum signal (cutoff) is -111db.
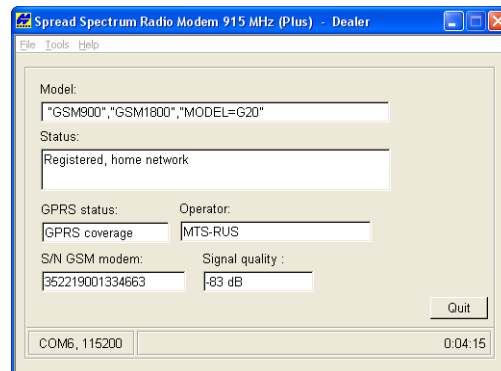
Figure 3-5. View GSM Information

5. On the *Serial Interface* tab, select a baud rate for the modem's serial port. The same rate must be used for both the receiver and the modem.

6. Click **Apply**, then click **File ▸ Disconnect**.

7. If needed, launch PC-CDU and set up the receiver to run as an RTK Base station.

Configuring the Receiver

The GR-3 can be configured in several ways for collecting data for RTK or post-processing.

- A static Base station collects measurement information and saves this data to its internal memory.

- An RTK Base station collects measurement information, determines differential corrections, and transmits them to the RTK Rover(s).

- A static Rover collects observation data from the same satellites during the same time interval as the static Base station.

- An RTK Rover collects measurement information and accepts corrections from the RTK Base station to compute its relative position.

- A Rover acting as a repeater to re-transmit RTK Base station measurements to other rover receivers, extending the range of a GPS system.

To configure, manage files, or maintain the receiver, connect the receiver and a computer using one of the following methods, and start PC-CDU:

- use a Bluetooth-enabled external device (computer)

- use an RS232 cable

- use a USB cable and a computer with the TPS USB driver installed (available on the TPS website)

PC-CDU is Personal Computer-Control Display Unit software used to manage the various functions of your receiver. The full range of PC-CDU configuration and function is outside the scope of this manual. For more information on any of the procedures in this section or on PC-CDU, refer to the *PC-CDU User's Manual* available on the TPS website.

PC-CDU configures the various parts of the receiver, saving the settings in the receiver's memory. These settings will be reflected when you use the MINTER. The full range of PC-CDU configuration and function is outside the scope of this manual.

Once you have established a connection between the receiver and the computer, you will be able to:

- configure the receiver and its components
- send commands to the receiver
- download files from the receiver's memory
- load a new OAF and other configuration files to a receiver

The following Base and Rover configurations are recommended for the most common applications. However, you can select configuration parameters as needed for your particular jobsite.

> **WARNING**
>
> Do not make other changes without consulting the *PC-CDU Reference Manual*.

1. Connect the receiver and computer as described in "Connecting the Receiver and a Computer" on page 2-19.
2. Start PC-CDU on your computer. The PC-CDU main screen displays (Figure 3-6).
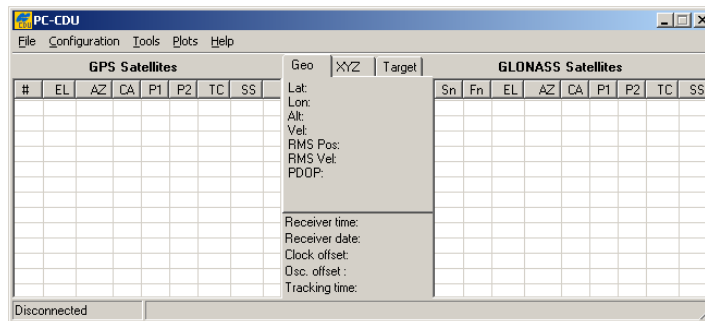
Figure 3-6. PC-CDU Main Screen

   Notice that the lower-left hand corner shows the receiver status as "Disconnected".

3. Click **File ▶ Connect**.

4. On the *Connection Parameters* dialog box, select the following parameters (Table 3-4) and click **Connect** (Figure 3-7).

Table 3-4. Connection Parameters

Parameter	RS232 or Bluetooth	USB
Connection Mode	Select Direct.	
Port	Select the port connecting the computer and receiver (typically COM1, COM2 for RS232 and COM3, COM4, etc. for Bluetooth)	Select USB
Baud Rate	Select the communication rate between the receiver and the computer (usually 115200).	n/a
Rec ID	n/a	Select the receiver's identification number.

RS232 or Bluetooth

USB
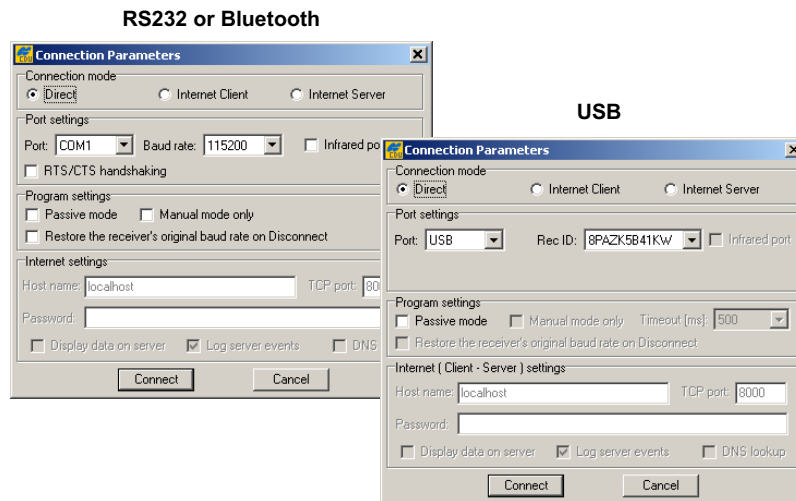
Figure 3-7. Connection Parameters

Once a PC-CDU connection with the receiver has been established, the current communications settings—such as, port name, baud rate (if applicable), and flow control (if applicable)—display in the lower-left corner of the main window of PC-CDU. A timer begins to count up in the lower-right corner as well (Figure 3-8).
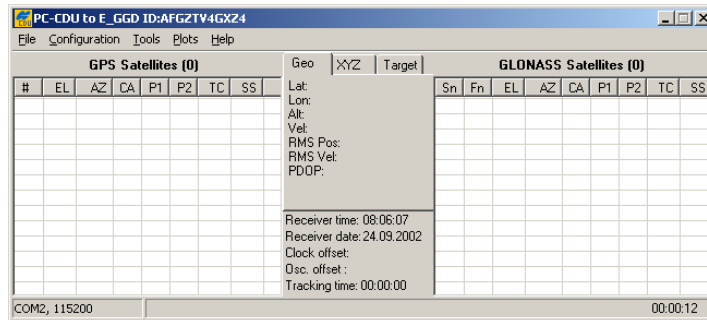
Figure 3-8. PC-CDU Connection Established

5. Click **Configuration ▶ Receiver**.

> **NOTICE** Click **Apply** after making any configuration change; otherwise, the receiver will not register the change.

6. Click **Set all parameters to defaults** (Figure 3-9).
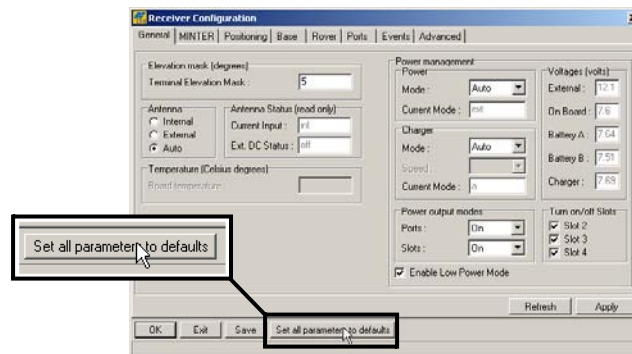
Figure 3-9. Set All Parameters to Defaults

3-13

7. Click the *MINTER* tab and configure the following settings (Table 3-5), then click **Apply** (Figure 3-10).

Table 3-5. Receiver Parameters for the MINTER Tab

Parameter	Base Receiver	Rover Receiver
Recording interval	Enter 15 seconds.	
Elevation mask angle	Enter 15 degrees.	
File name prefix	Enter a unique ID, such as the last 3 digits of receiver's serial number.	
FN key mode	(starts/stops data recording using the FUNCTION key)	
	For Static data recording, select *LED blink mode switch*.	For RTK data recording, select *Occupation mode switch*.
Initial data collection dynamic mode	n/a	Select *Kinematic*. (This setting is for trajectory surveys.)
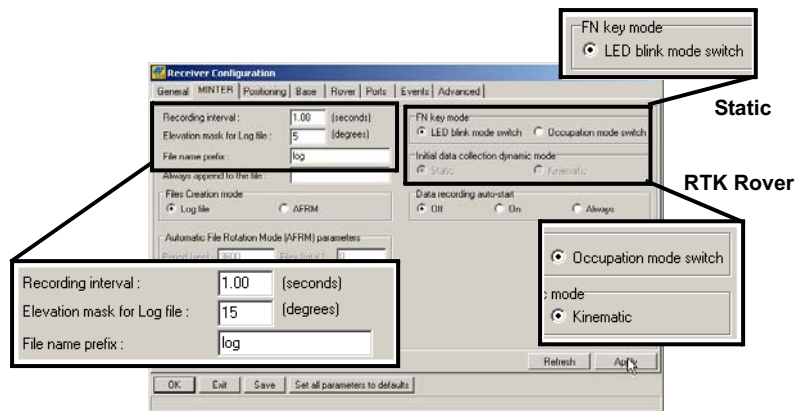
Figure 3-10. Configure Receiver's MINTER for Data Recording

8. Click the *Positioning* tab and set the *Elevation mask* to 15
    (Figure 3-11), then click **Apply**.
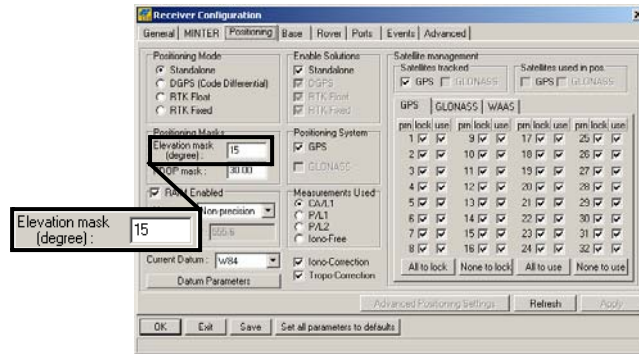
Figure 3-11. Configure Receiver Positioning – Elevation Mask

9. For the Base receiver, click the *Base* tab and set the following
    parameters (Figure 3-12 on page 3-16), then click **Apply**.

    • *GPS/GLO at one time* – enable

    • Antenna position – enter Lat, Lon, and Alt values using one
      of the following methods:

        – If known, type in the values.

        – Enable *Averaged* and enter the *Averaged Span* in seconds,
          then click **Apply**. Click **Tools ▸ Reset receiver** and wait
          until the specified interval (span) completes. Examine the
          Base coordinates on the Base tab, they should correspond
          to the coordinates obtained from the average. Click
          Refresh if the coordinates are zeros.

        – Click **Get from receiver**.

> **NOTICE** The reference geodetic coordinates specified on this
> tab relate to the antenna L1 phase center.

Continue with step 11 on page 3-17 for RTK surveys or step 12
on page 3-18.
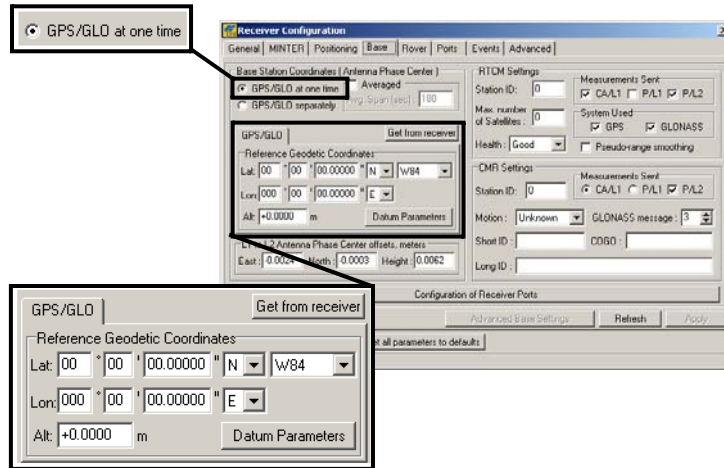
Figure 3-12. Base Configuration

10. For the Rover receiver, click the *Rover* tab and set the following
    parameters, then click **Apply** (Figure 3-13 on page 3-17).

   • *Positioning Mode* – For post-processed surveys, select
     Standalone; for RTK surveys, select RTK float or RTK fixed.

   • *RTK Parameters*, *RTK mode* – select either Extrapolation for
     RTK float (kinematic) or Delay for RTK fixed (static).

     – Extrapolation is for low-latency, high frequency output
       (>= 5 Hz) RTK applications. The Rover will extrapolate
       the Base station's carrier phase measurement corrections
       when computing the Rover's current RTK position.

       This setting (extrapolation) is recommended.

     – Delay is for 1 Hz high precision RTK applications. The
       Rover RTK engine will compute either a delayed RTK
       position (for the epoch to which the newly received
       RTCM/CMR message corresponds) or the current stand-
       alone position (while waiting for new RTCM/CMR
       messages coming from the base).

   • *RTK Parameters*, *Dynamics* – select Static or Kinematic.

- *RTK Parameters*, *Ambiguity fixing level* – (not applicable to RTK Float) select either Low, Medium, or High for indicator states of 95%, 99.5%, or 99.9%, respectively. The RTK engine uses the ambiguity fix indicator when making decisions whether or not to fix ambiguities. The higher the specified confidence level, the longer the integer ambiguity search time.
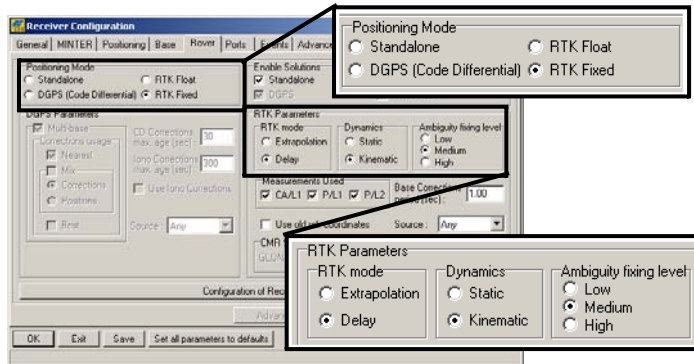
Figure 3-13. Rover Configuration

Continue with step 11 for RTK surveys or step 12 on page 3-18.

11. For RTK surveys, click the *Ports* tab and set the following port parameters for the serial port (Table 3-6), then click **Apply** (Figure 3-14 on page 3-18).

> **NOTICE** For post-processed surveys, keep the default values for these parameters.

Table 3-6. Receiver Parameters for the Ports Tab

Parameter	Base Receiver	Rover Receiver
Input	n/a (Leave the default.)	Select the same differential correction format selected for the Base.
Output	Select the type and format of differential corrections.	Select "None".

Table 3-6. Receiver Parameters for the Ports Tab (Continued)

Parameter	Base Receiver	Rover Receiver
Period (sec)	Enter the interval at which the receiver will transmit differential corrections.	n/a (Leave the default.)
Baud rate	Select a baud rate to use for transmitting differential messages from the receiver board to the modem module The baud rate must match the modem's serial port speed.	
RTS/CTS	Select to enable handshaking.	
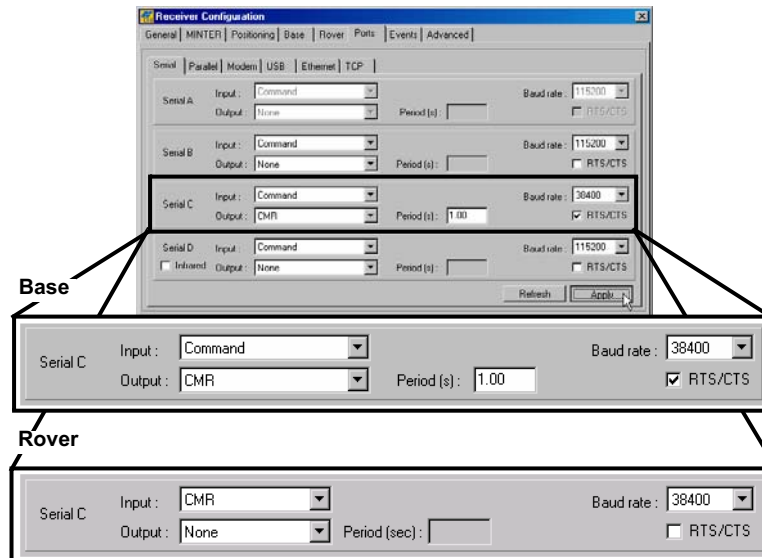
Figure 3-14. Base and Rover Configuration for RTK Surveys – Ports

12. Click the *Advanced* tab and then the *Multipath* tab. Set the following parameters and click **Apply** (Figure 3-15 on page 3-19).

   • *Code multipath reduction* – enable
   • *Carrier multipath reduction* – enable
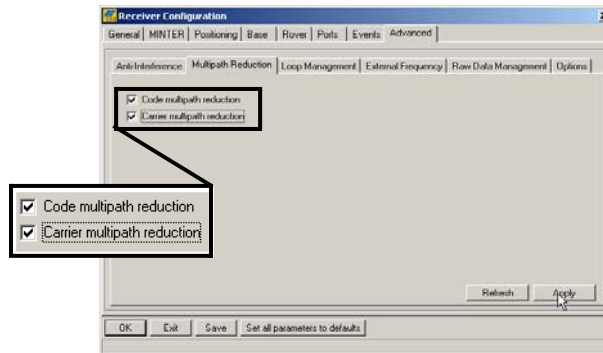
Figure 3-15. Configure Mulitpath Parameters

13. Click **OK** to save the settings and close the dialog box.

    Once the receiver is configured, the configuration will remain until you change it using PC-CDU/TopSURV/Pocket-3D or clearing the NVRAM.

    For more details on the settings available for configuring the Base and Rover receivers, refer to the *PC-CDU Reference Manual*.

14. Continue with other configuration activities or click **File ▶ Disconnect**, then **File ▶ Exit** to quit PC-CDU. Disconnecting before exiting ensures proper port management.

NOTICE   Disconnect the receiver from PC-CDU before exiting to eliminate possible conflicts with the management of the computer's serial ports.

MINTER Configuration

The Minimum INTERface (MINTER) consists of two keys (power and FUNCTION) that control the receiver's operation, four LEDs (STAT, REC, RX/TX, and BT) that display the receiver's operational status, and two LEDs that display the battery status (Figure 3-16).
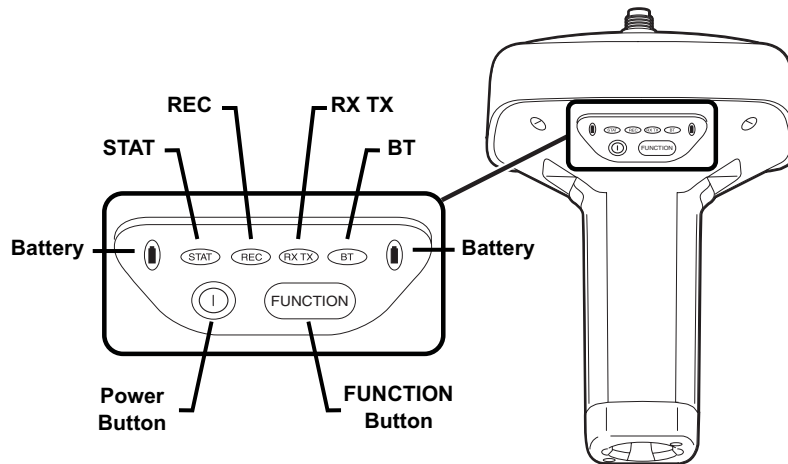
Figure 3-16. MINTER

The MINTER performs the following functions. For more information on using the MINTER, see "MINTER Operation" on page 4-7.

- Turns the receiver on or off; puts it in Sleep mode.
- Turns data recording on or off (FUNCTION button).
- Changes the receiver's information mode.
- Shows the number of GPS (green) and GLONASS (orange) satellites being tracked (STAT LED).
- Shows the data recording status (REC LED).
- Shows each time data is recorded to internal memory (REC LED).
- Shows the status of post-processing mode (static or dynamic) when performing a Post-Processing Kinematic survey with the help of FN key (REC LED).

- Shows the status (high charge, intermediate charge, or low charge) of the battery (BATT LED).

- Shows the power status for the receiver (BATT LED).

- Shows the status of the modem and if it receives signals (TX RX LED).

- Shows Bluetooth activity (BT LED).

Use PC-CDU to configure MINTER settings. The procedure below describes the most common settings; refer to the *PC-CDU Reference Manual* for other possible MINTER configurations.

1. Connect your receiver and computer. See "Connecting the Receiver and a Computer" on page 2-19 for this procedure.

2. On the PC-CDU Main window, click **File ▶ Connect**.

3. On the *Connection Parameters* dialog box, enable RTS/CTS handshaking (Figure 3-17).

   See "Connecting the Receiver and a Computer" on page 2-19 for details on setting other parameters.

4. Click **Connect**.
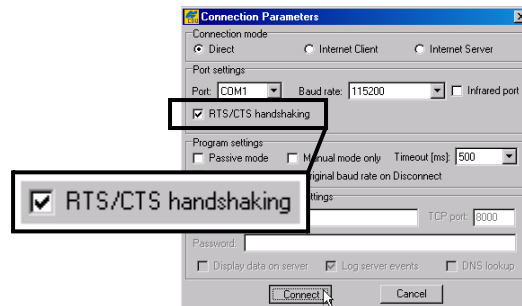
Figure 3-17. Connection Parameters – MINTER Settings

5. Click **Configuration ▶ Receiver** then click the **MINTER** tab, set the following parameters and click **Apply** (Figure 3-18). See the following pages for descriptions of these parameters.

   - *Recording interval* on page 3-22
   - *Elevation mask for log file* on page 3-22
   - *File name prefix* on page 3-22
   - *Always append to the file* on page 3-23

- *Files Creation mode* on page 3-23
- *Automatic File Rotation Mode (AFRM)* on page 3-23
- *FN key mode* on page 3-24
- *Initial data collection dynamic mode* on page 3-25
- *Data recording auto-start* on page 3-25
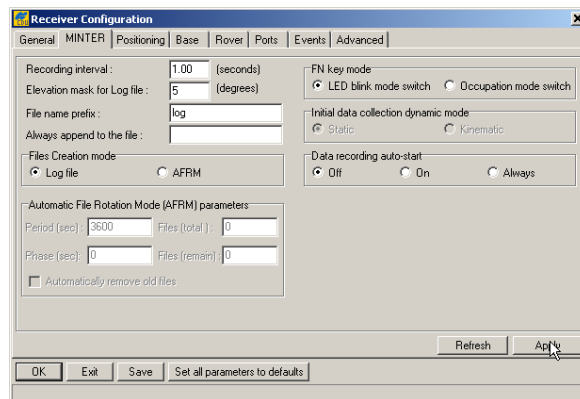
Figure 3-18. Receiver Configuration – MINTER Tab

Recording Interval parameter This parameter specifies the logging rate of the log file when the MINTER **FUNCTION** button (pressed for 1–5 seconds) activates data logging. This setting is used for both logging a single log file and logging receiver data in AFRM mode. Values are 1–86400 seconds. The default value is one second.

Elevation Mask for Log File parameter This parameter specifies the minimum elevation angle for the satellites whose data will be put in the receiver files logged when pressing **FUNCTION**. The default value is five degrees.

File Name Prefix parameter This parameter specifies the prefix added to the names of receiver files created when pressing **FUNCTION**. The prefix can be up to 20 characters long. The default value for the Name Prefix is "log".

Log file names have the following structure:

<prefix><month><day><sequential alphabet letter>

The file name depends on both the file creation time (month and day) and additional letter suffixes to avoid confusion between files created on the same day.

Always Append to the File parameter If you want new receiver data to be appended to an existing log file, enter the desired file name in this parameter. The setting can be up to 20 characters long.

Files Creation Mode parameter This parameter has the following operation modes:

- Log file – If the log file radio button has been selected, pressing the FUNCTION button closes the current log file. If data logging is off, pressing FUNCTION opens a new log file.

- AFRM – If AFRM radio button has been selected, pressing FUNCTION enables this mode. If AFRM has been enabled, pressing **FUNCTION** disables this mode.

Automatic File Rotation Mode (AFRM) parameters TPS receivers are capable of automatically rotating log files. During a "file rotation" event, the receiver closes the current file and opens a new one according to a user-defined schedule. The Period and Phase parameters specify this schedule. File rotation launches the moment the receiver time module Period is equal to Phase. More precisely, a new log file opens immediately before the scheduled epoch causing data tagged with this epoch to be recorded to the new log file.

When opening a new log file, the receiver enables the default set of messages output with the default output period. Both the default set of messages and the default output period are programmable.

- Period – specifies the time duration of each log file created in AFRM mode. Values are 60 to 86400 seconds; default value is 3600 seconds.

- Phase – specifies the "phase" (constant time shift) of creating multiple log files in AFRM mode. Values are 0 to 86400 seconds; default value is zero seconds.

- Files (total) – a counter that specifies how many multiple log files must be created in AFRM until this mode automatically turns off. This counter decrements on every file rotation until it value

becomes zero, then file rotation automatically stops. The counter initializes with AFRM.

Note that a log file opens immediately after turning AFRM on. This startup file is not considered a file rotation event; the AFRM counter will not decrement.

Values are 0 to $[2^{31}-1]$; default value is 0 (zero). Zero means that an unlimited number of log files will be created.

> **NOTICE**   The receiver's memory holds up to 512 files.

• Files (remain) – specifies the number of files left for the receiver to create in AFRM. Values are 0 to $[2^{31}-1]$; default value is zero.

• Automatically remove old files – when no free memory is available to log data, automatically removes the earliest log file. If this parameter is enabled, your receiver will erase the file with the earliest file creation time/date. AFRM must be enabled to use this FIFO (First-In, First-Out) feature. The default value is off (disabled).

FN Key Mode parameter Use these two radio buttons to program how the receiver will react when pressing the **FUNCTION** key.

• LED blink mode switch – pressing **FUNCTION** will toggle between the MINTER's normal/extended information modes and start/stop data recording of Static survey.

  – **FUNCTION** pressed for less than 1 second: changes the information mode (Normal or Extended Information Modes).

  – **FUNCTION** pressed for 1 to 5 seconds: starts or stops data recording (Static post-processing mode).

• Occupation mode switch – pressing **FUNCTION** (less than one second) will insert into the corresponding log file a message indicating that the survey type has been changed from static to kinematic, or vice versa. If the REC LED blinks green, the current mode is dynamic, if it blinks orange, the current mode is static. For more details, see Table 1-2 on page 1-14 and refer to the *PC-CDU Reference Manual*.

Initial Data Collection Dynamic Mode parameter These radio buttons specify the starting occupation type descriptor inserted at the beginning of receiver files logged. Select Static or Kinematic to specify that the corresponding log file will start with a static (STOP) or kinematic (GO, Trajectory) occupation, respectively.

Data Recording Auto-start parameter These radio buttons allow you to program your receiver's behavior in the event of a power failure.

Table 3-7 describes the different scenarios available and the results after power is restored to the receiver. "Specified file" refers to the file name entered in the *Always append to file* field.

Table 3-7. Data Recording Parameter Behavior

Before Power Failure	Enabled Radio Button Results		
	Off	**On**	**Always**
Receiver data logged to file specified.	Data logging will not resume when power is restored.	Receiver will resume data logging to the same file when power is restored.	Receiver will resume data logging to the same file when power is restored.
Receiver data logged to default file.	Data logging will not resume when power is restored.	A new log file will open when power is restored and data will log to this file.	A new log file will open when power is restored and data will log to this file.
File specified; receiver data logging not started.	No file will open with this name. Data logging will not start when power is restored.	No file will open with this name. Data logging will not start when power is restored.	A log file with this name will open and data logging will start after power is restored.
No file specified; receiver data logging off.	Data logging will not start when power is restored.	Data logging will not start when power is restored.	A log file with a default name will open and data logging will start after power is restored.

Also, if *Always* is enabled, the receiver will automatically start logging data (to a newly created or an existing file) in the following three cases:

• After turning on the receiver using the power button.

• After resetting the receiver (using PC-CDU).

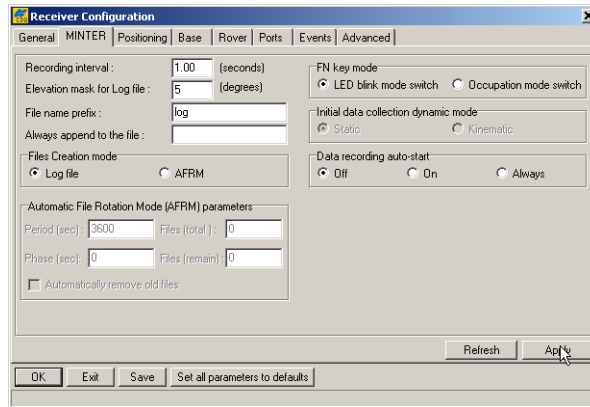• After taking the receiver out of Sleep Mode.

Figure 3-19. MINTER Tab

GR-3 Receiver Setup and Survey

After configuring the receivers for surveying, each receiver needs to be setup up and the receiver's height measured and the survey can begin. The MINTER provides quick access for logging data, changing receiver modes, and viewing general data logging and satellite information during a survey.

Receiver Setup

A typical GPS survey system consists of a Base station set up over a known point and a Rover receiver set up to be a mobile data collector. After setting up the Base and Rover receivers, the antenna height must be measured.

Before collecting data, make sure the Base and Rover receivers contain a current almanac and current ephemeris data (see "Collecting Almanacs and Ephemerides" on page 2-26).

Step 1: Set up the Receivers

The Base station must be set up, logging data, and transmitting data before setting up the Rover receiver. Receiver setup for either post-process or RTK surveys is the same.

☐ Set up the Base station and its components.

See "To set up the Base receiver" on page 4-2 for details.

☐ Set up the Rover receiver.

See "To set up the Rover receiver" on page 4-3 for details.

To set up the Base receiver (Figure 4-1):

1. Install a tripod over a known control point.
2. Secure the universal tribrach to the tripod. Place the tribrach adapter (either universal or precision) on the tribrach and tighten the screws.
3. Insert the L-plug (horizontal spacer) into the precision tribrach adapter.
4. Attach the GR-3 receiver to the tribrach adapter. Attach the desired antenna to the modem antenna connector.
5. Carefully level the tripod and tighten the screws.
6. Attach any other accessories as needed (for example, a backup power supply).

GR-3 Receiver

Horizontal Spacer

Tribrach Adapter (Precision)

Universal Tribrach
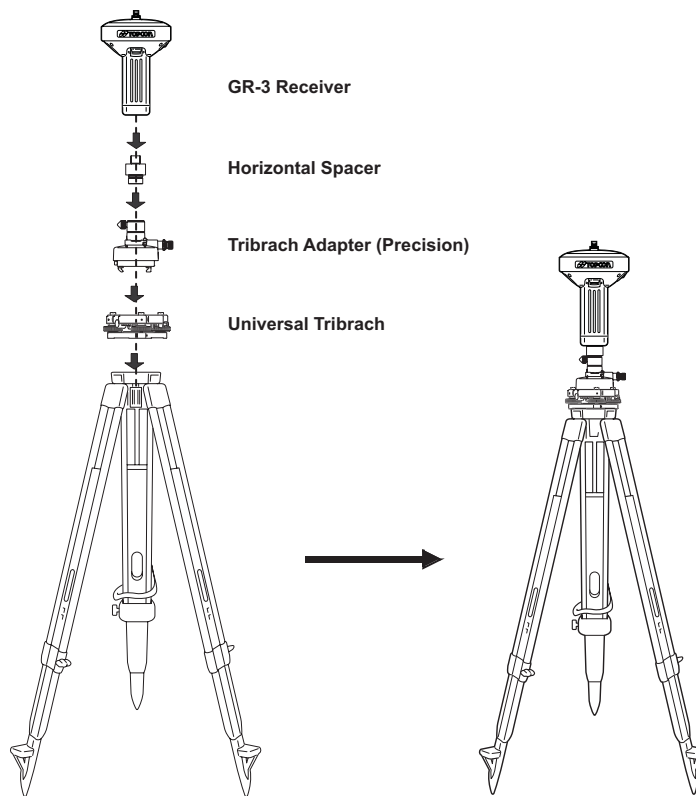
Figure 4-1. Install Tripod and Receiver over Control Point

To set up the Rover receiver (Figure 4-2):

1. If needed, attach the quick disconnect to the bipod/range pole.

> **NOTICE** Use a bipod during post-process surveys to ensure the antenna/receiver remains unmoving during data logging.

2. Attach the GR-3 receiver to the quick disconnect. Make sure the receiver locks into place.
3. Attach the desired antenna to the modem antenna connector.

GR-3 Recevier

Quick disconnect

5/8 inch screw

Lock
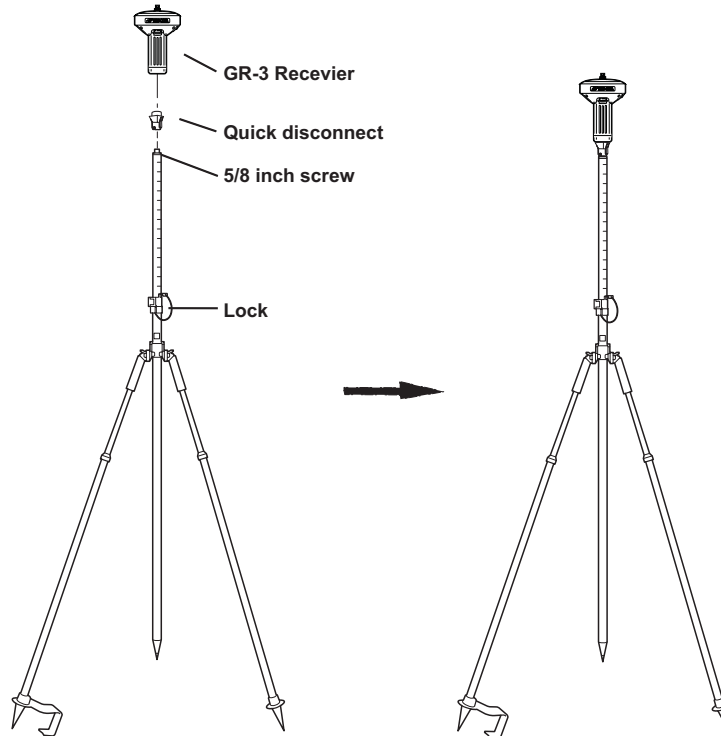
Figure 4-2. Connect GR-3 Receiver to Bipod

Step 2: Measure Antenna Height

The location of the antenna relative to the point being measured is very important for both surveys in which the elevation of the points is important and in surveys for horizontal location only. Horizontal surveys are often larger in area than can reliably fit on a flat plane, therefore the antenna adjustment must be done in three dimensions and then projected onto a two dimensional plane.

The receiver calculates the coordinates of the antenna's phase center. To determine the coordinates of the station marker, the user must specify the following:

• Measured height of the antenna above the station marker

• Method of measuring the antenna height

• Model of the antenna used

Antennas have two types of measurements:

• Vertical – measured from the marker to the antenna reference point (ARP) located on the bottom of the receiver at the base of the mounting threads.

• Slant – measured from the marker to the lower edge of the antenna slant height measure mark (SHMM) located on both end panels of the receiver.

The point to which surveying with GPS/GLONASS measures is called the Phase Center of the antenna. This is analogous to the point at which a distance meter measures in a prism. A user must enter the prism offset to compensate for this point not being at a physical surface of the prism. For a GPS/GLONASS antenna, the offset is entered depending on the type of measurement taken.

• For vertical, the offset is simply added to the measured vertical height to produce a "true" vertical height.

• For slant height, the vertical height must first be calculated using the radius of the antenna, then the offset can be added.

The offsets are different because of the difference in location between the slant measuring point and the vertical measuring point.

1. Measure the antenna height above the control point or marker, either the slant height or the vertical height (Figure 4-3).

2. Record the antenna height, point name, and start time in the field notes.

66.5mm

234.5mm

168mm

A = ARP to edge = 78.3
B = ARP to corner = 95.8

Slant Height
to Base of
Corner on
Gray Bumper

Vertical Height
to ARP

49mm

Station Marker
or
Tip of RTK Pole

When measuring the height of
the Rover antenna, include the
height of the Quick Disconnect.
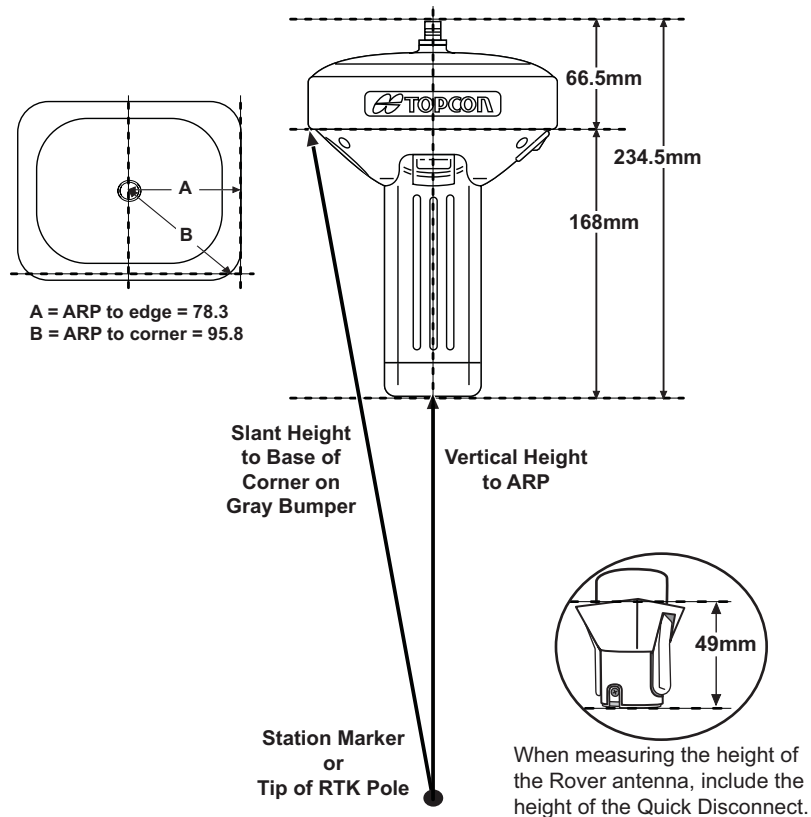
Figure 4-3. Antenna Offset Measurements

- SHMM to ARP vertical offset = 168mm

- SHMM to ARP radius = 78.3mm to side; 95.8mm to corner

Table 4-1 gives the offset values for the receivers.

Table 4-1. Offset Values for GR-3 Receiver

	ARP To L1 Phase Center	**ARP To L2 Phase Center**
Up	228.8mm	216.3mm

Step 3: Collect Data

See the remaining sections in this chapter for more information on collecting data.

1. Turn on the receiver. The STAT (status) light (LED) will blink red at first.

2. Once the receiver has locked on to one or more satellites, the STAT light will blink green for GPS satellites and orange for GLONASS satellites. A short red blink indicates that the receiver has not solved a position. Four or more satellites provide optimal positioning.

3. Once the short red blink is gone, the receiver has a position and surveying can begin; wait for green and orange lights before beginning data collection. This ensures that the receiver has the correct date and time, and is locked on to enough satellites to ensure good quality data.

   The process of locking on to satellites normally takes less than one minute. In a new area, under heavy tree canopy, or after resetting the receiver, it may take several minutes.

4. To begin collecting data, press and hold the **FUNCTION** key (for more than one second and less than five seconds).

5. Release the **FUNCTION** key when the REC (recording) LED turns green. This indicates that a file has opened and data collection has started. The REC LED blinks each time data is saved to the internal memory.

> **TIP** Use PC-CDU to configure data logging. See "MINTER Configuration" on page 3-20 or refer to the *PC-CDU Reference Manual*.

6. When finished, press and hold the **FUNCTION** key until the REC LED light goes out.

7. To turn off the receiver, press and hold the **power** key until all lights go out, then release.

MINTER Operation

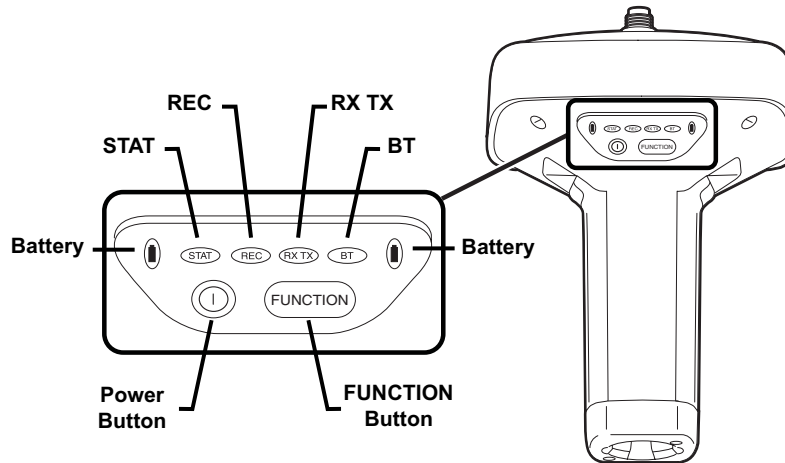The MINTER is the receiver's minimum interface used to display and control data input and output (Figure 4-4).

Figure 4-4. GR-3 MINTER

The MINTER performs numerous functions, including the following:

- Turns the receiver on or off.
- Turns data recording on or off (FUNCTION key).
- Changes the receiver's information mode.
- Shows the number of GPS (green) and GLONASS (orange) satellites being tracked (STAT LED).
- Shows the data recording status and each time data is recorded to internal memory (REC LED).
- Shows the status of post-processing mode (static or dynamic) during a post-processed kinematic survey (REC LED).
- Shows the status (high charge, intermediate charge, or low charge) of the battery (BATT LED).
- Shows the power status for the receiver (BATT LED).
- Shows the status of the modem and if it receives signals (RX TX LED).
- Show Bluetooth activity (BT LED).

See "MINTER" on page 1-11 for a full description of the MINTER.

To turn on/off the receiver, press the **power** button (Figure 4-5).

- When turning on, press the **power** button until the MINTER's LEDs briefly flash.

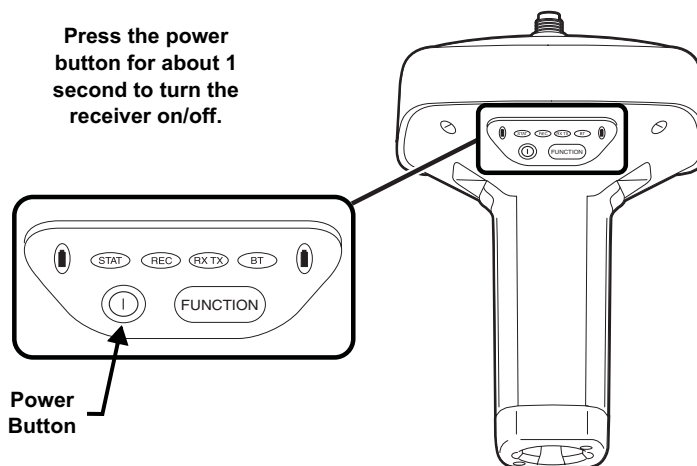- When turning off, press the **power** button until the LEDs go out, then release.

Figure 4-5. Power Button Functions

To start/stop logging data, press the **FUNCTION** button for 1–5 seconds (Figure 4-6).

- During data recording, the REC LED is green. Use PC-CDU to set the recording time interval. See "Recording Interval parameter" on page 3-22 for details.

- The REC LED blinks green each time data is written to the SD/ MMC memory.

- If the REC LED is red, the receiver has run out of memory, has a hardware problem, has no SD/MMC card, or contains an improper OAF (see "Option Authorization File (OAF)" on page 1-23 for more information).

Use PC-CDU to enable the desired FUNCTION key mode in the receiver, either "LED blink mode switch" for static surveys or

"Occupation mode switch" for kinematic surveys. See "FN Key Mode parameter" on page 3-24 for details.

Each time you turn off or on data recording, either a new file opens or data appends to a particular file. See "Always Append to the File parameter" on page 3-23 and "Files Creation Mode parameter" on page 3-23 for information on setting these functions.
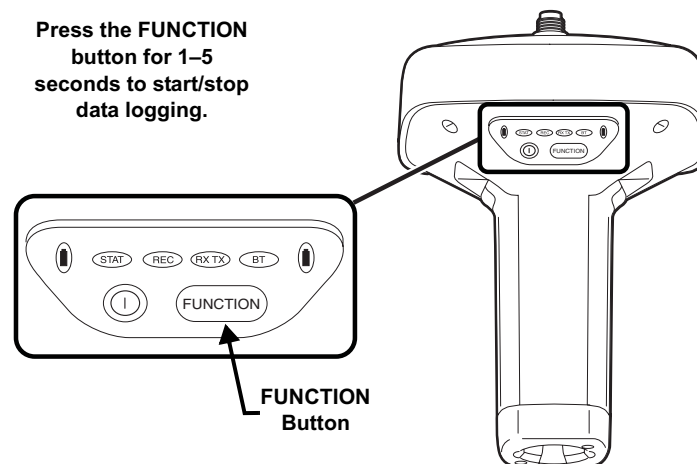

Figure 4-6. FUNCTION Button Functions

To toggle between post-processing modes, press the **FUNCTION** button for less than 1 second when "Occupation mode switch" has been enabled using PC-CDU.

To change the information mode of the receiver, press the **FUNCTION** button for less than 1 second when "LED blink mode switch" has been enabled using PC-CDU.

To change the baud rate of the receiver's serial port, press the **FUNCTION** button for 5–8 seconds. This is useful if the data collector does not support the rate that the receiver port is set to.

After about five seconds, the REC LED becomes red. Release the **FUNCTION** button during the next three seconds.

Static Surveying for Base Stations

Static surveying is the classic survey method, well suited for all kinds of baselines (short, medium, long). At least two receiver antennas, plumbed over survey marks, simultaneously collect raw data at each end of a baseline during a certain period of time. These two receivers track four or more common satellites, have a common data logging rate (5–30 seconds), and the same elevation mask angles. The length of the observation sessions can vary from a few minutes to several hours. The optimal observation session length depends on the surveyor's experience as well as the following factors:

*   The length of the baseline measured

*   The number of satellites in view

*   The satellite geometry (DOP)

*   The antenna's location

*   The ionospheric activity level

*   The types of receivers used

*   The accuracy requirements

*   The necessity of resolving carrier phase ambiguities

Generally, single-frequency receivers are used for baselines whose lengths do not exceed 15 kilometers (9.32 miles). For baselines of 15 kilometers or greater, use dual-frequency receivers.

Dual-frequency receivers have two major benefits. First, dual-frequency receivers can estimate and remove almost all ionospheric effect from the code and carrier phase measurements, providing much greater accuracy than single-frequency receivers over long baselines or during ionospheric storms. Secondly, dual-frequency receivers need far less observation time to reach the desired accuracy requirement.

After the survey completes, data the receivers collect can be downloaded onto a computer and processed using post-processing software (for example, Topcon Tools).

Kinematic (Stop & Go) Surveying for Rover Stations

In a kinematic, stop and go survey, the stationary receiver (Base station) is set up at a known point such as a survey monument, or an unknown point. The receiver continually tracks satellites and logs raw data into its memory. The Rover receiver is set up at an unknown point and collects data in static mode for 2 to 10 minutes. When finished, assign the Rover to kinematic status and move to the next survey point. At this point, and each subsequent point, the receiver is changed to static mode to collect data. So, while moving, the Rover is in kinematic mode, and while collecting data, the Rover is in static mode.

1. Set up the Rover at an unknown point and press **power**. Allow the Rover to collect static data for two to ten minutes. The REC LED will be orange.

2. Check the STAT light for satellites tracked.

3. When finished, press the **FUNCTION** button for less than 1 second to assign the Rover to kinematic.

> Remember, if the REC LED blinks green, the current mode is dynamic, if it blinks orange, the current mode is static.

4. Move the Rover to the next location (survey point), and press the **FUNCTION** button for less than a second to collect the data in static mode for two to ten minutes.

5. Repeat steps five and six until all points have been surveyed. The occupation time for the points depends on the same factors as for the static survey method.

6. When finished, press the **FUNCTION** button for one to five seconds to stop logging data. Turn off the Rover if needed.

This method of GPS survey allows the operator to reduce the point occupation time, thus permitting field crews to survey many more points compared to the other methods available.

Real Time Kinematic Surveying

With RTK surveying, as with kinematic surveying described above, one receiver serves as the reference station and conducts observations with its antenna affixed to a stationary tripod or some other device. The other receiver functions as a rover and conducts observations (using an antenna) affixed to a mobile pole and moved to observation points.

Unlike post-processed kinematic surveys, RTK surveys utilize a communications link between the Base and Rover. Using a radio modem link, the Base receiver transmits its measurement and location data to the Rover receiver. The Rover, based on the transmitted data and its own observation data, immediately conducts a baseline analysis and outputs the results. For specific settings used in RTK surveys, see "Configuring the Radio Modem" on page 3-3 and "Configuring the Receiver" on page 3-10.

If using PC-CDU to monitor an RTK Rover receiver, check the *LQ* field on the main screen (Figure 4-7 on page 4-13) to ensure the receiver obtains differential corrections. Usually, the receiver will start to output the coordinates of the antenna's phase center along with the solution type within 10–30 seconds. However, spread spectrum radios and GSM phones may take as long as 60 seconds to synchronize.

The geodetic coordinates displayed on the Geo tab are always computed in WGS84 and have four solution types.

- Standalone – where the receiver computes 3D coordinates in autonomous mode without using differential corrections.

- Code differential – where the Rover receiver computes the current relative coordinate in differential mode using only pseudo ranges.

- RTK float – where the Rover receiver computes the current relative coordinates in differential mode using both pseudo ranges and phases; however, with a float solution, the phase ambiguity is not a fixed integer number and the "float" estimate is used instead.

- RTK fixed – where the Rover receiver computes current relative coordinates, with ambiguity fixing, in differential mode.

The *LQ* field reflects the status of the received differential messages and contains the following information:

- Data link quality in percentage

- Time (in seconds) elapsed since the last received message

- Total number of received correct messages (dependent on the message type received)

- Total number of received corrupt messages (dependent on the message type received)

If the receiver is not (for some reason) receiving differential corrections, or if none of the ports has been configured to receive differential corrections, the LQ field will either be empty or it will look like this: 100%(999,0000,0000).
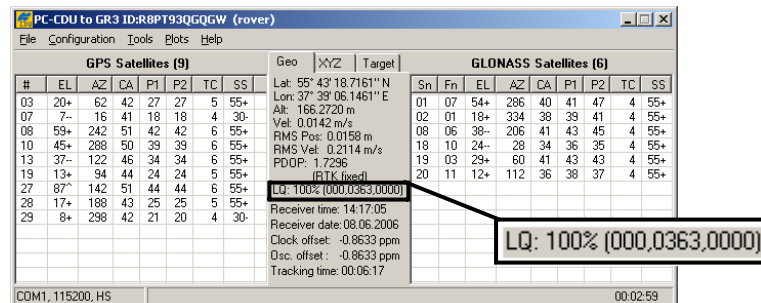

Figure 4-7. PC-CDU Main Screen

Notes:

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Receiver and File Maintenance

If post-processing the data after completing a survey, the data in the receiver's memory will need to be downloaded to a computer. Downloading and deleting files will also prepare the receiver's memory for the next survey. Occasionally, the receiver's NVRAM may need to be cleared to eliminate communication or tracking problems.

As project expectations expand, the receiver's OAF may need to be updated to provide expanded operation and functionality. The various boards inside the receiver (GPS, power, modem, and Bluetooth) require firmware to properly operate and provide appropriate functionality. As TPS releases firmware updates, loading these updates into the receiver will ensure that the receiver operates at its full potential.

Downloading Files to a Computer

After completing a survey, download data files to a computer for storage, post-processing, or backup. Also, the receiver memory holds a finite amount of files and information, so downloading data prevents files from being lost. PC-CDU and Topcon Link both provide a file managers to download files from the receiver to your computer, and to delete files from the receiver. PC-CDU Lite and Topcon Link are both free utilities available via your Topcon Dealer or the Topcon website (www.topconpositioning.com).

> Use Topcon Tools to download files from the SD card. Refer to the Topcon Tools Reference Manual for further details.

Downloading Files via Topcon Link

Topcon Link provides two options for downloading files from a receiver: via Windows® Explorer or via the Topcon Link interface.

Before you can download files, you must connect your receiver and computer (see "Connecting the Receiver and a Computer" on page 2-19 for this procedure).

...Using Windows Explorer

1. Connect your receiver and computer. See "Connecting the Receiver and a Computer" on page 2-19 for this procedure.

2. Open Windows Explorer and click the Topcon Receiver folder. The right panel of the window displays the automatic start of searching for Topcon receivers connected to any of the computer ports (COM and USB) (Figure 5-1).

3. When finished, all receivers connected to the computer ports (Figure 5-1) display.
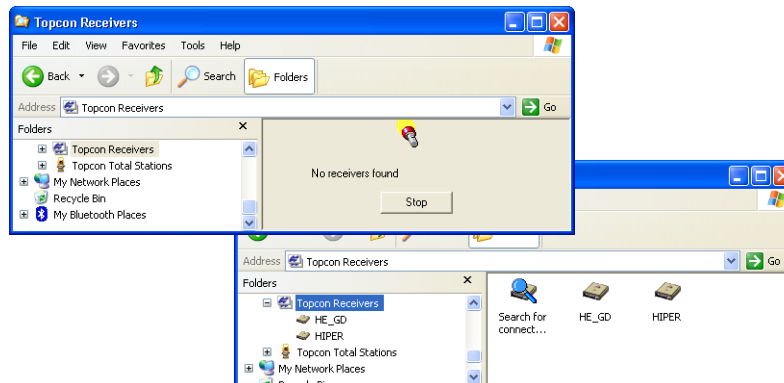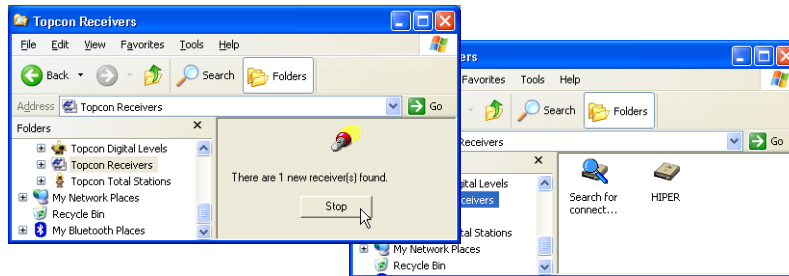

Figure 5-1. Searching and Finding Topcon Receivers in Windows Explorer

4. To stop searching for receivers when the desired receiver has been found, click **Stop**. Only the discovered receivers will display.


Figure 5-2. Break Of Searching Receivers

5. To update information about the receivers connected to the computer port, click *Search for connected receivers*.

6. To view information about the receiver (Figure 5-3), right-click the desired receiver and select the *Properties* option.

7. To view the collected raw file, click on the desired receiver.
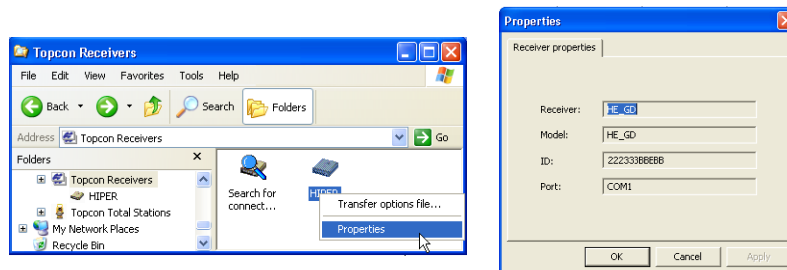
Figure 5-3. Receiver Properties

8. To import the file(s) from the receiver to a folder, select the desired file(s) and copy to the folder using drag-and-drop method (Figure 5-4).
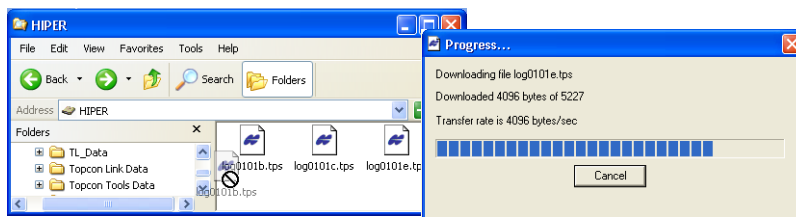
Figure 5-4. Start of File Import from the TPS Receiver/Import in Progress

...Using Topcon Link

1. Connect your receiver and computer. See "Connecting the Receiver and a Computer" on page 2-19 for this procedure.

2. To start Topcon Link, click the **Import from Device** button on the Toolbar.

3. From the left panel of the *Import from Device* dialog box, double-click *Topcon Receivers* (Figure 5-5).
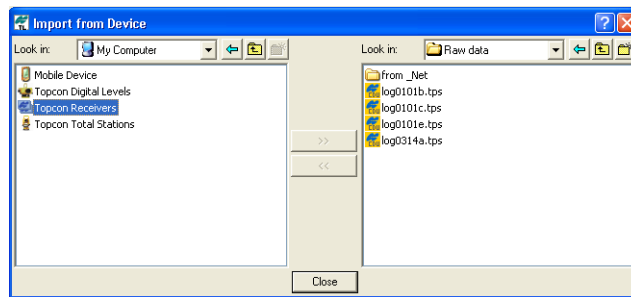

Figure 5-5. Import From Device Window

4. The program automatically searches for Topcon receivers connected to the computer ports (COM and USB). When finished all receivers connected to the computer ports (Figure 5-6) display.
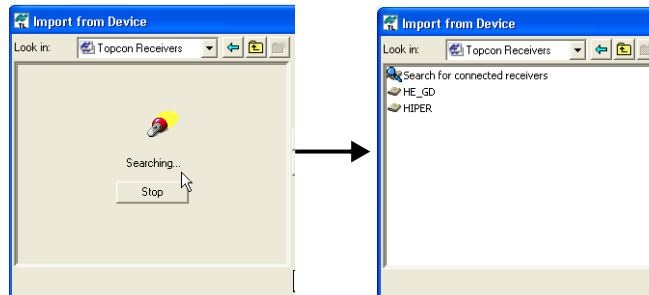

Figure 5-6. Search for Topcon Receivers

5. To view information about the receiver, right-click the desired receiver and select the *Properties* option (Figure 5-7).
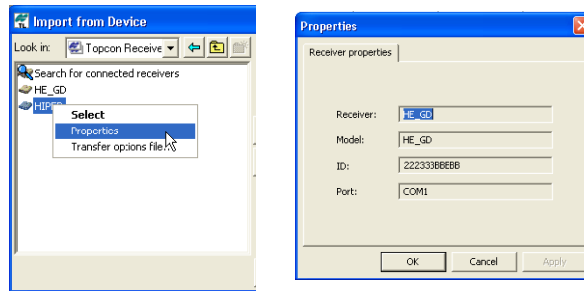

Figure 5-7. Receiver Properties

6. In the right panel of the *Import From Device* window, navigate to and select, or create, a folder to save the files (Figure 5-8).

7. To view the collected raw file, double click (or click *Select* in the pop-up menu) the desired receiver. To import the file(s) from the receiver to the computer and to save in the selected folder, highlight the desired file(s) and click the double arrows (Figure 5-8).

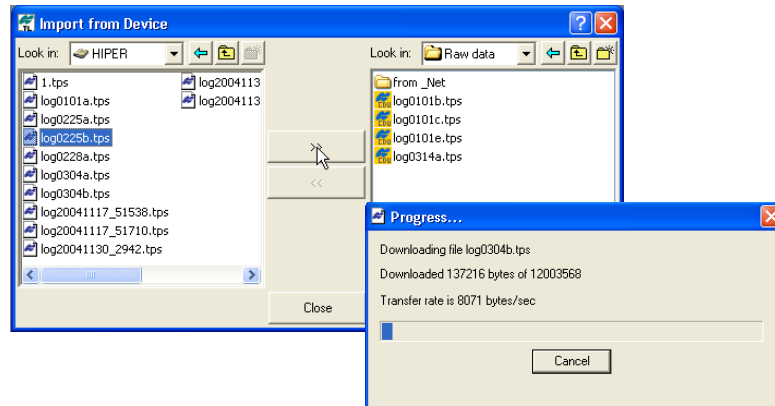8. The import in progress displays (Figure 5-8).

Figure 5-8. Select the Raw Data File to Import and View Import Progress

Downloading Files via PC-CDU

1. Connect your receiver and computer. See "Connecting the Receiver and a Computer" on page 2-19 for this procedure.

2. Open PC-CDU. On the *Connection Parameters* dialog box, enable *RTS/CTS handshaking* and click **Connect** (Figure 5-9).
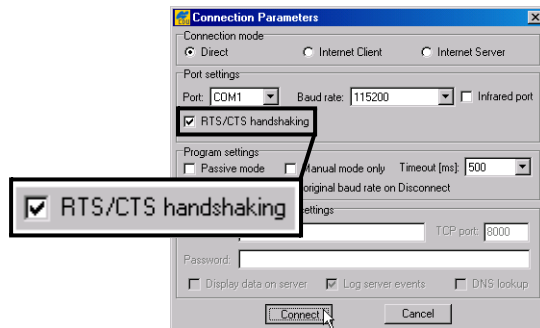

Figure 5-9. Connection Parameters – RTS/CTS Handshaking

3. Click **File ▶ File Manager**, then click the **Download path** tab on the *File Manager* dialog box (Figure 5-10).
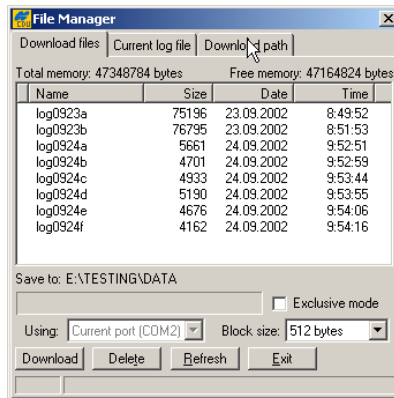

Figure 5-10. Find Files to Download

4. Navigate to or create (using the **Create** button) the folder in which to download and store files.

5. Click the **Download files** tab and select the file(s) to download (Figure 5-11 on page 5-7).

To select multiple files, press the **shift** key while clicking non-sequential files; or, press the **Ctrl** key and click individual files.
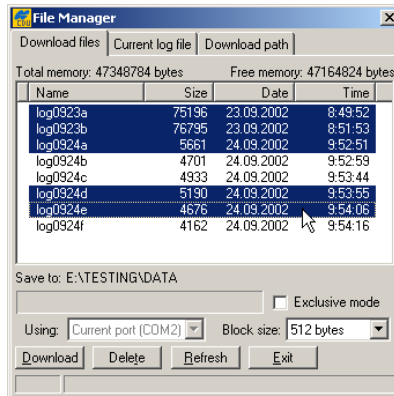
Figure 5-11. Download Files

6. Click the **Download** button. During the download, status indicators display next to each file (Figure 5-12).

 • Blue indicator – file in queue for downloading.

 • Red indicator – file currently downloading.

 • Green indicator – file has successfully downloaded.
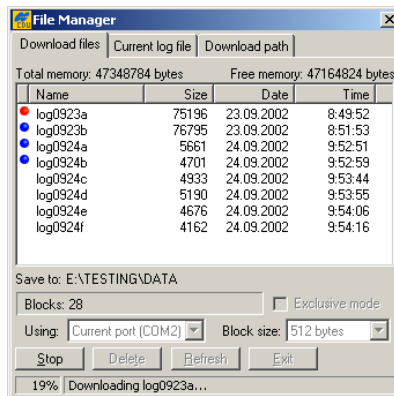
Figure 5-12. Download Files – Status Indicators

7. When done, click **Exit** on the *File Manager* dialog box.

8. Continue with other operations. Or, click **File ▶ Disconnect**, then **File ▶ Exit** to quit PC-CDU.

Deleting Files from the Receiver's SD Card

Use the following steps to delete files from your receiver.

1. Connect your receiver and computer. See "Connecting the Receiver and a Computer" on page 2-19 for this procedure.

2. On the **Connection Parameters** dialog box, enable *RTS/CTS handshaking* (Figure 5-13).
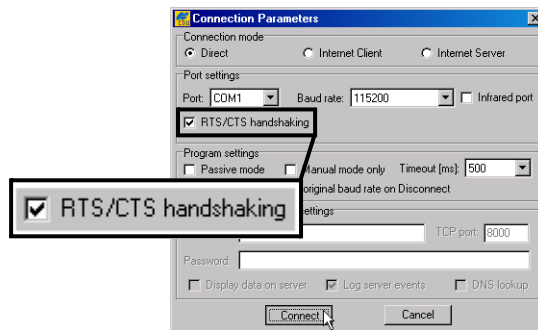
Figure 5-13. Connection Parameters – RTS/CTS Handshaking

3. Click **File ▸ File Manager** and select the file(s) to delete on the *Download files* tab (Figure 5-14 on page 5-9).

   To select multiple files, hold down the **shift** key and click on non-sequential files to select several files at once; or hold down the **Ctrl** key and click on individual files.

4. Click **Delete** (Figure 5-14 on page 5-9).

5. Click **Yes** at the delete files confirmation dialog box. PC-CDU deletes the selected files.

6. Click **Exit** on the File Manager screen.

7. Continue with other operations. Or Click **File ▸ Disconnect**, then **File ▸ Exit** to quit PC-CDU.
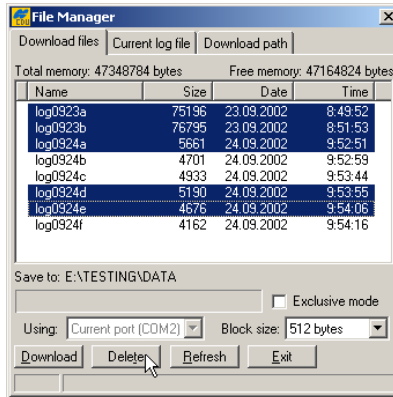
Figure 5-14. Delete Files

Managing Receiver Memory

When using the receiver in static or dynamic applications, you may need to know the amount of memory the receiver's log file occupies. The specific memory size depends on the type of data being recorded. Use the formulas below to compute the approximate size of the receiver's log files. These equations are based on the default set of messages.

- SS – the estimated size of one epoch of raw data in the receiver's log file (expressed in bytes).

- N – the number of observed satellites per epoch.

When recording only L1 data:

SS = 183 + 22*N

When recording L1 and L2 data:

SS = 230 + 44*N

Managing Receiver Options

The Option Authorization File enables certain functions, features, and options in the receiver, such as the following:

- the type of signal (L1, L1/L2, etc.) the receiver will process
- the amount of data the receiver will store in the memory
- the rate at which data will be transmitted or received

For a complete list of available options and details, consult with your TPS dealer.

Checking the Receiver's OAF

Use PC-CDU to view the status of the receiver's options.

1. Connect your receiver and computer. See "Connecting the Receiver and a Computer" on page 2-19 for this procedure.

2. Click **Tools ▶ Receiver Options**. The *Options Manager* dialog box (Figure 5-15 on page 5-11) contains the following information:

    - Option name – a name/description of the option
    - Current – the current status of the option
    - Purchased – if the option is purchased or not
    - Leased – if the option is leased or not
    - Expiration date – the date the option will be disabled, if applicable

    Since Options can be both purchased and leased, the "Current" status of the option displays the currently effective value. Option values can be one of the following:

    - -1 or "-----" – the firmware version does not support this option
    - 0 – the receiver option is disabled
    - positive integer – the option is enabled
    - yes or no – the option is either enabled or disabled

3. When finished, click **Exit** on the *Option Manager* dialog box, then click **File ▶ Disconnect** to disconnect from PC-CDU (and prevent conflicts with serial port management).

Tools
- Initialize file system
- Clear NVRAM
- Reset receiver
- Receiver options

Option Manager

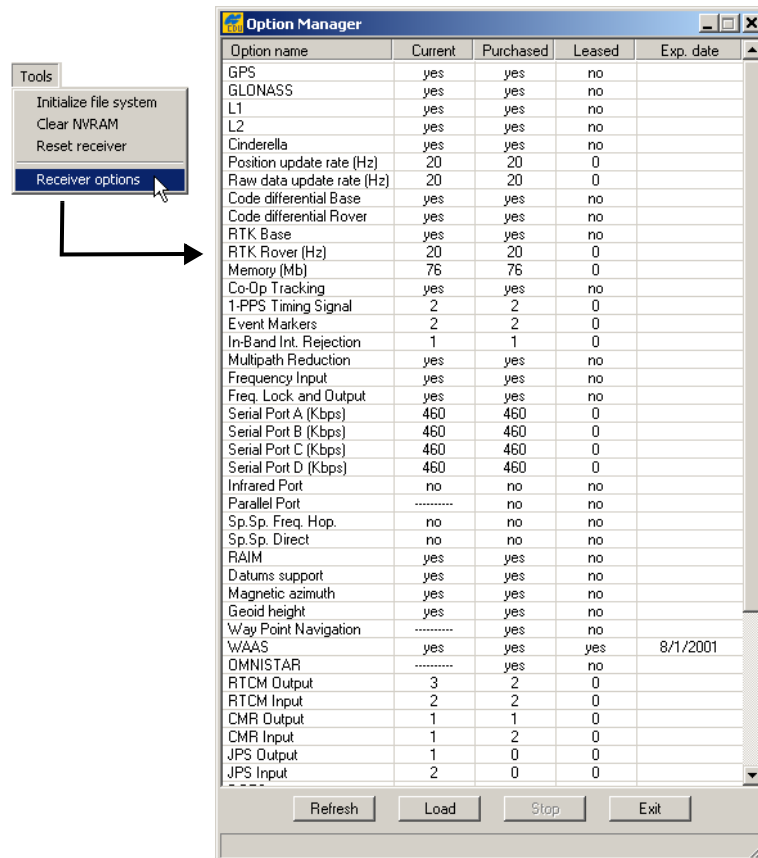| Option name	Current	Purchased	Leased	Exp. date
GPS	yes	yes	no	
GLONASS	yes	yes	no	
L1	yes	yes	no	
L2	yes	yes	no	
Cinderella	yes	yes	no	
Position update rate (Hz)	20	20	0	
Raw data update rate (Hz)	20	20	0	
Code differential Base	yes	yes	no	
Code differential Rover	yes	yes	no	
RTK Base	yes	yes	no	
RTK Rover (Hz)	20	20	0	
Memory (Mb)	76	76	0	
Co-Op Tracking	yes	yes	no	
1-PPS Timing Signal	2	2	0	
Event Markers	2	2	0	
In-Band Int. Rejection	1	1	0	
Multipath Reduction	yes	yes	no	
Frequency Input	yes	yes	no	
Freq. Lock and Output	yes	yes	no	
Serial Port A (Kbps)	460	460	0	
Serial Port B (Kbps)	460	460	0	
Serial Port C (Kbps)	460	460	0	
Serial Port D (Kbps)	460	460	0	
Infrared Port	no	no	no	
Parallel Port	---------	no	no	
Sp.Sp. Freq. Hop.	no	no	no	
Sp.Sp. Direct	no	no	no	
RAIM	yes	yes	no	
Datums support	yes	yes	no	
Magnetic azimuth	yes	yes	no	
Geoid height	yes	yes	no	
Way Point Navigation	---------	yes	no	
WAAS	yes	yes	yes	8/1/2001
OMNISTAR	---------	yes	no	
RTCM Output	3	2	0	
RTCM Input	2	2	0	
CMR Output	1	1	0	
CMR Input	1	2	0	
JPS Output	1	0	0	
JPS Input	2	0	0	

Refresh   Load   Stop   Exit

Figure 5-15. View Option Manager

Loading an OAF

Topcon Positioning System dealers provide customers with OAF files. For any OAF related questions, e-mail TPS at options@topconps.com and include the receiver's ID number (see the bottom of the receiver for the ID).

1. To load a new OAF, follow steps one and two in "Checking the Receiver's OAF" on page 5-10.

2. Click **Load** at the bottom of the *Option Manager* dialog box (see Figure 5-15 on page 5-11).

3. Navigate to the location of the new Option Authorization File. OAFs have .jpo or .tpo extensions and are unique to each receiver (Figure 5-16).
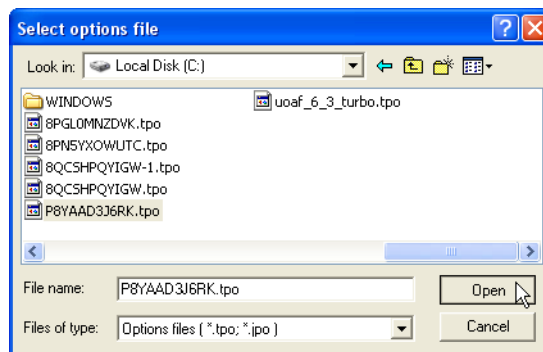
Figure 5-16. Load OAF

4. Select the appropriate file and click **Open** (Figure 5-16). The new receiver option loads onto the receiver and the Option Manager table updates.

5. When finished, click **Exit** on the *Option Manager* dialog box, then click **File ▸ Disconnect** to prevent conflicts with serial port management.

Clearing the NVRAM

The receiver's Non-Volatile Random Access Memory (NVRAM) holds data required for satellite tracking, such as ephemeris data and receiver position. The NVRAM also keeps the current receiver's settings, such as active antenna input, elevation masks and recording interval, and information about the receiver's internal file system.

Even though clearing the NVRAM is not a common (nor normally a recommended) operation, there are times when clearing the NVRAM can eliminate communication or tracking problems. Clearing the NVRAM in your receiver can be interpreted as a "soft boot" in your computer.

After clearing the NVRAM, your receiver will require some time to collect new ephemerides and almanacs (around 15 minutes).

Clearing the NVRAM of your receiver will not delete any files already recorded in your receiver's memory. However, it will reset your receiver to factory default values.

In addition, the NVRAM keeps information about the receiver file system. Note that after clearing the NVRAM, the receiver's STAT LED will flash orange for a few seconds indicating that the receiver is scanning and checking the file system.

Using the MINTER to Clear the NVRAM

1. Press the **power** key to turn off the receiver.
2. Press and hold the **FUNCTION** key.
3. Press and hold the **power** key for about one second. Release the **power** key while continuing to hold the **FUNCTION** key.
4. Wait until the STAT and REC LEDs are green
5. Wait until the STAT and REC LEDs blink orange.
6. Release the **FUNCTION** key while the STAT and REC LEDs blink orange.

Using PC-CDU to Clear the NVRAM

1. Connect your receiver and computer. See "Connecting the Receiver and a Computer" on page 2-19 for this procedure.

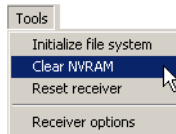2. Click **Tools ▸ Clear NVRAM** (Figure 5-17).

Figure 5-17. Clear NVRAM with PC-CDU

While the NVRAM clears, the REC LED flashes green and red; the STAT LED flashes red. The receiver automatically disconnects when finished.

Changing Receiver Modes

The receiver has the following three modes, two information modes and one power modes:

*   Normal Mode – the standard surveying mode.
*   Extended Information Mode – used for testing purposes during normal operation.
*   Sleep Mode – used to stop recording data, but keeps the receiver powered on "standby".

Entering Extended Information Mode

Extended Information Mode (EIM) is used for receiver testing purposes. In this mode, the receiver continues to work as usual, but the STAT LED indicates "extended" information using a delimiter.

The Delimiter is a distinguishable double-blink that shows the overall status of tests performed in EIM. The STAT LED color for delimiter is calculated from the colors of other LED blinks, and will be one of the following colors when the tests complete:

*   Orange – at least one blink is orange.
*   Red – no orange blink and at least one red blink.

• Green – all other cases.

The delimiter double-blink is followed by six LED blinks corresponding to six receiver tests, where each blink indicates the following information:

Blink 1. Sufficient data for position computation.

Blink 2. GPS S/N ratios are good (Table 5-1).

Blink 3. GLONASS S/N ratios are good (Table 5-1).

Blink 4. Oscillator's frequency offset is less than three ppm (parts per million).

Blink 5. Oscillator's Allan Variance is better than 2.7e-10 (currently, always orange).

Blink 6. Continuous tracking time is more than 15 minutes.

Table 5-1. Signal-to-Noise (S/N) "Good" Ratios

	CA/L1	P/L1	P/L2
GPS	51	39	39
GLONASS	51	49	40

The color of the blink indicates that information for test is unavailable (orange), the receiver passed the test (green), or the receiver failed the test (red).

1. To switch to EIM, press and quickly release (within one second) the **FUNCTION** key on the MINTER.

2. Watch for the delimiter double-blink. With good receiver, antenna, and observation conditions, all blinks should be green within 15 minutes of powering on.

   • Green – ok

   • Orange – wait

   • Red – some tests failed

3. To switch back to normal mode, press the **FUNCTION** key.

Sleep (Off) Mode

In sleep mode, the power board and Bluetooth module will continue to draw power from the batteries, causing the batteries to drain over time. Sleep mode is the normal "off" state of the receiver.

1. Turn on your receiver.
2. Press the receiver's **power** key for more than four seconds and less than eight seconds. The STAT LED will be orange. The receiver enters Sleep Mode.
3. Any activity on the RS232 port will turn the receiver on.

> **NOTICE** If you press the power key for more than 14 seconds, it will be ignored. This protects receiver operation against stuck keys.

Loading New Firmware

Base and Rover receivers must be loaded with the same firmware version. Use the latest firmware version, available for download from the TPS website, to ensure your receiver has the most recent updates.

> **NOTICE** The GR-3 receiver must be loaded with firmware version 3.0 or newer.

> **CAUTION** Do not attempt to load firmware older than 3.0.

The receiver board and power board must be loaded with firmware from the same package. The Bluetooth module's firmware is independent of the receiver card and power board, and has a different firmware package.

The receiver uses FLoader, a Windows®-based utility, to load firmware onto the receiver and power boards. You can download FLoader to your computer from the TPS website. For more information, refer to the *FLoader User's Manual*, also available on the TPS website. See "Installing FLoader" on page 2-6 for installing FLoader on the computer.

1. Download the new firmware package to your computer.
2. Connect your receiver and computer. See "Connecting the Receiver and a Computer" on page 2-19 for this procedure.
3. Start FLoader.
4. On the *Connection* tab, select the COM port on your computer that connects with your receiver and select its speed (usually 115200) (Figure 5-18 on page 5-17).
5. See "Loading Receiver and Power Board Firmware" on page 5-18to load the appropriate firmware.
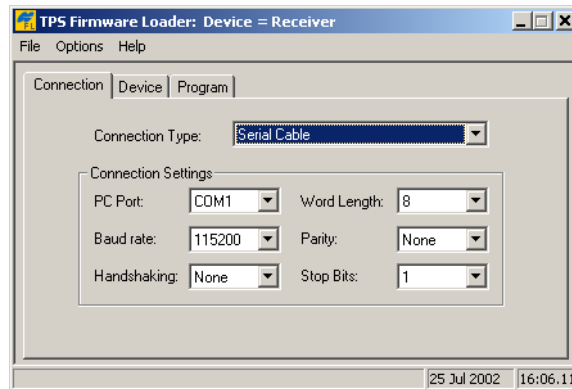
Figure 5-18. FLoader Main Screen

Loading Receiver and Power Board Firmware

Receiver and power board firmware is released as a compressed file that you download and decompress. This file contains the following three files:

- ramimage.ldr – the Receiver board RAM file
- main.ldp – the Receiver board Flash file
- powbrd.ldr – the Power board RAM file

> **NOTICE** You must load all three files when loading new firmware. These files must come from the same firmware package.

1. In FLoader, click the **Device** tab and set the *Device Type* as "Receiver". Then click **Get from Device** for device information (Figure 5-19).
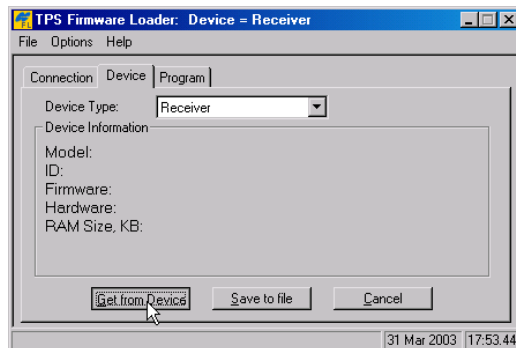
Figure 5-19. Set Device Type

2. Click the **Program** tab and set the *Capture Method* to "Soft Break Capture" (recommended) (Figure 5-20).
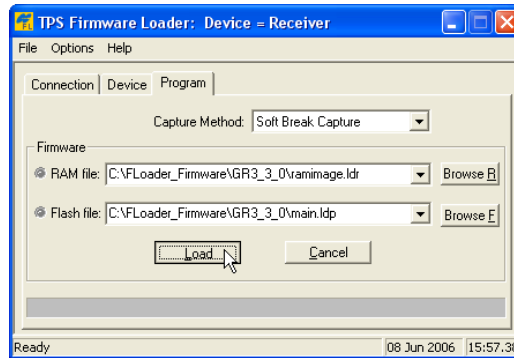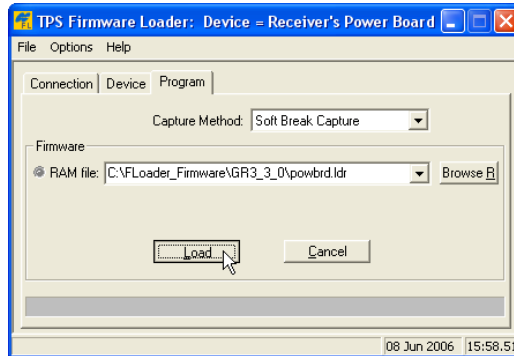

Figure 5-20. Program Tab Settings

3. Browse for and select the receiver board's RAM file and Flash file (Figure 5-20).

4. Click **Load** and wait until 100% of the files load into the receiver.

NOTICE	If you selected an incorrect file, an error message displays at the bottom of the dialog box. Select the correct file.

---

5. Click the **Device** tab and set the *Device Type* as "Receiver's Power Board". Then click **Get from Device** for device information (Figure 5-21).

Figure 5-21. Set Device Type

6. Click the **Program** tab and set the *Capture Method* to "Soft Break Capture" (recommended) (Figure 5-22).

Figure 5-22. Program Tab Settings

7. Browse for and select the Power board's RAM file (Figure 5-22).

8. Click **Load** and wait until 100% of the power board file loads into the receiver.

> **NOTICE** If you selected an incorrect file, an error message displays at the bottom of the dialog box. Select the correct file.

9. Click **File ▸ Exit**.

10. Clear the receiver's NVRAM (see "Clearing the NVRAM" on page 5-13) and update the almanac (see "Collecting Almanacs and Ephemerides" on page 2-26) after loading new firmware.

Troubleshooting

This chapter will help you diagnose and solve some common problems you may encounter with your receiver.

> **WARNING**
>
> Do not attempt to repair equipment yourself. Doing so will void your warranty and may damage the hardware.

Check This First!

Before contacting Topcon support, check the following:

* Check all external receiver connections carefully to ensure correct and secure connections. Double check for worn or defective cables.
* Check all power sources for drained batteries or incorrectly connected batteries/cables.
* Check that the most current software is downloaded onto the computer and that the most current firmware is loaded into the receiver. Check the TPS website for the latest updates.
* If connecting via Bluetooth, check that the port used for connection is in Command mode. See page 6-9 for details.

Then, try the following:

* Reset the receiver using PC-CDU (**Tools ▸ Reset receiver**).
* Restore default settings using PC-CDU (**Configuration ▸ Receiver**, then click **Set all parameters to defaults**).
* Clear the NVRAM (see "Clearing the NVRAM" on page 5-13).
* Initialize the file system (click **Tools ▸ Initialize file system**). This will erase all files inside the receiver.

If the problem persists, see the following sections for other solutions.

Troubleshooting Quick List

For receiver power issues:

> If "The receiver does not power up." see page 6-3.

> If "The receiver cannot establish a connection to a computer or external controller." see page 6-4.

For receiver issues:

> If "The receiver does not lock on to satellites for a long period of time." see page 6-4.

> If "The receiver tracks too few satellites." see page 6-5.

> If "The receiver cannot obtain Code Differential and/or RTK solutions." see page 6-5.

> If "The receiver does not start data logging." see page 6-8.

For Bluetooth connection issues:

> If "BTCONF error message: Can't find receiver." see page 6-9.

> If "BTCONF error message: Can't find Bluetooth." see page 6-10.

> If "BTCONF error message: Open COM# port failed: Access is denied." see page 6-11.

> If "After searching for available devices, none are discovered." see page 6-11.

> If "Can see the icon for the receiver's Bluetooth module on the computer screen, but cannot connect to it." see page 6-11.

For modem issues:

> If "Modem-TPS cannot connect to the receiver." see page 6-12.

> If "TX RX LED Blink Pattern on Error Conditions" see page 6-13.

Powering Problems

All receivers are preset in the factory to "Auto mode" for both batteries. To check these settings, use the following procedure:

1. Connect your receiver and computer and run PC-CDU (see "Connecting the Receiver and a Computer" on page 2-19).

2. Once connected, click **Configuration ▸ Receiver**.

3. On the *General* tab, view the *Power* and *Charger* fields. These fields should be set to "Auto". If not, change them to Auto and click **Apply**.

> Clearing the NVRAM will also return the receiver to Auto power mode (see "Clearing the NVRAM" on page 5-13).

The receiver does not power up.

⇨ The attachable batteries may be improperly attached.

 • Check that the batteries are correctly attached.

 • Check that the battery contacts at the top of the attachable battery are clean and dust free.

⇨ The batteries may be discharged.

 • Connect/attach a fully charged battery and retry. See "Powering the Receiver" on page 2-14.

 • Charge the batteries overnight. See "Powering the Receiver" on page 2-14.

⇨ If using an external power source, the cable may be disconnected or damaged.

  Check that the cable is securely connected and undamaged.

⇨ The receiver may have a defective charger or defective batteries.

  If, after changing the batteries or connecting an external power source, the receiver still does not power up, contact TPS Customer Support for advice.

Receiver Problems

The following are some of the most commonly encountered receiver problems.

The receiver cannot establish a connection to a computer or external controller.

Cable specific problems:

⇨ The cable is not properly plugged in.

- Check that the cable connector is attached to the correct receiver port.
- Unplug the cable, then securely and properly reconnect it to the receiver.
- See "GR-3 Receiver" on page 1-10 and "Connector Specifications" on page A-11 for information on the receiver's connectors.

⇨ The cable is damaged.

Use an undamaged cable. Contact your Dealer to replace the cable.

Generic problems:

⇨ The receiver port used for connection is not in Command mode.

1. Connect your receiver and a computer using a free port (see "Connecting the Receiver and a Computer" on page 2-19) and start PC-CDU.
2. Click **Configuration ▸ Receiver ▸ Ports**.
3. Change the *Input* for the port used for connection to "Command".

The receiver does not lock on to satellites for a long period of time.

⇨ The receiver stores an old almanac.

Update the almanac. See "Collecting Almanacs and Ephemerides" on page 2-26 for details.

⇨ The corresponding receiver options may be disabled or expired (L1/L2, GPS/GLONASS must be on to track satellites).

- See "Managing Receiver Options" on page 5-10 for details on how to check current options.
- Order a new OAF with the desired options activated to enable or extend validity of the corresponding receiver options. Contact your dealer or visit the TPS website for details
- Refer to the *PC-CDU Reference Manual* for a detailed description of options.

The receiver tracks too few satellites.

⇨ The elevation mask value is too high (above 15 degrees).

Lower the elevation mask. See page 3-15 for information on setting the elevation mask.

⇨ The survey is conducted near obstructions (tree canopy, tall buildings, etc.).

- Check that the Multipath Reduction boxes have been enabled.

  1. Connect your receiver and a computer and start PC-CDU. See "Connecting the Receiver and a Computer" on page 2-19.
  2. Click **Configuration ▶ Advanced** and the *Multipath Reduction* tab. Enable the two boxes and click **Apply**.

- Move to an area free of obstructions, if applicable.

The receiver cannot obtain Code Differential and/or RTK solutions.

⇨ Incorrect Base coordinates entered.

Specify the correct coordinates for the Base station using PC-CDU or another suitable field data collection software.

⇨ The receiver is not configured as a Base or Rover.

- If the receiver should function as a Base, ensure it has the proper configuration. See Chapter 3 for details.

- If the receiver should function as a Rover, ensure it has the proper configuration. See Chapter 3 for details.

⇨ The corresponding receiver options may be disabled or expired.

- See "Managing Receiver Options" on page 5-10 for details on how to check current options.
- Order a new OAF with the desired options activated to enable or extend validity of the corresponding receiver options. Contact your dealer or visit the TPS website for details
- Refer to the *PC-CDU Reference Manual* for a detailed description of options.

⇨ There are not enough common satellites. In order to obtain a fixed solution, the Base and Rover should track at least five common satellites.

- Ensure that both the Rover and Base receivers use the same, and updated, almanac. See "Collecting Almanacs and Ephemerides" on page 2-26.
- Check the elevation masks of the Rover and Base receivers; they should be the same. See page 3-15 for information on setting the elevation mask.

⇨ A discrepancy exists between the differential standards used at the Base and Rover receivers.

Ensure the Base and Rover receivers use the same corrections input/output format:

1. Connect your receiver and a computer and start PC-CDU. See "Connecting the Receiver and a Computer" on page 2-19.
2. Click **Configuration ▶ Receiver** and the *Ports* tab. Use the same input/output format for both receivers.

⇨ Poor satellite geometry (PDOP/GDOP values are too high).

Conduct your survey when PDOP values are low.

⇨ The elevation mask is above 15 degrees.

Lower the elevation mask. See page 3-15 for information on setting the elevation mask.

⇨ The modem battery is low.

• Attach an external power source to the receiver. See "Using an Auxiliary Power Source" on page 2-17.

• See "Powering the Receiver" on page 2-14 for details.

⇨ The transmitting and/or receiving antenna may be improperly connected.

• Check that the radio modem's antenna is securely and properly connected to the antenna connector.

• Check that the radio modem's antenna is undamaged. If damaged, contact your TPS dealer to replace the antenna.

⇨ The specified baud rate is incompatible with the baud rates the modem supports.
The baud rate is the rate at which the receiver transmits differential messages to the modem and vice versa.

Change the baud rate to that which your modem supports. Refer to the modem's manual for information.

⇨ The Base and Rover modems use different radio link parameters.

Configure the Base and Rover radio modems according to the procedures listed in the applicable section.

• For details on an FH915+ modem, see "Configuring a Spread Spectrum Radio Modem" on page 3-3.

• For details on a GSM modem, see "Configuring a GSM Radio Modem" on page 3-7.

⇨ The distance between the Base and Rover is too far.

• Close the distance between the Base and Rover.

• Use repeaters to increase radio coverage.

⇨ There may be a source of radio interference that disrupts radio communications.

- Change the RF channel (if possible).
- Use a spectrum analyzer to detect the radio characteristics of the interfering signal and change your system's configuration accordingly.
- Remove the source of jamming signal or relocate your radio antennas (if possible).

The receiver does not start data logging.

⇨ The receiver has no the SD card installed or the memory option is disabled or expired.

- Check that the card is properly inserted. For details, see "To install the SD card" on page 2-7.
- Check that the memory option is enabled. For details, see "Checking the Receiver's OAF" on page 5-10.

⇨ The receiver's memory card has no free space.

- Download and/or delete data files to free up space for new files (see "Downloading Files to a Computer" on page 5-1 and "Deleting Files from the Receiver's SD Card" on page 5-8).
- Use the AFRM feature. See "Automatic File Rotation Mode (AFRM) parameters" on page 3-23.

Bluetooth Problems

The following are some of the most commonly encountered error messages and other problems.

BTCONF error message: Can't find receiver.

⇨ The receiver is turned off.

Ensure the receiver has power and is turned on.

⇨ If using a cable, the cable's connectors are improperly attached.
- Check that the cable connector is attached to the correct serial port.
- Unplug the cable, then securely and properly reconnect it to the receiver.

⇨ If using a cable, the cable is damaged.
- Use an undamaged cable.
- Contact your TPS dealer to purchase a new cable.

⇨ The COM port the receiver is attached to differs from the one selected in BTCONF.
- Ensure that the RS232 cable is attached to the COM port specified in the BTCONF communication port list.
- See "Bluetooth Module Configuration" on page 2-22 for details.

⇨ The receiver port used for connection is not in Command mode.
1. Connect your receiver and a computer using a free port (see "Connecting the Receiver and a Computer" on page 2-19) and start PC-CDU.
2. Click **Configuration ▶ Receiver ▶ Ports**.
3. Change the *Input* for the serial port used for connection to "Command".

> This is the most common cause for this error message. Use PC-CDU to double check the settings for the connection port.

⇨ The settings for Port D may have been changed.

- The settings for Port D are: 115200 baud rate, 8 data bits, 1 stop bit, no parity, and no handshaking.
- Try enabling RTS/CTS handshaking for Port D. Do not change other settings.

⇨ The corresponding receiver options may be disabled or expired (serial port D must be enabled).

- See "Managing Receiver Options" on page 5-10 for details on how to check current options.
- Order a new OAF with the desired options activated to enable or extend validity of the corresponding receiver options. Contact your dealer or visit the TPS website for details
- Refer to the *PC-CDU Reference Manual* for a detailed description of options.

BTCONF error message: Can't find Bluetooth.

⇨ The receiver's Slot 2(C) is turned off.

1. See "Establishing an RS232 Cable Connection" on page 2-21 to connect the computer and receiver.
2. Click **Configuration ▸ Receiver ▸ General**.
3. In the *Turn on/off Slots* area, enable the Slot 2(C) check box.

⇨ The Bluetooth module is linked with another device.

Close the connection with the device, then connect to your receiver.

⇨ The receiver does not have a Bluetooth module.

- Continue with other configuration/survey functions using a serial or USB cable.
- Contact your TPS dealer to purchase a Bluetooth enabled receiver.

BTCONF error message: Open COM# port failed: Access is denied.

⇨ Another application uses the computer port dedicated for connection.

- Close the application, then re-connect.
- Connect the receiver via another, unused computer port.

After searching for available devices, none are discovered.

⇨ The receiver is not receiving power.

- Check that the receiver is getting power and is turned on.
- Check that the power cable is attached to the port marked "PWR".
- Unplug the cable, then securely and properly reconnect it to the receiver.
- If the power cable is damaged, contact your Dealer to purchase a new cable.

⇨ The receiver's Slot 2(C) is turned off.

1. Connect your receiver and a computer using an RS232 cable (see "Establishing an RS232 Cable Connection" on page 2-21).
2. Click **Configuration ▸ Receiver ▸ General**.
3. In the *Turn on/off Slots* area, enable the Slot 2(C) check box.

Can see the icon for the receiver's Bluetooth module on the computer screen, but cannot connect to it.

⇨ Device security settings probably differ.

- Make sure your Bluetooth enabled devices use the same security settings.
- See "Bluetooth Module Configuration" on page 2-22, specifically Figure 2-23 on page 2-25 for details on changing security settings.

⇨ Bluetooth module settings may have changed.

1. If you changed settings for your Bluetooth module, remove it from the list of discovered Bluetooth devices using the Bluetooth manager program (supplied with the device used to manage the receiver).

2. Repeat the search.

Modem-TPS Problems

The following is the most commonly encountered Modem-TPS problem.

Modem-TPS cannot connect to the receiver.

⇨ The receiver is turned off.

Ensure the receiver has power and is turned on.

⇨ If using a cable, the cable's connectors are improperly attached.

• Check that the cable connector is attached to the correct serial port.

• Unplug the cable, then securely and properly reconnect it to the receiver.

⇨ If using a cable, the cable is damaged.

• Use an undamaged cable.

• Contact your Dealer to purchase a new cable.

⇨ If using Bluetooth wireless technology, the incorrect port is selected, or the receiver or computer does not support Bluetooth.

• Use a computer or receiver that has Bluetooth wireless technology enabled/installed.

• Check that the computer and receiver use the correct ports for communication. For the GR-3 receiver, this is port A.

⇨ The corresponding modem options may be disabled or expired.

- See "Managing Receiver Options" on page 5-10 for details on how to check current options.
- Order a new OAF with the desired options activated to enable or extend validity of the corresponding receiver options. Contact your dealer or visit the TPS website for details
- Refer to the *PC-CDU Reference Manual* for a detailed description of options.

⇨ The type of radio modem is disabled for detection using Modem-TPS.

1. If needed, click **Cancel** on the *Connection* dialog box or **Stop** on the *Connecting to device* dialog box.
2. In Modem-TPS, click **Tools ▸ Options**.
3. Enable the modem type installed in the receiver connected to the computer. Click **Ok**.
4. Click **File ▸ Connect**.

TX RX LED Blink Pattern on Error Conditions

For internal FH915+ modems: the TX RX LED flashes red.

⇨ A fault condition has been detected.

- Check that the radio modem's antenna is undamaged. Contact your dealer to replace the antenna.
- Check that the radio modem's antenna is securely and properly connected to the antenna connector.
- Move the antenna/receiver away from conducting objects (such as, large metal objects).

⇨ The cable is damaged.

- Use an undamaged cable.

- Contact your Dealer to replace the cable.

For internal GSM modems: the TX RX LED flashes orange.

⇨ The Rover uses the wrong PIN code, or no PIN code was selected.

1. In TopSURV, click **Job ▸ Config ▸ Survey**.
2. Click the "**...**" (continue) button and press **Next** to navigate to the *Rover Radio* configuration screen.
3. Press **Configure GSM**.
4. Select the PIN of the Base Station and press **OK**.

⇨ An initialization error has occurred.

- Check that the radio modem's antenna is undamaged. Contact your dealer to replace the antenna.
- Check that the radio modem's antenna is securely and properly connected to the antenna connector on the radome.

Obtaining Technical Support

If the troubleshooting hints and tips in this Operator's Manual fail to remedy the problem, contact TPS Customer Support.

Before contacting TPS Customer support about any problems with the receiver, see "Check This First!" on page 6-1 for some solutions that may fix the issue.

Phone

To contact TPS Customer Support by phone, call:

1-866-4TOPCON (1-866-486-7266)
Monday through Friday
7:00am to 5:00pm, Pacific time

E-mail

To contact TPS Customer Support via e-mail, use one of the following electronic mail addresses (Table 6-1).

Table 6-1. Technical Support E-mail

For Questions Related To...	Use...
Hardware (receivers, antennas, firmware)	hardware@topcon.com
GPS+ and 3DMC	psg@topcon.com
OAF	options@topcon.com
RTK	rtk@topcon.com
PC-CDU	pccdu@topcon.com
If in doubt...	support@topcon.com

> **TIP** For quick and effective support, provide a detailed description of the problem.

When e-mailing TPS customer support, provide the following information for better, faster service:

1. The receiver model and configuration settings.

    In PC-CDU, click **Help ▸ About** and click **Save to file**. Enter a name for the file and save it to your computer. Attach this file to the email.

2. The system/hardware specifications for the computer running PC-CDU; such as, operating system and version, memory and storage capacity, processor speed, etc.

3. The symptoms and/or error codes/messages that precede and follow the problem.

4. The activities being tried when the problem occurs. If possible, include the exact steps being taken up to when the error message or other problem occurs.

5. How regularly the problem occurs.

Generally, a customer support representative will reply within 24 hours, depending on the severity of the problem.

Website

The Topcon Positioning Systems website provides current information about Topcon's line of products. The support area of the website provides access to frequently asked questions, configuration procedures, manuals, e-mail support, etc.

To access the TPS website, use:

www.topconpositioning.com

Specifications

This TPS product is a 72-channel GNSS receiver with an internal radio modem, a Bluetooth® wireless technology module, an optional GMS module, an optional, removable SD memory card, and a rugged magnesium housing complete with MINTER and cable connectors.

> **NOTICE**
>
> Performance specifications assume a minimum of 6 GPS satellites above 15 degrees in elevation and adherence to the procedures recommended in this manual.

> **NOTICE**
>
> In areas of high multipath, during periods of large PDOP, and during periods of increased ionospheric activity, performance may degrade.

> **NOTICE**
>
> Use robust checking procedures in areas of extreme multipath or under dense foliage.

Receiver Specifications

The following sections provide specifications for the receiver and its internal components.

General Details

Table A-1 table lists the receiver's general specifications.

Table A-1. Receiver General Specifications

Physical	
Enclosure	Magnesium, IPX 6 extrusion, rainproof
Color	Topcon Yellow and Topcon Grey
Dimensions	W:156.6 x H:234.5 x D:156.6 mm
Weight	1.78 kg
Antenna	Internal
Battery	Two external, detachable
Controller	External
Mounting	5/8-11, quick disconnect
Seals	Silicon (molding in Color)

Keys	Two keys:
	    Power – On/Off
	    Function – start/stop data logging; switch information mode.

LEDs	Six LEDs:
	    STAT – satellite and receiver status
	    REC – record and data status
	    RX TX – modem status
	    BT – Bluetooth wireless technology connection status
	    BATT x 2 – battery status

Environment	
Operating temperature	-20 C° to +50 C° with batteries

Table A-1. Receiver General Specifications (Continued)

Storage temperature	-20 C° to +35 C° with batteries -40 C° to +75 C° without batteries
Humidity	95%
Power	
External batteries	Li-ion, 3900 mAh, 7.2 V; 2 batteries; detachable
Battery size	132 x 52 x 25 (mm)
Battery weight	165 g (1 battery)
Operating time Average with Bluetooth "on" and 12 SVs tracked. Using new batteries and operating at room temperature.	• Modem = off – approx. 16 hours • 915 receive-only modem – approx. 13 hours • 915 modem transmitting at 250 mW – approx. 11 hours • 915 modem transmitting at 1 W – approx. 9 hours • AA-sized battery shells attached to both battery slots and modem is off – approx. 2.5 hours • Urban areas with short distance to cell sites and GSM/GPRS is on – approx. 12 hours continuous call
External power	1 port
Input voltage	9 to 21 V DC (for work) 10 to 21 V DC (for charge battery) Maximum Charge Current <=2 Amp
Consumption Average with Bluetooth "on" and 12 SVs tracked.	• Modem = off – approx. 3.5 W • 915 receive-only modem – approx. 4.4 W • 915 modem transmits at 250 mW – approx. 5.0 W • 915 modem transmits at 1 W – approx. 6 W • Urban areas with short distance to cell sites and GSM/GPRS is on – approx 4.2 W
Battery charge	Connect the AC adaptor to charge the internal battery. Available run charge when connected to external battery.
Charging time	~6 hours for full charge
On-board	Backup battery for timekeeping and almanac data storage; 10 years minimum operation

Table A-1. Receiver General Specifications (Continued)

I/O	
Communication Ports	A high speed RS232 serial port (rimmed in black), a USB port (rimmed in yellow), and an internal Bluetooth communication port (port D).
Port specifications	RS232 Serial Port Baud rate: 460800,230400,115200(Default),57600, 38400,19200,9600,4800,2400,1200,600, 300 Flow control: RTS/CTS Length: 7,8 (default) Sop bit: 1 (default), 2 Parity: None (default), Odd, Even Bluetooth port Available USB port Version 1.1
Connectors	Modem Antenna (BNC or reverse polarity TNC depending on modem type), PWR, RS232 Serial, USB
MINTER	Six external LEDs (see "LEDs" on page A-2 for details) ON/OFF control input (power button) Data logging control (FUNCTION button)
Data Features	
	Up to 20 Hz update rate for real time position and raw data (code and carrier) 10cm code phase and 0.1mm carrier phase precision RTCM SC104 version 2.1, 2.2, 2.3, and 3.0 I/O Multiple Base RTCM Geoid and Magnetic Variation models RAIM Different DATUMs support Output of grid coordinates CMR and CMR+ support
Technology	
	Advanced Multipath mitigation WAAS Adjustable PLL and DLL parameters

Table A-1. Receiver General Specifications (Continued)

NMEA	
NMEA version	Ver. 2.1, 2.2, 2.3, 3.0 output
Messages	GGA, GLL, GNS, GRS, GSA, GST, GSV, HDT, RMC, VTG, ZDA, ROT, GMP
Output interval	1Hz standard; 5, 10, 20Hz optional

DGPS	
Correction format	RTCM SC104 Ver 2.1, 2.2, 2.3, and 3.0
RTCM message type	1, 3, 9, 31, 32, 34; user selectable
Process interval	1Hz standard; 5, 10, 20Hz optional
Output interval for RTCM correction data	1Hz standard; 5, 10, 20Hz optional
Elevation mask	0 to 90 degrees (independent of data logging)
Multi-base DGPS	Differential correction select mode: Nearest, Mix, Best (optional)

RTK	
Correction format	CMR2/CMR+ (Trimble compatible), RTCM SC104 Ver 2.2, 2.3, or 3.0
RTCM message type	3, 18, 19, 20, 21, 22; user selectable
Ambiguity initialize	OTF (L1, L1/L2)
Baseline Length	Up to 50km in the morning and evening. Up to 32km at noon.
Initialize time	5 seconds to 10 min depending on the base line length and multipath conditions
Output interval for CMR/RTCM	1Hz standard; 5, 10, 20Hz optional
Elevation	0 to 90 degrees (independent of data logging)

Table A-1. Receiver General Specifications (Continued)

Solution mode	Delay (synchronization) Extrapolation (not synchronized)
Process interval	1Hz standard; 5, 10, 20Hz optional
Latency	Delay mode – 20 msec to 20 sec (depends on latency which receives corrections data from base receiver) Extrapolation – 20 to 30 msec
Raw Data logging	The receiver can record raw data at another interval during RTK operation
Status	Fix, Float, DOP, Data Link Status, Modem Latency, Common satellites, Percentage of fixing
Results	RTK coordinates, HRMS, VRMS, Covariance Matrix
Ambiguity fixing level	Selectable thresholds Low: 95%; Medium: 99.5%; High: 99.9%
Survey Modes	
Base or Rover	Static Kinematic (Stop and Go) RTK (Real-time Kinematic) DGPS (Differential GPS) WASS/EGNOS DGPS
Survey Accuracy	
Static, Fast Static	For L1+L2 – H: 3mm + 0.5ppm (x baseline length); V: 5mm + 0.5ppm (x baseline length)
Kinematic, RTK	For L1+ L2, L1 – H: 10mm + 1.0ppm (x baseline length); V: 15mm + 1.0ppm (x baseline length)
DGPS	Post processing: less than 0.25 m (HRMS) DGPS/RTCM based: less than 0.25 m (HRMS)
Cold Start Warm Start Reacquisition	< 60 sec < 10 sec < 1 sec

GPS Board Details

Table A-2 lists the GPS board's general specifications.

Table A-2. GPS Board Specifications

Receiver Type (set by activating the proper OAF)	
Internal board: GR-3	GPS: L1 (C/A & P), L2, L2C, L5 GLONASS: L1, L2 (both code and phase) GALILEO: E2-L1-E1, E5a
Hardware type: country/region/ purpose dependent	with FH915+ TX/RX/RP with FH915+ TX/RX/RP + GSM
Tracking Specifications	
Standard Channels	72 universal channels (G, GG, GD, GGD)
Optional	Cinderella days (see page A-8 for details)
Tracked Signals	GPS/GLONASS, L1/L2 C/A, L5, GALILEO, and P-Code and Carrier, WAAS/EGNOS
Tracking Functions	
Multi-path reduction	Code and Carrier
PLL/DLL setting	Bandwidth, order, adjustable
Smoothing interval	Code and Carrier
WAAS/EGNOS	WAAS optional; EGNOS optional
Data Features	
Formats	TPS, NMEA, RTCM, CMR, BINEX
Features	Up to 20 Hz update rate for real time position and raw data (code and carrier) 10cm code phase and 0.1mm carrier phase precision RTCM SC104 version 2.1, 2.2, 2.3, and 3.0 I/O Multiple Base RTCM Geoid and Magnetic Variation models RAIM Different DATUMs support

Table A-2. GPS Board Specifications (Continued)

Features (continued)	Output of grid coordinates CMR and CMR+ support
Memory	
Internal Memory	SD (secure data) card, removable
Capacity	Dependent on capacity of the installed SD/MMC card[a], currently up to 1 GB
Logging Time	53 hours (8 MB, 15sec, L1/L2, 7 satellites)
Logging Interval	0.05 to 86400 seconds, depending on purchased options

a. SD = secure digital; MMC = mulit-media card

Cinderella days is an option that turns a single frequency, GPS receiver into a dual-frequency, GPS+GLONASS receiver for 24 hours every other Tuesday at GPS midnight. Refer to Topcon's website for more information and specific Cinderella day dates.

Bluetooth Module Details

Table A-3 lists the Bluetooth wireless technology module's general specifications.

Table A-3. Bluetooth Module Specifications

Range	up to 10 m (indoor); up to 50 m (outdoor)
Type	Class 2
Service classes	Miscellaneous
Supported profiles	LM, L2CAP, SDP, SPPP
Frequency Country Code	North America and Europe

Internal TPS Spread Spectrum Modem Details

Table A-4 lists the internal TPS spread spectrum modem's general specifications.

Table A-4. Internal TPS Spread Spectrum Specifications

General	
Frequency Range country/region/ purpose dependent	902 to 928 MHz, United States 915 to 925 MHz, Australia
Signal structuring	Frequency-hopping spread spectrum
Hopping pattern	5 per band, user-selectable
Hopping channels	128
Occupied bandwidth	100 KHz
Frequency modulation technique	FSK, 64 Kbps
System gain	135 dB
Network topology	Point-to-point, Point-to-multipoint
Operation mode	Transmitter, Receiver, Repeater
Protocol	FH915, FH915+
Transmitter (TX)	
Carrier power	250 mW (24 dBm)/1 W (30 dBm), user selectable
Receiver (RX)	
Sensitivity	-105 dBm at 10-4 BER
Dynamic range	105 dBm

Table A-4. Internal TPS Spread Spectrum Specifications (Continued)

Data communications	
Serial interface	RS232
Serial data rate	9600, 19200, 38400, 57600 bps, user selectable
Effective radio link rate	9600, 10200, 17000, 51000 bps User selectable for FH915; automatic selection for FH915+
Error correction	FEC (15.7), majority decoding
Antenna Type	
Type	1/2 wave articulating whip
Connector	Reverse polarity TNC
Gain	2.5 dBi

Optional GSM/GPRS Module Details

Table A-5 lists the internal general specifications for the internal modem connection for an optional GSM/GPRS module.

Table A-5. GSM/GPRS Module Specifications

Operating systems	EGSM: 900/1800 MHz; GSM: 850/1900 MHz;
TX power	0.6 W (850 MHz); 2 W (900 MHz); 1 W (1800/1900 MHz);
GPRS	Multi-slot class 8 (4 down; 1 up); Max BR 85.6 Kbps; Class B GSM 07.10 multiplexing protocol; Coding scheme CS1-CS4;
CSD	Max BR 14.4 Kbps;
SMS	MO/MT Text and PDU modes; Cell broadcast;

Connector Specifications

The GR-3 has one antenna connector for radio transmission/reception and three port connectors for power and data upload/download.

Radio (Modem) RF Connector

The modem connector (Table A-6) is a reverse polarity TNC connector for spread spectrum.

Table A-6. Modem Connector Specifications

Modem	Type	Signal Type	Dir	Details
Spread Spectrum	Reverse polarity TNC	Modem I/O	I/O	RF/GSM output from modem antenna

Power Connector

Rimmed in red, the power connector (Figure A-1) is a sealed receptacle, 5 pin, ODU part number G80F1C-T05QF00-0000.
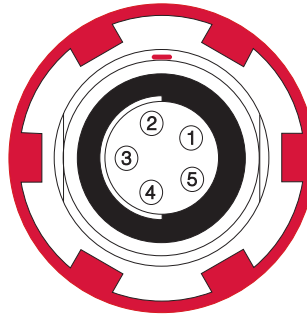
Figure A-1. Power Connector

Table A-7 gives power connector specifications.

Table A-7. Power Connector Specifications

Number	Signal Name	Dir	Details
1	Power_INP	P	9 to 21 volts DC input

Table A-7. Power Connector Specifications (Continued)

Number	Signal Name	Dir	Details
2	Power_INP	P	9 to 21 volts DC input
3	Power_GND	P	Ground, power return
4	Power_GND	P	Ground, power return
5	Aux_Power	P	9 to 21 volts DC input

Serial C-RS232 Connector

Rimmed in black, the serial RS232 connector (Figure A-2) is a sealed receptacle, 7 pin, ODU part number G80F1C-T07QC00-0000.

Figure A-2. Serial RS232 Connector

Table A-8 gives the RS232 cable connector specifications.

Table A-8. RS232 Connector Specifications

Number	Signal Name	Dir	Details
1			Not used
2	GND	-	Signal ground
3	CTS	I	Clear to send
4	RTS	O	Request to send
5	RXD	I	Receive data
6	TXD	O	Transmit data

Table A-8. RS232 Connector Specifications (Continued)

Number	Signal Name	Dir	Details
7			Not used

USB Connector

Rimmed in yellow, the USB connector is a sealed receptacle, 4 pin TPS cable connector (Figure A-3).
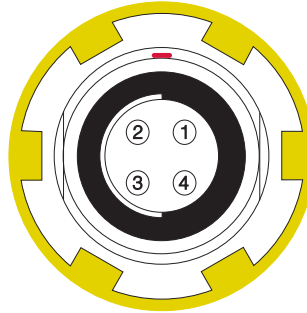
Figure A-3. USB Connector for GGD Options

Table A-9 gives the USB connector specifications.

Table A-9. USB Specifications

Number	Signal Name	Dir	Details
1	USB_PWR	P	Bus power input
2	USB D-	I/O	Data minus
3	USB D+	I/O	Data plus
4	GND	-	Ground

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Safety Warnings

General Warnings

NOTICE

To comply with RF exposure requirements, maintain at least 25cm between the user and the radio modem.

WARNING

TPS receivers are designed for survey and survey related uses (that is, surveying coordinates, distances, angles and depths, and recording such measurements). This product should never be used:

- Without the user thoroughly understanding this manual.
- After disabling safety systems or altering the product.
- With unauthorized accessories.
- Without proper safeguards at the survey site.
- Contrary to applicable laws, rules, and regulations.

DANGER

TPS receivers should never be used in dangerous environments. Use in rain or snow for a limited period is permitted.

Battery Pack Warnings

DANGER	Never attempt to open the casing of the detachable batteries! Lithium-Ion batteries can be dangerous if mishandled!
DANGER	Do not incinerate or heat battery pack above 212 degrees fahrenheit (100 degrees celsius). Excessive heat can cause serious damage and possible explosion.
WARNING	Tampering with the batteries by end users or non-factory authorized technicians will void the battery's warranty. • Do not attempt to open the battery pack or replace it. • Do not disassemble the battery pack. • Do not charge in conditions different than specified. • Do not use other than the specified battery charger. • Do not short circuit. • Do not crush or modify.

Usage Warnings

⚠️ **CAUTION**
If this product has been dropped, altered, transported or shipped without proper packaging, or otherwise treated without care, erroneous measurements may occur.

The owner should periodically test this product to ensure it provides accurate measurements.

Inform TPS immediately if this product does not function properly.

⚠️ **CAUTION**
Only allow authorized TPS warranty service centers to service or repair this product.

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Regulatory Information

The following sections provide information on this product's compliance with government regulations for use.

FCC Compliance

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.

This equipment has been tested and found to comply with the limits for a digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause interference to radio or television equipment reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Move the equipment away from the receiver.
- Plug the equipment into an outlet on a circuit different from that to which the receiver is powered.
- Consult the dealer or an experienced radio/television technician for additional suggestions.

> **CAUTION**
>
> Any changes or modifications to the equipment not expressly approved by the party responsible for compliance could void your authority to operate such equipment.

Community of Europe Compliance

The product described in this manual is in compliance with the R&TTE and EMC directives from the European Community.

WEEE Directive

Following information is for EU-member states only:

The use of the symbol indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. For more detailed information about the take-back and recycling of this product, please contact your supplier where you purchased the product or consult.

Warranty Terms

TPS laser and electronic positioning equipment are guaranteed against defective material and workmanship under normal use and application consistent with this Manual. The equipment is guaranteed for the period indicated, on the warranty card accompanying the product, starting from the date that the product is sold to the original purchaser by TPS' Authorized Dealers.[1]

During the warranty period, TPS will, at its option, repair or replace this product at no additional charge. Repair parts and replacement products will be furnished on an exchange basis and will be either reconditioned or new. This limited warranty does not include service to repair damage to the product resulting from an accident, disaster, misuses, abuse or modification of the product.

Warranty service may be obtained from an authorized TPS warranty service dealer. If this product is delivered by mail, purchaser agrees to insure the product or assume the risk of loss or damage in transit, to prepay shipping charges to the warranty service location and to use the original shipping container or equivalent. A letter should accompany the package furnishing a description of the problem and/ or defect.

The purchaser's sole remedy shall be replacement as provided above. In no event shall TPS be liable for any damages or other claim including any claim for lost profits, lost savings or other incidental or consequential damages arising out of the use of, or inability to use, the product.

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1. The warranty against defects in a Topcon battery, charger, or cable is 90 days.

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Topcon Positioning Systems, Inc.
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FM 68448