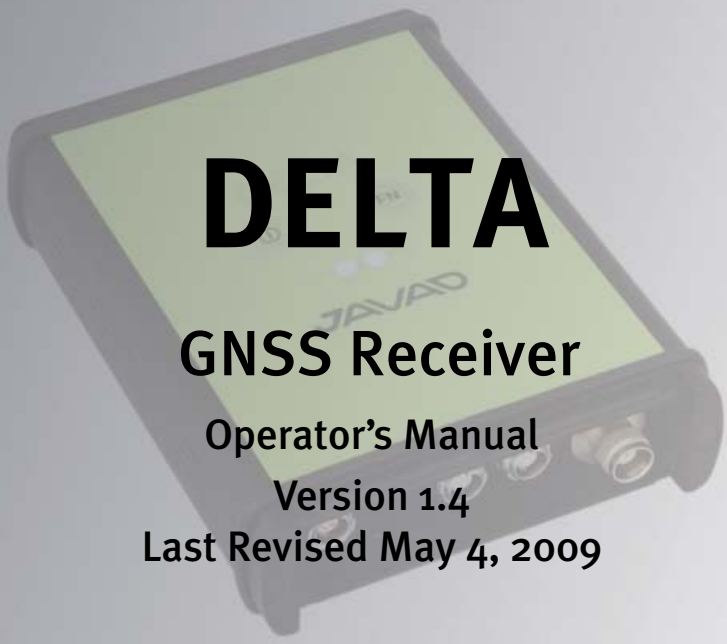

DELTA

GNSS Receiver

Operator's Manual

Version 1.4

Last Revised May 4, 2009

Table of Contents

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 the DELTA receiver and its use is subject to these terms and conditions (the "Terms and Conditions").

Note: Please read these Terms and Conditions carefully.

Terms and Conditions

USE – JAVAD GNSS receivers are designed to be used by a professional. The user is expected to have a good knowledge and understanding of the user and safety instructions before operating, inspecting or adjusting. Always wear the required protectors (safety shoes, helmet, etc.) when operating the receiver.

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SAFETY – Improper use of the DELTA receiver can lead to injury to persons or property and/or malfunction of the product. The DELTA receiver should only be repaired by authorized JAVAD GNSS warranty service centers. Users should review and heed the safety warnings in Appendix B on page 87.

MISCELLANEOUS – The above Terms and Conditions may be amended, modified, superseded, or canceled, at any time by JAVAD GNSS.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

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.

Declaration of Conformity

Cesky [Czech]	JAVAD GNSS tímto prohlašuje, že tento DELTA Receiver je ve shodì se základními požadavky a dalšími pøíslušnými ustanoveními smìrnice 1999/5/ES.
Dansk [Danish]	Undertegnede JAVAD GNSS erklærer herved, at følgende udstyr DELTA Receiver overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF.
Deutsch German]	Hiermit erklärt JAVAD GNSS, dass sich das Gerät DELTA Receiver in Übereinstimmung mit den grundlegenden Anforderungen und den übrigen einschlägigen Bestimmungen der Richtlinie 1999/5/EG befindet.
Eesti [Estonian]	Käesolevaga kinnitab JAVAD GNSS seadme DELTA Receiver vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.
English	Hereby, JAVAD GNSS, declares that this DELTA Receiver is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Español [Spanish]	Por medio de la presente JAVAD GNSS declara que el DELTA Receiver cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE.
Ελληνική [Greek]	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ JAVAD GNSS ΔΗΛΩΝΕΙ ΟΤΙ DELTA Receiver ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/ΕΚ.
Francais [French]	Par la présente JAVAD GNSS déclare que l'appareil DELTA Receiver est conforme auxexigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE.
Italiano [Italian]	Con la presente JAVAD GNSS dichiara che questo DELTA Receiver è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Latviski [Latvian]	Ar šo JAVAD GNSS deklare, ka DELTA Receiver atbilst Direktivas 1999/5/EK butiskajam prasibam un citiem ar to saistitajiem noteikumiem.
Lietuviu [Lithuanian]	ŠiuoJAVAD GNSS deklaruoja, kad šis DELTA Receiver atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.
Nederlands [Dutch]	Hierbij verklaart JAVAD GNSS dat het toestel DELTA Receiver in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG.

Malti [Maltese]	Hawnhekk, JAVAD GNSS, jiddikjara li dan DELTA Receiver jikkonforma mal-.ti.ijiet essenzjali u ma provvedimenti o.rajn relevanti li hemm fid-Dirrettiva 1999/5/EC.
Magyar [Hungarian]	Alulírott, JAVAD GNSS nyilatkozom, hogy a DELTA Receiver megfelel a vonatkozó alapvetõ követelményeknek és az 1999/5/EC irányelv egyéb elõírásainak.
Polski [Polish]	Niniejszym JAVAD GNSS oświadcza, że DELTA Receiver jest zgodny z zasadniczymi wymogami oraz pozostałymi stosownymi postanowieniami Dyrektywy 1999/5/EC.
Portugues [Portuguese]	JAVAD GNSS declara que este DELTA Receiver está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.
Slovensko [Slovenian]	JAVAD GNSS izjavlja, da je ta DELTA Receiver v skladu z bistvenimi zahtevami in ostalimi relevantnimi doloèili direktive 1999/5/ES.
Slovensky [Slovak]	JAVAD GNSS týmto vyhlasuje, že DELTA Receiver spåòa základné požiadavky a všetky príslušné ustanovenia Smernice 1999/5/ES.
Suomi [Finnish]	JAVAD GNSS vakuuttaa täten että DELTA Receiver tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Svenska [Swedish]	Härmed intygar JAVAD GNSS att denna DELTA Receiver står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.
Íslenska [Icelandic]	Hér með lýsir JAVAD GNSS yfir því að DELTA Receiver er í samræmi við grunnkröfur og aðrar kröfur, sem gerðar eru í tilskipun 1999/5/EC.
Norsk [Norwegian]	JAVAD GNSS erklærer herved at utstyret DELTA Receiver er i samsvar med de grunnleggende krav og øvrige relevante krav i direktiv 1999/5/EF.

DECLARATION of CONFORMITY

According to ISO/IEC Guide 22 and EN45014

Manufacturer's Name:	JAVAD GNSS, Inc
Manufacturer's Address:	1731 Technology Drive San Jose, CA 95110 USA

declares, that the products

Product Name:	DELTA GNSS Receivers
Product Number:	01-580300-01, 01-580301-01, 01-580302-01, 01-58030X-01
Product Options:	All

conforms to the following Product Specification:

Safety:	
Low Voltage Directive 73/23/EEC	IEC 60950: 1999 3RD Edition / EN 60950-1:2001
EMC:	
Directive 89/336/EEC	EN 301 489 – 1, EN 301 444

Supplementary Information:

The product herewith complies with the essential requirements of the directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment (R&TTE) and the mutual recognition of their conformity and carries the CE marking accordingly

1) These products were tested in a typical configuration with JAVAD GNSS, Inc. products

V. Zhukov

San Jose, January, 14, 2008

Vladimir Zhukov, Product Regulations Manager

European contact for regulatory topics only: ALLSAT GmbH Am Hohen Ufer 3A, 30159 Hannover, Germany
USA contact: Javad GNSS, Inc 1731 Technology Drive, San Jose, CA 95110. Phone (408)573-8100

Manual Conventions

This manual uses the following conventions:

Example	Description
File ▸ *Exit*	Click the *File* menu and click *Exit*
TriPad	This format represents titles of dialog windows/boxes, names of menu options, identifies program interface objects, such as checkboxes, edit boxes, radio buttons, etc.
`Temp`	This format is used to enter various string information (e.g., file and directory names) as well as operator commands.

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

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

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

DANGER: UNDER NO CIRCUMSTANCES SHOULD THIS ACTION BE PERFORMED.

Screen Captures

This manual includes sample screen captures. Your actual screen can look slightly different from the sample screen due to the receiver 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 QUESTIONS system at the JAVAD GNSS World Wide Web site: www.javad.com

Return Material Authorization

Initially, the customer contacts support to report a problem. Please refer to support: Question section on www.javad.com. If support determines the problem cannot be resolved over e-mail/ internet, it will authorize the return of the unit for repair or replacement, depending on the nature of the problem.

INTRODUCTION

Based on the TRIUMPH Chip, DELTA is a fully integrated package ready for your demanding jobs, offering precise and automatic performance beyond anything that you have experienced so far (Figure 1-1).

Figure 1-1. DELTA Receiver

DELTA can receive and processes multiple signal types (including the latest GPS L2C, GPS L5, GLONASS C/A L2, and Galileo signals) improving the accuracy and reliability of your measuring points and positions, especially under difficult jobsite conditions.

The GNSS component of DELTA receivers means you can access the GPS (Global Positioning System) satellites of the United States, the Galileo (an upcoming global positioning system maintained and operated by Galileo Industries,) and the GLONASS (Global Navigation Satellite System) satellites of the Russian Federation, increasing the number of satellites your receiver can detect, thus improving the accuracy of your measuring points, increasing productivity, and reducing cost.

Several other features provide under-canopy and low signal strength reception. The DELTA receiver provides the functionality, accuracy, availability, and integrity needed for fast and easy data collection.

1.1. Principles of Operation

Measuring with the right GNSS receiver can provide users accurate and precise positioning, a requirement for any measuring project. This section gives an overview of existing and proposed Global Navigation Satellite Systems (GNSS) and receiver functions to help you understand and apply basic operating principles, allowing you to get the most out of your receiver.

1.1.1. GNSS Overview

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

- GPS – the Global Positioning System maintained and operated by the United States Department of Defense. For information on the status of this system, visit the US Naval Observatory website (http://tycho.usno.navy.mil/) or the US Coast Guard website (http://www.navcen.uscg.gov/).
- GLONASS – the Global Navigation Satellite System maintained and operated by the Russian Federation Ministry of Defense. For information on the status of this system, visit the Coordinational Scientific Information Center website (http://www.glonasscenter.ru/frame_e.html).
- Galileo – an upcoming global positioning system maintained and operated by Galileo Industries, a joint venture of several European space agencies/companies working closely with the European Space Agency. Unlike GPS and GLONASS, this is a civil endeavor and is currently in the development and validation stage. For information on the status of this system, visit the Galileo Industries website (http://www.galileo-industries.net).

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

- Space – GPS, GLONASS, and Galileo satellites orbit approximately 12,000 nautical miles above Earth and are equipped with a clock and radio. These satellites broadcast ranging signals and various digital information (ephemerides, almanacs, time&frequency corrections, etc.).
- Control – Ground stations located around the Earth that monitor the satellites and upload data, including clock corrections and new ephemerides (satellite positions as a function of time), to ensure the satellites transmit data properly.
- User – The community and military that use GNSS receivers to calculate positions.

1.1.2. Calculating Absolute Positions

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

1.1.3. Calculating Differential Positions

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

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

- The type of GNSS measurements used, either code-phase differential measurements or carrier-phase differential measurements
- If real-time or post-mission results required Real-time applications can be further divided according to the source of differential data and communication link used.

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

- For real-time applications, these measurements and the reference station coordinates are then built up to the industry standard RTCM – or various proprietary standards established for transmitting differential data – and broadcast to the remote receiver(s) using a data communication link. The remote receiver applies the transmitted measurement information to its observed measurements of the same satellites.
- For post-mission applications, the simultaneous measurements from reference and rover stations are normally recorded to the receiver's internal memory (not sent over communication link). Later, the data are downloaded to computer, combined, and processed.

Using this technique, the spatially correlated errors – such as satellite orbital errors, ionospheric errors, and tropospheric errors – can be significantly reduced, thus improving the position solution accuracy. A number of differential positioning implementations exist, including post-processing measuring, real-time kinematic measuring, maritime radio beacons, geostationary satellites, and satellite based augmentation systems (WAAS, EGNOS, MSAS). The real-time kinematic (RTK) method is the most precise method of real-time measuring. RTK requires at least two receivers collecting navigation data and communication data link between the receivers. One of the receivers is usually at a known location (Base) and the other is at an unknown location (Rover). The Base receiver collects carrier phase measurements, generates RTK corrections, and sends this data to the Rover receiver. The Rover processes this transmitted data with its own carrier phase observations to compute its relative position with high accuracy, achieving an RTK accuracy of up to 1 cm horizontal and 1.5 cm vertical.

1.1.4. Essential Components for Quality Measuring

Achieving quality position results requires the following elements:

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

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

  – The more satellites in view, the stronger the signal, the lower the DOP number, the higher positioning accuracy.
- Availability – The availability of satellites affects the calculation of valid positions. The more visible satellites available, the more valid and accurate the position. Natural and man-made objects can block, interrupt, and distort signals, lowering the number of available satellites and adversely affecting signal reception.
- Integrity – Fault tolerance allows a position to have greater integrity, increasing accuracy. Several factors combine to provide fault tolerance, including:

  – Receiver Autonomous Integrity Monitoring (RAIM) detects faulty GNSS satellites and removes them from the position calculation.

  – Five or more visible satellites for only GPS or only GLONASS; six or more satellites for mixed scenarios.

  – Satellite Based Augmentation Systems (WAAS, EGNOS, etc.) creates and transmit, along with DGPS corrections, data integrity information (for example, satellite health warnings).

  – Current ephemerides and almanacs.

1.2. Getting Acquainted

DELTA is a 216-channel GNSS receiver, up to three data ports, an interface for controlling and viewing data logging (TriPad).

1.2.1. DELTA Receiver

TriPad

The TriPad is the receiver's minimum interface used to display and control data input and output (Figure 1-2).

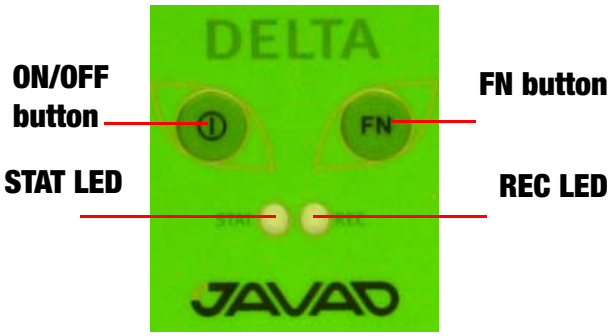


Figure 1-2. DELTA TriPad

The *STAT (Status) LED* displays the number of tracked satellites.

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

The *On/Off* (*power) button* turns the receiver on and off.

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

- During the first second of pressing the FN button, the REC LED is orange.
- Pressing the *FN button* for more than one and less than five seconds will start/stop data recording.
- During data recording the REC LED is green or orange.

- If the *REC LED* is red, the receiver has run out of memory, has a hardware problem, or contains an improper OAF (see “Option Authorization File (OAF)” on page 22 for more information on OAFs).
- The *REC LED* blinks green or orange each time data is written to the internal receiver's memory.
- Each time you turn off or on data recording, either a new file opens or data appends to a particular file. See “Always Append to the File parameter” on page 36 and “Files Creation Mode parameter” on page 36 for information on setting this function.
- Pressing the FN button for more than five and less than eight seconds will turn the baud rate of serial port A to 9600. After about five seconds of pressing the FN button, the REC LED becomes red. Release the FN button while the REC LED is red (during the next three seconds).
- Pressing the FN button for more than eight seconds has no impact.

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

Data and Power Ports

The DELTA receiver can be equipped according users needs and have different ports on the front panel. Below are presented some examples of possible configurations (Figure 1-3):

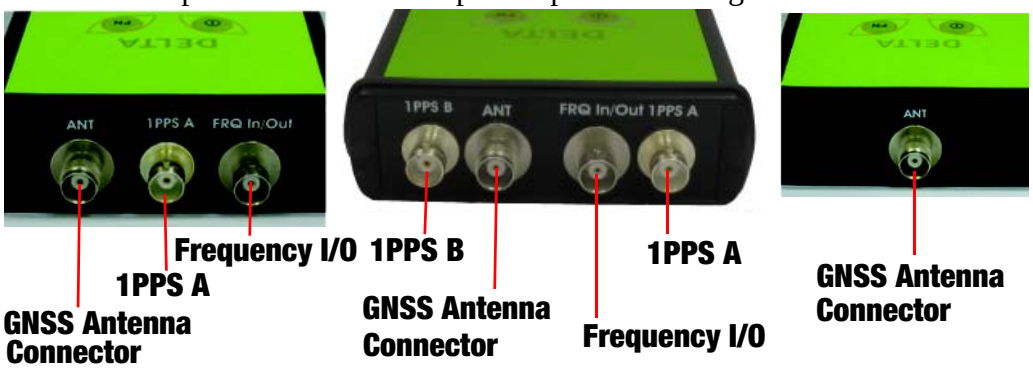
Figure 1-3. DELTA Ports

- Power – used to connect the receiver to an external power source. This port can also be used to charge the batteries. The body of the connector on the corresponding cable is red.
- Serial – used for communication between the receiver and an external device. The body of the connector on the corresponding cable is green.

- Ethernet - used to connect the receiver to local network. The body of the connector on the corresponding cable is gray.
- USB –used for high-speed data transfer and communication between the receiver and an external device. The body of the connector on the corresponding cable is black.

Connectors

The DELTA receiver can be equipped according users need and have different connectors on the back panel. Below are presented some examples of possible configurations:



- The external GNSS antenna connects to the TNC external antenna connector (optional)
- The 1PPS and Event marker TNS connectors (up to two) (optional)
- External Frequency Input/Output TNC connector (optional)

1.2.2. Cables

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

Receiver-to-computer RS232 serial cable – connects the receiver's serial port and an external device (hand-held controller or computer) p/n 14-578103-01	
Receiver-to-SAE power cable – connects the receiver's power port and the power supply's SAE connector or the extension cable's SAE connector p/n 14-578101-01	
SAE-to-SAE cable extension – connects SAE connectors over longer distances p/n 14-578102-01	

1.2.3. Literature

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

- *DELTA Operator's Manual*
- Functional specifications

1.2.4. 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° - +85°C, and no exposure to direct sunlight.
3. Use a clean cloth, moistened with a neutral detergent or water, to clean the receiver. Never use an abrasive cleaner, ether, thinner benzene, or other solvents.
4. Always make sure the instrument is completely dry before storing. Dry the receiver with a soft, clean cloth.

1.3. Option Authorization File (OAF)

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

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

For a complete list of available options and details, visit the JAVAD GNSS website (http://www.javad.com) or consult your dealer.

Chapter 2

Pre-measuring Preparation

Before beginning to measure with the DELTA receiver, the following software needs to be installed and configurations need to be applied:

- Install receiver configuration software. See “Installing JAVAD GNSS Software” on page 23.
- Collect almanacs and ephemerides. See “Collecting Almanacs and Ephemerides” on page 28.

2.1. Installing JAVAD GNSS Software

Use the TriVU software programs for configuring and maintaining the receiver. This software is available on the JAVAD GNSS website. If downloading the program(s) from the website, extract the program’s files into a folder on your hard drive. The following sections describe installing this software, and other sections throughout the manual describe using this software with the receiver.

TriVU™ is a comprehensive Windows® software product designed for controlling GNSS receivers developed by JAVAD GNSS.

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

To uninstall TriVU:

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

2.2. Powering the Receiver

A single external power supply with 5 pin ODU connector or SAE connector is necessary to operate DELTA. If external power supply has only SAE connector, Receiver-to-SAE power cable shall be used. 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 have an output rated for 4,5...35 V DC, not less than 2A. This may not be the same range as other JAVAD GNSS products with which you are familiar.

Note: JAVAD GNSS recomends sertified Phihong power supply PSAA60W-120 (JAVAD GNSS p/n 22-570101-01) for indoor use.

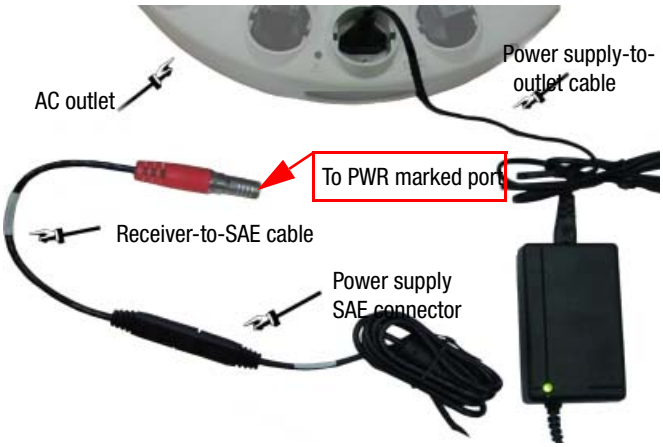


Figure 2-1. Powering DELTA

2.2.1. Turning On/Off the Receiver

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

There are two ways to switch on DELTA automatically when switch on power:

1. Use a special power cable which connects pin 5 of power connector with ground.
2. Request by placing an order to add internal jumper, which would disactivate Power ON/OFF button and DELTA will be turned ON when receiver is powered from external power supply.

Note: Jumper is installed by default if DELTA ordered without TriPad.

2.3. Connecting the Receiver and a Computer

JAVAD GNSS TriVU software provides an interface for various configuration, monitoring, and management functions for the receiver.

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

- an RS232 cable and a computer/controller
- a USB cable and a computer/controller with the JAVAD GNSS USB driver installed

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

2.3.1. Establishing an RS232 Cable Connection

1. Using the RS232 cable, connect the serial port of your computer (usually COM1) to the receiver's serial port A.
2. Press the power buttons on the receiver and computer to turn them on.
3. Connect to the desired configuration software (TriVU).

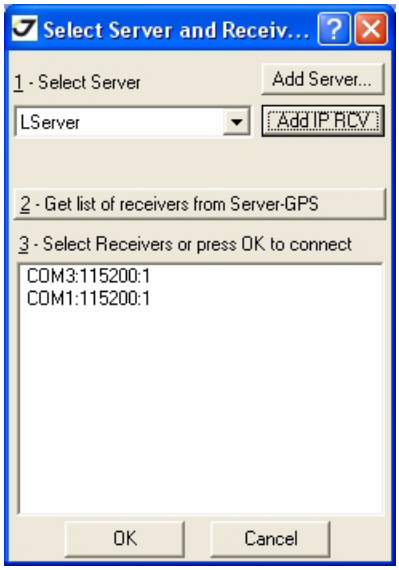


Figure 2-2. Connection via RS-232

2.3.2. Establishing a USB Cable Connection

Make sure the computer has JAVAD GNSS's USB driver installed (available from www.javad.com) before continuing.

1. Using the USB cable, connect the USB port on the receiver to a USB port on the computer.
2. Press the *power* buttons on the receiver and computer to turn them on.

3. Connect to the desired configuration software (TriVU).

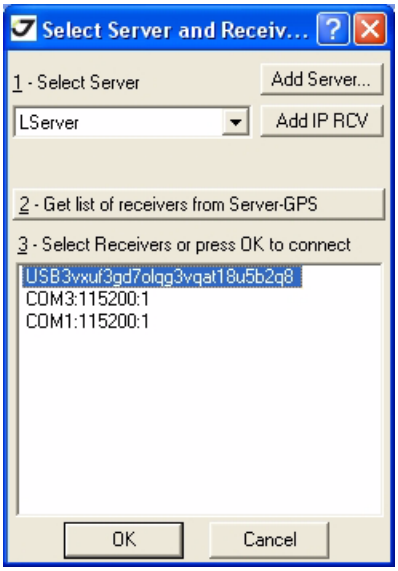


Figure 2-3. Connection via USB

2.4. Collecting Almanacs and Ephemerides

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

- GPS and GLONASS satellites broadcast ephemeris data cyclically, with a period of 30 seconds.
- GPS satellites broadcast almanac data cyclically with a period of 12.5 minutes; GLONASS satellites broadcast almanac data cyclically with a period of 2.5 minutes.

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

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

1. Set up the receiver in a location with a clear view of the sky.
2. Turn on the receiver.
3. Wait for about 15 minutes while the receiver collects complete almanac and ephemeris data from the satellites.

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

- If the receiver has been off for a long time.
- If the last known receiver position, stored in the NVRAM, is different from the present position by several hundred kilometers.
- After loading a new OAF.

Note: If 15 minutes have passed and the receiver does not lock on to satellites, clear the NVRAM. See for details.

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

Chapter 3

CONFIGURATION

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

- In applications where real-time positioning results are required, the Base receiver provides the correction information needed to properly calculate the location of the Rover receiver. A Base station is normally set up over a known point and collects GPS/GLONASS data from satellites. As the receiver picks up satellite data, it measures the carrier and code phases to accurately compute and verify its location. Then, the receiver transmits this information via radio to the Rover receiver.
- The Rover receiver applies correction information from the Base station to its current location to accurately calculate one or more points. Rovers are mobile GNSS receivers on a measuring pole or bipod that compares the information from the Base station to the data it logs from satellites and applies correction algorithms to accurately calculate a new point.
- In applications intended for post-processing, the receivers typically log code phase and/or carrier phase measurements separately from common satellites and during the same time interval. This data is then processed using post-processing software (for example, Justin).

When configuring receivers for RTK measuring, use the following list to ensure the receivers are properly set up:

- Perform pre-measuring preparation as described in Chapter 2.
- Configure one receiver as an RTK Base station and the other receiver as an RTK Rover. See “Configuring the Receiver” on page 30.
- Set up the Base receiver over a known point to begin collecting static observation data and transmitting corrections. Set up the Rover receiver to begin collecting RTK data. See “Receiver Setup” on page 49 for more information.

When configuring receivers for post-processing measuring, use the following list to ensure the receivers are properly set up:

- Perform pre-measuring functions as described in Chapter 2.
- Configure one receiver as a Base station and the other receiver as a Rover. See “Configuring the Receiver” on page 30.

- Set up the Base receiver over a known point to begin collecting static observation data. Set up the Rover receiver to begin collecting static or kinematic observation data. See “Receiver Setup” on page 49 for more information.

3.1. Configuring the Receiver

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

- A static Base station collects measurement information and saves this data to its internal memory.
- An RTK Base station collects measurement information, determines differential corrections, and transmits them to the RTK Rover(s).
- A static Rover collects observation data from the same satellites during the same time interval as the static Base station.
- An RTK Rover collects measurement information and accepts corrections from the RTK Base station to compute its relative position.
- A Rover acting as a repeater to re-transmit RTK Base station measurements to other rover receivers, extending the range of a GPS system.

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

- use an RS232 cable
- use a USB cable and a computer with the JAVAD GNSS USB driver installed (available on the JAVAD GNSS website)

TriVU is a software used to manage the various functions of your receiver. The full range of TriVU configuration and function is outside the scope of this manual. For more information on any of the procedures in this section or on TriVU, refer to the *TriVU Software Manual* available on the JAVAD GNSS website.

TriVU configures the various parts of the receiver, saving the settings in the receiver’s memory. These settings will be reflected when you use the TriPad.

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

- configure the receiver and its components
- send commands to the receiver
- download files from the receiver’s memory

- load a new OAF and other configuration files to a receiver
- load new firmware

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

Note: Do not make other changes without consulting the *TriVU Software Manual*.

1. Connect the receiver and computer as described in "Connecting the Receiver and a Computer" on page 25.
2. Start TriVU. Select the COM port and click Ok (Figure 3-1).

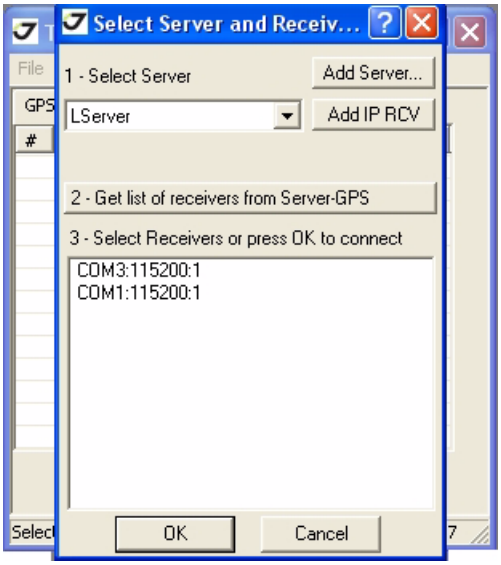


Figure 3-1. Connection Parameters

3. Click *Configuration* ▸ *Receiver.*

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

4. In the *General* tab click *Set all parameters to defaults* and set up the antenna parameter: *Auto*, *Internal* or *External*, when external antenna is used.(Figure 3-2).

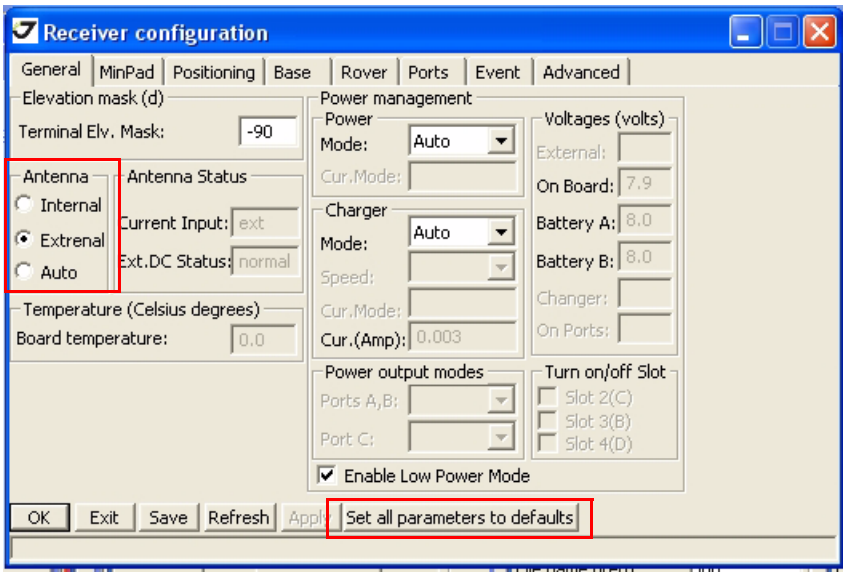


Figure 3-2. Set all parameters to defaults

5. Click the *MinPad* tab and configure the following settings (Table 3-1), then click *Apply* (Figure 3-3 on page 33).

Table 3-1. Receiver Parameters for the MinPad Tab

Parameter	Base Receiver	Rover Receiver
Recording interval	Enter 15 seconds.	
Elevation mask angle	Enter 15 degrees.	
File name prefix	Enter a unique ID, such as the last 3 digits of receiver's serial number.	

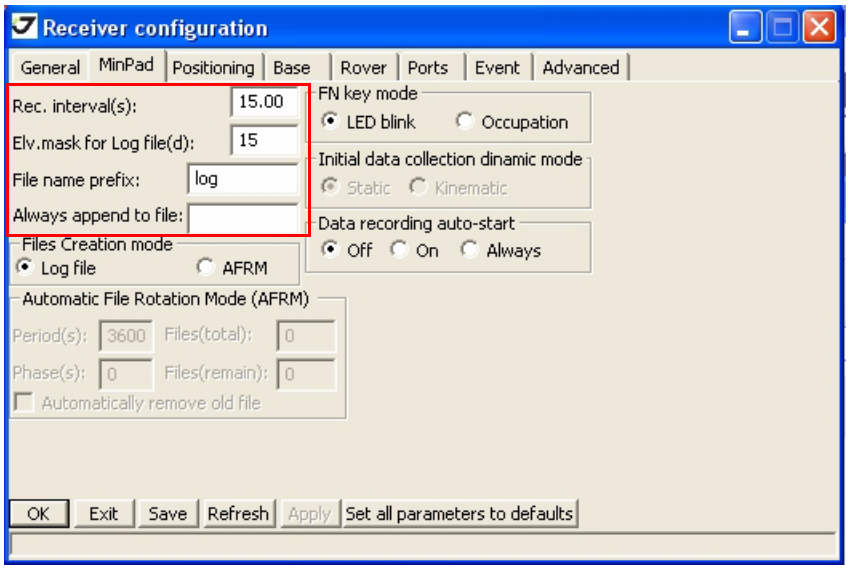


Figure 3-3. Configure Receiver Positioning – MinPad for data recording

6. Click the *Positioning* tab and set the Elevation mask to 15 (Figure 3-4), then click *Apply.*

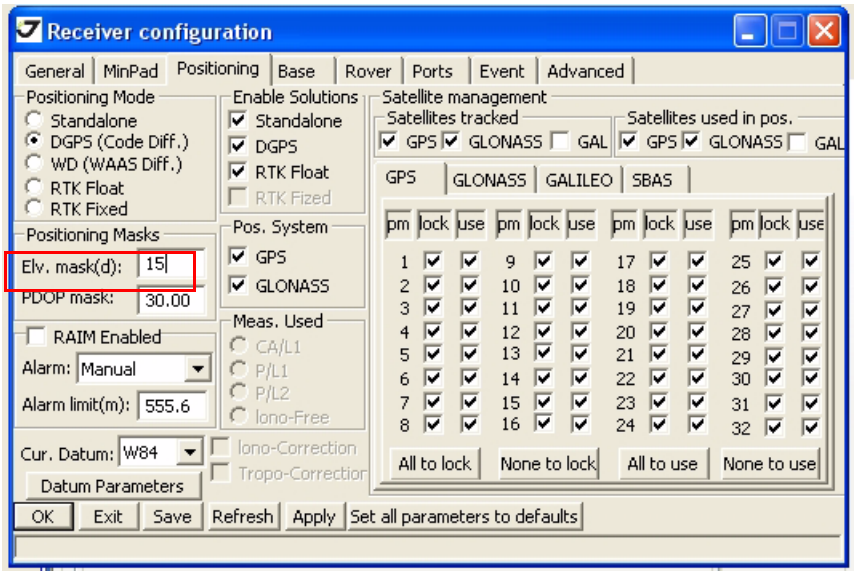


Figure 3-4. Configure Receiver Positioning – Elevation Mask

7. For the Base receiver, click the *Base* tab and set the following parameters (Figure 3-5 on page 34), then click *Apply.*

- *GPS/GLO at one time* – enable

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

  – If known, type in the values.

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

  – Click *Get from receiver.*

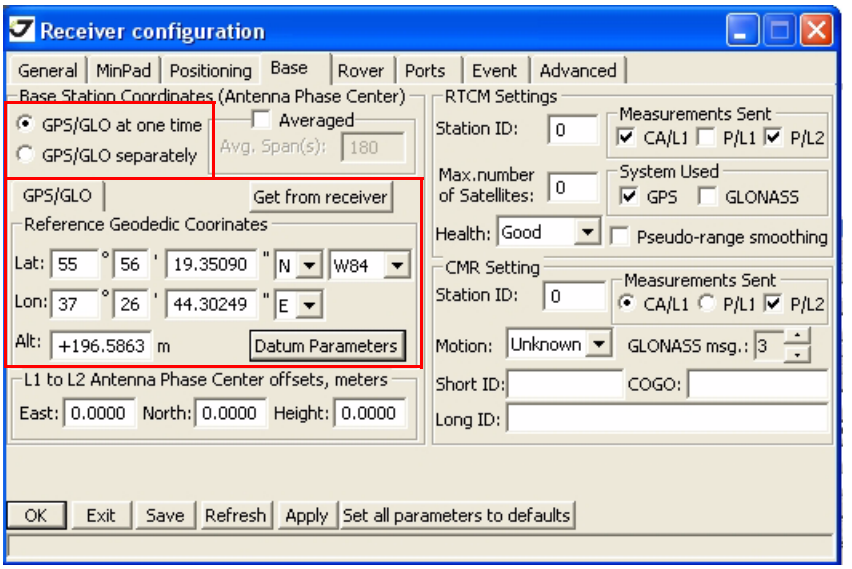


Figure 3-5. Base Configuration

8. For the Rover receiver, click the *Rover* tab and set the following parameters, then click *Apply* (Figure 3-6 on page 35).

- *Positioning Mode* – For post-processed measuring, select *Standalone*; for RTK Missourians, select *RTK float* or *RTK fixed*.
- *RTK Parameters, RTK mode* – select either *Extrapolation* for RTK float (kinematic) or *Delay* for RTK fixed (static).

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

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

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

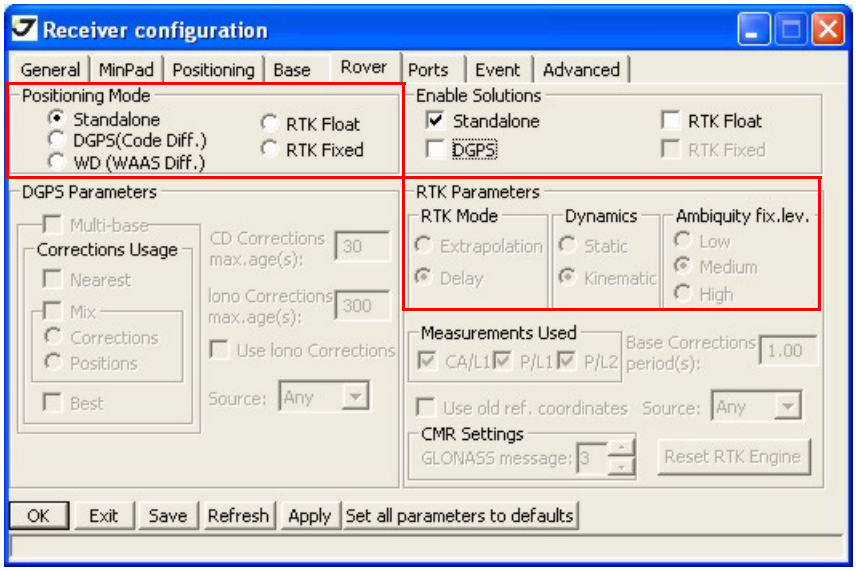


Figure 3-6. Rover Configuration

9. For RTK measurings, click the *Ports* tab and set the following port parameters for the serial port (Table 3-6), then click *Apply* (Figure 3-7 on page 36).

Note: For post-processed measurings, keep the default values for these parameters.

Table 3-2. Receiver Parameters for the Ports Tab

Parameter	Base Receiver	Rover Receiver
Input	n/a (Leave the default.)	Select the same differential correction format selected for the Base.
Output	Select the type and format of differential corrections.	Select “None”.
Period (sec)	Enter the interval at which the receiver will transmit differential corrections.	n/a (Leave the default.)

Parameter	Base Receiver	Rover Receiver
Baud rate	Select a baud rate to use for transmitting differential messages from the receiver board to the modem module. The baud rate must match the modem's serial port speed.	
RTS/CTS	Select to enable handshaking.	

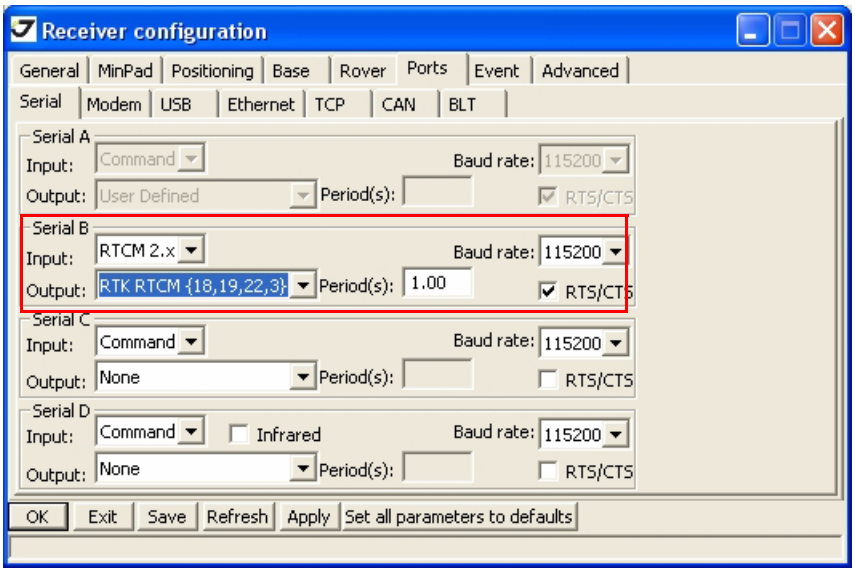


Figure 3-7. Base and Rover Configuration for RTK – Ports - If external modem is used

10. Click the *Advanced* tab and then the *Multipath* tab. Set the following parameters and click *Apply* (Figure 3-8 on page 37).

- *Code multipath reduction* – enable

- *Carrier multipath reduction* – enable

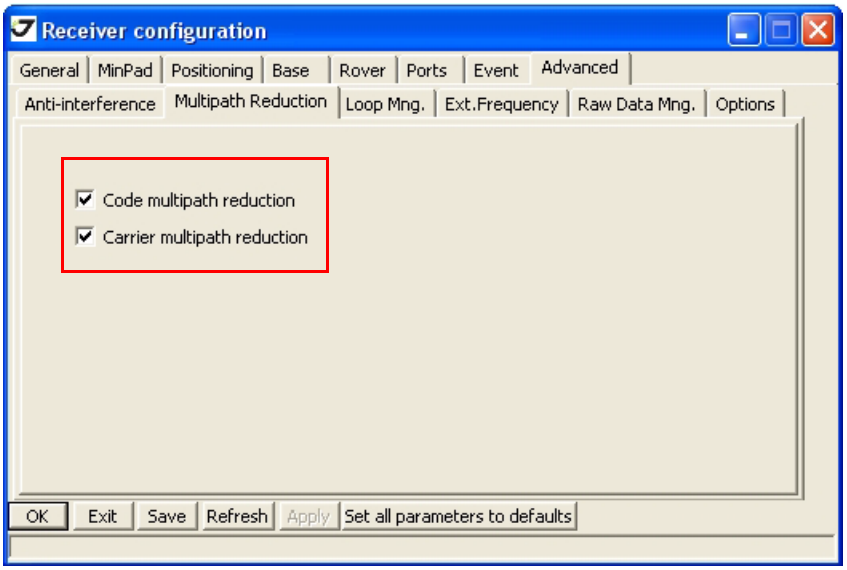


Figure 3-8. Configure Mulitpath Parameters

11. Click OK to save the settings and close the dialog box. Once the receiver is configured, the configuration will remain until you change it using TriVU or clearing the NVRAM. For more details on the settings available for configuring the Base and Rover receivers, refer to the *TriVU Software Manual*.
12. Continue with other configuration activities or click *File* ▸ *Disconnect*, then *File* ▸ *Exit* to quit TriVU. Disconnecting before exiting ensures proper port management.

Note: Disconnect the receiver from TriVU before exiting to eliminate possible conflicts with the management of the computer's serial ports.

3.2. DELTAD Systems Configuration

The DELTAD-G2 and DELTAD-G2D provide real-time position calculations and true heading outputs at rates up to 50 Hz. The system DELTAD-G2 is a single frequency GPS/Galileo receiver board. The system DELTAD-G2D adds second frequency to the processing.

DELTAD-G2 and DELTAD-G2D can also operate in the RTK or DGPS modes receiving differential corrections from an external base station to provide differentially corrected position and velocity.

In what follows, we do not distinguish between the two systems, so that the manual refers to both.

3.2.1. Hardware

The unit has two antenna inputs ‘a’ and ‘b’ as shown in the figure below. It can be considered as two independent receivers. In this case the receivers will be denoted as ‘a’ and ‘b’ accordingly to antenna inputs.

Figure 3-9. Back panel. Antenna connectors

Any of communication ports on the front panel (serial A and C, USB, Ethernet) can be used for connection with the user. Another one can be set to receive differential corrections from the base station.

3.2.2. Antennas setup

Antennas must be rigidly attached to the vehicle. There are no any special restrictions on their mutual location. However, antennas should not shade each other. Also, inverse proportional dependency of the error RMS on the between antennas distance should be taken into account.

3.2.3. How to Work with DELTAD-G2/G2D

Although the heading system DELTAD-G2/G2D can be used to perform any types of receiver's measuring, the heading mode is its primary purpose.

Below, a brief description of the heading determination is given.

Heading and Pitch Angles Determination

The local horizon frame is depicted inFigure 3-10; its axes are called 'North', 'East', and 'Up'.

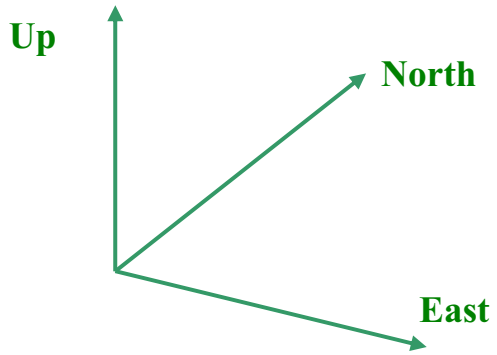


Figure 3-10. Local horizon coordinate frame

Two angles that define orientation between antennas base line are available as shown in the Figure 3-11.

- The heading angle is the angle between the projection of the base line onto the local horizon plane and the North direction.

- The pitch angle is the angle between the base line vector and the local horizon plane.

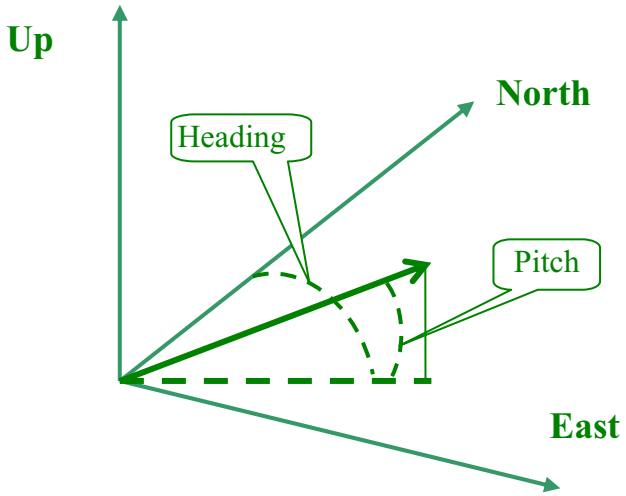


Figure 3-11. Local horizon coordinate frame

Standalone Setup

The standalone position of the antenna ‘a’ or ‘b’ is available along with two orientation angles.

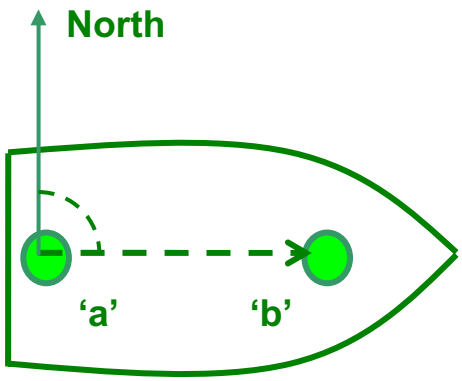


Figure 3-12. Standalone operation of the unit

Differentially corrected setup

The unit receives differential corrections from the Remote base, see Fig. 6. The radio modem can be connected to any of communication ports. The position of the antenna ‘a’ is calculated in differentially corrected mode: RTK or DGPS depending on the setting of the operation mode. The position of the antenna ‘b’ is calculated differentially corrected from the position of the antenna ‘a’. In other words, the antenna ‘b’ is calculated as an RTK rover corrected from the ‘moving base’ ‘b’

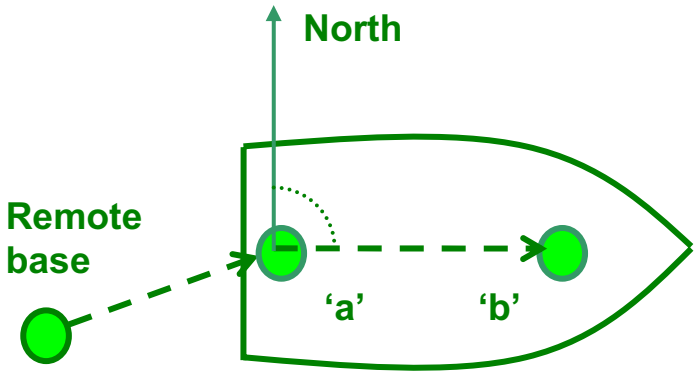


Figure 3-13. Differentially corrected operation of the unit

Unit Setup

Let us suppose for example that the system should operate at 5 Hz. The 10 Hz, 20 Hz, and 50 Hz cases are considered the same way.

1. *Setting of the standalone setup*. The following set of commands must be sent to the unit:

```
set,rover/mode/,off
set,base/mode/,off
set,pos/elm,10
set,raw/msint,200
set,pos/msint,200
set,pos/mode/cur,pd
set,pos/pd/period,1
set,pos/pd/mode,extrap
set,pos/pd/aflevel,medium
set,pos/pd/dyn,1
set,pos/pd/usebasedop,off
set,pos/pd/hd/mode,on
```

Next two settings can be used or not used

`set,pos/pd/hd/len/,<value>`

sets the known distance between antennas ‘a’ and ‘b’ to <value> in meters.

`set,pos/pd/hd/uselen,on`

says the unit to use the known distance between antennae. If this set to off, the heading engine can estimate this value itself. To let the unit to estimate the distance between antennas use the command

`set,pos/pd/hd/tune,on`

The number of epochs used for averaging the distance is set by the setting

`set,pos/pd/hd/naver,<N>`

where <N> means number of measurements collected in the ‘fixed’ mode, default value is 60.

2. *Setting of the differentially corrected setup.* In addition to the listed above commands the input mode of one of the ports must be set. For example, if CMR corrections are received through the serial port ‘c’, the setting

`set,dev/ser/c/imode,cmr`

Angle messages

The heading angle is available in the NMEA string message HDT which is activated by the command em,,nmea/HDT.

The heading and pitch angles are available in the NMEA string message PTPSR,ATT from the rover which is activated by the command em,,nmea/P_ATT. It contains not only time, heading, and pitch, but also the solution status for the between antennas base line. The format of the message is: $PTPSR,ATT,%C,%6.2F,%.3F, %.3F,%C*%2X where fields mean:

- UTC time indicator, V means valid, N means that UTC time is not valid,
- UTC time,
- True heading [deg],
- Pitch [deg],
- Base line solution status: R for fixed, F for float, empty field means ‘not available’,
- Check sum.

Example: $PTPSR,ATT,V,173311.00,284.548,0.240,R*39

Also the binary message jps/ha is activated by the command em,,jps/ha. The structure is described below:

```
struct
{
f4 heading; // in degrees
f4 pitch; // in degrees
u1 type; // between antennas base line solution type
u1 cs; // check sum
}
```

3.3. TriPad Configuration

The DELTA's simple user interface (TriPad) consists of two buttons (Power and FN) and up to six LEDs that control and display the receiver's operation (Figure 3-14).

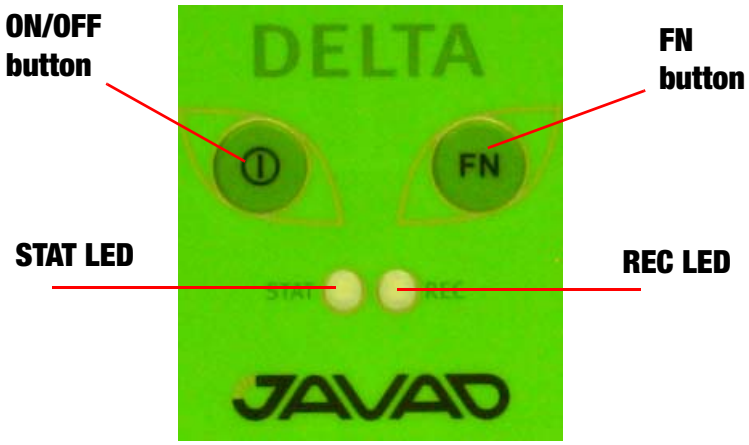


Figure 3-14. DELTA TriPad

The TriPad performs numerous functions:

- Turn the receiver on/off.
- Turn data recording on or off (FN button).
- Show the status of satellites being tracked (STAT LED).
- Show data recording status (REC LED).
- Show each time data records to internal memory (REC LED).

- Show the status of post-processing mode (static or dynamic) when performing a Post-Processing Kinematic measuring with the help of FN button (REC LED).

You use TriVU to configure TriPad settings. Refer to the *TriVU Software Manual* for all possible TriPad configurations.

1. Connect your receiver and computer. See “Connecting the Receiver and a Computer” on page 25 for this procedure.
2. Start TriVU. Select the COM port and click Ok (Figure 3-1).

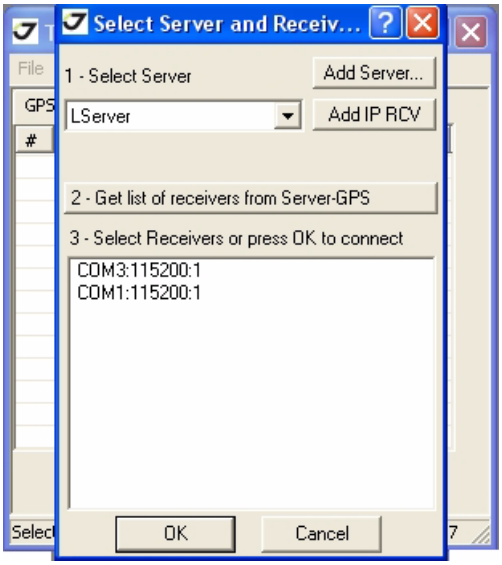


Figure 3-15. Connection Parameters

3. Click the *Configuration* ▸ *Receiver* and open the *MinPad* tab. Set the following parameters and click *Apply.* See the following pages for descriptions of these parameters.
   - Recording interval on page 45.
   - Elevation mask for log file on page 45.
   - File name prefix on page 45.
   - Always append to the file on page 46.
   - Files Creation mode on page 46.
   - Automatic File Rotation Mode (AFRM) on page 46.

- Data recording auto-start on page 47.

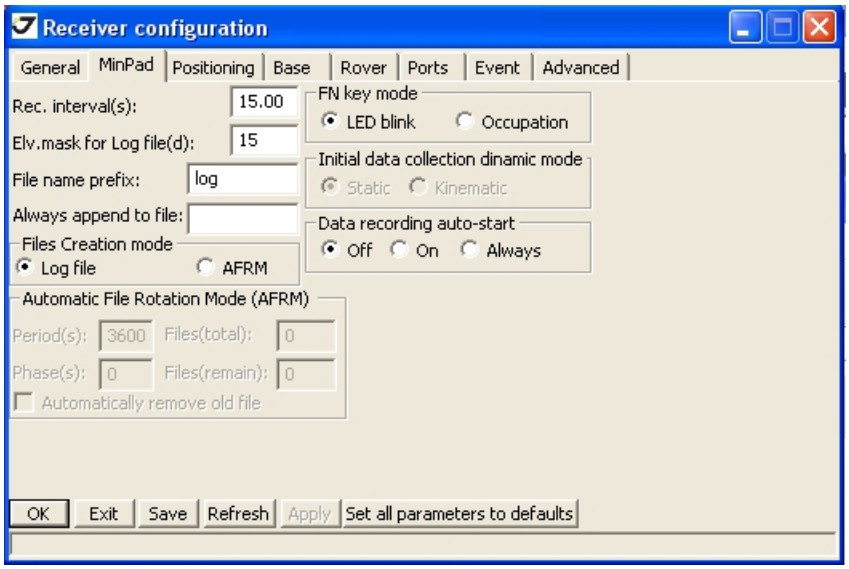


Figure 3-16. Receiver Configuration – MinPad tab

Recording Interval parameter

This parameter specifies the message output interval into the log file when the TriPad FN button (pressed for1-5 seconds) activates data logging. This setting is used not only when logging a single log file, but also when logging receiver data in AFRM mode. Values are 1-86400 seconds.

The default value is one second.

Elevation Mask for Log File parameter

This parameter specifies the minimum elevation angle for the satellites whose data will be put in the receiver files logged when pressing FN.

The default value is five degrees.

File Name Prefix parameter

This parameter specifies what prefix will be added to the names of the receiver files created when pressing FN. The prefix can be up to 20 characters long.

The default value is log.

Log file names have the following structure:

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

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

Always Append to the File parameter

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

Files Creation Mode parameter

This parameter has two possible operation modes:

- Log file - If the log file radio button has been selected, pressing the FN button will result in closing the current log file. If data logging is off, pressing FN will open a new log file.
- AFRM - If AFRM radio button has been selected, pressing FN will enable this mode. If AFRM has been enabled, pressing FN will disable this mode.

Automatic File Rotation Mode (AFRM) parameters

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

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

- Period - specifies the time duration of each log file created in AFRM mode.
- Values are 60 to 86400 seconds. The default value is 3600 seconds.
- Phase - specifies the "phase" (constant time shift) of creating multiple log files in AFRM mode.
- Values are 0 to 86400 seconds. The default value is zero seconds.
- Files (total) - a counter that specifies how many multiple log files must be created in AFRM until this mode automatically turns off. This counter decrements on every file rotation until it value becomes zero, then file rotation automatically stops. The counter initializes with AFRM.

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

Values are 0 to [231^{-1}]. The default value is 0 (zero). Zero means that an unlimited number of log files will be created.

- Files (remain) - specifies the number of files left for the receiver to create in AFRM.
- Values are 0 to [231^{-1}]. The default value is zero.
- Automatically remove old files - when no free memory is available to log data, automatically removes the earliest log file. If this parameter is enabled, your receiver will erase the file with the earliest file creation time/date. AFRM must be enabled to use this FIFO (First-In, First-Out) feature.
- The default value is off (disabled).

Data Recording Auto-start parameter

These radio buttons allow you to program your receiver's behavior in the event of a power failure.

Table below gives the different scenarios available and the results after power is restored to the receiver. “Specified file” refers to the file name entered in the *Always append to file* parameter.

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

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

- After pressing the *Power* button to turn on the receiver.
- After resetting the receiver (with TriVU).
- After taking the receiver out of Sleep Mode.

Chapter 4

Setup and Measuring

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

4.1. Receiver Setup

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

Before collecting data, make sure the Base and Rover receivers contain a current almanac and current ephemeris data (see "Collecting Almanacs and Ephemerides" on page 28).

4.1.1. External Antenna Setup

The DELTA receiver can be used with an external antenna. Follow the steps below to connect an external antenna to DELTA and measure its offset.

1. Attach the antenna to a tripod or bipod and center it over the point at which data will be collected.
2. Measure the antenna height, as described in "Measure Antenna Height" on page 50.
3. Record the antenna height, point name, and start time in the field notes.
4. Attach the flexible RF cable from the external antenna to the antenna connector on the bottom panel of the receiver.

4.1.2. Measure Antenna Height

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

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

- Measured height of the antenna above the station marker
- Method of measuring the antenna height
- Model of the antenna used

Antennas have two types of measurements:

- Vertical – measured from the marker to the antenna reference point (ARP) located on the bottom of the receiver at the base of the mounting threads.
- Slant – measured from the marker to the lower edge of the antenna slant height measure mark (SHMM) located on both end panels of the receiver.

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

- For vertical, the offset is simply added to the measured vertical height to produce a "true" vertical height.
- For slant height, the vertical height must first be calculated using the radius of the antenna, then the offset can be added.

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

1. Measure the antenna height above the control point or marker, either the slant height or the vertical height.
2. Record the antenna height, point name, and start time in the field notes.

4.2. TriPad Operation

The TriPad is the receiver's minimum interface used to display and control data input and output. See the description of the TriPad on page 21.

To turn on/off the receiver, press the On/Off button (Figure).

- When turning on, press the On/Off button until the TriPad's LEDs briefly flash.
- When turning off, press the On/Off button until the LEDs go out, then release.

To start/stop logging data, press the FN button for 1–5 seconds (Figure).

- During data recording, the REC LED is green. Use TriVU to set the recording time interval. See "Recording Interval parameter" on page 61 for details.
- The REC LED blinks green each time data is written to the memory.
- If the REC LED is red, the receiver has run out of memory, has a hardware problem, or contains an improper OAF (see "Option Authorization File (OAF)" on page 26 for more information).

Use TriVU to enable the desired FN button mode in the receiver, either "LED blink mode switch" for static measurings or "Occupation mode switch" for kinematic measurings. See "Data Recording Auto-start parameter" on page 63 for details.

Each time you turn off or on data recording, either a new file opens or data appends to a particular file. See "Always Append to the File parameter" on page 62 and "Files Creation Mode parameter" on page 62 for information on setting these functions.

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

To change the information mode of the receiver, press the FN button for less than 1 second when "LED blink mode switch" has been enabled using TriVU.

To change the baud rate of the receiver's serial port, press the FN button for 5–8 seconds. This is useful if the data collector does not support the rate that the receiver port is set to. After about five seconds, the REC LED becomes red. Release the FN button during the next three seconds.

4.3. Static Measuring for Base Stations

Static measuring is the classic measuring method, well suited for all kinds of baselines (short, medium, long). At least two receiver antennas, plumbed over measuring marks, simultaneously collect raw data at each end of a baseline during a certain period of time. These two receivers track four or more common satellites, have a common data logging rate (5–30 seconds), and the

same elevation mask angles. The length of the observation sessions can vary from a few minutes to several hours. The optimal observation session length depends on the following factors:

- The length of the baseline measured
- The number of satellites in view
- The satellite geometry (DOP)
- The antenna's location
- The ionospheric activity level
- The types of receivers used
- The accuracy requirements
- The necessity of resolving carrier phase ambiguities

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

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

After the measuring completes, data the receivers collect can be downloaded onto a computer and processed using post-processing software (for example, JAVAD GNSS Justin).

4.4. Kinematic (Stop & Go) Measuring for Rover Stations

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

1. Set up the Rover at an unknown point and press power. Allow the Rover to collect static data for two to ten minutes. The REC LED will be yellow.
2. Check the SAT light for satellites tracked.
3. When finished, press the FN button for less than 1 second to assign the Rover to kinematic.

4. Move the Rover to the next location (measuring point), and press the FN button for less than a second to collect the data in static mode for two to ten minutes.
5. Repeat steps five and six until all points have been measured. The occupation time for the points depends on the same factors as for the static measuring method.
6. When finished, press the FN button for one to five seconds to stop logging data. Turn off the Rover if needed. This method of GNSS measuring allows the operator to reduce the point occupation time, thus permitting field crews to measuring many more points compared to the other methods available.

4.5. Real Time Kinematic Measuring

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

Unlike post-processed kinematic measurings, RTK measurings utilize a communications link between the Base and Rover. Using a radio modem link, the Base receiver transmits its measurement and location data to the Rover receiver. The Rover, based on the transmitted data and its own observation data, immediately conducts a baseline analysis and outputs the results. For specific settings used in RTK measurings, see “Configuring the Receiver” on page 30.

Usually, the receiver will start to output the coordinates of the antenna’s phase center along with the solution type within 10–30 seconds. However, UHF radios and GSM phones may take as long as 60 seconds to synchronize.

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

- Standalone – where the receiver computes 3D coordinates in autonomous mode without using differential corrections.
- Code differential – where the Rover receiver computes the current relative coordinate in differential mode using only pseudo ranges.
- RTK float – where the Rover receiver computes the current relative coordinates in differential mode using both pseudo ranges and phases; however, with a float solution, the phase ambiguity is not a fixed integer number and the “float” estimate is used instead.
- RTK fixed – where the Rover receiver computes current relative coordinates, with ambiguity fixing, in differential mode. The LQ field reflects the status of the received differential messages and contains the following information:
    - Data link quality in percentage

- Time (in seconds) elapsed since the last received message
- Total number of received correct messages (dependent on the message type received)
- Total number of received corrupt messages (dependent on the message type received)

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

Chapter 5

Receiver and File Maintenance

If post-processing the data after completing a measuring, the data in the receiver's memory will need to be downloaded to a computer.

Downloading and deleting files will also prepare the receiver's memory for the next measuring. Occasionally, the receiver's NVRAM may need to be cleared to eliminate communication or tracking problems.

As project expectations expand, the receiver's OAF may need to be updated to provide expanded operation and functionality. The receiver requires firmware to properly operate and provide appropriate functionality. As JAVAD GNSS releases firmware updates, loading these updates into the receiver will ensure that the receiver operates at its full potential.

5.1. Downloading Files to a Computer

When your measuring finishes, you can download your measuring files to a computer for storage, post-processing, or backup. Also, the DELTA memory holds a finite amount of files and information, so downloading the files to a computer ensures that no files are lost.

You should download files as soon as possible after collecting data at the jobsite. TriVU provides a File Manager to download files to your computer and delete files from the receiver DELTA.

1. Connect your receiver and computer. See "Connecting the Receiver and a Computer" on page 25 for this procedure.

2. Start TriVU. Select the COM port and click Ok (Figure 5-1).

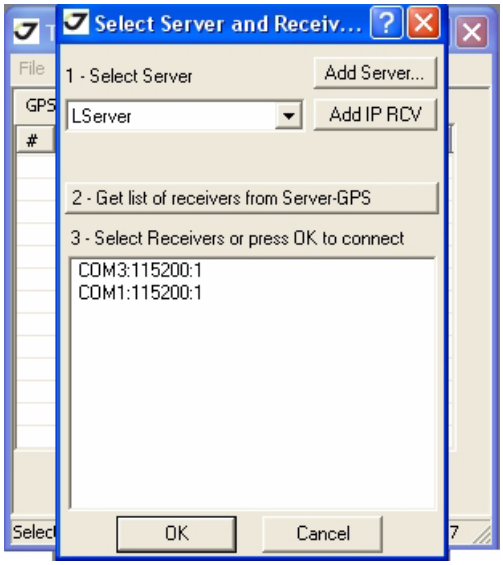


Figure 5-1. Connection Parameters

3. Click *File* ▸ *File Manager*, then click the *Download path* tab on the *File Manager* dialog box.
4. Navigate to or create (using the *Create* button) the folder in which to download and store files (Figure 5-2).

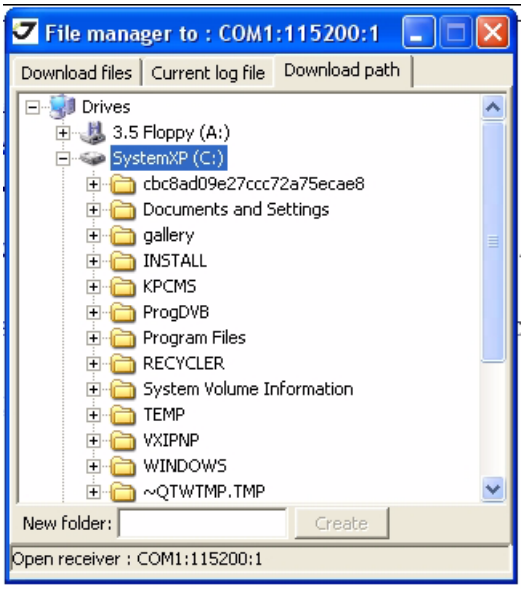


Figure 5-2. Download path tab

5. Click the *Download files* tab and select the file(s) to download (Figure 5-3).
6. To select multiple files, hold down the shift key and click on nonsequential files to select several files at once; or hold down the Ctrl key and click on individual files.

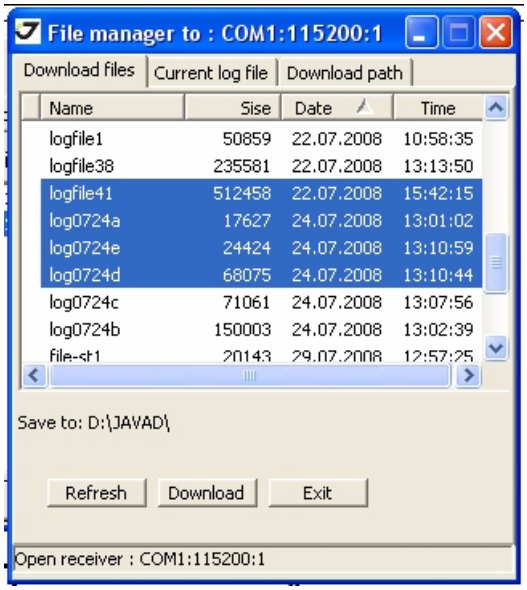


Figure 5-3. Download Files

7. Click the *Download* button. During the download, status indicators display next to each file (Figure 5-4 on page 58).
    - Red indicator – file currently downloading.
    - Green indicator – file has successfully downloaded.

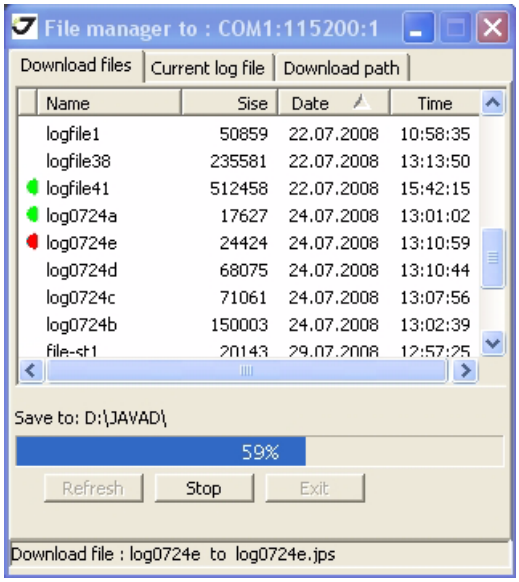


Figure 5-4. Download Files – Status Indicators

8. When done, click *Exit* on the *File Manager* dialog box.
9. Continue with other operations. Or, click *File* ▸ *Disconnect*, then *File* ▸ *Exit* to quit TriVU.

5.2. Deleting Files

Use the following steps to delete files from your receiver.

1. Connect your receiver and computer. See “Connecting the Receiver and a Computer” on page 25 for this procedure.

2. Start TriVU. Select the COM port and click Ok (Figure 5-5).

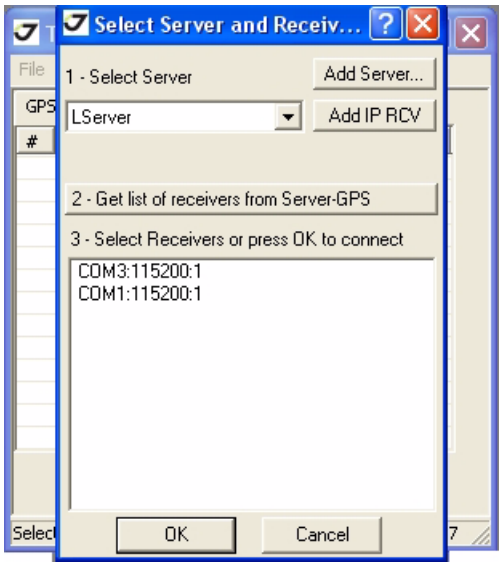


Figure 5-5. Connection Parameters

3. Click *File* ▸ *File Manager* and select the file(s) to delete on the *Current log files* tab (Figure 5-6).

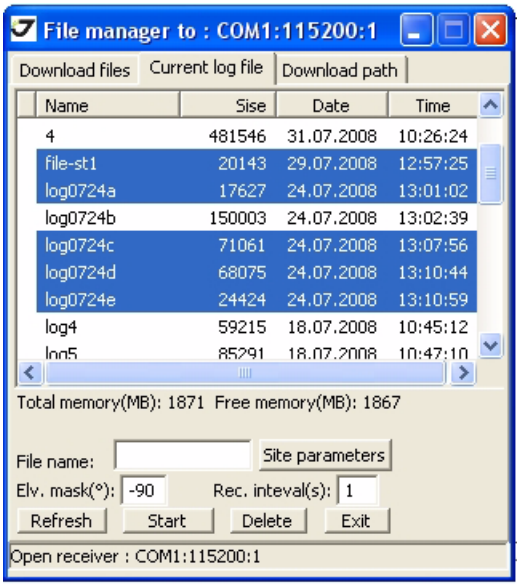


Figure 5-6. Current log files tab

4. To select multiple files, hold down the shift key and click on nonsequential files to select several files at once; or hold down the Ctrl key and click on individual files.

5. Click *Delete* (Figure 5-6 on page 59).
6. Click *Yes* at the delete files confirmation dialog box. TriVU deletes the selected files.
7. Click *Exit* on the *File Manager* screen.
8. Continue with other operations. Or click *File* ▸ *Disconnect*, then *File* ▸ *Exit* to quit TriVU.

5.3. Managing Receiver Options

5.3.1. Checking an OAF

Note: For a complete list of options and their details, visit the JAVAD GNSS website.

You can check the status of your receiver's options, and load any new OAFs, using the RS232 cable, a computer, and TriVU. Refer to the *TriVU Software Manual* for a more complete description of the TriVU software.

1. Connect your receiver and computer. See “Connecting the Receiver and a Computer” on page 25 for this procedure.
2. Start TriVU. Select the COM port and click Ok (Figure 5-7).

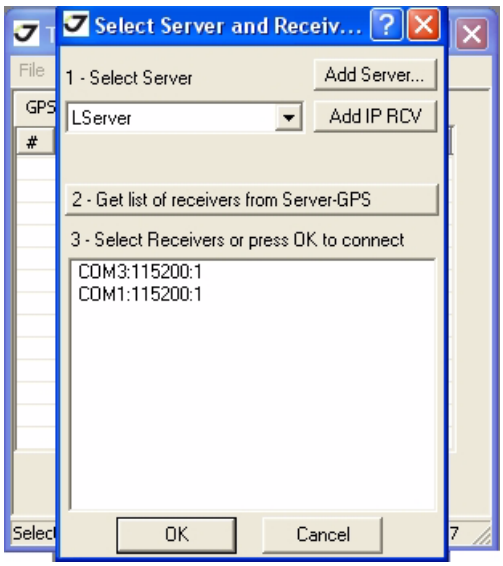


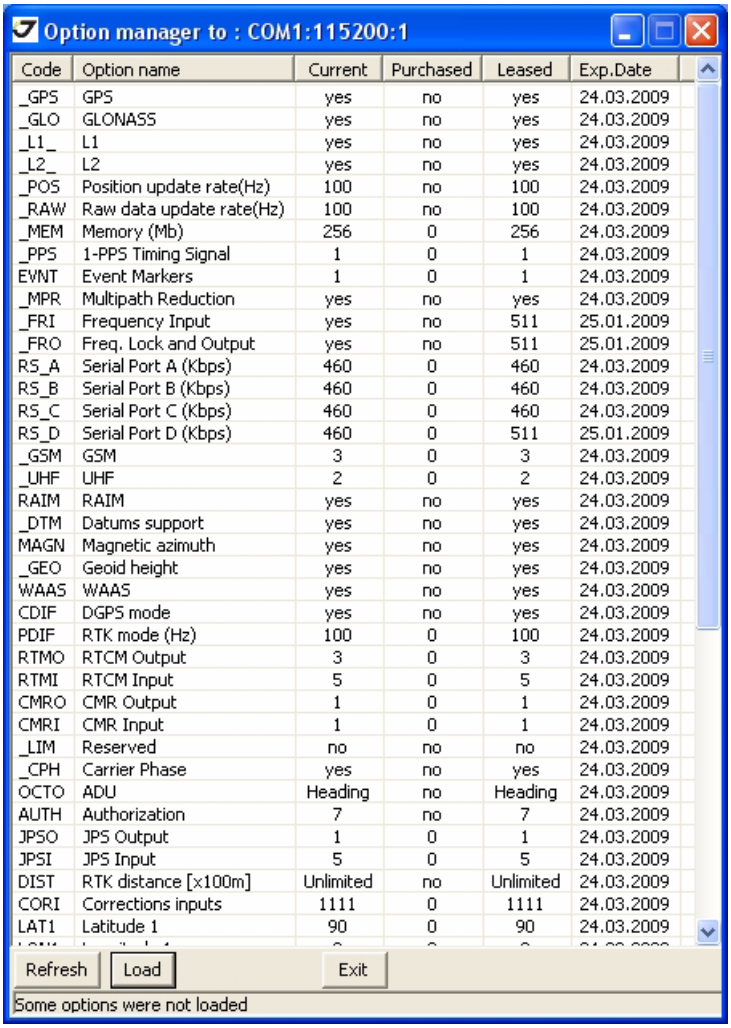
Figure 5-7. Connection Parameters

3. Click *Tools* ▸ *Receiver Options*. The Options Manager dialog box (Figure 5-8) contains the following information:

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

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

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



Code	Option name	Current	Purchased	Leased	Exp.Date
_GPS	GPS	yes	no	yes	24.03.2009
_GLO	GLONASS	yes	no	yes	24.03.2009
_L1_	L1	yes	no	yes	24.03.2009
_L2_	L2	yes	no	yes	24.03.2009
_POS	Position update rate(Hz)	100	no	100	24.03.2009
_RAW	Raw data update rate(Hz)	100	no	100	24.03.2009
_MEM	Memory (Mb)	256	0	256	24.03.2009
_PPS	1-PPS Timing Signal	1	0	1	24.03.2009
EVNT	Event Markers	1	0	1	24.03.2009
_MPR	Multipath Reduction	yes	no	yes	24.03.2009
_FRI	Frequency Input	yes	no	511	25.01.2009
_FRO	Freq. Lock and Output	yes	no	511	25.01.2009
RS_A	Serial Port A (Kbps)	460	0	460	24.03.2009
RS_B	Serial Port B (Kbps)	460	0	460	24.03.2009
RS_C	Serial Port C (Kbps)	460	0	460	24.03.2009
RS_D	Serial Port D (Kbps)	460	0	511	25.01.2009
_GSM	GSM	3	0	3	24.03.2009
_UHF	UHF	2	0	2	24.03.2009
RAIM	RAIM	yes	no	yes	24.03.2009
_DTM	Datums support	yes	no	yes	24.03.2009
MAGN	Magnetic azimuth	yes	no	yes	24.03.2009
_GEO	Geoid height	yes	no	yes	24.03.2009
WAAS	WAAS	yes	no	yes	24.03.2009
CDIF	DGPS mode	yes	no	yes	24.03.2009
PDIF	RTK mode (Hz)	100	0	100	24.03.2009
RTMO	RTCM Output	3	0	3	24.03.2009
RTMI	RTCM Input	5	0	5	24.03.2009
CMRO	CMR Output	1	0	1	24.03.2009
CMRI	CMR Input	1	0	1	24.03.2009
_LIM	Reserved	no	no	no	24.03.2009
_CPH	Carrier Phase	yes	no	yes	24.03.2009
OCTO	ADU	Heading	no	Heading	24.03.2009
AUTH	Authorization	7	no	7	24.03.2009
JPSO	JPS Output	1	0	1	24.03.2009
JPSI	JPS Input	5	0	5	24.03.2009
DIST	RTK distance [x100m]	Unlimited	no	Unlimited	24.03.2009
CORI	Corrections inputs	1111	0	1111	24.03.2009
LAT1	Latitude 1	90	0	90	24.03.2009

Figure 5-8. View Option manager

5.3.2. Loading OAFs

JAVAD GNSS dealers provide customers with OAF files. For any OAF related questions, E-mail at support@javad.com. Please have your receiver ID number available (see “Checking Firmware Version” on page 65).

1. To load a new OAF, follow steps 1-3 in “Checking an OAF” on page 60.
2. Click *Load* (Figure 5-8 on page 61) to load a new OAF file, or *Update* to update the OAF file. The new receiver option loads onto the receiver and the *Option Manager* table updates.
3. Navigate to the location of the new Option Authorization File. OAFs have .jpo extension and are unique to each receiver (Figure 5-9).

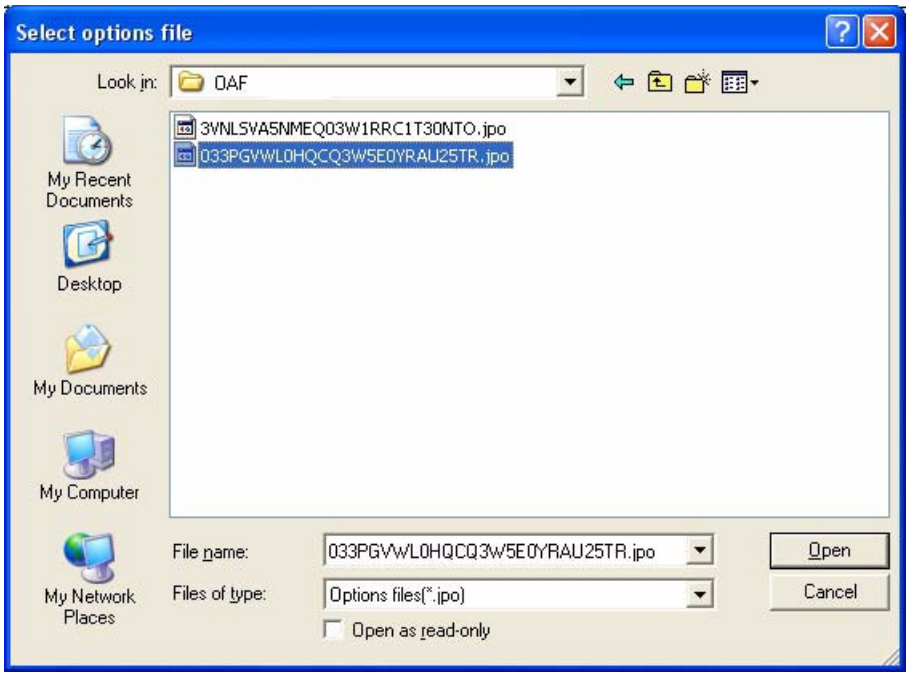


Figure 5-9. Load OAF

4. Select the appropriate file and click *Open*. The new receiver option loads onto the receiver and the *Option Manager* table updates.
5. When finished, click *File* ▸ *Disconnect*, then *File* ▸ *Exit* to quit TriVU.

5.4. Managing Receiver Memory

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

- *SS* – the estimated size of one epoch of raw data in the receiver's log file (expressed in bytes).
- *N* – the number of observed satellites per epoch.

When recording only L1 data: SS = 183 + 22*N

When recording L1 and L2 data: SS = 230 + 44*N

5.5. Clearing the NVRAM

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

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

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

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

In addition, the NVRAM keeps information about the receiver file system.

Note that after clearing the NVRAM, the receiver’s SAT LED will flash yellow for a few seconds indicating that the receiver is scanning and checking the file system.

5.5.1. Using TriPad to Clear NVRAM

1. Press the *power* button to turn off the receiver.
2. Press and hold the *FN* button.

3. Press and hold the power button for about 4 to 8 seconds. Release the power button while continuing to hold the *FN* button.
4. Wait until the four LEDs blink yellow.
5. Release the *FN* button.

5.5.2. Using TriVU to Clear NVRAM

1. Connect your receiver and computer. See “Connecting the Receiver and a Computer” on page 25 for this procedure.
2. Start TriVU. Select the COM port and click Ok (Figure 5-7).

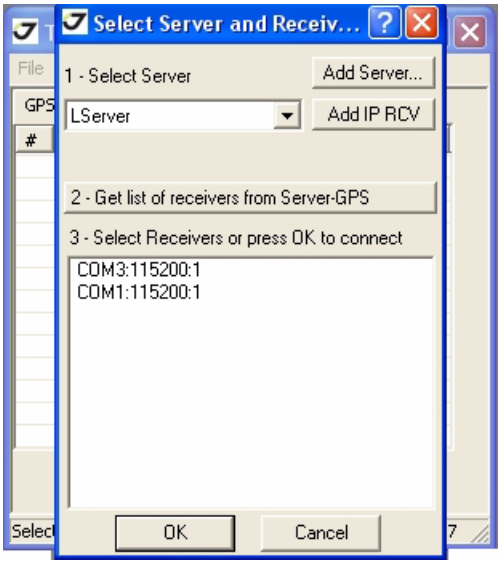


Figure 5-10. Connection Parameters

3. Click the *Tools* ▸ *Clear NVRAM* (Figure 5-11).

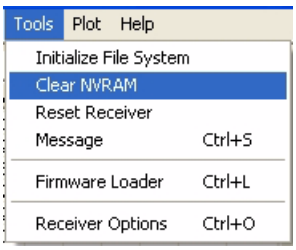


Figure 5-11. Clear NVRAM

4. Click *OK* at the clear NVRAM confirmation dialog box. The REC LED rapidly flashes green and red; the SAT LED flashes red.

The receiver will automatically disconnect once the NVRAM is cleared.

5.6. Checking Firmware Version

Use TriVU to check the firmware version of your receiver.

1. Connect your receiver and computer. See “Connecting the Receiver and a Computer” on page 25 for this procedure.
2. Start TriVU. Select the COM port and click Ok (Figure 5-7).

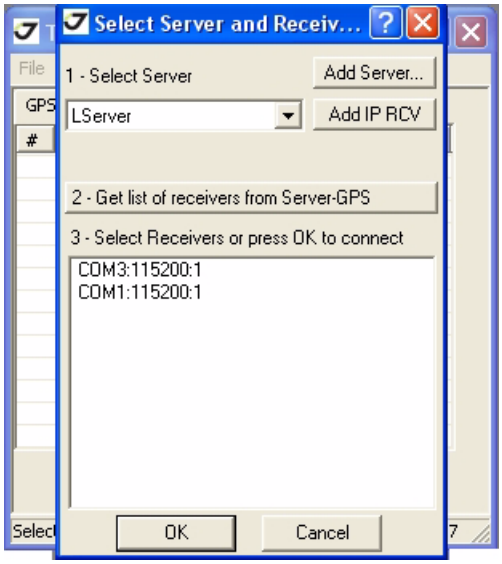


Figure 5-12. Connection Parameters

3. Click on *Help* ▸ *About TriVU* (Figure 5-13).

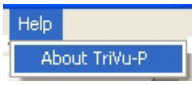


Figure 5-13. Help->About

The *About TriVU* dialog box opens (Figure 5-14).

Figure 5-14. About TriVU

About TriVU lists important information about the different hardware accessories and software properties. This list includes the following, which you will need if you contact JAVAD GNSS or your dealer:

- Receiver model
- Receiver IDs
- Firmware version

4. When finished, click *OK*, then click *File* ▸ *Disconnect*, then *File* ▸ *Exit* to quit TriVU.

5.7. Loading New Firmware

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

The receiver uses Firmware Loader to load firmware onto the receiver.

1. Download the Firmware Loader from www.javad.com to your computer.
2. Download the new firmware package www.javad.com to your computer.
3. Start Firmware Loader double clicking the icon.

4. Select the COM port receiver is connected to. Click the *Test* button to ensure the receiver is connected. Click *Next>>* (Figure 5-15).

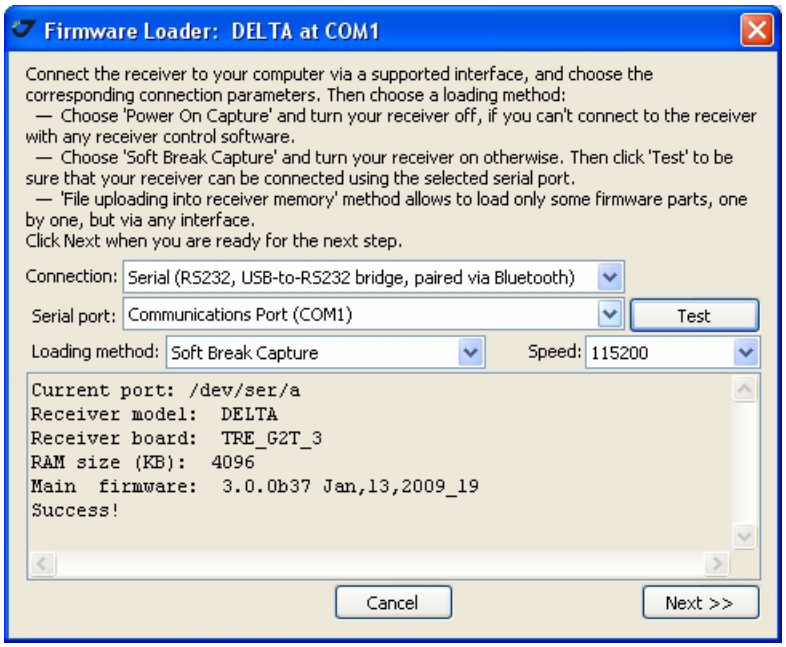


Figure 5-15. Connection Parameters

5. Select the ZIP archive, or any file from unzipped set of firmware images, or one image to load. Click *Next>>* (Figure 5-16).

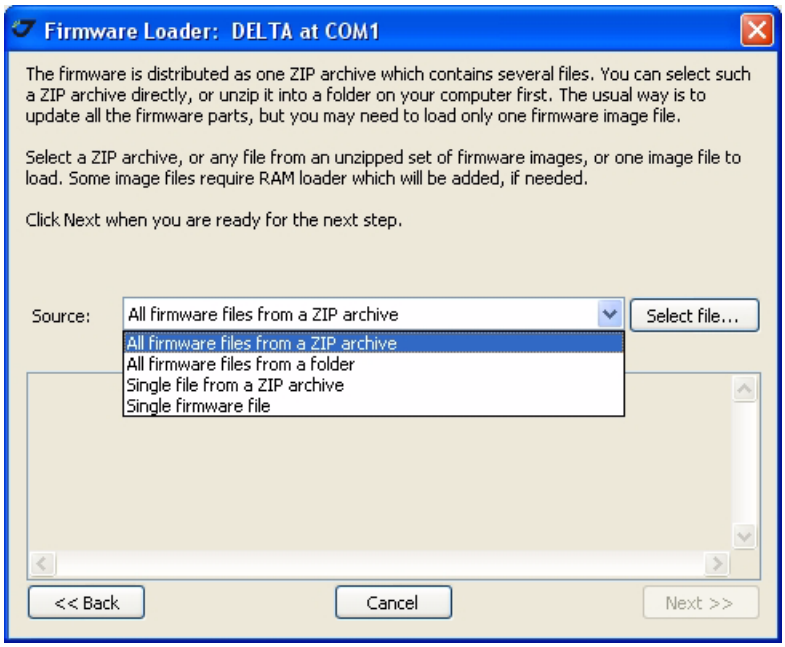


Figure 5-16. Firmware Source

6. Open the required firmware folder. Select the *.zip* file and click *Open* (Figure 5-17):

Figure 5-17. New firmware package

7. Click *Next>>* to load new firmware (Figure 5-18).

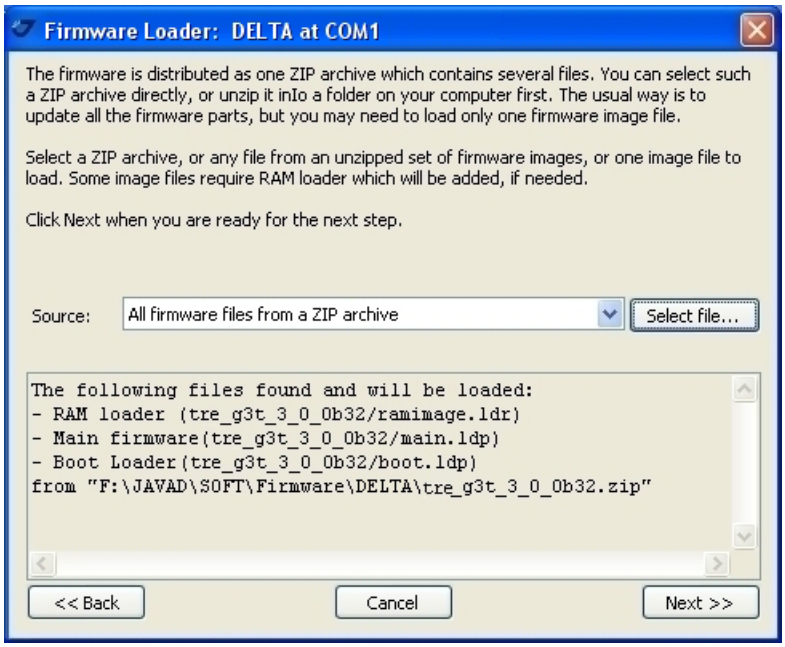


Figure 5-18. Files to load

8. Click *Exit* to quit Firmware Loader.
9. Clear the receiver's NVRAM (see "Clearing the NVRAM" on page 63) and update the almanac ("Collecting Almanacs and Ephemerides" on page 39) after loading new firmware.

Chapter 6

TROUBLESHOOTING

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

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

6.1. Check This First!

Before contacting JAVAD GNSS support, check the following:

- Check all external receiver connections carefully to ensure correct and secure connections. Double check for worn or defective cables.
- Check all power sources.
- Check that the most current software is downloaded onto the computer and that the most current firmware is loaded into the receiver. Check the JAVAD GNSS website for the latest updates.

Then, try the following:

- Reset the receiver using TriVU: *Tools* ▸ *Reset Receiver* (Figure 6-1):

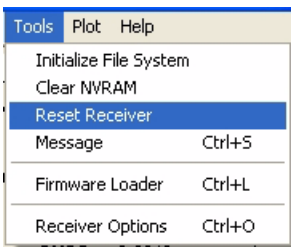


Figure 6-1. Tools->Reset receiver

- Restore default settings using TriVU (*Configuration* ▸ *Receiver*, then click *Set all parameters to defaults*).
- Clear the NVRAM (see “Clearing the NVRAM” on page 63).

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

6.2. Receiver Problems

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

Cable specific problems

◎ The cable is not properly plugged in.

- Check that the cable connector is attached to the correct receiver port.
- Unplug the cable, then securely and properly reconnect it to the receiver.
- See “DELTA Receiver” on page 19 and “Connector Specifications” on page 82 for information on the receiver’s connectors.

◎ The cable is damaged.

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

Generic problems

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

1. Connect your receiver and a computer using a free port (see “Connecting the Receiver and a Computer” on page 25) and start TriVU.
2. Click *Configuration* ▸ *Receiver* ▸ *Ports*.
3. Change the *Input* for the port used for connection to “Command”.

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

- The receiver stores an old almanac.

  Update the almanac. See “Collecting Almanacs and Ephemerides” on page 28 for details.

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

- See “Managing Receiver Options” on page 60 for details on how to check current options.
- Order a new OAF with the desired options activated to enable or extend validity of the corresponding receiver options. Contact your dealer or visit the JAVAD GNSS website for details.
- Refer to the *TriVU Software Manual* for a detailed description of options.

The receiver tracks too few satellites

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

- Lower the elevation mask. See “TriPad Configuration” on page 43 for information on setting the elevation mask.

◎ The measuring is conducted near obstructions (tree canopy, tall buildings, etc.).

- Check that the Multipath Reduction boxes have been enabled.
  - Connect your receiver and a computer and start TriVU. See "Connecting the Receiver and a Computer" on page 25.
  - Click *Configuration* ▸ *Advanced and the Multipath Reduction* tab. Enable the two boxes and click Apply.
- Move to an area free of obstructions, if applicable.

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

◎ Incorrect Base coordinates entered

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

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

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

◎ The corresponding receiver options may be disabled or expired.

- See "Managing Receiver Options" on page 60 for details on how to check current options.
- Order a new OAF with the desired options activated to enable or extend validity of the corresponding receiver options. Contact your dealer or visit the JAVAD GNSS website for details.
- Refer to the *TriVU Software Manual* for a detailed description of options.

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

- Ensure that both the Rover and Base receivers use the same, and updated, almanac. See "Collecting Almanacs and Ephemerides" on page 28.
- Check the elevation masks of the Rover and Base receivers; they should be the same. See "TriPad Configuration" on page 43 for information on setting the elevation mask.

◎ A discrepancy exists between the differential standards used at the Base and Rover receivers. Ensure the Base and Rover receivers use the same corrections input/output format:

1. Connect your receiver and a computer and start TriVU. See "Connecting the Receiver and a Computer" on page 25.
2. Click and the *Ports* tab. Use the same input/output format for both receivers.

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

- Conduct your measuring when PDOP values are low.

◎ The elevation mask is above 15 degrees.

- Lower the elevation mask.

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

- Check that the radio modem's antenna is securely and properly connected to the antenna connector.
- Check that the radio modem's antenna is undamaged. If damaged, contact your JAVAD GNSS dealer to replace the antenna.

◎ The specified baud rate is incompatible with the baud rates the receiver supports.

- The baud rate is the rate at which the receiver transmits differential messages to the receiver and vice versa. Change the baud rate to that which your receiver supports.

◎ .The Base and Rover receivers use different radio link parameters.

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

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

- Close the distance between the Base and Rover.
- Use repeaters to increase radio coverage.

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

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

The receiver does not start data logging

◎ The memory option is disabled or expired.

- Check that the memory option is enabled. For details, see "Checking an OAF" on page 60.

◎ The receiver's memory has no free space.

- Download and/or delete data files to free up space for new files (see "Downloading Files to a Computer" on page 55 and "Deleting Files" on page 58).
- Use the AFRM feature. See"TriPad Configuration" on page 43.

6.3. Technical Support

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

Before contacting JAVAD GNSS Customer support about any problems with the receiver, see "Check This First!" on page 71 for some solutions that may fix the issue.

To contact JAVAD GNSS Customer Support use the QUESTIONS button available on the www.javad.com.

Note: For quick and effective support, provide a detailed description of the problem.

Appendix A

SPECIFICATIONS

This JAVAD GNSS product is a 216-channel GNSS receiver with a rugged magnesium housing complete with TriPad and cable connectors.

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

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

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

A.1. Receiver Specifications

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

A.1.1. General Details

Table below lists the receiver's general specifications.

Table A-1. Receiver General Specifications

Physical	
Enclosure	Aluminum extrusion, waterproof IP66
Color	JAVAD GNSS Green and Gray
Dimensions, mm	109 x 35 x 169
Weight, g DELTAS-G2T DELTAS-G3T, G3TAJ DELTAD DELTAQ	 394 401 414 454
GNSS Antenna	External
Buttons	Two buttons: Power – On/Off Function (FN) – start/stop data logging.

LEDs	Two LEDs: STAT – satellite and receiver status REC – record and data status
Environment	
Operating temperature	-40° C to +80° C
Storage temperature	-45° C to +85° C
Humidity	95% non-condensing
External power	
External power input	1 port
Input voltage	+4.5 to +35 V DC
I/O	
Communication Ports	- 3x serial (RS232) up to 460.8 kbps - serial (RS422) up to 460.8 kbps - High speed USB 2.0 device port (480 Mbps) - Full-duplex 10BASE-T/100BASE-TX Ethernet port
Connectors	- External GNSS Antenna - External power (PWR) - CAN (optional) - up to two 1PPS output (optional) - up to two Event Marker input (optional)
TriPad	- Two LEDs (STAT, REC) - Two function buttons (ON/OFF, FN)
Data Features	
Up to 100 Hz update rate for real time position and raw data (code and carrier)[1] 10 cm code phase and 1 mm carrier phase precision Hardware Viterbi decoder RTCM SC104 versions 2.x and 3.x Input/Output NMEA 0183 versions 2.x and 3.0 Output Multi-Base Code Differential Rover Code Differential Base Geoid and Magnetic Variation models RAIM Different DATUMs support Output of grid coordinates	
Technology	
Low signal tracking Advanced Multipath mitigation KFK WAAS/EGNOS (SBAS) Adjustable PLL and DLL parameters In-Band Interference Rejection[2] (IBIR) (DELTAS-G3TAJ only)	
NMEA	
NMEA version	Ver. 2.1, 2.2, 2.3, 3.0

Messages	GGA, GLL, GNS, GRS, GSA, GST, GSV, HDT, RMC, VTG, ZDA, ROT, GMP
Output interval	1, 5, 10, 20, 50, 100 Hz optional
DGPS	
Correction format	RTCM SC104 Ver 2.1, 2.2, 2.3, and 3.0
RTCM 2.x message type	1, 3, 9, 31, 32, 34; user selectable
RTCM 3.0 message type	1003, 1004, 1005, 1006, 1007, 1008, 1011, 1012, 1019, 1020; user selectable
Process interval	1, 5, 10, 20, 50, 100 Hz optional
Output interval for RTCM correction data	1, 5, 10, 20, 50, 100 Hz optional
Elevation mask	0 to 90 deg (independent of data logging)
Multi-base DGPS	Differential correction select mode: Nearest, Mix, Best (optional)
RTK	
Correction format	RTCM SC104 Ver 2.2, 2.3, or 3.0
RTCM 2.x message type	3, 18, 19, 20, 21, 22; user selectable
RTCM 3.0 message type	1003, 1004, 1005, 1006, 1007, 1008, 1019, 1011, 1012, 1020; user selectable
Ambiguity initialize	OTF (L1, L1/L2)
Baseline Length	Up to 50 km in the morning and evening. Up to 32 km at noon.
Initialize time	5 seconds to 10 min depending on the base line length and multipath conditions
Output interval for CMR/RTCM	1, 5, 10, 20, 50, 100 Hz optional
Elevation	0 to 90 degrees (independent of data logging)
Solution mode	Delay (synchronization); Extrapolation (not synchronized)
Process interval	1, 5, 10, 20, 50, 100 Hz optional
Latency	Delay mode – 20 msec to 20 sec (depends on latency which receives corrections data from base receiver); Extrapolation – 20 to 30 msec
Raw Data logging	The receiver can record raw data at another interval during RTK operation
Status	Fix, Float, DOP, Data Link Status, Receiver Latency, Common satellites, Percentage of fixing
Results	RTK coordinates, HRMS, VRMS, Covariance Matrix
Ambiguity fixing level	Selectable thresholds Low: 95%; Medium: 99.5%; High: 99.9%
Measuring Modes	

Base or Rover	Static, Fast Static Kinematic (Stop and Go) RTK (Real-time Kinematic) DGPS (Differential GPS) SBAS DGPS
Measuring Accuracy	
Autonomous	< 2m
Static, Fast Static	Horizontal: 0.3 cm + 0.5 ppm * base_line_length[3] Vertical: 0.5 cm + 0.5 ppm * base_line_length
Kinematic, RTK	Horizontal: 1 cm + 1 ppm * base_line_length Vertical: 1.5 cm + 1.5 ppm * base_line_length
RTK (OTF)	Horizontal: 1 cm + 1 ppm * base_line_length Vertical: 1.5 cm + 1.5 ppm * base_line_length
DGPS	< 0.25 m Post Processing, < 0.5 m Real Time
Real time attitude accuracy (for DELTAD and DELTAQ only)	Heading ~ 0.004/L [rad] RMS, where L is the antenna separation in [m
Cold Start Warm Start Reacquisition	< 35 sec < 5 sec < 1 sec

1. RTK update rate means the position update rate of the rover working in the “extrapolation” mode. In the extrapolation mode you may use the base with measurements update rate = 1 Hz and run the rover at 100 Hz RTK update rate.
2. In-Band interference usually is caused by harmonics of external transmitters (like TV stations) located close to GPS receiver. Interference decreases SNR and may stop receiver operation completely. Our In-Band Interference Rejection technique suppresses interference and recovers SNR. Multipath signal propagation worsens code/phase measurements. Advanced Multipath Reduction technique reduces this harmful effect.
3. The accuracy estimate is applicable to base lines up to several hundreds of km. But normally RTK works predictable on base lines up to 50 km.

A.1.2. GNSS Board Details

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

Table A-2. GNSS Board Specifications

Receiver type	
DELTAS	GPS L1/L2, L5 GLONASS L1/L2 (G3T, G-3TAJ only)
DELTAD	GPS L1/L2 Galileo E1
DELTAQ	GPS L1/L2 GLONASS L1/L2 Galileo E1
Tracking Specifications	
Standard channels	Total 216 channels: all-in-view (GPS L1/L2/L2C/L5, Galileo E1, GLONASS L1/L2, SBAS)
Tracked signals	L1/L2 C/A and P Code & Carrier
Tracking Functions	
Multipath reduction	Code and Carrier
PLL/DLL settings	Bandwidth, order, adjustable Smoothing interval Code and Carrier
WAAS/EGNOS	WAAS optional; EGNOS optional
Memory	
Internal Memory	Up to 2048MB of on board non-removable memory for data storage
Raw Data Recording	Up to 100 times per second (100Hz)
Data Type	Code and Carrier from GPS L1, L2, Galileo E1/E5A, GLONASS L1/L2 (G3T only)
1PPS Output (optional)	
Number of PPS ports	1
Edge	Rise, Fall
Period	10 to 1000000000 ms
Offset	-500000000 to 500000000 msec
Reference time	GPS, GLONASS, UTC (USNO), UTC (SU)
Event Marker (optional)	
Number of event Marker ports	1
Edge	Rise, Fall
Reference time	GPS, GLONASS, UTC (USNO), UTC (SU)

A.2. Connector Specifications

Power Connector

The power connector (Figure A-1) is a sealed receptacle, 5 pin, ODU p/n G80F1C-T05QF00-0000.

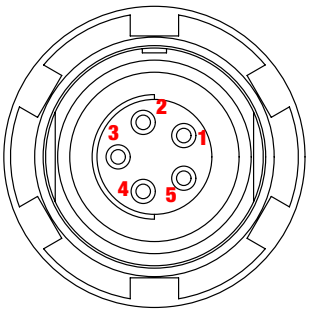


Figure A-1. Power Connector

Table A-3 gives power connector specifications.

Table A-3. Power Connector Specifications

Number	Signal Name	Dir	Details
1	Power_INP	P	10 to 30 volts DC input
2	Power_INP	P	10 to 30 volts DC input
3	Power_GND	P	Ground, power return
4	Power_GND	P	Ground, power return
5			Not used

Serial RS-232C Connector

The RS232 connectors (Figure A-2) are sealed receptacle, 7 pin, ODU p/n G80F1C-T07QC00-0000.

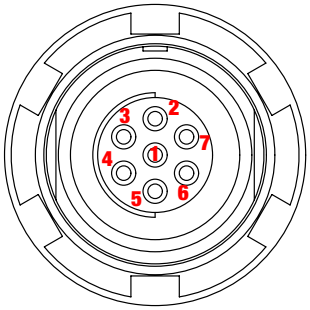


Figure A-2. RS-232C Connector

Table A-4 gives the RS-232C cable connector specifications.

Table A-4. RS-232C Cable Connector Specifications

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

USB Connector

Rimmed in black, the USB connector is a sealed receptacle, 5 pin, ODU p/n G80F2C-P05QF00-0000 (Figure A-3).

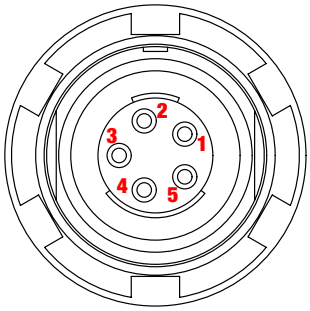


Figure A-3. USB Connector

Table A-5 gives the USB connector specifications.

Table A-5. USB Connector Specifications

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

Ethernet Connector

The Ethernet connector is a sealed receptacle, 7 pin, ODU p/n G80F2C-P07QC00-0000 (Figure A-4).

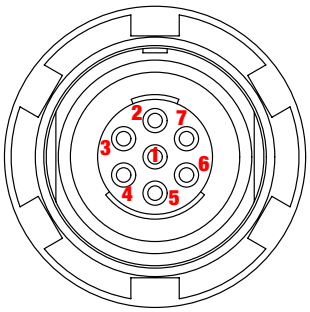


Figure A-4. Ethernet Connector

Table A-6. Ethernet Connector Specifications

Number	Signal Name	Dir	Details
1			Not used
2	Power_GND		Signal ground
3	TXD+	O	Transmit data plus
4	TXD-	O	Transmit data minus
5	RXD+	I	Receive data plus
6	RXD-	I	Receive data minus
7	LAN LED		External LAN LED anode

RS422 and CAN Connector

The RS422/CAN connector is a sealed receptacle, M12, 8 pin Male receptacle, FM, M16x1.5, flying lead connector Binder-USA p/n 09-3481-700-08 (Figure A-5)

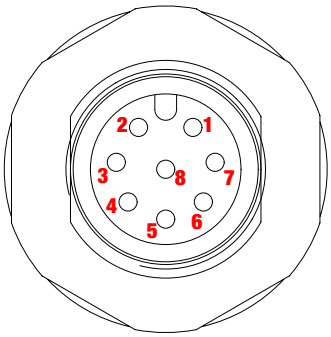


Figure A-5. RS422 and CAN Connector

Table A-7 gives the RS422/CAN connector specification.

Table A-7. RS422/CAN Specification

Number	Signal Name	Dir	Details
1	PWR IN	P	Bus power
2	GND	-	Signal ground
3	422_TX+	O	Port TX+ line
4	422_TX-	O	Port TX- line
5	422_RX+	I	Port RX+ line
6	422_RX-	I	Port RX- line
7	CAN_H	I/O	CAN_H bus line (dominant high)
8	CAN_L	I/O	CAN_H bus line (dominant low)

GNSS External Antenna RF Connector

The external antenna connector type is a TNC RF connector with an Applied Engineering Product p/n 6001-7051-003. RF input from LNA, 100 mA at 5.0 volts DC output.

EVENT and 1PPS Connectors (Optional)

The EVENT and 1PPS connectors are coaxial female receptacles of BNC series, Kings Electronics part number KC-79-108. These connectors are optional.

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.
- Use only with a pole, cart, stand, or tripod, specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.
- Unplug this apparatus during lightning storms or when unused for long periods of time.
- 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.

General Warnings

JAVAD GNSS receivers are designed for measuring and measuring related uses (that is, measuring coordinates, distances, angles and depths, and recording such measurements). 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.
- Without proper safeguards at the measuring site.
- Contrary to applicable laws, rules, and regulations.

DANGER: THE DELTA RECEIVER SHOULD NEVER BE USED IN DANGEROUS ENVIRONMENTS. USE IN RAIN OR SNOW FOR A LIMITED PERIOD IS PERMITTED.

Power Supply

A single external power supply with 5 pin ODU connector or SAE connector is necessary to operate DELTA. If external power supply has only SAE connector, Receiver-to-SAE power cable shall be used. 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 have an output rated for 4,5...35 V DC, not less than 2A. This may not be the same range as other JAVAD GNSS products with which you are familiar.

CAUTION: *To reduce the risk of electric shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.*

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 receiver will suspend operation. If the voltage supplied is above the maximum specification, the receiver may be permanently damaged, voiding your warranty.*

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.

If you have difficulty inserting the plug, turn it over and reinsert it. If the unit will not the used for a long time, disconnect the plug from the outlet.

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

Note: JAVAD GNSS recomends sertified Phihong power supply PSAA60W-120 (JAVAD GNSS p/n 22-570101-01) for indoor use.

Note: Before plugging the power cord into an AC outlet, make sure that all the connections have been made.

Usage Warnings

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

Note: Do not connect or disconnect equipment with wet hands, you are at risk of electric shock if you do!

The owner should periodically test this product to ensure it provides accurate measurements. Inform JAVAD GNSS immediately if this product does not function properly.

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

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[1].

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.

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

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