TOPCON

GMS-110

Multi-purpose GIS/Mapping System

Operator's Manual

TOPCON
POSITIONING SYSTEMS

GMS-110
Operator's Manual

for Surveying with the Map-RT Receiver

Part Number 7010-0727
Rev. A

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Preface

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NOTICE

Please read these Terms and Conditions carefully.

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Regulatory Information

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.

About This Manual

This manual provides installation, configuration, operating and safety instructions that will help you get the most out of your GMS-110 GIS data collection system. Even if you have used other GPS mapping systems, it is recommended that you read this manual in order to become familiar with the full range of the features this system offers.

Manual Conventions

This manual uses the following conventions:

Example	Description
Start ▸ Programs	Tap/click the Start menu and tap/click Programs.
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.
Exit	Indicates the button or key labeled Exit.

TIP

Supplementary information that can help you configure, maintain, or set up a system.

NOTICE

Supplementary information that can have an affect on system operation, system performance, measurements, or personal safety.

CAUTION

Notification that an action has the potential to adversely affect system operation, system performance, data integrity, or personal health.

WARNING

Notification that an action *will* result in system damage, loss of data, loss of warranty, or personal injury.

DANGER

UNDER NO CIRCUMSTANCES SHOULD THIS ACTION BE PERFORMED.

Manual Organization

This manual is divided into five chapters and four appendixes.

Chapter 1: Introduction

- Describes the GMS-110 system, including features and functions.
- Introduces GPS and DGPS technology.
- Lists items included in the standard package.

Chapter 2: GMS-110 Setup & Quick Start

Provides information on quick setup of and getting started using the GMS-110 system.

Chapter 3: Managing the Map-RT Receiver

- Describes configuring the Map-RT using PC-CDU.
- Provides firmware update procedures for the Map-RT.
- Describes using the Map-RT receiver.

Chapter 4: Using TopSURV GIS

- Describes configuring, monitoring, and using the GMS-110 system with the TopSURV GIS module software.
- Provides steps for surveying with the GMS-110 using the TopSURV GIS module software.

Appendix A: Satellite and DGPS Details

- Lists OmniSTAR satellites and shows OmniSTAR worldwide coverage.

- Provides information about radio beacon stations throughout the world along with their coverage areas.
- Lists satellite navigation status codes.

Appendix B: Specifications

Provides technical specifications for the system's components.

Appendix C: Safety Warnings

Lists various safety warnings to be aware of while using, storing, or handling the various GMS-110 components.

Appendix D: Warranty Terms

Provides information on return and repair of components.

Introduction

This chapter provides an overview of the GMS-110 system (Figure 1-1), including its features and physical elements, as well as an additional information about the principals of GPS operation and DGPS services.

Figure 1-1. GMS-110 System

GMS-110 Features

The GMS-110 system is a GPS-based, mapping-grade system manufactured by Topcon Positioning Systems, Inc. GMS-110 is designed for capturing and updating geographical data in a wide range of GIS-related applications, such as:

- Land use management
- Urban and regional planning
- Pipeline mapping
- Natural resource exploration and management
- Agriculture
- Power pole inventory and maintenance
- Fish and wildlife management
- Forestry

The system includes the following hardware:

- Map-RT – a 20-channel, single frequency GPS/GLONASS receiver and the OmniSTAR/Beacon receiver in a compact, rugged, environmentally sealed housing
- External DGPS antenna (MG-A5)
- Hand-held controller
- Software suite
- Cables and other accessories

By bringing together Topcon's leading GPS+ tracking technology and the latest innovations in real-time DGPS services, the GMS-110 system becomes the most advanced, versatile and compact GIS data collection system on the market. The system's versatility allows you to select among the following sources of real-time differential corrections:

- OmniSTAR® VBS
- WAAS/EGNOS
- Radio Beacon

Depending on working conditions and the source of differential correction data, the system provides various levels of position accuracy (from meter-level to decimeter-level). Using a powerful field GIS data collection will allow you to update and add new information to existing GIS data.

The GMS-110 system can be bundled in a number of different package configurations. When unpacking the package contents, check all items thoroughly. If any item is damaged or missing, contact your local dealer as quickly as possible to fix or replace the item.

Hardware

The GMS-110 system hardware packages can include the following:

- Map-RT receiver with Bluetooth wireless technology
- MG-A5 GIS antenna
- Hand-held control device (controller) (optional purchase)
- Various cables
- Power supply and charger
- Backpack and antenna pole

See “Getting Acquainted” on page 1-11 for details on each item.

Software

For a controller with the Windows® CE operating system, the following software is available:

- CE-CDU – this Topcon software provides an easy-to-use interface for configuring and monitoring the status of the GMS-110 system in the field. CE-CDU is for purchase from your Topcon representative.
- TopSURV GIS – this Topcon software provides an easy-to-use interface for configuring survey jobs and collecting GIS data. TopSURV GIS is a module of Topcon’s fully featured TopSURV software and is available for purchase from your Topcon representative.

For a Windows-based computer, the following software is available on the GPS+ CD included with the package, as well as the TPS website:

- Modem-TPS – this Topcon software provides an interface for configuring the OmniSTAR/Beacon component of the Map-RT receiver.
- PC-CDU Lite – this Topcon software provides an interface for managing the various functions of the GPS board in the Map-RT receiver.
- FLoader – this Topcon software provides an interface for uploading receiver board, Bluetooth module, and OmniSTAR/Beacon board firmware to the Map-RT receiver.
- BTCONF – this Topcon software provides an interface for configuring the Bluetooth component of the Map-RT receiver.

Literature

Standard GMS-110 system literature includes the following. The GPS+ CD also includes literature for the various included software.

- *GMS-110 Operator's Manual*
- OmniSTAR registration form

Some manuals and other product information are also available on the Topcon website.

- www.topcongps.com/support/manuals.html
- 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*

GMS-110 Surveying Overview

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 on or near the Earth's surface. At any one time, with a standard 15 degree angle, up to 10 or 12 GPS satellites are visible from any point on earth. The Global Navigation Satellite System (GLONASS) is run by the Russian Federation Ministry of Defence and it a counterpart to GPS.

For information on current GPS constellation status, visit the U.S. Navel Observatory website (http://tycho.usno.navy.mil/) or the U.S. Coast Guard Navigation Center website (www.navcen.uscg.gov). For information on the current GLONASS constellation, visit the GLONASS website (http://www.glonass-center.ru).

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

Each GPS satellite continuously transmits signals on two carrier frequencies known as L1 and L2 carriers. The L1 carrier is modulated with a Coarse Acquisition Code (C/A code) and a Precise Code (P code). The L2 carrier is modulated only with the P code. Also, a navigation message is modulated and transmitted on both frequencies.

Once the receiver locks on to a satellite, it starts recording measurements and receiving the various digital information (ephemeris, 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 (that is, the speed of light) and *Time* is the difference between the signal transmission time and signal reception time.

To calculate absolute 3D positions (latitude, longitude, altitude) the receiver must lock on to four satellites. In a mixed GPS and GLONASS scenario, receivers must lock on to 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. Usually, the number of GPS and GLONASS satellites in view does not exceed twenty (20).

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 three elements:

- Accuracy – The accuracy of a position depends upon the number, signal integrity, and placement (also known as Dilution of Precision, or DOP) of satellites.
  - Differential GPS (DGPS) 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, providing more accurate positioning.
- 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 weaken signals, lowering the number of available satellites.
- 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.
  - Wide Area Augmentation System (WAAS) creates and transmits DGPS correction messages.
  - Five or more visible satellites for only GPS or only GLONASS; six or more satellites for mixed scenarios.
  - Current ephemerides and almanacs.
  - Several algorithms to detect and correct faulty information.

Conclusion

This overview simply outlines the basics of GPS and GLONASS positioning. For more detailed information, visit the TPS website (www.topconps.com/gpstutorial/).

DGPS Overview

DGPS, or Differential GPS, typically uses the measurements from two or more remote receivers to calculate difference (corrections) between measurements, thus providing more accurate position solutions.

With DGPS, one receiver is placed at a known, surveyed location and is referred to as the reference receiver or base station. Another receiver is placed at an unknown, location and is referred to as the remote receiver or rover. The reference station collects the range measurements from each GPS satellite in view and forms the differences (corrections) between the calculated distance to the satellites and the measured pseudo-ranges to the satellites.

These corrections are then built up to the industry standard (RTCM or various proprietary standards) established for transmitting differential corrections and broadcast to the remote receiver(s) using a data communication link. The remote receiver applies the transmitted DGPS corrections to its range measurements of the same satellites.

Using this technique, the spatially correlated errors—such as satellite orbital errors, ionospheric errors, and tropospheric errors—can be significantly reduced, thus improving the position solution accuracy of the GPS. The maritime radio beacons system is one example of this approach to correcting GPS solutions.

Another DGPS approach employs the geostationary satellites for the distribution of the corrections. One of the most widely used applications is the OmniSTAR Worldwide DGPS positioning service.

The OmniSTAR system provides differential corrections for all GPS satellites in view. Permanent ground stations compute corrections, forward these corrections to the Network Control Center which uploads the data to the OmniSTAR geostationary satellites. GPS receivers with OmniSTAR boards and a subscription to the OmniSTAR service can then receive these differential corrections for sub-meter survey accuracies.

OmniSTAR DGPS Service

OmniSTAR is the world leader in the provision of satellite-delivered differential GPS corrections. Using geo-stationary communication satellites, DGPS corrections from OmniSTAR's network of 70 reference stations are made available to 90% of the world's land mass. Two Network Control Centers maintain the control and integrity of the system and are located in the USA and Australia.

OmniSTAR is an international service company offering worldwide, real-time, DGPS services. Visit the OmniSTAR website for more information (www.omnistar.com).

Coastal Navigation Beacons DGPS Service

Throughout the world, a number of coastal radio beacon networks have been initially established to improve the accuracy of maritime navigation around harbors and critical waterways.

In the United States, the coastal navigation beacons are managed by the United States Coast Guard and provide differential correction service in coastal areas and much of the interior of the United States.

In other parts of the world, coastal navigation beacons modeled after the US Coast Guard system are available. Check with your local maritime authority to learn more about services available in your area. The Beacon system is provided free of charge in the United States.

- For detailed information on the coastal navigation beacon system in the United States, visit the US Coast Guard's Navigation Center website (www.navcen.uscg.gov).
- For detailed information on the coastal navigation beacon system in other parts of the world, visit the International Association of Marine Aids to Navigation and Lighthouse Authorities website (http://www.iala-aism.org/web/index.html).

WAAS/EGNOS DGPS Service

The Wide Area Augmentation System (WAAS) is a satellite-based system developed by the Federal Aviation Administration (FAA) in the United States. WAAS is designed to improve the accuracy and availability of, as well as ensure the integrity of, information broadcast from GPS satellites.

WAAS works by providing a net of ground stations that receive GPS signals, generating correction messages and uploading them to geostationary satellites. These correction messages are then broadcast to a GPS receiver using the GPS L1 frequency. The receiver applies these messages to correct for various errors that affect the measurements. In addition, the geostationary satellites can be used for positioning as ordinary GPS satellites, improving system availability.

WAAS provides accuracy performance of 0.6–0.7 meters horizontal and 0.9–1.0 meters vertical throughout the majority of the continental U.S. and large parts of Canada and Alaska. For more information on WAAS, visit the FAA website (http://gps.faa.gov/).

The European Geostationary Navigation Overlay System (EGNOS) is a similar satellite system under development of the European Space Agency (ESA), the European Commission (EC), Eurocontrol, and the European Organization for the Safety of Air Navigation. For more information on EGNOS, visit the ESA website (http://www.esa.int/esaNA/egnos.html).

Getting Acquainted

The GMS-110 system's advanced design reduces the number of cables required for system operation, allowing jobs to be performed more reliably and efficiently, especially when the receiver is moving. The GMS-110 is versatile and can be configured according to the usage and function of the receiver at the jobsite.

Map-RT Receiver

The Map-RT (Figure 1-2) is a multi-function, multi-purpose rover 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.

Figure 1-2. Map-RT Receiver

The Map-RT receiver is 159 mm wide, 172 mm deep, 88 mm high, and weighs 1.4 kg. The casing allocates space for two non-removable, on-board Li-Ion batteries, a power board, and two Euro cards. One of those cards is the GPS+ L1 receiver and the other is the OmniSTAR/ Beacon receiver.

The receiver's serial number and part number are displayed on the bottom panel of the receiver; the back panel displays the product name for the receiver.

The serial and power ports, antenna connectors, and MINTER (Minimum INTERface) are located on the receiver's front panel (Figure 1-3). For details on using the various button and LEDs, see "Using the MINTER" on page 3-20.

- MINTER – The Minimum INTERface for the receiver. The MINTER consists of three keys and five LEDs.
- Reset – This key can be used to leave Zero Power Mode or if the receiver does not respond to commands.
- PWR – The power input port to which an external power source (+6 to +28 V DC) is connected and where the unit is charged.
- Port A – The serial port used for communication between the Map-RT and an external control device to configure the OmniSTAR/Beacon and GPS+ receivers and collect data. This port can also be used for power and file management using PC-CDU on a computer.
- GPS antenna connector – External GPS/OmniSTAR/Beacon antenna connector; transfers RF signals from the antenna to the receiver and supplies DC power (+5.0 V DC) to the antenna's low-noise amplifier (LNA).
- Bluetooth antenna – Located inside the receiver's casing, this antenna provide Bluetooth wireless technology communication between two Bluetooth-enabled devices. This can be used instead of port A.

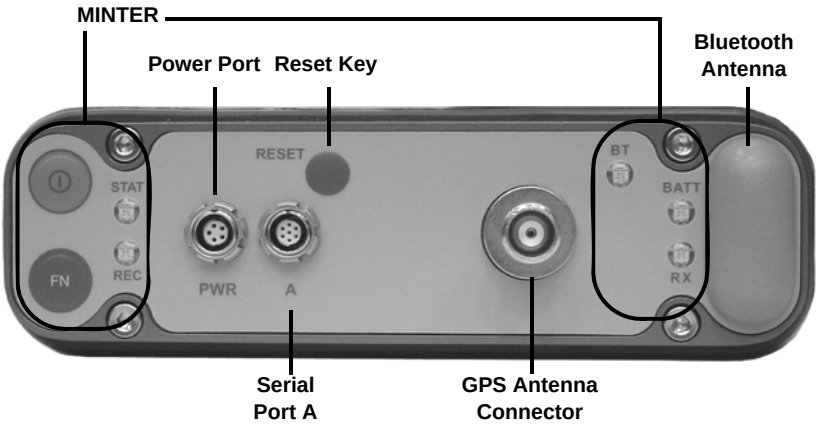


Figure 1-3. Map-RT Front Panel

GPS+ Board

The GPS+ board located inside the casing is a 20-channel L1 receiver. This receiver board applies differential corrections, received via internal port C from the internal port of the OmniSTAR/Beacon receiver, to its current GPS+ observations to provide a high level of real-time positioning accuracy.

OmniSTAR/Beacon Board

The OmniSTAR/Beacon board combines the L-band receiver with a Beacon receiver into an integrated unit.

The L-band (OmniSTAR) receiver component controls the process of tracking signals from the network of L-band satellites. Once the signal from the L-band geostationary satellite is received, it is captured, digitized, demodulated, and decoded. Finally, differential corrections (optimized for the location) are retrieved and applied to the GPS measurements to achieve real-time position solutions with decimeter accuracies.

The Beacon component of the board provides access to real-time DGPS corrections transmitted by marine radio beacons in coastal and inland regions. These radio beacons, which operate in the 283.5 KHz to 325 KHz band, transmit differential corrections by modulating the signal with the DGPS correction messages. The format of these correction messages has been defined by the Radio Technical Committee for Maritime Services (RTCM) and is used throughout the marine DGPS system.

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 3-34 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.

Bluetooth Module

A combination of software and hardware technology makes the Map-RT receiver a mobile DGPS unit that supports a point-to-point serial profile. As such, the Map-RT receiver can transfer and synchronize files between the receiver and any other Bluetooth wireless technology device that supports serial profile, including portable hand-held 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 board and power board.

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 1-1 describes the operating times for the Map-RT receiver with the internal batteries fully charged and dependent on the mode the receiver is running in.

Table 1-1. Map-RT Operating Times

Operating Mode	Average Run Time
GPS board, OmniSTAR/Beacon board, and Bluetooth module ON	~15 hours
GPS board and Bluetooth module ON	~18 hours

The Li-Ion batteries used in the Map-RT 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 (p/n 22-034101-01) is included with the standard package. See Appendix B for technical specifications on the battery.

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 the receiver to be used for a pre-determined 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)
- Memory (standard 32 MB) (optional 128 MB)
- Update rate standard 1Hz (optional 5, 10, or 20 Hz)
- RTCM Input/Output
- Co-Op tracking
- Advanced multipath reduction (optional)
- Wide Area Augmentation System (WAAS) (optional)
- OmniSTAR
- Receiver Autonomous Integrity Monitoring (RAIM) (optional)

OmniSTAR Activation

The OmniSTAR service is a subscription service. The Fugro ID of the OmniSTAR/Beacon receiver and the available satellite name are the values to be given to Fugro to set up a subscription. Then an authentication is transmitted over the satellite to the receiver to activate the subscription. The receiver must be tracking satellites to receive this authentication. Depending on the subscription type, this authentication might only entitle the user to a restricted area.

See “Step 2: Activate OmniSTAR Service (Optional Service)” on page 2-4, the OmniSTAR website, and the OmniSTAR registration form for more information on activating this service.

MG-A5 Antenna

The GMS-110 system is configured with the MG-A5 antenna for DGPS surveying. The MG-A5 antenna (Figure 1-4) is designed to receive signals transmitted by GPS satellites at 1575.42 MHz (L1), and by OmniSTAR satellites at 1525–1559 MHz (L-band) and Beacon stations at 283.5–325 kHz. The MG-A5 antenna attaches to an aluminum adapter that allows the antenna cable to be easily connected.

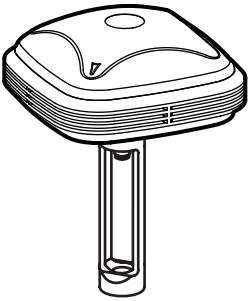


Figure 1-4. MG-A5 Antenna

Cables

The GMS-110 system uses various cables (Figure 1-5) to connect the receiver and antenna, receiver and controller, receiver and computer, receiver to power source, etc. The terminology used for each cable here will be used throughout this manual.

- RS232 serial cable (p/n 14-008005-02) – used to connect the receiver's port A and an external device (controller or computer)
- Receiver-to-SAE power cable (p/n 14-008016-03) – used to connect 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) – used to connect SAE connectors over longer distances
- Power supply-to-outlet cable (p/n 14-008052-01 for U.S. or 14-008052-02 for E.U.) – used to connect the power charger to a power outlet
- Alligator clips-to-SAE cable (p/n 14-008025-01) – used to connect any 12-volt DC power source and the Receiver-to-SAE power cable
- SAE-to-P-clip cable (p/n 14-008016-03) – used to connect an external battery and the Receiver-to-SAE power cable
- Antenna cable (p/n 14-008012-01, -03, or -05 depending on cable length) – used to connect the receiver and antenna

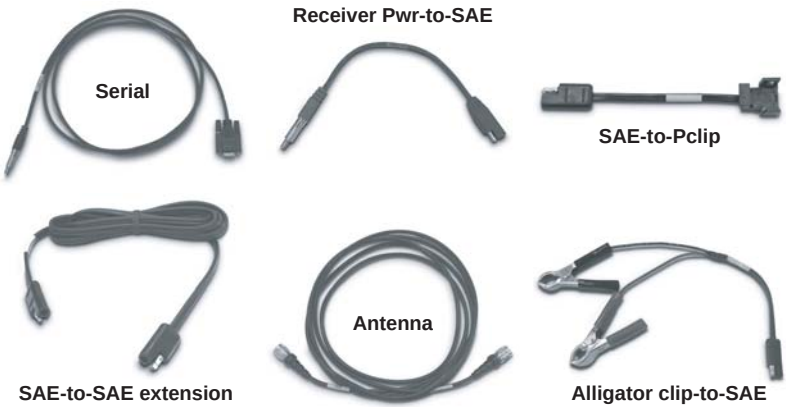


Figure 1-5. GMS-110 System Cables

Power Supply/Charger

The power supply/charger unit (p/n 22-034101-01) can be used as an external power source or as the charger for internal batteries (Figure 1-6 on page 1-18). This unit converts the alternating current (AC) normally supplied from an electrical outlet to a direct current (DC), which is then used to charge the batteries and power the receiver.

- input voltage – between 90 and 264 V AC
- frequency of input power – between 47 Hz and 63 Hz
- output voltage – 12 V DC@2.5 A (30 W)

Figure 1-6. Power Supply/Charger

Backpack

The GMS-110 system backpack (Figure 1-7) provides a convenient transport and carry-all for the receiver and antenna, as well as other field tools, for an all-in-one solution to GIS surveying.

Figure 1-7. GMS-110 Backpack

Optional Accessories

Optional accessories for the GMS-110 include a hand-held controller and an external battery. Contact your local Topcon representative for information on purchasing these items.

- The GMS-110 system works with any hand-held control device using the Windows® CE operating system. This allows the surveyor to configure and monitor the system directly in the field.

  The mobile control device (controller) is an optional purchase. Possible controllers include Topcon's suite of hand-held controllers, such as the FC-100 (Figure 1-8 on page 1-20), or third party devices, including the Ranger, Recon, or iPAQ.

Figure 1-8. Mobile Controller – Topcon's FC-100

- An external battery (from TPS, p/n 22-001001-01) can be used to extend the receiver's working time when the batteries become discharged (Figure 1-9). This external battery provides 12 V DC and 2.3 A*h.

Figure 1-9. External Battery

GMS-110 Setup & Quick Start

This chapter provides the minimum steps required to warm up the GMS-110 system and start using it in the shortest time possible. The procedures described in this chapter assume a basic understanding of GPS and DGPS concepts, as well as a working knowledge of TPS receivers.

For a detailed description of the procedures listed here, or the terms and concepts mentioned, see the sections referenced throughout this chapter. Also, refer to the additional documentation referenced throughout this chapter.

Pre-survey Setup

Before surveying with the GMS-110 system, charge the system's batteries, install field software onto the controller, and activate OmniSTAR service (if needed). Also, make sure that you have all items needed to perform these pre-installation procedures.

Required Equipment

To charge the receiver and controller, have the following ready:

- Map-RT receiver
- Hand-held controller
- Receiver and controller power supply/chargers
- Cables required to charge the receiver
- Cables required to charge the controller (refer to the controller's documentation)

To install application software, have the following ready:

- A computer with an RS-232C port or USB-to-serial adapter
- An RS-232C or USB (with adapter) cable
- ActiveSync installed on the computer
- CD with the software
- Hand-held controller
- A null modem adapter (for iPAQ only)

To activate OmniSTAR service, have the following ready:

- Map-RT receiver with connected DGPS antenna
- OmniSTAR serial number (displayed on bottom of receiver)
- Hand-held controller
- An RS-232C communication cable
- A null modem adapter (for iPAQ only)

Step 1: Charge System Components

The Map-RT receiver and the hand-held controller usually leave the factory with fully charged batteries. However, the batteries may lose some charge during transportation and storage. A full charging cycle ensures that the system does not suddenly lose power.

Charge the Receiver's Internal Batteries

To check the status of the internal batteries, view the BATT LED on the receiver's front panel.

- A green light indicates greater than 85% charge.
- An orange light indicates an intermediate charge.
- A red light indicates less than 15% charge.

Figure 2-1 on page 2-3 shows the receiver and power cables connected to an outlet for charging.

1. Plug the Receiver-to-SAE cable into the receiver's power port (labled PWR).
2. Connect the SAE end of this cable to the battery charger's SAE connector.

3. Plug the power supply-to-outlet cable into the battery charger then to a grounded AC outlet.
4. Press and hold the **Reset** key for about one second to ensure that the receiver is in Normal mode for charging. The receiver will not charge in Zero Power Mode (for more information, see “Zero Power Mode” on page 3-34).
5. Press and hold the **PWR** key for one to four seconds to turn off the receiver (the STAT and REC LEDs turn off; the BATT LED remains blinking).
6. Leave overnight. Fully charging the batteries takes approximately ten hours with the receiver ON; eight hours with the receiver OFF. The internal batteries cannot be overcharged.

Figure 2-1. Charge the Map-RT Receiver

Charge the Controller’s Internal Battery

For detailed instructions on charging the controller’s internal battery, refer to the controller’s documentation.

If using Topcon’s FC-100, ensure the batteries have been installed, then plug the AD-9B/7C power cable connector into the power port. Plug the other end into an outlet. The Charge LED will turn on and the batteries will be fully when the Charge LED glows green (up to five hours for first-time charging).

Step 2: Activate OmniSTAR Service (Optional Service)

The OmniSTAR (www.omnistar.com) system provides differential corrections for all GPS satellites in view. See Appendix A for more information.

For further instructions on activating OmniSTAR, refer to the "OmniSTAR Registration Form" included with the Map-RT package.

1. Record the Fugro ID (OmniSTAR serial number) found on the bottom of the Map-RT receiver.
2. Call, or contact through e-mail, one of the following OmniSTAR customer service centers based on the geographic area you intend to work in. OmniSTAR customer service technicians are available 24 hours a day, 7 days a week.
   - North America: 1-888-883-8476 or 713-785-5850
     Subscription orders: signals@omnistar.com
   - Central and South America: 1-888-883-8476
     Subscription orders: signals@omnistar.com
   - Europe/Africa: +31-70-317-09-00
     Subscription orders: dgps@omnistar.nl
   - Asia/Australia: +61-8-9322-5295
     Subscription orders: g.glazier@fugro.com.au
3. Provide the technician with the following information:
   - serial number of the OmniSTAR board
   - subscription payment method, either credit card or Purchase Order (for rated firms); all major credit cards accepted
   - either your geographic location or the selected satellite frequency of the satellite that corresponds to your geographic area (see Table A-1 on page A-2 for satellites and frequencies)
   - for a VBS subscription, further subscription fees are required

   When finished subscribing to OmniSTAR service, the technician will advise you of the approximate time the subscription will be activated, usually within 15 minutes.

TIP

If desired, the technician can delay the subscription transmission for a period of time.

4. Just before the designated time, connect the receiver and antenna using the antenna cable, and turn on the receiver. Set up the antenna and receiver outside, with a clear view of the sky.

   For first-time activations or if the receiver has been stored for a long period of time, up to 30 minutes can pass while the receiver accumulates required information from OmniSTAR and GPS satellites.

Step 3: Install Software

The CD in the GMS-110 package includes Modem-TPS. The following receiver configuration procedures use Modem-TPS on a computer, but other Topcon software can also be used to configure the receiver using the controller (such as, CE-CDU or TopSURV GIS).

CAUTION

Do not use PC-RCC to configure this receiver.

Install Modem-TPS onto a computer to configure the Map-RT receiver (GPS receiver board and OmniSTAR/Beacon board).

1. Insert the GPS+ CD into the computer's CD-ROM drive.
2. Navigate to and open the Modem-TPS folder on the GPS+ CD.
3. Double-click the Modem-TPS setup file ("setup.exe").
4. Click **Finish** to install the program into the indicated directory. Then click **OK** to exit.
5. Create a Modem-TPS shortcut on the desktop. Refer to the *Modem-TPS User's Manual* for further details on using this software.

Step 4: Configure the OmniSTAR/ Beacon Board

The procedure below uses Modem-TPS to configure the Map-RT receiver; however, CE-CDU or TopSURV also performs this function (Do Not use PC-RCC). Regardless of the software used, the configuration parameters are the same. Refer to the *Modem-TPS User's Manual* for specific details on the parameters listed below.

The Map-RT receiver supports OmniSTAR service or Beacon service. For details on these service options, see "DGPS Overview" on page 1-8. To configure the board for either service, see the following sections ("Option A: OmniSTAR Configuration" on page 2-6 or "Option B: Beacon Configuration" on page 2-8).

Option A: OmniSTAR Configuration

1. Connect the RS232 serial cable to the receiver's port A and the other end to a serial port on the computer. Turn on the receiver.
2. Start Modem-TPS. Click **Cancel** then click **Tool ▸ Options**. Set the following connection parameters (Figure 2-2) and click **OK**:
   - Select "Internal" as the type of modem to connect with.
   - On the *Modem* tab, select *L-Band&Beacon* and set the *Baud Rate* to 38400.
   - On the Receiver tab, set the *Baude Rate* to 115200 and select "Port C" for the *Daisy Chain*.

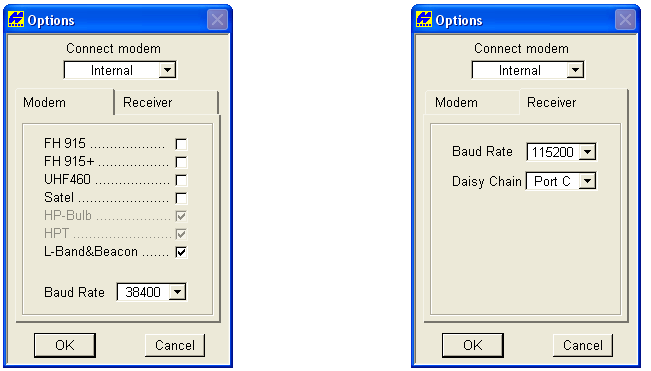


Figure 2-2. Set Map-RT Connection Parameters in Modem-TPS

3. Click **File ▸ Connect**. Select the computer serial port the receiver is connected to (usually COM1) and click **Connect**.
4. Once connected, select "Monitor" as the *Mode after Reset* and "ON" for the *GPS antenna*. Click **Apply** (Figure 2-3).
5. Click the **L-Band** tab, select the *Satellite* that corresponds to an active OmniSTAR subscription (Figure 2-3). This satellite must be the same as the satellite you subscribed to in "Step 2: Activate OmniSTAR Service (Optional Service)" on page 2-4.

   The Map-RT will be ready to receive signals when logged on to the correct satellite signal and with a valid subscription. To see the availability of the subscription, click **VBS Status**.
6. Click **Apply** to save these settings. Click **File ▸ Disconnect** and then **File ▸ Exit** to exit Modem-TPS.

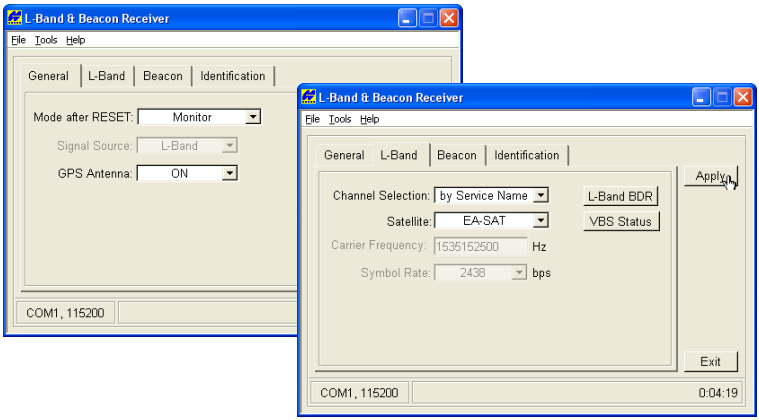


Figure 2-3. Modem-TPS – OmniSTAR Configuration

7. Connect to PC-CDU ("Establishing a PC-CDU Connection" on page 3-13) and click **Receiver ▸ Configuration** to configure the receiver for DGPS.
   - On the *Positioning* tab, select "DGPS (Code Differential)" as the *Positioning Mode*.
   - On the *Ports* tab, select "Omni" as the *Serial C* port's input.
8. Click **Apply** then **Ok** to save the settings, then click **Tools ▸ Reset receiver** to reset the receiver.
9. Click **File ▸ Disconnect** and then **File ▸ Exit** to exit PC-CDU.

Option B: Beacon Configuration

1. Connect the RS232 serial cable to the receiver's port A and the other end to a serial port on the computer. Turn on the receiver.
2. Start Modem-TPS. On the ***Connection*** dialog box, select the computer serial port the receiver is connected to (usually COM1), and click **Connect**.
3. Once connected, select "Monitor" as the *Mode after Reset* and "ON" for the *GPS antenna*. The *Signal Source* should be automatically set to "Beacon". Click **Apply** (Figure 2-3 on page 2-7).
4. Click the **Beacon** tab and select the following mode settings for searching the radio beacon needed using the Beacon receiver's Channels A and B (Figure 2-4 on page 2-9).
   - Channel A – accepts, demodulates, retrieves, and passes the retrieved RTCM corrections to the GPS engine.
     - *Mode*: sets the searching mode to either Nominal (the carrier frequency set by the user), Full Range with 0.5 kHz step, Full Range with 1 kHz searching step, or Stored frequency.
     - Baud Rate: sets the baud rate for the frequencies being searched; either 50, 100, or 200.
     - Mode after lose of capture: sets the mode for the beacon receiver channel A; either repeat search by config (according to settings in the configuration file), or use source from second receiver (the best Beacon radio transmitter found in the area).
   - Channel B – performs a continuous background search for Beacon stations throughout the region.
     - *Mode*: sets the searching mode for the scanning receiver to either Full Range (0.5 kHz) or Full Range (1 kHz).
     - *Baud Rate*: sets the baud rate for the frequencies being searched; either full (50,100,200) or short (100,200).
5. Click **Apply** to save these settings. Click **File ▸ Disconnect** and then **File ▸ Exit** to exit Modem-TPS.

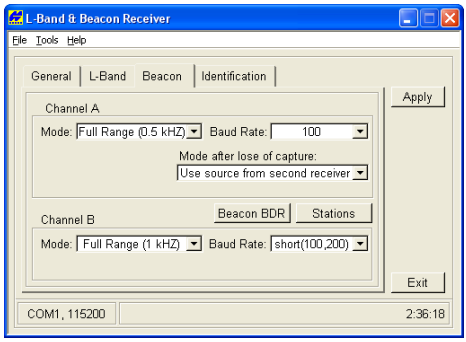


Figure 2-4. Modem-TPS – Beacon Configuration

Setting up Hardware

This section contains the basic information required to install, attach cables and start up the GMS-110 system. For first time users, become familiar with the setup and startup procedures before operating the GMS-110 system in the field.

Step 1: Site Considerations

Follow these guidelines when setting up the system in the field:

- If possible, select a location with a clear view of the sky.
- Avoid placing the antenna near potential sources of interference, such as transmitting antennas, radars, cell phones, and other electronic equipment that can interfere with the radio signal.

Step 2: Set up & Connect

The GMS-110 is a mobile system specifically designed to be easily and efficiently carried and operated in the field. The following illustrations show a DGPS setup with the MG-A5 antenna.

1. Connect the antenna cable and serial cable to the receiver. Turn on the receiver (Figure 2-5).
    - If using Bluetooth wireless technology, see “Establishing a Wireless Connection” on page 3-10.

- Check the color of the BATT LED to verify the receiver has sufficient power for the survey.

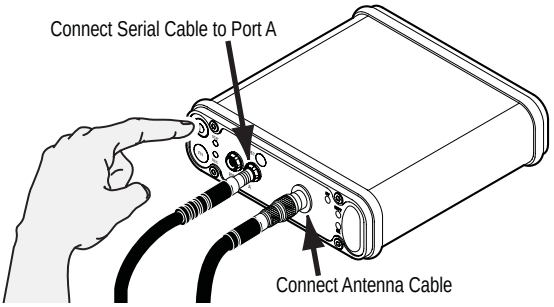


Figure 2-5. Connect Cables and Turn on Receiver

2. Securely arrange the receiver in the backpack with the connectors facing the direction in which the cables will emerge from the backpack (Figure 2-6).
3. Thread the cables through the desired hole at the bottom of the flap and close the flap.

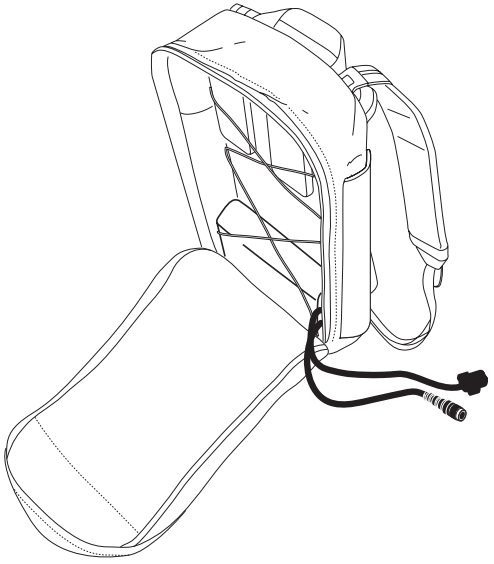


Figure 2-6. Arrange Receiver in Backpack

4. With the antenna attached to the pole, insert the antenna pole into the compartment on the same side the cables emerge from (Figure 2-7).
5. Connect the antenna cable to the antenna, wrapping it around the pole (Figure 2-7).

   If needed, open the backpack and count the number of STAT LED green blinks to verify the receiver tracks five or more satellites. You may need to wait several minutes while the almanac updates.

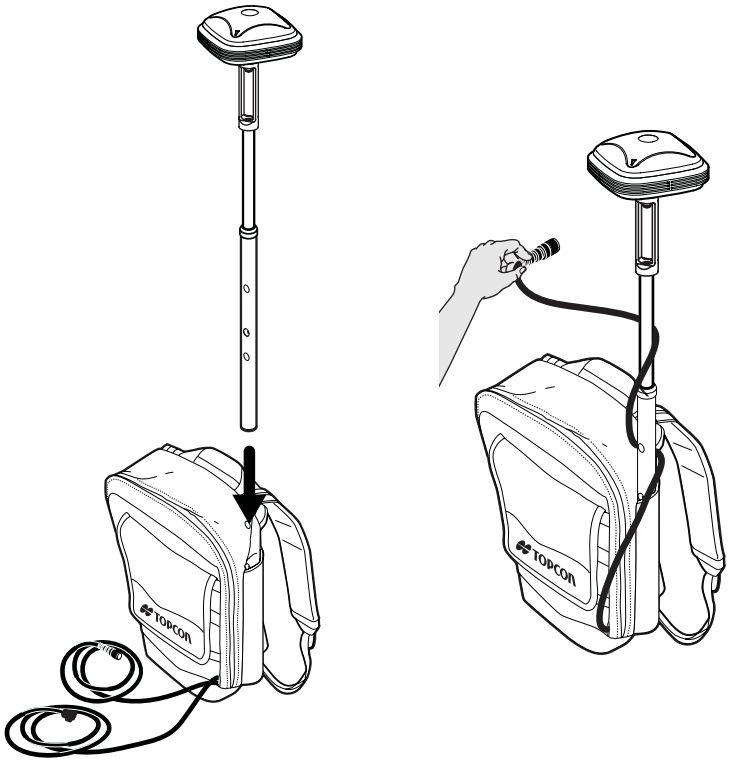


Figure 2-7. Insert Antenna and Connect Antenna Cable

6. Carefully put on the backpack. Once positioned comfortably, connect the receiver and hand-held controller with the serial cable or using Bluetooth, and turn on the controller (Figure 2-8 on page 2-12).

   For Bluetooth connectivity details, see “Establishing a Wireless Connection” on page 3-10.

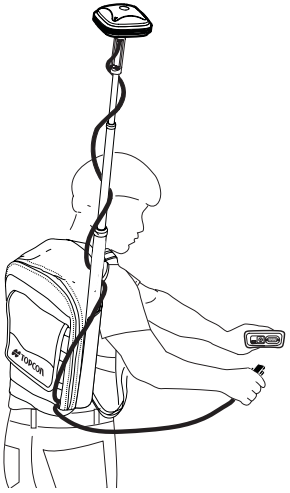


Figure 2-8. Getting Ready to Survey (with Serial Cable)

Verifying System Performance

Before beginning to survey, check the following items to ensure the system performs as expected:

- The receiver must track five or more GPS satellites.
- The receiver must display the correct position, desired differential corrections source, and position type.
- The controller and receiver batteries should be fully charged to provide expected run time.
  - To check the controller's power, tap **Start ▸ Settings ▸ System ▸ Power** using the controller's operating system.
  - To check the receiver's power, view the BATT LED on the MINTER. Or use TopSURV GIS: click **Srv ▸ Status ▸ Sys** and view the percentages of receiver and controller power.

The following checks use TopSURV to verify system performance (Figure 2-9).

1. Tap **Survey** ▸ **Status** and tap the *SVs* tab to view status information about the GPS and GLONASS satellites being tracked.
2. Tap **Survey** ▸ **Status** and tap the *Pos* tab to view position, desired differential corrections source, and position type.

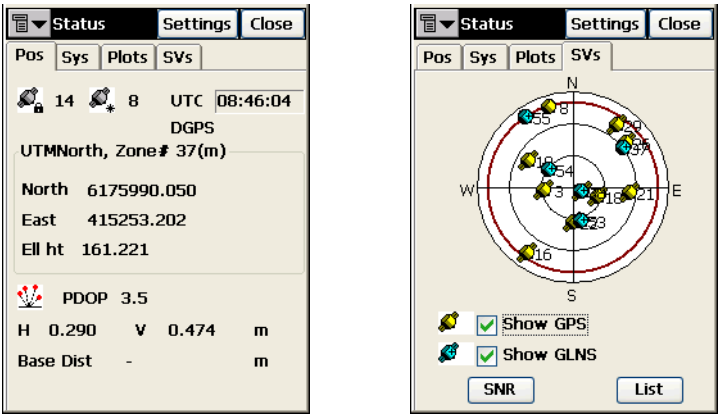


Figure 2-9. TopSURV – View Position Information and Tracked Satellites

Collecting Data

TopSURV GIS provides an interface for collecting data with the GMS-110 system. For detailed information on collecting data with this software, see Chapter 4 and refer to the *TopSURV User's Manual*.

Performing a Topo Survey

If needed, press **Settings** and set the desired *Auto Accept* parameter: either the number of epochs to be averaged or the utmost position precision.

1. With the controller and receiver connected (using either a serial or Bluetooth connection), start TopSURV GIS.
2. Tap **Survey** ▸ **Topo** to survey locations
3. Walk to the first point location.
4. Tap **Start** and wait while TopSURV stores the point.
5. Walk to the next position(s) and repeat step 4.

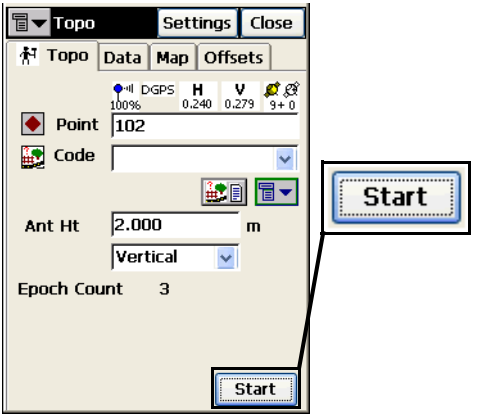


Figure 2-10. TopSURV – Topo Survey

Performing an Auto Topo Survey

Before beginning to survey, use the ***Survey Parameters*** screen to set either a time or distance interval.

- If the interval is set to time, TopSURV GIS will record a point when the time expires (for example, every 10 minutes).
- If the interval is set to distance, TopSURV GIS will record a point when the distance has been reached (for example, every 20 feet).

1. With the controller and receiver connected (using either a serial or Bluetooth connection), start TopSURV GIS.
2. Tap **Survey** ▸ **Auto Topo** to survey trajectories.
3. Walk to the first point location.
4. Press **Start** and begin walking along the trajectory.

   To store the current position at any time, press **Log Now**.

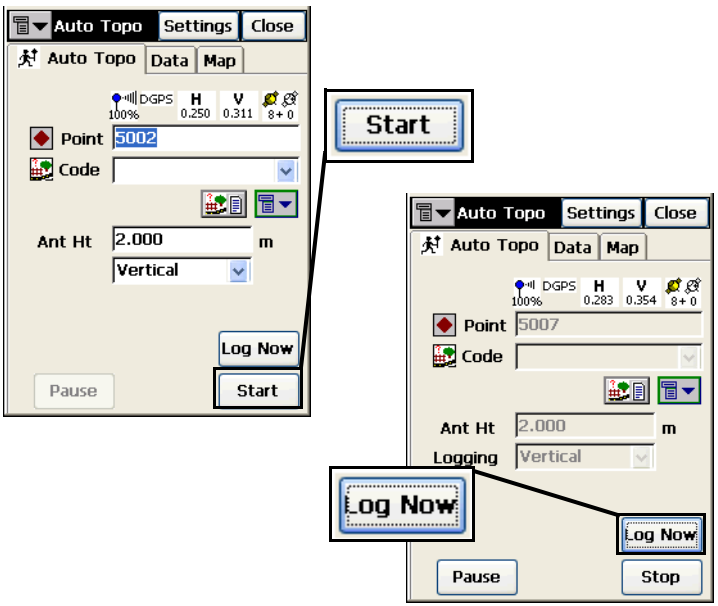


Figure 2-11. TopSURV – Auto Topo Survey

5. To stop data logging, press **Stop**.

Notes:

Managing the Map-RT Receiver

This chapter describes managing the Map-RT receiver and configuring the Bluetooth module.

Powering the Map-RT

You can power the receiver using the internal batteries or an optional external battery.

Internal Batteries

Table 3-1 describes the operating times for the Map-RT receiver with the internal batteries fully charged and dependent on the mode of the receiver.

Table 3-1. Map-RT Operating Times

Operating Mode	Average Run Time
GPS board, OmniSTAR/Beacon board, and Bluetooth module ON	~15 hours
GPS board and Bluetooth module ON	~18 hours

See “Charging the Map-RT Receiver” on page 3-7 for details on setting receiver parameters for charging the internal batteries.

External Batteries

In addition to the internal batteries, the receiver can use an external battery the internal batteries become discharged. To use external battery, you must have:

- a 12 V, 2.3 A*h battery
- a 2.3 A*h battery SAE-to-Pclip cable
- a Receiver PWR-to-SAE cable

A single external 12 V, 2.3 A*h battery should run the GPS receiver for about 5 hours and the GPS receiver and the OmniSTAR/Beacon receiver for no less than 7 hours.

NOTICE *NOTICE*

When the receiver uses an external battery, make sure the charger mode is set to Off. Otherwise, the external battery will also charge the internal batteries, causing operation time to decrease. See "Power Management" on page 3-3 for more information on setting the charger mode.

To power the receiver from an external battery (Figure 3-1 on page 3-3), connect the equipment as follows:

1. Turn off the receiver. Connect the SAE-to-Pclip cable to the external battery.
2. Connect the Receiver-to-SAE cable to the SAE-to-Pclip cable.
3. Plug the power cable into the receiver's power port.

Figure 3-1. Charging/Powering Receiver from External Battery

4. Turn on the receiver and check the BATT LED for the status of the external battery:
   - Solid light – an external power supply is used and the internal batteries are not being charged.
   - Blinking once a second – an external power supply is used and the internal batteries are being charged.

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 manual can be downloaded from the TPS website.

To access the tab controlling the power settings of your receiver, take the following steps:

1. Connect your receiver and computer. See "Connecting the Map-RT and a Computer" on page 3-12 for this procedure.
2. Once connected, click **Configuration ▸ Receiver**.

3. Select the **Power Mode** drop-down list to set the desired power source (Figure 3-2). **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

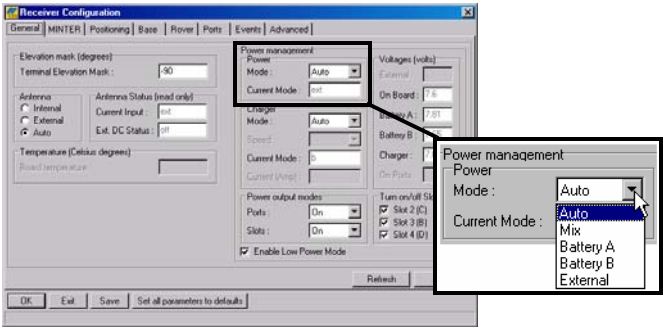


Figure 3-2. Select Power Mode

4. Select the **Charger Mode** drop-down list to set the desired charger mode (Figure 3-3 on page 3-5). *Current Mode* displays the charging battery: a, b, or none (off).
   - Off – receiver will not charge batteries.
   - Charge A – receiver will charge only battery A
   - Charge B – receiver will charge only battery B
   - Auto – receiver will automatically detect and charge both batteries

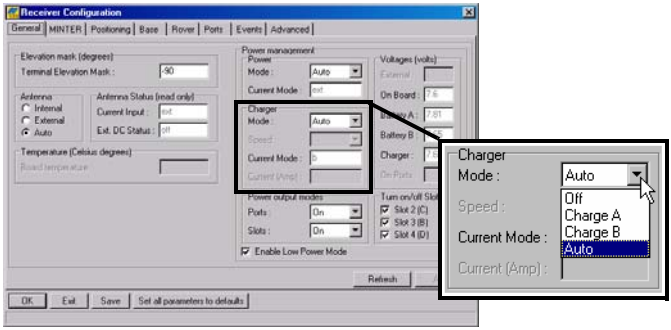


Figure 3-3. Select Charger Mode

5. Select the **Power output modes Ports** drop-down list to set power output for the serial ports (Figure 3-4 on page 3-6).
   - On – the power board delivers voltage on pin one of all serial port connectors when the receiver is turned on; if receiver is off, no power is delivered to any port
   - Off – the power is absent, even if the receiver is on
   - Always – the power board delivers voltage on pin one of all serial port connectors, even if the receiver is off
6. Select the **Power output modes Slots** drop-down list to set power output on for the internal slots (Figure 3-4 on page 3-6).
   - On – all slots have power if the receiver is turned on
   - Off – internal slots do not have power, even if the receiver is turned on
   - Always – internal slots have power, even if the receiver is turned off

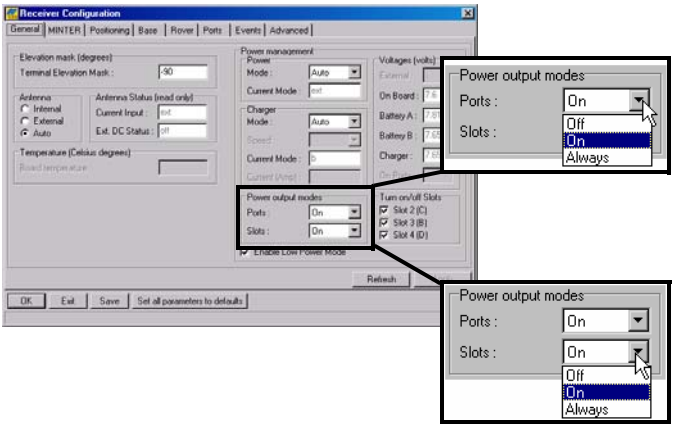


Figure 3-4. Select Power Output Modes – Ports and Slots

7. View the Voltages information (Figure 3-5).
   - External – external power supply's voltage
   - On Board – voltage drawn by the receiver board
   - Battery A – voltage of battery A
   - Battery B – voltage of battery B
   - Charger – charger's output voltage during battery charging
   - On Ports – voltage output on pin one of all serial ports connectors

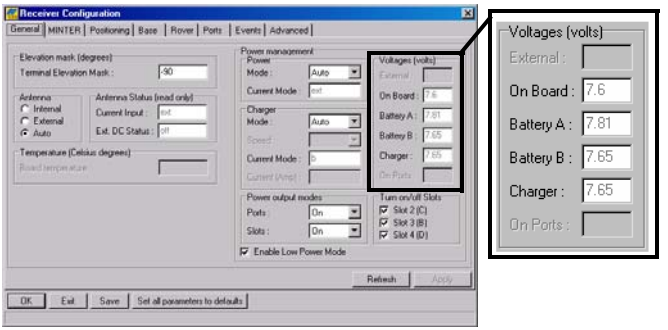


Figure 3-5. View Voltages Information

8. Select and check each of the **Turn on/off Slots** check boxes to enable the corresponding internal slots (Figure 3-6).

9. Select and check the **Enable Low Power Mode** check box to put the receiver's processor into low power consumption mode (Figure 3-6).

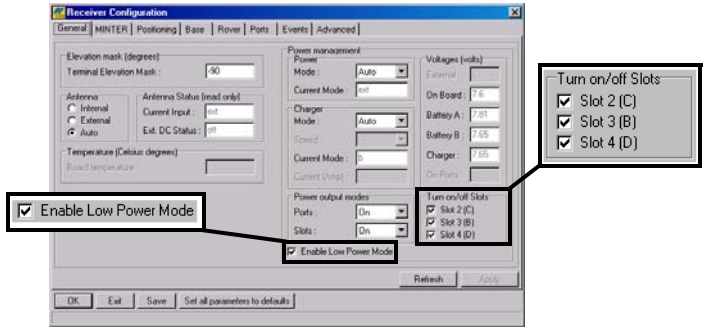


Figure 3-6. Enable Slots and Low Power Mode

10. Click **Apply**.

Charging the Map-RT Receiver

Fully charging the batteries takes approximately ten hours with the receiver ON; eight hours with the receiver OFF. The internal batteries cannot be overcharged. See Table 3-1 on page 3-1 for details on the receiver's operating times.

Figure 3-7 on page 3-8 shows the receiver and power cables connected to an outlet for charging.

1. Plug the receiver-to-SAE cable into the receiver's power port (labled PWR).
2. Connect the SAE end of this cable to the power supply/charger's SAE connector.
3. Plug the power supply-to-outlet cable into the power supply/charger then to a grounded AC outlet.

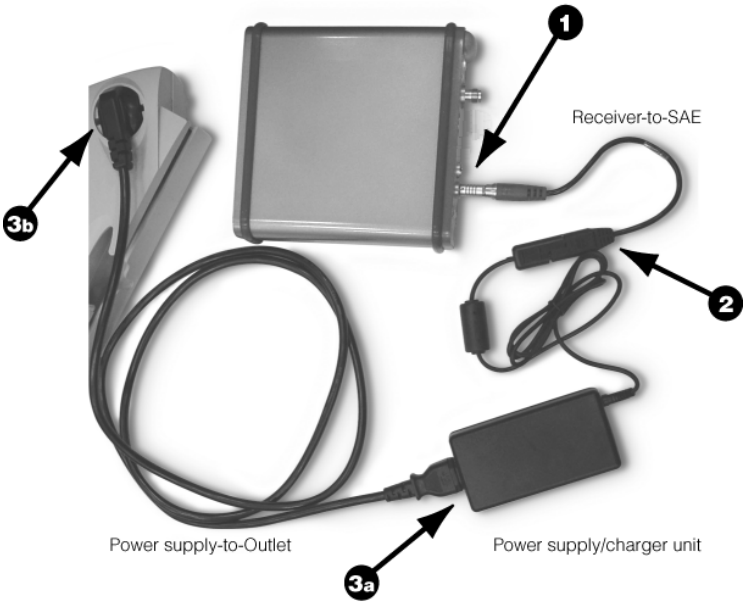


Figure 3-7. Charging the Map-RT Receiver

4. Press and hold the **Reset** key for about one second to 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 3-34 for more information).

5. Press and hold the **PWR** key for one to four seconds to turn off the receiver (the STAT and REC LEDs turn off; the BATT LED remains blinking).
6. Leave the receiver overnight to fully charge the batteries.

To check the status of the internal batteries, view the BATT LED on the receiver's front panel.

- A green light indicates greater than 85% charge.
- An orange light indicates an intermediate charge.
- A red light indicates less than 15% charge.

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.

Connecting the Map-RT and a Hand-held Controller

The use of a compact, lightweight, and powerful hand-held controller in surveying is one of the essential components that makes the GMS-110 mobile and easy to manage. The hand-held controller provides a significant increase in the productivity of the operator and reliability of the survey.

This section contains detailed information on connecting a hand-held controller and Map-RT receiver. Once you have established a connection, use Topcon's TopSURV GIS module (or CE-CDU) on the controller to perform the following functions:

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

See Chapter 4, or refer to the TopSURV or CE-CDU manuals for more details on performing these functions with controller software.

Establishing an RS232 Cable Connection

1. Using the RS232 serial cable, connect the serial port of your controller to the receiver's GPS port.

   Note that iPAQs require a null modem adapter, which can be purchased at any computer store.
2. Press the **power** buttons on the receiver and controller to turn them on.
3. Start the appropriate software on the hand-held controller and continue with software configuration or operation functions as needed.

Establishing a Wireless Connection

The Map-RT 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, a hand-held controller.

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.

If needed, refer to your controller's documentation for detailed Bluetooth connection information.

Option A: Connect using Bluetooth and an Expansion Device

In this connection scenario, the Bluetooth device is an expansion device, such as a Compact Flash card.

1. Insert the Bluetooth adapter into the appropriate slot on the hand-held controller.
2. Turn on the controller and TPS receiver.
3. After the controller recognizes the card, the Bluetooth icon will appear (usually at the bottom of the "Today" screen). 
4. Using the controller's Bluetooth Manager software, turn the Bluetooth adapter on (if required) and run TopSURV.
5. In TopSURV, open a job and tap **Job ▸ Mode**.
6. Enable the Bluetooth checkbox and tap **OK**.

   The Bluetooth adapter starts searching for the Bluetooth devices available (for the first-time connection). Once the search is complete, select your Map-RT, enable the *Save selection* for future use and tap **Select**.

After saving this receiver for future use, simply tap **Select** in the Bluetooth Devices window to establish a Bluetooth connection with this receiver.

7. Once connected, continue with other configuration procedures as needed.

Option B: Connect using Bluetooth in an Integrated Device

In this connection scenario, the Bluetooth device is an integral part of the hand-held controller.

1. Turn on the controller and TPS receiver. After a brief period of time, the Bluetooth icon will appear at the bottom of the "Today" screen.

2. Using the controller's Bluetooth Manager software, turn the Bluetooth adapter on (if required) and run TopSURV.
3. In TopSURV, open a job and tap **Job ▸ Mode**.
4. Enable the Bluetooth checkbox and tap **OK**.

   The Bluetooth adapter starts searching for the available Bluetooth devices. Once the search is complete, select your Map-RT, from the list of discovered devices and tap **Select**.
5. Once connected, continue with other configuration procedures as needed.

Connecting the Map-RT and a Computer

To configure, manage files, or maintain the GPS receiver in the office, connect the receiver and a computer, and start the desired application software. The software procedures in this chapter use examples from PC-CDU for configuration and data management; however, many of the data management operations can be performed using other Topcon software, such as Topcon Link.

To use an RS232 cable to connect the computer and receiver:

Connect the cable to the computers serial port and the receiver's GPS port. Turn on the receiver.

To use Bluetooth wireless technology to connect the computer and receiver:

When at the computer, turn on the receiver. Follow the computer's on-screen instructions to establish a connection.

When establishing a Bluetooth connection with the computer, a USB-to-Bluetooth adapter or PCMCA-to-Bluetooth adapter must be installed.

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. Plug in your Bluetooth adapter to the matching computer's port. Also make sure that you have the Bluetooth configuration software installed on your computer.
2. Using the Bluetooth configuration software, assign the computer's communication port (usually COM7or COM8) to the Bluetooth serial port service.
3. Turn on the TPS receiver.

4. Using configuration software instruct the computer's Bluetooth adapter to search for the receiver.
5. Once the receiver is detected, run the software such as PC-CDU, select the serial port assigned to the Bluetooth serial port service (usually COM7 or COM8) and connect.

If the receiver cannot establish a connection, use a serial connection and PC-CDU to check that the receiver's slot three is enabled.

1. Click **Configuration ▸ Receiver ▸ General**.
2. In the **Turn on/off Slots** area, ensure the **Slot 3 (B)** checkbox is enabled.

Once you have established a connection, you will be able to:

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

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. 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 for Bluetooth or RS232 connections and click **Connect** (Figure 3-8):
   - Set the *Connection mode* as “Direct”.
   - Set the port for your computer from the *Port* drop-down list (typically COM1 or COM2 for RS232 connection and COM3 or above for Bluetooth connection).
   - Set the *Baud rate* (communication rate) between the receiver and the computer (usually 115200).

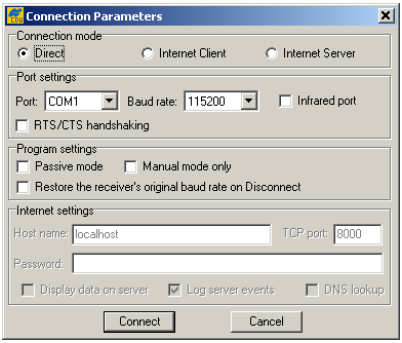


Figure 3-8. Bluetooth and RS232 Connection Parameters

Once a PC-CDU connection with the receiver has been established, the current communications settings display in the lower-left corner of the main window. A timer begins to count up in the lower-right corner as well (Figure 3-9).

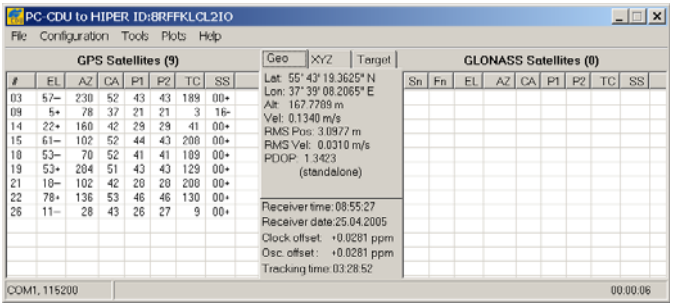


Figure 3-9. PC-CDU Connection Established

Configuring the Bluetooth Module Using BTCONF

Use BTCONF, Topcon's Bluetooth module 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, or remove, 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 serial 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. Run the Bluetooth module configuration program (Btconf.exe) (Figure 3-10).

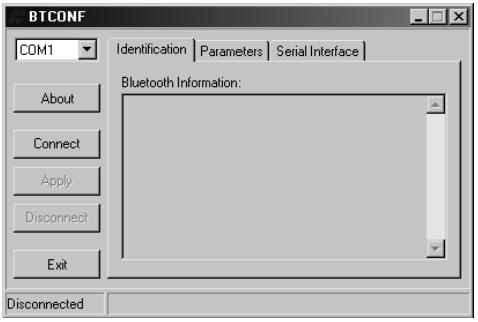


Figure 3-10. Bluetooth Module Configuration Main Screen

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.

4. From the drop-down list in the upper left corner, select the computer serial port (usually COM1) used for communication. Click **Connect** to connect the computer and Bluetooth module (Figure 3-11).

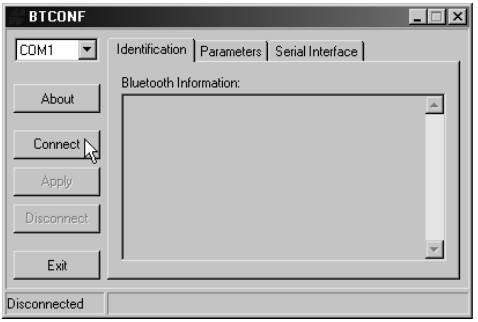


Figure 3-11. Select Communication Port and Click Connect

Once the receiver and computer connect through BTCONF, the *Identification* tab (Figure 3-12) displays the module's name, address, and firmware version.

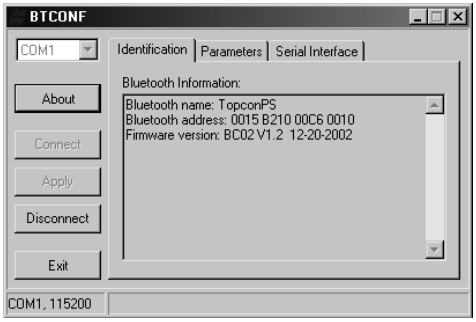


Figure 3-12. BTCONF Identification Tab

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

5. Click the **Parameters** tab (Figure 3-13 on page 3-17) to set identification and security information for the Bluetooth module. The security section sets 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 3-13), and click **Apply**.

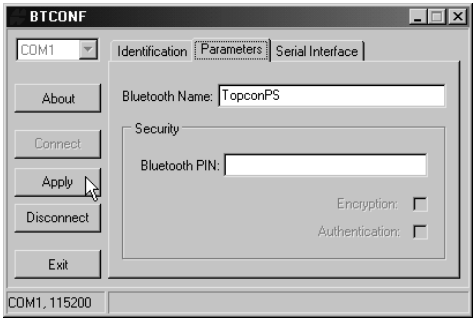


Figure 3-13. BTCONF Parameters Tab

7. Apply security (Figure 3-14 on page 3-18) parameters as needed. 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 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 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.

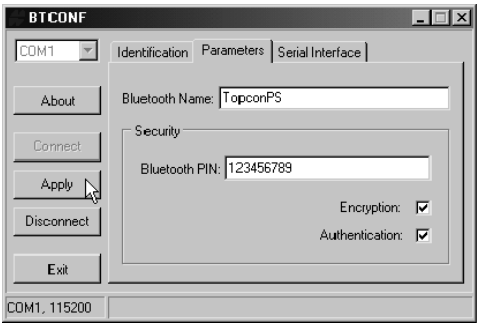


Figure 3-14. BTCONF Security Parameters

8. Click the *Serial Interface* tab (Figure 3-15). Enable **Echo** to display Bluetooth module replies and corresponding commands on the computer terminal. If needed, click **Apply**.

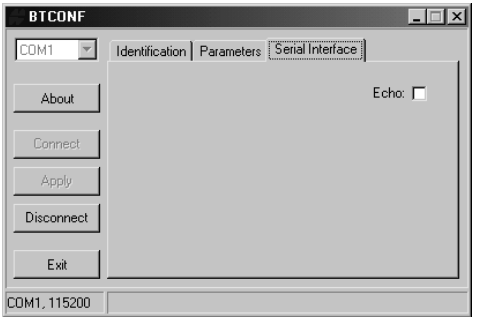


Figure 3-15. BTCONF Serial Interface Tab

9. Click **Disconnect** then **Exit** to quit BTCONF.

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.

NOTICE

See also "Step 2: Activate OmniSTAR Service (Optional Service)" on page 2-4 if using OmniSTAR service for subscription details.

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 and external antenna 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

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 3-32 for this procedure.

You will need to collect or update the almanac:

- 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.

Using the MINTER

The MINTER (Figure 3-16) is Topcon's Minimum INTERface used to display and control data input and output.

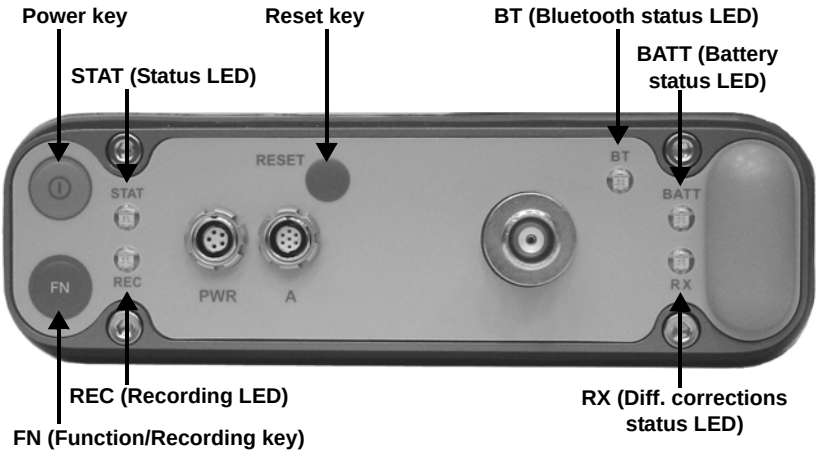


Figure 3-16. Map-RT MINTER

The following sections describe the MINTER components.

Power Key

Pressing the power key turns the receiver on and off.

Status LED

- When the receiver is on and no GPS satellites are tracked, the STAT LED will blink red.
- When satellites are tracked, the STAT LED will produce one green blink for each tracked satellite.

Reset Key

Pressing the reset key for about one second causes a hard reset of the receiver OR causes the receiver to leave Zero Power Mode and return to Normal Mode.

NOTICE

Only use the reset key if the receiver does not respond to commands or does not charge the internal batteries (is in Zero Power Mode).

FN Key and Record LED

Table 3-2 on page 3-22 summarizes FN key functions and REC LED statuses.

- Pressing the **FN** key for less than one second switches the receiver between different information modes (normal and extended information), or between static and dynamic post-processing modes, depending on the receiver's configuration.

  During the first second of pressing the **FN** key, the REC LED is orange.

- Pressing and holding the FN key for more than five and less than eight seconds will turn the baud rate of serial port A to 9600. After about five seconds of pressing the FN key, the REC LED becomes red. Release the FN key while the REC LED is red (during the next three seconds).

  Pressing and holding the FN key for more than eight seconds has no impact.

- After loading new firmware or clearing the receiver's NVRAM, the receiver checks its internal file system.

  During this operation, the REC LED flashes orange, and the file system is not accessible for CDU (control display unit) applications or for data recording. This operation may require from fractions of a second to several minutes, depending on the circumstances and the amount of internal memory.

Table 3-2. FN Key Functions and REC LED Status

FN Key	REC LED	Status
When data recording is off, and the FN key is...		
Not pressed	No light	No data recording.
	Orange blink	Internal file system test in progress.
	Red	No free memory; hardware problem with data recording.
Pressed for < 1 second	If FN key mode is “LED blink mode switch”	
	Orange	Release to change information mode.
	If FN key mode is “Occupation mode switch”	
	Orange	No function.
Pressed for 5–8 seconds	Red	Release to turn serial port A baud rate to 9600 bps.
Pressed for > 8 seconds	No light	No function.

Bluetooth LED

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

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

Battery LED

The color of the BATT LED indicates the level of internal battery charge in the receiver:

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

The pattern of blinks of the BATT LED also indicates the source of power:

- Solid light – an external power supply is used and the batteries are not being charged
- Blinking once a second – the batteries are being charged.
- Blinking once every five seconds – the receiver uses the internal batteries for power
- Not blinking – the receiver is in Zero Power Mode or the internal batteries are completely discharged and no external power is connected

NOTICE *NOTICE*

When the internal batteries have completely discharged and no external power is connected, the receiver will go into Zero Power Mode to prevent the batteries from over discharging.

RX LED

The color of the RX LED indicates the status of the differential corrections for the OmniSTAR/Beacon board.

When using OmniSTAR service:

- Blinks green – the receiver is searching for the selected OmniSTAR satellite
- Solid green – the selected OmniSTAR satellite is locked
- Solid green plus red blinks – the OmniSTAR satellite is locked and raw data is being received

When using Beacon service:

- Blinks green – the receiver is scanning for a Beacon station signal
- Solid green – a signal from the Beacon station is locked
- Solid green plus red blinks – the receiver is tracking the signal from the Beacon station and RTCM messages are being received

Information Modes

The receiver has two information modes: Normal and Extended Information Mode (EIM).

Normal

In normal mode, the STAT LED indicates the number of tracked satellites and the position's computation status.

Extended Information Mode (EIM)

EIM is used for receiver testing purposes. In this mode, the receiver continues to work as usual, but the LED indicates "extended" information using a delimiter. The delimiter is a distinguishable double-blink that shows the overall status of tests performed in EIM. The LED color for delimiter is calculated from the colors of other LED blinks.

- Orange – at least one blink is orange
- Red – no orange blink and at least one red blink
- Green – all other cases

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

Blink 1. Sufficient data for position computation.

Blink 2. GPS S/N ratios are good (Table 3-3).

Blink 3. GLONASS S/N ratios are good (not applicable for GMS-110).

Blink 4. Oscillator's frequency offset is less than three ppm.

Blink 5. Oscillator's Allan Variance is better than 2.7e-10.

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

Table 3-3. Signal-to-Noise (S/N) "Good" Ratios

	CA/L1	P/L1	P/L2
GPS	51	39	39

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

1. To switch to EIM, press and quickly release (within one second) the **Main FN** button.
2. Watch for the delimiter double-blink. With good receiver, antenna, and observation conditions, all blinks should be green within 15 minutes of powering on.
   - Green – ok
   - Orange – wait
   - Red – some tests failed
3. To switch back to normal mode, press the **FN** button.

Map-RT General Operation

This section describes managing receiver files, including logged data files, an option authorization file, or updated firmware files. For this, use either CE-CDU software on the controller or PC-CDU software on the computer. The procedures in the sections below use PC-CDU; however, the steps will be similar regardless of the software used.

Refer to the *CE-CDU Reference Manual* for details on the CE-CDU software and the *PC-CDU User's Manual* for a more complete description of the PC-CDU software.

Downloading Files to a Computer

When the survey finishes, you can download survey files to a computer for storage, post-processing, or backup. Also, the receiver memory holds a finite amount of files and information, so downloading the files prevents files from being lost.

PC-CDU (and CE-CDU) provides a File Manager to download files to your computer and delete files from the receiver.

1. Connect your receiver and computer. See "Connecting the Map-RT and a Computer" on page 3-12 for this procedure.
2. On the ***Connection Parameters*** dialog box, enable **RTS/CTS handshaking**.
3. Once connected, click **File ▸ File Manager**.
4. Click the **Download path** tab and do one of the following:
   - Navigate to and open the folder in which to download and store files.
   - Type a new folder name and click **Create** to create a new folder in which to download and store files. Open this new folder.
5. Click the **Download files** tab.
6. Click the file(s) to download (Figure 3-17 on page 3-27).

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

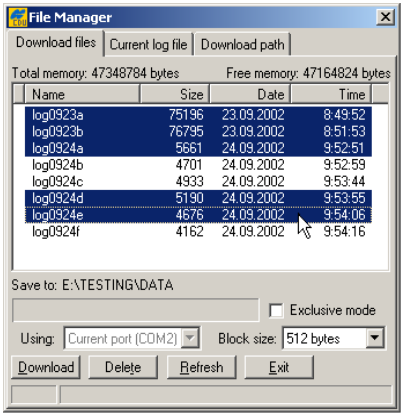


Figure 3-17. Download Files to Computer

7. Click **Download**. During the download, status indicators display next to each file (Figure 3-18).
   - Blue indicator – file in queue for downloading
   - Red indicator – file currently downloading
   - Green indicator – file has successfully downloaded

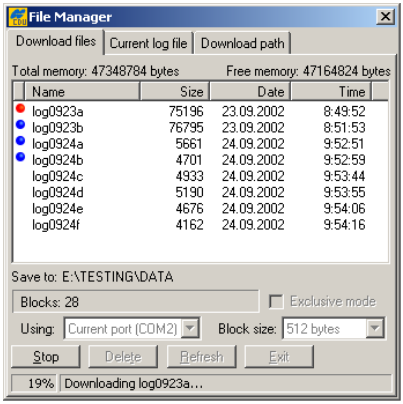


Figure 3-18. Download Files – Status Indicators

8. Click **Exit** on the ***File Manager*** dialog box. Continue with other operations. Or, click **File ▸ Disconnect**, then **File ▸ Exit** to quit PC-CDU.

Deleting Files

Use the following steps to delete files from your receiver.

1. Connect your receiver and computer. See “Connecting the Map-RT and a Computer” on page 3-12 for this procedure.
2. On the ***Connection Parameters*** dialog box, enable **RTS/CTS handshaking**.
3. Click **File ▸ File Manager**.
4. On the *Download files* tab, select the file(s) you want to delete (Figure 3-19).

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

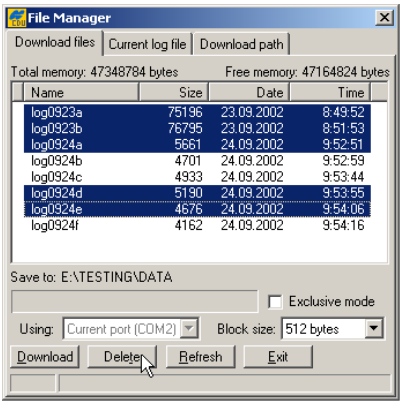


Figure 3-19. Delete Files

5. Click **Delete** (Figure 3-19). Click **Yes** at the confirmation.
6. Click **Exit** on the ***File Manager*** screen.

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

Checking Options

TIP

For a complete list of options and their details, visit the Topcon website.

You can check the status of your receiver's options, as well as load any new OAF, using PC-CDU or CE-CDU. The following procedure uses PC-CDU to check options.

1. Connect your receiver and computer. See "Connecting the Map-RT and a Computer" on page 3-12 for this procedure.
2. Click **Tools ▸ Receiver Options**.

The ***Options Manager*** dialog box contains the following information (Figure 3-20 on page 3-30):

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

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

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

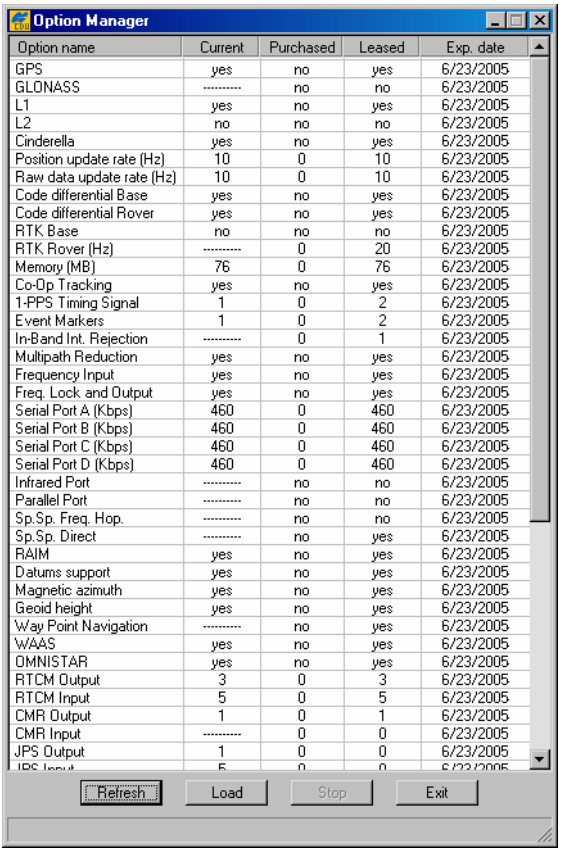


Figure 3-20. Option Manager

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

Loading an OAF

Topcon Positioning System dealers provide customers with OAF files. For any OAF related questions, E-mail TPS at options@topconps.com. Be sure to have your receiver ID number available (see “Checking Firmware Version” on page 4-22).

Both PC-CDU and CE-CDU can upload an OAF to the MAP-R receiver. The following procedure uses PC-CDU.

1. To load a new OAF, follow steps 1 and 2 in “Checking Options” on page 3-29.
2. Click **Load** at the bottom of the ***Option Manager*** dialog box (Figure 3-20 on page 3-30).
3. Navigate to the location of the new Option Authorization File. OAFs have .jpo or .tpo extensions and are unique to each receiver (Figure 3-21).
4. Select the appropriate file and click **Open** (Figure 3-21). The new receiver option uploads to the receiver and the Option Manager table updates.

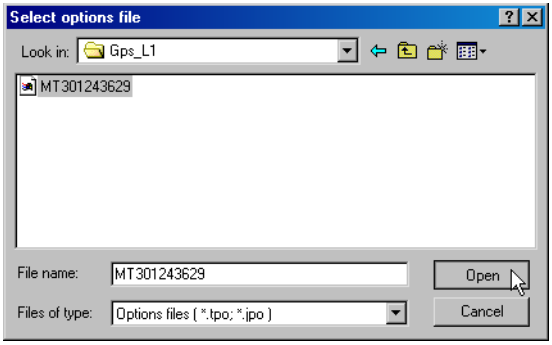


Figure 3-21. Load OAF

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

Clearing the NVRAM

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

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

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

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

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

Use the MINTER to Clear the NVRAM

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

Use PC-CDU to Clear the NVRAM

1. Connect your receiver and computer, then connect to PC-CDU. See “Connecting the Map-RT and a Computer” on page 3-12 for this procedure.
2. Click **Tools ▸ Clear NVRAM** (Figure 3-22). The REC LED rapidly flashes green and red; the STAT LED flashes red.

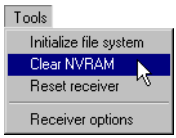


Figure 3-22. Clear NVRAM

The receiver will automatically disconnect once the NVRAM is cleared.

Changing Receiver Modes

The Map-RT receiver has four modes, two information modes and two power modes:

- Normal Mode
- Extended Information Mode
- Sleep Mode
- Zero Power Mode

See “Information Modes” on page 3-24 for a description of Normal Mode and Extended Information Mode.

Sleep Mode

In sleep mode, the power board and Bluetooth module will continue to draw power from the batteries, causing the batteries to drain over time. Put the receive in Zero Power Mode to prevent this (see “Zero Power Mode” on page 3-34).

Follow these steps to put the Map-RT into sleep mode.

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

NOTICE *NOTICE*

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

Zero Power Mode

When your receiver is off, even in Sleep Mode, the power board will continue to draw power from the batteries. This means that if you fully charge your receiver, turn it off and store it, the receiver will drain its battery power in less than two months. To stop the power board from draining the batteries, you can put your receiver in Zero Power Mode.

1. Turn on your receiver.
2. Press and hold the **power** key for more than 8 seconds, but less than 14 seconds.
3. Release the **power** key when the STAT and REC LEDs become red. When the LEDs turn off, your receiver will be in Zero Power Mode.
4. Press the **Reset** key for about one second to return to Normal mode.

NOTICE *NOTICE*

When the internal batteries have completely discharged and no external power is connected, the receiver will go into Zero Power Mode automatically to prevent the batteries from over discharging.

Checking GPS and Power Board Firmware Versions

NOTICE *NOTICE*

The GPS receiver should be loaded with firmware version 2.5 or newer.

1. Connect the receiver GPS port and a computer COM port. See “Connecting the Map-RT and a Computer” on page 3-12 for this procedure.
2. Click **Help ▸ About**. The ***About PC-CDU*** dialog box opens (Figure 3-23).

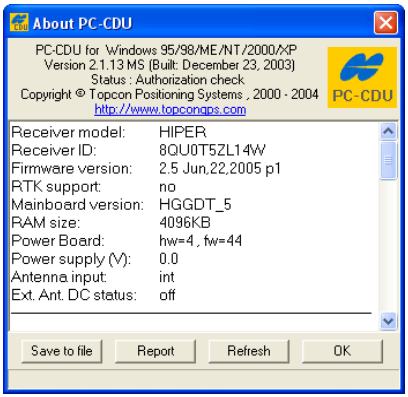


Figure 3-23. About PC-CDU

The ***About PC-CDU*** dialog box lists important information about the different hardware accessories and software properties. This list includes the following, which you will need if you contact TPS or your dealer:

- Receiver model
- Receiver ID
- Firmware version

3. When finished, click **OK**, then click **File ▸ Disconnect** to prevent conflicts with serial port management.

Checking OmniSTAR/Beacon Board Firmware Version

NOTICE *NOTICE*

The OmniSTAR/Beacon receiver should be loaded with firmware version 3.1 or higher.

1. Connect the receiver GPS port and a computer COM port. See “Connecting the Map-RT and a Computer” on page 3-12 for this procedure, but start Modem-TPS instead of PC-CDU.
2. Click the **Identification** tab for OmniSTAR/Beacon board version information (Figure 3-24).

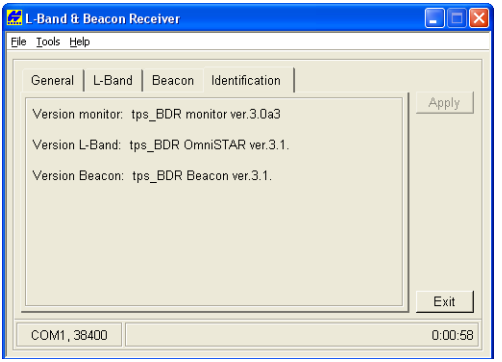


Figure 3-24. About OmniSTAR/Beacon

3. When finished, click **File ▸ Disconnect** to prevent conflicts with serial port management.

Loading New Firmware

Use the latest firmware, available for download from the TPS website, to ensure the receiver has the most recent updates.

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

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

Both FLoader and CE-CDU can upload firmware to the receiver. The following sections describe using FLoader to load new firmware.

1. Download and install FLoader, if applicable.
2. Download the new firmware package to your computer.
3. Connect your receiver and computer. See "Connecting the Map-RT and a Computer" on page 3-12 for this procedure.
4. Start FLoader (Figure 3-25).

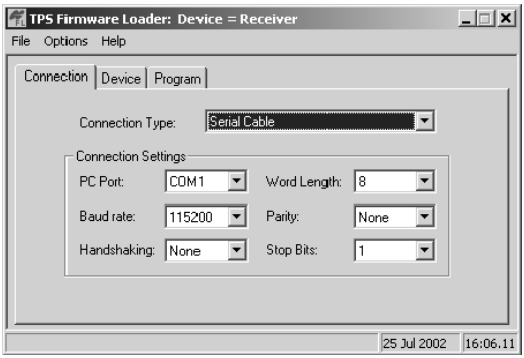


Figure 3-25. FLoader Main Screen

5. On the *Connection* tab, select the COM port on your computer that connects with your receiver and select its speed (usually 115200) (Figure 3-25).

GPS Receiver and Power Board Firmware

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

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

NOTICE *NOTICE*

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

1. In FLoader, select the *Device* tab and set the **Device Type** as Receiver (Figure 3-26).

Figure 3-26. Set Device Type

2. Click **Get from Device** for device information (Figure 3-26).

3. On the *Program* tab, set the *Capture Method* to Soft Break Capture (recommended). Browse for and select the receiver board's RAM file and Flash file (Figure 3-27).

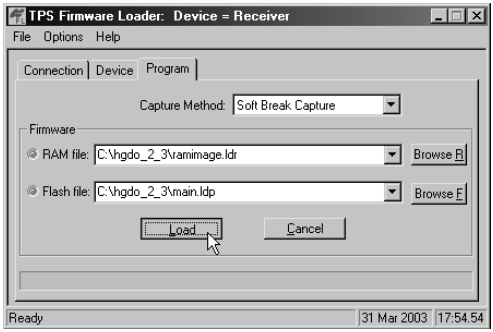


Figure 3-27. Program Tab Settings

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

NOTICE

NOTICE

If you selected an incorrect RAM or Flash file, an error message will display at the bottom of the dialog box. Reselect the correct file.

5. On the *Device* tab, set the **Device Type** as Receiver's Power Board (Figure 3-28).

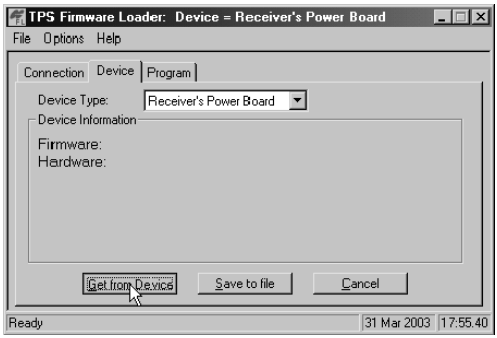


Figure 3-28. Set Device Type

6. Click **Get from Device** for device information (Figure 3-28).

7. Select the *Program* tab and set the *Capture Method* to Soft Break Capture (recommended). Browse for and select the Power board's RAM file (Figure 3-29).

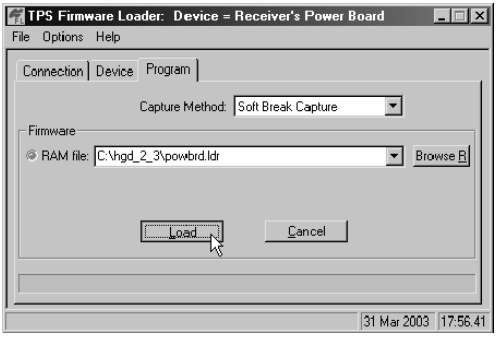


Figure 3-29. Program Tab Settings

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

NOTICE *NOTICE*

If you selected an incorrect RAM file, an error message will display at the bottom of the dialog box. Reselect the correct file.

9. Click **File ▸ Exit**.
10. Clear the receiver's NVRAM and update the almanac after loading new firmware.
    - see "Clearing the NVRAM" on page 3-32
    - see "Collecting Almanacs" on page 3-19

OmniSTAR/Beacon Receiver Firmware

OmniSTAR/Beacon receiver firmware is released as a compressed file that you download and decompress. This file contains the following two files:

- obloader.ldr – the Receiver board RAM file
- obmain.ldp – the Receiver board Flash file

1. Connect the receiver and computer using Port A on the receiver. Do Not connect using Bluetooth wireless technology.
2. Continue with the procedure described in "GPS Receiver and Power Board Firmware" on page 3-38 for downloading these files.

Bluetooth Module Firmware

Bluetooth module firmware is released as a compressed file that you download and decompress. This file contains the following two files:

- btloader.ldr – the Bluetooth module RAM file
- btmain.ldp – the Bluetooth module Flash file

NOTICE *NOTICE*

You must load both files when loading new firmware. These files must come from the same firmware package.

1. In FLoader, select the *Device* tab and set the **Device Type** as Receiver (Figure 3-30).

Figure 3-30. Get Device Type

2. Click **Get from Device** for device information (Figure 3-30).
3. Select the *Program* tab and set the **Capture Method** to Soft Break Capture (recommended). Browse for and select the Bluetooth module's RAM file and Flash file (Figure 3-31).

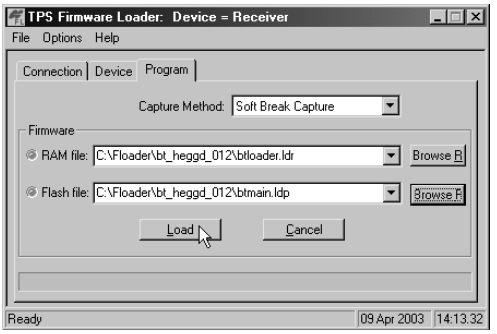


Figure 3-31. Program Tab Settings

4. Click **Load** and wait until 100% of the files load into your receiver (Figure 3-32).

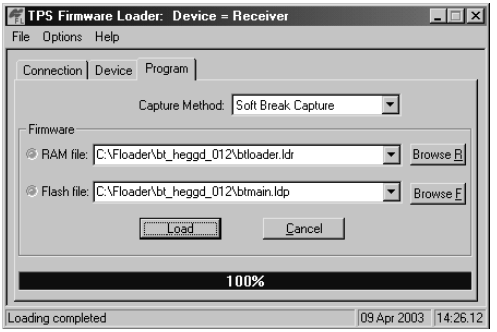


Figure 3-32. Bluetooth Firmware Load Complete

NOTICE *NOTICE*

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

5. Click **File ▸ Exit**.

Using TopSURV GIS

TopSURV is a field data collection, stakeout, and control software used on a hand-held controller. The GIS module of TopSURV is structured to provide the surveyor with capture and update functions for geographical data in a wide range of GIS-related applications.

While TopSURV GIS is packaged separately from the GMS-110 package, this chapter will provide a brief overview of getting started with and using TopSURV GIS with the Map-RT receiver.

Installing TopSURV onto a Controller

TopSURV can be installed onto a controller running the Windows® CE operating system—such as, Topcon's FC-2000 or FC-100, an iPAQ, or a Ranger or Recon. Installing TopSURV onto a controller requires the following:

- An RS232 or USB serial cable (controller dependent) to connect a computer and the controller.
- Microsoft® ActiveSync® installed on the computer. ActiveSync is a free utility that can be downloaded from the Microsoft website (http://www.microsoft.com/windowsmobile/downloads/pocketpc.mspx).
- The TopSURV CD.
- 21.0 MB free space on the controller.

Before installing TopSURV onto the controller, make sure the controller's batteries are charged. Refer to the *TopSURV User's Manual* for specific installation details.

1. Connect the computer and controller using the appropriate serial cable. Turn on the controller.

2. Follow the instructions on the computer screen to establish a Microsoft ActiveSync connection between the devices.
3. Insert the TopSURV CD into the computer's CD drive.
4. Navigate to the location of the TopSURV executable file and double-click it to begin the installation. Follow the on-screen instructions to install TopSURV onto the controller.
5. When the installation completes, run TopSURV on the controller. The ***Security*** screen will display.
6. Record the two *Key Values* and contact a Topcon representative to receive a GIS *Activation ID*. Once received, enter this ID and press **OK**.

Configuring GMS-110 for DGPS

TopSURV comes with pre-defined job configurations that contain the most common parameters. Follow the steps below to create a new or edit a current DGPS job configuration.

1. With the receiver (via the GPS port or Bluetooth wireless technology) and controller connected, start TopSURV.
2. Tap **Job** ▸ **Config** ▸ **Units** and check or apply the *Distance* and *Angle* measurement units for the job.
3. Tap **Job** ▸ **Config** ▸ **Survey**, select "My RT DGPS", and press the **browse** (**...**) button. Press the **Edit** button (Figure 4-1).

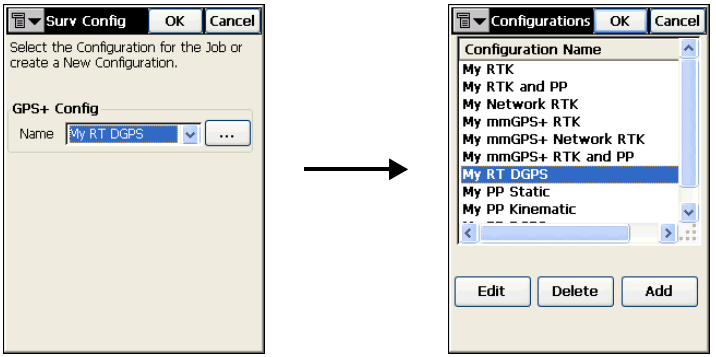


Figure 4-1. Edit Configuration DGPS Configuration

4. Enter or select the following DGPS configuration parameters (Figure 4-2) and press **Next**:
   - Name – enter a unique name for the configuration
   - Type – select "Real Time DGPS"
   - Corrections – select the source of differential corrections; either Beacon, OmniSTAR-VBS, WAAS, or EGNOS

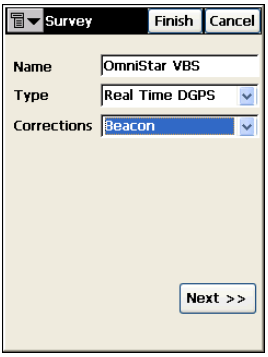


Figure 4-2. Select Source for Differential Corrections

5. Enter an *Elevation Mask* for the satellites used in position calculation. For a Beacon, WAAS and EGNOS configurations, also select a DGPS format (Figure 4-3). Press **Next**.

For OmniSTAR

For Beacon, WAAS, or EGNOS

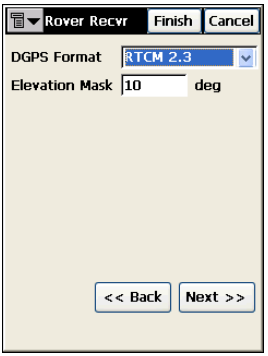
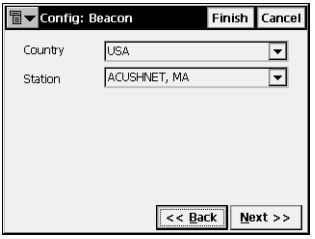


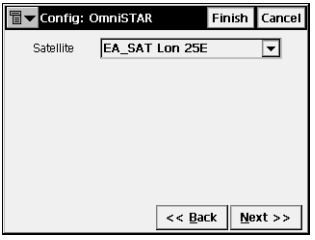
Figure 4-3. Set Elevation Mask and Select DGPS Format

6. Press **Next**. Depending on the configuration, select the following source information for receiving corrections data. (The following screen shot examples are taken from an FC-1000 controller.)

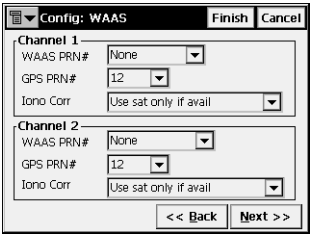
For Beacon configurations, select the *Country* in which the Beacon station resides and the *Station* closest to your position.



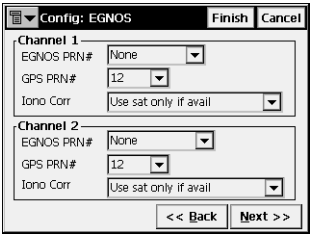
For OmniSTAR configurations, select the same satellite that you subscribed to. The receiver will be ready to work when the receiver is logged on to the correct satellite signal and the subscription is valid.



For WAAS configurations, select the *WAAS PRN#*, the *GPS PRN#*, and the desired ionoshperic corrections (*Iono Corr*) for both channels.



For EGNOS corrections, select the *ECNOS PRN#*, the *GPS PRN#*, and the desired ionoshperic corrections (*Iono Corr*) for both channels.



7. Press **Next** and select the following antenna parameters (Figure 4-4):
   - Ant Type – select MG-A5
   - Ant Ht – enter the measured height of the antenna from the ground to the base of the antenna
   - Meas Type – select either vertical or slant

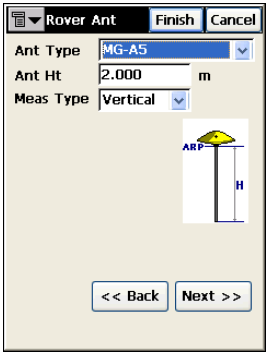


Figure 4-4. Enter Antenna Parameters

TIP

At this point, press Finish then OK to save these settings, keep the remaining default settings, and begin surveying. To make further edits to the configuration, continue below.

8. Press **Next** on the ***Rover Antenna*** screen.
9. Enter or select the following survey parameters and press **Next** (Figure 4-5 on page 4-6):
   - Solution Type – select a DGPS filter to use for logging data
   - Auto Accept – enter the number of measurements to be averaged and/or the acceptable horizontal and vertical precision.
   - Auto Topo – select the method to use for automatically logging data logging (by time or by distance) and the interval (in time or ft/m).

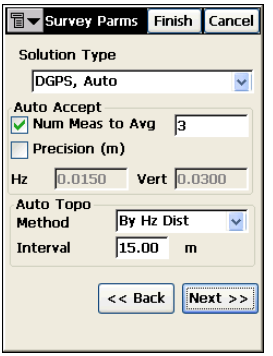


Figure 4-5. Enter Survey Parameters

10. Enter or select the following stakeout parameters and press **Next** (Figure 4-6):
    - Hz Dist Tolerance – the default is usually sufficient
    - Reference Direction – for most DGPS surveys, select "Moving Direction"
    - Store Staked Point As – note these settings and change as needed
    - Solution Type – select a DGPS filter to use for logging data

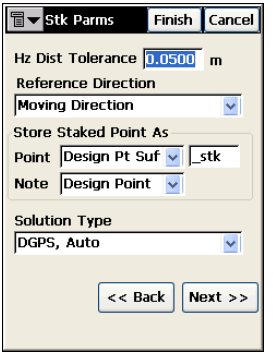


Figure 4-6. Enter Stakeout Parameters

11. Press **Finish** to save the job configuration.

Starting OmniSTAR Service in TopSURV

If using the OmniSTAR service, start the service in TopSURV before beginning to survey.

NOTICE *NOTICE*

It may take 20–40 minutes to accumulate required information from OmniSTAR and GPS satellites.

1. With the correct (L-band) DGPS configuration applied to the job, tap **Survey ▸ Status**.
2. Tap the bitmap menu in the upper left corner and tap **Config OmniSTAR**.
3. Select the satellite that you are subscribed to. The ***OmniSTAR*** screen also displays OmniSTAR/Beacon board information, including the OmniSTAR serial number (Figure 4-7). To view the satellite's status, press **Status**.
4. Press **OK** to connect to and begin logging data from the selected satellite.

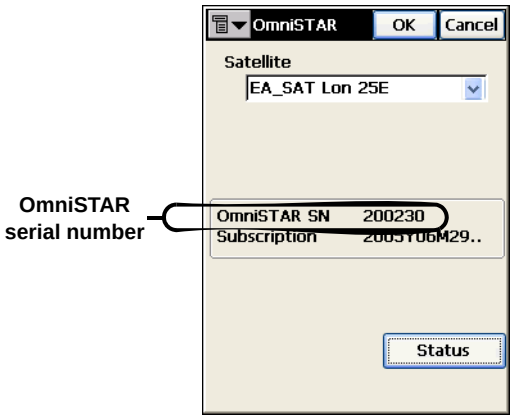


Figure 4-7. Start OmniSTAR Service

Verifying Survey Readiness

After setting up the GMS-110 hardware and before beginning to survey, check the following items using TopSURV:

- The receiver must track five or more GPS satellites.
- The receiver must display the correct position, desired differential corrections source, and position type.

To verify that GMS-110 is ready to begin surveying, tap **Survey ▸ Status** to view the ***Status*** screen (Figure 4-8).

- The *Pos* tab shows position, desired differential corrections source, and position type.
- The *SVs* tab shows status information about the GPS and GLONASS satellites being tracked.

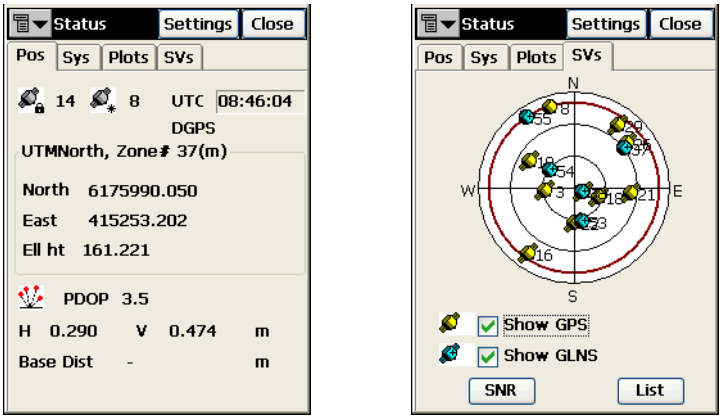


Figure 4-8. Check Position Information and Tracked Satellites

Performing a Topo Survey with TopSURV

If needed, press **Settings** and set the desired *Auto Accept* parameter: either the number of epochs to be averaged or the utmost position precision.

1. With the controller and receiver connected (using either a serial or Bluetooth connection), start TopSURV GIS.
2. Make sure the correct configuration is applied to the job (using **Job ▸ Config ▸ Survey**).
3. Tap **Survey ▸ Topo** to survey locations.
4. Walk to the first point location.
5. Tap **Start** and wait while TopSURV stores the point.

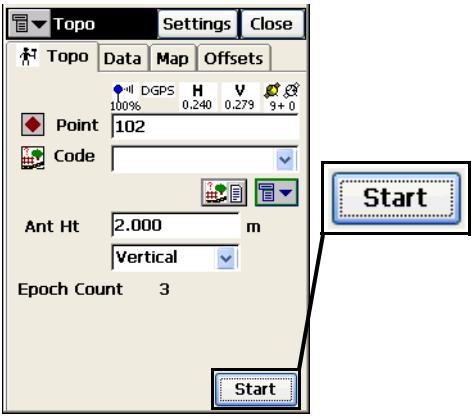


Figure 4-9. Performing a Topo Survey

Performing an Auto Topo Survey with TopSURV

Before beginning to survey, use the *Survey Parameters* screen to set either a time or distance interval.

- If the interval is set to time, TopSURV GIS will record a point when the time expires (for example, every 10 minutes).
- If the interval is set to distance, TopSURV GIS will record a point when the distance has been reached (for example, every 20 feet).

1. With the controller and receiver connected (using either a serial or Bluetooth connection), start TopSURV GIS.
2. Make sure the correct configuration is applied to the job (using **Job ▸ Config ▸ Survey**).
3. Tap **Survey ▸ Auto Topo** to survey trajectories.
4. Walk to the first point location.
5. Press **Start** and begin walking along the trajectory.

   To store the current position at any time, press **Log Now**.

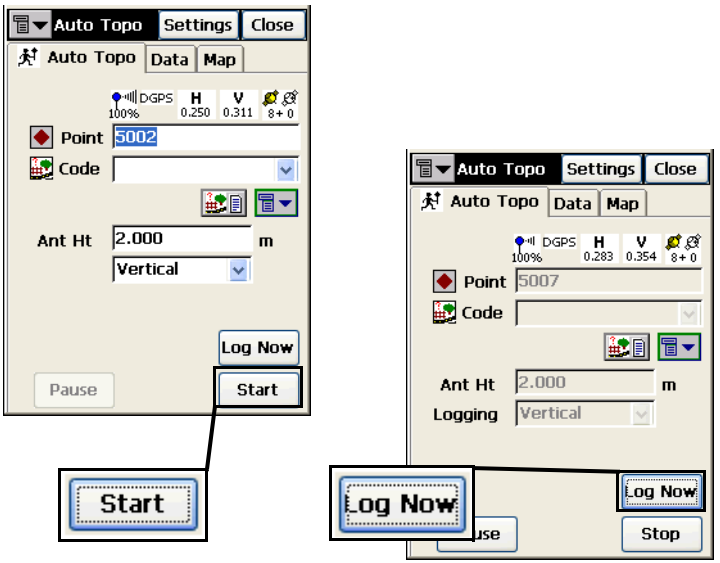


Figure 4-10. Performing an Auto Topo Survey

L-band/Beacon Details

The sections below describe OmniSTAR satellite and radio beacon station coverages, as well as satellite navigation status codes.

OmniSTAR Worldwide Coverage

The OmniSTAR (www.omnistar.com) system provides differential corrections for all GPS satellites in view. Using geo-stationary communication satellites, DGPS corrections from OmniSTAR's network of 70 reference stations are made available to 90% of the world's land mass (Figure A-1 to Figure A-3).

Figure A-1. MSV-ECW and AM-SAT Coverage

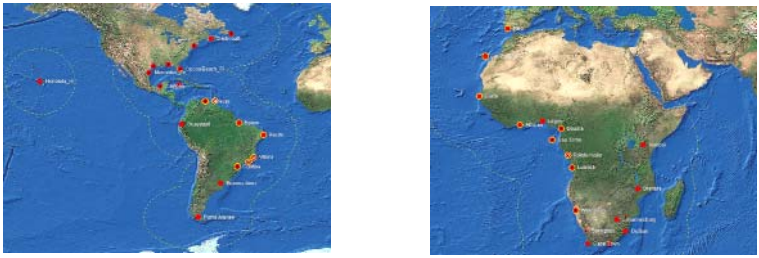
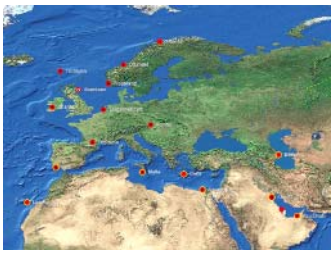


Figure A-2. AP-SAT and AF-SAT Coverage



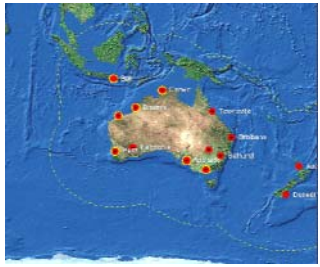


Figure A-3. EA-SAT and OPTUS Coverage

OmniSTAR service requires a subscription to a specified geographic area and satellite frequency. Table A-1 lists the coverage area and frequency for OmniSTAR satellites.

Table A-1. OmniSTAR L-band Satellite Information

General Coverage Area	Satellite Location (latitude/longitude)	Frequency	Data Rate[a]	Satellite Channel
Eastern U.S.[b]	44°59’59.99” -80°0’ 0.00”	1530.3590	1200	MSV-East
Central U.S.	44°59’59.99” -94°59’59.99”	1534.7410	1200	MSV-Central
Western U.S.	44°59’59.99” -119°59’59.99”	1536.7820	1200	MSV-West
north, Central, South America, and the Caribbean	1200 0°0’ 0.00” -97°59’59.99”	1535.1375	1200	AM-SAT
Asia, Pacific Islands	1200 0°0’ 0.00” 109°30’0.00”	1535.1375	1200	AP-SAT
Africa	1200 0°0’ 0.00” 40°0’ 0.00”	1535.0800	600[c]	AF-SAT
East Africa and the Middle East	1200 0°0’ 0.00” 25°0’ 0.00”	1535.1525	1200	EA-SAT
Australia and the Far East	-19°59’59.99” 144°59’59.99”	1558.5100	1200	OPTUS

a. A data (baud) rate of 1200 equals a symbol rate of 2438.
b. Coverage for East, Central, and West U.S. is from northern Canada to southern Mexico.
c. A data (baud) rate of 600 equals a symbol rate of 1219.

NOTICE *NOTICE*

Refer to the OmniSTAR website for detailed subscription information and current satellite information.

Table A-2 lists the OmniSTAR reference stations.

Table A-2. OmniSTAR Reference Stations

Station	ID	VBS	HP
AM-SAT			
Houston, Texas	100	yes	yes
Cocoa Beach, Florida	120	yes	yes
Long Island, New York	333	yes	yes
Carmen, Mexico	110	yes	yes
Punta Arenas, Chile	210	yes	no
Guayaquil, Ecuador	202	yes	no
Rio de Janeiro, Brazil	225	yes	yes
St. Johns, Newfoundland	470	yes	yes
Dartmouth, nova Scotia	440	yes	no
Recife, Brazil	075	yes	no
Port Of Spain, Trinidad	111	yes	yes
Caracas, Venezuela	112	yes	yes
Belem, Brazil	017	yes	no
Caymen, Grand Cayman	192	yes	yes
Honolulu, USA	210	yes	no
Curtiba, Brazil	257	yes	yes
Pensacola, USA	301	yes	yes
Vitoria, Brazil	205	yes	yes

Table A-2. OmniSTAR Reference Stations (Continued)

Station	ID	VBS	HP
Mercedes, USA	263	yes	yes
Buenos Aires, Argentina	345	yes	no
AF-SAT			
Abidjan, Ivory Coast	050	yes	no
Blantyre, Malawi	155	yes	no
Cape Town, South Africa	335	yes	no
Dakar, Senegal	144	yes	no
Douala, Cameroon	043	yes	yes
Durban, South Africa	305	yes	no
Faro, Portugal	371	yes	no
Lagos, Nigeria	060	yes	no
Las Palmas, Canaries	280	yes	no
Luanda, Angola	095	yes	yes
Nairobi, Kenya	015	yes	no
Pointe-noire, Congo	045	yes	yes
Port Elizabeth, South Africa	337	yes	no
Rogaland, norway	580	yes	yes
Sao Tome, Sao Tome	011	yes	yes
Walvis Bay, Namibia	235	yes	no
AP-SAT			
Auckland, NZ	022	yes	no
Karratha, Australia	215	yes	no
Darwin, Australia	125	yes	no
Broome, Australia	185	yes	no

Table A-2. OmniSTAR Reference Stations (Continued)

Station	ID	VBS	HP
Asahikawa, Japan	261	yes	no
Singapore	010	yes	yes
Miri, Malaysia	042	yes	yes
Vung Tua, Vietnam	012	yes	yes
Hong Kong	220	yes	no
Seoul, S. Korea	370	yes	no
Kota Kinabalu, Malaysia	061	yes	no
Bali, Indonesia	096	yes	yes
Mumbai-Arvi, India	191	yes	yes
Subic Bay, Phillipines	151	yes	no
Kuwait	290	yes	no
Abu Dhabi, UAE	016	yes	no
Kuantan, Malaysia	041	yes	no
Bangkok, Thailand	141	yes	yes
Chennai, India	131	yes	no
Bathurst, Australia	336	yes	no
Kalgoorlie, Australia	315	yes	no
Melbourne, Australia	385	yes	no
Okinawa, Japan	261	yes	no
Platong, Thailand	018	yes	no
Sakhalin, Russia	510	yes	no
Bahrain, Bahrain	260	yes	no
EA-SAT			
Abu Dhabi, UAE	016	yes	yes

Table A-2. OmniSTAR Reference Stations (Continued)

Station	ID	VBS	HP
Kuwait	290	yes	yes
Bahrain	260	yes	no
Aberdeen, Scotland	571	yes	yes
Alexandria, Egypt	310	yes	no
Astrakhan, Russia	462	yes	no
Baku, Azerbaijan	400	yes	no
Bodo, norway	122	yes	no
Crete, Greece	340	yes	no
Faro, Portugal	371	yes	yes
Istanbul, Turkey	410	yes	no
Leidschendam, The Netherlands	521	yes	yes
Malta	351	yes	no
Ny Alesund, Spitsbergen	101	yes	no
Orlandet, norway	630	yes	yes
Rogaland, norway	580	yes	yes
Shannon, Ireland	530	yes	no
Torshavn, Faroes	620	yes	no
Toulouse, France	431	yes	no
Tromso, norway	690	yes	no
Vardo, norway	114	yes	no
Visby, Sweden	229	yes	no
Vienna, Austria	480	yes	no
Kharkiv, Russia	500	yes	no

Radio Beacon Stations

Throughout the world, a number of coastal radio beacon networks have been established to improve the accuracy of maritime navigation around harbors and critical waterways. These signals also cover some inland areas in proximity to the radio beacon station.

For a listing of worldwide radio beacon stations, visit the CSI Wireless support site (http://www.csi-wireless.com/support/pdfs/radiolistings.pdf). This PDF is periodically updated and lists the following information for radio beacon stations:

- Broadcast site
- Frequency (kHz)
- MSK (bps)
- Latitude and Longitude
- Reference ID and Station ID
- Field Strength
- Status

Radio beacon stations are constantly being added to the worldwide system. Check with your local maritime authority to learn more about services available in your area. See the following websites for further information the Coastal Navigation Beacon system in your geogrphic area:

- For the United States, visit the US Coast Guard's Navigation Center website (www.navcen.uscg.gov).
- For Australia, visit the Australian Maritime Safety Authority website (http://www.amsa.gov.au/ns/dgps/dgps.htm).
- For other parts of the world, visit the International Association of Marine Aids to Navigation and Lighthouse Authorities website (http://www.iala-aism.org/web/index.html).

Satellite Navigation Status Codes

Table A-3 lists the codes as seen in the *Status* column on the ***Satellite Information*** dialog box in the GMS-100 manager software.

Table A-3. Satellite Navigation Status Structure

Code	Description
00	C/A data used for position computation
01	P1 data used for position computation
02	P2 data used for position computation
03	Ionosphere-free combination used for position computation
04	Measurements unavailable
05	Ephemeris unavailable
06	Unhealthy SV (as follows from operational (=ephemeris) SV health)
07	Time-Frequency parameters from the ephemeris data set may be wrong[a]
08	Initial conditions (position and velocity vectors) from the ephemeris data set may be wrong[a]
09	Almanac SV health indicator unavailable for this satellite[a]
10	Unhealthy SV [as follows from the almanac SV health indicator][a]
11	"Alert" flag (from the word "HOW") is set[b]
12	URA indicates the absence of accuracy prediction for this SV[b]
13	User excluded this SV from position computation
14	User excluded this SV with this frequency channel number from position computation[a]
15	This SV is excluded from solution since its system number is unknown[a]
16	This SV has an elevation lower than the specified mask angle
17	Reserved
18	Ephemeris data is too old
19	This SV does not belong to the constellation the user has selected
20	Differential data from Base Station unavailable for given satellite (applicable only when receiver runs in DGPS)
21	Reserved

Table A-3. Satellite Navigation Status Structure (Continued)

Code	Description
22	RAIM has detected wrong measurements
23	SNR below specified minimum level
24, 25	Reserved
26	DLL not settled
27	Ionospheric corrections are not received from Base Station
28	Coarse code outlier has been detected
29	Reserved
30	SV is not used in RTK processing (similar to code 20 but is used specifically for RTK)
31	The same as 30
32-50	Reserved
51	C/A slot used in RTK processing
52	P L1 slot used in RTK processing
53	P L2 slot used in RTK processing
54	P L1 & P L2 measurements used in RTK processing
55	C/A & P L2 measurements used in RTK processing
56-62	Reserved
63	Satellite navigation status is undefined

a. GLONASS only
b. GPS only

Notes:

Specifications

This TPS product is an easy-to-use yet powerful GIS data collection system that includes the following:

- a 20-channel GPS receiver with an internal OmniSTAR/Beacon DGPS board, a Bluetooth wireless technology module, and a rugged aluminum housing complete with MINTER and cable connectors
- an MG-A5 antenna
- a hand-held controller
- cables, backpack, and other accessories

NOTICE *NOTICE*

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

NOTICE *NOTICE*

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

NOTICE *NOTICE*

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

Map-RT Specifications

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

General Details

Table B-1 lists general Map-RT receiver specifications.

Table B-1. Map-RT General Specifications

Component	Details
Physical	
Enclosure	Aluminum; rainproof
Color	Topcon Grey
Dimensions	W:157 x H:48 x D:172 mm
Weight	1.4 kg
Environment	
Operating temperature	-30 C° to + 60 C° with batteries
Storage temperature	-20 C° to +35 C° with batteries
Humidity	95%
Power	
Input voltage	6 to 28 V DC (for work) 9 to 28 V DC (for charge battery) Maximum Charge Current <=2 Amp
Power consumption	With OmniSTAR Beacon ON: 4W With OmniSTAR Beacon OFF: 3.3W
Internal battery	Li-ion, 4000 mAh, 7.4V x 2 (not removable)
Battery size	132 x 35 x 18 (mm)
Battery weight	165 g (1 battery)
External power	1 port for charging receiver or using an external battery

Table B-1. Map-RT General Specifications (Continued)

Component	Details
On-board battery	Backup battery for timekeeping and almanac data storage; 10 years expected operation
I/O	
Communication Ports	One high speed RS232 serial port and Bluetooth wireless technology
Connectors	One external GPS/OmniSTAR/Beacon antenna connector and one external power input port (PWR)
MINTER	Five external LEDs ON/OFF control input
Bluetooth Module specifications	
Range	Up to 10 m (indoors); up to 50 m (outdoors)
Type	Class 2
Service classes	Miscellaneous
Supported profiles	Serial port profile: LM, L2CAP, SDP, PPP
Frequency Country Code	North America and Europe
Control Keys and Status Indicator	
Keys	Three keys: Power – On/Off Function (FN) – start/stop data logging; switch information mode. Reset – receiver hardware reset
Indicators	Five LEDs: STAT – satellite and receiver status REC – record and data status BATT – battery status RX – OmniSTAR/Beacon status BT – Bluetooth connectivity status

Table B-1. Map-RT General Specifications (Continued)

Component	Details
Data Features	
	Up to 20 Hz update rate for real time position and raw data (code and carrier) 10cm code phase and 0.1mm carrier phase precision RTCM SC104 version 2.1, 2.2, and 2.3 I/O Multiple Base RTCM Geoid and Magnetic Variation models RAIM Different DATUMs support Output of grid coordinates
DGPS	
Correction format	RTCM SC104 Ver 2.1, 2.2, and 2.3
RTCM message type	1, 3, 9, 31, 32, 34; user selectable
Process interval	1Hz standard; 5, 10, 20Hz optional
Output interval for RTCM correction data	1Hz standard; 5, 10, 20Hz optional
Elevation mask	0 to 90 deg (independent of data logging)
Multi-base DGPS	Differential correction select mode: Nearest, Mix, Best (optional)
Survey Accuracy	
Correction format	RTCM SC104 Ver 2.1, 2.2, and 2.3; TPS
DGPS position accuracy: OmniSTAR VBS Beacon WAAS/EGNOS	 σ 25 cm (X, Y), 50 cm Z < 1 m (RMS) 1 m (3DRMS)
Kinematic	H: 10mm + 1.0ppm (x baseline length); V: 15mm + 1.0ppm (x baseline length)
Static	H: 3mm + 0.8ppm (x baseline length); V: 4mm + 0.1ppm (x baseline length)

Table B-1. Map-RT General Specifications (Continued)

Component	Details
Cold Start Warm Start Reacquisition	< 60 sec < 10 sec < 1 sec

GPS Board Specifications

Table B-2 lists GPS Board component specifications.

Table B-2. GPS Board Specifications

Component	Details
Receiver Type (set by activating the proper OAF)	
Internal board: Euro-112T (HGGDT)	G: GPS L1 GG: GPS/GLONASS L1
Tracking Specifications	
Standard Channels	20 channels
Tracked Signals	GPS and GLONASS L1 C/A Carrier
Cold Start Warm Start Reacquisition	< 60 sec < 10 sec < 1 sec
Data Formats and Features	
Formats	TPS, NMEA, RTCM, BINEX
Features	Up to 20 Hz update rate for real time position and raw data (code and carrier) 10cm code phase and 0.1mm carrier phase precision RTCM SC104 version 2.1, 2.2, and 2.3 I/O Multiple Base RTCM Geoid and Magnetic Variation models RAIM Different DATUMs support Output of grid coordinates

Table B-2. GPS Board Specifications (Continued)

Component	Details
Memory	
Internal Memory	On-board flash memory (not removable)
Capacity	Standard – 32MB Maximum – 128MB
Logging Time	53 hours (8 MB, 15sec, L1/L2, 7 satellites)
Logging Interval	0.05 to 86400 seconds, depending on purchased options

OmniSTAR/Beacon Board Specifications

Table B-3 lists OmniSTAR/Beacon board component details.

Table B-3. OmniSTAR/Beacon Board Specifications

Component	Details
L-Band (OmniSTAR)	
Frequency Range	1525 MHz to 1559 MHz To use OmniSTAR DGPS service
Sensitivity	-120 dBm for < 10^{-3} BER
Tuning mode	manual, automatic
Adjacent channel rejection	30 dB
Correction Output Protocol:	Position Data, RTCM SC-104
Beacon	
Frequency range	283.5 to 325 kHz To use Beacon DGPS service
Channel spacing	500 Hz

Table B-3. OmniSTAR/Beacon Board Specifications (Continued)

Component	Details
Modulation	Minimum Shift Keying (MSK) MSK bit rates = 50, 100, 200 bps (manual or autoselection)
Channels	2-channel, parallel operating
Operation mode	manual, automatic
Adjacent channel rejection	65 dB ± 1 dB@f_0 ± 400 Hz
Cold start time	< 1 min
Warm start time	< 2 sec
Dynamic range	80 dB
Frequency offset	±0.5 Hz (~1.5 ppm)

MG-A5 Antenna Specifications

Table B-4 lists the MG-A5 antenna's details.

Table B-4. MG-A5 Specifications

Component	Details
Frequency range	1525...1559 MHz 285~325 KHz
Centering	Micro Center
Type	Microstrip antenna
Weight	0.8 Kg
Overall Dimensions	W:142 x H:190.04 x D:102.8 with adapter W:142 x H:88 x D:102.8 without adapter
DC voltage @ current supplied	+4.0~+12 V; 50 mA @ 5.0 typical
LNA gain	30 +/- 3 dB

Table B-4. MG-A5 Specifications (Continued)

Component	Details
Output	50 Ohm
Connector	TNC
Environmental	waterproof
Operating temperature	-40°C to +65°C
Shock resistance	2-meter pole drop

Accessory Specifications

The following sections list the specifications for accessories accompanying the GMS-110.

FC-100 Controller

Table B-5 lists specifications for the optional FC-100 controller.

Table B-5. FC-100 Controller Quick Specifications

Component	Details
Dimensions	182x102.8x58.3mm
Weight	under 500g (including batteries)
Microprocessor	Intel PXA255 X-Scale
Processor speed	400 MHz
Operating System	Windows CE.Net
Memory	Eboot: 512kB 64MB SDRAM ROM: 64MB/128MB (internal memory)
Data card	1 CompactFlash® 1 SD Media Card
Bluetooth capable	yes

Table B-5. FC-100 Controller Quick Specifications (Continued)

Component	Details
Display and backlight	320x240 QVGA (portrait) with LED backlight
Keyboard	7 keys with smart keyboard technology incorporated in TopSURV
Ports	RS-232C serial DS9; USB (type B mini) version 1.1
Power and Operation	External, removable, rechargeable, LI-ION battery power: 20+ hours with single battery; 40+ hours with backlight off
Operating temperature	-20°C to +60°C

Power Supply/Charger Details

Table B-6 lists specifications for the power supply/charger accessory.

Table B-6. Power Supply/Charger Specifications

Component	Details
Size	W:60 x L:112 x H:36 mm
Weight	235 g
Operating temperature	0°C to +40°C
Storage temperature	-40°C to +85°C
AC input: voltage frequency current	 90 to 264 V 47 to 63 Hz 1 A (110 V AC)
DC output voltage	12 V, 2.5 A (30 W)
Connector	Input (AC): Standard 3-pins AC receptacle Output (DC): SAE
Batteries charge time	10 hours for full charge

Connector Specifications

The following sections list receiver connector details.

Power Connector

The power connector (Figure B-1) is a sealed receptacle, 5 pin, ODU part number G80F1C-T05QF00-0000.

Figure B-1. Power Connector

Table B-7 gives power connector specifications.

Table B-7. Power Connector Specifications

Number	Signal Name	Dir	Details
1	Power_INP	P	6 to 28 volts DC input
2	Power_INP	P	6 to 28 volts DC input
3	Power_GND	P	Ground, power return
4	Power_GND	P	Ground, power return
5			Not used

Serial RS232 Connector

For the port A. The RS232 connectors (Figure B-2) are sealed receptacle, 7 pin, ODU part number G80F1C-T07QC00-0000.

Figure B-2. RS232 Connector

Table B-8 gives the RS232 cable connector specifications.

Table B-8. RS232 Connector Specifications

Number	Signal Name	Dir	Details
1	Power_OUT	P	Power Output (Supplied Voltage)
2	GND	-	Signal ground
3	CTS	I	Clear to send
4	RTS	O	Request to send
5	RXD	I	Receive data
6	TXD	O	Transmit data
7			Not used

Antenna RF Connector

The external antenna connector type (Table B-9) is a TNC RF connector with an Applied Engineering Product part number 6001-7051-003.

Table B-9. External Antenna Connector Specifications

Type	Signal Name	Dir	Details
TNC	Ant_IN	I	RF input from LNA, 100 mA at 5.0 volts DC output

Safety Warnings

General Warnings

CAUTION

Do not use PC-RCC to configure this receiver.

WARNING

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

– Without the user thoroughly understanding this manual.

– After disabling safety systems or altering the product.

– With unauthorized accessories.

– Without proper safeguards at the survey site.

– Contrary to applicable laws, rules, and regulations.

DANGER

TPS RECEIVERS SHOULD NEVER BE USED IN DANGEROUS ENVIRONMENTS. USE IN RAIN OR SNOW FOR A LIMITED PERIOD IS PERMITTED.

Internal Battery Pack Warnings

DANGER

NEVER ATTEMPT TO OPEN THE RECEIVER'S CASING OR REPLACE THE BATTERIES! LITHIUM-ION BATTERIES CAN BE DANGEROUS IF MISHANDLED!

DANGER

DO NOT INCINERATE OR HEAT BATTERY PACK ABOVE 212 DEGREES FAHRENHEIT (100 DEGREES CELSIUS). EXCESSIVE HEAT CAN CAUSE SERIOUS DAMAGE AND POSSIBLE EXPLOSION.

WARNING

Tampering with the internal batteries by end users or non-factory authorized technicians will void the receiver's warranty.

– Do not attempt to open the battery pack or replace it.

– Do not disassemble the battery pack.

– Do not charge in conditions different than specified.

– Do not use other than the specified battery charger.

– Do not short circuit.

– Do not crush or modify.

Usage Warnings

CAUTION

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

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

Inform TPS immediately if this product does not function properly.

CAUTION

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

Notes:

Warranty Terms

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

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

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

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

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

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