



# **HPT402**

**UHF Modem**

**Operator's Manual**

**Version 1.3**

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# TABLE OF CONTENTS

<b>Preface</b> .....	<b>7</b>
Terms and Conditions .....	7
Regulatory Information .....	9
FCC Class A Compliance .....	9
Canadian Emissions Labeling Requirements .....	9
WEEE Directive .....	9
Manual Conventions .....	10
Screen Captures .....	10
Technical Assistance .....	10
<b>Chapter 1. Introduction</b> .....	<b>11</b>
1.1. Getting Acquainted .....	12
1.1.1. LEDs .....	12
1.1.2. Data and Power Port .....	12
1.1.3. External Antenna Connector .....	13
1.1.4. Cables .....	13
1.1.5. Mounting Bracket .....	13
1.1.6. Literature .....	14
1.1.7. External Antenna (not included) .....	14
1.1.8. Storage Precautions .....	14
<b>Chapter 2. Configuration</b> .....	<b>15</b>
2.1. Powering HPT 402 .....	15
2.1.1. Power supply requirements .....	15
2.2. Configuring HPT402 .....	16
2.3. Installing ModemVU .....	16
2.4. Connecting HPT402 and Computer .....	17
2.5. Connecting HPT402 and TRIUMPH-1 .....	18
2.6. Configuring HPT402 .....	18
2.7. Checking Firmware Version .....	22

2.8. Loading New Firmware .....	23
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**Chapter 3. Command Line Interface..... 25**


3.1. Command Line Interface Convention.....	26
3.1.1. Software Switching to Command Mode .....	26
Happy Flow.....	27
Escape-Sequence in Data .....	27
3.1.2. Hardware Switching to Command Mode.....	28
3.1.3. Switching to Data Mode.....	28
3.2. Networking Commands .....	28
3.2.1. LINK.....	28
3.3. Serial Interfacing Commands .....	30
3.3.1. DPORT.....	30
3.3.2. MPORT .....	30
3.4. Special Commands .....	31
3.4.1. BOOT .....	31
3.4.2. HELP .....	32
3.4.3. SAVE .....	32
3.4.4. SLEEP .....	33
3.5. Diagnostics and Identification Commands.....	33
3.5.1. INFO.....	33
3.5.2. STATE .....	34

**Chapter 4. Configuration Example..... 35**

4.1. HPT402 as a Base Configuration .....	35
4.2. TRIUMPH-1 internal UHF radio as a Rover Configuration .....	40

**Appendix A. Specifications..... 45**

A.1. HPT402 UHF Modem Specifications .....	45
A.1.1. General Radio Specifications .....	45
A.1.2. Environmental Specifications .....	46
A.1.3. Transmitter Specifications.....	46
A.1.4. Receiver Specifications .....	47
A.2. Connector Specifications.....	48
DB15 Connector .....	48
External Antenna RF Connector.....	48



<b>Appendix B. UHF Radio Usage</b> .....	<b>49</b>
<b>Appendix C. Safety Warnings</b> .....	<b>51</b>
C.1. General Warnings .....	52
<b>Appendix D. Warranty Terms</b> .....	<b>53</b>



# PREFACE

Thank you for purchasing this product. The materials available in this Manual (the “Manual”) have been prepared by JAVAD GNSS, Inc. (“JAVAD GNSS”) for owners of JAVAD GNSS products. It is designed to assist owners with the use of HPT402 and its use is subject to these terms and conditions (the “Terms and Conditions”).

**Note:** Please read these Terms and Conditions carefully.

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**SAFETY** – Improper use of HPT402 can lead to injury to persons or property and/or malfunction of the product. The HPT402 modem should only be repaired by authorized JAVAD GNSS warranty service centers. Users should review and heed the safety warnings in Appendix C.

**MISCELLANEOUS** – The above Terms and Conditions may be amended, modified, superseded, or canceled, at any time by JAVAD GNSS. The above Terms and Conditions will be



governed by, and construed in accordance with, the laws of the State of California, without reference to conflict of laws.

## Regulatory Information

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

### FCC Class A Compliance

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 interference 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.

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

### Canadian Emissions Labeling Requirements

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

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

### WEEE Directive

The following information is for EU-member states only: The use of the symbol indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. For more

detailed information about the take-back and recycling of this product, please contact your supplier where you purchased the product or consult.



## Manual Conventions

This manual uses the following conventions:

Example	Description
<i>File ▶ Exit</i>	Click the <i>File</i> menu and click <i>Exit</i>
<i>Link Space</i>	This format represents titles of dialog windows/boxes, names of menu options, identifies program interface objects, such as checkboxes, edit boxes, radio buttons, etc.

## Screen Captures

This manual includes sample screen captures. Your actual screen can look slightly different from the sample screen due to the modem you have connected, operating system used and settings you have specified. This is normal and not a cause for concern.

## Technical Assistance

If you have a problem and cannot find the information you need in the product documentation, contact your local dealer. Alternatively, request technical support using the JAVAD GNSS World Wide Web site at: [www.javad.com](http://www.javad.com).



# INTRODUCTION

External extra rugged digital high power UHF radio transceiver programmable in frequency ranges from 406.1 to 470 MHz. It has GMSK, DBPSK, DQPSK, 4FSK, D8PSK, and D16QAM modulations with advanced forward error correction and data scrambling. The output power is programmable up to 2 W.



**Figure 1-1. HPT402**

It takes incoming data, modulates it with GMSK, FSK, PSK or most spectrum efficient QAM modulation and transmits it at RF power output levels from 13 dBm up to 33 dBm operating in 406.1 to 470 MHz.

The UHF transceiver is also capable of receiving RF signals through a 50 Ohm impedance external antenna port. These signals are demodulated and output to the RS-232 serial port.

HPT402 delivers a reliable radio link at up to 38.4 kbps over the air for the 25 kHz channel spacing, 30 kbps for 20 kHz, 19.2 kbps for 12.5 kHz, and 9.6 kbps for 6.25 kHz.

The unmatched features of HPT402 include data scrambling, frequency hopping, user selectable transmit output power level, low power consumption sleep modes, autoscanning for base.

The unit's user settings can be changed through the built-in Command Line interface (CLI), Tracy Software or through ModemVU.

## 1.1. Getting Acquainted

The HPT402 is a rugged and very powerful external radio transceiver 146 mm wide 75 mm deep 44 mm high, weighs 488 g.

### 1.1.1. LEDs

External LED's (see Figure 1-2) are used for Link and Line status indication:

Position	LED Name	Color	Description
1	PWR	Green	Active if Power connected to modem
2	SYNC	Red	Active whenever a signal with a level sufficient for reliable reception exists on the radio channel.
3	TX/RX	Green	Active if modem receives or transmits Data over serial interface
4	ALARM	Red	Reserved

### 1.1.2. Data and Power Port

The HPT402 data and power port (DB15 connector) is placed on the front of the unit (Figure 1-2).



**Figure 1-2. HPT402 front side**



Through the DB15 port the HPT402 can be connected to PC with Accessory Data-Ser-Pwr Cable, DB9/DB15/SAE (6ft/1.8m) p/n 14-578108-02, or with JAVAD GNSS receiver with Accessory Data-Ser-Pwr Cable, ODU-7/DB15/SAE (6ft/1,8m) p/n 14-578110-02 and can be powered. See “Powering HPT 402” on page 15 for detailed information.

### 1.1.3. External Antenna Connector

The external antenna connects to the BNC external antenna connector placed on the back side of HPT402.

### 1.1.4. Cables

The HPT402 package includes standard communication and power cables for configuring the modem and providing a power source to the modem.

Accessory Data-Ser-Pwr Cable, DB9/DB15/SAE (6ft/1.8m) p/n 14-578108-02	
Accessory Data-Ser-Pwr Cable, ODU-7/DB15/SAE (1,8m) p/n 14-578110-02	

### 1.1.5. Mounting Bracket

The mounting bracket p/n 10-578102-01 (Figure 1-3) allows connecting the modem to a standard pole/adaptor.



**Figure 1-3. Mounting Bracket**

## 1.1.6. Literature

HPT402 literature, including manuals and other product information are available on the JAVAD GNSS website (<http://www.javad.com>):

- *HPT402 Operator's Manual*
- Functional specifications

## 1.1.7. External Antenna (not included)

Antenna type depends on the site requirements, and may be directional or omni-directional.

## 1.1.8. Storage Precautions

1. Always clean the instrument after use. Wipe off dust with a cleaning brush, then wipe off dirt with a soft cloth.
2. Store in a location with a temperature of  $-40^{\circ}$  -  $+85^{\circ}\text{C}$ , and no exposure to direct sunlight.
3. Use a clean cloth, moistened with a neutral detergent or water, to clean the modem. Never use an abrasive cleaner, ether, thinner benzene, or other solvents.

Always make sure the instrument is completely dry before storing. Dry the modem with a soft, clean cloth.

# CONFIGURATION

## 2.1. Powering HPT 402

You can use the rechargeable battery or power supply with SAE connector and Accessory Data-Ser-Pwr Cable, DB9/DB15/SAE (1,8m), p/n14-578108-02 or Accessory Data-Ser-Pwr Cable, ODU-7/DB15/SAE (1,8m), p/n14-578110-02.



**Figure 2-1. Access Data-Ser-Pwr Cables**

### 2.1.1. Power supply requirements

The socket-outlet shall be installed near the equipment and shall be easily accessible.

A single external power supply is necessary to operate HPT402. The external power supply needs to be Listed for US and Certified for EU countries, it needs also to be a Limited Power Source and rated for Outdoor Use and have an output rated for +9 to +16 V, 2A. This may not be the same range as other JAVAD GNSS products with which you are familiar.

**CAUTION:** *To avoid the introduction of hazards when operating and installing, before connecting of the equipment to the supply, make sure that the supply meets local and national safety ordinances and matches the equipment's voltage and current requirements.*

**CAUTION:** *Never attempt any maintenance or cleaning of the supply while plugged in. Always remove supply from AC power before attempting service or cleaning.*

**Warning:** *If the voltage supplied is below the minimum specification, the radio will suspend operation. If the voltage supplied is above the maximum specification, the radio may be permanently damaged, voiding your warranty.*

## Configuration

Configuring HPT402

Power supply requirements

Make sure cords are located so that will not be stepped on, tripped over, or otherwise subjected to damage or stress. Do not operate equipment with a damaged cord or plug – replace immediately. To reduce the risk of damage to the equipment, pull by the plug body rather than the output cord when disconnecting the equipment.

Do not operate the supply if it has received a sharp blow, been dropped, or otherwise damaged. Do not disassemble the supply.

**Warning:** *Before connecting the external power source and the radio, make sure that the power source matches the radio's voltage and current requirements.*

## 2.2. Configuring HPT402

ModemVU is JAVAD GNSS's configuration utility for external modems. ModemVU provides the following functions:

- Connecting a computer to an UHF modem via a serial port.
- Displaying information about the radio modem installed in the modem.
- Programming the radio modem's settings.
- Loading the new modem firmware.

See the *ModemVU Software Manual* available on the JAVAD GNSS website for details on configuring the modem with an internal UHF modem and/or GSM radio modem, or an external UHF modem. To configure the HPT402 modem, have the following ready:

- Computer running Windows®;
- ModemVU Software installed on the computer;
- A serial cable.

## 2.3. Installing ModemVU

ModemVU™ is a Windows® application is a configuration program for the radio modem. ModemVU is available from the JAVAD GNSS website.

**Note:** Refer to the *ModemVU Software Manual* for full details on installing and using ModemVU Software.

1. If downloading the program from the website, extract the program files into a folder on your hard drive.
2. Navigate to the location of the ModemVU program and double-click the Setup.exe icon.



3. Follow the on-screen installation instructions. Click *Next* to continue, *Back* to get back to previous step, or *Cancel* to quit the installation.
4. Keep the default installation location or select a new location.
5. Click *Finish* to complete the installation.
6. If desired, create a shortcut on the computer's desktop for quick access to ModemVU.

To uninstall ModemVU use the *Start* menu on your computer:

1. Navigate to the location of the ModemVU program and double-click the Setup.exe icon.
2. Follow the on-screen installation instructions.

## 2.4. Connecting HPT402 and Computer

To configure, or maintain HPT402, you need to connect the modem and a computer using an Accessory Data-Ser-Pwr Cable, DB9/DB15/SAE (1,8m), p/n14-578108-02.



**Figure 2-2. Accessory Data-Ser-Pwr Cables DB9/DB15/SAE**

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

- Configure the modem and its components
- Send commands to the modem
- Use ModemVU to load new firmware to the modem

## Configuration

Connecting HPT402 and TRIUMPH-1  
Power supply requirements

## 2.5. Connecting HPT402 and TRIUMPH-1

Connect the external HPT402 UHF radio to receiver's port B with cable Accessory Data-Ser-Pwr Cable, ODU-7/DB15/SAE (6 ft./1,8m), p/n14-578110-02.



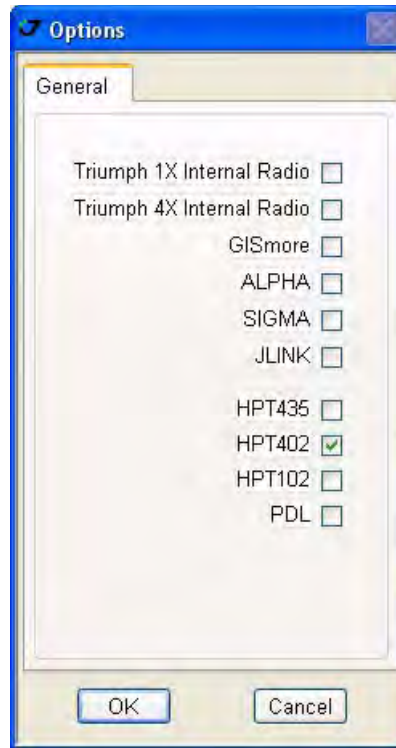
**Figure 2-3. Connecting HPT402 and TRIUMPH-1**

**Note:** The TRIUMPH-1 port B is optional. Make sure you have such option purchased.

## 2.6. Configuring HPT402

1. Connect the computer and HPT402, as described in “Connecting HPT402 and Computer” on page 17. Turn on the HPT402.
2. Start ModemVU.

3. Select the HPT402 (Figure 2-4), and click *OK*:



**Figure 2-4. Options window**

4. Select the COM port the HPT402 modem is connected to (Figure 2-5). Click *Connect*.



**Figure 2-5. Connect to ModemVU**

5. On the *Radio Link* tab, set the following parameters (Table 2-1) and click *Apply* (Figure 2-6 on page 21).

## Configuration

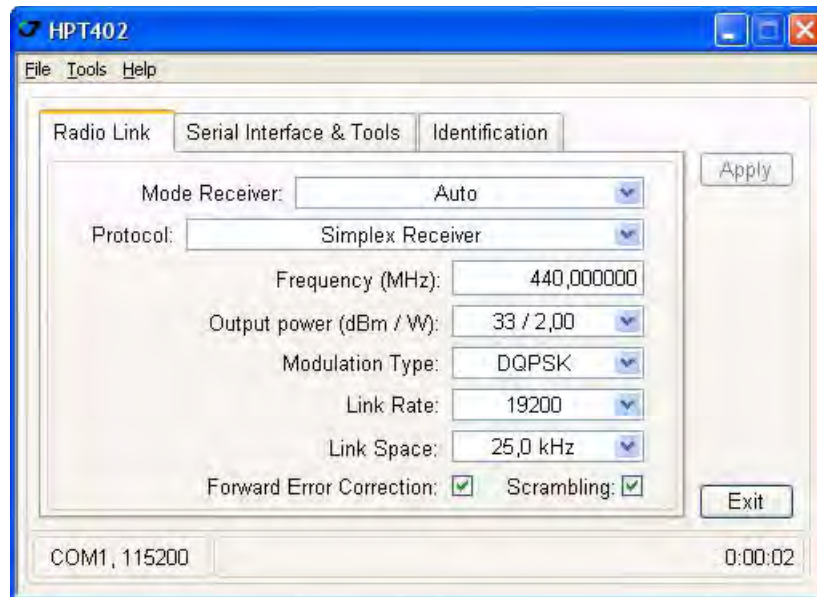
Configuring HPT402

Power supply requirements

**Table 2-1. Modem Parameters for the Radio Link Tab**

Parameter	Base Modem	Repeater	Rover Modem
Protocol	Simplex Transmitter or Simplex Transmitter to Repeater	Simplex Repeater	Simplex Receiver
	For Base, Repeater, and Rover modems the protocol type must be the same.		
Mode receiver/ Echo to serial port	-	ON- enables echoing to serial port; OFF - disables echoing to serial port	Auto - allows receiving data from base and repeater in auto mode <sup>1</sup> . Only from Repeater - allows receive data only from repeater <sup>2</sup> . Only from transmitter to Repeater - allows receive data from base transmitter <sup>3</sup> .
Frequency	Set the frequency in band 406.1-470 MHz with 6.25 kHz channel spacing. For both Base and Rover modems the frequency must be the same.		
Output power	Select the transmission power for the radio modem.		n/a
Modulation type	Specifies a modulation scheme that will be used by your modem. DQPSK is recommended. For both Base and Rover modems the modulation type must be the same.		
Link Rate	The link rate is selected automatically		
Link Space	For both Base and Rover modems the link space must be the same.		
Forward Error Correction	Enable		Enable
Scrambling	Enable		Enable

1. In Auto mode rover receives the data from both base transmitter and repeater. The sophisticated algorithm of data receiving allows the modem to eliminate any data doubling.
2. In this mode the incoming data from base transmitter will be ignored.
3. In this mode the incoming data from repeater will be ignored.



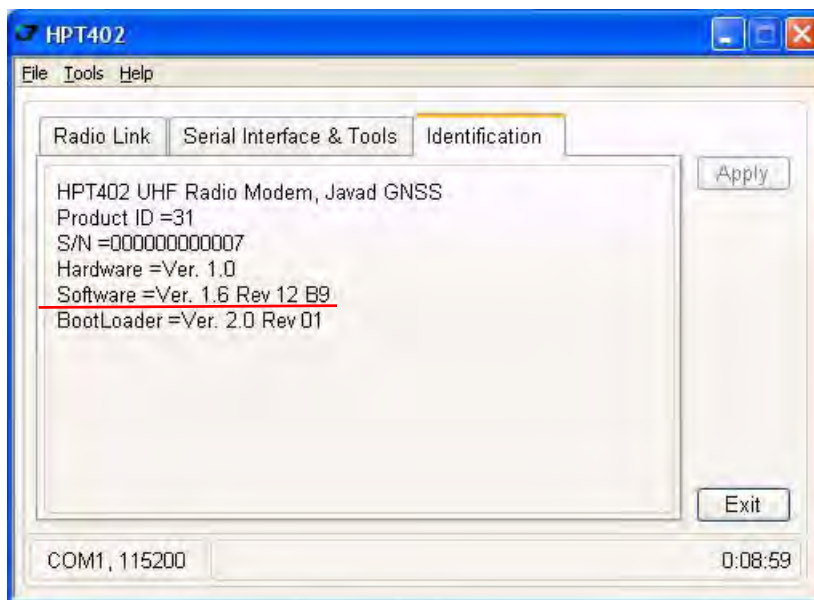
**Figure 2-6. Radio Link tab**

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

## 2.7. Checking Firmware Version

Use ModemVU to check the firmware version of your HPT402.

1. Connect your modem and computer. See “Connecting HPT402 and Computer” on page 17 for this procedure.
2. Start ModemVU. Select the HPT402 and then the COM port and click Ok (see “Configuring HPT402” on page 18).
3. Click on *Identification* tab (Figure 2-7).



**Figure 2-7. Identification tab**

This tab lists important information about the hardware accessories and software properties.

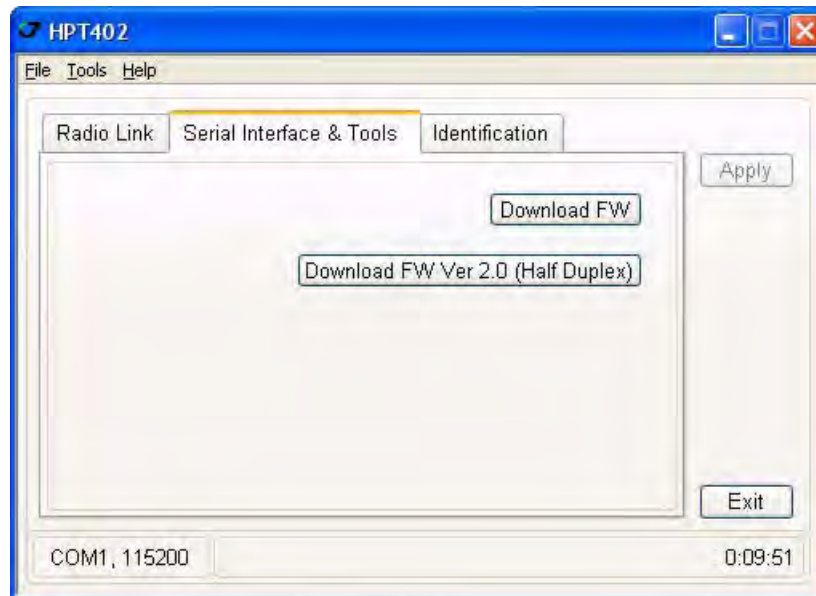
4. Click *File* ▶ *Disconnect*, then *File* ▶ *Exit* to quit ModemVU.

## 2.8. Loading New Firmware

Base, Repeater, and Rover modems must be loaded with the same firmware version. Use the latest firmware version, available for download from the JAVAD GNSS website, to ensure your modem has the most recent updates.

The modem uses ModemVU to load firmware onto the modem. For more information, refer to the *ModemVU Software Manual*, available on the JAVAD GNSS website.

1. Download the new firmware package to your computer.
2. Connect your modem and computer, as described in “Connecting HPT402 and Computer” on page 17.
3. Start ModemVU. Select the HPT402 and then the COM port and click Ok (see “Configuring HPT402” on page 18).
4. Click the *Serial Interface & Tools* tab.
5. Click *Download Firmware* button to load firmware version 1.x.x or *Download FW Ver. 2.0 (Half-Duplex)* to load firmware version 2.x.x (Figure 2-8).



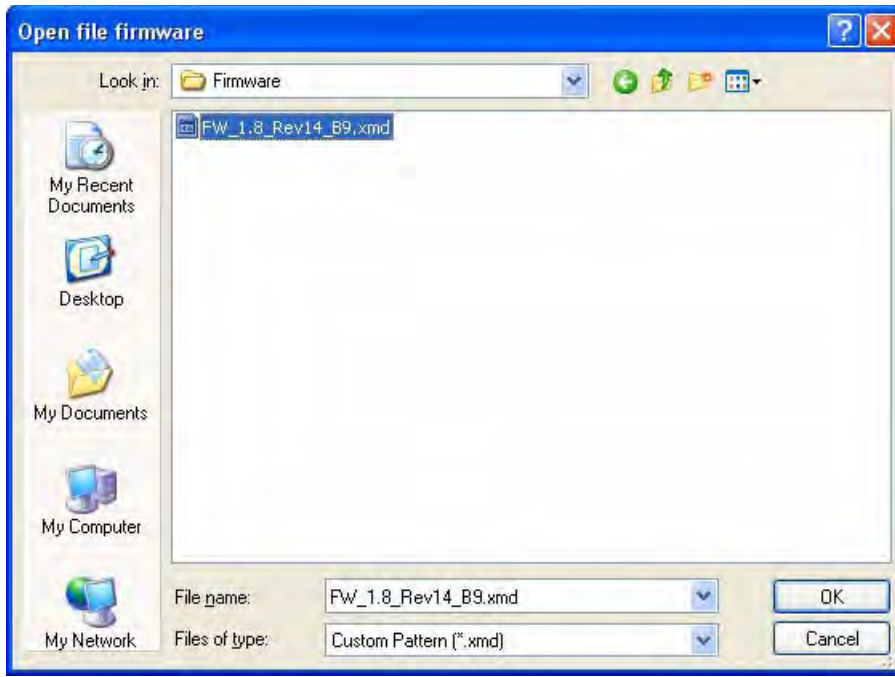
**Figure 2-8. Serial Interface & Tools tab**

**Note:** To update your firmware from 1.x.x version to 2.x.x click *Download FW Ver. 2.0 (Half-Duplex)* button.

## Configuration

Loading New Firmware  
Power supply requirements

6. Open the required firmware folder. Select the *.xmd* file and click OK (Figure 2-9):



**Figure 2-9. Load New Firmware**

7. Wait until the new firmware version loading will be complete.
8. Click *File* ► *Disconnect*, then *File* ► *Exit* to quit ModemVU.



# COMMAND LINE INTERFACE

The built-in user-friendly Command Line Interface (CLI) allows user to perform a full configuration of the unit and read the statistics and alarm status. It is the most powerful tool to configure the unit. It makes changes to all possible settings that system will not be able to determine automatically.

The CLI commands allow user to configure and reconfigure the unit's settings. The user configuration parameters that could be changed through the CLI are:

- Data Port Settings
  - Baud Rate
  - Data Bits (8, 7)
  - Parity (Odd, Even, None)
  - Flow control (None or RTS/CTS)
- Alarm Settings
- Radio Operation Modes
- Sleep modes
  - On/Off
  - Activate by internal real-time clock
  - Activate through RTS/CTS lines
  - Activate by external sense lines
  - Activate by any combination of the parameters mentioned before

**Note:** The unit's configuration that is set or modified through the CLI will be lost after unit's reboot, unless the saving operation is used to store a new setting in the unit's configuration file.

The CLI commands also provide filing operations, which include:

- Downloading
  - Unit's Configuration files
  - Software Images
- Uploading Unit's Configuration files
- Saving into the configuration files the configuration parameters modified through the CLI.

## 3.1. Command Line Interface Convention

The following convention is implemented in HPT402 Command Line Interface (CLI):

- The Carriage Return/Line Feed (CR/LF, 0x0D/0x0A) is a command delimiter.
- The Carriage Return/Line Feed (CR/LF, 0x0D/0x0A) is a reply delimiter followed by the “CLI>” prompt if Echo option is On.
- The Carriage Return/Line Feed (CR/LF, 0x0D/0x0A) is a reply delimiter if Echo option is Off (default option).
- The 2-digit number followed by “@” in the unit's reply indicates the error code (refer to Table 3 for description), if Echo Off is selected, otherwise the error message is displayed.
- A successfully performed command is replied by @00 code, if Echo Off is selected, otherwise the set value is replied.
- A command with the certain [Parameter Name] and blank [Parameter List] displays the current settings for a given parameter.
- To set the mode ordered by CLI commands as permanent User Setting (the setting automatically selected for the boot-up unit) the SAVE command must be asserted.
- A command followed by “/F” option displays the Parameters in the predefined frame format. The display frame format is unique for each command supporting “/F” option.

**Table 3-1. Command Line Interface Error Codes**

Error Code	Short Description
0x01	Command Syntax Error. A command followed by “/?” displays a command usage.
0x02	The parameter has a format error. A command with the certain [Parameter Name] followed by “/?” displays the format and range of the variable.
0x03	The parameter is out of allowed range. A command with the certain [Parameter Name] followed by “/?” displays the format and range of the variable.
0x04	The command is not valid for specific radio model. To display the list of available commands, the HELP command must be used.
0x05	Unspecified Error

### 3.1.1. Software Switching to Command Mode

On power-up the radio modem is in data-mode. To switch to command mode the special byte-sequences with special meanings are used:

- Escape-Sequence: “+++” with 20 ms guard time before and after the command characters
- Escape-Acknowledge: “@00<CR><LF>”

20 ms toggling on CTS control line needed to acknowledge switching from Data to Command mode and vice versa.

## Happy Flow

1. In data-mode the unit starts looking for the Escape-sequence if there is no data from DTE (Data Terminal Equipment) for more than 20 ms (Start Guard Time).
2. If the unit detects the Escape-Sequence:
  - The transmitter continues sending over the air the data received from DTE before Escape-Sequence and buffers the data from DTE;
  - The Receiver immediately stops forwarding to DTE the data received over the air and buffers it instead.
3. The radio unit waits for 20 ms and then sends Escape-Acknowledge to DTE if there is no data from DTE during 20 ms of Stop Guard Time.
4. The unit goes to command mode and discards Escape-Sequence from input buffer. The modem is immediately ready to receive commands. At the same time it continues buffering the data received over the air since step 2.

## Escape-Sequence in Data

During its waiting in step 3, the unit receives data from DTE:

- The unit sends buffered Escape-Sequence from DTE to the air;
- The unit sends all buffered data received from the air since step 2 to DTE and stays in data-mode (i.e. transmits data received from DTE over the air – including the just received, unexpected, data and forwards data received over the air to DTE.)

## 3.1.2. Hardware Switching to Command Mode

As alternative to Software Switching, the switching through the MP/DP (Data Terminal Ready, DTR) control line can be used. To set Command Mode, the DTE must assert DTR signal active and then passive. By falling edge of DTR signal the unit goes to command mode and then sends Escape-Acknowledge to DTE (“@00<CR><LF>”).

20 ms toggling on CTS control line needed to acknowledge switching from Data to Command mode and vice versa.

**Note:** The powered up radio modem by default goes to Data Mode regardless of DTR control line polarity.

## 3.1.3. Switching to Data Mode

- DTE sends the CLI command “DATAMODE<CR><LF>” to the unit.
- Unit answers with Escape-Acknowledge („@00<CR><LF>“) and immediately goes to datamode, so that the DTE can start sending data as soon as the Escape-Acknowledge has been received.
- If no valid CLI commands received from DTE within 1 minute, the unit will automatically switch back to data-mode.

**Note:** The data received over the air could be lost due to Rx buffer overflow if the unit stays in Maintenance mode longer than 15 second.

## 3.2. Networking Commands

### 3.2.1. LINK

The LINK command is responsible for configuring radio’s operation mode. It has six parameters listed below.

LINK [*Parameter Name*] [*Parameters List*] [/?]

Parameter Name	Parameter List
PROT	1 - "Simplex Receiver", a default setting for Remote units 2 - "Simplex Transmitter" 3 - "Half Duplex" specific for remote units (Reserved for future use) 4 - "Half Duplex" specific for base unit (Reserved for future use) 5 - "Full Duplex" specific for remote units (Reserved for future use) 6 - "Full Duplex" specific for base unit (Reserved for future use) 7 - "TRMB Receiver" (used with GMSK modulation, Reserved for future use) 8 - "TRMB Transmitter" (used with GMSK modulation, Reserved for future use) 9 - "Transparent w/EOT" Repeater (used with GMSK and 4FSK) 10 - "Repeater" (ArWest Proprietary Simplex) 11 - "TRMB Repeater" (used with GMSK modulation, Reserved for future use) 12 - "Transparent w/EOT" Receiver (used with GMSK and 4FSK modulation) 13 - "Transparent w/EOT" Transmitter (used with GMSK and 4FSK modulation) 14 - "STL Receiver" (used with 4FSK modulation) 15 - "STL Transmitter" (used with 4FSK modulation)
MOD	1 - DBPSK 2 - DQPSK, a default settings 3 - D8PSK 4 - D16QAM 5 - GMSK 6 - 4FSK
SPACE	Sets channel spacing: 0 - 25kHz, a default setting 1 - 12.5kHz 2 - 6.25kHz 3 - 20kHz
PWRB / PWRW	(13 - 33) / (20 - 2000) - RF output Power in dBm / mW
FHOP	(1 - 128) - Frequency Hopping Pattern number LINK FHOP command can be processed only if the Channel Map (up to 32 channels)
SCRAM	0 - No Scrambling (a default setting) (1 - 255) - Seed for Pseudo-Random Sequence Generator
FEC	0 - Disable Forward Error Correction (FEC), a default setting 1 - Enable Reed-Solomon encoding
RTR	Base Unit 0 - No Retransmission in the wireless cluster 1 - There is Repeater Remote Unit 0 - Auto Detect (Base or Repeater) 1 - Receive from Repeater 2 - Receive from Base

**Note:** The frequency defined by CHAN parameter is not valid if Frequency Hopping mode is selected. In the Frequency Hopping mode, the Frequency Pattern generator must generate the random numbers smaller than the number of frequencies listed in the unit's frequency list.

## 3.3. Serial Interfacing Commands

### 3.3.1. DPORT

The DPORT is an object that responsible for data port interface configurations like Bit Rate, Flow Control, etc.

DPORT [*Parameter Name*] [*Parameters List*] [/?]

Parameter Name	Parameter List
RATE	0 – Maintenance Port baud rate, a default setting 1 – 1200 baud 2 – 2400 baud 3 – 4800 baud 4 – 9600 baud 5 – 14400 baud 6 – 19200 baud 7 – 38400 baud 8 – 57600 baud 9 – 115200 baud, a default setting
BITS	Set number of bits in one byte (8 or 7) 8 is a default setting
PARITY	0 – None, a default setting 1 – Odd 2 – Even
FLOW	0 – None, a default setting 1 – Not used 2 – HW (RTS/CTS)

### 3.3.2. MPORT

The MPORT is an object that responsible for maintenance serial port interface configurations such as data rate and number of bits in a byte.

MPORT [*Parameter Name*] [*Parameters List*] [/?]

Parameter Name	Parameter List
RATE	0 – Auto. 1 – 1200 baud 2 – 2400 baud 3 – 4800 baud 4 – 9600 baud 5 – 14400 baud 6 – 19200 baud 7 – 38400 baud 8 – 57600 baud 9 – 115200 baud, a default setting

**Note:** JAVAD GNSS radio modem’s does not support data flow and parity on the maintenance serial port. The radio modem with none-dedicated maintenance serial port must keep CTS line always active in MPORT mode (DP/MP is low).

## 3.4. Special Commands

### 3.4.1. BOOT

The factory software image and default configuration is set for the new unit. The BOOT command is intended to reboot the unit using specified software image and selected configuration.

BOOT [*Parameter Name*] [*Parameters List*] [/?]

Parameter Name	Parameter List
IMAGE	0 - selects the factory loaded real-time software/firmware image 1 - selects the user updated real-time software/firmware image
CFG	0 - selects the factory default configuration 1 - selects user modified configuration

The BOOT command with no parameters selects the user settings defined by the prior “parameterized” BOOT commands.

## 3.4.2. HELP

The HELP command types the list of all available commands:

```
HELP - Display this usage
BOOT - Reboot the unit
LINK - RF Link Operation Mode
DPORT- Data Port Configuration
MPORT - Maintenance Port Configuration
ALARM - Alarm Indication and Alarm Control Configuration
SLEEP - Sleep Mode Configuration
CONNECT - Connect to Specified Unit
STATE - Display Status and Statistics
SAVE- Save Current Configuration into Configuration File
INFO - Display Product ID along with Hardware/Software Versions
DATAMODE - Exit Maintenance Mode
[COMMAND] /? - Display Command Usage
```

## 3.4.3. SAVE

The SAVE command is intended to store the unit's currently used configuration into the User Configuration file. The configuration stored in the User Configuration file is activated by automatically after unit's reboot.



### 3.4.4. SLEEP

The SLEEP command determines the sleep mode parameters. The sleeping HPT402 can be activated by real-time CLK, DTR/RTS lines, and command received through TTL inputs. The user can select one, two, or all three conditions.

SLEEP [*Parameter Name*] [*Parameters List*] [/?]

Parameter Name	Parameter List
CLK	0 – Do not activate by internal real-time clock (1 – 255) – Activate by internal real-time clock after 100 to 25500 msec of sleeping
HW	0 – Do not activate through DTR/RTS lines 1 – Activate through DTR/RTS lines
TTL	0 – Do not activate by external sense lines 1 – Activate by external sense lines
GTS	0 – Disable Sleep mode (default) (1 – 255) – Go to sleep mode if there is no activity in 10 to 2550 msec

## 3.5. Diagnostics and Identification Commands

### 3.5.1. INFO

The INFO command is used to retrieve the Radio ID along with its Hardware version, the loaded real-time software version/revision and BootLoader's version/revision.

INFO [*Parameter Name*] [*Parameters List*] [/?]

Parameter Name	Parameter List
ID	Product ID: 31 - HPT402
SN	Six bytes Serial Number (SN)
HW	1.0 - hardware version in numeric “Major.Minor” format
SW	Ver. 1.0 Rev. A - displays software's version in numeric “Major.Minor” format and revision in numeric format (range from 01 to 99) for engineering releases and alphabetic format (A to Z) for manufacturing releases
BL	Ver. 1.0 Rev. A - displays BootLoader's version in numeric “Major.Minor” format and revision in numeric format (range from 01 to 99) for engineering releases and alphabetic format (A to Z) for manufacturing releases

The INFO command without Parameter Name indicates all values:

```
HPT402 UHF Radio Modem, Javad GNSS
```

## Command Line Interface

Diagnostics and Identification Commands

### STATE

```
Product ID =31
S/N =000000000007
Hardware =Ver. 1.0
Software =Ver. 1.6 Rev 12 B9
BootLoader =Ver. 2.0 Rev 01
```

## 3.5.2. STATE

The STATE command is used to check the state of the wireless link, the unit in the link, and the alarm control lines. To specify a radio unit (local or remote), the CONNECT command must be used in prior of STATE command using.

STATE [*Parameter Name*] [*Parameters List*] [/?]

Parameter Name	Parameter List
TTL1	0/1 - State of TTL_IN1 line
TTL2	0/1 - State of TTL_IN2 line
RSSI	-52 to -116 dBm - Indicates the Receive Signal Strength in dBm
BER	1.0E-6 to 9.9E-3 - Indicates the BER level
FREQ	403.000000 to 470.000000 MHz - Displays the central frequency of the operating channel.

The STATE command without Parameter Name indicates all values as shown below:

```
RSSI =-106 dBm
BER =0E-0
FREQ =440.000000 MHz
CHAN =-4
TEMP =23
SYNC =0
TTL1 =1
TTL2 =1
MODE =FIXED
```

# CONFIGURATION EXAMPLE

## 4.1. HPT402 as a Base Configuration

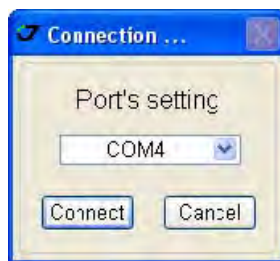
1. Connect the TRIUMPH-1 receiver to computer. See for details the TRIUMPH-1 Operator's Manual.
2. Connect the external HPT402 UHF radio to receiver's port B with cable Accessory Data-Ser-Pwr cable, ODU-7/DB15/SAE (1.8 m) p/n 14-578108-02. See "Connecting HPT402 and TRIUMPH-1" on page 18.
3. Power the HPT402.
4. Turn on the TRIUMPH-1 receiver.
5. Start ModemVU.

6. Select *HPT402* and click OK (Figure 4-1).



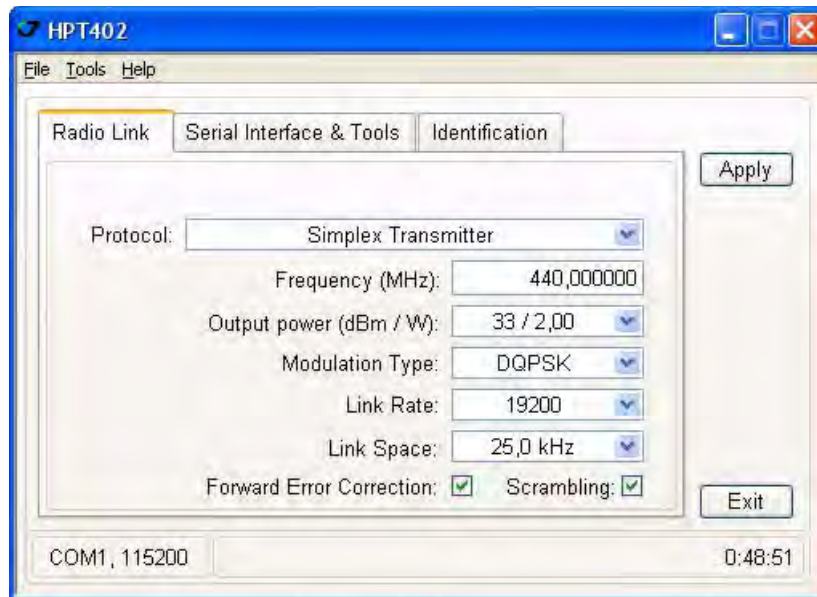
**Figure 4-1. ModemVU. Options window**

7. Select the port the TRIUMPH-1 receiver is connected to and click *Connect* (Figure 4-2).



**Figure 4-2. ModemVU. Connection**

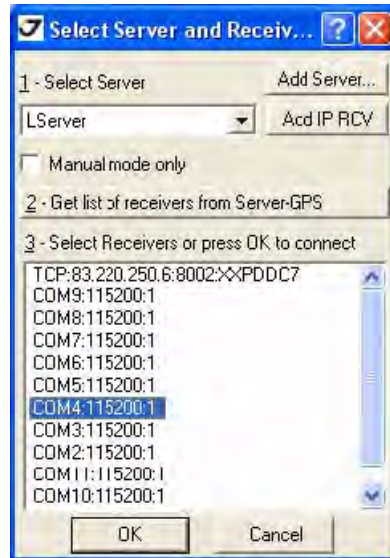
8. In the *Radio Link* tab set the following parameters, and click *Apply* (Figure 4-3):



**Figure 4-3. Radio Link tab settings**

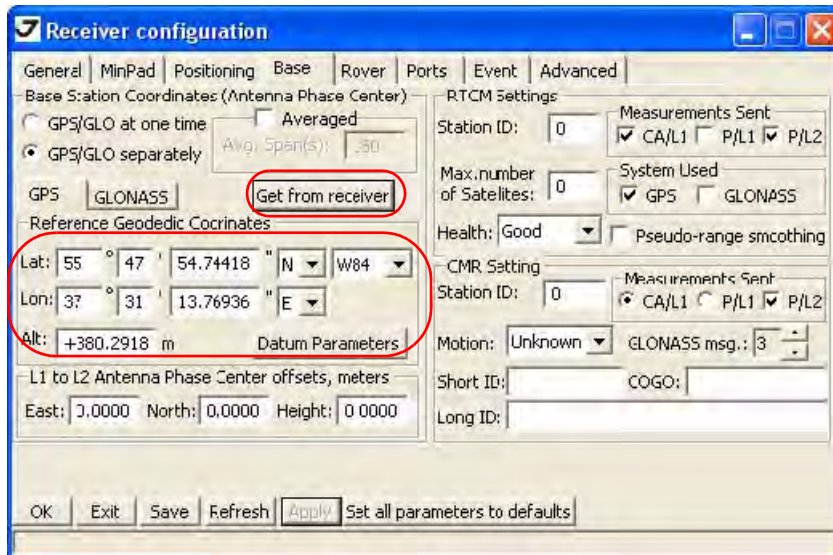
- Protocol: Simplex Transmitter
  - Frequency (MHz): 406.1 to 470
  - Output power (dBm/W): 33/2.00
  - Modulation Type: DQPSK
  - Link Rate: 19200
  - Link Space: 25.0 kHz
  - Forward Error Corrections: ON
  - Scrambling: ON
9. Quit ModemVU by clicking *Exit* button.

10. Start TriVU. Select port the TRIUMPH-1 receiver is connected to and click OK (Figure 4-4).



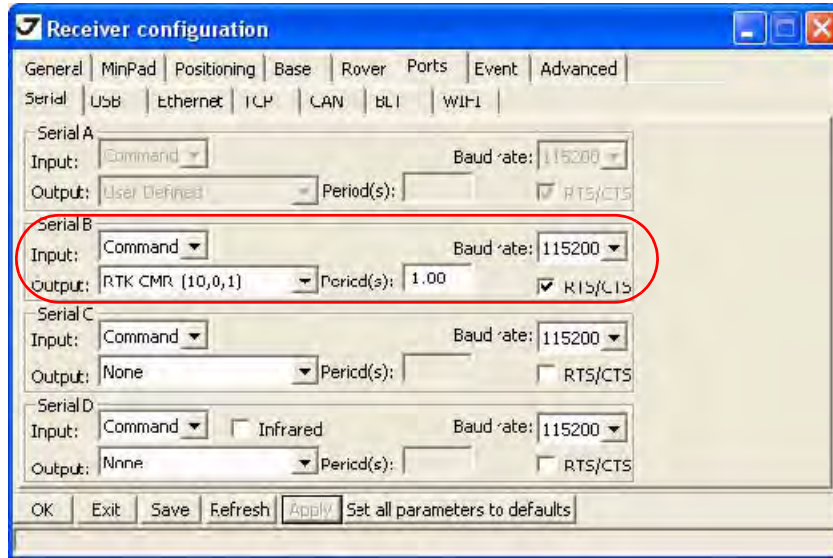
**Figure 4-4. TriVU. Selecting port**

11. Click *Configuration* ▶ *Receiver*.
12. In the *Base* tab click the *Get from receiver* button. Reference geodetic coordinates appear. Click *Apply* (Figure 4-5).



**Figure 4-5. Base tab**

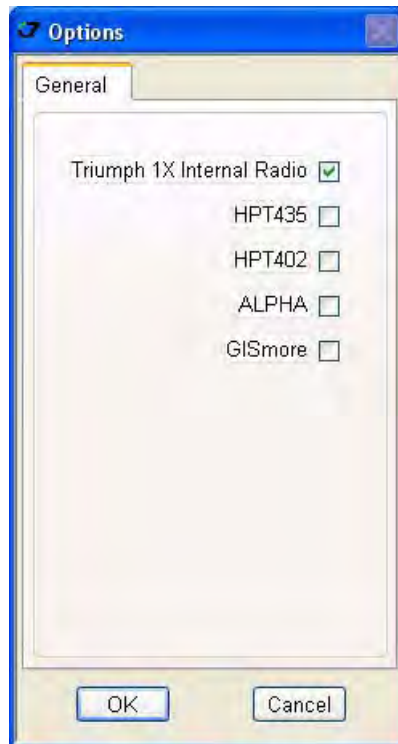
13. In the *Ports* tab set the Port B *Output mode* to RTK CMR, and click *Apply*, then OK (Figure 4-6).



**Figure 4-6. Rover tab**

## 4.2. TRIUMPH-1 internal UHF radio as a Rover Configuration

1. Connect the receiver and computer as described in TRIUMPH-1 Operator's Manual.
2. Start ModemVU.
3. Select *Triumph 1X Internal Radio* and click OK (Figure 4-7).



**Figure 4-7. ModemVU. Options window**

4. Select the port receiver is connected to and click *Connect* (Figure 4-8).



**Figure 4-8. ModemVU. Connection**

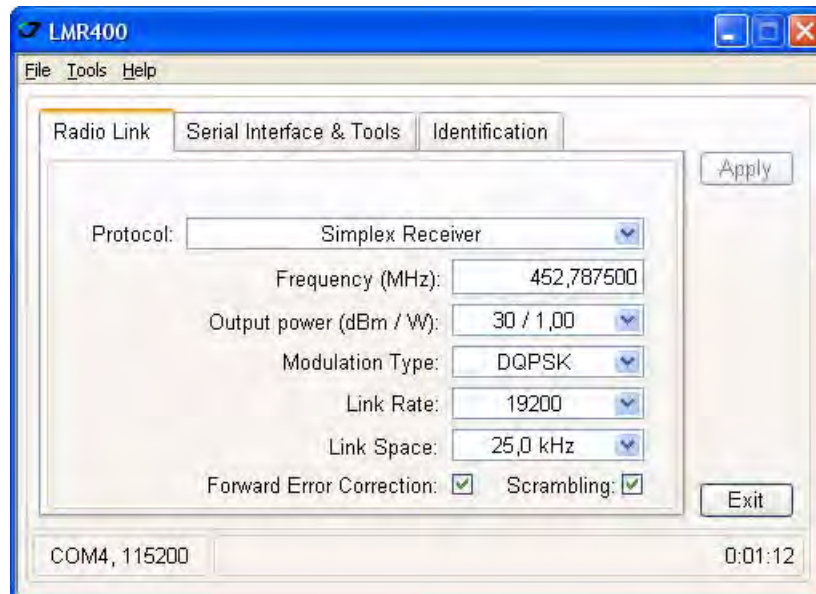


5. Select the *ON* mode for *Radio*, click *Apply* and click *Connect Radio* button (Figure 4-9).



**Figure 4-9. ModemVU TRIUMPH Internal Radio selection**

6. In the *Radio Link* tab set the following parameters, and click *Apply* (Figure 4-10):



**Figure 4-10. Radio Link tab settings**

- Protocol: Simplex Receiver
- Frequency (MHz): 406 to 470
- Output power (dBm/W): 30/1.00
- Modulation Type: DQPSK
- Link Rate: 19200
- Link Space: 25.0 kHz
- Forward Error Corrections: ON
- Scrambling: ON

7. Quit ModemVU by clicking *Exit* button.

## Configuration Example

TRIUMPH-1 internal UHF radio as a Rover Configuration

8. Start TriVU. Select port the receiver is connected to and click OK (Figure 4-4).

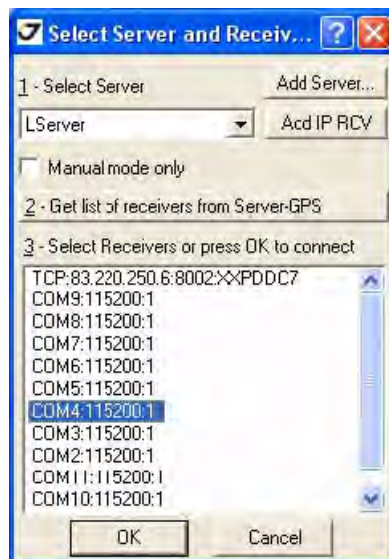


Figure 4-11. TriVU. Selecting port

9. Click *Configuration* ▶ *Receiver*.
10. In the *Positioning* tab set RTK fixed Positioning Mode, then click *Apply* (Figure 4-12).

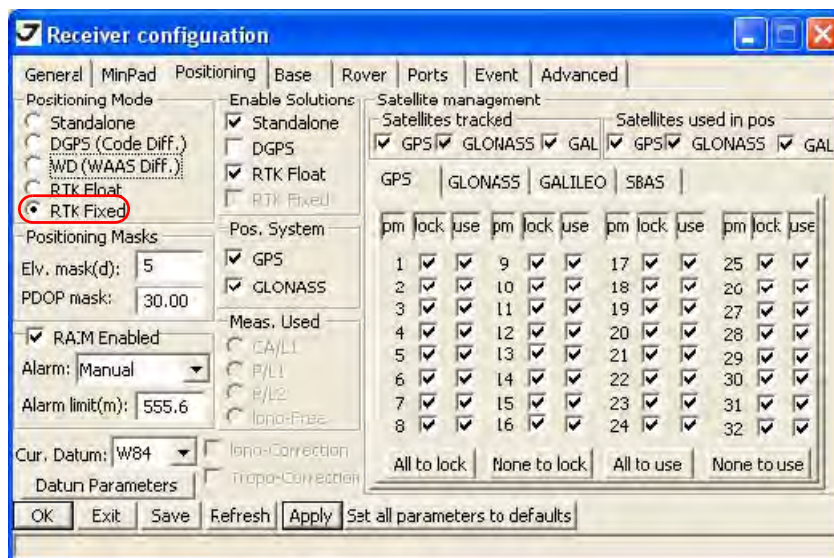


Figure 4-12. Positioning tab

11. In the *Rover* tab set Positioning Mode to RTK fixed mode (Figure 4-13), then click *Apply*:

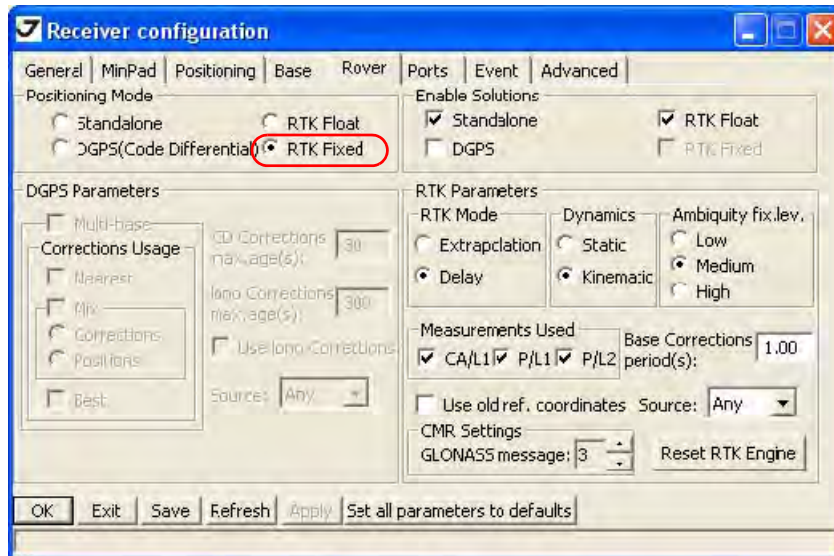


Figure 4-13. Rover tab

12. In the *Ports* tab set the *Input* mode for port D to CMR, then click *Apply* and OK (Figure 4-14).

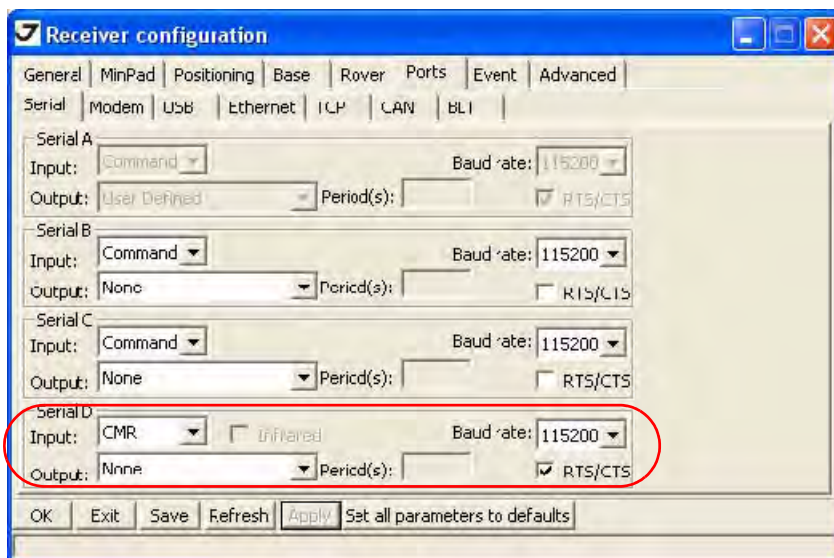


Figure 4-14. Ports tab

### Configuration Example

TRIUMPH-1 internal UHF radio as a Rover Configuration

13. The receiver will obtain the RTK Fixed solution (Figure 4-15).

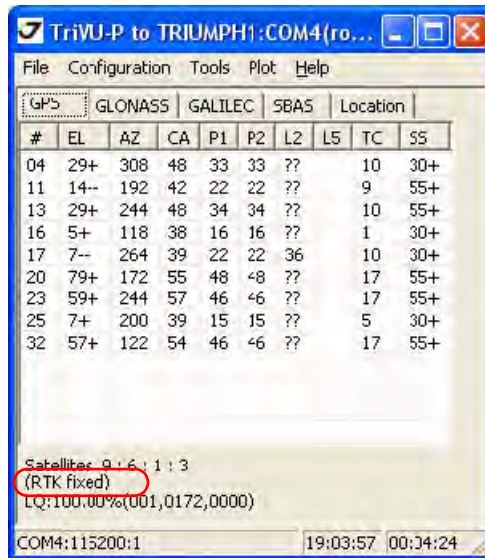


Figure 4-15. TriVU. RTK fixed

# SPECIFICATIONS

## A.1. HPT402 UHF Modem Specifications

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

### A.1.1. General Radio Specifications

Table below lists the modem's general specifications.

**Table A-1. General Radio Specifications**

Parameter	Specification
Operating Frequency Range	406.1 - 470 MHz
Channel Spacing	25/20/12.5/6.25 kHz
Data Rate (25kHz Channel Spacing)	9600 bps – DBPSK/GMSK 19200 bps – DQPSK/4FSK 28800 bps – D8PSK 38400 bps – D16QAM
Data Rate (20kHz Channel Spacing)	7500 bps – DBPSK/GMSK 15000 bps – DQPSK/4FSK 22500 bps – D8PSK 30000 bps – D16QAM
Data Rate (12.5kHz Channel Spacing)	4800 bps – DBPSK/GMSK 9600 bps – DQPSK/4FSK 14400 bps – D8PSK 19200 bps – D16QAM
Data Rate (6.25 kHz Channel Spacing)	2400 bps – DBPSK 4800 bps – DQPSK 7200 bps – D8PSK 9600 bps – D16QAM
System Gain for DBPSK modulation (Antenna gain is not included)	149 dB (for 25 kHz Channel Spacing) 149 dB (for 20 kHz Channel Spacing) 151 dB (for 12.5 kHz Channel Spacing) 152 dB (for 6.25 kHz Channel Spacing)
Roaming Speed for DBPSK modulation	75 mph / 120 km/h
Modulation	GMSK/4FSK/DBPSK/DQPSK/D8PSK/D16QAM

## Specifications

HPT402 UHF Modem Specifications  
Environmental Specifications

Nominal Impedance	50 Ohms
End to End delay	60 ms
Communication Mode	Time Division Duplex (TDD) Time Division Multiple Access (TDMA)
Maximum Distance Range	11 miles / 18 km
Input/Output	Serial (RS232) up to 115200 bps

### A.1.2. Environmental Specifications

Table A-2 lists the modem's environmental specifications.

**Table A-2. Environmental Specifications**

Parameter	Specification
Temperature	Operating $-40^{\circ}\text{C}$ to $+60^{\circ}\text{C}$ Storage $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
Environmental	IP 66
Dimensions (H x W x D)	152 mm x 84 mm x 72 mm
Weight	900 g
Power Supply Voltage	+9 to +16 VDC nominal
Power Consumption (Average)	6W / 2W / 0.05W –Transmit / Receive / Sleep
Housing/Color	Aluminum / Two-tone JAVAD GNSS Green / Gray
Antenna Connector	BNC, 50W $\Omega$

### A.1.3. Transmitter Specifications

Table A-3 lists the transmitter specifications.

**Table A-3. Transmitter Specifications**

Parameter	Specification
Output Power	DBPSK/GMSK 13 dBm to 33 dBm in 1 dB steps (32 mW to 2 W) DQPSK/4FSK 13 dBm to 33 dBm in 1 dB steps (32 mW to 2 W) D8PSK 13 dBm to 33 dBm in 1 dB steps (32 mW to 2 W) D16QAM 13 dBm to 33 dBm in 1 dB steps (32 mW to 2 W)
Output Power Control Accuracy	$\pm 1.5$ dB (at normal test conditions) $+2.0$ dB and $-3.0$ dB (under extreme test conditions)
Carrier Frequency Stability	$\pm 1.5$ ppm initial stability over temp with $\pm 3.0$ ppm aging/year



Max. Frequency Error	±1.0 kHz (at normal test conditions) ±1.5 kHz (under extreme test conditions)
Adjacent Channel Power (Conducted) 25/12.5/6.25 kHz CS	Part §90.210 (C, D, E) for USA and Canada 60 dBc for Europe
Spurious Emission (Conducted)	-36 dBm (9 kHz – 1GHz) -30 dBm (1GHz – 4 GHz)
Spurious Emission (Radiated)	-36 dBm (9 kHz to 1 GHz) -30 dBm (1 GHz to 4 GHz)

## A.1.4. Receiver Specifications

Table A-4 lists the receiver specifications.

**Table A-4. Receiver Specifications**

Parameter	Specification
Noise Figure	4 dB
Receiver Sensitivity (BER 1x10 <sup>-4</sup> , 25 kHz CS	DBPSK -116 dBm 25kHz / -117 dBm 12.5kHz DQPSK -115 dBm 25kHz / -116 dBm 12.5kHz D8PSK -110 dBm 25kHz / -111 dBm 12.5kHz D16QAM -106 dBm 25kHz / -107 dBm 12.5kHz GMSK -113 dBm 25kHz / -114 dBm 12.5kHz
Dynamic Range	-115 to -15 dBm
Max. Input Signal Level	-10 dBm
Co-channel Rejection	-8 dB for 25 kHz Channel Spacing -8 dB for 20 kHz Channel Spacing -12 dB for 12.5 kHz Channel Spacing -16 dB for 6.25 kHz Channel Spacing
Adjacent Channel Selectivity	70 dB for 25 kHz Channel Spacing 70 dB for 20 kHz Channel Spacing 60 dB for 12.5 kHz Channel Spacing 50 dB for 6.25 kHz Channel Spacing

## Specifications

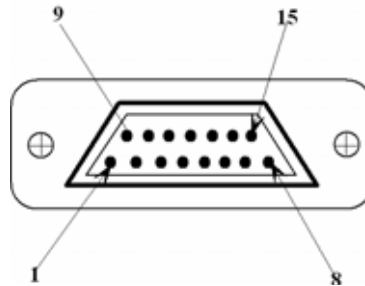
Connector Specifications

Receiver Specifications

# A.2. Connector Specifications

## DB15 Connector

This provides DB15 connectivity for the HPT402 with a DB9 for connection to a PC/CE Device for configuration.



**Figure A-1. DB15 Connector**

**Table A-5. DB15 Connector Specifications**

Number	Signal Name	Dir	Details
1	DCD	O	Data Carrier Detect
2	DSR	O	Data Set Ready
3	RTS	I	Request To Send
4	DATAIN	I	Data from PC Serial Port to Modem
5	Reserved		Do not use
6	Reserved		Do not use
7	Reserved		Do not use
8	PWRIN		DC Power between 9 and 16 VDC
9	DTR	I	Data Terminal Ready
10	CTS	O	Clear To Send
11	DATAOUT	O	Data from Modem to PC Serial Port
12	Reserved		Do not use
13	Reserved		Do not use
14	Reserved		Do not use
15	GND		DC Power and Signal to Ground

## External Antenna RF Connector

The external antenna connector type is a BNC RF connector AEP Connectors p/n 6501-7051-003.



# UHF RADIO USAGE

Many countries require a license for radio users (such as the United States). Be sure you comply with all local laws while operating a UHF radio.

Surveying in RTK mode has made UHF the most popular choice for communications between base and rover receivers. Know the strengths and weaknesses of this technology to get the best use out of your receiver.

The quality and strength of the UHF signals translates into range for UHF communications.

The system's range will greatly depend on the local conditions. Topography, local communications and even meteorological conditions play a major role in the possible range of RTK communications.

If needed, use a scanner to find clear channels for communication.



# SAFETY WARNINGS

Read these instructions.

- Keep these instructions.
- Heed all warnings.
- Follow all instructions.
- Clean only with a damp cloth.
- Do not block any of the ventilation openings. Install in accordance with the manufacturer's instructions.
- Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
- Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
- Only use attachments/accessories specified by the manufacturer.
- Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, or has been dropped.
- Apparatus shall not be exposed to dripping or splashing and no objects filled with liquids, shall be placed on the apparatus.

## **C.1. General Warnings**

This product should never be used:

- Without the user thoroughly understanding operator's manual.
- After disabling safety systems or altering the product.
- With unauthorized accessories.
- Contrary to applicable laws, rules, and regulations.

**DANGER: THE HPT402 SHOULD NEVER BE USED IN DANGEROUS ENVIRONMENTS.**

# WARRANTY TERMS

JAVAD GNSS electronic equipment are guaranteed against defective material and workmanship under normal use and application consistent with this Manual. The equipment is guaranteed for the period indicated, on the warranty card accompanying the product, starting from the date that the product is sold to the original purchaser by JAVAD GNSS' Authorized Dealers<sup>1</sup>.

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

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

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

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



900 Rock Avenue, San Jose, CA 95131 USA

Phone: +1(408)770-1770

Fax: +1(408)770-1799

[www.javad.com](http://www.javad.com)

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