TOPCON
POSITIONING SYSTEMS

HiPer® XT
Operator's Manual

Part Number 7010-0713
Rev A

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ECO#xxxx

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Notes:

Preface

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NOTICE *NOTICE*

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

FCC Class B 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 Class B 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.

Canadian Emissions Labeling Requirements

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Réglement sur le matériel brouilleur du Canada.

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**.

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, 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.

Introduction

This chapter describes:

- The HiPer® XT receiver (Figure 1-1)
- GPS and your receiver
- Common receiver functions
- Standard package contents and configurations
- Receiver components
- The Option Authorization File (OAF)

Figure 1-1. HiPer XT Receiver

Overview

Topcon Positioning System's HiPer XT is a dual-frequency, GPS+ receiver built to be the most advanced and compact receiver for the surveying market. The HiPer XT 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 HiPer XT can receive and process both L1 and L2 signals, improving the accuracy of your survey points and positions. The dual-frequency and GPS+ features of HiPer XT combine to provide a real time kinematic (RTK) system accurate for short and long baselines. Several other features, including multipath mitigation and co-op tracking, provide under-canopy and low signal strength reception. The receiver provides the functionality, accuracy, availability, and integrity needed for fast and easy data collection.

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 GPS and receiver functions to help you understand and apply GPS principles, allowing you to get the most out of your receiver.

GPS Overview

The Global Positioning System (GPS) is a satellite-based, line-of-sight radio navigation system run by the United States Department of Defense (DoD). This system offers a global, all weather, 24-hour positioning, velocity, and time service to any user equipped with a GPS tracking receiver, who is on or near the Earth's surface. The Global Navigation Satellite System (GLONASS), is the Russian Federation Ministry of Defense counterpart to GPS.

For information on the current status of the GPS constellation, visit http://tycho.usno.navy.mil/ or http://www.navcen.uscg.gov/. For GLONASS, visit http://www.glonass-center.ru/frame.html.

Despite numerous technical differences in the implementation of these systems, both GPS and GLONASS have three essential components:

- Space – GPS and GLONASS satellites orbiting approximately 12,000 nautical miles above Earth and are equipped with a clock and radio. These satellites broadcast 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 GPS/GLONASS receivers and the corresponding satellites to calculate positions.

Calculating Positions

Once the receiver locks on to a satellite, it starts recording measurements and receiving the various digital information (ephemerides, almanac, and so on) the satellites broadcast. To calculate a position, receivers use the following formula:

Velocity x Time = Distance

Where Velocity is the speed at which radio waves travel (i.e., the speed of light) and Time is the difference between the signal transmission time and signal reception time.

To calculate absolute 3-D positions—latitude, longitude, altitude—the receiver must lock on to four satellites. In a mixed, GPS and GLONASS scenario, receiver's must lock onto at least five satellites to obtain an absolute position.

To provide fault tolerance using only GPS or only GLONASS, the receiver must lock onto a fifth satellite. Six satellites will provide fault tolerance in mixed scenarios.

Once locked on to a satellite, the receiver collects ephemerides and almanacs, saving this information to its NVRAM (Non-Volatile RAM).

- 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.

GPS Positioning

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 anti-spoofing 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 GPS and GLONASS 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.

– Wide Area 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 GPS and GLONASS positioning. For more detailed information, visit the TPS website (www.topconps.com/gpstutorial/).

Receiver Overview

When power is turned on and the receiver self-test completes, the receiver's 20 channels initialize and begin tracking visible GPS satellites. Each of the receiver's channels can be used to track C/A-L1, P-L1, or P-L2 signals. The number of channels available allows the receiver to track all visible GPS 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, it is possible to solve the so-called "absolute positioning problem" and compute the receiver's coordinates (in WGS-84) and the time offset between the receiver clock and GPS time. All this information is stored in the receiver's memory, which can be downloaded later onto a computer and processed using a post-processing software package. When the receiver is run 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:

- Co-Op Tracking
- Multipath reduction
- Wide area augmentation system (WAAS)
- Adjustable phase locked loop (PLL) and delay lock loop (DLL) parameters
- Dual-frequency static, kinematic, real-time kinematic (RTK), and differential GPS (DGPS) survey modes
- Auto data logging
- Setting different mask angles
- Setting different survey parameters
- Static or dynamic modes

Standard Package Contents

The HiPer XT comes in either a base or real-time kinematic (RTK) package (also, refer to the packaging instruction card). The contents of this package include:

- One HiPer XT receiver and one Legacy-E+, GB-500, or GB-1000 receiver

  OR

  Two HiPer XT receivers
- LitePole
- Tripod, tribrach, and adapter
- Topcon Tools™ software (optional)
- Cables, connectors, and adapters
- Literature

Cables

Standard cables (Figure 1-2) can include the following:

- Receiver-to-computer RS232 serial cable (p/n 14-008005-03) – connects the receiver's serial port and an external device (hand-held controller or computer)
- Receiver-to-SAE power cable (p/n 14-008016-03) – connects the receiver's power port and the power supply's SAE connector or the extension cable's SAE connector
- SAE-to-SAE cable extension (p/n 14-008022-01) – connects SAE connectors over longer distances
- Alligator clips-to-SAE cable (p/n 14-008025-01) – connects any 12-volt DC power source and the Receiver-to-SAE power cable
- Power supply-to-outlet cable (p/n 14-008052-01 for U.S. or 14-008054-01 for E.U.) – connects the power charger to a power outlet
- USB cable (p/n 14-008031-01) – connects the receiver and an external device (hand-held controller or computer) via the USB ports

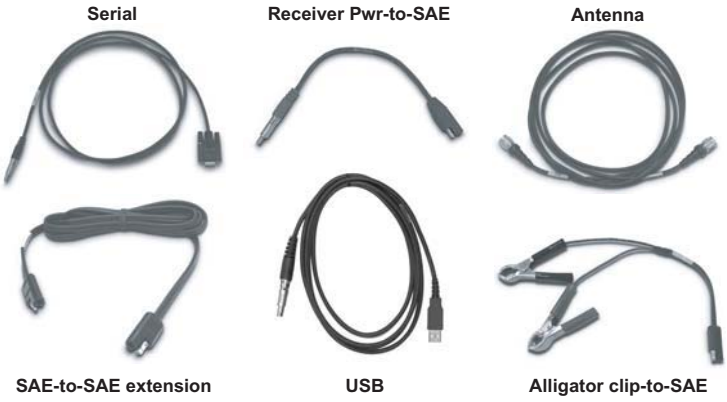

Figure 1-2. System Cables

Power Supply/Charger

The Power Supply/Charger unit (p/n 22-034101-01) is used to charge the internal batteries when connected to a grounded outlet; it can also be used as an external power source (Figure 1-3). This unit converts the alternating current (AC) normally supplied from an electrical outlet to a direct current (DC) used to charge the batteries and power the receiver.

- input voltage – between 100 and 240 V AC
- frequency of input power – between 50 Hz and 60 Hz
- output voltage – 12 V DC@2.5 A (30 W)

Figure 1-3. Power Supply/Charger

Software

Standard receiver software includes:

- PC-CDU – controller software that can run on a Windows®-based computer.
- FLoader – Topcon's firmware loader; available on the Topcon website.
- BTCONF – Topcon's Bluetooth® wireless technology module configuration program; available on the Topcon website.
- Modem-TPS – Topcon's radio modem configuration software; available on the Topcon website.
- Topcon Tools – optional; Topcon's post-processing software.

Software and software information are also available on the Topcon website (www.topcongps.com/software/index.html or http://www.topcongps.com/software/3rdparty.html).

The following software will also be useful for operating, caring for and using your receiver, and may be required for some applications.

- TopSURV – Topcon's field data collection software; among many other functions, can be used to configure the radio/modem.
- Carlson SurvCE – optional third-party software for data collection; contact your TPS dealer.

Literature

Receiver literature includes:

- One year warranty card
- *HiPer XT Operator's Manual*
- Functional specifications
- Packaging instruction card

Manuals and other product information are also available on the Topcon website—www.topcongps.com/support/manuals.html or www.topcongps.com/hardware/index.html (then click on the appropriate product).

The following manuals will also be useful for operating and caring for your receiver. These are also available on the Topcon website (www.topcongps.com/support/manuals.html).

- *PC-CDU User's Manual*
- *FLoader User's Manual*
- *BTCONF User's Manual*
- *Modem-TPS User's Manual*

Getting Acquainted

The HiPer XT receiver is 158.5mm wide, 173mm deep, 113mm high, and weighs approximately ??kg. The receiver's advanced design allows users to significantly reduce the number of cables required for receiver operation, with the ability to perform jobs more reliably and efficiently, especially when moving.

The receiver is also versatile and can be configured in several different ways. The casing allocates space for two nonremovable, on-board Li-Ion batteries, a Bluetooth wireless technology module, a GSM communication module (optional), and two Euro cards. One of the Euro cards is the GPS receiver and the other is used for UHF communications.

See Table 1-2 on page 1-13 for a description of the operating times for the HiPer XT receiver as a Base or Rover. For receiver specifications, see Appendix A.

Internal Components

The following sections describe the internal components of the HiPer XT receiver.

GPS+ Antenna

An internal, micro-strip antenna capable of receiving GPS L1/L2 signals and GLONASS L1/L2 signals.

Bluetooth Module

A combination of software and hardware technology that makes the HiPer XT a mobile, wireless, GPS+ receiver that support a point-to-point serial profile. As such, the HiPer XT can transfer and synchronize files between the receiver and any other Bluetooth wireless technology device that supports serial profile, including portable handheld devices and external controllers, Bluetooth adapters for PC-USB/RS ports, mobile computers and phones, IPAQs, PCMCA-to-Bluetooth adapters, etc.

With Bluetooth wireless technology, the receiver's reception and transmission distance is 10 meters (32 feet) for interior projects and 30–50 meters (98–164 feet) for exterior projects.

The Bluetooth module's processor and firmware are independent of the receiver card and power board.

Radio Modem

The receiver incorporates an internal, TPS UHF transmitter/receiver at 20MHz bandwidth, with a 12.5/25kHz channel spacing, and a maximum 2W power output for data transmission. The Base station's modem transmits the carrier phase and code measurements along with the reference station information (that is, location) to the Rover station modem.

The frequency range of the modem depends on the country in which the receiver is used: for North America, the frequency range is 410–470; for all other countries, contact your local distributor.

TIP

The HiPer XT is compatible with Pacific Crest radio modems.

GSM Module

GSM modems function similarly to a standard cell phone, where one modem (at the Rover) calls another (at the Base). If your receivers are configured with GSM capabilities, a phone number and service plan are required. Contact your Topcon dealer for details.

ANYTHING ELSE??

The GSM module internally connects to and controls through the UHF modem board.

Power Board

The internal power board manages receiver power and battery charging, and is connected to the receiver board and the batteries. The power board receives power from the internal batteries, even when the

receiver is turned off. This feature allows the internal batteries to charge, regardless of the receiver's status (on or off). To prevent the batteries from discharging when the receiver is stored, put the receiver in Zero Power Mode (see "Zero Power Mode" on page 4-19 for more information). The batteries will not charge in this mode.

The power board's processor and firmware are independent of the receiver card. To ensure firmware compatibility, the GPS receiver board and power board must be loaded with firmware from the same package.

GPS+ Receiver Board

The receiver is supplied with a Euro-112T card capable of processing the following signals:

- GPS L1 or GPS L1/L2
- GPS/GLONASS L1 or GPS/GLONASS L1/L2

Table 1-1 lists the options available for these cards.

Table 1-1. Euro Card Options for HiPer XT

Euro Card Model	Available Options
Euro-112T (HGGDT)	G: GPS L1 GD: GPS L1/L2 GG: GPS/GLONASS L1 GGD: GPS/GLONASS L1/L2

A WAAS-enabled TPS receiver allows simultaneous tracking of two WAAS satellites. Each of the WAAS satellites is allocated its own channel.

Battery

The receiver is equipped with two non-removable, on-board, rechargeable Lithium-Ion battery packs connected to the receiver's power board. Each one of these Lithium-Ion battery packs is 7.4 V and 4 Ah, giving you a total power of 7.4 V, nominal, and 8 Ah when fully charged.

Table 1-2 describes the operating times for the HiPer XT receiver, with the internal batteries fully charged and dependent on the mode of the modem.

Table 1-2. Operating Times

Modem Mode	Base	Rover
TX mode ON (2W)	11 hours	--
TX mode ON (1W)	??	--
RX mode ON	--	14 hours
OFF	16 hours	16 hours

The Li-Ion batteries used in the HiPer XT should run at no less than 98% capacity after 500 charging cycles. These batteries do not need to be drained before recharging.

A battery charger (AC adapter) is included with the standard package. See Appendix A for technical specifications on the battery.

External Components

The HiPer XT casing includes panels for radio antenna attachment, a user interface, a power port, and ports for configuration.

Bottom Panel

The bottom panel of the HiPer XT receiver has the receiver serial number, receiver part number, receiver type (Base or Rover), and antenna reference point (ARP).

Radome

Figure 1-4 on page 1-14 shows the radome components:

- Internal antenna – Location of GPS/GLONASS internal antenna.
- Modem antenna connector – Modem antenna connector used for internal modem RF connection. This is a BNC female connector for UHF modems.

Figure 1-4. HiPer XT Radome

Front Panel

Figure 1-5 on page 1-15 shows front panel components for the HiPer XT receiver:

- MINTER – The Minimum INTERface for the receiver consisting of three keys and four, three-color LEDs. See “Using the MINTER” on page 4-2 for descriptions and usages of the MINTER components.
- Reset – This key performs a hard reset for both the receiver board and the power board. Once this key is pressed, the controllers governing the receiver and power boards reboot and the device restarts.
- This key can be used to leave Zero Power Mode or if the receiver does not respond to commands. See “Using the MINTER” on page 4-2 for more information.
- Four serial ports:
  - Port A used for communication between the receiver and a controller or any other external device.
  - Port B used internally to connect the receiver board and Bluetooth module.

– Port C used internally to connect the modem and receiver boards.

– Port D used for communication between the receiver and an external device.

- USB – used for high-speed data transfer and communication between the receiver and an external device.
- PWR – The power input port to which an external power source (+6 to +28 V DC) is connected and where the unit is charged.
- Slant height measure mark (SHMM).

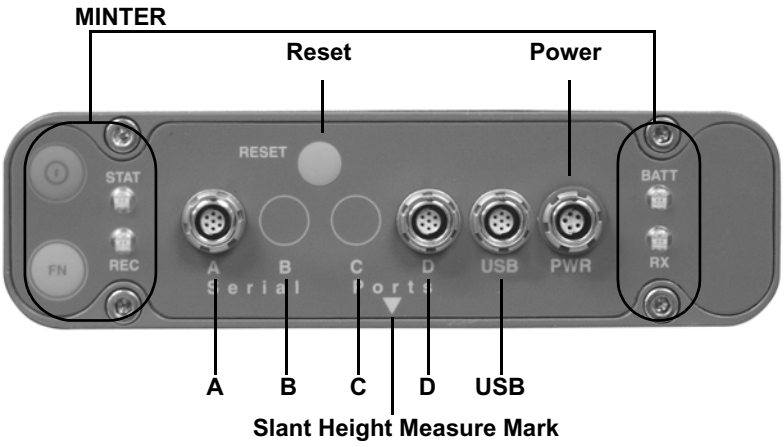

Figure 1-5. HiPer XT Front Panel

Back Panel

Figure 1-6 shows back panel components for the HiPer XT.

- Vent plug – Equalizes the pressure between the inside of the receiver and the outside environment.
- Slant height measure mark (SHMM)

Figure 1-6. HiPer XT Back Panel

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 (www.topcongps.com/tech/index) or consult your TPS dealer.

- Type of signal (standard L1; optional L2)
- Memory (standard 0MB; optional 1MB to 128MB)

- Update rate standard 1Hz (optional 5, 10, or 20Hz)
- RTK at 1Hz, 5Hz, 10Hz, and 20Hz
- RTCM/CMR Input/Output
- Event marker
- Co-Op tracking
- Advanced multipath reduction
- Wide Area Augmentation System (WAAS)
- Receiver Autonomous Integrity Monitoring (RAIM)
- 1 PPS (Pulse-Per-Second; a timing signal)

Notes:

Configuration

This chapter describes:

- Receiver's power supply
- Connecting the receiver and a computer
- Configuring the receiver
- Minimum INTERface (MINTER) configuration
- Radio configuration
- Bluetooth module configuration
- Collecting almanacs

Before you can begin using the HiPer XT receiver, do the following:

1. Charge the batteries. See "Powering the Receiver" on page 2-2.
2. Configure the various parts of your receiver. See:
   - "Connecting the Receiver and a Computer" on page 2-10,
   - "Receiver Configuration" on page 2-15,
   - "MINTER Configuration" on page 2-18,
   - "Radio Configuration" on page 2-25, and
   - "Bluetooth Module Configuration" on page 2-43.
3. Collect an almanac. See "Collecting Almanacs" on page 2-48.

Powering the Receiver

You can power the receiver using the internal batteries, using an external battery, or a battery charger.

Internal Batteries

With a full charge, and depending on the mode of the radio modem, the internal batteries should power the GPS receiver and the radio modem according to the times listed in Table 2-1.

Table 2-1. Operating Times

Modem Mode	Base	Rover
TX mode ON (2W)	11 hours	--
TX mode ON (1W)	??	--
RX mode ON	--	14 hours
OFF	16 hours	16 hours

1. To charge the internal batteries:
   - Plug the receiver-to-SAE power cable into the receiver's power input port.
   - Connect the receiver-to-SAE power cable and the power supply-to-outlet cable to the AC adapter.
   - Plug the power supply-to-outlet cable into an available outlet.
2. Press the **Reset** key on the receiver. This will ensure that the receiver is in Normal mode for charging. The receiver will not charge in Zero Power Mode (for details, see "Zero Power Mode" on page 4-19).
3. Leave overnight. An approximately seven-hour charge cycle will charge the batteries about 90%. An approximately nine-hour charge cycle will fully charge the receiver. The internal batteries can not be overcharged.

The speed of the charge depends on the Power and Charger settings on the Receiver Configuration screen, and whether the receiver is turned off or on. See “Power Management” on page 2-5 for more information.

The Li-Ion batteries used in the receiver should run at no less than 98% capacity after 500 charging cycles. These batteries do not need to be drained before recharging.

External Batteries

In addition to the internal batteries, you can use your receiver with external batteries (Figure 2-1 on page 2-4). External batteries allows you to continue using the receiver in case the internal batteries are discharged and requires the following:

- a 12 V, 2.3 A*h battery
- a 2.3 A*h battery clip-to-SAE cable
- an SAE-to-Power Plug cable

NOTICE

When the receiver uses external batteries, set the charger mode to Off. Otherwise, the external batteries will also charge the internal batteries, causing operation time to decrease. See “Power Management” on page 2-5 for more information on setting the charger mode.

1. Connect the SAE ends of the battery clip-to-SAE and the SAE-to-power plug cables.
2. Plug the power cable into the receiver’s power port.
3. Attach the battery clip to the battery.

A single external 12 V, 2.3 A*h battery should run the receiver for about 7 hours and the receiver and modem for 5 hours.

Figure 2-1. External Battery Attached to Receiver

TIP

You can also use an SAE-to-SAE extension cable and an Alligator clip-to-SAE cable, and power the receiver from a battery, such as the battery used to power your Base radio or similar battery.

Battery Charger

The same charger used to charge the internal batteries can be used as an external power supply for the receiver. The charger is provided with the receiver package.

1. Connect the receiver-to-SAE cable to the receiver's power port.
2. Connect the SAE end of the cable to the battery charger.
3. Plug the battery charger's power cable into the AC adapter.
4. Plug the power cable into an available, grounded outlet. The power input for your battery charger should be AC between 90 and 264 V 1A (110 V AC) and between 47 Hz and 63 Hz. The battery charger outputs DC 12 V 2.5 A (30 W).

Turning On/Off the Receiver

To turn ON the receiver, press and hold the green **power** key for about 0.5 seconds and release it.

NOTICE *NOTICE*

If the receiver does not turn on, it may be in Zero Power Mode. See "Zero Power Mode" on page 4-19 for more information.

To turn OFF the receiver, press and hold the green **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.

Power Management

You can use Topcon's PC-CDU software to manage your receiver's power. The complete description of PC-CDU exceeds the scope of this manual, but can be found in the *PC-CDU User's Manual*. The latest copy of this software and the manual can be downloaded from the TPS website.

To access the dialog box controlling the power settings for the receiver, take the following steps:

1. Connect your receiver and computer. See "Connecting the Receiver and a Computer" on page 2-10 for this procedure.
2. Once connected, click **Configuration ▸ Receiver**.
3. Select the *Power Mode* drop-down list to set the desired power source (Figure 2-2 on page 2-6). *Current Mode* displays the current power source.
    - Auto – receiver automatically selects the power source
    - Mix – receiver automatically detects and consumes power from the source with the largest voltage
    - Battery A – receiver consumes power from battery A
    - Battery B – receiver consumes power from battery B

- External – receiver uses an external power supply

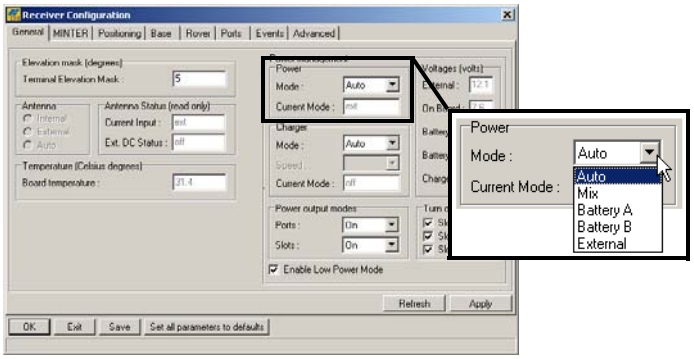

Figure 2-2. Select Power Mode

4. Select the *Charger Mode* drop-down list to set the desired charger mode (Figure 2-3). *Current Mode* displays the charging battery: a, b, or none (off).

   - Off – receiver will not charge batteries
   - Charge A – receiver charges only battery A
   - Charge B – receiver charges only battery B
   - Auto – receiver automatically detects and charges both batteries

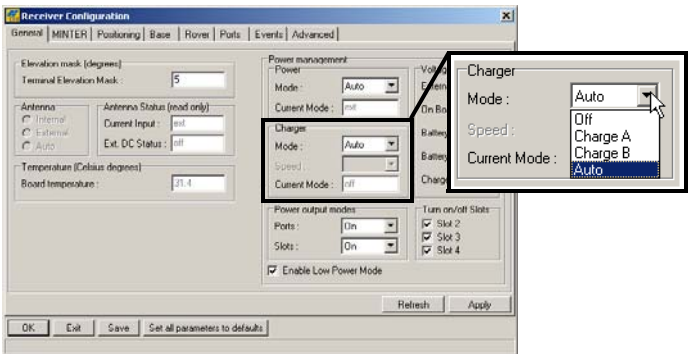

Figure 2-3. Select Charger Mode

5. Select the *Power output modes Ports* drop-down list to set power output on the serial ports (Figure 2-4).
   - On – the power board will deliver voltage on pin one of all serial port connectors when the receiver is turned on. If the receiver is turned off, there will be no power on any ports.
   - Off – power will be absent even if the receiver is on.
   - Always – the power board will deliver voltage on pin one of all serial port connectors even if the receiver is turned off.
6. Select the *Power output modes Slots* drop-down list to set power output on internal slots (Figure 2-4).
   - On – all slots are powered if the receiver is turned on
   - Off – internal slots will not be powered even if the receiver is turned on
   - Always – internal slots will be powered even if the receiver is turned off

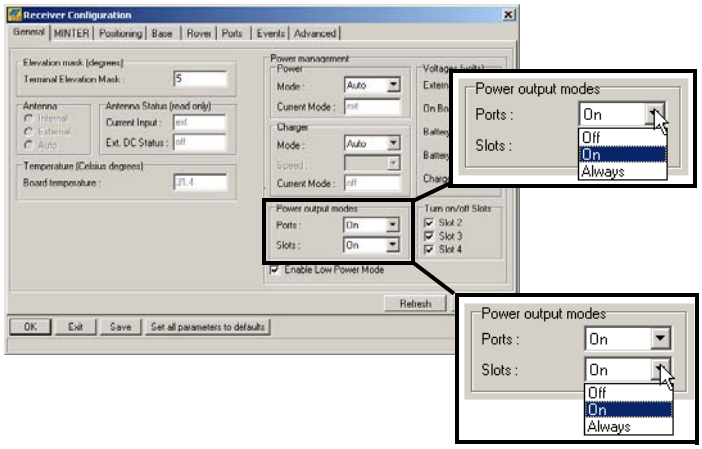

Figure 2-4. Select Power Output Modes – Ports and Slots

7. View the *Voltages* information (Figure 2-5 on page 2-8).
   - 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

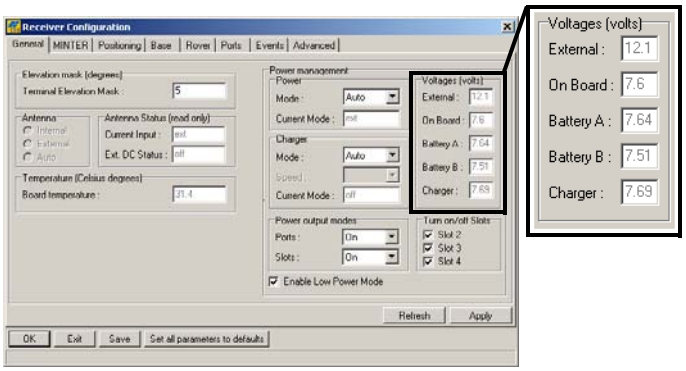

Figure 2-5. View Voltages Information

8. Select and check each of the *Turn on/off Slots* check boxes to enable the corresponding internal slots (Figure 2-6).
9. Select and check the *Enable Low Power Mode* check box to put the receiver's processor into low power consumption mode (Figure 2-6).

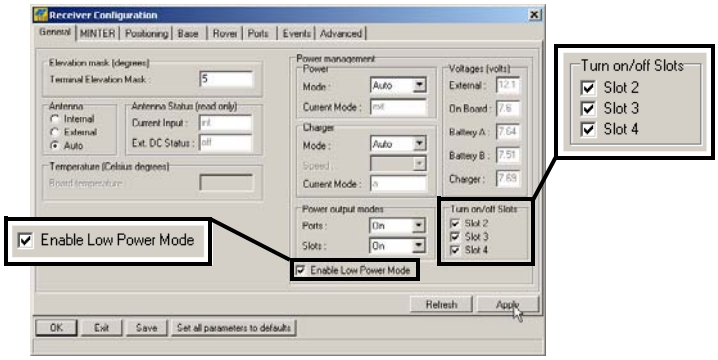

Figure 2-6. Enable and Apply Power Settings

10. Click **Apply**.

Charging Internal Batteries

Use one of the following conditions for maximum battery charge speed:

- The receiver is turned off. Power Mode and Charger Mode are set to Auto. See “Power Management” on page 2-5 for setting these parameters.
- The receiver is turned on. Power Mode is set to External and Charger Mode is set to Auto.

1. To charge the internal batteries:
   - Plug the receiver-to-SAE power cable into the receiver’s power input port.
   - Connect the receiver-to-SAE power cable and the power supply-to-outlet cable to the AC adapter.
   - Plug the power supply-to-outlet cable into an available outlet.
2. Press the **Reset** key on the receiver. This will ensure that the receiver is in Normal mode for charging. The receiver will not charge in Zero Power Mode (see “Zero Power Mode” on page 4-19 for more information).
3. Leave overnight. A seven-hour charge will charge the batteries about 90%. A nine-hour charge will fully charge the receiver. The internal batteries cannot be overcharged.
4. When finished charging, set the *Power Mode* to *Auto*.

NOTICE *NOTICE*

If you remove a power supply cable before setting Power Mode to Auto, the receiver will be turned off. To turn it on, you will need to connect an external power supply once again.

Checking Internal Battery Status

To check the status of the internal batteries:

1. Check the BATT LED 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.
2. Do one of the following:
   - 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.

Connecting the Receiver and a Computer

To configure, manage files, or maintain the receiver, connect the receiver and a computer, 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 at http://www.topcongps.com/software/updates.html)

Once you have established a connection between the receiver and the computer (whether through Bluetooth wireless technology, the RS232 cable, or the USB cable), you will be able to:

- configure the receiver and its components
- send commands to the receiver
- download files from the receiver's memory
- load new firmware using FLoader™, OAFs, and configuration files to a receiver

Establishing a Wireless Connection

The HiPer XT 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 iPAQ, or a computer with USB-to-Bluetooth adapter or PCMCA-to-Bluetooth adapter installed.

NOTICE *NOTICE*

Changing the receiver's Port B default settings will affect the Bluetooth link. The default settings for Port B 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 *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. Once connected, continue with Step 1 in "Establishing a PC-CDU Connection" on page 2-13.

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 3* (B) 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 A.
2. Press the **power** buttons on the receiver and computer to turn them on.
3. Continue with Step 1 in "Establishing a PC-CDU Connection" on page 2-13.

Establishing a USB Connection

Make sure the computer has the TPS USB driver installed.

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. Continue with Step 1 in "Establishing a PC-CDU Connection" on page 2-13.

Establishing a PC-CDU Connection

PC-CDU is a 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.

1. Once the receiver and a computer are connected, start PC-CDU on your computer. The PC-CDU main screen displays (Figure 2-7).

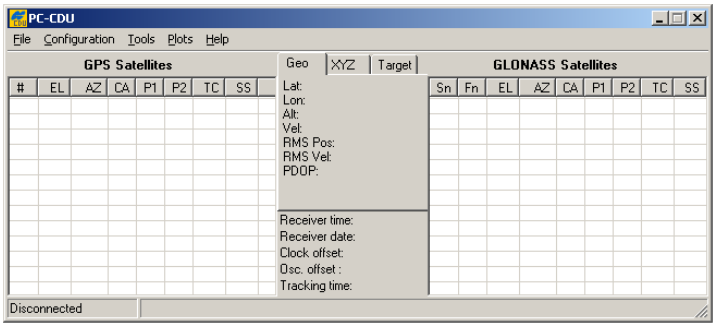

Figure 2-7. PC-CDU Main Screen

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

2. Click **File ▸ Connect**.
3. On the ***Connection Parameters*** dialog box, select the following parameters and click **Connect**:
   - for Bluetooth or RS232 connections (Figure 2-8 on page 2-14):
     – Set the Connection mode (Direct).
     – Set the port for your computer (typically COM1, COM2 for RS232 connection and COM3, COM4, etc. for Bluetooth connection) from the Port drop-down list.

– Set the communication rate between the receiver and the computer (usually 115200) from the Baud rate drop-down list.

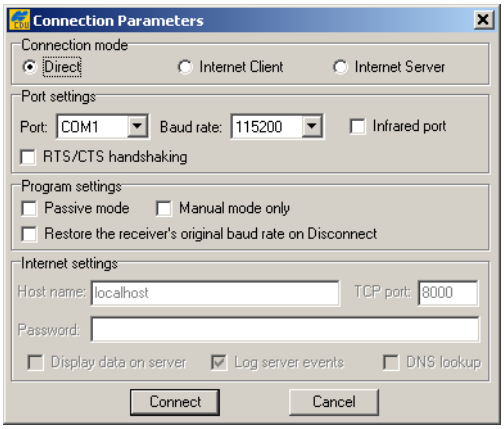

Figure 2-8. Bluetooth and RS232 Connection Parameters

- for USB connections (Figure 2-9):
  – Set the Connection mode (Direct).
  – Set the port for your computer (USB) from the Port drop-down list.
  – Select the receiver's ID from the Rec ID drop-down list.

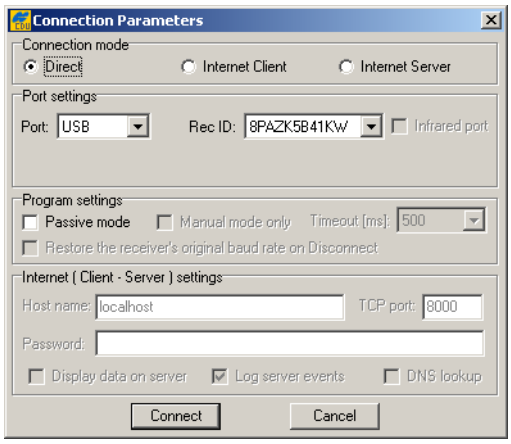

Figure 2-9. USB Connection Parameters

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 2-10).

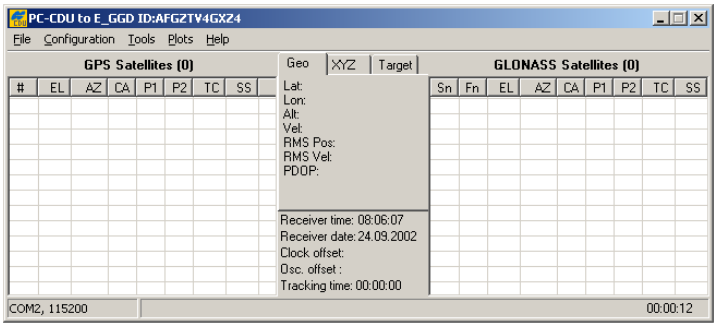

Figure 2-10. PC-CDU Connection Established

Receiver Configuration

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

TIP

Refer to the *PC-CDU User's Manual* to manage all possible receiver configurations.

The following configuration is recommended for the most common applications. However, you can select configuration parameters as needed for your particular jobsite.

NOTICE

Click Apply after making any configuration change, otherwise your receiver will not accept the change.

1. Connect your receiver and computer. See “Connecting the Receiver and a Computer” on page 2-10 for this procedure.
2. Once connected, click **Configuration ▸ Receiver** (Figure 2-11).
3. Click the **MINTER** tab, configure the following settings, and click **Apply** (Figure 2-11).
   - Set the *Recording interval* in seconds.
   - Set the *Elevation mask for Log file* in degrees.
   - Enter the *File name prefix*. Use the last three digits of the receiver serial number.The receiver’s serial number and part number can be found on the bottom panel of the receiver.

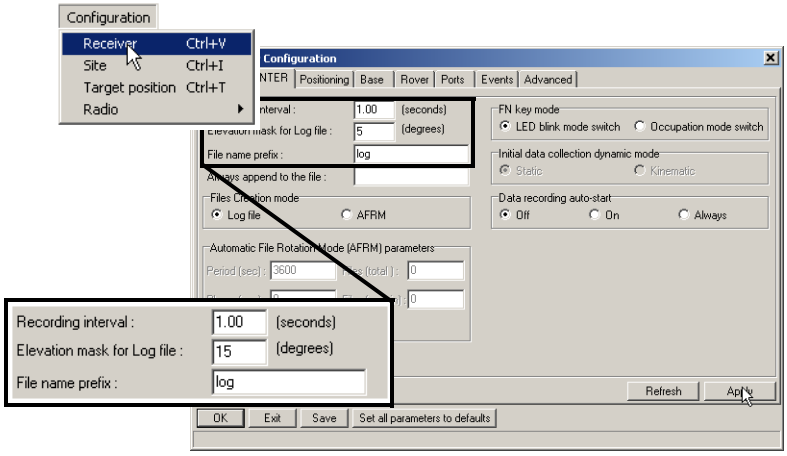

Figure 2-11. Receiver Configuration – MINTER Tab

If your jobsite is in an area that has obstructions (buildings, trees, etc.), and/or the antenna location is near reflective objects, configure the receiver to reduce errors from these sources.

WARNING

Do not make other changes without consulting the *PC-CDU User’s Manual*.

4. Click the **Advanced** tab then the **Multipath Reduction** tab, enable the following boxes, and click **Apply** (Figure 2-12).
   - *Code multipath reduction*
   - *Carrier multipath reduction*

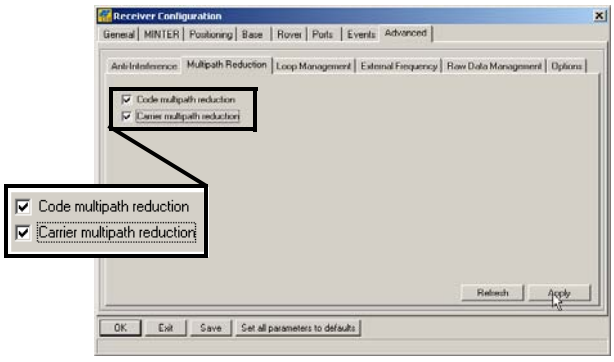

Figure 2-12. Receiver Configuration – Advanced Tab

5. Click the **Loop Management** tab, enable the following boxes, and click **Apply** (Figure 2-13).
   - *Enable Co-Op tracking*
   - *Static Mode*

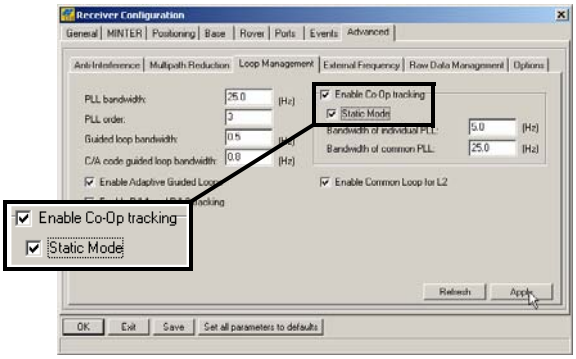

Figure 2-13. Advanced Configuration – Loop Management

6. Click **OK** to close the ***Receiver Configuration*** dialog box.
7. Click **File ▸ Disconnect**, then **File ▸ Exit** to quit PC-CDU. Disconnecting before exiting ensures proper port management.

NOTICE

Disconnecting the receiver from the computer before exiting will eliminate any possible conflict in the management of your serial ports.

Once the receiver is configured, the configuration will remain until you change it either using PC-CDU or clearing the NVRAM.

MINTER Configuration

The Minimum INTERface (MINTER) consists of three keys (Power, FN, and Reset) and four LEDs (STAT, REC, BATT, and RX) that control and display the receiver's operation (Figure 2-14).

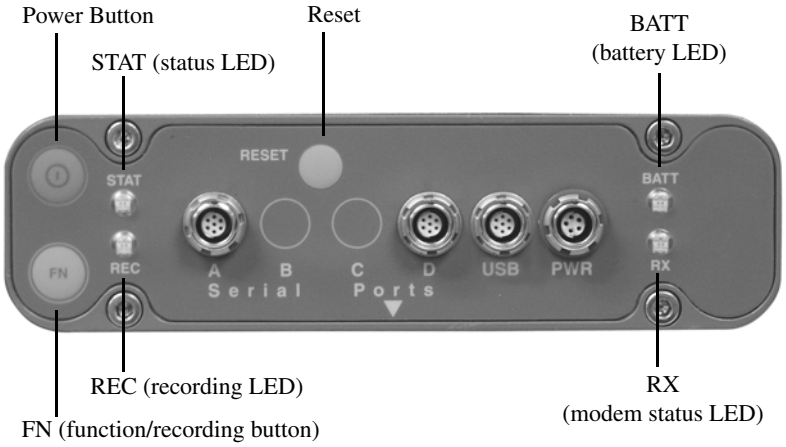

Figure 2-14. MINTER

The MINTER performs numerous functions:

- Turn the receiver on or off, put it in either Sleep mode or Zero power mode.
- Turn data recording on or off (FN key).
- Change the receiver's information mode.
- Show the number of GPS (green) satellites being tracked (STAT led).

- Show data recording status (REC led).
- Show each time data is recorded to internal memory (REC led).
- Show the status of post-processing mode (static or dynamic) when performing a Post-Processing Kinematic survey with the help of FN key (REC LED).
- Show the status (high charge, intermediate charge, or low charge) of the battery (BATT LED).
- Show the power source for the receiver (BATT LED).
- Show the status of the modem and if it receives signals (RX LED).

Use PC-CDU to configure MINTER settings. Refer to the *PC-CDU User's Manual* for other possible MINTER configurations.

1. Connect your receiver and computer. See "Connecting the Receiver and a Computer" on page 2-10 for this procedure.
2. On the ***Connection Parameters*** dialog box, enable RTS/CTS handshaking (Figure 2-15).

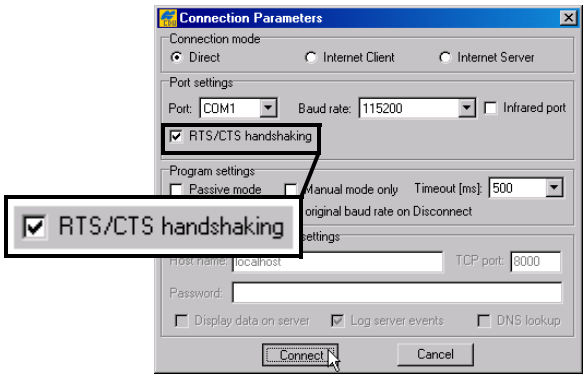

Figure 2-15. Connection Parameters – MINTER Settings

3. Click **Configuration ▸ Receiver** then click the **MINTER** tab, set the following parameters and click **Apply** (Figure 2-16 on page 2-20). See the following pages for descriptions of these parameters:
   - *Recording interval* on page 2-20

- *Elevation mask for log file* on page 2-20
- *File name prefix* on page 2-21
- *Always append to the file* on page 2-21
- *Files Creation mode* on page 2-21
- *Automatic File Rotation Mode (AFRM)* on page 2-21
- *FN key mode* on page 2-23
- *Initial data collection dynamic mode* on page 2-23
- *Data recording auto-start* on page 2-23

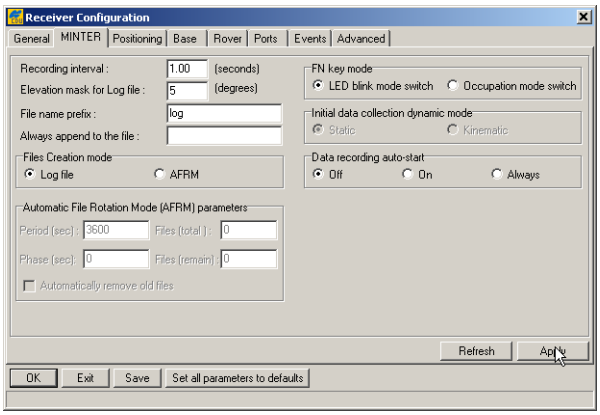

Figure 2-16. Receiver Configuration – MINTER Tab

Recording Interval parameter

This parameter specifies the message output interval into the log file when the MINTER **FN** key (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 **FN**.

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 **FN**. 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 two possible operation modes:

- Log file – If the log file radio button has been selected, pressing the FN key closes the current log file. If data logging is off, pressing FN opens a new log file.
- AFRM – If AFRM radio button has been selected, pressing FN enables this mode. If AFRM has been enabled, pressing **FN** 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 outputted 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 *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 **FN** key.

- LED blink mode switch – pressing **FN** will toggle between the MINTER's normal/extended information modes and start/stop data recording of Static survey.
  - **FN** pressed for less than 1 second: changes the information mode (Normal or Extended Information (EI) Modes).
  - **FN** pressed for 1 to 5 seconds: starts or stops data recording (Static post-processing mode).
- Occupation mode switch – pressing **FN** (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 4-1 on page 4-5 and refer to the *MINTER User's Manual* and *PC-CDU User's 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 2-2 on page 2-24 gives 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 parameter.

Table 2-2. Data Recording Parameter Behavior

Before Power Failure	Enabled Radio Button Results		
	Off	On	Always
1 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.
2 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.
3 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.
4 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, your 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 key.
- After resetting the receiver (using PC-CDU or pressing the Reset key).
- After taking the receiver out of Sleep Mode.

Radio Configuration

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

- Connecting a PC 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 HiPer XT with UHF or GSM radio modem using Modem-TPS.

Topcon's configuration and surveying software, TopSURV, also has the ability to configure HiPer receivers. Refer to the *TopSURV Reference Manual* or *TopSURV User's Manual* for details.

TIP

Use TopSURV for convenient in-field configuration.

NOTICE

Note that the UHF radio and the GSM radio do not work simultaneously. Only one radio may be used at a time.

Installing Modem-TPS

Modem-TPS is available from the TPS website or the GPS+ CD.

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

Computer requirements for Modem-TPS are: Windows® 98 or newer and an RS-232C or USB port. Use Modem-TPS version 1.7 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**.

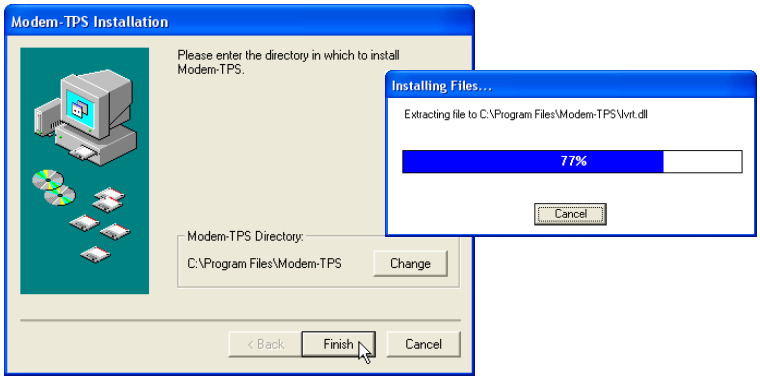

Figure 2-17. Select Modem-TPS Installation Location and Install

3. Click **OK** to complete the installation.
4. If desired, create a shortcut on the computer's desktop for quick access to Modem-TPS (Figure 2-18).

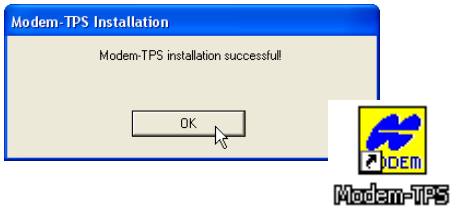

Figure 2-18. Installation Complete and Shortcut

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.

Configuring a Base Station's UHF Radio Modem

NOTICE

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

For HiPer XT receivers, the integrated TPS UHF radio modem provides TX/RX UHF communications between a Base Station and Rover. To configure the UHF radio modems, have the following ready:

- Computer running Windows® 98 or newer
- Modem-TPS ver 1.7 or newer
- Serial cable (or Bluetooth wireless technology capabilities)

1. Connect the computer and receiver using an RS232 cable or Bluetooth wireless technology.
2. Turn on the receiver.
3. Open Modem-TPS and select the COM port the receiver is connected to (Figure 2-19).
4. Click **Connect**.

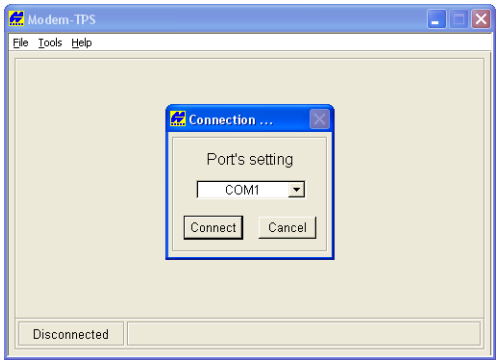

Figure 2-19. Connect to Modem-TPS

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

There are two scenarios for configuring the radio-modem:

- with a dedicated channel
- with the FCS mode

Set Radio Link Parameters for a Dedicated Channel

1. From the **Protocol** control, select between TPS and PDL.
   - TPS – Select this protocol if all of the radio-modems at your jobsite are manufactured by Topcon Positioning Systems.
   - PDL – Select this protocol if you use PDL radio-modem(s) together with TPS radio-modem(s) at the jobsite.
2. From the **Modulation Type** control, select a modulation scheme that will be used by your base radio-modem. It can be either **4-Level-FSK** (Frequency Shift Keying) or **GMSK** (Gaussian Minimum Shift Keying). The following table shows you what modulation technique can be used at a specific link rate.

If the Link Rate is...	Use...
4800 baud	GMSK
9600 baud	GMSK or 4-Level-FSK
19200 baud	4-Level-FSK

3. From the **Link Rate** control, select the rate at which data is transmitted over the RF link. The UHF radio-modem supports 4800, 9600, and 19200 baud. Note that this setting affects the **Modulation Type** control and vice versa.
4. From the **TX** control, select the operating frequency that will be used by your base radio-modem to transmit differential data.
5. Select **Scrambling**. If enabled, this parameter provides more robust data communications over the areas with possible interference.

6. For a maximum data communication reliability, select the **Forward Error Correction** checkbox. With this parameter enabled, the rover radio-modem has the capability to check and correct transmission errors (if any) in an incoming data stream.

NOTICE *NOTICE*

While providing error control in data transmission, FEC adds redundant check bits to the data stream reducing data throughput. If you are going to use FEC and a format of differential messages requires a great deal of data (e.g., RTCM 2.x) transmitted over the radio link, it is recommended to select 19200@4-Level-FSK. This will ensure reliable radio communication between the base and rover receivers.

7. From the **Protocol Mode** control, select the appropriate link protocol among the following available:
   - Transparent w/EOT Character
   - Transparent w/EOT Timeout
   - Fast Async
8. If you select **Transparent w/EOT Character**, the **EOT Character (Dec)** field will be displayed. In this field enter a decimal value (usually a control character). Once the specified character is found in the incoming data stream, the modem begins data transmission.

   If you select **Transparent w/EOT Timeout**, the **TX ACK Timeout (in x10 ms)** field will be displayed. In this field enter an integer value between 1 (corresponds to 10 ms) and 50 (corresponds to 500 ms). Once the timeout between incoming data exceeds the specified value, the modem begins data transmission.

9. From the **Output Power** control, select the level of RF transmit power from 10 mW to 2 W.

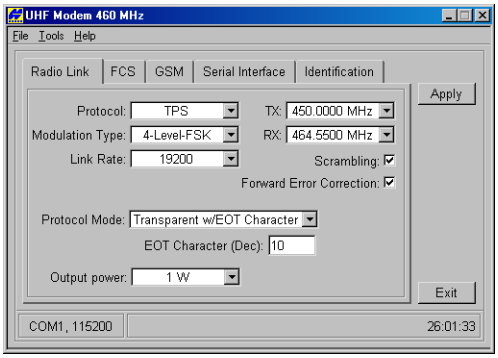

Figure 2-20. Radio Link Tab

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

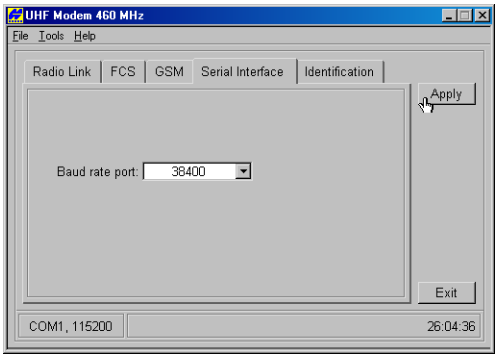

Figure 2-21. Serial Interface Tab

11. Click **Apply**, then click on **File** and select **Disconnect**. If you want to close the program, click **File->Exit**.
12. Launch PC-CDU and set up the receiver to run as an RTK Base Station. For how to set up an RTK Base using PC-CDU, refere to your receiver's documentation or *PC-CDU User's Manual*.

Set Radio Link Parameters for Free Channel Scan

1. From the **Protocol** control, select TPS.
2. From the **Modulation Type** control, select a modulation scheme that will be used by your base radio-modem. It can be either **4-Level-FSK** (Frequency Shift Keying) or **GMSK** (Gaussian Minimum Shift Keying). The following table shows you what modulation technique can be used at a specific link rate.

If the Link Rate is...	Use...
4800 baud	GMSK
9600 baud	GMSK or 4-Level-FSK
19200 baud	4-Level-FSK

3. From the **Link Rate** control, select the rate at which data is transmitted over the RF link. The UHF radio-modem supports 4800, 9600, and 19200 baud. Note that this setting affects the **Modulation Type** control and vice versa.
4. Select **Scrambling**. If enabled, this parameter provides more robust data communications over the areas with possible interference.
5. For a maximum data communication reliability, select the **Forward Error Correction** checkbox. With this parameter enabled, the rover radio-modem has the capability to check and correct transmission errors (if any) in an incoming data stream.

NOTICE *NOTICE*

While providing error control in data transmission, FEC adds redundant check bits to the data stream reducing data throughput. If using FEC and a format of differential messages requires a great deal of data (e.g., RTCM 2.x) transmitted over the radio link, it is recommended to select 19200@4-Level-FSK. This will ensure reliable radio communication between the base and rover receivers.

6. From the **Protocol Mode** control, select the appropriate link protocol among the following available:
   - Transparent w/EOT Character
   - Transparent w/EOT Timeout
   - Fast Async
7. If you select **Transparent w/EOT Character**, the **EOT Character (Dec)** field will display. In this field enter a decimal value (usually a control character). Once the specified character is found in the incoming data stream, the modem begins data transmission.

   If you select **Transparent w/EOT Timeout**, the **TX ACK Timeout (in x10 ms)** field will display. In this field enter an integer value between 1 (10 ms) and 50 (500 ms). Once the timeout between incoming data exceeds the specified value, the modem begins data transmission.
8. From the **Output Power** control, select the level of RF transmit power from 10 mW to 2 W.
9. Click on the *FCS* tab.
10. From the **Mode** control, select **Master**.
11. In the **Free Scan Frequency List** control, you will see the frequencies that are used in the scan process. Double-click a frequeny in the list to exclude/include this frequency from/to the scan process. You may also select/deselect all frequencies at one time with the **Select all** and **Deselect all** controls.

NOTICE

For FCS to operate properly, you must select at least two frequencies.

12. In the **Time Out** edit box, enter the number of seconds that a base radio modem will send a service word to the rover radio modem.

NOTICE

Set the Time out larger (by 2, 3 seconds) than the period of transmitting differential corrections.

13. In the **Noise Level** field, specify a threshold value for the noise level.
    - High – sets the noise level to -70 dBm. Recommended in noisy environments.
    - Medium – sets the noise leve to -85dBm. Recommended in most environments.
    - Low – sets the noise level to -100 dBm. Recommended in low-noise environments.

    The base radio-modem regularly scans the current operating frequency to determine the degree of a radio noise/interference on this frequency. Should the level of noise on the given operating frequency be greater than the level specified in this field, the transmitter will take the following measures:
    - Stops broadcasting on this frequency
    - Switches to the next frequency in the list and performs the scan on this *new* frequency.
      – If the frequency is clear of noise, the radio-modem will start using this frequency for data transmission.
      – Otherwise, the radio-modem will continue the scan process throughout the frequency list until the frequency with an acceptable amount of noise is found.

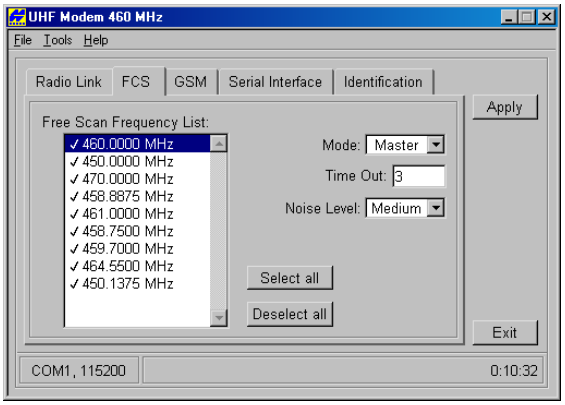

Figure 2-22. FCS Tab

14. Click the ***Serial Interface*** tab and select a baud rate for the modem's serial port. The same rate must be used for both the receiver and the modem.
15. Click **Apply**, then click on **File** and select **Disconnect**. If you want to close the program, click **File ▸ Exit**.
16. Launch PC-CDU and set up the receiver to run as an RTK Base Station. For how to set up an RTK Base using PC-CDU, refere to your receiver's documentation or *PC-CDU User's Manual*.

Configuring a Rover Station's UHF Radio Modem

NOTICE

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

Repeat steps 1-4 from page 2-27.

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

There are two scenarios for configuring the radio-modem:

- With a dedicated channel.
- With the FCS mode.

Set Radio Link Parameters for a Dedicated Channel

1. From the **Protocol** control, select between TPS and PDL.
    - TPS – Select this protocol if all of the radio-modems at your jobsite are manufactured by Topcon Positioning Systems.
    - PDL – Select this protocol if you use PDL radio-modem(s) together with TPS radio-modem(s) at the jobsite.

2. From the **Modulation Type** control, select a modulation scheme that will be used by your rover radio-modem. It can be either **4-Level-FSK** (Frequency Shift Keying) or **GMSK** (Gaussian Minimum Shift Keying). The following table shows you what modulation technique can be used at a specific link rate.

If the Link Rate is...	Use...
4800 baud	GMSK
9600 baud	GMSK or 4-Level-FSK
19200 baud	4-Level-FSK

   Must be the same for base and rover.
3. From the **Link Rate** control, select the rate at which data is transmitted over the RF link. The UHF radio-modem supports 4800, 9600, and 19200 baud. Note that this setting affects the **Modulation Type** control and vice versa. Must be the same for base and rover.
4. From the **RX** control, select the operating frequency that will be used by your rover radio-modem to receive differential data. Must be the same for the base and rover.
5. Select **Scrambling**. If enabled, this parameter provides more robust data communications over the areas with possible interference. Must be the same for base and rover.
6. For a maximum data communication reliability, select the **Forward Error Correction** checkbox. With this parameter enabled, the rover radio-modem has the capability to check and correct transmission errors (if any) in an incoming data stream. Must be the same for base and rover.

NOTICE *NOTICE*

While providing error control in data transmission, FEC adds redundant check bits to the data stream reducing data throughput. If you are going to use FEC and a format of differential messages requires a great deal of data (e.g., RTCM 2.x) transmitted over the radio link, it is recommended to select 19200@4-Level-FSK. This will

ensure reliable radio communication between the base and rover receivers.

7. From the **Protocol Mode** control, select the appropriate link protocol among the following available:
   - Transparent w/EOT Character
   - Transparent w/EOT Timeout
   - Fast Async

   Use the same protocol as at the base station.
8. From the **Output Power** control, set the level of RF transmit power to 10 mW.

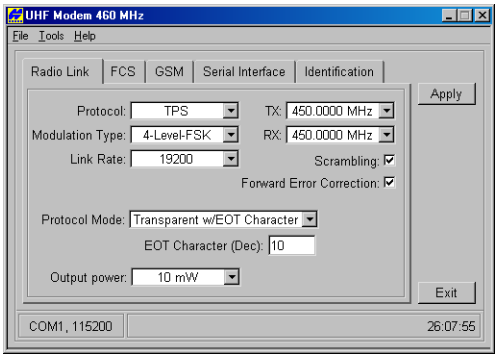

Figure 2-23. Radio Link Tab

9. Click the ***Serial Interface*** tab and select a baud rate for the modem's serial port. The same rate must be used for both the receiver and the modem.
10. Click **Apply**, then click on **File** and select **Disconnect**. If you want to close the program, click **File ▸ Exit**.
11. Launch PC-CDU and set up the receiver to run as an RTK Rover Station. For how to set up an RTK Rover using PC-CDU, refere to your receiver's documentation or *PC-CDU User's Manual*.

Set Radio Link Parameters for Free Channel Scan

1. From the **Protocol** control, select TPS.
2. From the **Modulation Type** control, select a modulation scheme that will be used by your rover radio-modem. It can be either **4-Level-FSK** (Frequency Shift Keying) or **GMSK** (Gaussian Minimum Shift Keying). The following table shows you what modulation technique can be used at a specific link rate.

If the Link Rate is...	Use...
4800 baud	GMSK
9600 baud	GMSK or 4-Level-FSK
19200 baud	4-Level-FSK

   Must be the same for base and rover.
3. From the **Link Rate** control, select the rate at which data is transmitted over the RF link. The UHF radio-modem supports 4800, 9600, and 19200 baud. Note that this setting affects the **Modulation Type** control and vice versa.
4. Select **Scrambling**. If enabled, this parameter provides more robust data communications over the areas with possible interference. Must be the same for base and rover.
5. For a maximum data communication reliability, select the **Forward Error Correction** checkbox. With this parameter enabled, the rover radio-modem has the capability to check and correct transmission errors (if any) in an incoming data stream. Must be the same for base and rover.

NOTICE *NOTICE*

While providing error control in data transmission, FEC adds redundant check bits to the data stream reducing data throughput. If you are going to use FEC and a format of differential messages requires a great deal of data (e.g., RTCM 2.x) transmitted over the radio link, it is recommended to select 19200@4-Level-FSK. This will

ensure reliable radio communication between the base and rover receivers.

6. From the **Protocol Mode** control, select the appropriate link protocol among the following available:
   - Transparent w/EOT Character
   - Transparent w/EOT Timeout
   - Fast Async

   Use the same protocol as at the base station.
7. If you select **Transparent w/EOT Character**, the **EOT Character (Dec)** field will be displayed. In this field enter a decimal value (usually a control character). Once the specified character is found in the incoming data stream, the modem begins data transmission.
8. If you select **Transparent w/EOT Timeout**, the **TX ACK Timeout (in x10 ms)** field will be displayed. In this field enter an integer value between 1 (10 ms) and 50 (500 ms). Once the timeout between incoming data exceeds the specified value, the modem begins data transmission.
9. From the **Output Power** control, set the level of RF transmit power to 10 mW.
10. Click on the ***FCS*** tab.
11. From the **Mode** control, select **Slave**.
12. In the **Free Scan Frequency List** control, you will see the frequencies that are used in the scan process. Double-click a frequeny in the list to exclude/include this frequency from/to the scan process. You may also select/deselect all frequencies at one time with the **Select all** and **Deselect all** controls.

NOTICE *NOTICE*

For FCS to operate properly, you must select at least two frequencies. Also the selected frequencies must be the same as at the base radio-modem.

13. In the **Time Out** edit box, specify a period of time in seconds within which the rover radio-modem will listen to the incoming data on the current operating frequency. Should there be no any data detected during the specified amount of time, the rover will switch to the next frequency in the list and so forth until the frequency with data is found.

NOTICE *NOTICE*

It is recommended to make this parameter greater than the base radio-modem's Time out by 2 to 3 seconds.

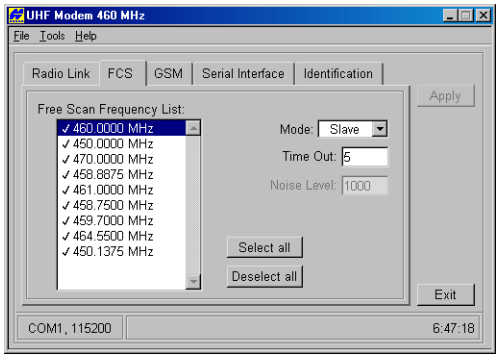

Figure 2-24. FCS Tab

14. Click the ***Serial Interface*** tab and select a baud rate for the modem's serial port. The same rate must be used for both the receiver and the modem.
15. Click **Apply**, then click on **File** and select **Disconnect**. If you want to close the program, click **File ▸ Exit**.

Launch PC-CDU and set up the receiver to run as an RTK Rover Station. For how to set up an RTK Rover using PC-CDU, refere to your receiver's documentation or the *PC-CDU User's Manual*.

Configuring a Base Station's GSM Module with Modem-TPS

NOTICE

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

1. Repeat steps 1-4 from page page 2-27.

   When finished configuring the GSM module, always disconnect from Modem-TPS before exiting to prevent conflicts with serial port management.
2. Click the ***GSM*** tab.
3. In the **Mode** control, select **Slave**.
4. In the **PIN** field, enter a Personal Identification Number (PIN) if required.
5. For the base station, leave the **Dial** field blank.
6. In the **Send time** field, enter a period of time in seconds with which the base GSM modem will send a service word to the rover GSM modem. This parameter is used to maintain reliable communication between the pair of modems and avoid unnecessary modem reinitialization.

NOTICE

To ensure reliable and secure modem communication, this parameter must be larger then the period of transmitting diferential corrections.

If both of your receivers are HiPer XT with internal GSM modems, set Send time to zero.

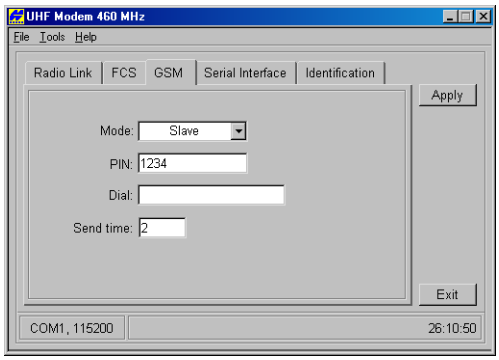

Figure 2-25. GSM Tab

7. Click the ***Serial Interface*** tab and select a baud rate for the modem's serial port. The same rate must be used for both the receiver and the modem.
8. Click **Apply**, then click on **File** and select **Disconnect**. If you want to close the program, click **File->Exit**.
9. Launch PC-CDU and set up the receiver to run as an RTK Base Station. For how to set up an RTK Base using PC-CDU, refere to your receiver's documentation or *PC-CDU User's Manual*.

Configuring a Rover Station's GSM Module with Modem-TPS

NOTICE

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

1. Repeat steps 1-4 from page 2-27.

   When finished configuring the GSM module, always disconnect from Modem-TPS before exiting to prevent conflicts with serial port management.
2. Click the ***GSM*** tab.
3. In the **Mode** control, select **Master**.

4. In the **PIN** field, enter a Personal Identification Number (PIN) if required.
5. In the **Dial** field, enter the phone number of the base GSM modem.
6. In the **Send time** field, enter a period of time in seconds with which the rover GSM modem will send a service word to the base GSM modem. This parameter is used to maintain reliable communication between the pair of modems and avoid unnecessary modem reinitialization.

NOTICE *NOTICE*

If both of your receivers are HiPer XT with internal GSM modems, set Send time to zero.

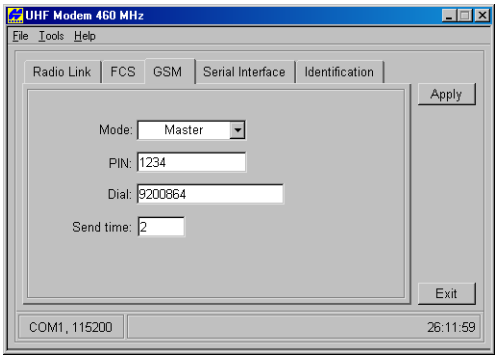

Figure 2-26. GSM Tab

7. Click the ***Serial Interface*** tab and select a baud rate for the modem's serial port. The same rate must be used for both the receiver and the modem.
8. Click **Apply**, then click on **File** and select **Disconnect**. If you want to close the program, click **File->Exit**.
9. Launch PC-CDU and set up the receiver to run as an RTK Rover Station. For how to set up an RTK Rover using PC-CDU, refer to your receiver's documentation or the *PC-CDU User's Manual*.

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.

1. Create or locate the following folder:

   `C:\Program Files\TPS\BTCONF`

2. Download btconf.zip from the TPS website and unzip it into the BTCONF folder. This file contains Btconf.exe, the executable file for the Bluetooth module configuration program.

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

TIP

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

To uninstall BTCONF, delete any applicable BTCONF directories or folders, and any BTCONF shortcuts.

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 A. If needed, turn on the receiver and computer.

2. Run the Bluetooth module configuration program (Btconf.exe) (Figure 2-27).

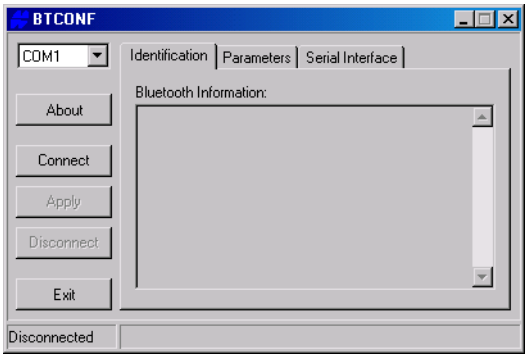

Figure 2-27. Bluetooth Module Configuration Main Screen

Notice that the lower left corner shows a "Disconnected" status for the computer and Bluetooth module.

For BTCONF version and copyright information, click the **About** button.

3. From the drop-down list in the upper left corner, select the computer serial port (usually COM1) used for communication (Figure 2-28 on page 2-44).
4. Click **Connect** to connect the computer and Bluetooth module (Figure 2-28).

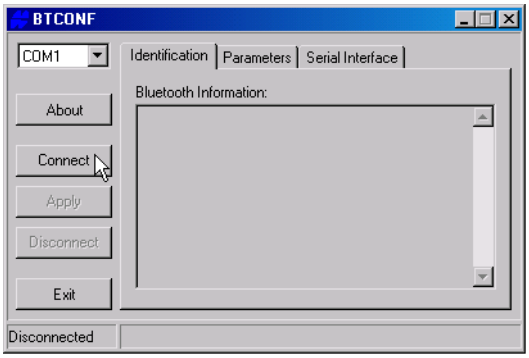

Figure 2-28. Select Communication Port and Click Connect

Once the receiver and computer connect through BTCONF, the Identification tab (Figure 2-29) displays the following information:

- Bluetooth name – the name of the Bluetooth module, set in the Parameters tab.
- Bluetooth address – the unique electronic address for your Bluetooth module.
- Firmware version – the current firmware version of the Bluetooth module.

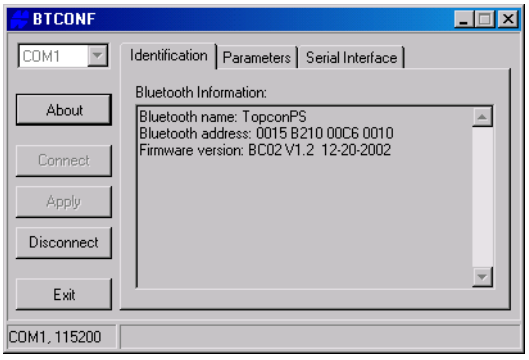

Figure 2-29. BTCONF Identification Tab

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

5. Click the **Parameters** tab (Figure 2-30). 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 2-30), and click **Apply**.

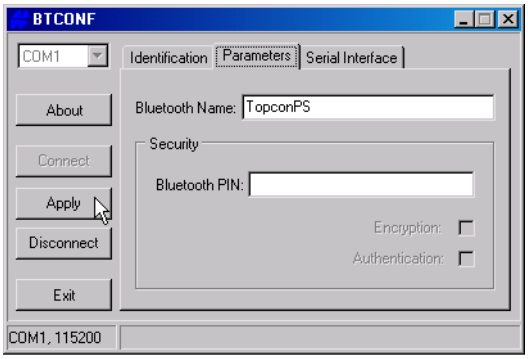

Figure 2-30. BTCONF Parameters Tab

7. To set security parameters (Figure 2-31 on page 2-47), 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 *NOTICE*

If you do not need security settings, leave these parameters disabled.

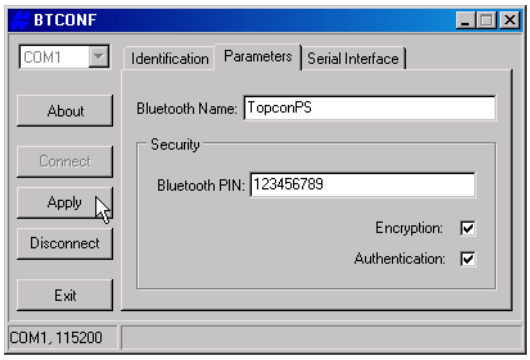

Figure 2-31. BTCONF Security Parameters

8. Click the **Serial Interface** tab (Figure 2-32). Enable Echo to display Bluetooth module replies and corresponding commands on the computer terminal. If needed, click **Apply**.

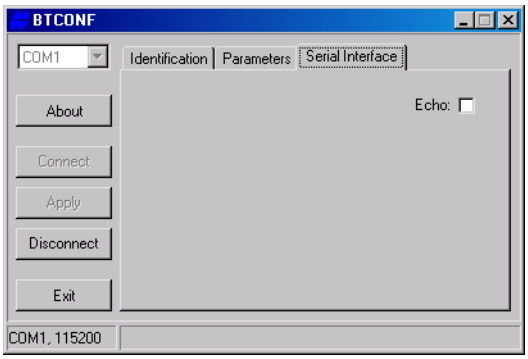

Figure 2-32. BTCONF Serial Interface Tab

9. Click **Disconnect** then **Exit** (Figure 2-33) to quit BTCONF.

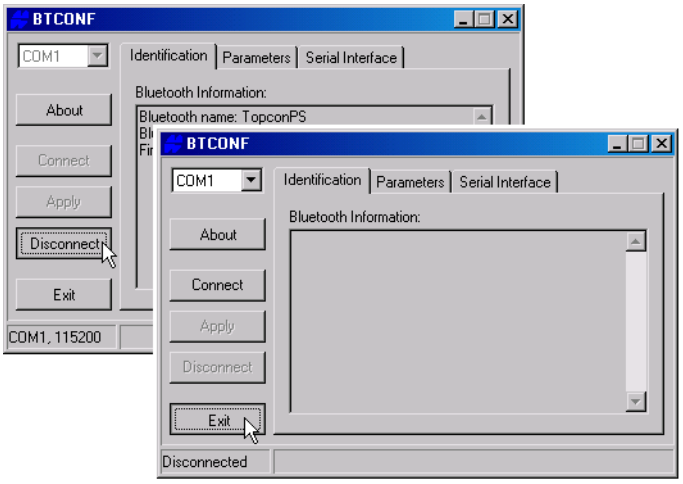

Figure 2-33. Click Disconnect then Exit

Collecting Almanacs

Each satellite broadcasts a message (almanac) which gives the approximate orbit for itself and all other satellites. 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 stores the most recent almanac in its Non-Volatile Random Access Memory (NVRAM).

1. Set up the receiver (connect the external antenna, if needed) 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 almanac data from the satellites.

NOTICE *NOTICE*

If 15 minutes have passed and the receiver does not lock on to satellites, you may need to clear the NVRAM. See "Clearing the NVRAM" on page 4-17 for this procedure.

You will need to collect or update the almanac 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.

Setup and Survey

This chapter describes:

- Receiver setup
- RTK Base station setup
- RTK Rover setup
- Basic surveying with the HiPer XT receiver

The HiPer XT package use one receiver as the Base station and the other as the Rover station.

Receiver Setup

NOTICE *NOTICE*

Note that the UHF radio and the GSM radio do not work simultaneously. Only one radio may be used at a time.

To set up the receivers, you must:

1. Configure the receivers as shown in Chapter 2.
2. Set up the Base and Rover stations. See “Step 1: Set up the Receiver” on page 3-2.
3. Measure the antenna height. See “Step 2: Measure Antenna Height” on page 3-2 for internal antennas.
4. Begin collecting data. See “Step 3: Collect Data” on page 3-4.

All receivers include an internal, micro-strip antenna able to capture L1/L2 signals from GPS and GLONASS satellites.

Step 1: Set up the Receiver

This section assumes the receiver has already been configured.

1. Place the receiver on the appropriate tripod or bipod.
2. Center the receiver over the point at which data will be collected. For most applications, this should be at a location with a clear view of the sky.

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.

1. Measure the antenna height above the point or marker.

   Figure 3-1 illustrates the antenna offsets. (See Figure 1-5 on page 1-15 and Figure 1-6 on page 1-16 for the exact SHMM location.)

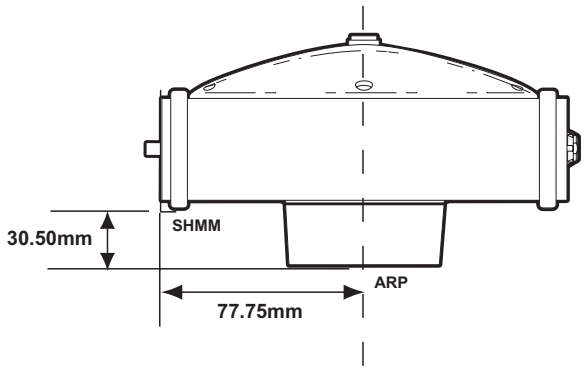

Figure 3-1. HiPer XT Antenna Offsets

- SHMM to ARP vertical offset = 30.50mm
- SHMM to ARP horizontal offset = 77.75mm

Table 3-1gives the offset values for the receivers.

Table 3-1. Antenna Offset Values for Receiver Options

	To L1 Phase Center	To L2 Phase Center
Up	105.9mm	97.1mm

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. In the case of 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 not the same number because of the difference in location between the slant measuring point and the vertical measuring point.

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

3. Press the **power** key and release it to turn the receiver on. The STAT (status) light (LED) will blink red at first.
4. Once the receiver has locked on to one or more satellites, the STAT light will blink green for GPS satellites, orange for GLONASS satellites, and a short red blink indicating it has not solved a position. Four or more satellites provide optimal positioning.
5. Once the short red blink is gone, the receiver has a position and surveying can begin. You should 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.

Step 3: Collect Data

1. To begin collecting data, press and hold the **FN** (function) key for more than one second and less than five seconds.
2. Release the **FN** key when the REC (recording) LED light 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 2-18 or refer to the *PC-CDU User’s Manual*.

3. When finished, press and hold the **FN** key until the REC LED light goes out.
4. To turn off the receiver, press and hold the **power** key until all lights go out, then release.

Surveying with the Receiver

The receiver can be used to perform Static, Kinemati, and Real-time kinematic (RTK) surveying.

NOTICE *NOTICE*

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

Static Survey

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).

The procedure that follows describes the steps the operator should take to perform a Static Survey using MINTER.

1. Connect your receiver and computer. See “Connecting the Receiver and a Computer” on page 2-10 for this procedure.
2. Open PC-CDU, click **Configuration ▸ Receiver ▸ MINTER** and specify the following parameters, then click **Apply** (Figure 3-2):
   - *Recording interval* – 15 seconds
   - *Elevation mask angle* – 15 degrees
   - *File name prefix* – last 3 digits of receiver serial number
   - *LED blink mode switc*h – enable to start and stop static data recording using the FN key

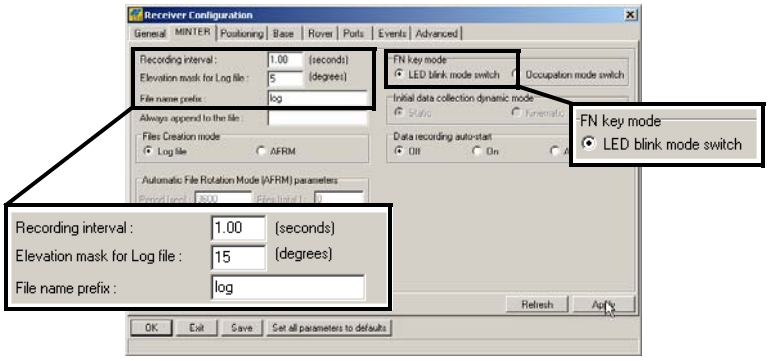

Figure 3-2. Configure MINTER

3. Click the *Advanced* tab and then the *Multipath* tab, set the following parameters, then click **Apply** (Figure 3-3):
   - *Code multipath reduction* – enable
   - *Carrier multipath reduction* – enable

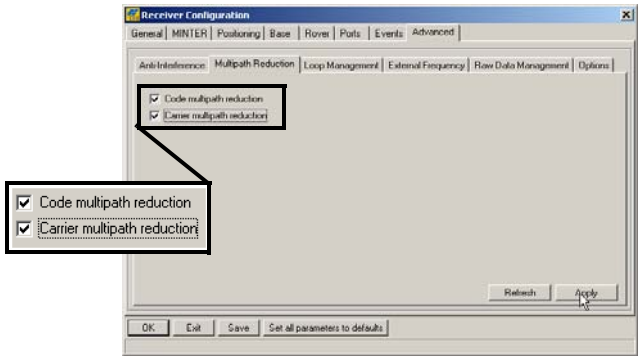

Figure 3-3. Configure Multipath

4. Click the *Loop Management* tab and set the following parameters, then click **Apply** (Figure 3-4):
   - *Enable Co-Op tracking* – enable
   - *Static mode* – enable

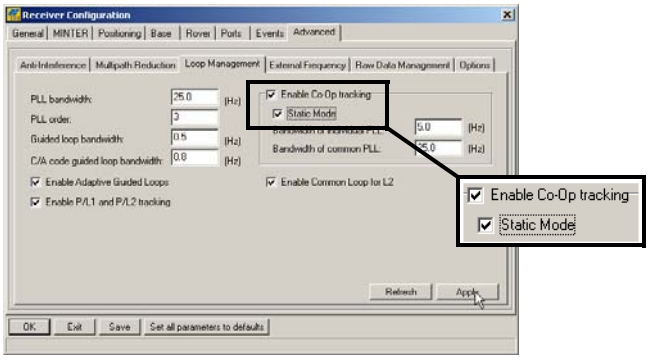

Figure 3-4. Configure Loop Management

5. Set up each antenna and receiver as described in "Receiver Setup" on page 3-1.
6. Begin surveying.

Kinematic (Stop and Go) Survey

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. Using PC-CDU, configure and set up the Base as described in "Static Survey" on page 3-5.
2. Click **Configuration ▸ Receiver ▸ MINTER**, configure the Rover with the these parameters, and click **Apply** (Figure 3-5):
   - *FN key mode*, *Occupation mode switch* – enable
   - *Initial data collection dynamic mode*, *Kinematic* – enable

   See Table 4-1 on page 4-5 for FN key functions and REC LED statuses.

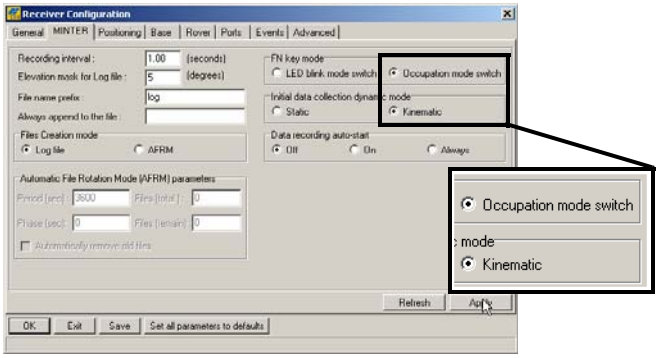

Figure 3-5. Rover MINTER Configuration

NOTICE *NOTICE*

Remember, both Base and Rover receivers must collect data from the same satellites, at the same data recording rate, and with identical elevation mask angles.

3. 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.
4. Check the STAT light for satellites tracked.
5. When finished, press the **FN** key for less than a second to assign the Rover to kinematic.

TIP

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

6. Move the Rover to the next location (survey point), and press the **FN** key for less than a second to collect the data in static mode for two to ten minutes.
7. 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.
8. When finished, press the **FN** key 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 Survey

Real-time kinematic (RTK) is a differential GPS process where information, such as differential corrections, is transmitted in real-time from a Base station to one or more Rover stations.

Set up an RTK Base Station

To configure an RTK Base station using PC-CDU, take the following steps:

1. Set up the Base station receiver's antenna as described in "Receiver Setup" on page 3-1.
2. Press the **power** key on the receiver.

3. Check the STAT light for tracked satellites.
4. Connect your receiver and computer. See “Connecting the Receiver and a Computer” on page 2-10 for this procedure.
5. Click **Configuration ▸ Receiver**.
6. Click **Set all parameters to defaults** (Figure 3-6).

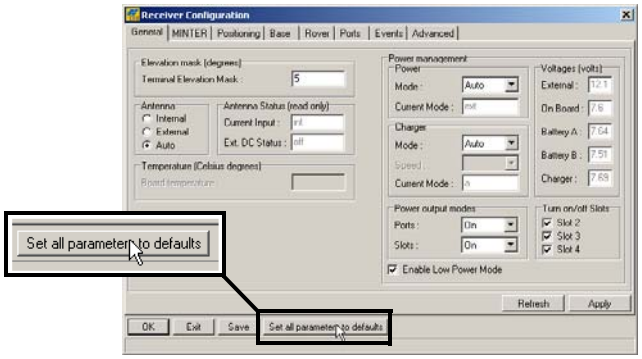

Figure 3-6. Set All Parameters to Defaults

7. On the ***Receiver Configuration*** screen, click the *MINTER* tab and specify the desired settings. Refer to the *PC-CDU User’s Manual* for more information.
8. Click the *Positioning* tab and set the Elevation mask parameter to 15 (Figure 3-7), then click **Apply**.

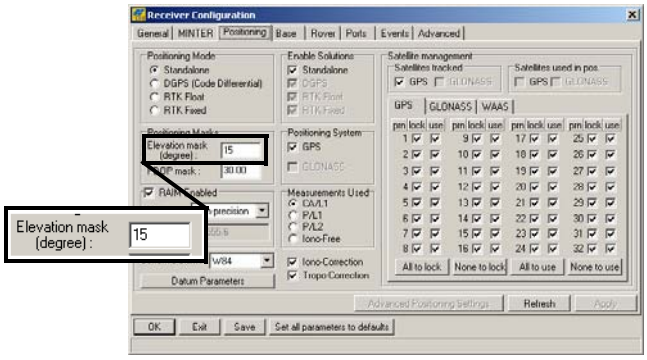

Figure 3-7. Configure Receiver Positioning – Elevation Mask

9. Select the **Base** tab, set the following parameters (Figure 3-8), and click **Apply**:
   - *GPS/GLO at one time* – enable
   - Antenna position – enter Lat, Lon, and Alt values. Do one of the following:
     – 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.

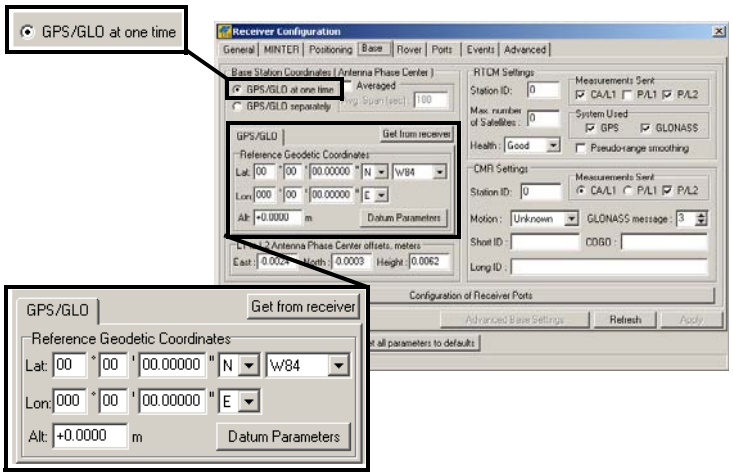

Figure 3-8. Base Configuration

10. Click the **Ports** tab and set the following port parameters for the serial port (Figure 3-9).
    - *Output* drop-down list – select type and format of differential corrections.
    - *Period (sec)* – enter interval at which receiver will generate differential corrections.
    - *Baud rate* drop-down list – select a baud rate (i.e., the rate at which differential messages will be transmitted from receiver to modem).
    - *RTS/CTS* – select to enable handshaking.

TIP

Use a 38400 baud rate.

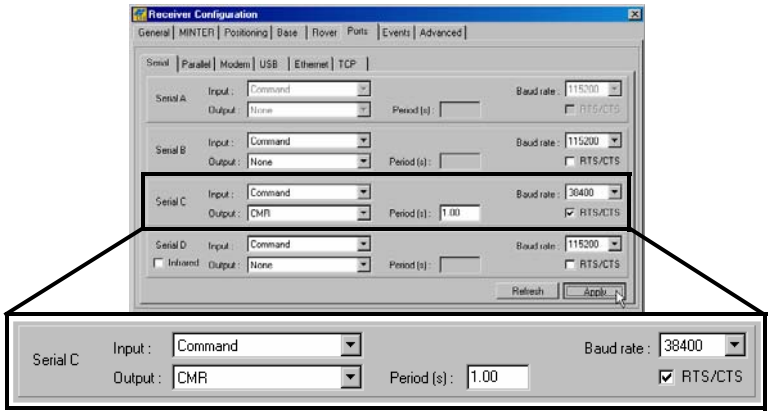

Figure 3-9. Base Configuration – Ports

11. Click **Apply**. The receiver begins sending data to the selected port.

For more details on the settings available for configuring the Base station, refer to the *PC-CDU User's Manual*.

Set up an RTK Rover

Use the following steps to set up an RTK Rover station. You should already have programmed the modem.

Figure 3-10 shows the hardware setup for a Rover station with an external controller.

Figure 3-10. Rover Station Setup

1. Set up the Rover station receiver's antenna as described in "Receiver Setup" on page 3-1.
2. Connect the receiver and computer. See "Connecting the Receiver and a Computer" on page 2-10.
3. Click **Configuration ▸ Receiver**.
4. Click the *Positioning* tab and set the *Position Masks*, *Elevation mask (degrees)* parameter to 15 (Figure 3-7 on page 3-10).

5. Click the *Rover* tab and set the desired *Positioning Mode* (Figure 3-11).

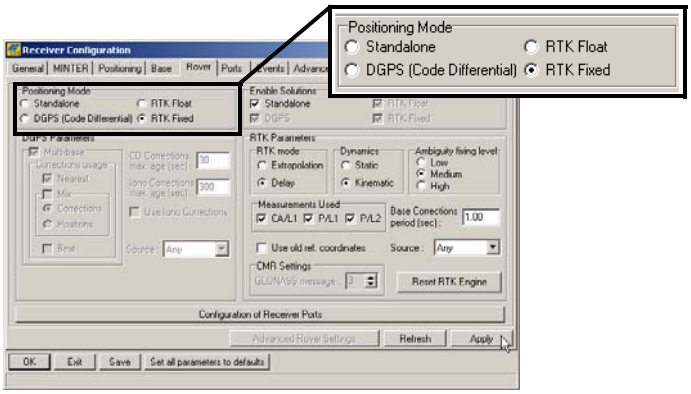

Figure 3-11. Rover Configuration

Adjust the following RTK Parameters settings:

- Under RTK mode in the RTK Parameters section, choose 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.
  - – 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).
- Select the antenna status during RTK, either Static or Kinematic.
- Specify the Ambiguity fixing level (not applicable to RTK Float). The Ambiguity Fixing Level radio buttons govern the process of the RTK engine, fixing integer ambiguities. The RTK engine uses the ambiguity fix indicator when making decisions whether or not to fix ambiguities. Low, Medium,

and High correspond to the indicator's 95%, 99.5% and 99.9% states, respectively. The higher the specified confidence level, the longer the integer ambiguity search time

6. Click the *Ports* tab and set the following parameters for the serial port (Figure 3-12):
   - *Input* drop-down list – select the desired differential correction format.
   - *Period (sec)* – leave as is.
   - *Baud rate* drop-down list – select a baud rate (i.e., the rate at which differential messages will be transmitted from modem to receiver).
   - *RTS/CTS* – select to enable handshaking.

TIP

Use a 38400 baud rate.

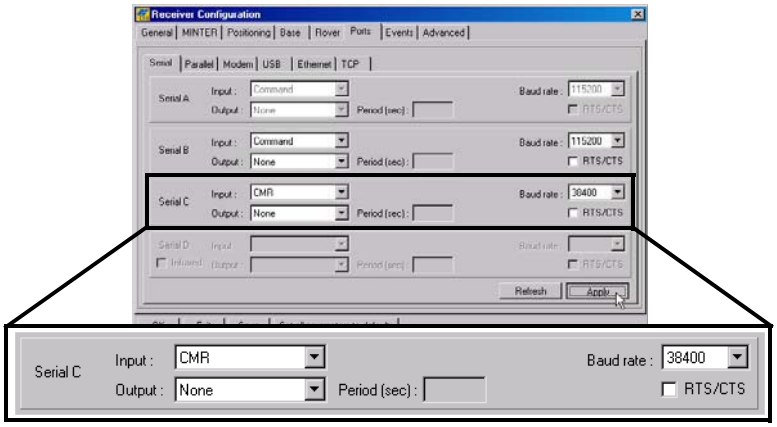

Figure 3-12. Rover Configuration – Ports

7. Click **Apply**.
8. Click **OK** to close the ***Receiver Configuration*** dialog box.

9. On the main screen (Figure 3-13), check the *LQ* field 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 may take as long as 60 seconds to synchronize.

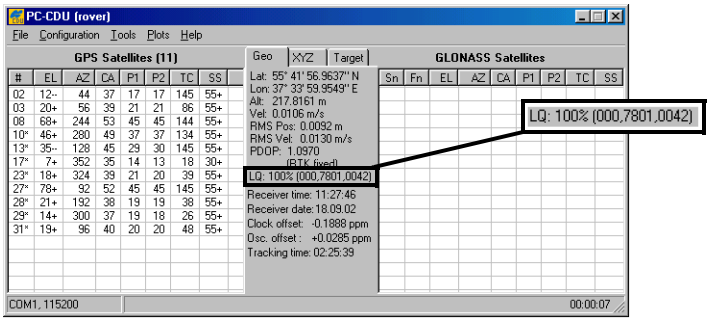

Figure 3-13. PC-CDU Main Screen

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

- Standalone – where 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).

Notes: