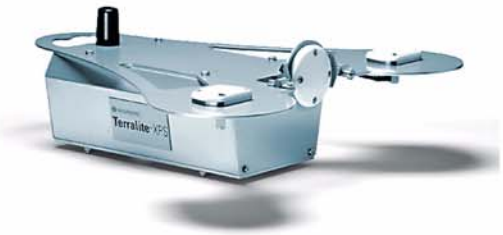
NOVARIANT™

IX100 REFERENCE STATION
TX100 TERRALITE™
TERRALITE™ XPS SYSTEM



INFRASTRUCTURE INSTALLATION MANUAL

This installation guide covers all models of the Novariant, TX100 Terralite, sold under FCC ID TMN-TX100. All transceiver models sold under FCC ID TMN-TX100 must be installed professionally on a fixed base. The device must be installed to provide a separation distance of at least 30 cm from all persons, and must not be collocated or operating in conjunction with any other antenna or transmitter. The power line of this device may not be modified; the connector must remain as part of the installation and may not be removed for hard-wiring purposes. This device transmits on two separate frequencies: 915 MHz spread spectrum and 9.752 GHz spread spectrum.

FCC Notification

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 device must be operated as supplied by Novariant, Inc. Any changes or modifications made to the device without the express written approval of Novariant, Inc. may void the user's authority to operate the device.

This device complies with part 90 of the FCC rules.

This device meets RF exposure rules described under parts 1.1307, 1.1310 and 2.1091 of the FCC Rules.

⚠ CAUTION

This device has a maximum transmitted output power of 955 mW (915 MHz) and 632 mW (9.752 GHz). It is required that the transmit antennas be kept at least 30 cm away from nearby persons to satisfy FCC RF exposure requirements.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interferences when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Prior to operating these transmitters, users are legally required to obtain frequency licenses, as required by the country-of-use. Please contact your local communications governing agency for the transmitter licensing requirements.

Copyright

Trademark

Terralite™ is a registered trademark of Novariant, Inc.

Technical Support

Contact Novariant for technical support.

Contact Information

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Web: www.novariant.com

IX100 Reference Station and TX100 Terralite Infrastructure Installation Manual
Part Number: 602-0077-01

Table of Contents

Safety Precautions

Observe the following general safety precautions during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of intended use of the instrument and may impair the protection provided by the equipment. Novariant, Inc. assures no liability for the customer's failure to comply with these requirements.

This **Safety Precautions** chapter includes the following sections:

- *Alert Statements*
- *Warning, Caution and Note Definitions*
- *Symbols Found on the Unit*
- *Safety Procedures and Precautions*

Alert Statements

Table 1-1 Alert Statements

Alert	Notice
Service By Qualified Personnel Only	Operating personnel must not attempt component replacement and internal adjustments. Only qualified service personnel may perform any service.
Danger Arising From Loss Of Ground	Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electrical shock.
Ground And Use Proper Electrical Fittings	Dangerous voltages are contained within this instrument. All electrical fittings and cables must be of the type specified, and in good condition. All electrical fittings must be properly connected.
Use The Proper Power Cord	Use only a power cord that is in good condition and which meets the input power requirements specified in the manual.
Use The Proper Power Source	This product is intended to operate from a power source that does not apply more voltage between the supply conductors, or between either of the supply conductors and ground, than that specified in the manual.
Use The Proper Fuse	Use only a fuse of the correct type, voltage rating, and current rating, as specified for your product.

Alert	Notice
Do Not Operate In An Explosive Environment	To avoid explosion, do not operate this product in an explosive environment unless it has been specifically certified for such operation.
Thermal Hazard	Do not cover the unit to avoid overheating. Store the unit in a room below 30° C/ 86°F.

Warning, Caution and Note Definitions

Table 1-2 Warning Statement Definition

	**⚠ WARNING** Warning indicates a hazard. It calls attention to a procedure, practice or condition which could result in injury to personnel. The icon shown in the left column displays the specific warning concern, in this case, electric shock.

Table 1-3 Caution Statement Definition

	**⚠ CAUTION** Caution Indicates a potentially hazardous situation which may result in minor or moderate injury. It may also be used to alert against unsafe practices. The icon shown in the left column displays the specific caution concern, in this case, a hot surface.

Note: The Note statement indicates important information. It calls attention to an operating procedure or practice which may enhance user interaction with the product. Notes may also be used to prevent information loss or damage to the product.

Symbols Found on the Unit

Table 1-4 defines the symbols that may be found on the unit.

Table 1-4 Safety Alert Symbol Definitions

Definition of Symbols Found on the Unit			
			
On (Supply) IEC 60417, No. 5007	Off (Supply) IEC 60417 No.5008	Earth Ground IEC 60417, No. 5017	Direct Current IEC 60417, No. 5031
			
Alternating Current IEC 60417, No. 5032	Caution, refer to accompanying documents ISO 3864, No. B.3.1	Caution, risk of electric shock ISO 3864, No. B.3.6	Caution, hot surface IEC 60417, No. 5041

Safety Procedures and Precautions

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of intended use of the instrument and may impair the protection provided by the equipment. Novariant, Inc. assumes no liability for the customer's failure to comply with these requirements.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT Do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to an Novariant Calibration and Service Center for service and repair to ensure that all safety features are maintained.
SERVICE BY QUALIFIED PERSONNEL ONLY Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel only.
GROUND AND USE PROPER ELECTRICAL FITTINGS Dangerous voltages are contained within this instrument. All electrical fittings and cables must be of the type specified, and in good condition. All electrical fittings must be properly connected and grounded.
USE THE PROPER POWER SOURCE This product is intended to operate from a power source that does not apply more voltage between the supply conductors, or between either of the supply conductors and ground, than that specified in the manual.
USE THE PROPER FUSE Use only a fuse of the correct type, voltage rating, and current rating, as specified for your product.
DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES To avoid explosion, do not operate this product in an explosive environment unless it has been specifically certified for such operation.
HIGH VOLTAGE DANGER High voltage is present in the cable, and in the sensor when the controller is turned on.

Introduction

This **TX100 Terralite and IX100 Reference Station Infrastructure Installation Manual Introduction** chapter contains the following sections:

- *TX100 Terralite and IX100 Reference Station Infrastructure Installation Manual Scope*
- *Document Outline*
- *Document Conventions*
- *Novariant Contact Information*
- *Related Sources of Information*
- *Revision History*

TX100 Terralite and IX100 Reference Station Infrastructure Installation Manual Scope

This section provides a description of the **TX100 Terralite and IX100 Reference Station Infrastructure Installation** manual scope. This **TX100 Terralite and IX100 Reference Station Infrastructure Installation** manual provides the information and procedures you need to perform the following tasks:

1. Unpack and examine the TX100 Terralite and IX100 Reference Station components.
2. Install the TX100 Terralite and IX100 Reference Station components.
3. Configure the IX100 Reference Station components to communicate within your GPS environment.
4. Verify the GPS positional accuracy.

Document Outline

This TX100 Terralite and IX100 Reference Station Infrastructure Installation manual contains the following sections:

Table 2-1 TX100 Terralite and IX100 Reference Station Infrastructure Installation Manual Document Structure

Section	Description
Safety Precautions	Defines the safety issues associated with the TX100 Terralite and IX100 Reference Station components.
Introduction	Defines the purpose of the TX100 Terralite and IX100 Reference Station Installation manual application and its general functions.
Getting Started	Defines the procedure for initiating the deployment of the TX100 Terralite and IX100 Reference Station components.
System Overview	Provides descriptions of the infrastructure and individual components that comprise the Novariant GPS mining solution.
System Specifications	Provides the system requirements for TX100 Terralite and IX100 Reference Station integration.
System Components	Describes the individual components within the system and the options.
TX100 Terralite and IX100 Reference Station Placement	Provides descriptions of the principles applied in the process of choosing the appropriate location for TX100 Terralite and IX100 Reference Station components within the mine environment.
Diagnostics and Maintenance	Provides descriptions of the utilities and methodologies available for analyzing the functional operation of the TX100 Terralite and IX100 Reference Station infrastructure and for performing routine and preventive system component maintenance.
Installation	Defines the procedure for initiating the integration and deployment of the TX100 Terralite and IX100 Reference Station components.
Troubleshooting	Provides procedures for isolating system failures.
IX100 Reference Station Configuration Software GUI Description	Provides descriptions of the windows, components, drop-down menus and fields within the IX100 configuration software.
TX100 Terralite Transmitter Configuration Software GUI Description	Provides descriptions of the windows, components, drop-down menus and fields within the TX100 configuration software.
Glossary of Terms	Provides descriptions of the various terms used throughout the documentation.

Document Conventions

This section describes the conventions and notation styles used in this document.

Table 2-2 Document Conventions

Text or Icon in Document	Purpose in Document
Bold Type with Initial Capital Letters	Command names, dialog box titles, checkbox options, buttons and dialog box options are shown in bold, initial capital letters. Example: **Track Changes** function.
bold type	Document names, directory names, project names, disk drive names, filenames, filename extensions, file directory paths, application names and software utility names are shown in bold font type. Examples: **Software Configuration, \print** directory, **D:** drive, **tutorial.pdf** file.
Italic Type with Initial Capital Letters	Cross references and procedural steps are shown in italic type with initial capital letters. Example: *Figure 10-3.*
Italic type	Parameters and variables are shown in italic type. Examples: $T^2_{critical}$, $n + 5$. Variable names are enclosed in angle brackets (< >) and shown in italic type. Example: <*file name*>, <*project name*>**.pdf** file.
Initial Capital Letters	Keyboard keys and menu names are shown with initial capital letters. Examples: Esc key, the Format menu.
"Subsection Title"	References to sections within a document and titles of on-line topics are shown in quotation marks. Example: "Configuration."
`Courier type`	Signal and port names are shown in lowercase `Courier` type. Examples: `data10`, `tdi`, input. Anything that must be typed exactly as it appears is shown in `Courier` type. For example: `c:\qdesigns\tutorial\chiptrip.gdf`. Also, sections of an actual file, such as a Archive File, references to parts of files (example, the keyword `SUBROUTINE`), as well as logic function names (example, `VECT`) are shown in `Courier`.
1., 2., 3., and/or a., b., c., etc.	Numbered steps are used to list items when the sequence of the items is significant, such as procedure steps.
•	Bullets are used to list items when the sequence of the items is not significant.
WARNING	Warning indicates a hazard. It calls attention to a procedure, practice or condition which could result in injury to personnel.
CAUTION	Caution indicates a potentially hazardous situation which may result in minor or moderate injury. It may also be used to alert against unsafe practices.
Note:	The Note paragraph tag identifies information requiring special attention.

Novariant Contact Information

This section provides contact information for Novariant customer support organizations.

Table 2-3 Novariant Contact Information

Communication Type	Contact Information
Technical Support	Tel: 1-602-324-3542 (US)
	Tel: 1-602-324-3542 (worldwide)
Non-Technical Customer Service	Tel: 1-650-644-1400 (US)
	Tel: 1-650-644-1400 (worldwide)
Product Literature	www.novariant.com
Download Site (FTP)	www.novariant.com
Documentation Feedback	documentation@novariant.com

Related Sources of Information

This section provides links to additional information.

Table 2-4 Related Information Sources

Information	Location
To Be Provided	Tel: 1-650-644-1400 (US)
	Tel: 1-650-644-1400 (worldwide)

Revision History

This section provides the revision history of this document.

Table 2-5 TX100 Terralite and IX100 Reference Station Infrastructure Installation Manual Revision History

Version	Date
Version 0.8 (Alpha)	01/19/06
Version 0.9 (Beta)	03/06/06

Getting Started

This **Getting Started** chapter provides general instructions for initiating the process of implementing and integrating the TX100 Terralite and IX100 Reference Station components into your GPS deployment.

The information for this **Getting Started** chapter is contained in the following sections:

- *What's in the Box*
  - *AX100 Antenna – (170-0003-01)*
  - *MX100 Receiver – (170-0001-01)*
  - *IX100 Reference Station – (170-0006-01)*
  - *TX100 Terralite Transmitter – (170-0007-01)*
  - *RTK Antenna – (170-0002-01)*
  - *Mount – (170-0004-01)*
  - *TX100 Stand – (500-0175-01)*
  - *IX100 Stand*
  - *Solar Power – (Optional)* (optional)
  - *External Diagnostic Radio*
- *High-Level Setup Process*

This section defines what you should expect to find in the shipping boxes sent with your TX100 Terralite and IX100 Reference Station components. This section also provides a high-level overview of the initial setup steps.

What's in the Box

Depending upon your specific mine requirements, there may be multiple shipping boxes for each of the various components necessary for your installation. Therefore, the total number of boxes in your shipment will depend upon the number of TX100 Terralite transmitters and mobile MX100 receivers.

- *AX100 Antenna – (170-0003-01)*
- *MX100 Receiver – (170-0001-01)*
- *IX100 Reference Station – (170-0006-01)*
- *TX100 Terralite Transmitter – (170-0007-01)*
- *RTK Antenna – (170-0002-01)*
- *Mount – (170-0004-01)*
- *TX100 Stand – (500-0175-01)*
- *IX100 Stand*
- *Solar Power – (Optional)*
- *External Diagnostic Radio*

AX100 Antenna – (170-0003-01)

1. AX100 antenna

MX100 Receiver – (170-0001-01)

1. MX100 Receiver
2. Receiver Harness (201-0256-01)
3. RF whip antenna (500-0090-01)
4. Ethernet Cable (201-0265-01)
5. Serial Adapter Cable (201-0257-01)
6. USB Adapter Cable (201-0260-01)
7. Power Cable, 3 foot (201-0263-04)
8. Lexmark 512Mb Jump Drive, Secure
9. CD Disk, MX100 Receiver Manual – (602-0079-01)

IX100 Reference Station – (170-0006-01)

1. IX100 Reference Station
2. Receiver Harness (201-0256-01)
3. RF Patch cable, 10 ft. (201-0167-03) (qty. 3)
4. DC Block (130-0045-01)
5. RF whip antenna (500-0090-01)
6. Ethernet Cable (201-0265-01)
7. Serial Adapter Cable (201-0257-01)
8. USB Adapter Cable (201-0260-01)
9. Power Cable, 3 foot (201-0263-02)
10. Lexmark 512Mb Jump Drive, Secure
11. CD Disk, Terralite Infrastructure Manual (602-0077-01)

TX100 Terralite Transmitter – (170-0007-01)

1. TX100 Terralite
2. Terralite Harness (201-0258-01) (pre-attached)
3. Ethernet Cable (201-0265-01) (pre-attached)
4. Serial Adapter Cable (201-0257-01)
5. USB Adapter Cable (201-0260-01)
6. Power Cable, 25 foot (201-0263-02)
7. Lexmark 512Mb Jump Drive
8. CD Disk, Terralite Infrastructure Manual (602-0077-01)

RTK Antenna – (170-0002-01)

1. RTK Phantom Antenna (500-0058-03)
2. RTK Phantom Antenna Bracket
3. RTK Phantom Antenna Cable, 50ft (201-0011-02)
4. Self Drill & Tap bolts (qty. 4)
5. Hose Clamp, 3" (qty. 2)

Mount – (170-0004-01)

Note: A Mount Kit Shipping box is included in your shipment for each MX100 receiver and AX100 antenna. Most customer orders include multiple Mount Kit Shipping boxes.

1. Vibration Plate (203-0195-01)
2. Vibration Mounts (202-0211-01) (qty. 4)
3. 10 – 32 x 0.75" PH PHIL 18-8 SS
4. 1/4 – 20 x 4.50" Hex Bolt Grade 8 (qty. 4)
5. 1/4 – 20 x 3.25" Hex Bolt Grade 8 (qty. 4)
6. 1/4 – 20 x 1.00" Hex Bolt Grade 8 (qty. 4)
7. 1/4 – 20 Hex Nut Grade 8 Nylock (qty. 8)
8. 1/4 – Washer 18-8 SS (qty. 12)
9. 1/4 – Fender Washer 1.25" OD ZP (qty. 8)
10. 3/8 – 16 2.00" Hex Bolt Grade 8 (qty. 4)
11. 3/8 – 16 Hex Nut Grade 8 Nylock (qty. 4)
12. 3/8 – Washer 18-8 SS (qty. 4)
13. 3/8 – Fender Washer 1.25" OD ZP (qty. 8)
14. 3/8-1/4 – Reducer Sleeve AL (qty. 4)

TX100 Stand – (500-0175-01)

1. Terralite Stand (500-0175-01)
2. Terralite Stand extension (fabricated on site by client)
3. Terralite Stand extension sleeve (fabricated on site by client)

IX100 Stand

1. Tripod (500-0222-01)(2 boxes)
2. Mounting Plate (vibration plate) (203-0195-01)
3. 4 – Bolt, ¼-20 x 4½"
4. 4 – Nut, ¼-20
5. 8 – Washer, ¼
6. 4 – Stand-offs
7. Mailbox
8. Mailbox mounting bracket
9. 2 – Bolt, ¼-20 x 1½"
10. 2 – Washer, ¼"
11. 2 – Nut, Keps, ¼-20
12. Mounting diagram

Solar Power – (Optional)

1. Solar Panel(s)
2. Fiberglass enclosure
3. Power Controller
4. 12VDC High Capacity Solar Gel Cells (qty. 2)
5. Power Cable, 25' (201-0263-02)
6. Solar Panel Stand (fabricated on site by client)
7. Field assembly and wiring (fabricated on site by client)

External Diagnostic Radio

1. External Radio Modem (200-0309-01)
2. RF whip antenna (500-0090-01)
3. Diagnostic Radio Harness (201-0264-01)
4. Power Splitter Cable
5. RTK Phantom Antenna (500-0058-03)
6. RTK Phantom Antenna Bracket
7. RTK Phantom Antenna Cable, 50ft (201-0011-02)
8. Vibration Plate (203-0195-01)
9. Vibration Mounts (202-0211-01) (qty. 4)
10. Bolt, 10-32 x ½" Pan Head, Phillips (qty. 4)
11. Bolt, 3/8-16 x 2½" Hex (qty. 4)
12. Nut, 3/8-16 (qty. 4)
13. Washer, fender, 3/8 (qty. 4)
14. Washer, 3/8 (qty. 4)
15. Radio Modem Bracket (202-0154-01)
16. Self drill & tap screws for Radio Modem Bracket

High-Level Setup Process

1. Unpack and examine the contents of the boxes.
2. Verify the delivered components match the shipping invoice.
3. Perform bench configuration and verification.
4. Install the mount structures in the selected locations.
5. Install the IX100 Reference Station Monitor.
6. Verify the IX100 Reference Station operation.
7. Install a TX100 Terralite transmitter.
8. Verify the connected TX100 Terralite transmitter.
9. Repeat Step 7. and Step 8. for the remaining TX100 Terralite transmitters.
10. Install an MX100 Receiver and an AX100 antenna on a machine.
11. Verify the operation of the installed MX100 Receiver.
12. Repeat Step 10. and Step 11. for the remaining MX100 Receivers and AX100 antennas.
13. Allow sufficient time for the receiver to self-calibrate.
14. Verify the GPS positional accuracy of the system.

System Overview

This **System Overview** chapter provides descriptions of the infrastructure and individual components that comprise the Novariant GPS mining solution.

This **System Overview** chapter contains the following sections:

- *TX100 Terralites*
- *IX100 Reference Station Monitor*
- *MX100 Receivers*

Open pit mining is used for copper-ore production, diamonds, and even gravel. Large circular depressions, about 500-1500 feet deep, are cut progressively deeper, and smaller diameter, as the mine matures, and the material is being excavated. The goals of a modern mine operator are to extract ore efficiently and safely with minimal damage to the environment and waste. Use of technology-based positioning in the mine is key to achieving these goals. A conical “hole” or “pit” is made in the ground, with distinctive “benches” and “highwalls.” In the first stages of the mine, regular GPS coverage is achieved, because the visibility of the sky is unrestricted. As the mine gets deeper, the sky visibility (and view of available satellites) is restricted, and areas of no GPS coverage begin to show up in the mine. This undermines the safety and efficiency of the mine, which relies on logistical tracking of their equipment. Novariant's Terralite XPS system has been designed to supplement the existing GPS coverage and fill in the areas of no coverage. *Figure 4-1* and *Figure 4-2* show an overview of the Terralite Infrastructure and the signals utilized within the Terralite infrastructure.

The Novariant Terralite XPS system consists of a minimum of 6 TX100 Terralites positioned around the rim of the mine, an IX100 Reference Station and an unlimited number of MX100 Receivers, mounted on mobile pieces of mine equipment, such as shovels or drills. MX100 Receivers combine the signals from TX100 Terralite transmitter units with GPS satellite signals to provide robust positioning in areas where the view of the GPS satellites is limited or obscured.

Figure 4-1 Terralite Infrastructure Overview

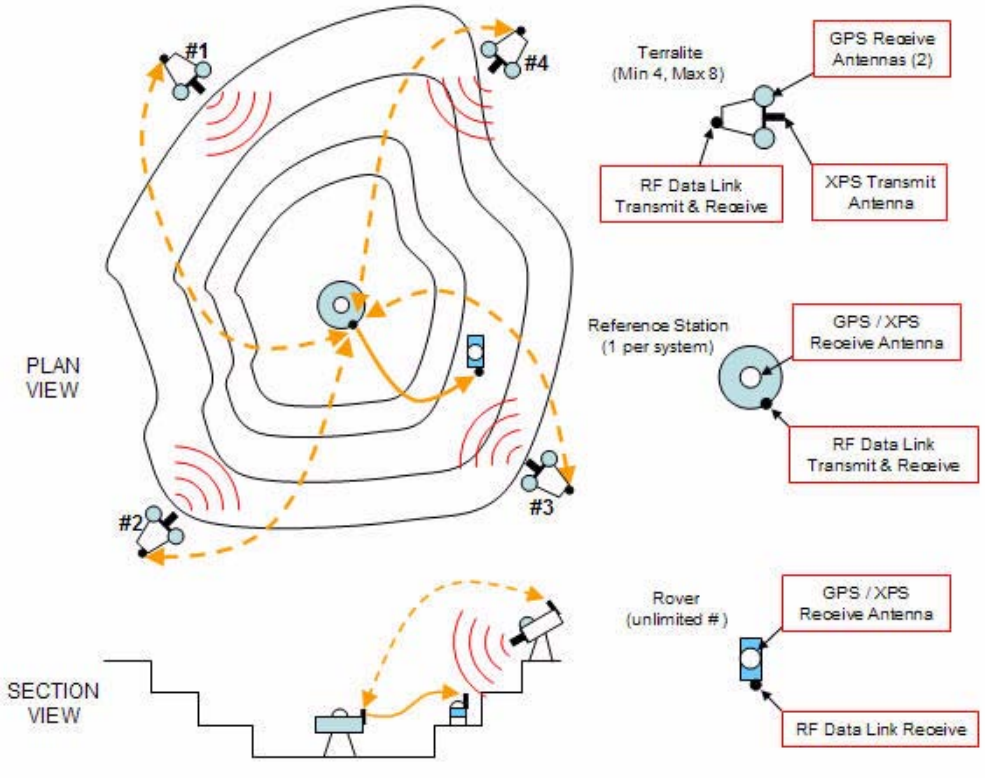
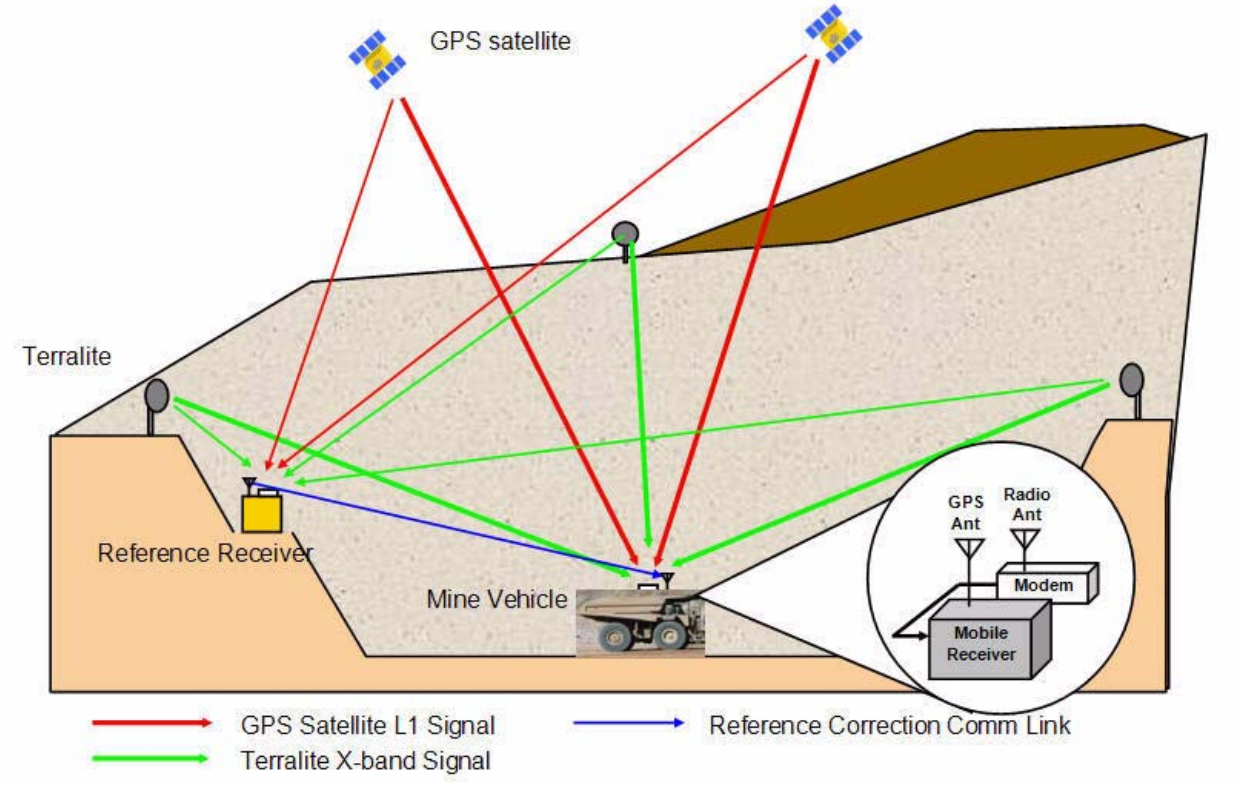


Figure 4-2 Terralite Infrastructure Signals



TX100 Terralites

The Terralites are the heart of the system - they transmit a proprietary XPS signal into the mine pit, which allows mobile receivers on mine equipment, to determine their location.

Each of the 6 Terralites are positioned around the rim of the pit to provide an unobstructed view of the sky as well as to have an unobstructed view into operational areas of the pit. Each Terralite is totally independent and self-sufficient, without any connections to the mine infrastructure. A 12 VDC battery bank provides the necessary power. The battery is charged by a solar array positioned nearby. The solar cell, controller and batteries are all part of a commercially available system, and can be provided by the customer or Novariant. The TX100 Terralite units can be powered by any 12 VDC source.

Each Terralite transmits the (9.75Ghz) XPS signal into the mine through a single antenna, located on the front of the unit. The XPS signal is used by the MX100 Receiver units to provide positioning in the absence of GPS satellite signals.

The last RF component of the Terralite is a 2 way RF Data Link, operating in the 900 MHz unlicensed band. In its current implementation, the radio link is internal to the Terralite. The Data Link is an internal radio providing the connectivity between the TX100 Terralite units and the IX100 Reference Station enabling integrity monitoring of the TX100 Terralite signal.

IX100 Reference Station Monitor

The IX100 Reference Station acts as a GPS reference station for all the MX100 receiver units within the mine. The IX100 Reference Station also acts as an integrity monitor for the TX100 Terralite signals.

The IX100 Reference Station requires 12 VDC to operate.

The Reference Station is equipped with an L1/L2 (1575.42/1227.6 MHz) antenna, which receives GPS signals. During the set-up, installation and commissioning, a surveyed set of WGS-84 coordinates location are downloaded into the IX100 Reference Station. By comparing the known location against the GPS location, the Reference Station can calculate the GPS errors (up to 30 meters) due to atmospheric disturbance and other factors and share the information with the Rover units. this information is used by the MX100 receiver units in conjunction with IX100 Reference Station's observed GPS signals to generate RTK positions.

Co-located with the L1/L2 antenna there is an XPS receiving antenna. It receives on 9.75 GHz. The AX100 antenna is also used by the IX100 Reference Station to receive the XPS signals from the TX100 Terralite units. The Reference Station receives these XPS signals from all of the TX100 Terralites, and compares them against the known, pre-programmed position, and checks for any errors.

There is a 2-way RF Data Link (900 MHz) associated with the TX100 Terralite XPS system. It's an identical piece of equipment to that in a Terralite. The internal radio communicates GPS measurements and other information necessary for the MX100 receivers precise positioning.

MX100 Receivers

The MX100 Receiver is the hardware component which mounts on the mobile mine equipment. It receives GPS and XPS data simultaneously on an AX100 antenna and generates a position output consistent with the signals received. The MX100 Receiver displays location of the mobile unit in one of three modes, a GPS location, an XPS location, or a hybrid location. The hybrid location is calculated when not enough satellites nor Terralites are visible to calculate a location solution using only one set of signals. This position is output to the on-board machine application as outlined in the Third Party Interface documentation.

System Specifications

This **System Specifications** chapter provides definitions for various components and interfaces. The information for this **System Specifications** chapter is contained in the following sections.

- *Power Requirements*
  - *TX100 Terralite Transmitter*
  - *MX100 Receiver*
  - *IX100 Reference Station*
- *Environmental Tolerances*
- *Calculation of FCC Exposure Limits*
- *Configuration PC Requirements*

Power Requirements

The power requirements for the TX100 Terralite infrastructure components are listed in the following sections:

- *TX100 Terralite Transmitter*
- *MX100 Receiver*
- *IX100 Reference Station*

TX100 Terralite Transmitter

Power

12 VDC @ 3.0A

MX100 Receiver

Power

12 VDC @ 2.5A

IX100 Reference Station

Power

12 VDC @ 2.5A

Environmental Tolerances

Temperature

Operating -20º C to +60º C

Storage -30º C to +80º C

Humidity

Humidity 100% condensing

Sealing

Dustproof, fully sealed enclosure

Calculation of FCC Exposure Limits

Novariant TX100 Terralite Transmitter contains two transmitting antennas, and two transmitters. One is designed and built by Novariant, used for positioning, and the second one is purchased as an off-the-shelf component for receiving and transmitting differential updates. The off-the-shelf transmitter (radio modem) is built into our device and carries FCC ID: KNY-6231812519.

This section contains RF exposure calculations for both the Novariant transmitter, and the radio modem as supplied by the manufacturer. Please note that the calculations for the KNY-6231812519 device use 20 cm distance, and use mobile device category limits. Novariant is only reprinting this information as provided by the manufacturer. The TX100 Terralite transmitter device calculations are done with a 30 cm distance (minimum user separation) and are performed using mobile device category limits as well, even though the TX100 device is categorized as a fixed transmitter. The calculations and compliance are valid, since the mobile device category limits are more stringent then fixed device category limits.

TX100 Terralite™ Transmitter Specifications:

- Transmit power 632 mW
- Antenna Gain 12.6 dBic
- Duty Cycle (DC) 12.5%

Limits from Table 1 of 47 CFR 1.1310:

- Power Density 5 mW/cm^2
- Averaging Time 6 minutes

Calculation:

The peak power density is:

$S_{pk} = P_t * Gt/(4\pi R^2) = 632\ mW*18.2/(4*\pi*(30.48\ cm)^2) = 0.985\ mW/cm^2$

The average power density in 6 minutes is:

$S_{avg} = S_{pk}*DC = 0.123\ mW/cm^2$

Predicted power density at 30 cm is 0.123 mW/cm^2 which is below the FCC limit of 5 mW/cm^2 for Occupational / Controlled Exposures (B).

KNY-6231812519 Device (reprinted from manufacturer's manual)

- 955 mW - Maximum peak output power at antenna input terminal.
- 20 (cm) - Prediction distance.
- 915 MHz - Prediction frequency.

- 3.05 mW/cm^2 - MPE limit for uncontrolled exposure at prediction frequency.
- 5 dB - Antenna Gain (typical).
- 3.16 (numeric) - Maximum antenna gain.
- 0.60 mW/cm^2 - Power density at prediction frequency at 20 cm.

Test Result - Predicted power density level at 20 cm is 0.60 mW/cm^2 which is below the limit of 3.05 mW/cm^2.

Configuration PC Requirements

- Windows XP Professional compatible PC
- Internet Explorer 6.x or greater
- Java Runtime Environment (JRE) version 5 update 5

System Components

This **System Components** chapter provides information on TX100 Terralite and TX100 Reference Station components contained in the following sections:

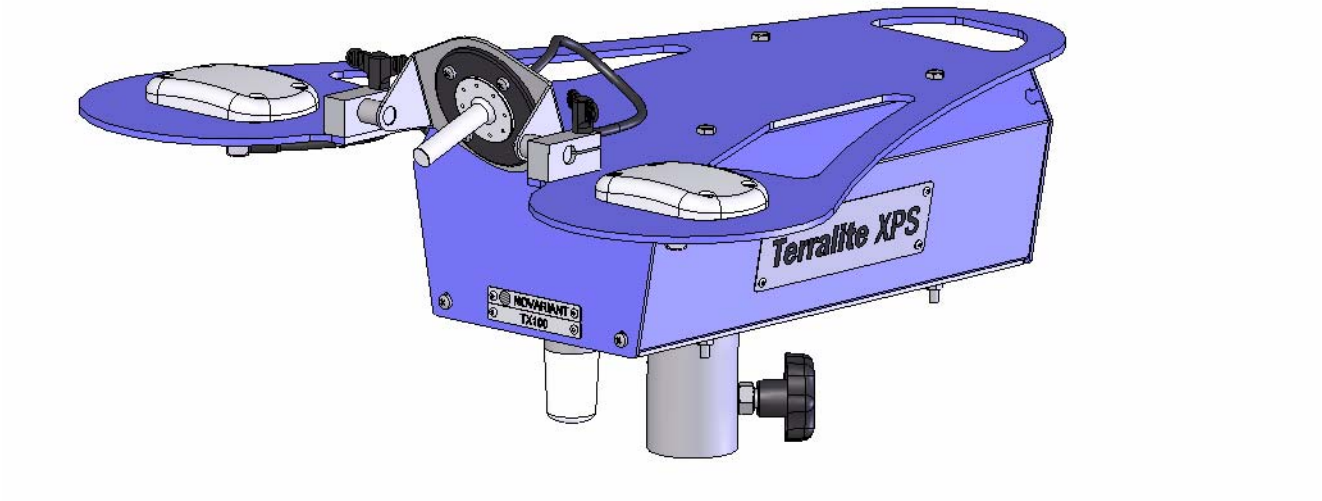
- *TX100 Terrralite Transmitter*
  - *Components*
  - *Dimensions*
  - *Cables and Accessories*
  - *Power Source*
  - *Mounting Structure*
- *IX100 Reference Station*
  - *Components*
  - *Dimensions*
  - *Cables and Accessories*
  - *Power Source*
  - *Mounting Structure*

TX100 Terrralite Transmitter

The components for the TX100 Terralite transmitter are provided in the following sections:

- *Components*
- *Dimensions*
- *Cables and Accessories*
- *Power Source*
- *Mounting Structure*

Figure 6-1 TX100 Terralite Transmitter

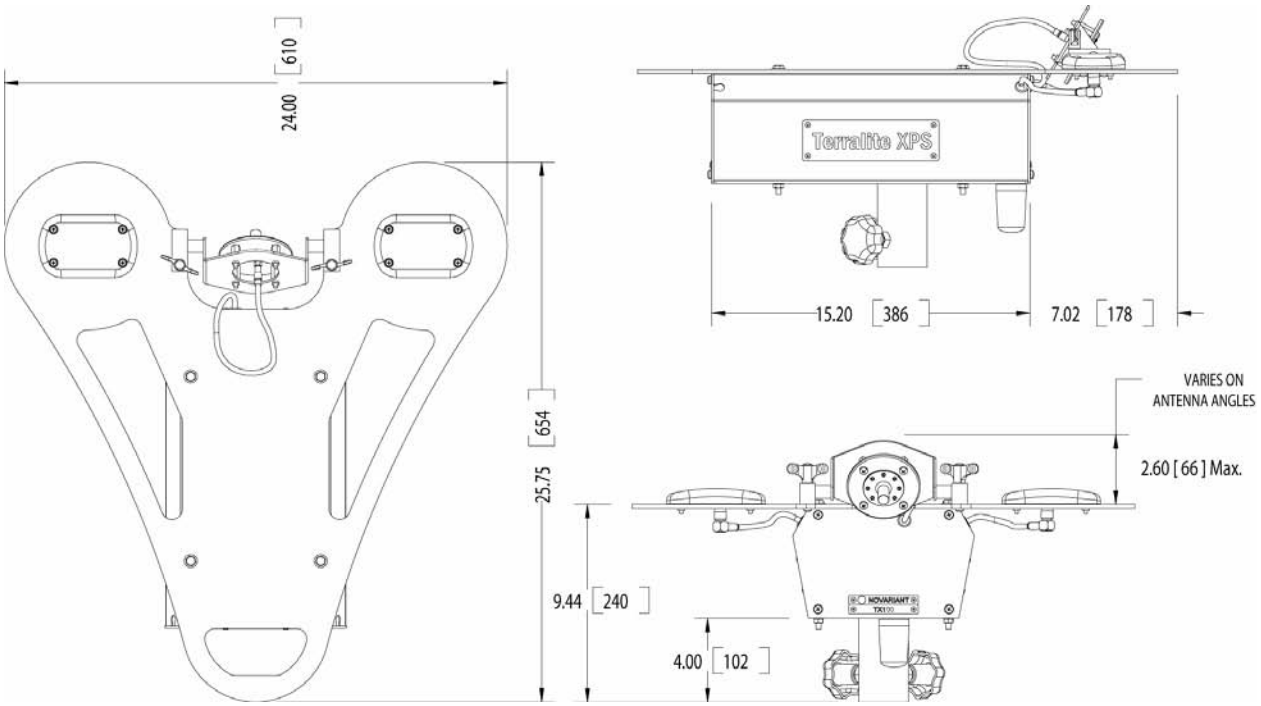


Components

1. TX100 Terralite Transmitter

Dimensions

Figure 6-2 TX100 Terralite Transmitter Dimensions



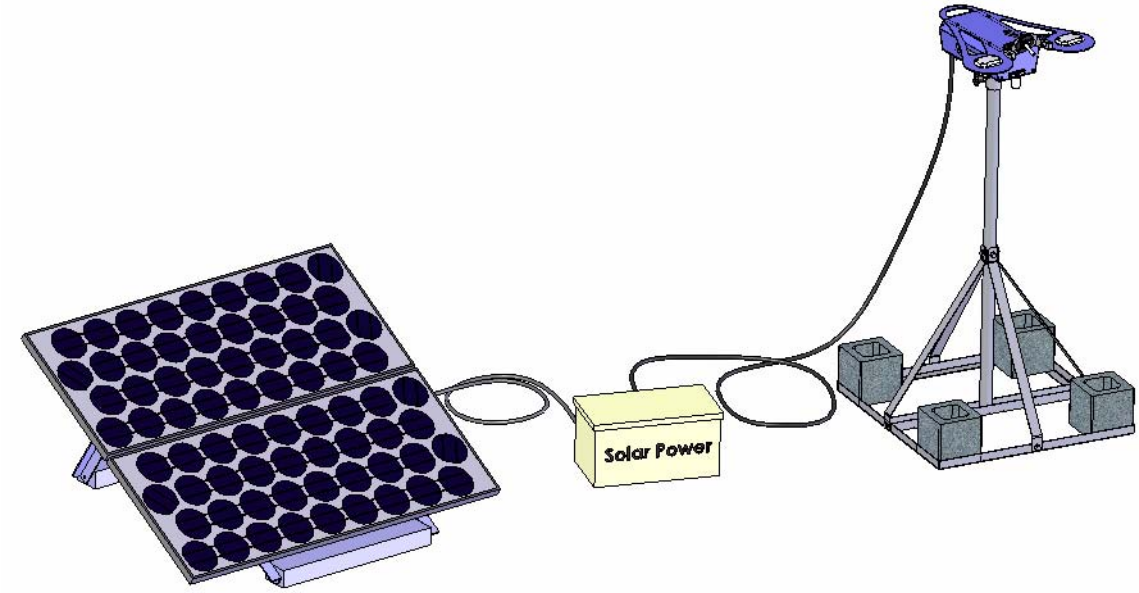
Cables and Accessories

1. Terralite Harness (201-0258-01) (pre-attached)
2. Ethernet Cable (201-0265-01) (pre-attached)
3. Serial Adapter Cable (201-0257-01)
4. USB Adapter Cable (201-0260-01)
5. Power Cable, 25 foot (201-0263-02)
6. Lexmark 512 Mb USB Jump Drive

Power Source

The TX100 Terralite transmitter requires 12VDC @ 2.5A. This power should be provided from a source with minimum noise and ripple. Typical installations implement either a photovoltaic array with a controller and batteries or a battery alone. The power source is selected and provided by mine personnel using the recommendations of your Novariant representative. *Figure 6-3* shows a TX100 Terralite connected to a solar panel designed to provide in excess of 175 watts during peak solar loading.

Figure 6-3 TX100 Terralite with Solar Panel



Mounting Structure

Typical TX100 Terralite installation uses a stand mounting. *Figure 6-4* shows the TX100 Terralite transmitter mount.

Figure 6-4 TX100 Terralite Stand

IX100 Reference Station

The components for the IX100 Reference Station are provided in the following sections:

- *Components*
- *Dimensions*
- *Cables and Accessories*
- *Power Source*
- *Mounting Structure*

Components

- IX100 Receiver
- AX100 Antenna

Dimensions

The IX100 Reference Station component dimensions are shown in *Figure 6-5* through *Figure 6-8*.

Figure 6-5 IX100 Receiver

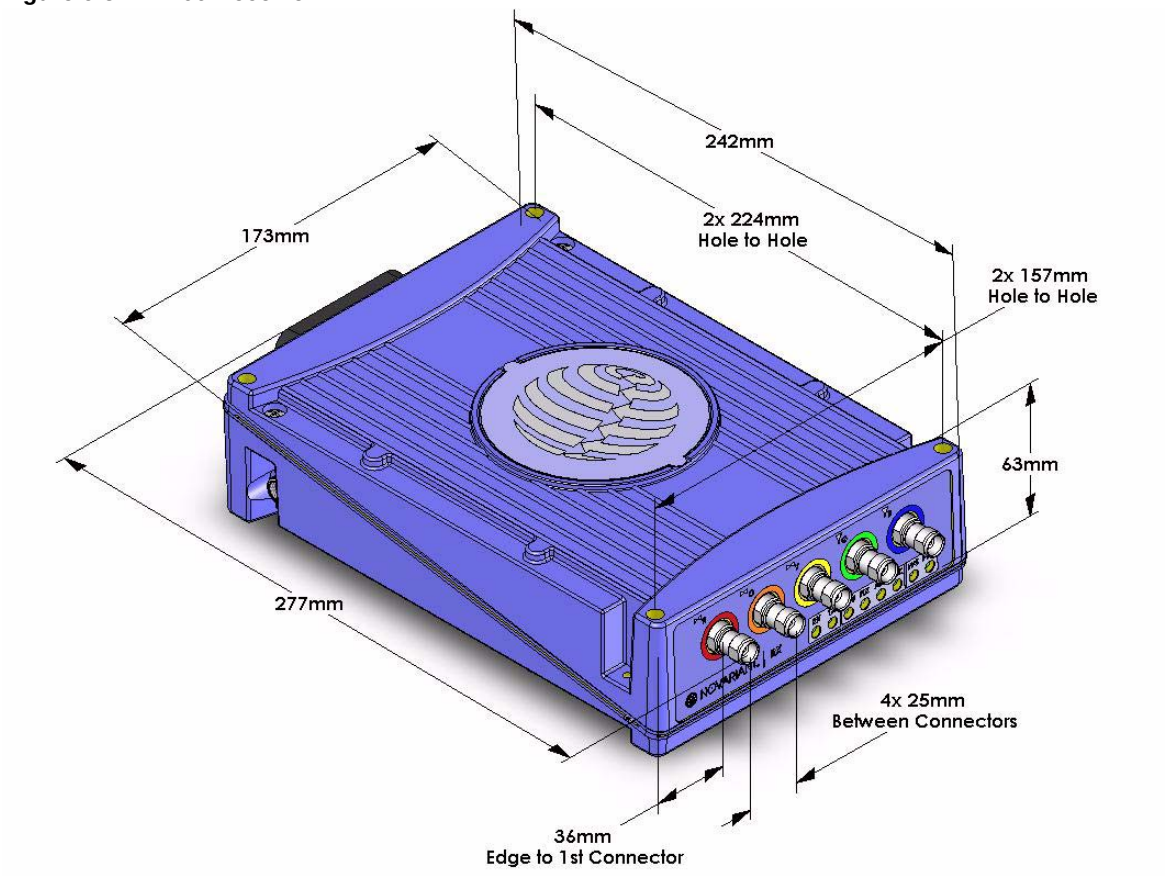


Figure 6-6 AX100 Antenna (front)

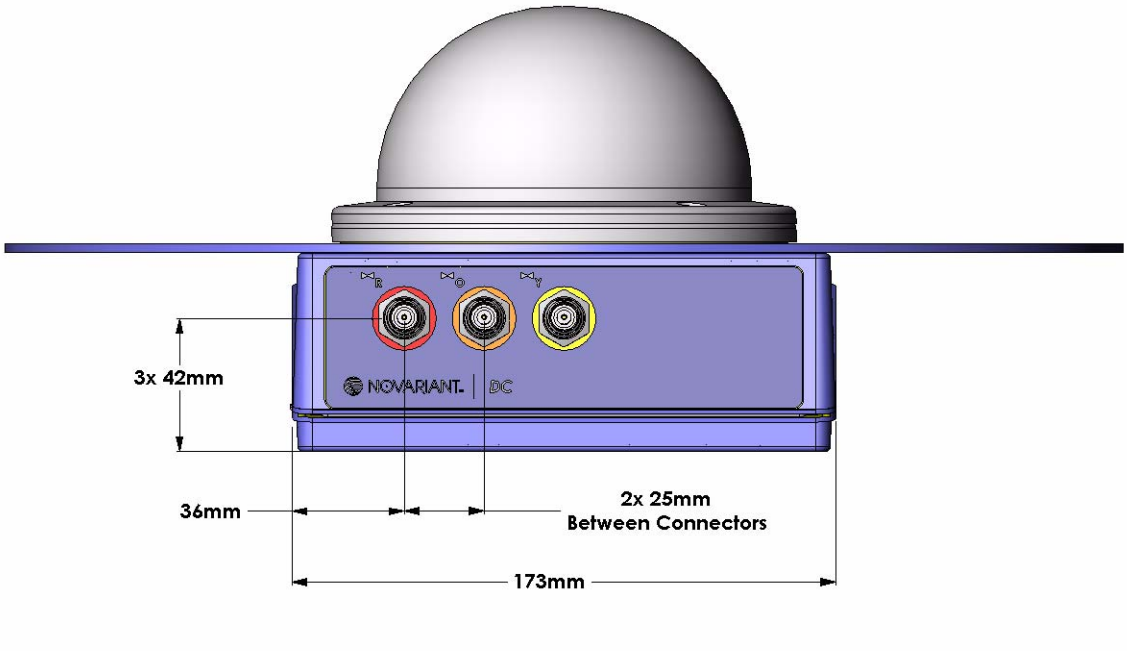


Figure 6-7 AX100 Antenna (side)

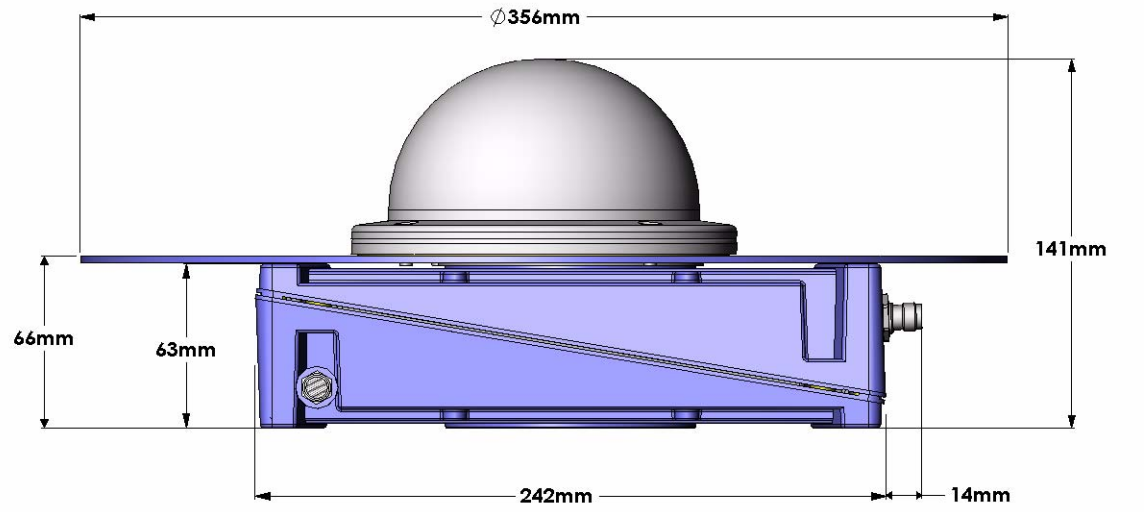
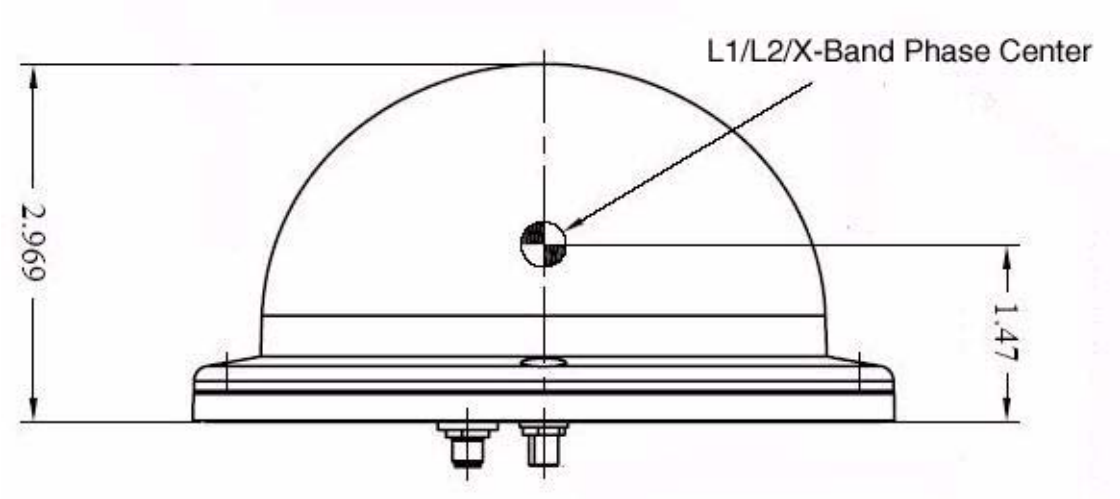


Figure 6-8 AX100 Antenna Phase Center (side)



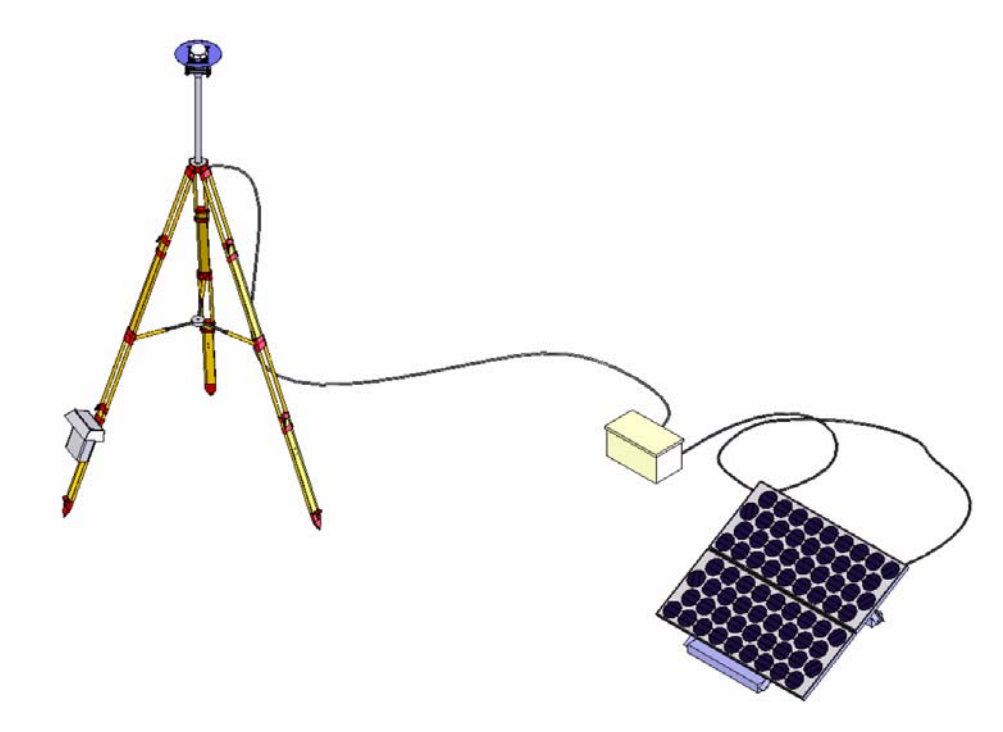
Cables and Accessories

1. Receiver Harness (201-0256-01)
2. RF Patch cable, 10 ft. (201-0167-03) (qty. 3)
3. Ethernet Cable (201-0265-01)
4. Serial Adapter Cable (201-0257-01)
5. USB Adapter Cable (201-0260-01)
6. Power Cable, 3ft (201-0263-04)

Power Source

The IX100 Reference Station requires 12VDC @ 2.5A. This power should be provided from a source with minimum noise and ripple. Typical installations implement either a photovoltaic array with a controller and batteries or a battery alone. The power source is selected and provided by mine personnel using the recommendations of your Novariant representative. *Figure 6-9* shows a IX100 Reference Station connected to a solar panel designed to provide in excess of 175 watts during peak solar loading.

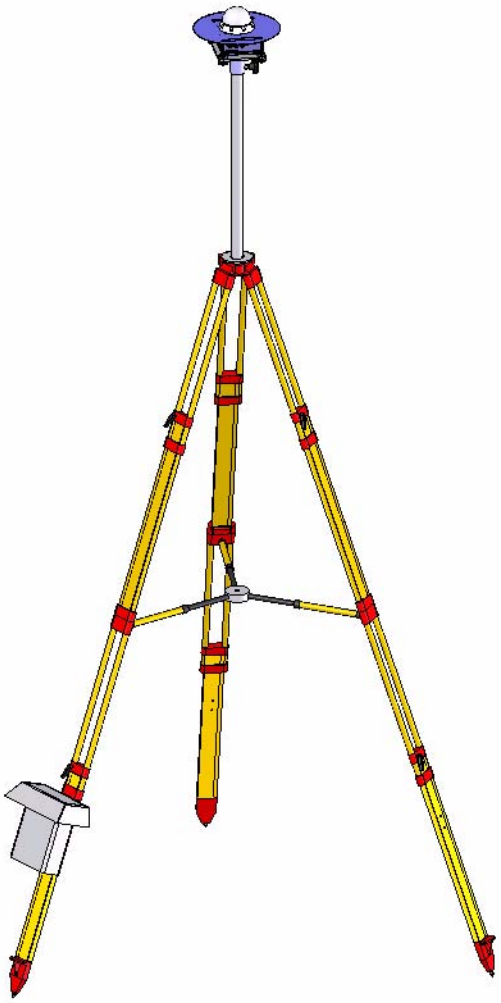
Figure 6-9 IX100 Reference Station with Solar Panel



Mounting Structure

The IX100 Reference Station is shown mounted on a tripod in *Figure 6-10*.

Figure 6-10 IX100 Reference Station with Tripod



TX100 Terralite and IX100 Reference Station Placement

This **TX100 Terralite and IX100 Reference Station Placement** chapter provides descriptions of the process of selecting the appropriate location for TX100 Terralite and IX100 Reference Station infrastructure components within the mine environment. The process involves assessment of the mine topography and the development of an installation plan for the deployment of the Novariant GPS+XPS infrastructure into the existing mine GPS equipment.

This **TX100 Terralite and IX100 Reference Station Placement** chapter contains the following sections:

- *Mine Assessment*
- *Installation*
- *Integration*
- *Verification*

Mine Assessment

The mine assessment process involves analysis of the mine topography and the equipment used within the mine in order to develop an efficient plan for GPS and XPS infrastructure location. *Figure 7-2* shows a generic Location Planning and Region Mapping Diagram. *Figure 7-3* through *Figure 7-5* show mine pit shapes and their typical Novariant infrastructure implementation.

Note: This section provides general guidelines for the purpose of understanding the mine assessment process. The assessment of your mine and the placement of your TX100 Terralite infrastructure components should be accomplished with the recommendations of your Novariant representative.

The process involves mine and Novariant personnel utilizing on-site and remote review of collected assessment data. The assessment procedure enables the Novariant Applications Engineers to define the components necessary to ensure the positional accuracy within the specific mine. *Figure 7-1* shows the TX100 Terrralite antenna patterns which are used for various mine pit shapes and topologies.

Note: During the assessment process it is important to consider the position solution provided by various TX100 Terralite and Satellite signal availability. *Figure 7-8* shows a matrix of TX100 Terralite unit and Satellite signals and the resulting position solutions.

An additional part of the assessment process involves analysis of the applications being implemented within mine infrastructure and the network environment upon which the infrastructure operates. This part of the assessment process ensures appropriate network protocols and application interfaces are implemented.

The Terralite XPS transmitters have three antenna options, wide-, medium-, and narrow-beam, to accommodate wider or narrower pit geometries. The nominal recommended for most situations is the medium-beam antenna. *Figure 7-1* shows the relative beam widths of each of these antennas. See *Table 7-1* for the three TX100 Terralite antenna Half-Power Beam Width (HPBW) values.

The different types of antennas can be used to ensure maximum coverage in a pit. Although each mine should be evaluated individually, three general categories of mines are considered here for illustrative purposes: A round pit, an elongated pit, and a complex-shaped pit. *Figure 7-3* through *Figure 7-5* show each of these cases and possible transmitter, antenna, and Reference station arrangements.

Table 7-1 TX100 Terralite Half-Power Beam Width Values

Narrow Beam	Medium Beam	Wide Beam
Gain: 12.6 dB	Gain: 10.4 dB	Gain: 9.0 dB
HPBW: 20 degrees	HPBW: 55 degrees	HPBW: 75 degrees

In all cases, the following requirements should be considered:

1. Each Terralite must have a direct line of sight to the IX100 Reference Station.
2. The Reference station must be lower in elevation than every Terralite.
3. Only areas that are directly in line-of-sight with the Terralite can receive and utilize that transmitter's signal. So, if you can see a vehicle from the Terralite installation point, then that vehicle can receive the XPS signal from the Terralite.

The general mine shapes in *Figure 7-3* through *Figure 7-5* provide a simplified view of typical mines. In practical application, terrain features such as different bench levels, high berms, roadways, and concave/convex variations can make it difficult to chose the best set of candidate equipment locations.

To provide some methodology to the evaluation of candidate locations, it is recommended that the equipment installer create a table to record the effectiveness of each location as it is visited. See *Table 7-2*. This table can then be inspected afterwards and the best combination of locations can be chosen. Keep in mind that the goal is to ensure visibility to at least four TX100 Terralites simultaneously at all active pit areas.

Infrastructure Component Location Selection Procedure:

1. Select landmarks such as different bench outlines or equipment locations to rough-out several recognizable regions in the pit where mining activity is expected.
2. Select a candidate IX100 Reference station location.
3. Select several (more than six) candidate TX100 Terralite locations.
4. Visit each candidate location. For each location, confirm visibility to the candidate IX100 Reference station location and note which of the previously outlined regions are fully visible. Mark the results in the table.
5. Repeat for each candidate TX100 Terralite location.
6. Select the best subset of six candidate locations that provides the greatest visibility to the various regions in the mine.
7. Repeat for other IX100 Reference station candidate locations, if necessary.

Table 7-2 TX100 Terralite Proposed Coverage

Region	Terralite Candidate Location 1	Terralite Candidate Location 2	Terralite Candidate Location 3	Terralite Candidate Location 4	Terralite Candidate Location 5	Terralite Candidate Location 6
Ref. Station						
Region 1						
Region 2						
Region 3						
Region 4						
Region 5						
Region 6						

Figure 7-1 TX100 Terralite Antenna Patterns

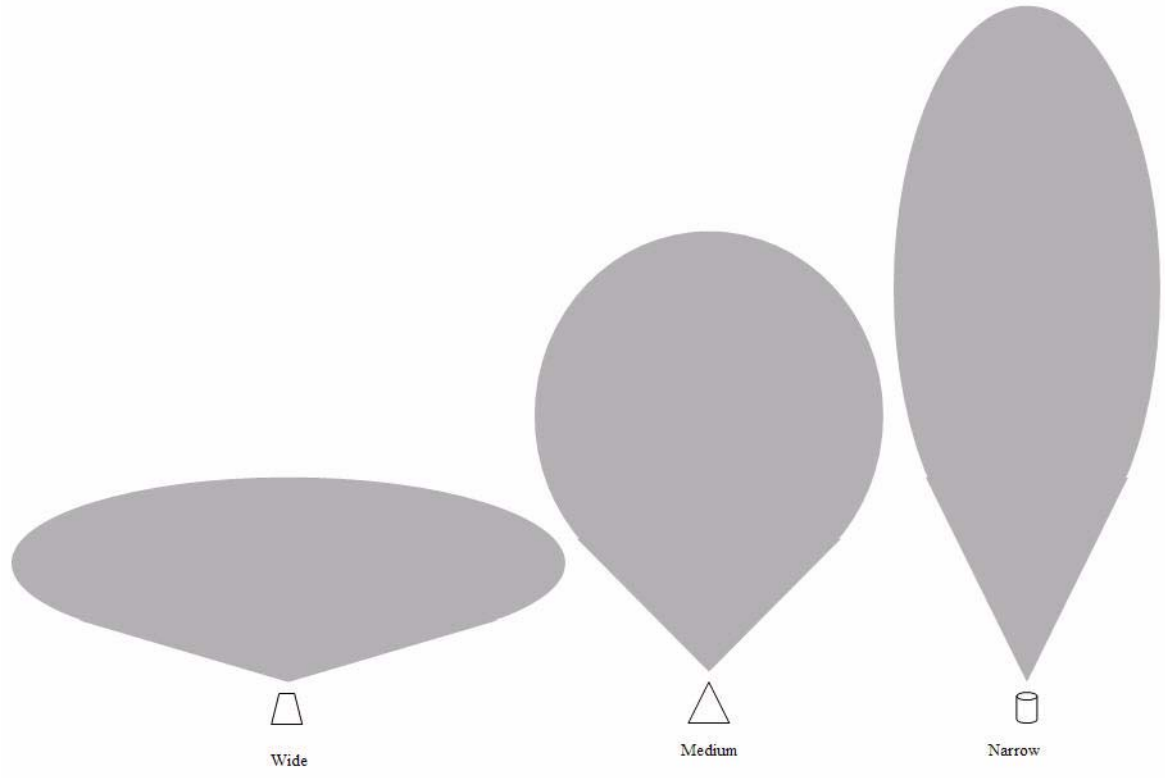


Figure 7-2 Location Planning and Region Mapping Diagram

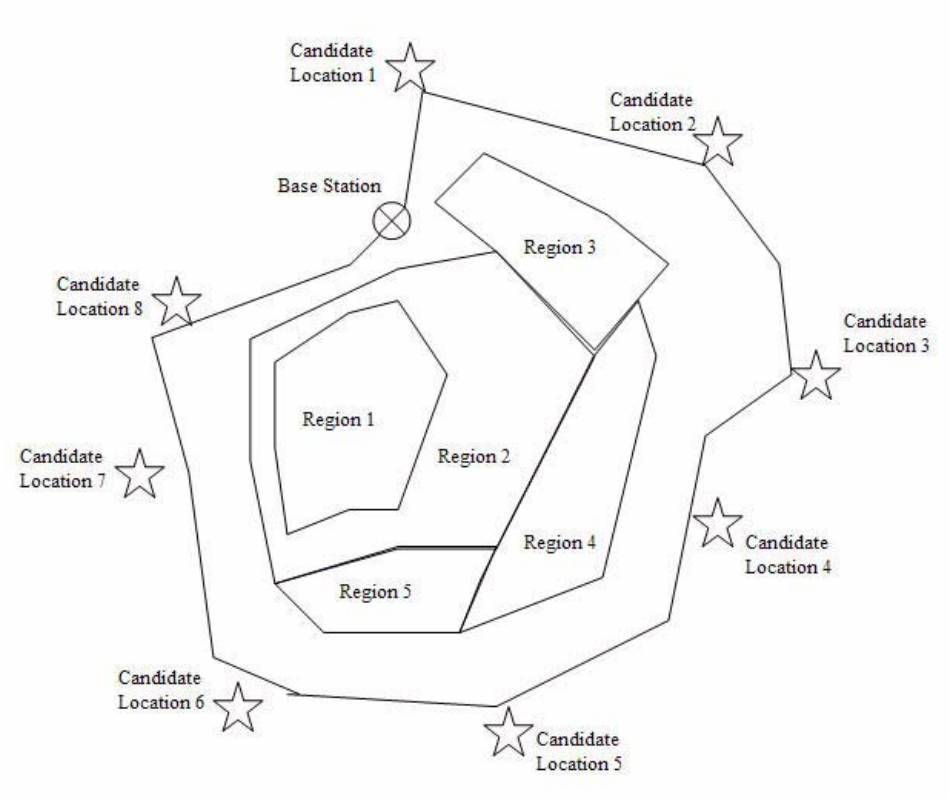


Figure 7-3 Round Mine Pit Infrastructure Implementation

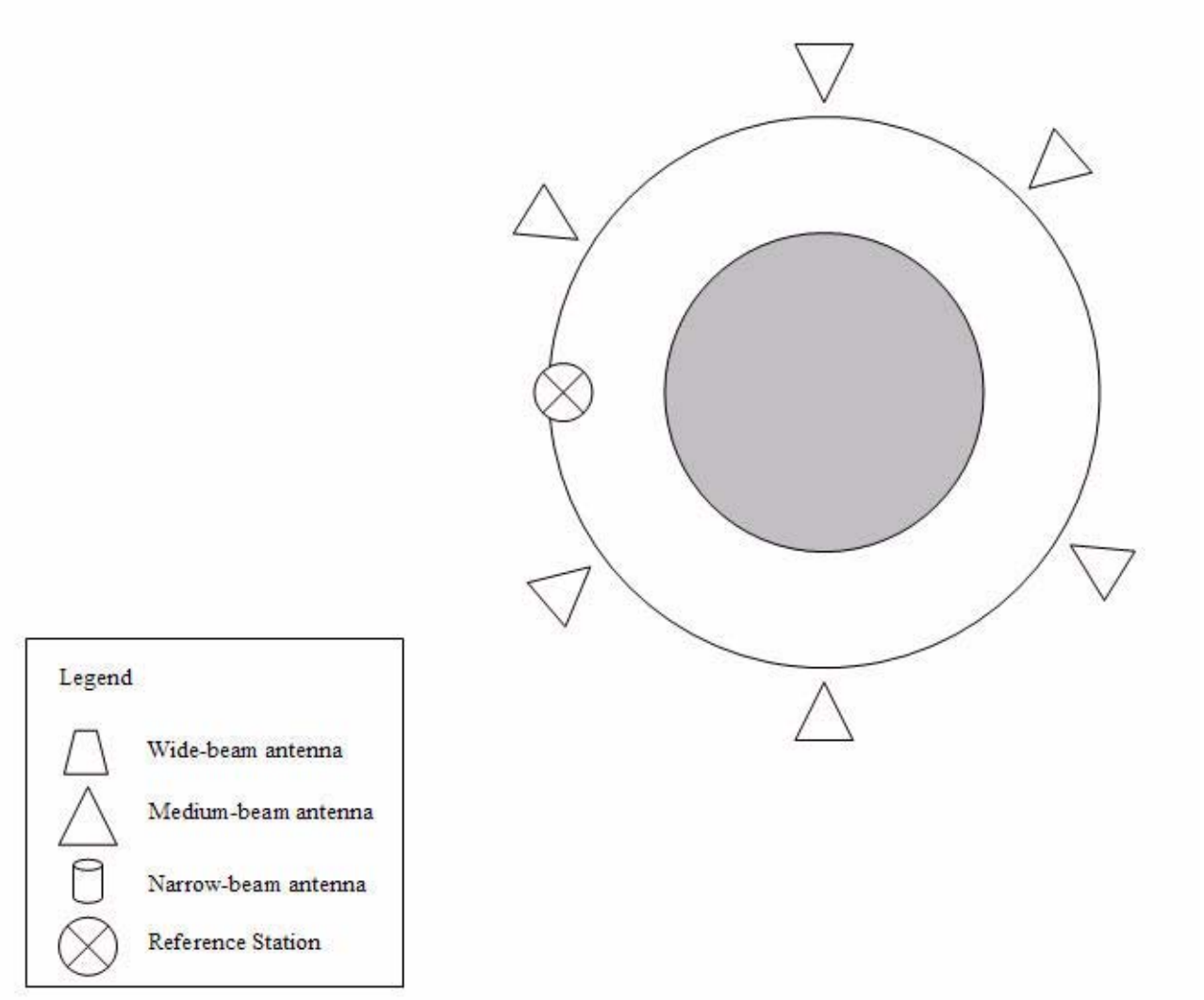


Figure 7-4 Elongated Mine Pit Infrastructure Implementation

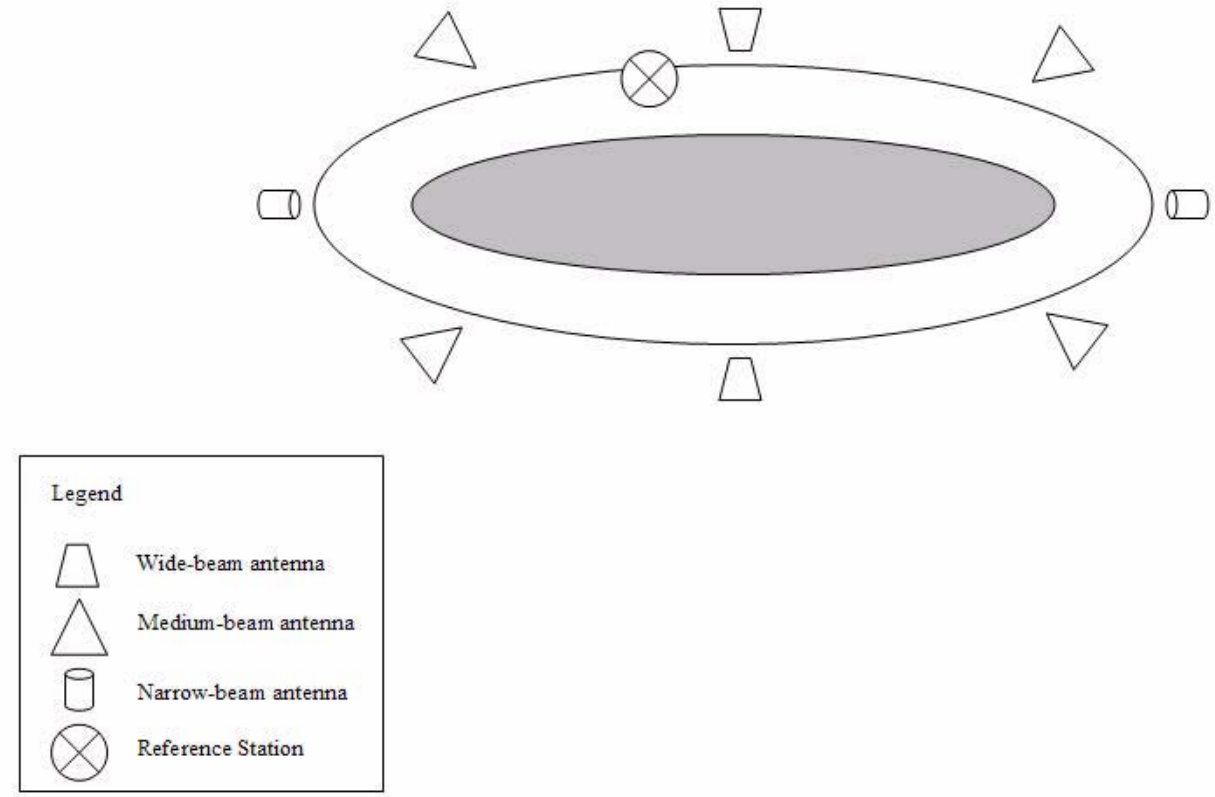
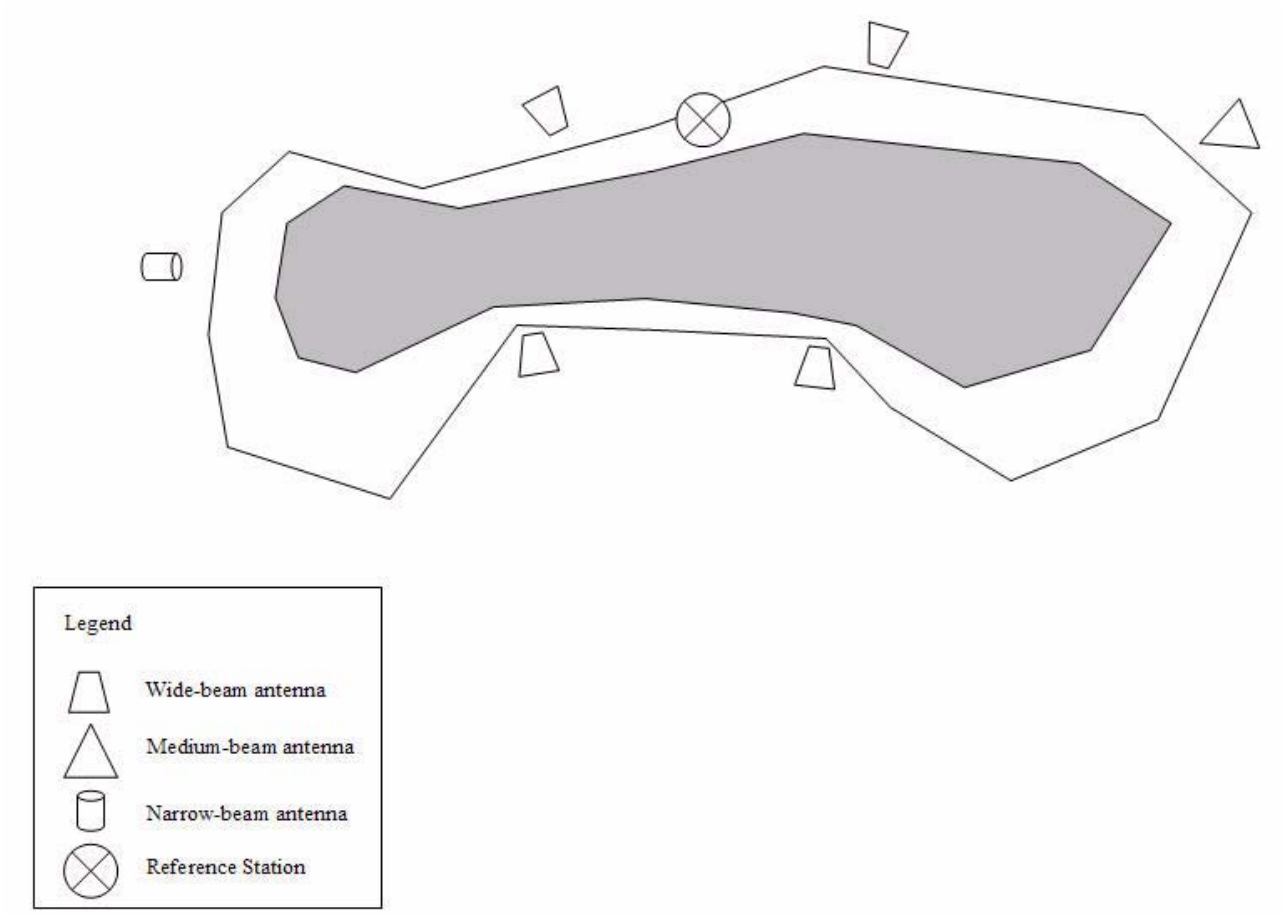


Figure 7-5 Complex Shaped Mine Pit Infrastructure Implementation

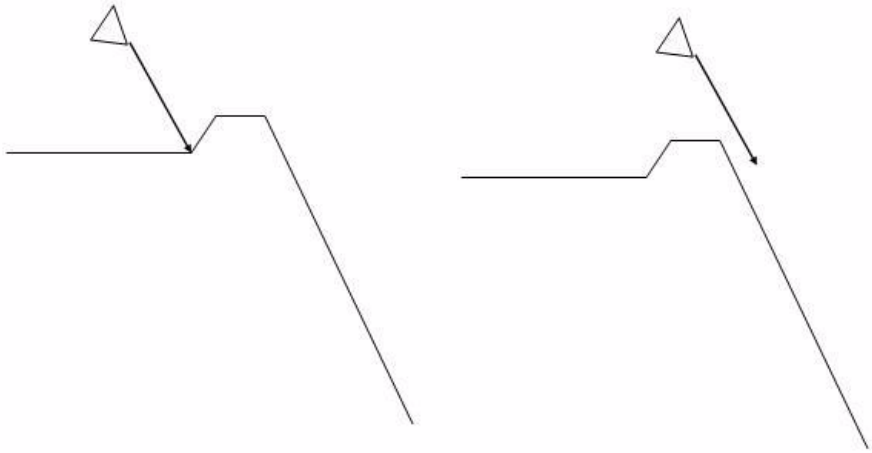


Installation

The infrastructure installation process is the physical placement of the hardware within the mine environment. The infrastructure installation is dependent upon the information provided in the mine assessment process. *Figure 7-6* and *Figure 7-7* show various placement issues within the mine.

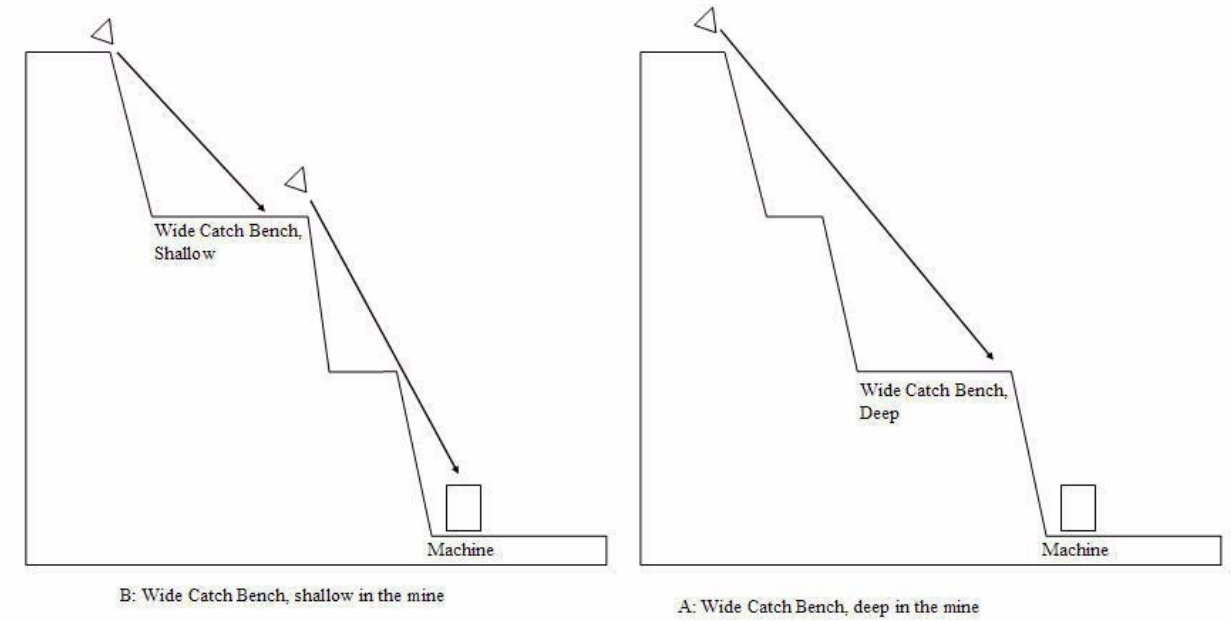
The specific procedures for installing the Novariant GPS+XPS infrastructure components are located in the *Installation* chapter of this manual.

Figure 7-6 Berm Occlusion



Note: Beware of berm occlusion at the TX100 Terralite installation. The TX100 Terralite should be placed as close to the edge as possible. To avoid unnecessary risk to personal safety, it may be required to install the TX100 Terralite on a counter-balanced boom to establish good clearance of the transmitter antenna over the berm.

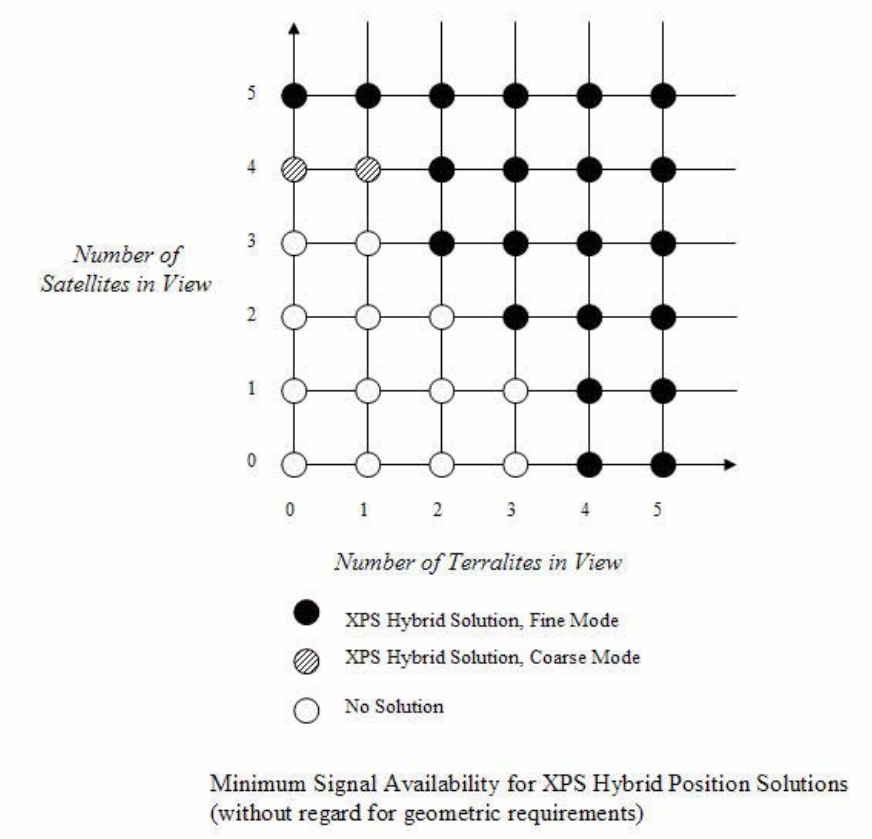
Figure 7-7 Catch Bench Occlusion



Note: Unusually wide catch benches cause line of sight problems for equipment mounted on the rim of the mine. A wide catch bench that is shallow in the mine may serve as a more suitable place to locate the TX100 Terralite, as long as it is still higher than the base station. A wide catch bench that is shallow presents more problems. The TX100 Terralite simply may not be able to cover the area immediate below its location. In these cases, ensure the machine of interest can see the minimum 4 - TX100 Terralites from other directions.

Figure 7-8 shows a matrix of the minimum numbers of satellites and Terralites required for an MX100 GPS+XPS receiver to generate a high accuracy position solution (XPS Hybrid Fine). It is worth noting that these minimums do not account for geometric limitations, and the actual minimum number of combined satellites and Terralites will be greater than the theoretical minimum.

Figure 7-8 TX100 Terralite and Satellite Signal Matrix



Integration

The infrastructure integration process begins with customer system specifications and developed engineering specifications obtained from the mine assessment process. The goal of the integration process is to implement the Novariant infrastructure within the existing GPS equipment environment. The integration process ensures the appropriate communications protocols are implemented to enable interaction between the Novariant infrastructure and the mine GPS equipment and applications.

If the mine is already using High-precision RTK GPS equipment with an established Reference station, then the Novariant IX100 Reference Station must be surveyed with respect to the existing Reference station to ensure data is consistent between the two systems. This can be done by temporarily plugging in one of the mine's existing survey receivers in to the Novariant Reference Station's GPS Antenna using a DC block and making a survey measurement, and then entering that information into the Novariant IX100 Reference Station via the web browser interface.

Caution: A supplied DC block must be used during Reference Station survey. If the DC Block is not used the AX100 antenna will be damaged and require replacement.

Note: The IX100 Reference Station should be mounted and tested with the rest of the Terralite system.

1. Mount the AX100 antenna securely on the mounting structure (nominally a tall tripod).
2. Temporarily disconnect the IX100 Reference station from power.
3. Disconnect the RF cables to the AX100 antenna at the IX100 TNC connector interface, noting the color-coordinated matching to the connectors.
4. Using a Novariant Reference Survey RF adapter DC Block kit, connect the YELLOW RF cable from the AX100 to the third party survey receiver. The orange and red RF cables from the AX100 remain unconnected. It may be necessary to add adapters to accommodate N-type, TNC, or SMA connectors on the third party receiver.
5. Perform a normal survey of the AX100 antenna to the mine's established Reference station.
6. Ensure the resulting coordinates are in the format of WGS 84 Latitude, Longitude, Altitude. If not, convert the coordinates as necessary. Be careful to ensure the coordinates are NOT in LOCAL LLA format!
7. Disconnect the third-party survey receiver from the AX100 antenna.
8. Remove the DC Block.
9. Re-connect the Novariant IX100 Reference Station and apply power.
10. Once the IX100 has started up, connect to the receiver via Ethernet using a web browser.
11. Go to menu item Utilities/Set Receiver Configuration.
12. Enter the Reference station Position Lat, Lon, Alt values as measured above.
13. Reboot the receiver using Utilities/Reboot Receiver

Note: Further verification (TBD), should be done, more involved - compare a Novariant mobile output to third-party survey receiver at various locations in mine.

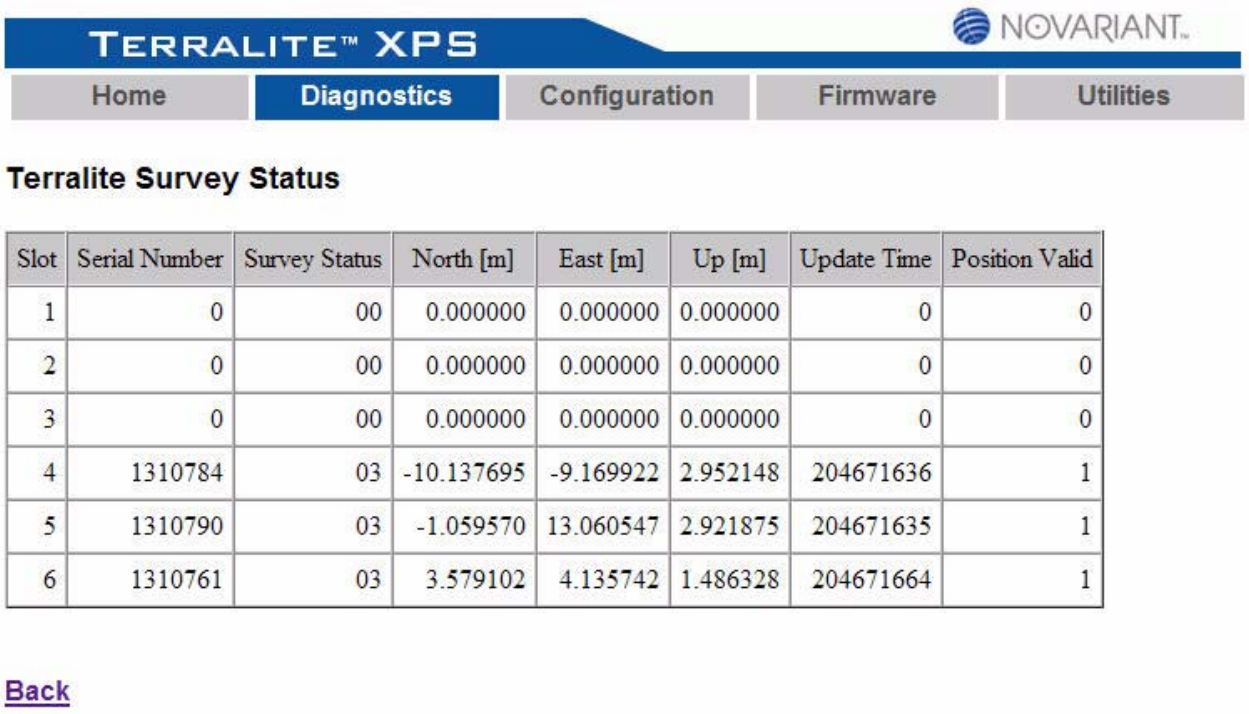
Verification

Verification is the process of checking the individual infrastructure components and ensuring their functional operation within the mine environment and GPS systems. *Figure 7-10* shows the placement of infrastructure and mobile units during verification.

The process includes the observation of signals from various infrastructure components and the analysis of communication data streams. The tools used include MX100 GPS+XPS Receivers, External Diagnostic Radios and PCs connected to the equipment.

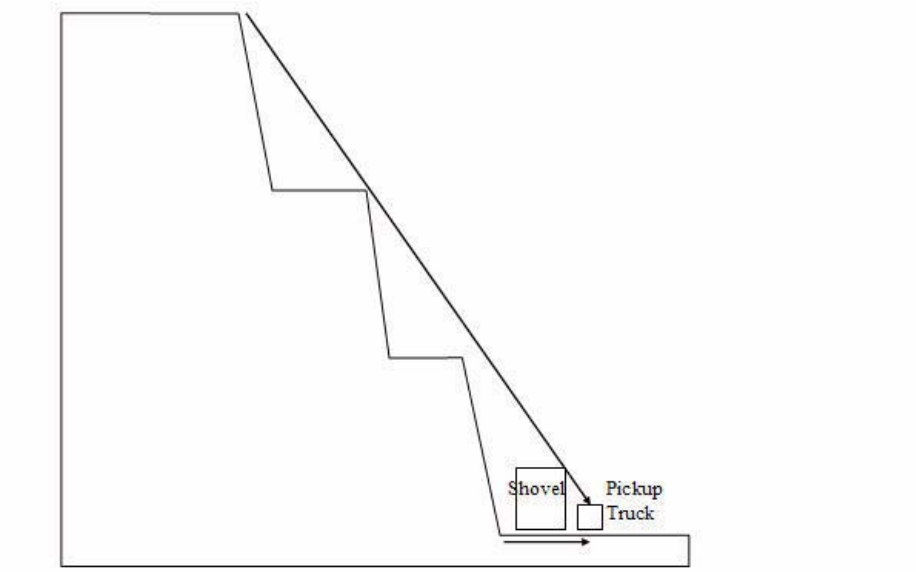
1. Connect to the Reference station via Ethernet and Web browser
2. Go to **Diagnostics**->**Terralite Survey Status** window.
3. Examine the output table shown in *Figure 7-9*. Look for the desired Terralite, as listed by the enumerated rows. The survey status information is captured in two ways: a "03" in the third column indicates successful survey. The time of the survey is updated every thirty seconds in the next-to-last column of the table.

Figure 7-9 Terralite Survey Status Window



Slot	Serial Number	Survey Status	North [m]	East [m]	Up [m]	Update Time	Position Valid
1	0	00	0.000000	0.000000	0.000000	0	0
2	0	00	0.000000	0.000000	0.000000	0	0
3	0	00	0.000000	0.000000	0.000000	0	0
4	1310784	03	-10.137695	-9.169922	2.952148	204671636	1
5	1310790	03	-1.059570	13.060547	2.921875	204671635	1
6	1310761	03	3.579102	4.135742	1.486328	204671664	1

Figure 7-10 Coverage Testing



Note: When testing TX100 Terralite coverage near a highwall from a low-profile vehicle, such as a pickup truck, compensate for differences in vehicle height by testing farther away from the highwall than the actual mine equipment would be, so as to achieve same view angle to the TX100 Terralite on the rim.

Diagnostics and Maintenance

This **Diagnostics and Maintenance** chapter provides descriptions of the utilities and methodologies available for analyzing the functional operation of the TX100 Terralite and IX100 Reference Station infrastructure and for performing routine and preventive system component maintenance.

This **Diagnostics and Maintenance** chapter contains the following sections:

- *Setup Hyperterminal Session for Data Capture and Analysis*
- *USB Serial Adapter Configuration*

Setup Hyperterminal Session for Data Capture and Analysis

1. Start Hyperterminal from the **Programs** > **Accessories** > **Communications** > **Hyperterminal**. See *Figure 8-1*.

Figure 8-1 Hyperterminal Selection Menu

2. A dialog box displays, asking for a name and icon to be selected, in this case we have chosen `Novariant Output - Aquila` and the first default Icon. See *Figure 8-2*.

Figure 8-2 Hyperterminal Connection Description Window

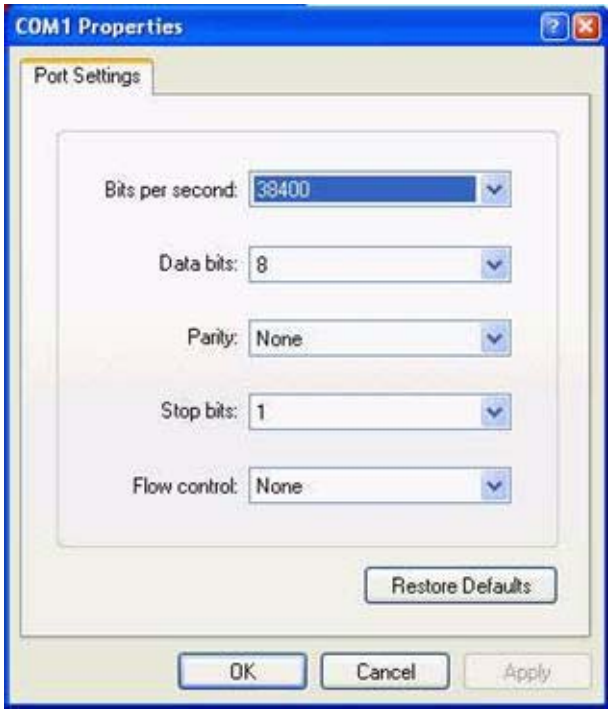
3. Hyperterminal prompts you for some information regarding location and the method for connection. Ignore the location and select the COM port you are using to connect to the MX100 Receiver. In this case we are selecting COM1. See *Figure 8-3*.

Note: If you are using a USB - Serial adaptor you will need to check the COM port number assigned to the serial port using the **Device Manager** in the **Control Panel**.

Figure 8-3 Hyperterminal Connect To Dialog Window

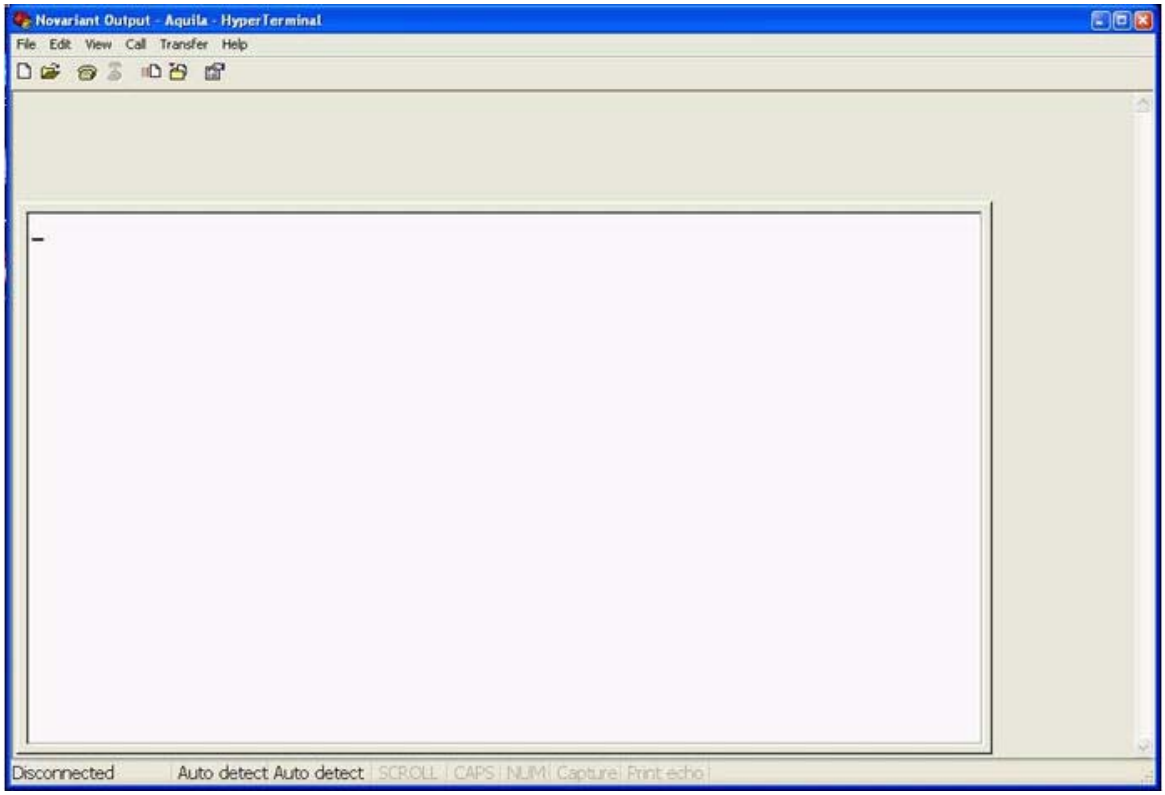
4. Modify the port settings to match the MX100 receiver. In this example, we are connecting to a MX100 connected to an Aquila system. See *Figure 8-4*.

Figure 8-4 Hyperterminal COM1 Properties Window



5. If the settings are correct, the **Terminal** window in *Figure 8-5* will display the data streaming in from the MX100 Receiver.

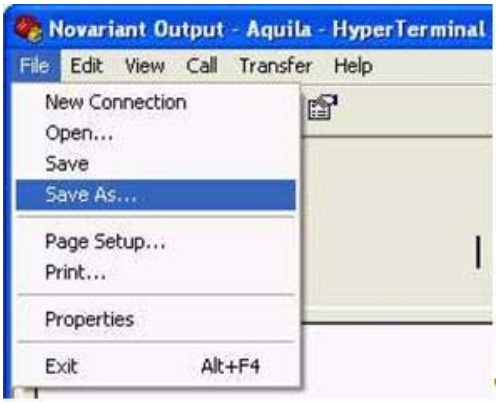
Figure 8-5 Hyperterminal Novariant Output Window



6. Left-click `file > Save As`. See *Figure 8-6*.

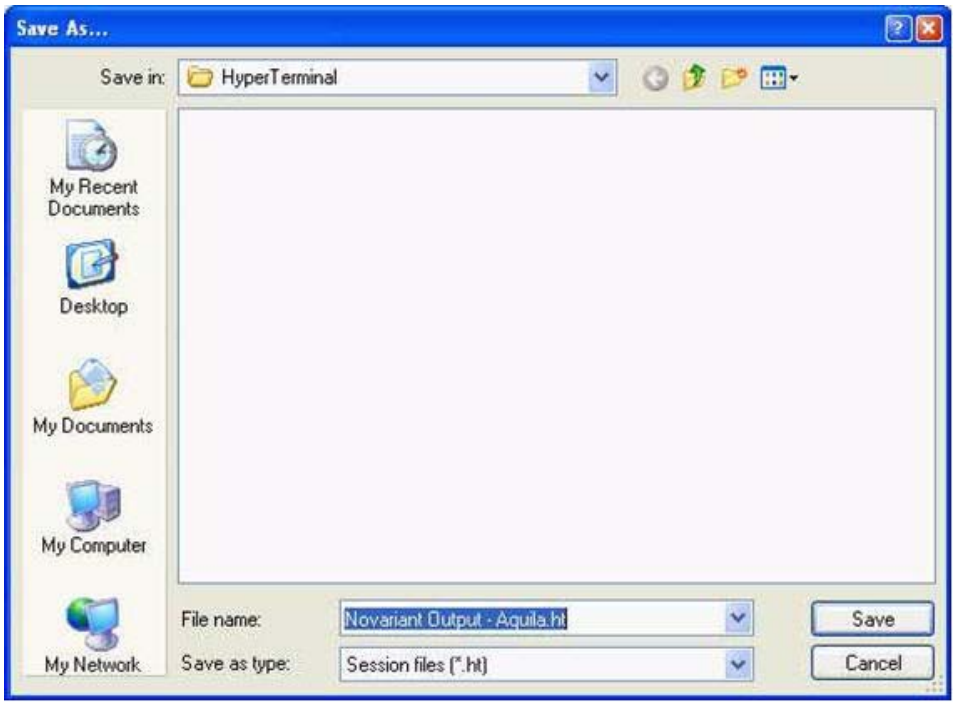
Note: It is advisable to save this session to allow the data output to be checked easily in the future.

Figure 8-6 Hyperterminal Save As Menu



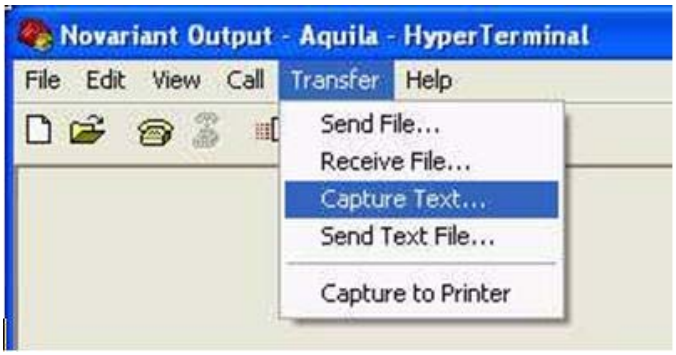
7. Enter a name for the session in this case we have used `Novariant Output - Aquila.ht`. See *Figure 8-7*.

Figure 8-7 Hyperterminal Save As Novariant Output Name



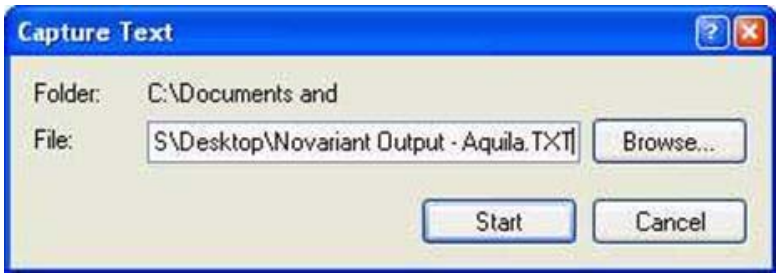
8. Click `Transfer > Capture Text`. In some cases it may be required to capture the data to send to Novariant for analysis. See *Figure 8-8*.

Figure 8-8 Hyperterminal Capture Text Menu



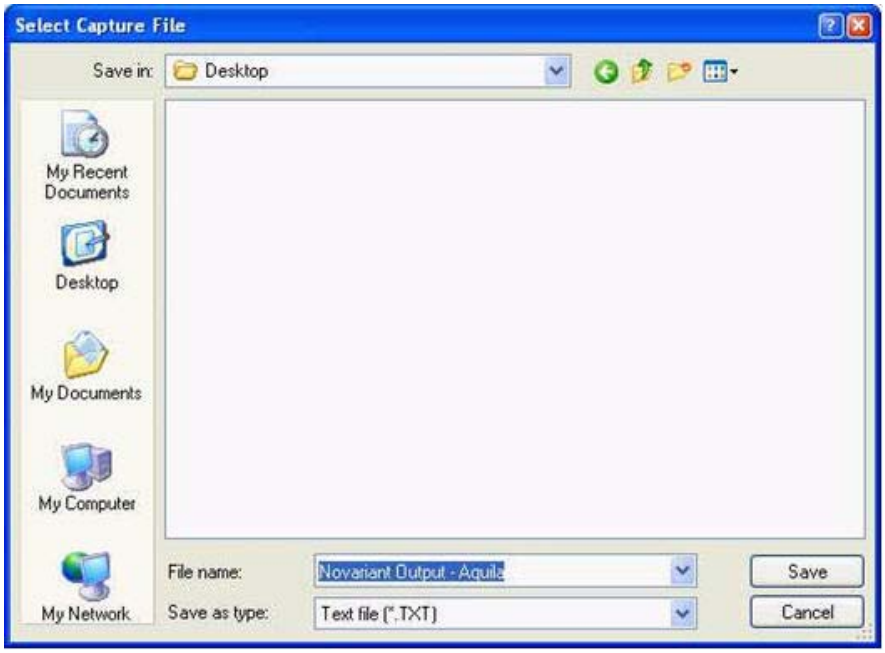
9. Browse to the location where you want the data to be saved. See *Figure 8-9*.

Figure 8-9 Hyperterminal Capture Text Browse Window



10. Enter a file name to store the data, in this example, we are using the desktop for the location and `Novariant Output - Aquila` as the filename. See *Figure 8-10*.

Figure 8-10 Hyperterminal Select Capture File Window



Note: When the capture text function is working the status bar at bottom of the terminal screen displays "Capture" as shown in *Figure 8-11*. Also, the text file set up size in *Figure 8-10* will increase.

Figure 8-11 Hyperterminal Status Bar

11. Click Transfer > Capture text > To stop text Capture. See *Figure 8-12*.

Figure 8-12 Hyperterminal Capture Stop Menu

Note: The resulting file should contain all of the messages as defined in the **MX100 Receiver Installation** manual **Third-Party Application Interface** chapter.

This test only proves if the data is streaming from the MX100 and the cabling up to the point where the PC has been connected is sound. If the application is still reporting no GPS data or similar it may still have a cabling issue further down the line. Alternatively the data from the MX100 may not be compatible because of a incorrect option/setting. These settings can be checked and the procedure is detailed elsewhere.

USB Serial Adapter Configuration

This section assumes the USB - Serial adapter software/driver has been installed and the adapter is connected to the PC. When using a USB - Serial port adapter the COM port number can be found in Windows' Device Manager.

Control panel > System > Device manager and then expand the branch for COM ports.

1. Click Control Panel from the Start menu. See *Figure 8-13*.

Figure 8-13 Windows Control Panel Menu

2. Left-click the System icon. See *Figure 8-14*.

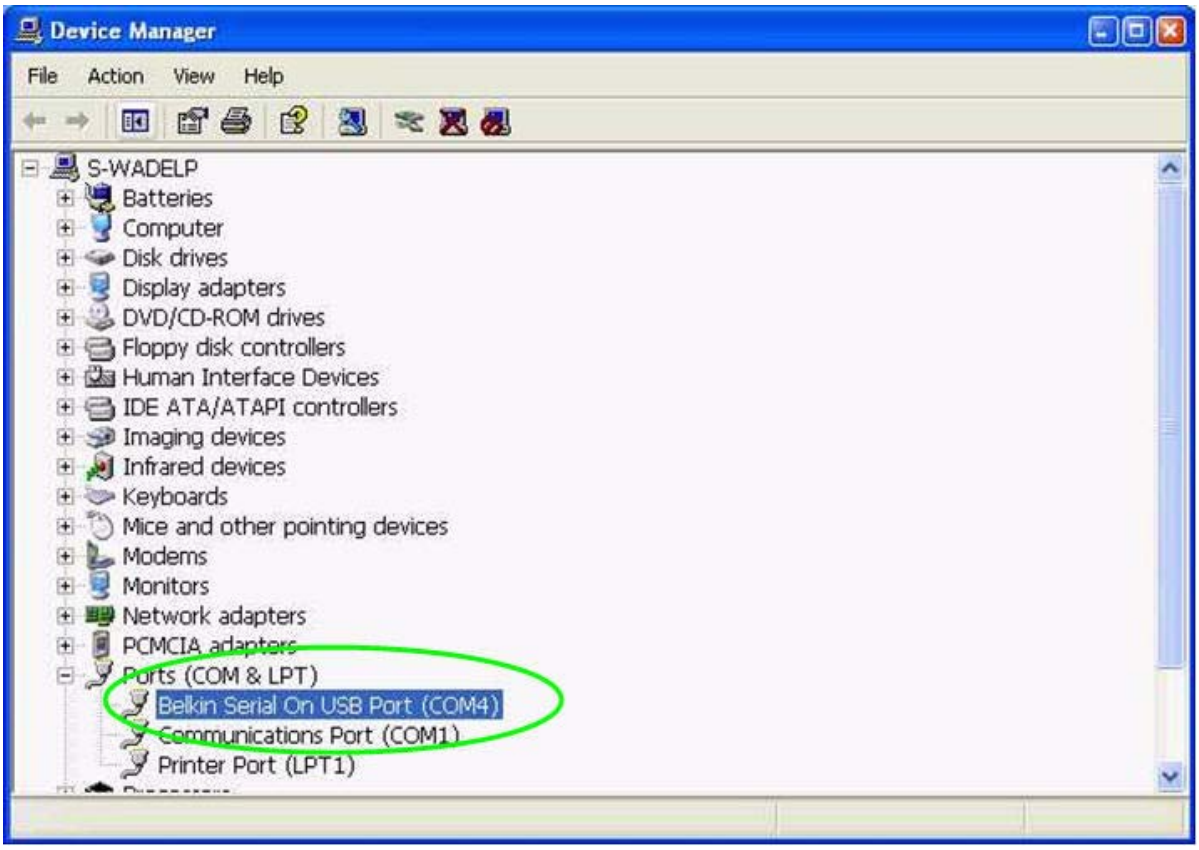
Figure 8-14 Control Panel System Icon

3. Left-click the Device Manager button. See *Figure 8-15*.

Figure 8-15 Device Manager Button

4. Expand the Ports (COM & LPT) branch. The displayed list should contain all the available PC serial ports with some Adaptor identification. See *Figure 8-16*.

Figure 8-16 Device Manager USB Port Icon



Installation

This **Installation** chapter provides the procedure for the site integration of your TX100 Terralite and IX100 Reference Station. The information for this **Installation** chapter is contained in the following sections:

- *IX100 Reference Station Installation*
  - *Location*
  - *Cables and Accessories*
  - *Power*
  - *Antenna Installation*
  - *Installation Procedure*
    - *Bench Test and Configuration*
    - *Field Installation*
- *TX100 Terralite Installation*
  - *Location*
  - *Cables and Accessories*
  - *Power*
  - *TX100 Terralite Installation*
  - *Installation Procedure*
    - *Bench Test and Configuration*
    - *Field Installation*
- *MX100 Receiver Installation*
- *External Diagnostic Radio*

The typical TX100 Terralite infrastructure installation process is performed after the mine assessment process and the TX100 Placement processes are complete. After receiving the TX100 Terralite components, you should take them to a test bench for site configuration and verification. Following the bench configuration and verification the TX100 Terralite transmitters are ready for site installation.

The TX100 Terralite infrastructure component physical installation is performed in the following order:

1. Reference Station.
2. TX100 Terralite transmitters (one at a time, for all the site specific required TX100 Terralite transmitters).
3. Customer selected wireless IP network radios.

IX100 Reference Station Installation

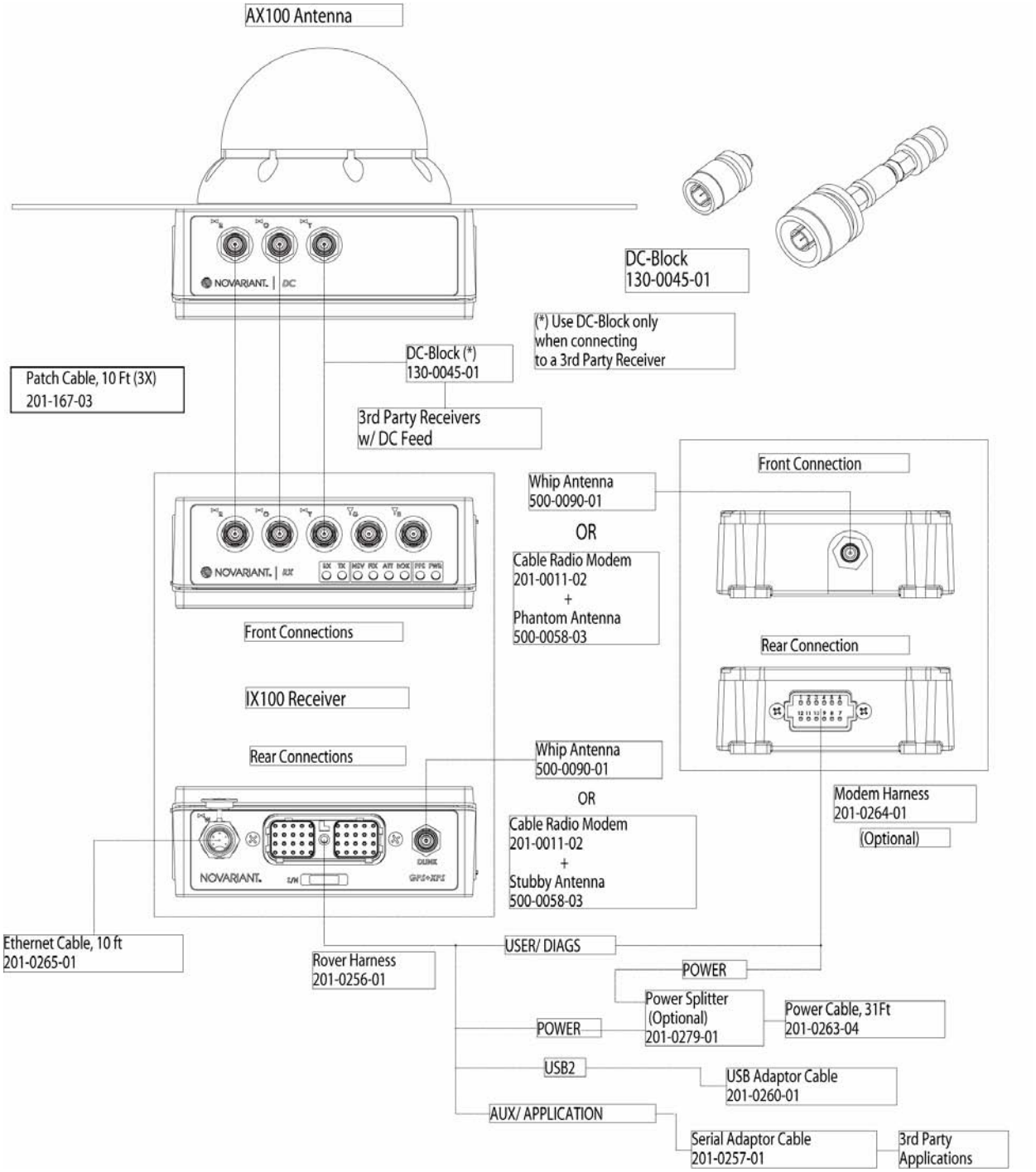
The purpose of the IX100 Reference Station is to calculate position corrections and transmit them to the mobile receivers and to monitor TX100 Terralite XPS signals. The mobile receivers use the position corrections to determine their positions with inch-level accuracy. The functionality provided by the IX100 Reference Station is also used during the infrastructure installation process to help verify the function of the TX100 Terralites as they are installed.

The IX100 Reference Station is the first TX100 Terralite infrastructure component installed in a new mine infrastructure. The location of the IX100 Reference Station should be lower than all of the TX100 Terralite locations, yet high enough to enable the least amount of terrain blockage for the GPS satellite signals.

The IX100 Reference Station is typically placed on a large tripod or pole, approximately 3 meters tall. A small pole to the side of the tripod provides communications antenna mounting. Power can be provided by a solar array with the same specifications used for the TX100 Terralite units, by another 12VDC power supply or battery.

To determine the exact coordinates of the Reference Station antenna a DC block is used to enable connection of a Third party surveying receiver to the IX100 Reference Station antenna for precise location survey to an existing coordinate, if one exists. This survey should be completed to identify the WGS-84 position of the unit as referenced to any existing mine coordinates.

Figure 9-1 IX100 Reference Station Interconnections



Location

The location of the IX100 Reference Station is provided from the mine assessment and TX100 Terralite and IX100

Reference Station Placement process information. The solar panel stands if used, need to be fabricated and completed by mine personnel in accordance with Novariant representative recommendations.

Cables and Accessories

The wiring for an IX100 Reference Station is very simple.

- 3-foot power cable (201-0263-01)
- Receiver Harness (201-0256-01)

Power

The IX100 Reference Station requires 12VDC @ 2.5A. This power should be provided from a source with minimum noise and ripple. Typical installations implement either a photovoltaic array with a controller and batteries or a battery alone. The power source is selected and provided by mine personnel using the recommendations of your Novariant representative.

Antenna Installation

The position of the Antenna is critical to the overall operation and accuracy of the GPS system. Improper antenna placement may be detrimental to system reliability and functionality. Consider the following issues when installing your antenna:

- Do not mount your antenna near transmitting antennas, satellite communications equipment or radar systems and arrays.
- Select a location with an unobstructed view of the sky.
- Avoid electrical interference, excessive heat, excessive mechanical vibration or strong magnetic fields.

Installation Procedure

The IX100 Reference Station installation procedure is divided into two sections:

- *Bench Test and Configuration*
- *Field Installation*

The Bench Test and Configuration portion of the process ensures the infrastructure components are properly prepared for site installation prior to moving the components to their installation locations within the mine. The Field Installation process places the site-specific configured infrastructure components into their operational position.

Bench Test and Configuration

Note: If failures occur during the installation procedure refer to the *Troubleshooting* chapter of this manual for the *Bench Test* troubleshooting recommendations.

1. Locate the IX100 Reference Station shipping container, check its contents and unpack it.
2. Get one tripod and rigid mount for installing an IX100 Reference Station and a TX100 Terralite.
3. Separate the two mounts (one rigid mount for TX100 Terralite - one tripod for IX100) by 30 meters.
4. Mount the IX100 Reference Station on the tri-pod (retracted to its minimum height).
5. Verify power supply voltages provided to the components.
6. Connect the IX100 power cable to a power source.
7. Connect the cables for IX100 Reference Station.
8. Connect a PC to the IX100 Reference Station.
9. Start an Internet browser on the PC connected to the IX100 Reference Station.
10. Browse to the IP Address of the IX100 Reference Station.
11. Login to the IX100 Reference Station.
12. Navigate to the **Signal View** window.
13. Perform the following operations in the **Signal View** window:
    - **a** Check for **Autonomous** mode indication.
    - **b** Check the **Lat, Long** and **Alt** (Altitude).
    - **c** Check the L1 and L2 signal strength. (should be greater than 20 on 5 or more Channels/Sats for one-half hour)
    - **d** Set the IX100 Reference Station output formats as needed (site specific) using the Configuration Window Serial Port Settings and Differential Corrections sub-windows.
    - **e** Use the **Signal View** window to ensure the differential communication link is operational by viewing the Reference Station L1/L2 signals.
    - **f** Reboot the IX100 Reference Station.
    - **g** Recheck the **Signal View** window readings.
14. Set the **Configuration**->**Differential Corrections** in the **Position Output** menu. This is a site specific setting. The factory default setting is: **INX**.
15. Replace Direct Ethernet with a wireless connection.
    - **a** Connect a wireless radio to your IX100 Reference Station and a second wireless radio to your PC for diagnostic data.
    - **b** Start a browser from your PC and connect to the IX100 Reference Station.
    - **c** Navigate to the **Signal View** window and verify the display updates at approximately a 1Hz rate. The display update rate should perform similar to when the PC was connected by a direct Ethernet cable.

Note: The display of the **Signal View** window verifies the wireless connection operation.

16. Leave the IX100 Reference Station power on. The IX100 Reference Station is used to complete the TX100 Terralite bench test procedure.

Note: With the IX100 Reference Station running in bench test mode, perform the bench test procedure for each TX100 Terralite transmitter. When the bench testing of all the TX100 Terralite transmitters is complete, proceed with the IX100 *Field Installation* procedure.

Note: The completion of the *Bench Test and Configuration* procedure verifies the IX100 Reference Station operation and its readiness for field installation.

Field Installation

1. Put all the IX100 Reference Station components into a transfer vehicle for delivery to the installation location within the mine.
2. Take the IX100 Reference Station equipment to the selected location.
3. Set up the IX100 Reference Station in accordance with the steps listed in the Bench Test section. *Step 1.* to *Step 16.*
4. Disconnect the RF cables to the AX100 antenna at the IX100 TNC connector interface, noting the color-coordinated matching to the connectors.
5. Using a Novariant Reference Survey RF adapter (DC Block) kit, connect the YELLOW RF cable from the AX100 to the third party survey receiver. The orange and red RF cables from the AX100 remain unconnected. It may be necessary to add adapters to accommodate N-type, TNC, or SMA connectors on the third party receiver.
6. Perform a normal survey of the AX100 antenna to the mine's established Reference station.
7. Ensure the resulting coordinates are in the format of WGS 84 Latitude, Longitude, Altitude. If not, convert the coordinates as necessary. Be careful to ensure the coordinates are NOT in LOCAL LLA format!
8. Disconnect the third-party survey receiver from the AX100 antenna.
9. Re-connect the Novariant IX100 Reference Station and apply power.
10. Once the IX100 has started up, connect to the receiver via Ethernet using a web browser.
11. Go to menu item Utilities/Set Receiver Configuration.
12. Enter the Reference station Position Lat, Lon, Alt values as measured above.
13. Reboot the receiver using Utilities/Reboot Receiver

Note: The completion of the *Field Installation* procedure verifies the IX100 Reference Station operational readiness.

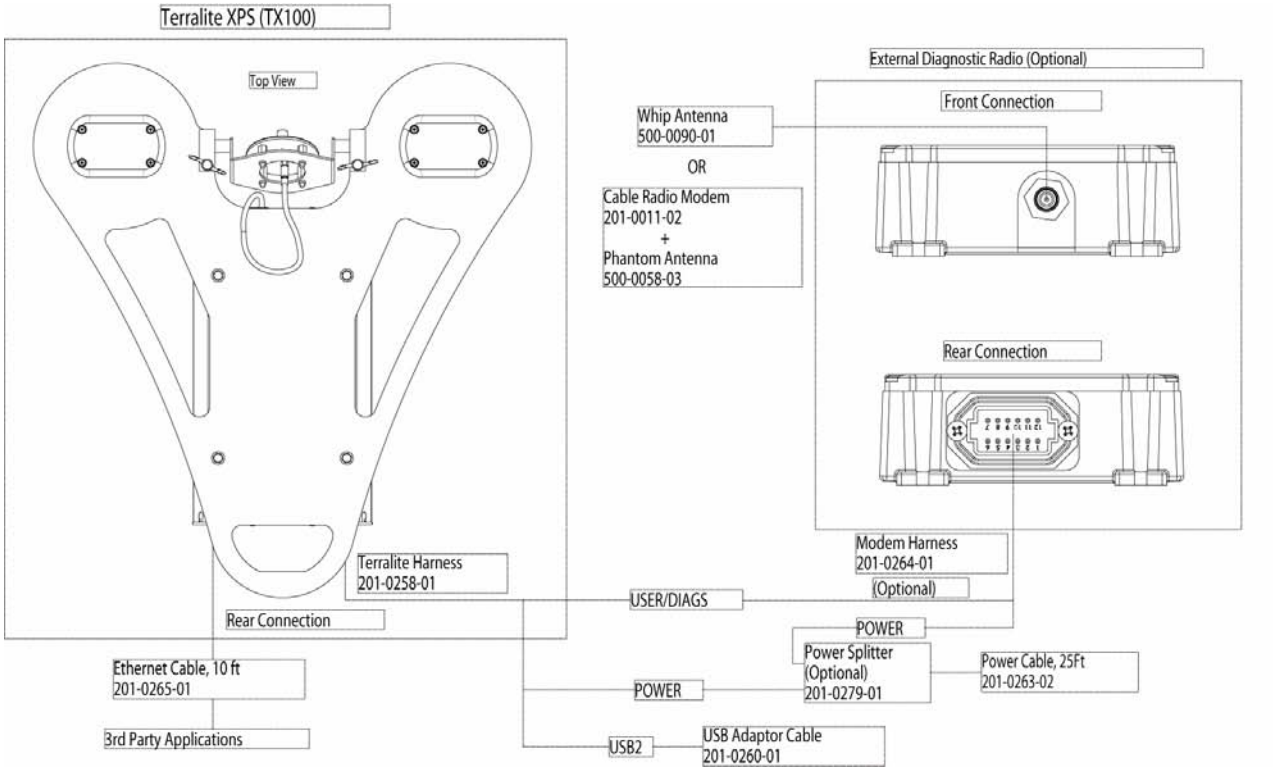
TX100 Terralite Installation

This **TX100 Terralite Installation** section provides instructions for installing the TX100 Terralite GPS Positioning system transmitters and contains mounting, configuration, verification procedures and interconnect diagrams. *Figure 9-2* shows the TX100 Terralite transmitter interconnection.

The purpose of the TX100 Terralite XPS system is to provide positioning information when GPS is not available. The actual output of the GPS+XPS MX100 Receiver is determined by the visible GPS constellation parameters. Therefore, the positional output to the application is a GPS position when sufficient satellites and PDOP exist, a hybrid GPS+XPS positional output when the GPS is insufficient, or a XPS-only solution in the complete absence of GPS.

In consideration of the requirements to provide a positional solution, the location of the TX100 Terralite transmitters becomes one of the paramount site specific installation issues.

Figure 9-2 TX100 Terralite Transmitter Interconnections



Location

The location of the TX100 Terralite transmitters is provided from the mine assessment and TX100 Terralite and IX100 Reference Station Placement process information. The fabrication of the site location components is completed by mine personnel in accordance with Novariant representative recommendations.

Cables and Accessories

1. Terralite Harness (201-0258-01) (pre-attached)
2. Ethernet Cable (201-0265-01) (pre-attached, unprotected RJ45)
3. Serial Adapter Cable (201-0257-01)
4. USB Adapter Cable (201-0260-01)
5. 25 foot Power Cable (201-0263-02)

Power

The TX100 Terralite transmitter requires 12VDC @ 3.0A. This power should be provided from a source with minimum noise and ripple. Typical installations implement either a photovoltaic array with a controller and batteries or a battery alone. The power source is selected and provided by mine personnel using the recommendations of your Novariant representative.

TX100 Terralite Installation

The position of the TX100 Terralite transmitter is critical to the overall operation and accuracy of the GPS system. Improper antenna placement may be detrimental to system reliability and functionality. Consider the following issues when installing your antenna:

- Do not mount your TX100 Terralite transmitter near transmitting antennas, satellite communications equipment or radar systems and arrays.
- Select a location with an unobstructed view of the sky.
- Avoid electrical interference, excessive heat, excessive mechanical vibration or strong magnetic fields.

Installation Procedure

The TX100 Terralite transmitter installation procedure is divided into two sections:

- *Bench Test and Configuration*
- *Field Installation*

The Bench Test and Configuration portion of the process ensures the infrastructure components are properly prepared for site installation prior to moving the components to their installation locations within the mine. The Field Installation process places the site-specific configured infrastructure components into their operational position.

Bench Test and Configuration

Note: If failures occur during the installation procedure refer to the *Troubleshooting* chapter of this manual for the *Bench Test* troubleshooting recommendations.

1. Mount the TX100 Terralite on the Terralite Stand.
2. Ensure each TX100 Terralite has a known and unique time slot setting value between 1 and 6.

Note: The transmitter slot setting is controlled in the **Configuration** -> **Transmitter Slot** window.

3. Keep 30 meters between IX100 Reference Station and the TX100 Terralite transmitter.
4. Point the TX100 Terralite antenna at IX100 Reference station.

⚠ WARNING

The TX100 Terralite transmitter output signal produces Radio Frequency radiation. All personnel should stay a minimum of 30 centimeters from the output antenna any time the transmitter is powered.

5. Connect and power up the first TX100 Terralite. (must have open sky view)
6. Connect a PC to the first TX100 Terralite transmitter.
7. Start an Internet browser on the PC connected to the TX100 Terralite transmitter.
8. Browse to the IP address for the TX100 Terralite transmitter
9. Login to the TX100 Terralite transmitter.
10. Navigate to the **Configuration** -> **Transmitter Slot** window and ensure the TX100 Terralite time slot setting.
11. Navigate to the **Signal View** window.

Note: The XPS Navigation Solution for each antenna will follow a sequence of modes. “GPS Fixed” in green is the final mode. The mode will follow this sequence: (1) “Connecting”, up to 2 minutes; (2) “Autonomous” in red, up to 1 minute; (3) “GPS Float” in yellow, up to 20 minutes; and finally, “GPS Fixed” in green.

12. Perform the following operations in the **Signal View** window:
    - **a** Verify the TX100 Terralite is receiving updates from the IX100 Reference Station.
    - **b** Check for five (5) satellites with greater than 20 signal strength on the L1/L2 antennas.
    - **c** Check the oscillator setting.
    - **d** Check for RTK fixed and green.
    - **e** Set the transmitter slot number.
    - **f** Verify the FCC license is set properly.
    - **g** Check for the IX100 Reference Station receiving this Terralite’s signal in the correct time slot.
13. Disconnect the PC connection from the TX100 Terralite.
14. Connect the wireless radio to the TX100 Terralite.
15. Test the wireless connection to the TX100 Terralite.
16. Repeat *Step 1.* through *Step 15.* for each subsequent Terralite transmitter.

Field Installation

1. Get the maximum number of infrastructure components into a transfer vehicle for delivery to the installation locations within the mine.
2. Take the TX100 Terralite equipment to the selected location.
3. Set up the TX100 Terralite in accordance with the steps listed in the Bench Test section. *Step 1.* to *Step 15.*

Note: The completion of the *Field Installation* procedure verifies the TX100 Terralite transmitter operational readiness.

MX100 Receiver Installation

Detailed installation guidelines and instructions for the **MX100 Receiver** are provided in the **MX100 Receiver Installation** manual. The **MX100 Receiver Installation** manual is included on the CD-ROM disc which shipped with your **MX100 Receiver.** Check the MX100 Receiver shipping box for the CD-ROM or contact your local Novariant representative.

External Diagnostic Radio

Detailed installation guidelines and instructions for the **External Diagnostic Radio** are provided in the **MX100 Receiver Installation** manual. The **MX100 Receiver Installation** manual is included on the CD-ROM disc which shipped with your **MX100 Receiver.** Check the **MX100 Receiver** shipping box for the CD-ROM or contact your local Novariant representative.

Troubleshooting

This **Troubleshooting** chapter provides procedures for isolating causes of poor system performance and system failures. Most pit mines are harsh and dangerous environments for setting up electronics equipment. Because of the difficulty of setting up equipment in remote locations in the mine, the recommended installation procedure includes a check-out stage called a “bench test” during which each separate component of the system is unpacked and tested from a central, easily accessed area in or near the ongoing operations. A convenient area for conducting the bench test may be in the vicinity of a radio or electronics shop typically present at most mines. The installation and troubleshooting steps of the bench test are nearly identically repeated when each component is deployed to its final remote location around the pit.

Information for this **Troubleshooting** chapter is contained in the following sections:

- *Bench Test*
- *Field Installation*

Bench Test

Note: During bench testing an outdoor antenna that sees the sky must be connected to the IX100 Reference Station and the TX100 Terralite transmitter.

1. Locate the IX100 Reference Station shipping container, check its contents and unpack it.
2. Get one Terralite Stand and one tripod for installing an IX100 Reference Station and a TX100 Terralite.
3. Separate the two mounts (one Terralite Stand for the TX100 Terralite - one tripod for the IX100) by 30 meters.
4. Mount the IX100 Reference Station on the tri-pod (retracted to its minimum height).
5. Connect the cables for both of the units.
6. Use batteries in place of solar power used in the final installation.
7. Connect a PC to the IX100 Reference Station.
8. Start an Internet browser on the PC connected to the IX100 Reference Station.
9. Browse to the IP Address of the IX100 Reference Station.

   Problem: Unknown IP address.

   a. Try the default address (192.168.117.220).
   b. Retrieve list of addresses from the Novariant shipping container and find the IP address assigned to receiver by serial number.
   c. Reset parameters by re-installing software using USB. IP address will be reset to the default.

Problem: Browser interface does not show up. Browser shows error such as: “The page cannot be displayed”

a Check the IP Address of the receiver. You may be using the wrong IP Address for the receiver.

b Check the Network settings on your PC. You may have the incorrect Network settings on your PC.

c Check the Ethernet cable for defects.

d Check the Receiver hardware or power supply.

e Try to ping the address from Command Prompt.

f Restart the browser and re-try to connect to the Receiver.

10. Login to the IX100 Reference Station – User ID: user Password: user

a Potential login failures:

1 Unknown password on the IX100 Reference Station – reload to system defaults using a USB drive.

11. Navigate to the **Diagnostic** ->**Signal View** window.

Note: If you cannot see the **Diagnostic** ->**Signal View** window, the required Java version could be missing on the PC connected to the IX100 Reference Station.

---

a Verify the following information on the **Diagnostic** ->**Signal View** window:

1 The XPS Navigation Solution displays “Autonomous” in red highlight. See *Figure 10-1* item number 1.

Problem: No Autonomous Mode

a Check the antenna for connection, malfunction or cable malfunction.

b Check Diagnostics/Bootlog and verify “IX-100 Up and running”; Reboot Receiver. The receiver may have not booted up properly. If the bootup failed, use the USB drive to re-install the receiver software.

c Check Voltage (Vs) (see *Figure 10-2* item number 7) on the bottom of **Diagnostic**->**Signal View** window.

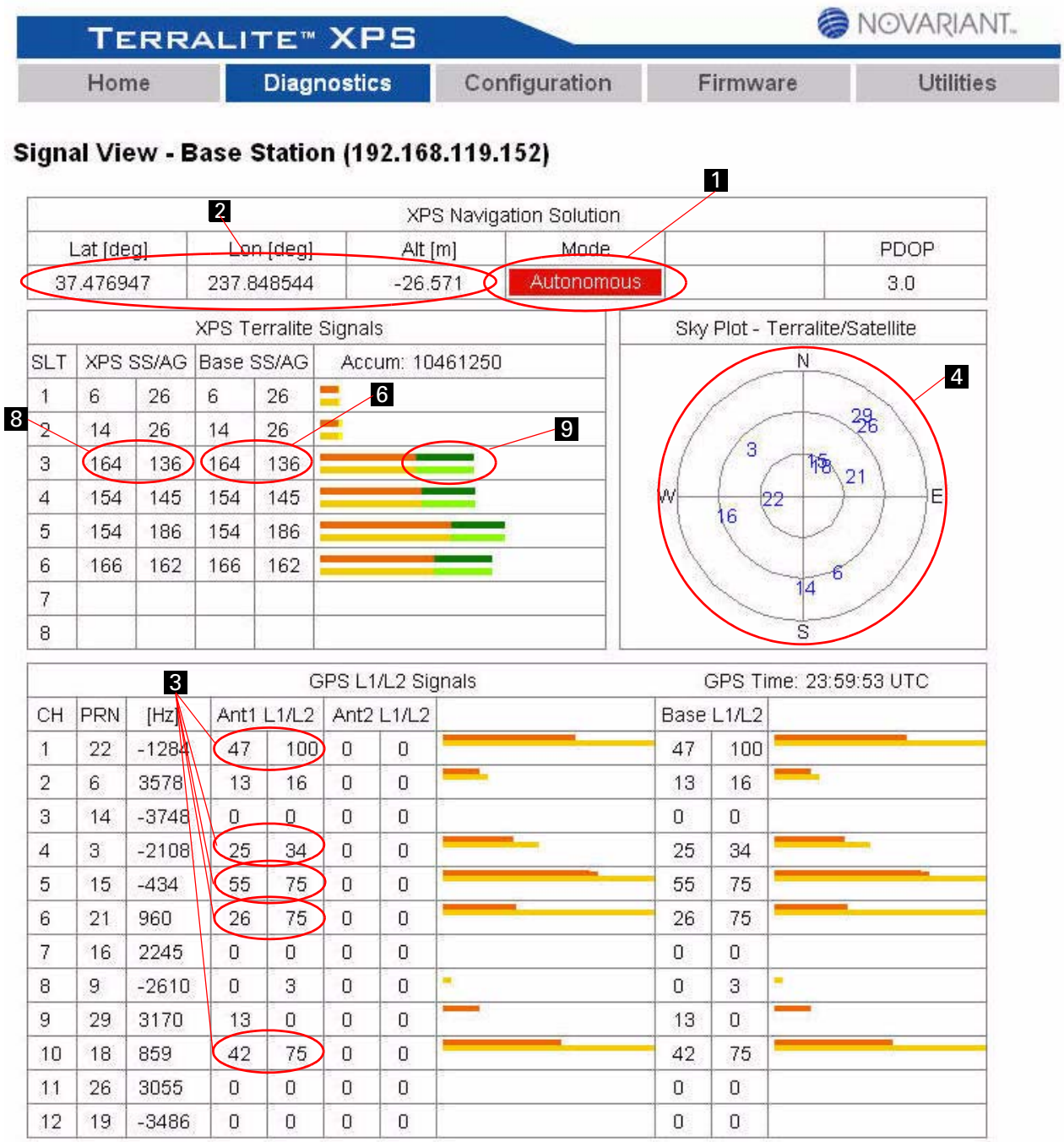
Note: The Latitude, Longitude, and Altitude measurements (see *Figure 10-1* item number 2) exist (non-zero) and the values are updating at roughly 1Hz. The values of these numbers typically change in the fourth place after the decimal (10,000ths) for the Latitude and Longitude measurements, and typically change in the units place for the altitude measurement.

Problem: No LLA displayed - See debug for “Autonomous Mode” above.

Note: The GPS L1/L2 Signals (see *Figure 10-1* item number 3) should be greater than 20 for at least 5 satellites for one-half hour.

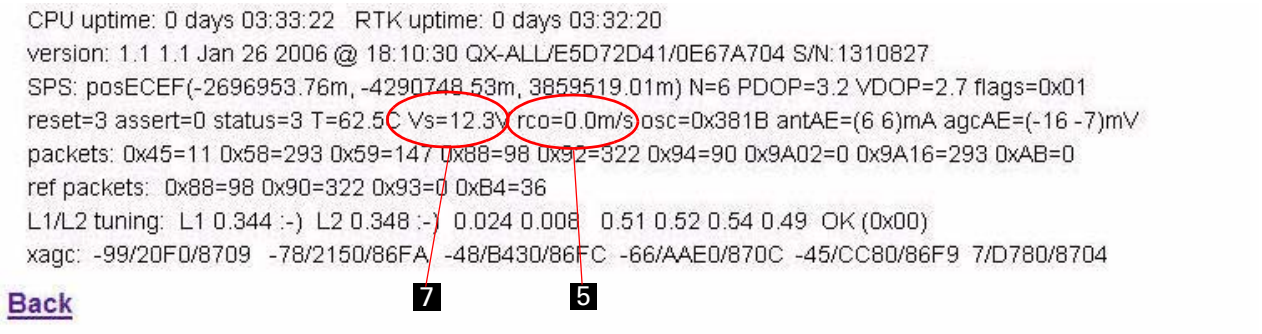
Note: *Figure 10-1* and *Figure 10-2* show the upper and lower portions of the **IX100 Reference Station Signal View** window.

Figure 10-1 IX100 Reference Station Signal View Window (upper portion)



Note: For a detailed description of the **IX100 Reference Station Signal View Window (upper portion)** features see the *IX100 Reference Station Configuration Software GUI Description* chapter of this manual.

Figure 10-2 IX100 Reference Station Signal View Window (lower portion)



a Problem: L1 and L2 signal strengths are lower than required.

b Problem: L2 signal strengths are much lower than the L1 signal strengths.

1 Antenna or cable malfunction: replace AX100 unit; replace AX100 cables.

c Problem: Fewer than 5 satellites have adequate signal strength.

1 The IX100 Reference Station location may have inadequate view of sky. Consider re-locating the IX100 Reference Station.

2 Verify the **Signal View** skyplot for greater than 5 satellites and even distribution. See *Figure 10-1* item number 4.

3 Check the oscillator value on the **Signal View** window, the value should be 0.0 ± 2. See *Figure 10-2* item number 5.

Note: Although the TX100 Terralites are shown in *Figure 10-1* item number 2, the TX100 Terralites will not be seen until later in the procedure when they are installed.

---

12. Set the **Configuration**->**Differential Corrections** in the **Position Output** menu. This is a site specific setting. The factory default setting is: **INX**.

13. Connect a wireless radio to your IX100 Reference Station and a second wireless radio to your PC.

14. Start a browser from your PC and connect to the IX100 Reference Station.

15. Navigate to the **Signal View** window and verify the display updates at approximately a 1Hz rate. The display update rate should perform similar to when the PC was connected by a direct Ethernet cable.

Note: The display of the **Signal View** window verifies the wireless connection operation.

---

16. Leave the IX100 Reference Station power on.

Note: Setup the TX100 Terralites in sequential order.

---

17. Ensure each TX100 Terralite has a known and unique time slot setting between 1 and 6.

Note: The transmitter slot setting is controlled in the **Configuration** -> **Transmitter Slot** window.

18. Connect and power up the first TX100 Terralite. (must have open sky view)
19. Keep 30 meters between IX100 Reference Station and the TX100 Terralite transmitter.
20. Point the TX100 Terralite antenna at IX100 Reference station.
21. Connect a PC to the first TX100 Terralite transmitter.
22. Start an Internet browser on the PC connected to the TX100 Terralite transmitter.

    Problem: Unknown IP address.

    a. Try the default address (192.168.117.220).
    b. Retrieve list of addresses from Novariant shipping container and find the IP address assigned to receiver by serial number.
    c. Reset parameters by re-installing software using USB. IP address will be reset to the default.

    Problem: Browser interface does not show up. Browser shows error such as: “The page cannot be displayed”

    a. Check the IP Address of the receiver. You may be using the wrong IP Address for the receiver.
    b. Check the Network settings on your PC. You may have the incorrect Network settings on your PC.
    c. Check the Ethernet cable for defects.
    d. Check the Receiver hardware or power supply.
    e. Try to ping the address from “Command Prompt.”
    f. Restart the browser and re-try to connect to the TX100 Terralite transmitter.
23. Login to the TX100 Terralite transmitter – User ID: user Password: user
    a. Potential login failures:
        1. Unknown password on the TX100 Terralite transmitter – reload to system defaults using a USB drive.
24. Go to the **Configuration** -> **Transmitter Slot** window and ensure the TX100 Terralite time slot setting.

Note: Ensure the TX100 Terralite numerical timeslots assignments are known and unique, as you test them one-by-one.

25. Verify the proper FCC license ID for US customers in the **Configuration** -> **FCC License** window.
26. Navigate to the **Signal View** window.
    a. If you cannot see the **Signal View** window, the required Java version could be missing on the PC connected to the IX100 Reference Station.
    b. Signal view displays but does not update: Receiver did not boot up properly: Check Diagnostics/Bootlog and verify “IX-100 Up and running”; Reboot Receiver; If fail, use USB to re-install receiver software.
    c. Verify the following information on the **Signal View** window:
        1. The XPS Navigation Solution displays “GPS Fixed” in green highlight for both antennas. See *Figure 10-3* item number 1.

Note: The XPS Navigation Solution for each antenna will follow a sequence of modes. “GPS Fixed” in green is the final mode. The mode will follow this sequence: (1) “Connecting”, up to 2 minutes; (2) “Autonomous” in red, up to 1 minute; (3) “GPS Float” in yellow, up to 20 minutes; and finally, “GPS Fixed” in green.

Problem: No GPS Fixed mode on either or both antennas.

a Check the antenna connection, for antenna malfunction and for cable malfunction.

The Latitude, Longitude, and Altitude measurements exist (non-zero) and the values are updating at roughly 1Hz. The values of these numbers typically change in the fourth place after the decimal (10,000ths) for the Latitude and Longitude measurements, and typically change in the units place for the altitude measurement.

Problem: No LLA displayed - See debug for “Autonomous Mode” above.

Note: The GPS L1/L2 Signals (see *Figure 10-3* item number 3) should be greater than 20 for at least 5 satellites for one-half hour.

Problem: L1 and L2 signal levels are lower than required.

Problem: L2 signal levels are much lower than L1.

1 Check for an antenna or cable malfunction.

Note: The AX100 Antenna is not a field serviceable unit. If it fails, return it to Novariant for repair or replacement.

Problem: Fewer than 5 satellites have adequate signal strength.

1 The TX100 Terralite location may have inadequate view of sky. Consider re-locating TX100 Terralite.

a Look for reference station signals. See *Figure 10-3* item number 8.

1 No Reference station signals – check RTK antenna on the IX100 Reference Station.

2 Check the configuration – possible differential radio configuration problem – contact support for reconfiguration.

3 Try a second Terralite to eliminate the Terralite as the defective side of the radio link.

b Look for evidence of the IX100 Reference Station receiving the TX100 Terralite signal in the correct time slot.

1 Check **Signal View** window – Ensure there is XPS signal level in the correct time slot display – signal strength and AGC should be greater than 100 (see *Figure 10-3* item number 6) and signal display should have orange and green bars (see *Figure 10-3* item number 9).

Note: The XPS signal level and AGC will always be zero. The value is zero because the TX100 Terralites do not receive signals from other TX100 Terralites. See Figure 10-3 item number 7.

2 Check oscillator value (-299 +/- 2) (check on **Signal View** window) See *Figure 10-4* item number 5)

3 If there is no signal in TX100 Terralite time slot – check the TX100 Terralite time slot configuration.

4 Check connection to the helical antenna (cable).

5 Ensure the Pulse cable is connected (open the TX100 Terralite backplate to verify the connection).

Figure 10-3 TX100 Terralite Transmitter Signal View Window (upper portion)

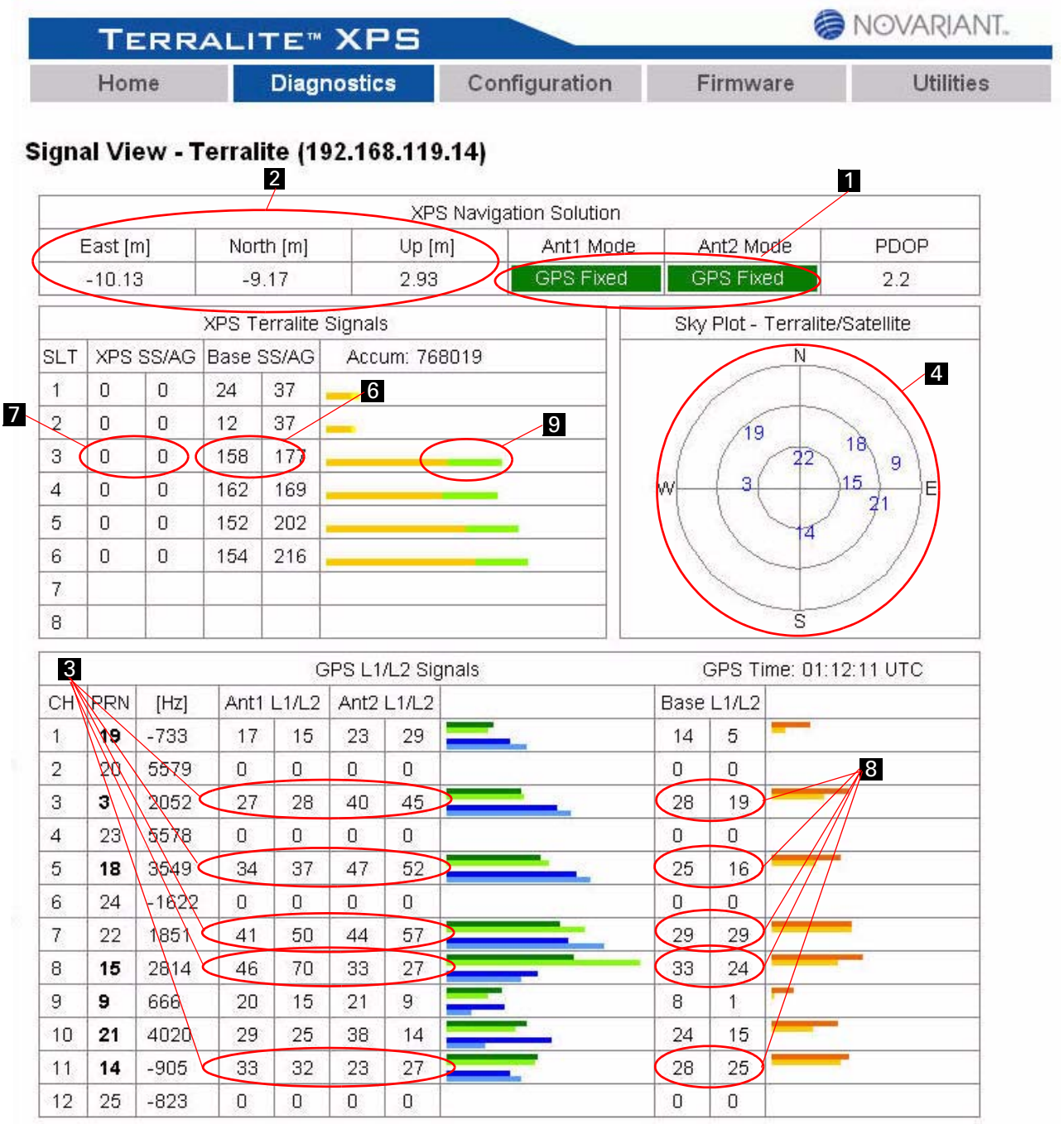
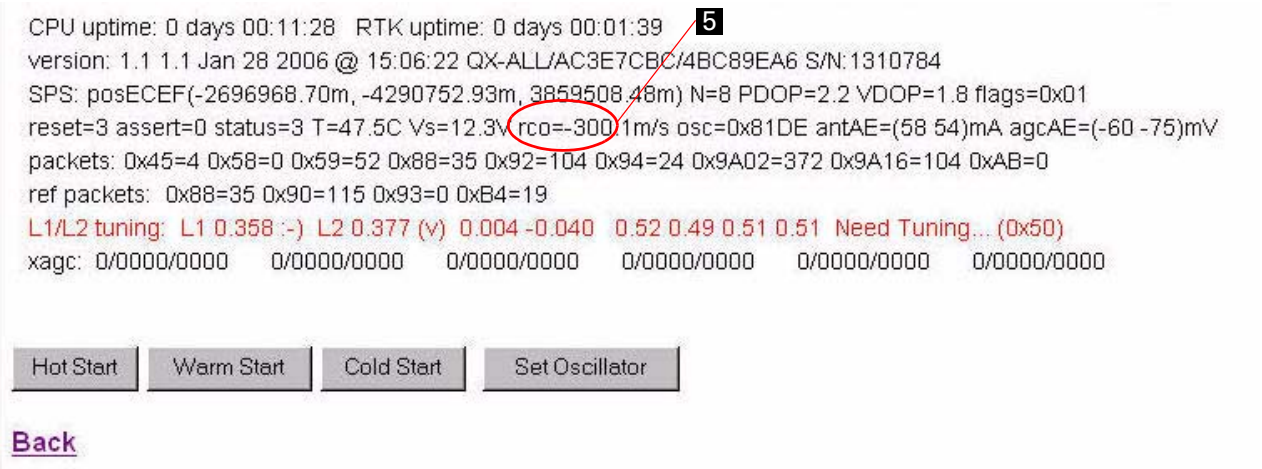


Figure 10-4 TX100 Terralite Transmitter Signal View Window (lower portion)



27. Disconnect the PC connection from the TX100 Terralite.
28. Connect the wireless radio to the TX100 Terralite.
29. Test the wireless connection to the TX100 Terralite.
30. Repeat *Step 17.* through *Step 29.* for each subsequent Terralite transmitter.
31. If the tests have failed at this point, contact a Novariant representative to return the unit for repair.

Field Installation

1. Get the maximum number of components into a transfer vehicle for delivery to the installation locations within the mine.
2. Take the Reference Station equipment to the selected location.
3. Set up the Reference Station in accordance with the steps listed in the Bench Test section. *Step 4.* to *Step 16.*
4. Initiate the installation process for each TX100 Terralite location.
5. Repeat the steps listed in the Bench Test section. Repeat *Step 17.* through *Step 29.* for each TX100 Terralite.
6. Perform a commissioning test to validate the overall system functionality.

Additional Installation Criteria

1. Place the TX100 Terralites in according to the previously performed mine assessment.
2. Connect the solar panel array to the Terralites.

Note: Check the TX100 Terralite reception at the IX100 Reference Station by connecting via a wireless connection. The IX100 Reference Station should show the reception of all the TX100 Terralite signals as shown in *Figure 10-1* item number 9. On the IX100 Reference Station only, both columns display the same signal value, as demonstrated in *Figure 10-1* item number 6 and *Figure 10-1 item number 8.* The signal bars show orange and green and yellow and green colors when the signals are locked. *See Figure 10-3* item number 9.

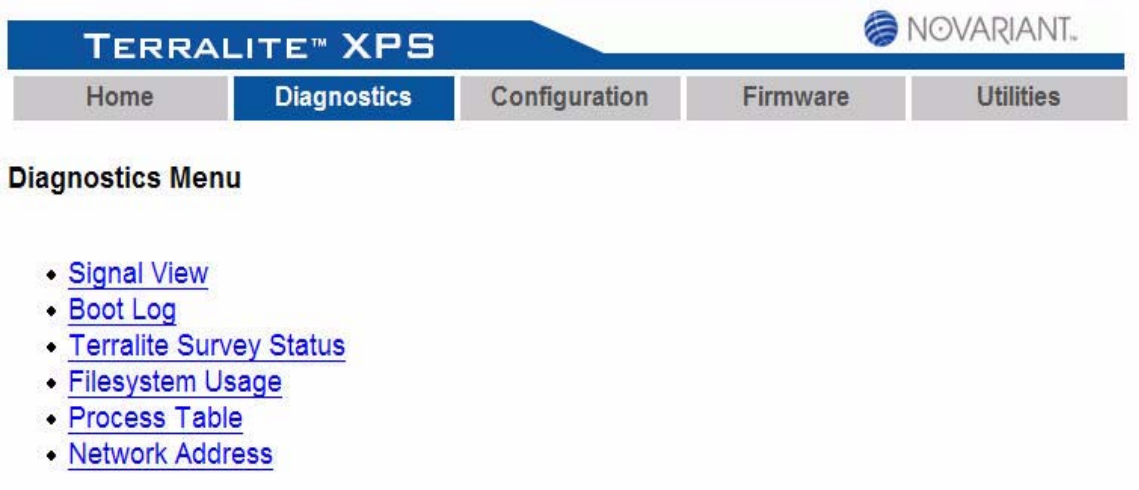
IX100 Reference Station Configuration Software GUI Description

This **IX100 Reference Station Configuration Software GUI Description** chapter provides the functions and commands you'll use to interact with the IX100 Receiver. *Figure 11-1* shows the **Main/Diagnostics** window of the IX100 Receiver Configuration Software.

The **Main/Diagnostics** window in the **IX100 Reference Station Configuration Software** application contains links to the following sub-windows:

- *Main/Diagnostics Window*
  - *Signal View Window*
  - *Terralite Survey Status Window*
  - *Network Address Window*
- *Configuration Window*
  - *Network IP Address Window*
  - *Base Station Position Window*
  - *Serial Port Window*
  - *Differential Correction Window*
  - *Position Output Window*
  - *Diagnostic Radio Window*
  - *Set Elevation Mask Window*
  - *Set PDOP Mask Window*
  - *Data Logging Window*
- *Firmware Window*
  - *Firmware Upgrade*
  - *Utilities Window*
- *Utilities Window*
  - *Reboot Receiver Window*
  - *User Login Password Window*
  - *NMEA Ping File Window*

Figure 11-1 Main Window



The **Main/Diagnostics** window contains the following components:

- *Configuration Window* link – Navigates to the **Configuration** window.
- *Firmware Window* link – Navigates to the **Firmware** window.
- *Utilities Window* link – Navigates to the **Utilities** window.
- *Signal View Window* link – Navigates to the **Signal View** window.
- *Terralite Survey Status Window* – Navigates to the **Terralite Survey Status** window.
- *Network Address Window* link – Navigates to the **Network Address** window.

Main/Diagnostics Window

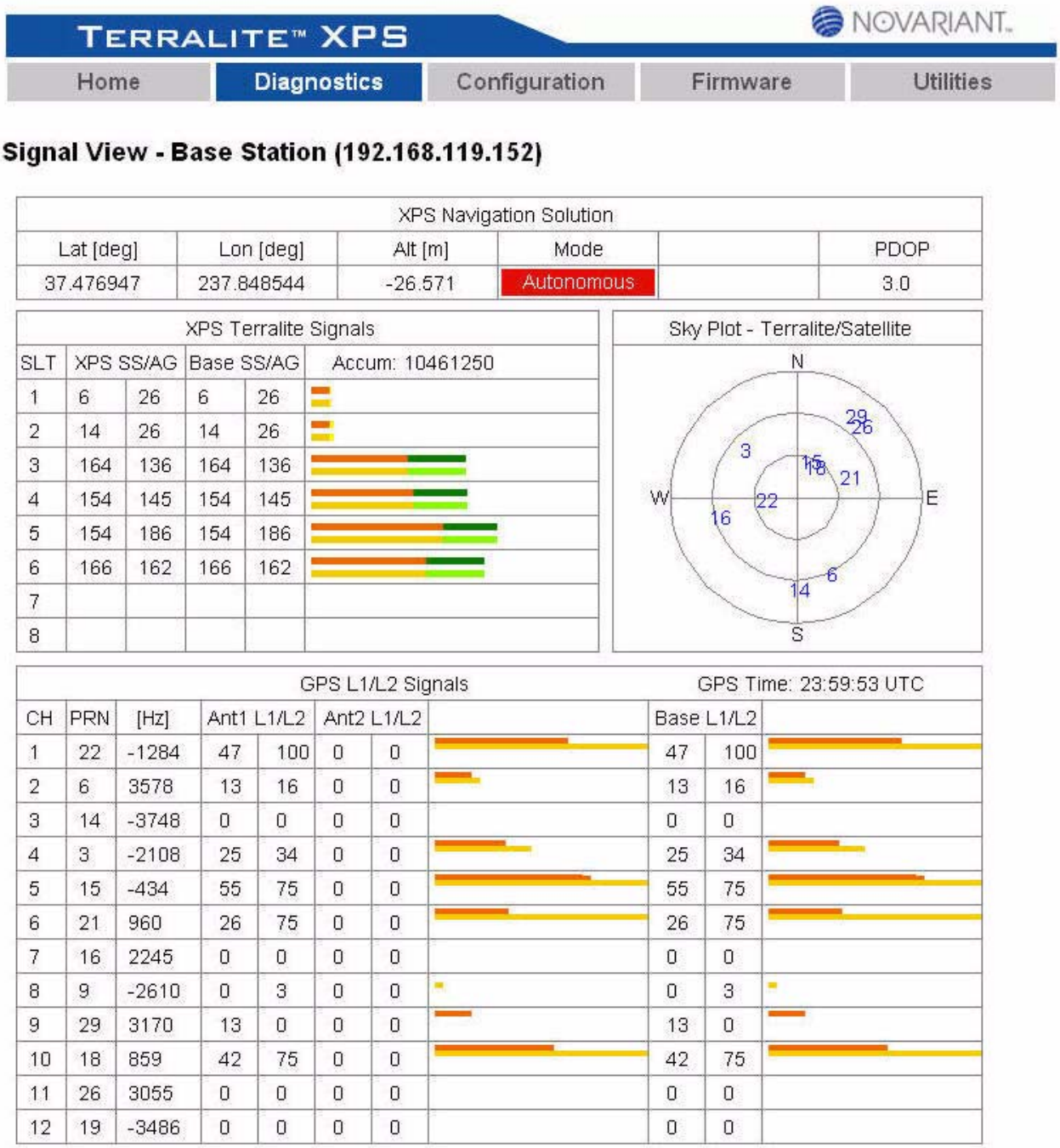
The **Diagnostic** window provides access to the diagnostic functions of the Configuration software and acts as the home page. The diagnostic functions provided within the Configuration software are accessed through the following windows:

- *Signal View Window*
- *Terralite Survey Status Window*
- *Network Address Window*

Signal View Window

The **Signal View** window provides access to satellite, IX100 Reference Station and TX100 Terralite™ Transmitter positioning data. *Figure 11-2* and *Figure 11-3* show the various **Signal View** windows for the IX100 Receiver.

Figure 11-2 IX100 Reference Station Signal View Window (upper portion)

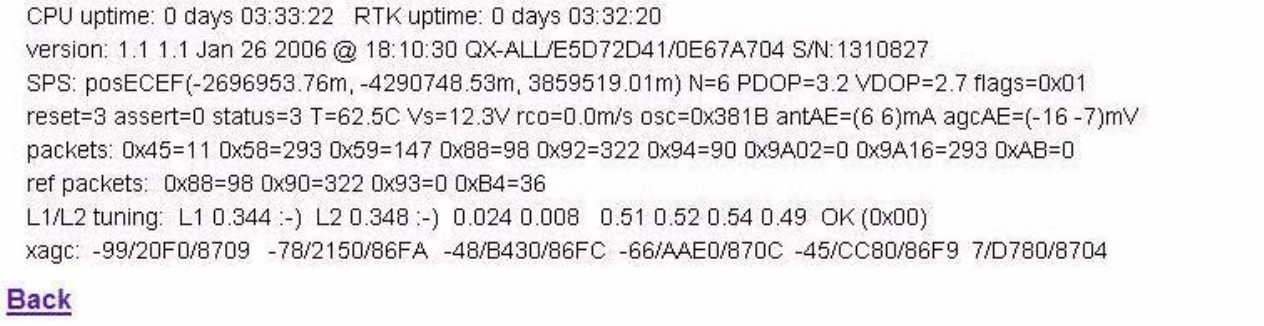


The **IX100 Reference Station Signal View** (upper portion) window contains the following components:

- **XPS Navigation Solution**
  - **Lat [deg]** display – The Reference Station Latitude measurement updated at a 1Hz rate.
  - **Lon[deg]** display – The Reference Station Longitude measurement updated at a 1Hz rate.
  - **Alt [m]** display – The Reference Station Altitude measurement updated at a 1Hz rate.
  - **PDOP** display – The current Position Dilution of Precision value.

- **XPS Terralite Signals**
  - **SLT** display – The assigned TX100 Terralite™ Transmitter slot number.
  - **XPS SS** display – XPS signal strength.
  - **XPS AG** display – XPS auto gain control values.
  - **Base SS** display – IX100 Reference Station signal strength.
  - **Base AG** display – IX100 Reference Station auto gain control values.
  - **Accum:** display – Accumulated data counter, incremented approximately1086 per second.
  - **Signal Strength** bar chart displays – XPS and IX100 Reference Station signal strength graphical display.
- **Sky Plot Terralite/Satellite** chart display – Shows the TX100 Terralite Transmitter and Satellite ID and positions.
- **GPS L1/L2 Signals**
  - **CH** display – The receiver channel assigned to a specific satellite.
  - **PRN** display – The number of the satellite providing GPS signals.
  - **Hz** display – The satellite doppler frequency.
  - **Ant 1 Signal Strength**
    - **L1** display – The L1 signal strength from antenna number 1.
    - **L2** display – The L2 signal strength from antenna number 1.
  - **Ant 2 Signal Strength**
    - **L1** display – The L1 signal strength from antenna number 2.
    - **L2** display – The L2 signal strength from antenna number 2.
  - **Antenna Signal Strength** bar chart displays –
  - **Base Signal Strength**
    - **L1** display – The strength of the signal from the IX100 Reference Station L1 antenna.
    - **L2** display – The strength of the signal from the IX100 Reference Station L2 antenna.
  - **Base Signal Strength** bar chart displays – The strength of the signal from the IX100 Reference Station.

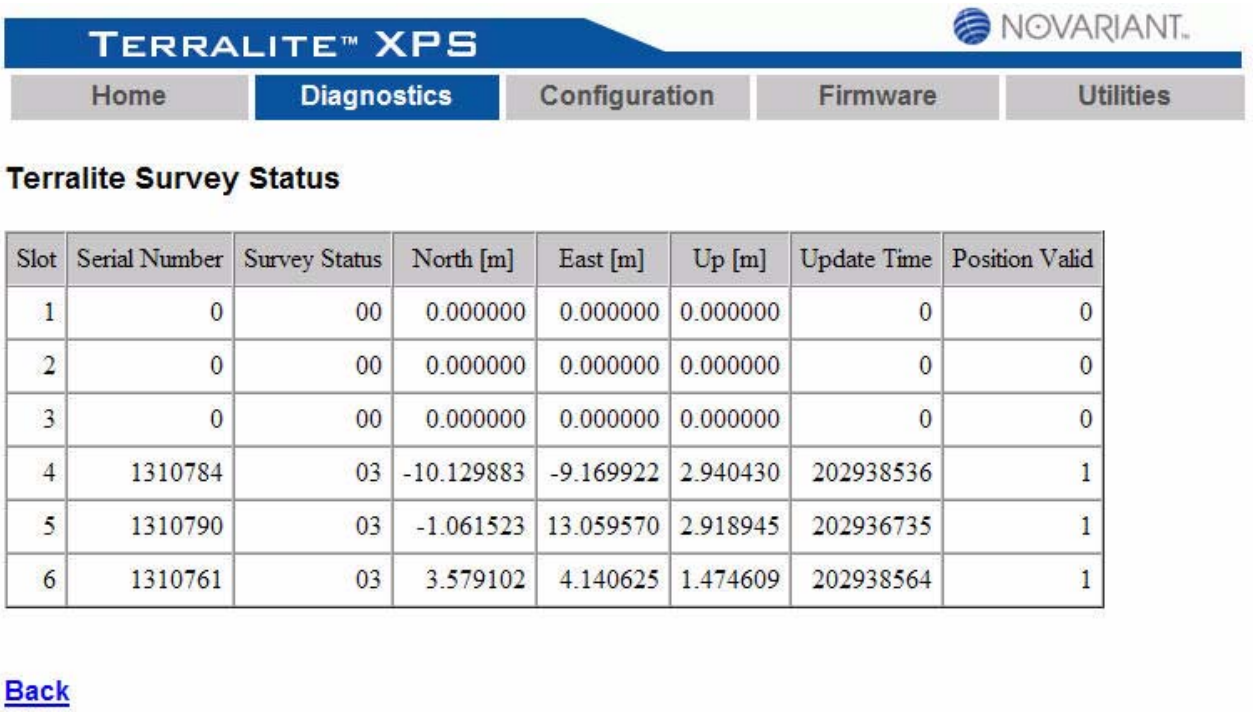
Figure 11-3 IX100 Reference Station Signal View Window (lower portion)



Note: *Figure 11-3* provides information for factory and support personnel.

Terralite Survey Status Window

Figure 11-4 Terralite Survey Status Window



Slot	Serial Number	Survey Status	North [m]	East [m]	Up [m]	Update Time	Position Valid
1	0	00	0.000000	0.000000	0.000000	0	0
2	0	00	0.000000	0.000000	0.000000	0	0
3	0	00	0.000000	0.000000	0.000000	0	0
4	1310784	03	-10.129883	-9.169922	2.940430	202938536	1
5	1310790	03	-1.061523	13.059570	2.918945	202936735	1
6	1310761	03	3.579102	4.140625	1.474609	202938564	1

The **Terralite Survey Status** window contains the following components:

- Slot – Terralite time slot assignment.
- Serial Number – Terralite serial number.
- Survey Status – Survey indicator, 3 indicates completed survey. 1 or 2 indicates only one of the antennas has completed the survey.
- North [m] – Distance (in meters) the TX100 Terralite is located North of the IX100 Reference Station.

Note: A negative value indicates a position south of the IX100 Reference Station.

- East [m} – Distance (in meters) the TX100 Terralite is located East of the IX100 Reference Station.

Note: A negative value indicates a position west of the IX100 Reference Station.

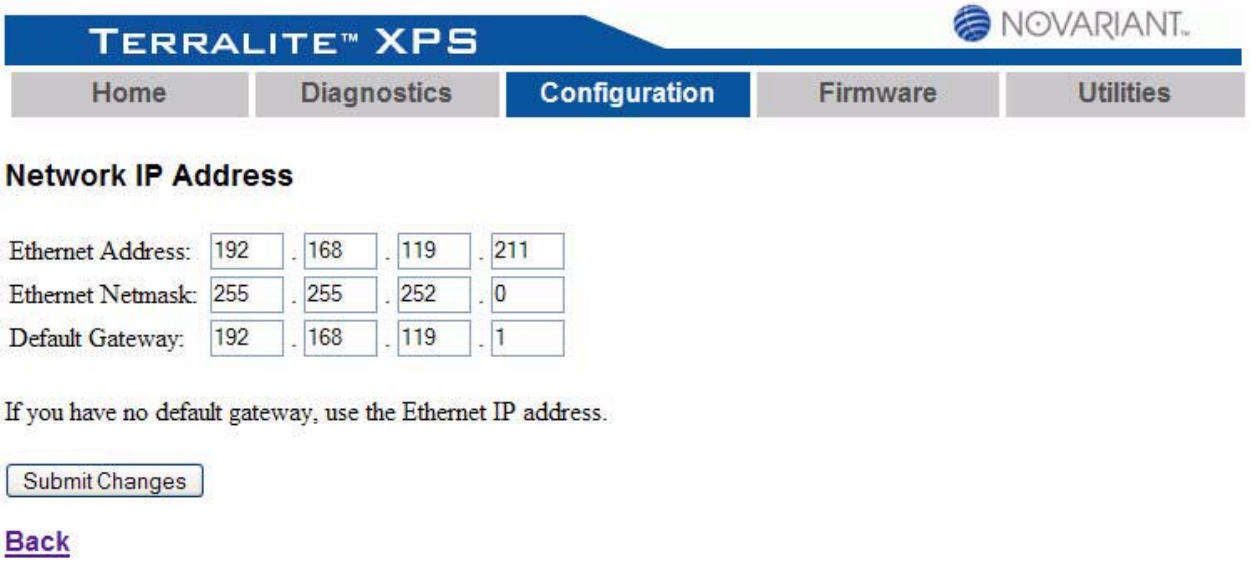
- Up [m] – Distance (in meters) the TX100 Terralite is located vertically of the IX100 Reference Station.

Note: A negative value indicates the IX100 Reference Station has a higher altitude than the TX100 Terralite.

- Update Time – GPS Time of Millennium (GPS Week(0-1023) x 604800 + GPS Time of Week(0-604800)).
- Position Valid – Status bit. If the survey is complete, the value is one (1).

Network Address Window

Figure 11-5 Network Address Window



The **Network Address** window contains the following components:

- **eth0** display – Provides Ethernet 0 configuration and status data.
- **eth0 Down** button – Disables Ethernet 0.
- **eth0 up** button – Enables Ethernet 0.

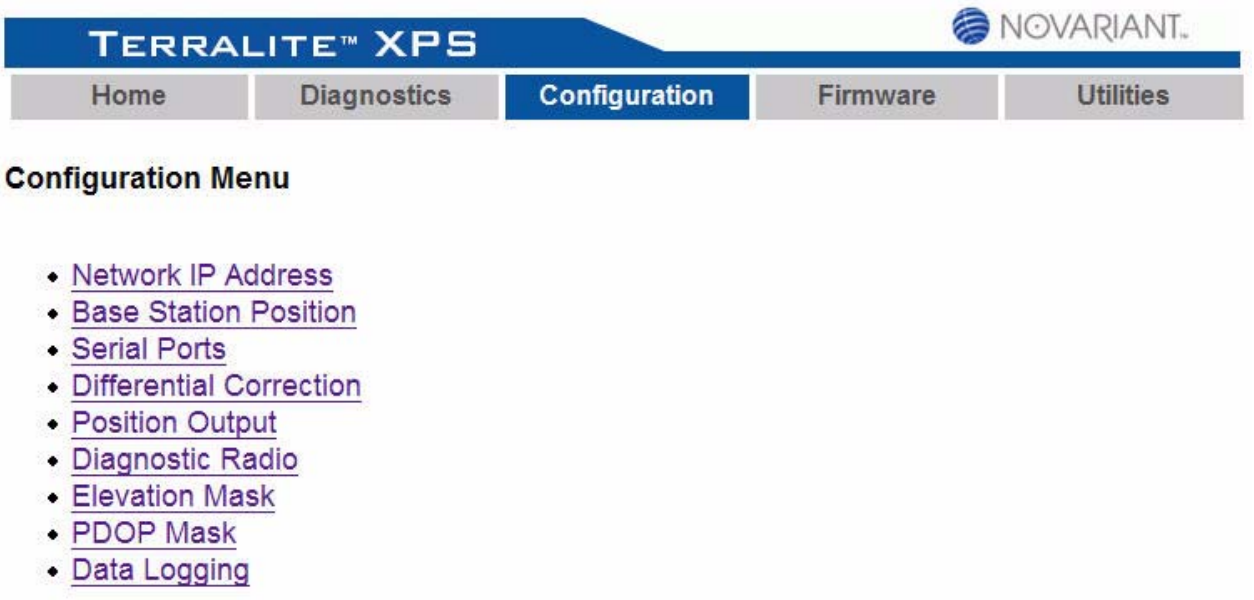
The Phase Dump window contains the following components:

- **Filename** field – Input field for the file to be used for phase dumping.
- **Start Dumping** button – Initiates the phase dumping process.
- **Back** button – Returns to the previous window.

Configuration Window

The **Configuration** window provides access to the application functions requiring performance and environmental setup. *Figure 11-6* shows the **Configuration** window.

Figure 11-6 IX100 Reference Station Configuration Window

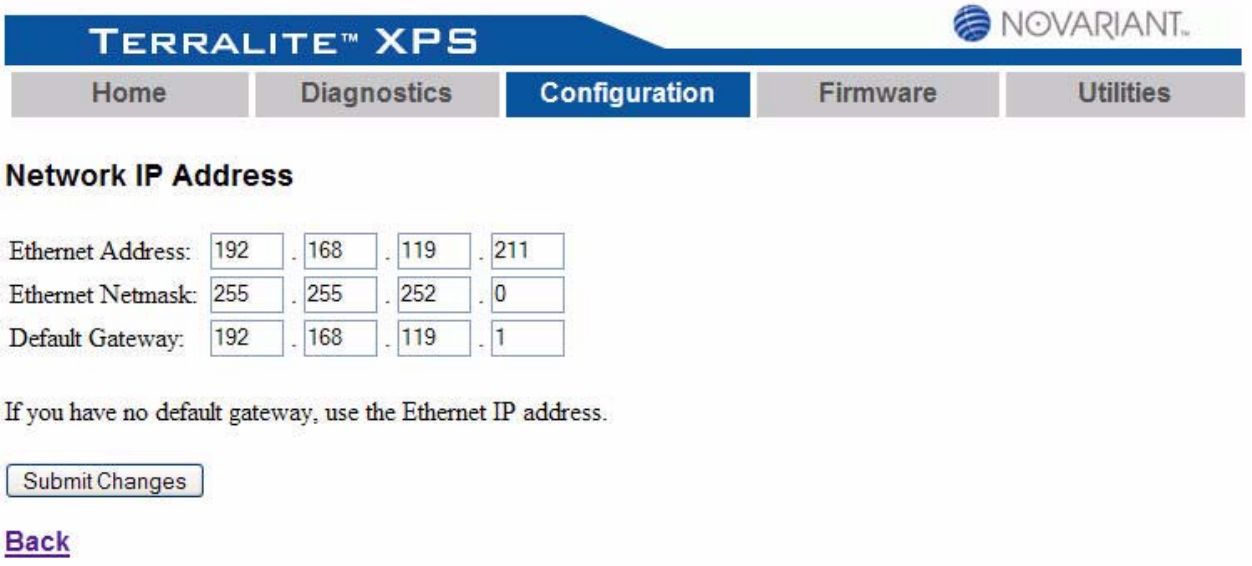


The **Configuration** window contains the following components:

- *Network IP Address Window* link – Enables configuration of the IP Address, Subnet Mask and default gateway settings.
- *Base Station Position Window* link – Enables access to the Base Station coordinate input fields.
- *Serial Port Window link* – Provides access to the serial port configuration functions.
- *Differential Correction Window* link – Enables access to the Differential port, protocol and location settings.
- *Position Output Window* link – Provides access to the IX100 output settings.
- *Diagnostic Radio Window* link – Enables access to the serial port selection function.
- *Set Elevation Mask Window* link – Provides access to the elevation mask configuration function.
- *Set PDOP Mask Window* link – Enables access to the PDOP mask settings.
- *Data Logging Window* link – Enables access to the Data Logging window.

Network IP Address Window

Figure 11-7 Network IP Address Window

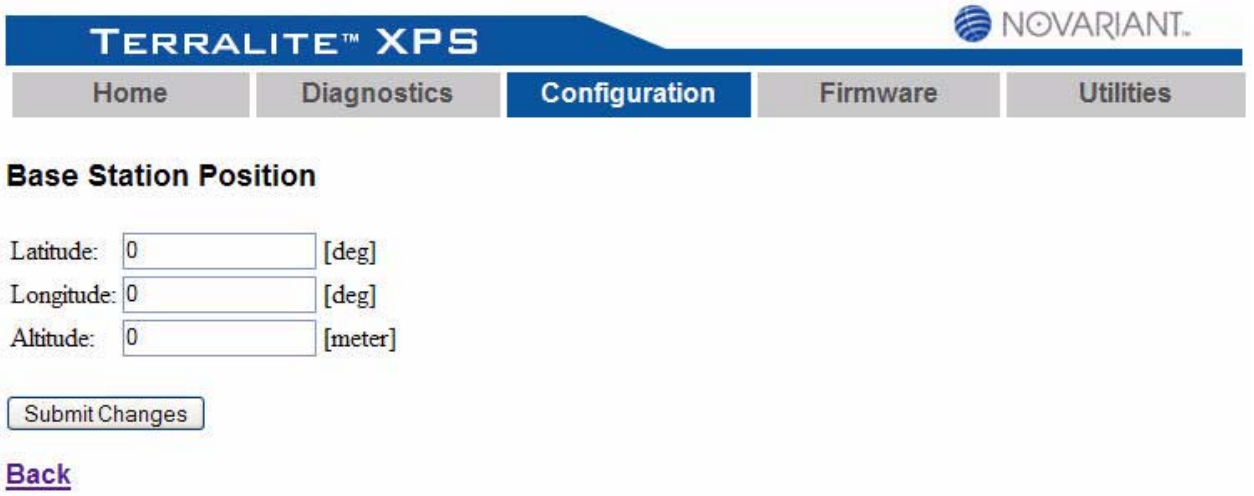


The **Network IP Address** window contains the following components:

- **Ethernet Address** fields – The unique number assigned to the receiver Ethernet network adapter defining its physical connection on the network.
- **Ethernet Netmask** fields – The subnet mask information used to inform the IP software which bits represent the network number and which bits represent the host number.
- **Default Gateway** fields – When used, it is the router used to forward all traffic that is not addressed to a node/computer within the local subnet.
- **Submit Changes** button – Saves the changes to the config file.
- **Back** link – Returns to the previous window.

Base Station Position Window

Figure 11-8 Base Station Position Window

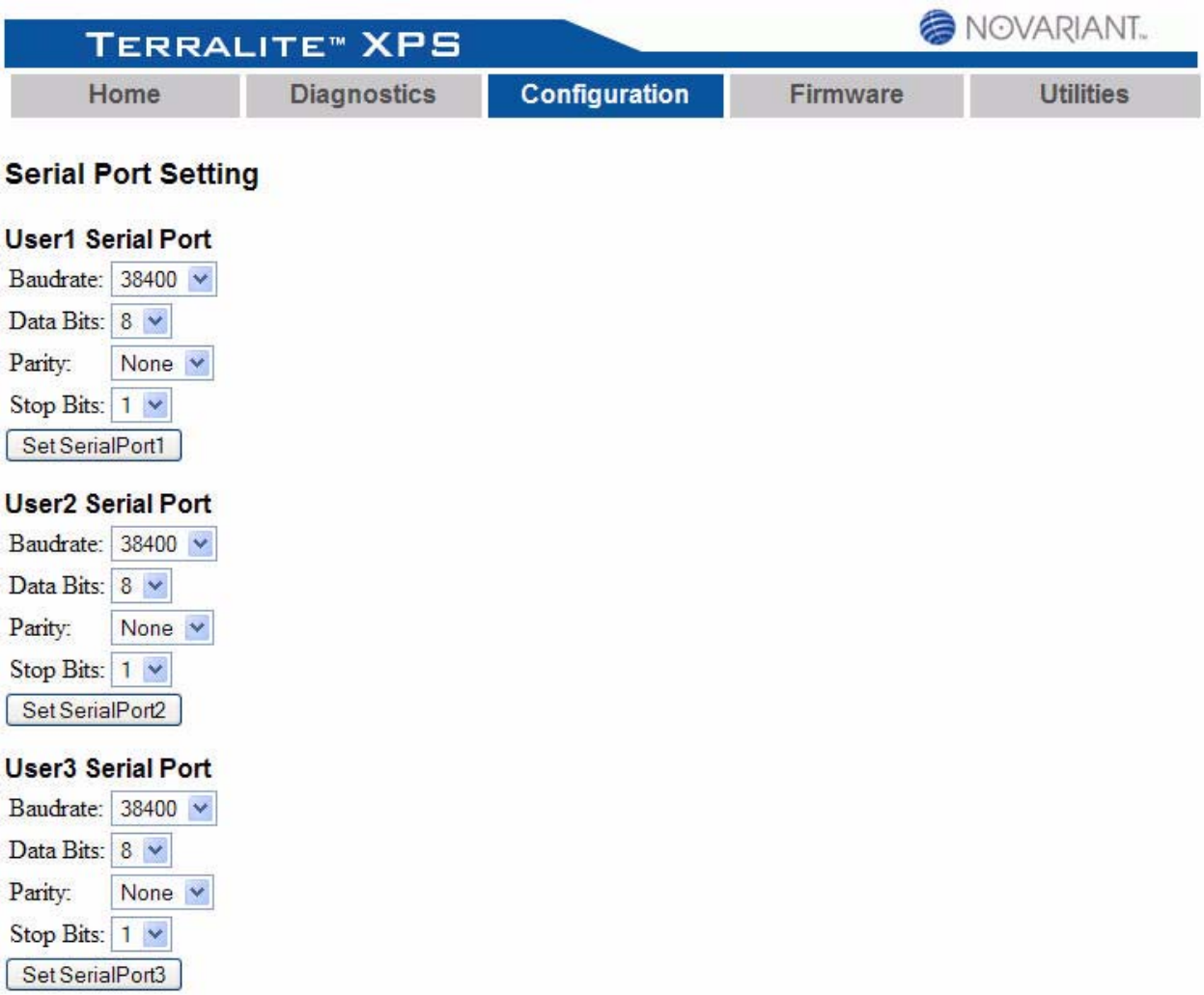


The **Base Station Position** window contains the following components:

- **Latitude** field – The Reference Station Latitude measurement updated at a 1Hz rate.
- **Longitude** field – The Reference Station longitude measurement updated at a 1Hz rate.
- **Altitude** field – The Reference Station altitude measurement updated at a 1Hz rate.
- **Submit Changes** button – Saves the changes to the config file.
- **Back** link – Returns to the previous window.

Serial Port Window

Figure 11-9 Serial Port Window



The **Serial Port** window contains the following components:

- Serial Port Settings

Note: The serial port functions are repeated identically for the three serial ports.

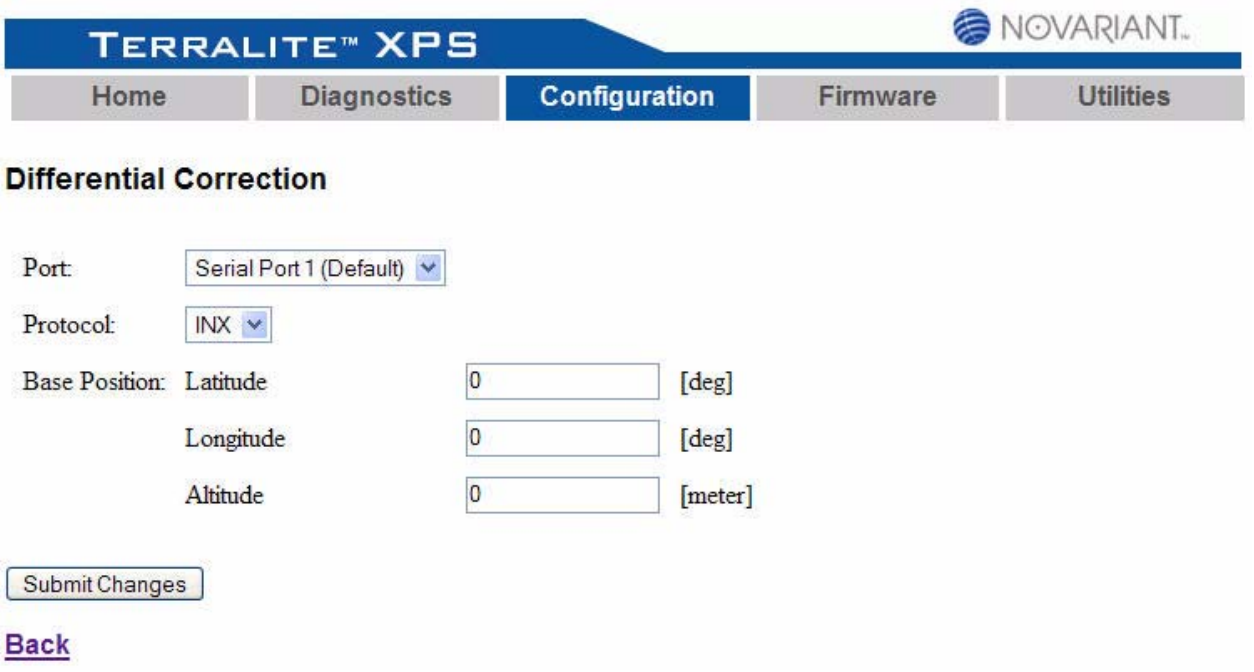
- **Port** drop-down menu – The receiver communication port.
- **Protocol** drop-down menu – The serial port data stream protocol.
- **Baudrate** drop-down menu – The serial port data transfer rate.
- **Parity** drop-down menu – The parity check on/off selection.
- **Stop Bits:** drop-down menu – asynchronous data delay bit settings.

- **Set Serial Port** button – sends the selected serial port settings to the configuration file.

- **Back** link – Returns to the previous window.

Differential Correction Window

Figure 11-10 Differential Correction Window



The **Set Elevation Mask** window contains the following components:

- **Port** drop-down menu – Enables the selection of the serial port used to transmit differential corrections.
- **Protocol** drop-down menu – Defines the differential correction data stream protocol.
- **Base Position Latitude** field – The Reference Station Latitude measurement updated at a 1Hz rate.
- **Base Position Longitude** field – The Reference Station Longitude measurement updated at a 1Hz rate.
- **Base Position Altitude** field – The Reference Station Altitude measurement updated at a 1Hz rate.
- **Submit Changes** button – Saves the changes to the configuration file.
- **Back** link – Returns to the previous window.

Position Output Window

Figure 11-11 IX100 Position Output Window

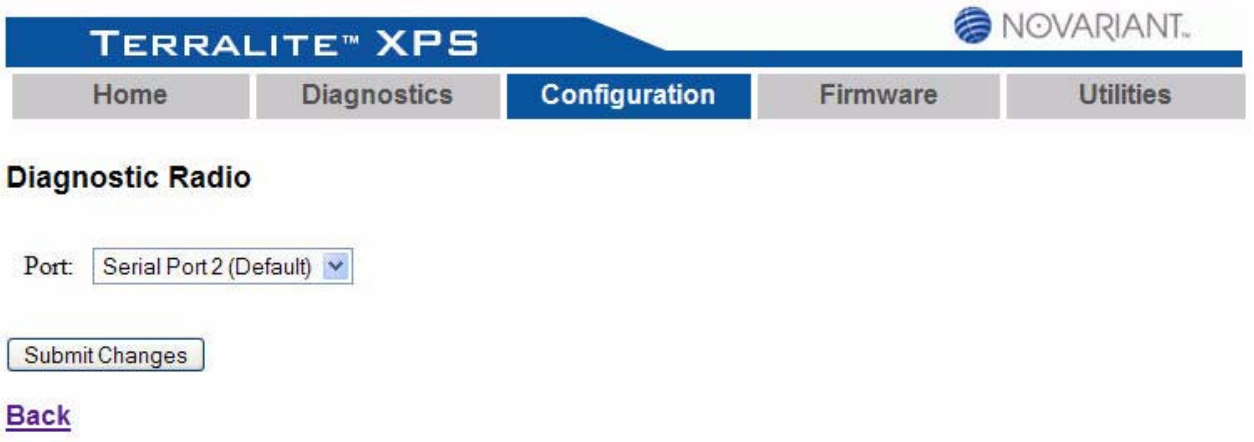
The **IX100 Position Output** window contains the following components:

- **Enable** radio button – Enables the differential correction radio output.
- **Disable** radio button – Disables the differential correction radio output.
- **Port** drop-down menu – Enables the serial port selection for the differential correction radio output.
- **Protocol** drop-down menu – Enables the selection of the differential correction radio protocol.
- **NMEA Output Format** drop-down menus
  - **GXP** drop-down menu – Sets the GXP message type output frequency which is providing position reporting combining satellite and TX100 Terralite Transmitter data.
  - **GST** drop-down menu – Sets the GST message type output frequency which is providing error estimates corresponding to the position report.
  - **GXA** drop-down menu – Sets the GSA message type output frequency which is providing DOP and tracking information regarding satellites and TX100 Terralite Transmitters used in the positional solution
  - **GXV** drop-down menu – Sets the GXV message type output frequency which is providing tracking and signal strength information for all available signals.
  - **GSV** drop-down menu – Sets the GSV message type output frequency which is providing tracking and signal strength information for all available signals. (Pre-XPS legacy systems)
- **Submit Changes** button – Saves the changes to the configuration file.

- **Back** link – Returns to the previous window.

Diagnostic Radio Window

Figure 11-12 IX100 Diagnostic Radio Window

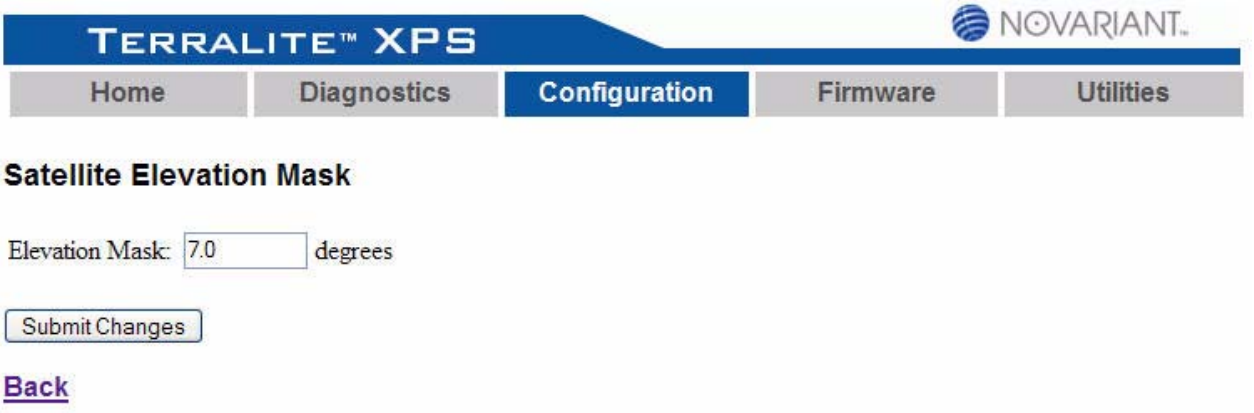


The **IX100 Diagnostic Radio** window contains the following components:

- **Port** drop-down menu – Serial port selection menu.
- **Submit Changes** button – Saves the changes to the configuration file.
- **Back** link – Returns to the previous window.

Set Elevation Mask Window

Figure 11-13 Set Elevation Mask Window

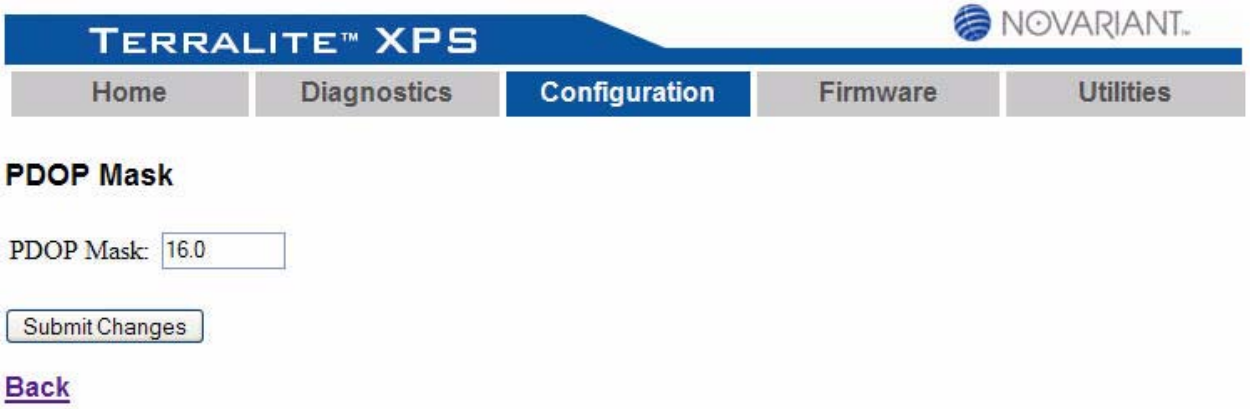


The **Set Elevation Mask** window contains the following components:

- **Elevation Mask** field – Sets the minimum elevation above the horizon that a receiver will track a satellite.
- **Submit Changes** button – Saves the changes to the configuration file.
- **Back** link – Returns to the previous window.

Set PDOP Mask Window

Figure 11-14 Set PDOP Mask Window

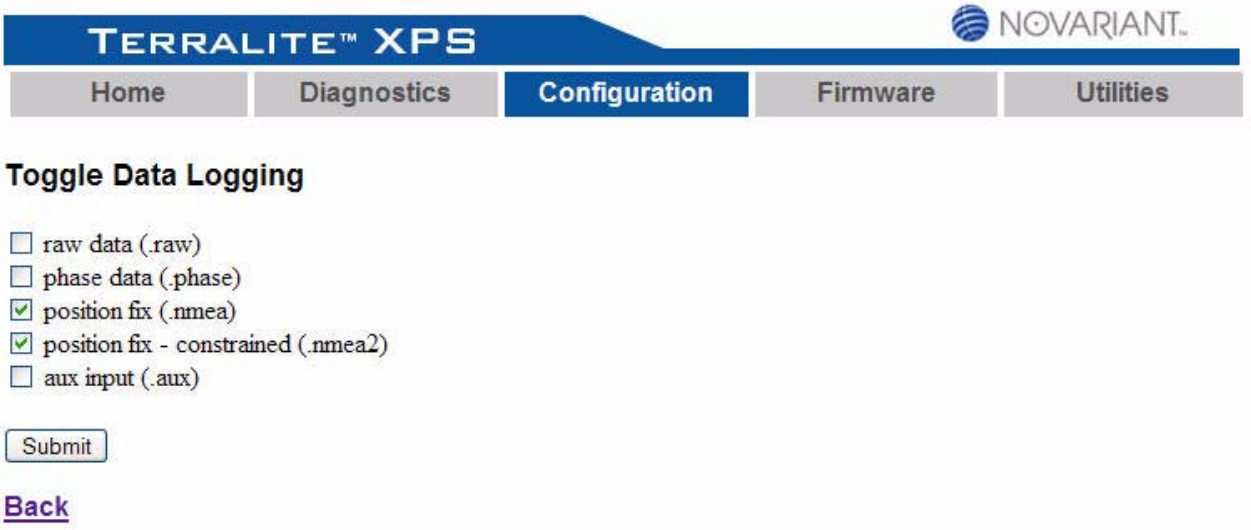


The **Set PDOP Mask** window contains the following components:

- **PDOP Mask** field – Enables the use of position data only within specified tolerances. The closer the PDOP value is to one (1), the better the geometry of the satellites the better the probability of positional accuracy.
- **Submit Changes** button – Saves the changes to the configuration file.
- **Back** link – Returns to the previous window.

Data Logging Window

Figure 11-15 Data Logging Window



The **Data Logging** window contains the following components:

- **Data Logging** checkboxes

Note: When the check boxes are checked, the data is logged into internal the Compact Flash disk (or into USB disk if CF is not mounted).

- **raw data (.raw)** checkbox – .raw file logs all the incoming data into RTK application in binary format.

Note: The naming convention is YYMMDD_HHMM.xxx. For example, 060213_2137.raw

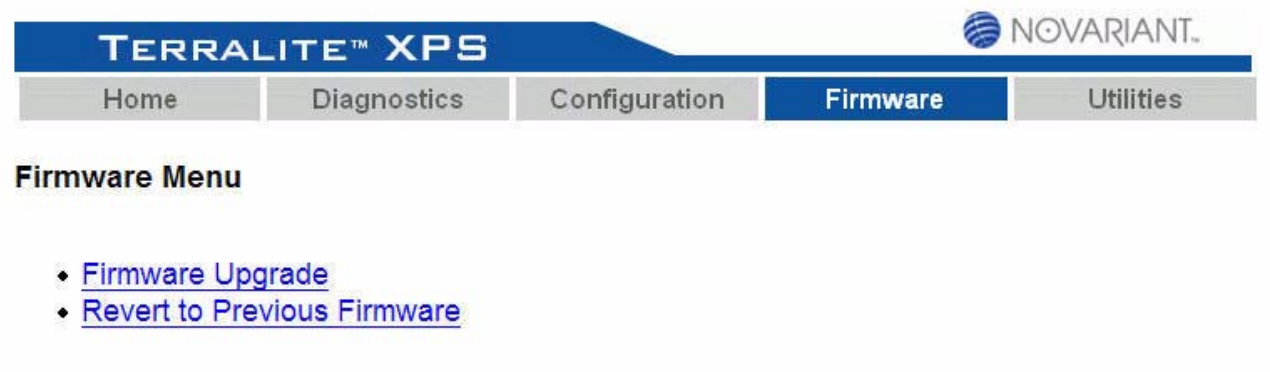
- **phase data (.phase)** checkbox – .phase file logs XPS code/carrier phase data in text format.
- **position fix (.nmea)** checkbox – .nmea file logs positioning output in the same format as NMEA output in "Position Output (Aux)" serial port.

Note: When a receiver is configured to output positioning in GSOF format in the serial port, the GUI displays ".gsof/.gsof2" instead of ".nmea/.nmea2".

- **position fix - constrained (.nmea2)** checkbox – .nmea2 file logs constrained positioning output, simulating limited satellite/terralite availability.
- **aux input (.aux)** checkbox – .aux file logs any incoming data stream from "Position Output (Aux)" serial port As Is.
- **Submit Changes** button – Saves the changes to the configuration file.
- **Back** link – Returns to the previous window.

Firmware Window

Figure 11-16 Firmware Window

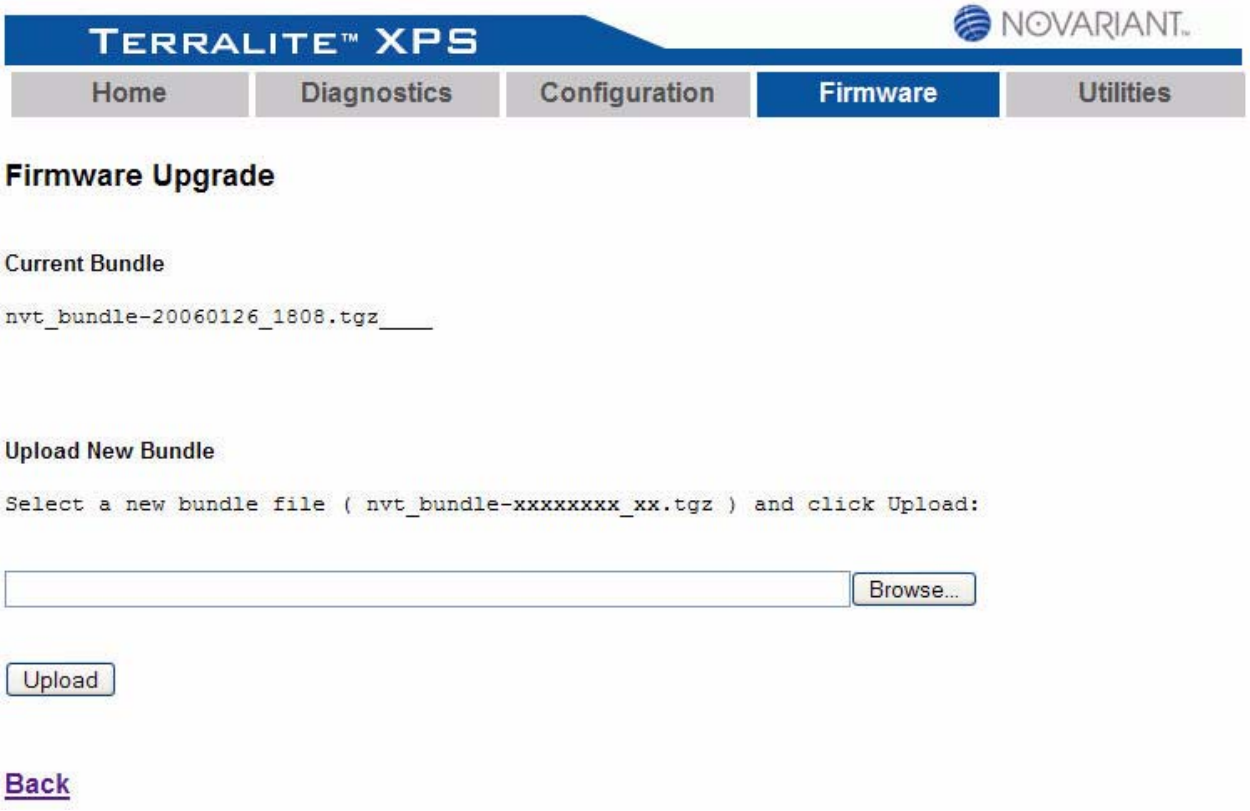


The **Firmware** window contains the following components:

- *Firmware Upgrade* link – Enables access to the **Firmware Upgrade** window.
- *Revert to Previous Firmware* link – Enable access to the **Revert to Previous Firmware** window.

Firmware Upgrade

Figure 11-17 Firmware Upgrade Window

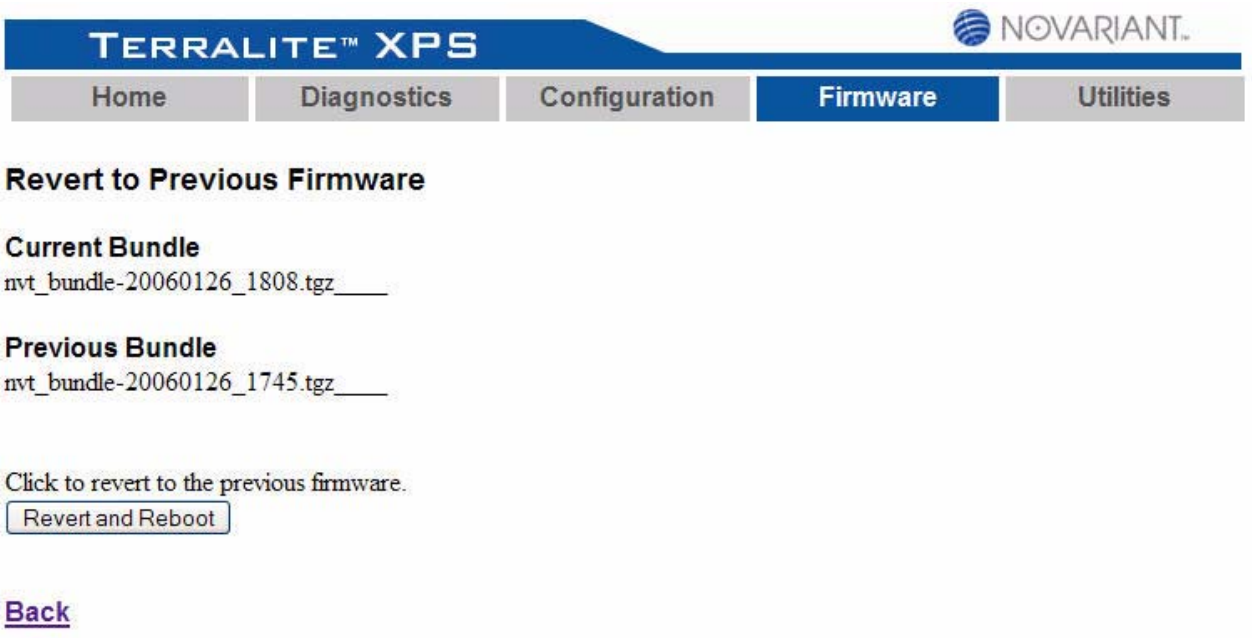


The **Firmware Upgrade** window contains the following components:

- **Current Bundle** display – Lists the current software bundle file name.
- **Upload New Bundle** input field – Enables bundle path and filename manual input.
- **Browse** button – Enables the search and insertion of a selected file from your files system or network.
- **Upload** button – Initiate the process to upload the selected file.
- **Back** link – Returns to the previous window.

Revert to Previous Firmware

Figure 11-18 Revert to Previous Firmware Window

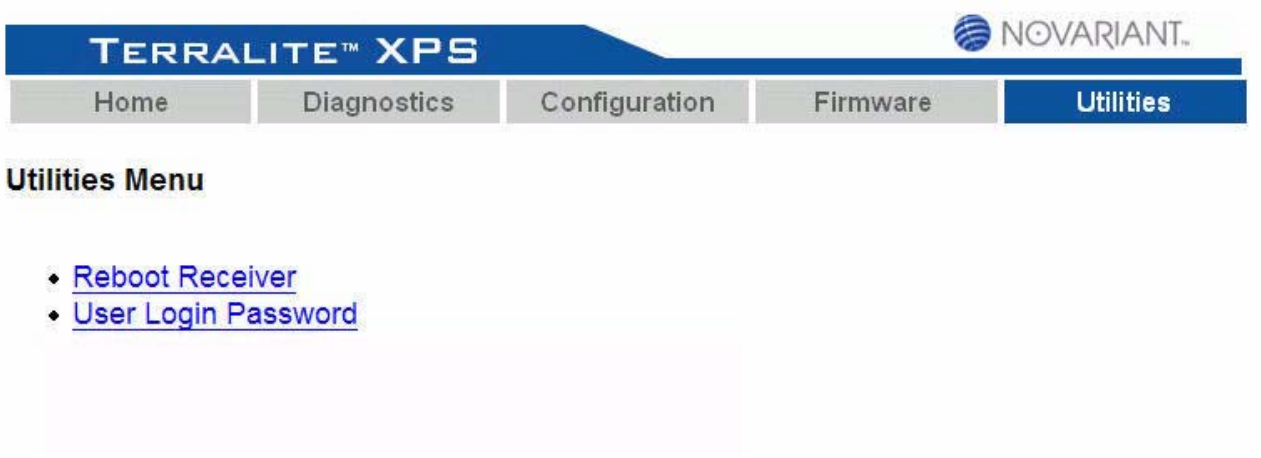


The **Revert to Previous Firmware** window contains the following components:

- **Current Bundle** display – Displays the current software bundle.
- **Previous Bundle** display – Displays the previously loaded software bundle.
- **Revert and Reboot** button – Returns to the previous software bundle version and reboots the receiver.
- **Back** link – Returns to the previous window.

Utilities Window

Figure 11-19 Utilities Menu Window

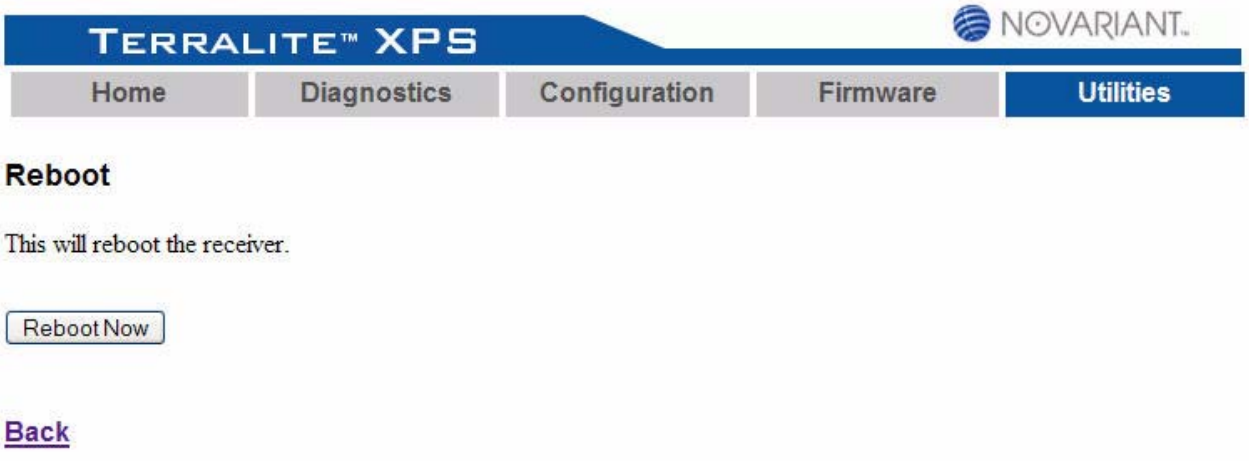


The **Utilities Menu** window contains the following components:

- *Reboot Receiver Window* link – Provides access to the receiver reboot function.
- *User Login Password Window* link – Enables a user to set a password.
- *NMEA Ping File Window* link – Provides access to download the NMEA ping file.

Reboot Receiver Window

Figure 11-20 Reboot Receiver Window

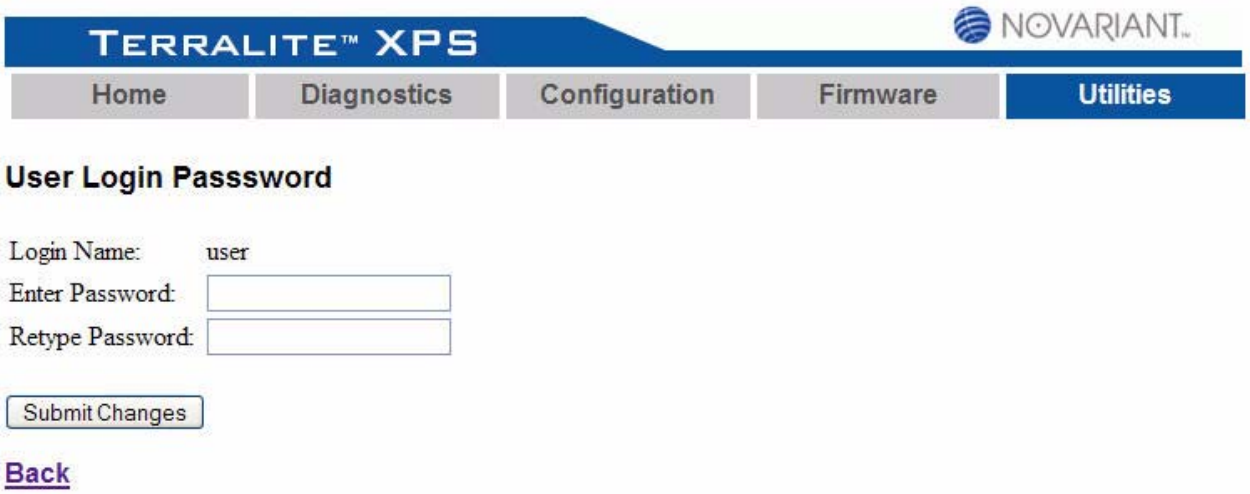


The **Reboot Receiver** window contains the following components:

- **Reboot Now** button – Restarts the receiver immediately.
- **Back** link – Returns to the previous window.

User Login Password Window

Figure 11-21 User Login Password Window



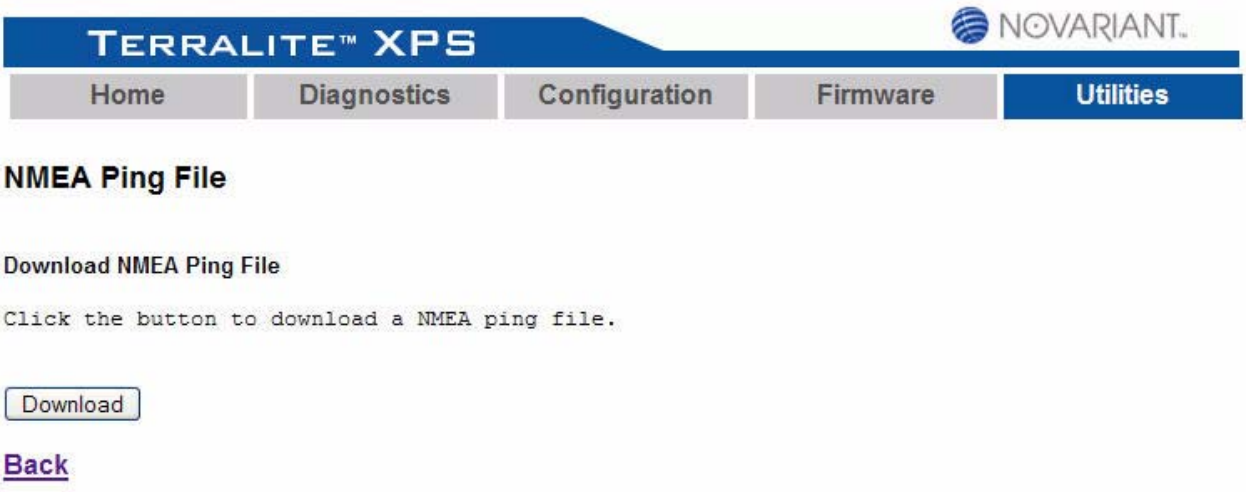
The **User Login Password** window contains the following components:

Note: The **IX100 Reference Station** is shipped with the following default user ID and password:
User: user
Password: user

- **Login Name** display – Displays the currently logged in user name.
- **Enter Password** field – Enables the data entry of your password.
- **Retype Password** field – Confirms the previously entered password.
- **Submit Changes** button – Saves the changes to the configuration file.
- **Back** link – Returns to the previous window.

NMEA Ping File Window

Figure 11-22 NMEA Ping File Window



The **NMEA Ping File** window contains the following components:

- **Download** button – Transfers the NMEA ping file.
- **Back** link – Returns to the previous window.

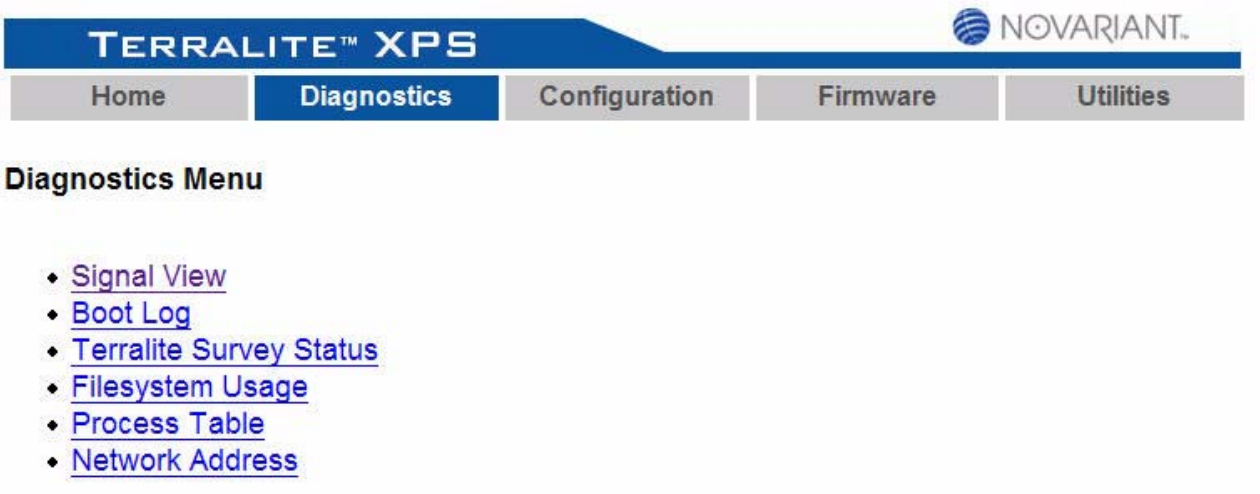
TX100 Terralite Transmitter Configuration Software GUI Description

This TX100 **Receiver Configuration GUI Description** chapter provides the functions and commands you'll use to interact with the TX100 Terralite system. *Figure 12-1* shows the **Main/Diagnostics** window of the TX100 Receiver Configuration Software.

The **TX100 Main/Diagnostics** window in the **Configuration Software** application contains links to the following sub-windows:

- *Main/Diagnostics Window*
  - *Signal View Window*
  - *Terralite Survey Status Window*
  - *Network Address Window*
- *Configuration Window*
  - Network IP Address Window
  - *Transmitter Slot Window*
  - *FCC License Window*
  - *Serial Port Window*
  - *Differential Correction Window*
  - *Position Output Window*
  - *Diagnostic Radio Link Window*
  - *Set Elevation Mask Window*
  - *Set PDOP Mask Window*
  - *Data Logging Window*
- *Firmware Window*
  - *Firmware Upgrade*
  - *Utilities Window*
- *Utilities Window*
  - *Reboot Receiver Window*
  - *User Login Password Window*
  - *NMEA Ping File Window*

Figure 12-1 Main Window



The **Main/Diagnostics** window contains the following components:

- *Configuration Window* link – Navigates to the **Configuration** window.
- *Firmware Window* link – Navigates to the **Firmware** window.
- *Utilities Window* link – Navigates to the **Utilities** window.
- *Signal View Window* link – Navigates to the **Signal View** window.
- *Terralite Survey Status Window* – Navigates to the **Terralite Survey Status** window.
- *Network Address Window* link – Navigates to the **Network Address** window.

Main/Diagnostics Window

The **Diagnostic** window provides access to the diagnostic functions of the Configuration software and acts as the home page. The diagnostic functions provided within the Configuration software are accessed through the following windows:

- *Signal View Window*
- *Terralite Survey Status Window*
- *Network Address Window*

Signal View Window

The **Signal View** window provides access to satellite, IX100 Reference Station and TX100 Terralite™ Transmitter positioning data. *Figure 12-2* and *Figure 12-3* show the various **Signal View** windows for the various GPS positioning infrastructure components.

Figure 12-2 TX100 Terralite Signal View Window (upper portion)

TERRALITE™ XPS — NOVARIANT.

Home | Diagnostics | Configuration | Firmware | Utilities

Signal View - Terralite (192.168.119.14)

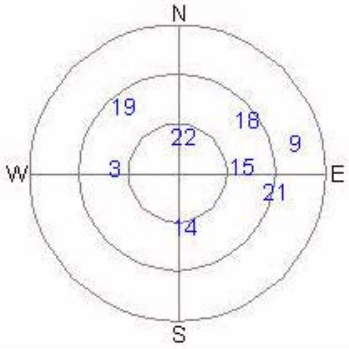
XPS Navigation Solution

East [m]	North [m]	Up [m]	Ant1 Mode	Ant2 Mode	PDOP
-10.13	-9.17	2.93	GPS Fixed	GPS Fixed	2.2

XPS Terralite Signals

SLT	XPS SS/AG		Base SS/AG		Accum: 768019
1	0	0	24	37	
2	0	0	12	37	
3	0	0	158	177	
4	0	0	162	169	
5	0	0	152	202	
6	0	0	154	216	
7					
8					

Sky Plot - Terralite/Satellite



GPS L1/L2 Signals — GPS Time: 01:12:11 UTC

CH	PRN	[Hz]	Ant1 L1/L2		Ant2 L1/L2			Base L1/L2	
1	**19**	-733	17	15	23	29		14	5
2	20	5579	0	0	0	0		0	0
3	**3**	2052	27	28	40	45		28	19
4	23	5578	0	0	0	0		0	0
5	**18**	3549	34	37	47	52		25	16
6	24	-1622	0	0	0	0		0	0
7	22	1851	41	50	44	57		29	29
8	**15**	2814	46	70	33	27		33	24
9	**9**	666	20	15	21	9		8	1
10	**21**	4020	29	25	38	14		24	15
11	**14**	-905	33	32	23	27		28	25
12	25	-823	0	0	0	0		0	0

The **TX100 Terralite Signal View** (upper portion) window contains the following components:

- **XPS Navigation Solution**
  - **East [m]** display – Distance (in meters) the TX1000 Terralite transmitter is located East of the IX100 Reference Station.

Note: A negative number in the **East [m]** field indicates the Terralite is West of the IX100 Reference Station.

- **North [m]** display – Distance (in meters) the TX1000 Terralite transmitter is located North of the IX100 Reference Station.

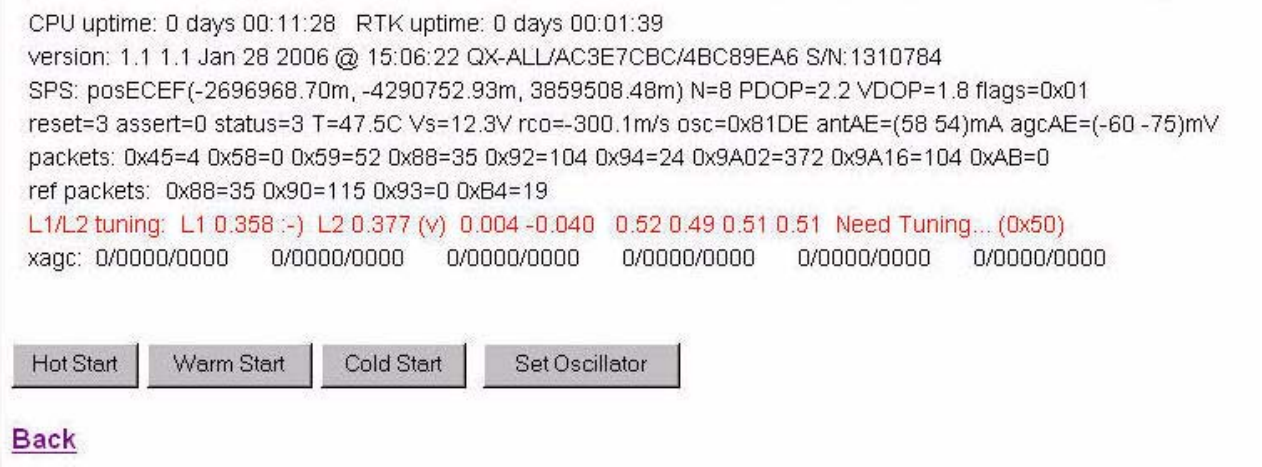
Note: A negative number in the **North [m]** field indicates the Terralite is South of the IX100 Reference Station.

- **Up [m]** display – Distance (in meters) the TX1000 Terralite transmitter is located vertically the IX100 Reference Station.

Note: A negative number in the **Up [m]** field indicates the Terralite is vertically lower in relationship to the IX100 Reference Station.

  - **PDOP** display – The current Position Dilution of Precision value.
  - **Flags** display – QX software status flags.
- **XPS Terralite Signals**
  - **SLT** display – The assigned TX100 Terralite™ Transmitter slot number.
  - **XPS SS** display – XPS signal strength.
  - **XPS AG** display – XPS auto gain control values.
  - **Base SS** display – IX100 Reference Station signal strength.
  - **Base AG** display – IX100 Reference Station auto gain control values.
  - **Accum:** display – Accumulated data counter, incremented approximately1086 per second.
  - **Signal Strength** bar chart displays – XPS and IX100 Reference Station signal strength graphical display.
- **Sky Plot Terralite/Satellite** chart display – Shows the TX100 Terralite Transmitter and Satellite ID and positions.
- **GPS L1/L2 Signals**
  - **CH** display – The receiver channel assigned to a specific satellite.
  - **PRN** display – The number of the satellite providing GPS signals.
  - **Hz** display – The satellite doppler frequency.
  - **Ant 1 Signal Strength**
    - **L1** display – The L1 signal strength from antenna number 1.
    - **L2** display – The L2 signal strength from antenna number 1.
  - **Ant 2 Signal Strength**
    - **L1** display – The L1 signal strength from antenna number 2.
    - **L2** display – The L2 signal strength from antenna number 2.
  - **Antenna Signal Strength** bar chart displays –
  - **Base Signal Strength**
    - **L1** display – The strength of the signal from the IX100 Reference Station L1 antenna.
    - **L2** display – The strength of the signal from the IX100 Reference Station L2 antenna.
  - **Base Signal Strength** bar chart displays – The strength of the signal from the IX100 Reference Station.

Figure 12-3 TX100 Terralite Signal View Window (lower portion)



Note: *Figure 12-3* provides information for factory and support personnel.

Terralite Survey Status Window

Figure 12-4 Terralite Survey Status Window

Terralite Survey Status

Slot	Serial Number	Survey Status	North [m]	East [m]	Up [m]	Update Time	Position Valid
1	0	00	0.000000	0.000000	0.000000	0	0
2	0	00	0.000000	0.000000	0.000000	0	0
3	0	00	0.000000	0.000000	0.000000	0	0
4	1310784	03	-10.129883	-9.169922	2.940430	202938536	1
5	1310790	03	-1.061523	13.059570	2.918945	202936735	1
6	1310761	03	3.579102	4.140625	1.474609	202938564	1

Back

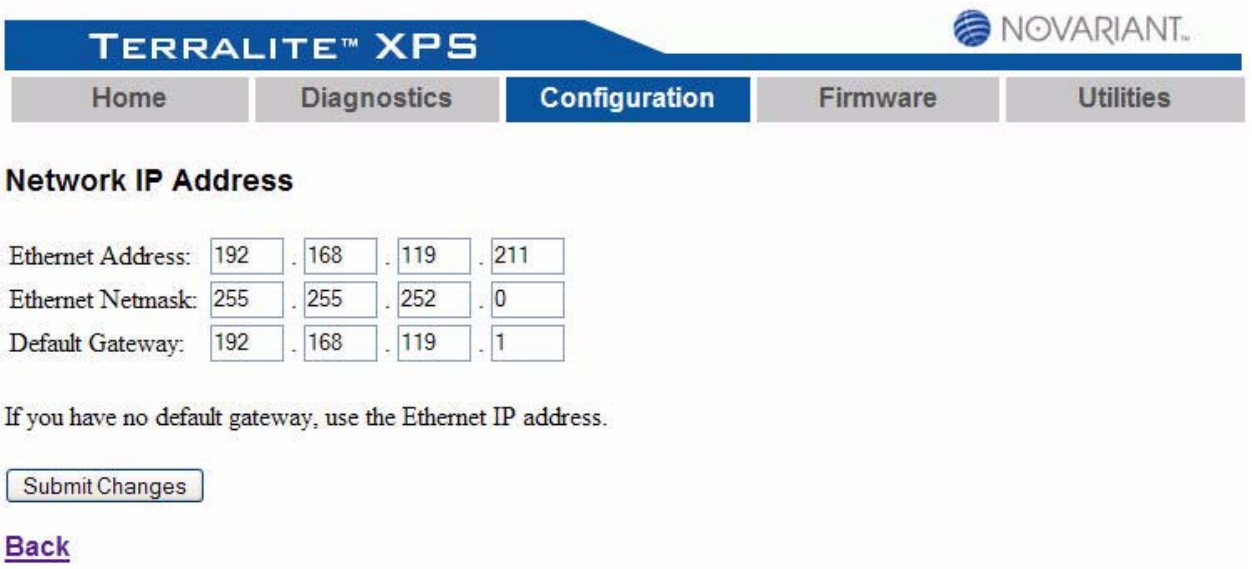
The **Terralite Survey Status** window contains the following components:

- Slot – Terralite time slot assignment.
- Serial Number – Terralite serial number.

- Survey Status – Survey indicator, 3 indicates completed survey. 1 or 2 indicates only one of the antennas has completed the survey.
- North [m] – Distance (in meters) the TX100 Terralite is located North of the IX100 Reference Station.
- East [m} – Distance (in meters) the TX100 Terralite is located East of the IX100 Reference Station.
- Up [m] – Distance (in meters) the TX100 Terralite is located vertically of the IX100 Reference Station.
- Update Time – GPS Time of Millennium (GPS Week(0-1023) x 604800 + GPS Time of Week(0-604800)).
- Position Valid – Status bit. If the survey is complete, the value is one (1).

Network Address Window

Figure 12-5 Network Address Window



The **Network Address** window contains the following components:

- **eth0** display – Provides Ethernet 0 configuration and status data.
- **eth0 Down** button – Disables Ethernet 0.
- **eth0 up** button – Enables Ethernet 0.

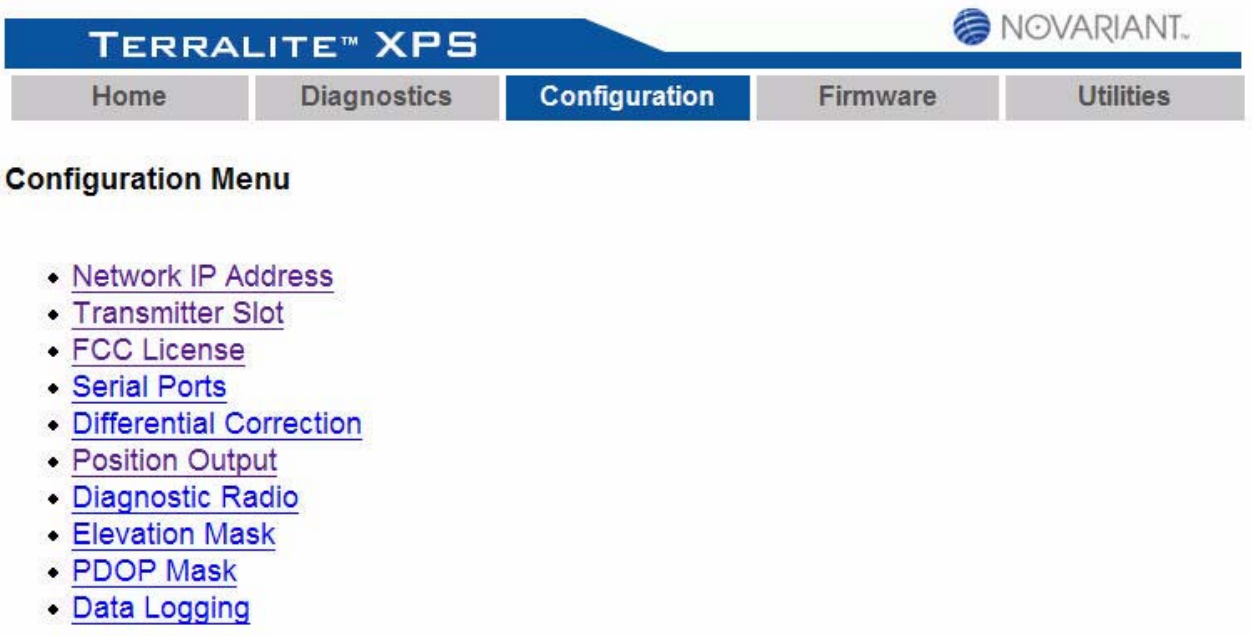
The Phase Dump window contains the following components:

- **Filename** field – Input field for the file to be used for phase dumping.
- **Start Dumping** button – Initiates the phase dumping process.
- **Back** button – Returns to the previous window.

Configuration Window

The **TX100 Terralite Configuration** window provides access to the application functions requiring performance and environmental setup. *Figure 12-6* shows the **Configuration** window.

Figure 12-6 TX100 Terralite Configuration Window

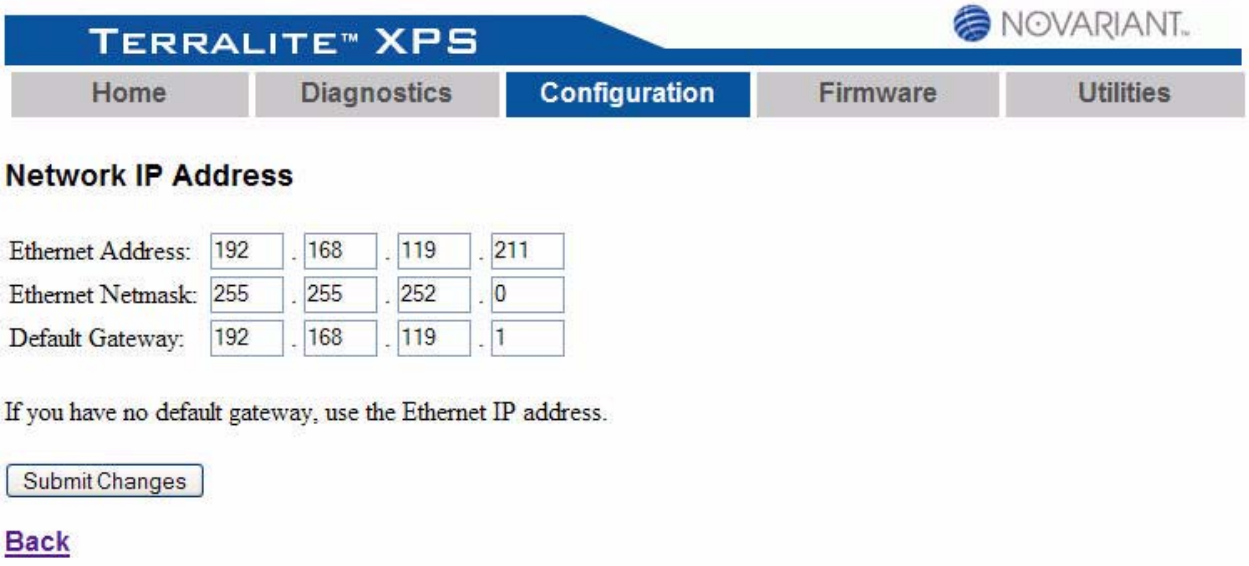


The **Configuration** window contains the following components:

- *Network IP Address Window* link – Enables configuration of the IP Address, Subnet Mask and default gateway settings.
- *Transmitter Slot Window* link – Enables access to the TX100 slot selection function.
- *FCC License Window* link – Provides access to the FCC License data entry field.
- *Serial Port Window link* – Provides access to the serial port configuration functions.
- *Differential Correction Window* link – Enables access to the TX100 Terralite timeslot assignment function.
- *Position Output Window* link – Enables access to the Differential Radio settings.
- *Diagnostic Radio Link Window* link – Provides access to the serial port setting.
- *Set Elevation Mask Window* link – Provides access to the elevation mask configuration function.
- *Set PDOP Mask Window* link – Enables access to the PDOP mask settings.
- Data Logging Window link – Enables access to the Data Logging window.

Network IP Address Window

Figure 12-7 Network IP Address Window

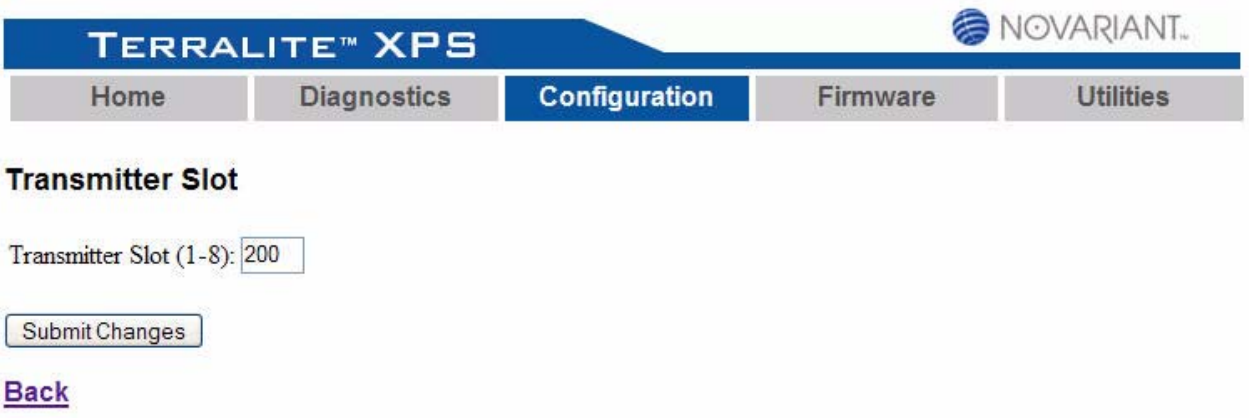


The **Network IP Address** window contains the following components:

- **Ethernet Address** fields – The unique number assigned to the receiver Ethernet network adapter defining its physical connection on the network.
- **Ethernet Netmask** fields – The subnet mask information used to inform the IP software which bits represent the network number and which bits represent the host number.
- **Default Gateway** fields – When used, it is the router used to forward all traffic that is not addressed to a node/computer within the local subnet.
- **Submit Changes** button – Saves the changes to the config file.
- **Back** link – Returns to the previous window.

Transmitter Slot Window

Figure 12-8 TX100 Transmitter Slot Window

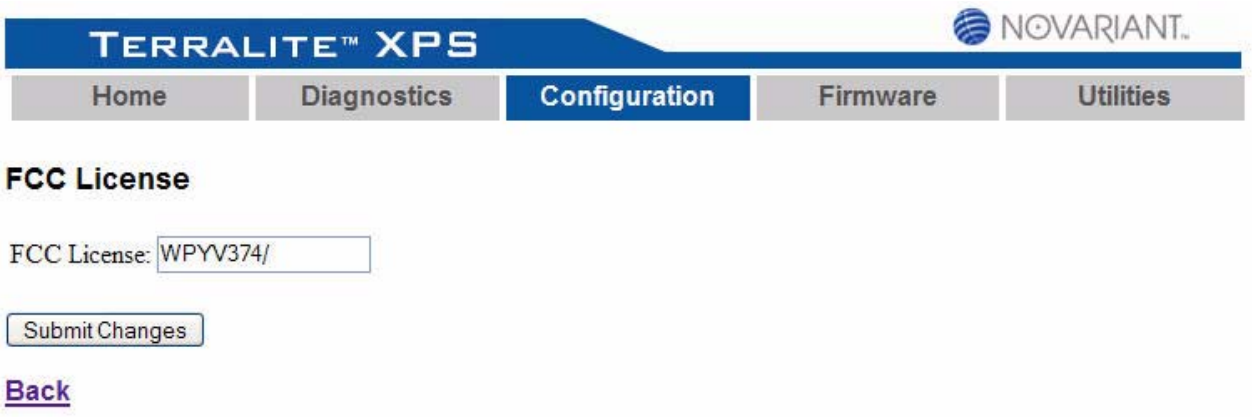


The **Transmitter Slot** window contains the following components:

- **Transmitter Slot (1-8):** field – Defines the timeslot assigned to the TX100 Terralite.
- **Submit Changes** button – Saves the changes to the config file.
- **Back** link – Returns to the previous window.

FCC License Window

Figure 12-9 FCC License Window

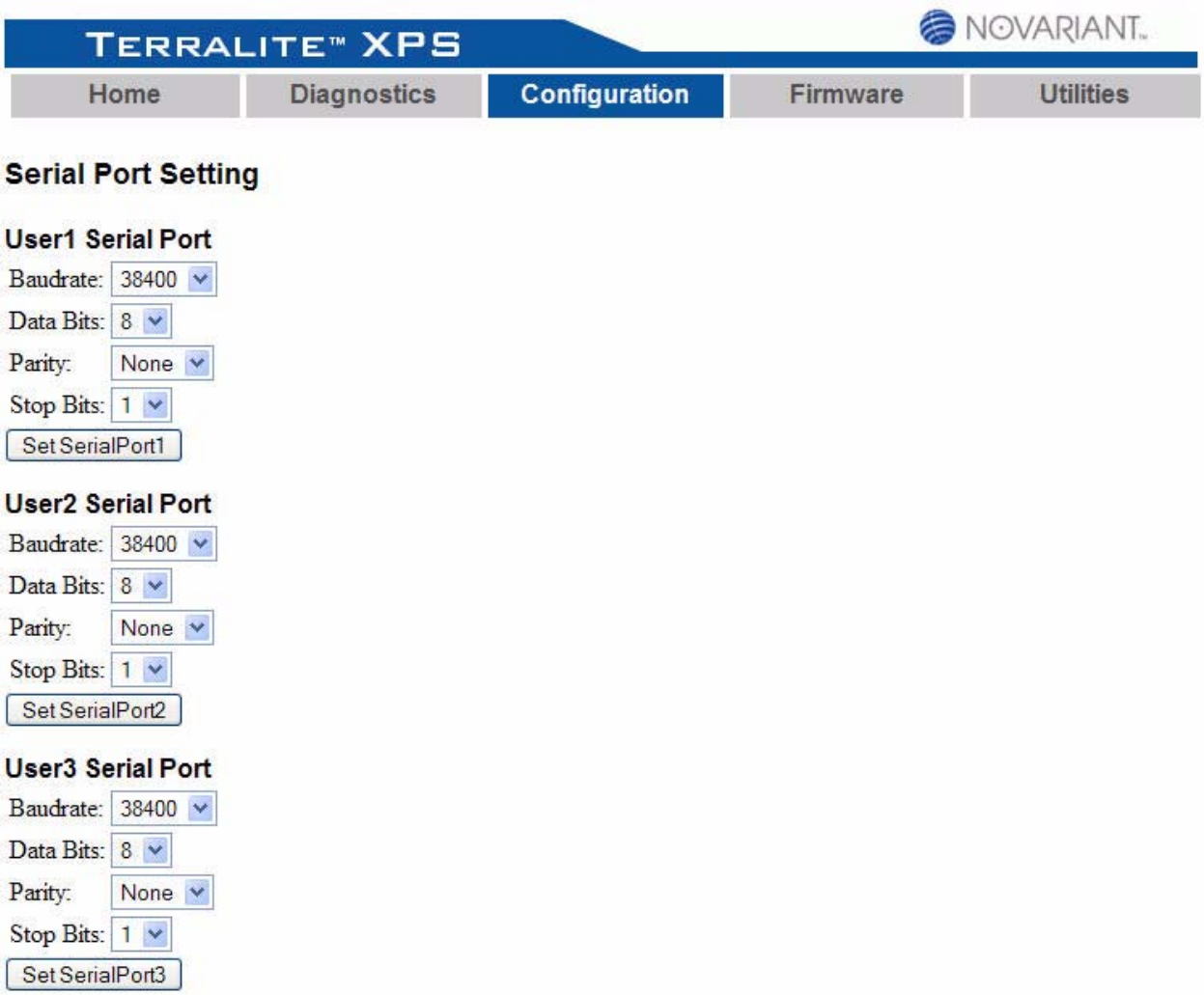


The **FCC License** window contains the following components:

- **FCC License** field – Data input field for the TX100 license.
- **Submit Changes** button – Saves the changes to the config file.
- **Back** link – Returns to the previous window.

Serial Port Window

Figure 12-10 Serial Port Window



The **Serial Port** window contains the following components:

- Serial Port Settings

Note: The serial port functions are repeated identically for the three serial ports.

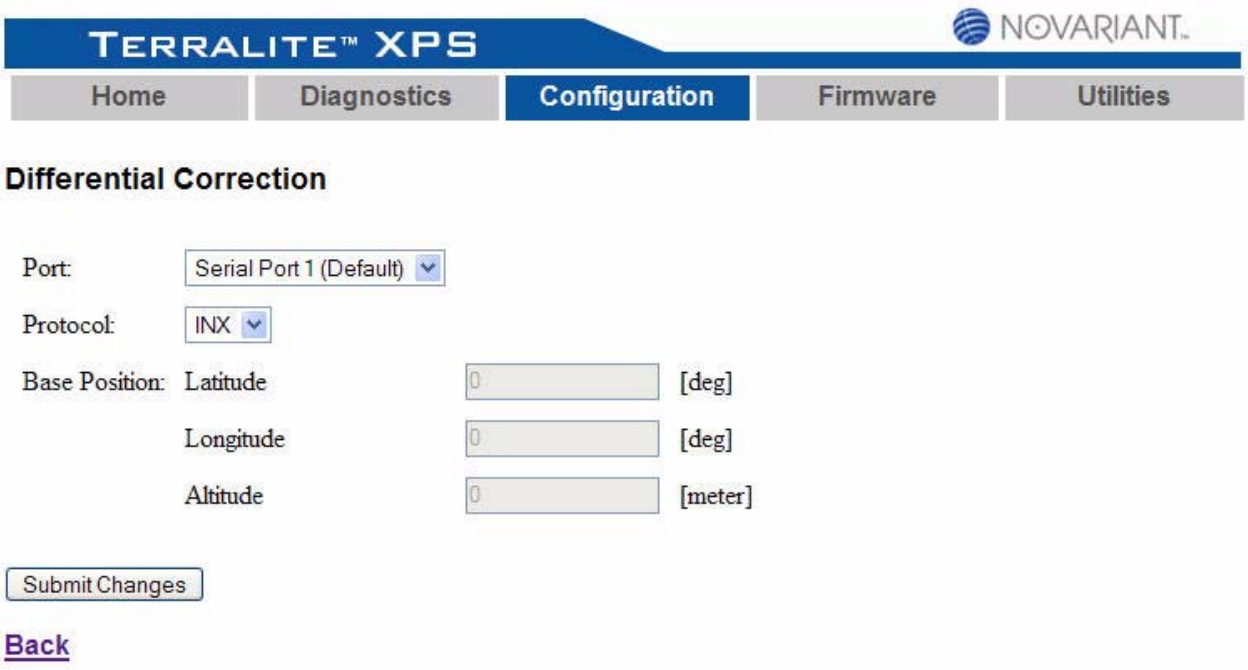
- **Port** drop-down menu – The receiver communication port.
- **Protocol** drop-down menu – The serial port data stream protocol.
- **Baudrate** drop-down menu – The serial port data transfer rate.
- **Parity** drop-down menu – The parity check on/off selection.
- **Stop Bits:** drop-down menu – asynchronous data delay bit settings.

- **Set Serial Port** button – sends the selected serial port settings to the configuration file.

- **Back** link – Returns to the previous window.

Differential Correction Window

Figure 12-11 Differential Correction Window

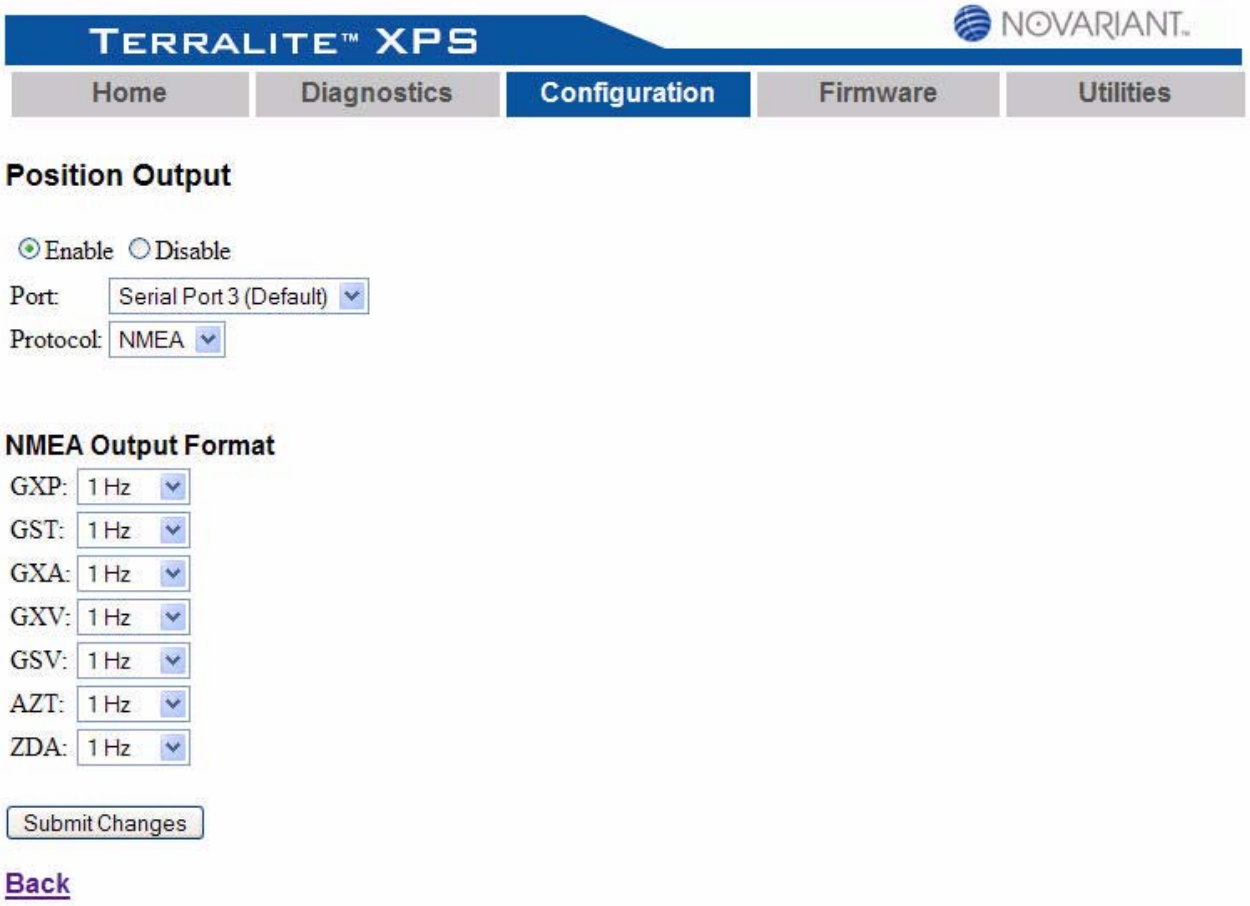


The **Differential Corrections** window contains the following components:

- **Port** drop-down menu – Enables the selection of the serial port used to transmit differential corrections.
- **Protocol** drop-down menu – Defines the differential correction data stream protocol.
- **Base Position Latitude** field – The Reference Station Latitude measurement updated at a 1Hz rate.
- **Base Position Longitude** field – The Reference Station Longitude measurement updated at a 1Hz rate.
- **Base Position Altitude** field – The Reference Station Altitude measurement updated at a 1Hz rate.
- **Submit Changes** button – Saves the changes to the configuration file.
- **Back** link – Returns to the previous window.

Position Output Window

Figure 12-12 TX100 Position Output Window



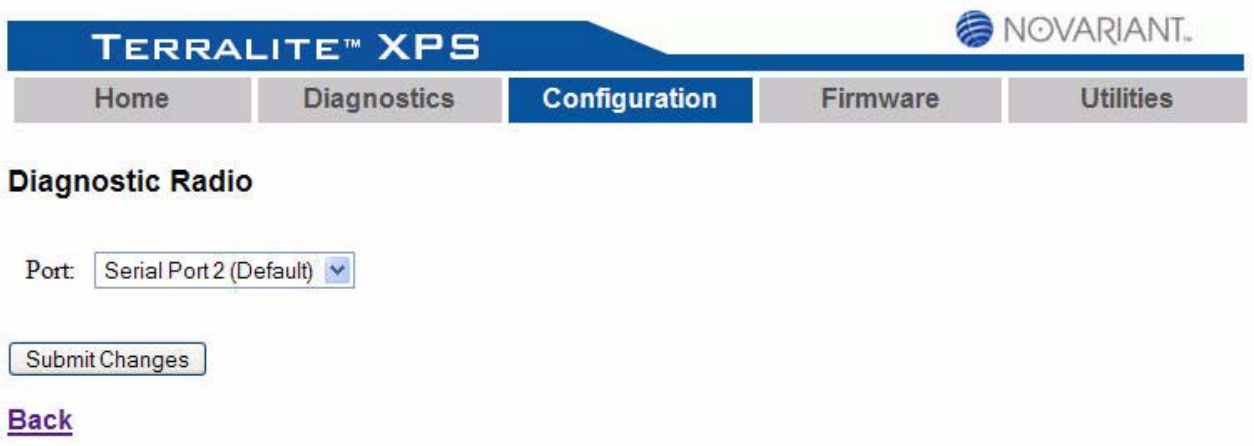
The **TX100 Position Output** window contains the following components:

- **Enable** radio button – Enables the differential correction radio output.
- **Disable** radio button – Disables the differential correction radio output.
- **Port** drop-down menu – Enables the serial port selection for the differential correction radio output.
- **Protocol** drop-down menu – Enables the selection of the differential correction radio protocol.
- **NMEA Output Format** drop-down menus – Selects the NMEA Output Format update rate.
  - **GXP** drop-down menu – Sets the GXP message type output frequency which is providing position reporting combining satellite and TX100 Terralite Transmitter data.
  - **GST** drop-down menu – Sets the GST message type output frequency which is providing error estimates corresponding to the position report.
  - **GXA** drop-down menu – Sets the GSA message type output frequency which is providing DOP and tracking information regarding satellites and TX100 Terralite Transmitters used in the positional solution
  - **GXV** drop-down menu – Sets the GXV message type output frequency which is providing tracking and signal strength information for all available signals.
  - **GSV** drop-down menu – Sets the GSV message type output frequency which is providing tracking and signal strength information for all available signals. (Pre-XPS legacy systems)
- **Submit Changes** button – Saves the changes to the configuration file.

- **Back** link – Returns to the previous window.

Diagnostic Radio Link Window

Figure 12-13 Diagnostic Radio Link Window

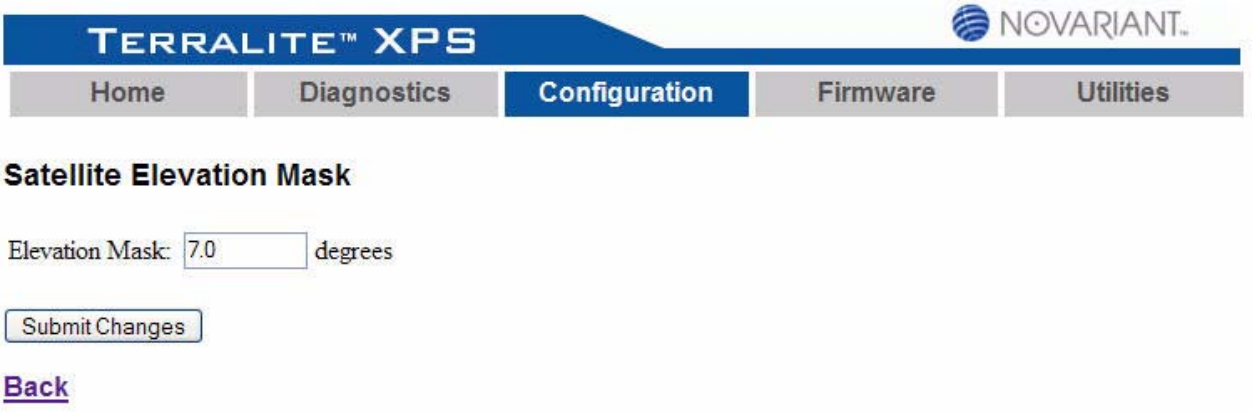


The **TX100 Diagnostic Radio** window contains the following components:

- **Port** drop-down menu – Serial port selection menu.
- **Submit Changes** button – Saves the changes to the configuration file.
- **Back** link – Returns to the previous window.

Set Elevation Mask Window

Figure 12-14 Set Elevation Mask Window

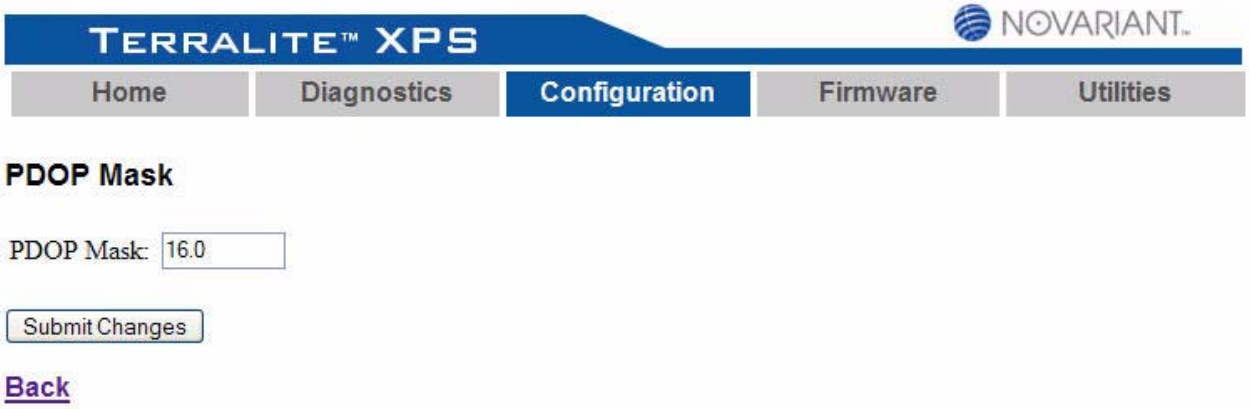


The **Set Elevation Mask** window contains the following components:

- **Elevation Mask** field – Sets the minimum elevation above the horizon that a receiver will track a satellite.
- **Submit Changes** button – Saves the changes to the configuration file.
- **Back** link – Returns to the previous window.

Set PDOP Mask Window

Figure 12-15 Set PDOP Mask Window

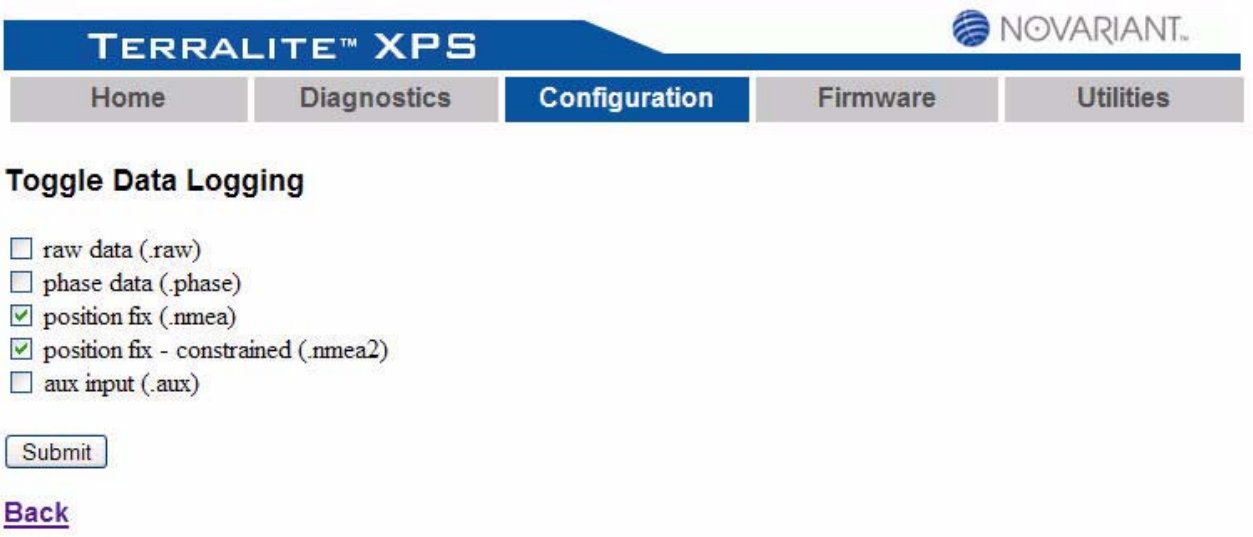


The Set PDOP Mask window contains the following components:

- **PDOP Mask** field – Enables the use of position data only within specified tolerances. The closer the PDOP value is to one (1), the better the geometry of the satellites the better the probability of positional accuracy.
- **Submit Changes** button – Saves the changes to the configuration file.
- **Back** link – Returns to the previous window.

Data Logging Window

Figure 12-16 Data Logging Window



The **Data Logging** window contains the following components:

- **Data Logging** checkboxes

Note: When the check boxes are checked, the data is logged into internal the Compact Flash disk (or into USB disk if CF is not mounted).

- **raw data (.raw)** checkbox – .raw file logs all the incoming data into RTK application in binary format.

Note: The naming convention is YYMMDD_HHMM.xxx. For example, 060213_2137.raw

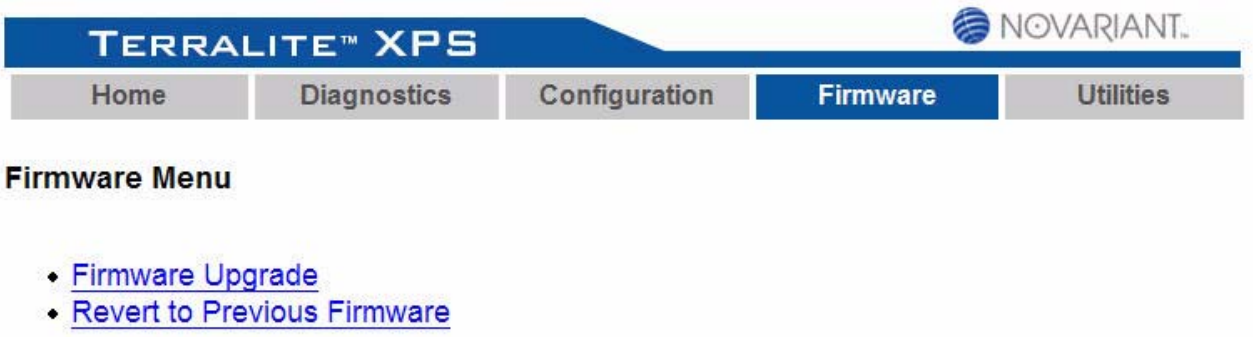
- **phase data (.phase)** checkbox – .phase file logs XPS code/carrier phase data in text format.
- **position fix (.nmea)** checkbox – .nmea file logs positioning output in the same format as NMEA output in "Position Output (Aux)" serial port.

Note: When a receiver is configured to output positioning in GSOF format in the serial port, the GUI displays ".gsof/.gsof2" instead of ".nmea/.nmea2".

- **position fix - constrained (.nmea2)** checkbox – .nmea2 file logs constrained positioning output, simulating limited satellite/terralite availability.
- **aux input (.aux)** checkbox – .aux file logs any incoming data stream from "Position Output (Aux)" serial port As Is.
- **Submit Changes** button – Saves the changes to the configuration file.
- **Back** link – Returns to the previous window.

Firmware Window

Figure 12-17 Firmware Window

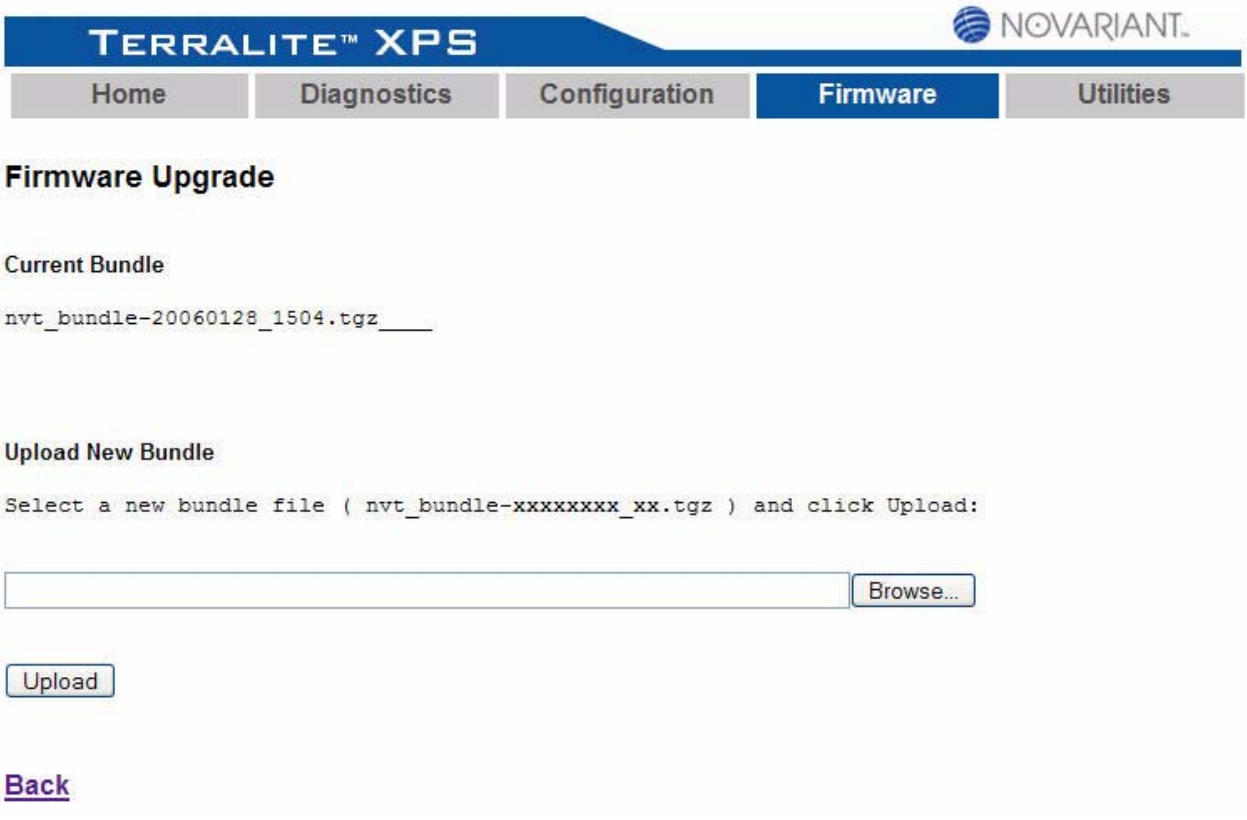


The **Firmware** window contains the following components:

- *Firmware Upgrade* link – Enables access to the **Firmware Upgrade** window.
- *Revert to Previous Firmware* link – Enable access to the **Revert to Previous Firmware** window.

Firmware Upgrade

Figure 12-18 Firmware Upgrade Window

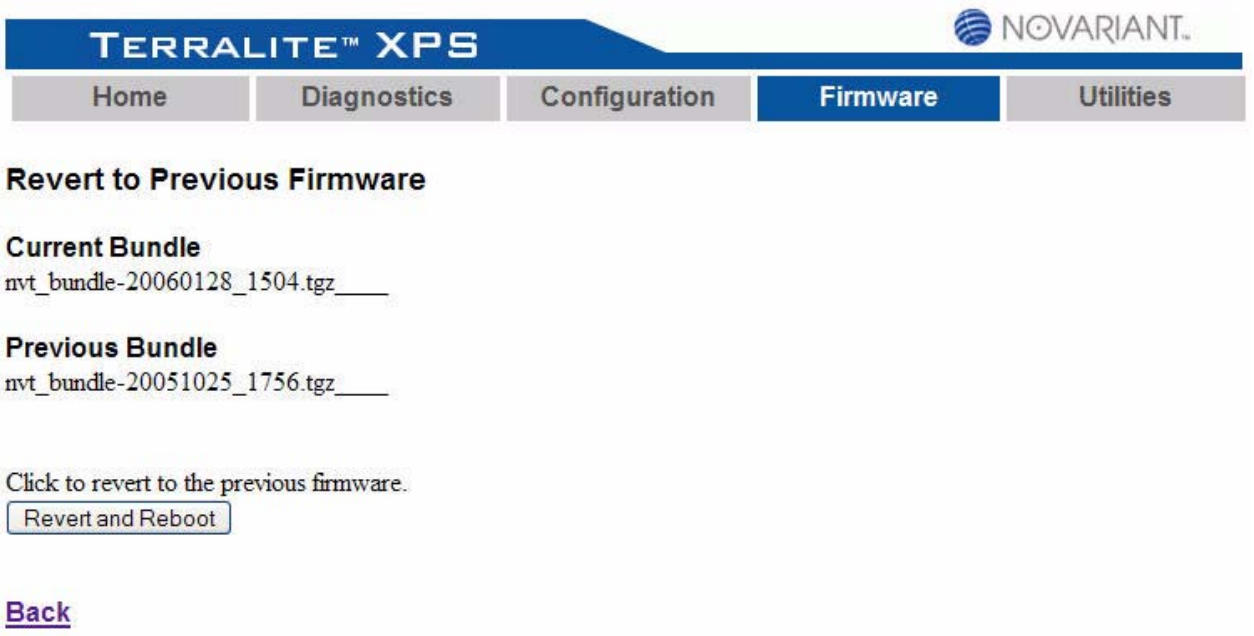


The **Firmware Upgrade** window contains the following components:

- **Current Bundle** display – Lists the current software bundle file name.
- **Upload New Bundle** input field – Enables bundle path and filename manual input.
- **Browse** button – Enables the search and insertion of a selected file from your files system or network.
- **Upload** button – Initiate the process to upload the selected file.
- **Back** link – Returns to the previous window.

Revert to Previous Firmware

Figure 12-19 Revert to Previous Firmware Window

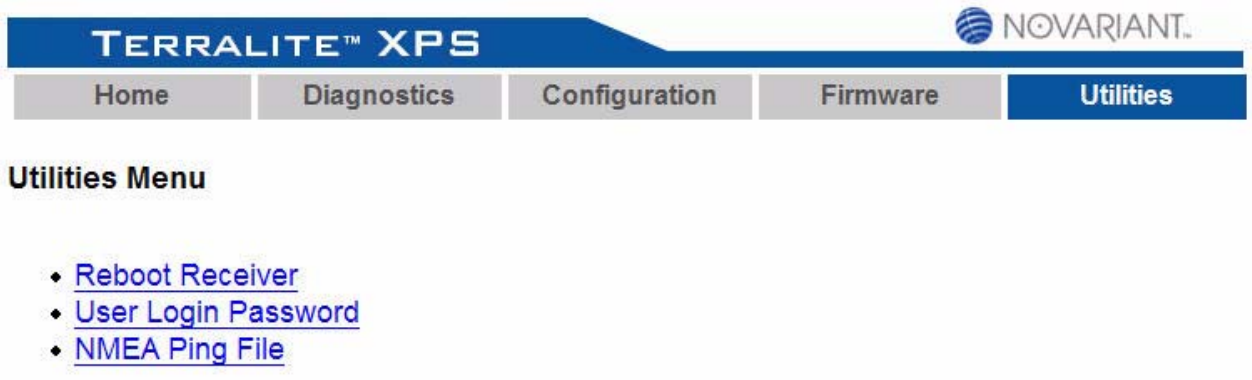


The **Revert to Previous Firmware** window contains the following components:

- **Current Bundle** display – Displays the current software bundle.
- **Previous Bundle** display – Displays the previously loaded software bundle.
- **Revert and Reboot** button – Returns to the previous software bundle version and reboots the receiver.

Utilities Window

Figure 12-20 Utilities Menu Window

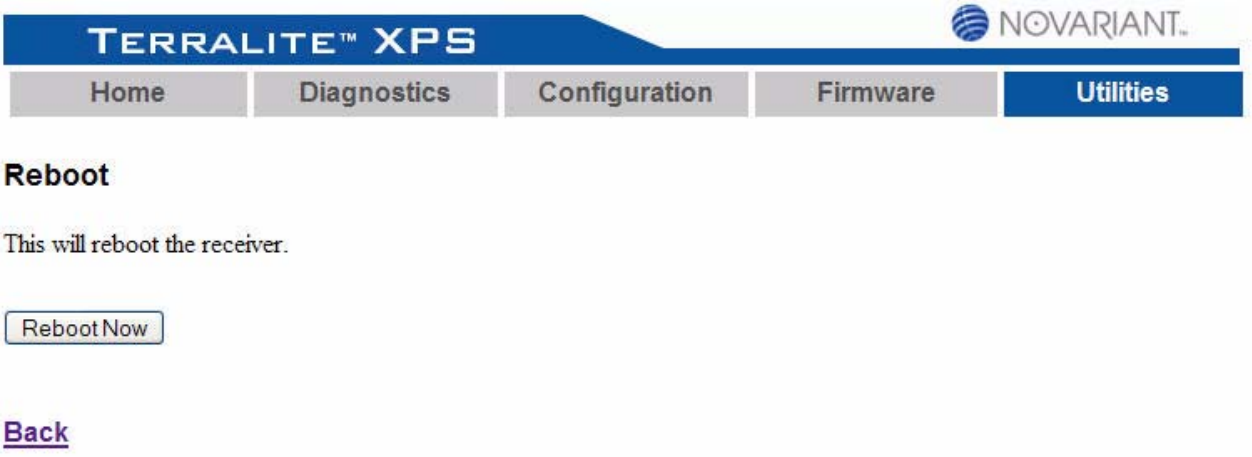


The **Utilities Menu** window contains the following components:

- *Reboot Receiver Window* link – Provides access to the receiver reboot function.
- *User Login Password Window* link – Enables a user to set a password.
- *NMEA Ping File Window* link – Enables a user to download an NMEA Ping file.

Reboot Receiver Window

Figure 12-21 Reboot Receiver Window

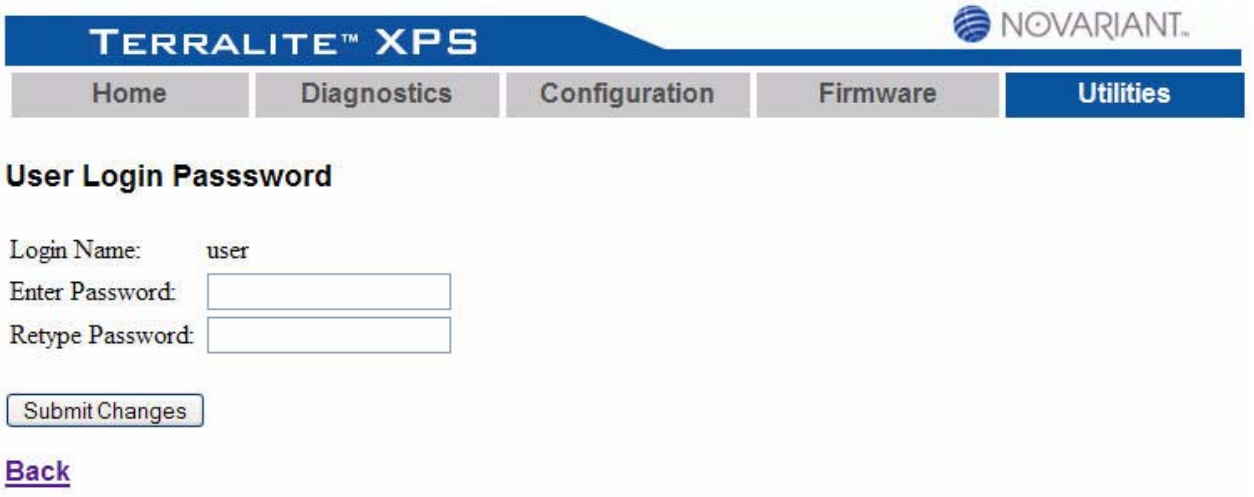


The **Reboot Receiver** window contains the following components:

- **Reboot Now** button – Restarts the receiver immediately.
- **Back** link – Returns to the previous window.

User Login Password Window

Figure 12-22 User Login Password Window



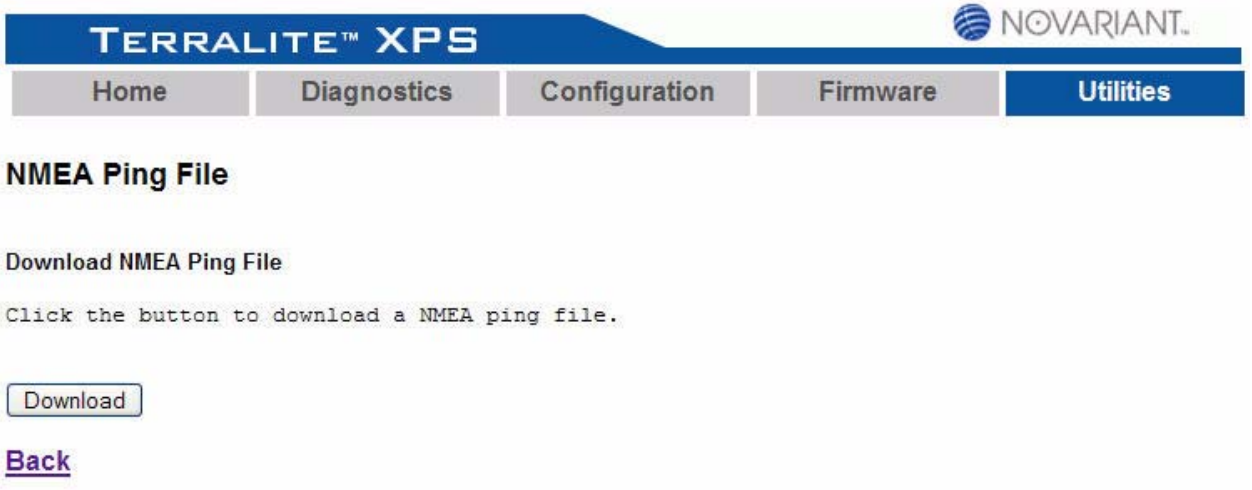
The **User Login Password** window contains the following components:

Note: The **TX100 Terralite** is shipped with the following default user ID and password:
User: user
Password: user

- **Login Name** display – Displays the currently logged in user name.
- **Enter Password** field – Enables the data entry of your password.
- **Retype Password** field – confirms the previously entered password.
- **Submit Changes** button – Saves the changes to the configuration file.
- **Back** link – Returns to the previous window.

NMEA Ping File Window

Figure 12-23 NMEA Ping File Window



The **NMEA Ping File** window contains the following components:

- **Download** button – Transfers the NMEA ping file.
- **Back** link – Returns to the previous window.

Glossary of Terms

Glossary

Term	Definition
Anywhere Fix	A receiver function enabling it to start position calculations without receiving the approximate time and location.
Bandwidth	The frequency range of a given signal.
C/A Code	The standard Course/Acquisition (civilian) GPS code. A sequence of 1023 pseudo-random, binary, biphase modulations on the GPS carrier at a chip rate of 1.023 MHz.
Carrier	A specific frequency in an analog communication channel that is modulated with an information-carrying signal.
Carrier-Aided Tracking	A signal processing methodology using the GPS carrier signal to derive an precise lock on the pseudo random code.
Carrier Frequency	The fundamental frequency used in both amplitude modulation and frequency modulation. It is the frequency which is modulated and the frequency to which a receiver should be tuned in order to demodulate the information signal.
Carrier Phase GPS	GPS measurements fixed upon the L1 or L2 carrier signals.
Channel	Particular frequencies at which GPS signals are transmitted and received.
Chip	The pseudo-random sequence transition time for individual bits.
Clock Bias	The difference between true universal time and a clock's indicated time.
Code Phase GPS	Pseudo random code (C/A or P) GPS measurements.
Control segment	GPS monitoring and control stations ensuring the accuracy of satellite positions and their clocks.
Cycle Slip	A discontinuity in the measured carrier beat phase resulting from a temporary loss of lock in the carrier tracking loop of a GPS receiver.
Data Message	A message from a satellite contained in the GPS signal which reports the satellite's location, health and clock corrections.
Dilution of Precision	Typically known as DOP or GDOP. It is the multiplicative factor that modifies ranging error. It is caused entirely by the distances between the user and their satellites.
Dithering	The inaccuracy added to GPS signals by the Department of Defense to produce selective availability.

Doppler Aiding	A measured doppler shift processing methodology used to help the receiver smoothly track the GPS signal. This technology enables more precise position and velocity measurements.
Doppler Shift	The perceived change in the signal frequency induced by the relative motion of a receiver and transmitter.
Elevation Mask	The minimum elevation above the horizon that a receiver will track a satellite.
Ephemeris	A description of the path of a celestial body indexed by time. The navigation message from each GPS satellite includes a predicted ephemeris for the orbit of that satellite valid for the current hour. The ephemeris is repeated every 30 seconds and is in the form of a set of 16 Keplerian-like parameters with corrections that account for the perturbations to the orbit caused by the Earth's gravitational field and other forces.
Frequency Spectrum	The display of signal amplitudes as a function of frequency.
Geometric Dilution of Precision (GDOP)	Typically known as DOP or GDOP. It is the multiplicative factor that modifies ranging error. It is caused entirely by the distances between the user and their satellites.
Hardover Word	The specific GPS word that containing synchronization information for the transfer of tracking from the C/A to P code.
Ionosphere	The region of ionized plasma 80 to 120 miles above the Earth's surface.
Ionospheric Refraction	Propagation mode occurring when radio waves travel into the ionosphere. The ionosphere bends and attenuates radio waves at frequencies below 30 MHz.
L-band	L band is a frequency range between 390Mhz and 1.55Ghz which is used for satellite communications and for terrestrial communications between satellite equipment.
Multipath Error	Errors caused by a GPS signal bouncing off a reflective surface prior to reaching the GPS receiver antenna.
Multi-Channel Receiver	A GPS receiver capable of simultaneously tracking signals from more than one satellite.
P-Code	A PRN code transmitted by GPS satellites. The code consists of about 2.35 3 1014 chips and is sent at a rate of 10.23 megabits per second. At this rate, it would take 266 days to transmit the complete code. Each satellite is assigned a unique one-week segment of the code that is reset at Saturday/Sunday midnight. The P-code is currently transmitted on both the L1 and L2 frequencies.
Precise Positioning Service (PPS)	The full-accuracy, single-receiver GPS positioning service provided to the United States and its allied military organizations and other selected agencies. It includes access to the unencrypted P-code and the removal of SA effects.
Pseudolite	A ground-based transmitter that mimics a GPS signal. These devices can be used around airports for such tasks as precision instrument landings.
Pseudo Random Code	Deterministic binary sequences with noise-like properties. Also called pseudonoise codes. These codes are used in spread-spectrum communications systems and in ranging systems such as GPS. Two PRN codes are transmitted by GPS satellites: the C/A-code and P-code.

Pseudorange	The range between the antenna phase centers of a GPS satellite and a receiver, measured by the receiver? delay-lock loop using either the C/A- or P-code. The range is biased by the offset of the clock in the receiver from that in the satellite and by atmospheric propagation delays.
Satellite Constellation	The spatial arrangement of a satellite group.
Selective Availability (SA)	The policy and procedure of denying to most nonmilitary GPS users the full accuracy of the system. SA is achieved by dithering the satellite clock (delta-process) and degrading the navigation message ephemeris (epsilon-process). Currently SA primarily uses the delta-process. The effects can be removed with encryption keys or through DGPS techniques.
Spread spectrum	A signal normally requiring a narrow transmission bandwidth but spread over a much larger bandwidth. For example, the 50-bits-per-second GPS navigation message, which could be transmitted in a bandwidth of 50 Hz or so, is spread over a bandwidth of about 1 MHz by the C/A-code.
Standard Positioning Service (SPS)	The GPS single receiver (stand-alone) positioning service available to any user on a continuous, worldwide basis. It is intended to provide access only to the C/A-code and the L1 carrier. The horizontal-position accuracy, as degraded by SA, currently is advertised as 100 meters, the vertical-position accuracy as 156 meters, and time accuracy as 334 nanoseconds, all at the 95-percent probability level. SPS also guarantees the user-specified levels of coverage, availability, and reliability.
Static positioning	Location determination when the receiver? antenna is presumed to be stationary on the earth. This allows the use of various averaging techniques to greatly improve accuracy.
Warm Start	The ability of a GPS receiver to begin navigating using almanac information stored in its memory from previous use.
World Geodetic System 1984 (WGS 84)	A set of parameters, established by the U.S. Defense Mapping Agency, for determining geometric and physical geodetic relationships on a global scale. The system includes a geocentric reference ellipsoid; a coordinate system; and a gravity field model. The ellipsoid is essentially that of the International Union of Geodesy and Geophysics Geodetic Reference System 1980. The coordinate system is a realization of the conventional terrestrial system, as established by the International Earth Rotation Service. The descriptions of the GPS satellite orbits in the navigation message are referenced to WGS 84.

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