

Euro-3 and Enclosures

USER MANUAL

Euro-3 and Enclosures User Manual

Publication Number: OM-20000089
Revision Level: 3
Revision Date: 2010/08/30

Associated Firmware Version: Euro-3 2.201 or higher

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Notices

The following notices apply to the EuroPak-3 and EuroPak-3T.

FCC NOTICE

This equipment has been tested and found to comply with the radiated and conducted emission limits for a Class B digital device, for both CISPR 22 and Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orient or relocate the receiving antenna
- Increase the separation between the equipment and the receiver
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

IMPORTANT: In order to maintain compliance with the limits of a Class B digital device, it is required to use properly shielded interface cables (such as Belden #9539 or equivalent) when using the serial data ports, and double-shielded cables (such as Belden #9945 or equivalent) when using the I/O strobe port.



WARNING: Changes or modifications to this equipment not expressly approved by NovAtel Inc. could result in violation of Part 15 of the FCC rules.

ELECTROSTATIC DISCHARGE



WARNING

Remember:

- **Always wear a properly grounded anti-static wrist strap when handling the GPSCard.**
 - **Always hold the GPSCard by its corners or the RF shield, and avoid direct contact with any of the components.**
 - **Do not let the GPSCard come in contact with clothing at any time because the grounding strap cannot dissipate static charges from fabrics.**
 - **Failure to follow accepted ESD handling practices could cause damage to the GPSCard.**
 - **Warranty may be voided if equipment is damaged by ESD.**
-
-

Please see *Section 2.2.1.1* on *Page 25* and the Electrostatic Discharge Control for more information about ESD precautions.

CE NOTICE

The enclosures carry the CE mark.



WARNING: This is a Class B product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

"Hereby, NovAtel Inc. declares that this EuroPak-3 and EuroPak-3T are in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC."

Electromagnetic Compatibility (EMC)

The EuroPak-3 and EuroPak-3T have passed the following regulatory tests:

- FCC, Part 15 Radiated Emissions, Class B
- EN 55022 Radiated Emissions, Class B (CISPR 22)
- EN 61000-6-1 Generic Immunity-Residential Commercial and Light Industrial (EuroPak-3T only)
- EN 61000-6-2 Generic Immunity-Industrial (EuroPak-3 only)
- EN 61000-4-2 Electrostatic Discharge Immunity
- EN 61000-4-3 Radiated RF EM Field Immunity Test
- EN 61000-4-4 Electrical Fast Transient/Burst Test
- EN 61000-4-6 Conducted Immunity
- EN 61000-4-8 Magnetic Field Immunity
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- IEC/EN 60950 Safety of Information Technology Equipment

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8. For software UPDATES and UPGRADES, and regular customer support, contact the NovAtel GPS Hotline at 1-800-NOVATEL (U.S. or Canada only), or 403-295-4900, or fax 403-295-4901, e-mail to support@novatel.ca, visit our Web site <http://www.novatel.com> or write to:

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Warranty Policy

NovAtel Inc. warrants that its Global Positioning System (GPS) products are free from defects in materials and workmanship, subject to the conditions set forth below, for the following periods of time:

Euro-3 GPSCard Receivers	One (1) Year
EuroPak-3	One (1) Year
GPSAntenna™ Series	One (1) Year
Cables and Accessories	Ninety (90) Days
Software Support	One (1) Year

Date of sale shall mean the date of the invoice to the original customer for the product. NovAtel's responsibility respecting this warranty is solely to product replacement or product repair at an authorized NovAtel location.

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There are no user serviceable parts in the GPS receiver and no maintenance is required. When the status code indicates that a unit is faulty, replace with another unit and return the faulty unit to NovAtel Inc.

Before shipping any material to NovAtel or Dealer, please obtain a Return Material Authorization (RMA) number from the point of purchase. You may also visit our Web site at www.novatel.com and log in through *Support | Helpdesk & Solutions | E-Service*.

Once you have obtained an RMA number, you will be advised of proper shipping procedures to return any defective product. When returning any product to NovAtel, please return the defective product in the original packaging to avoid ESD and shipping damage.

Customer Support

Contact Information

If you have any questions or concerns regarding your Euro-3 receiver, please contact the NovAtel Customer Support using any one of the following methods:

NovAtel GPS Hotline:	1-800-NOVATEL (U.S. and Canada) 403-295-4900 (International)
Fax:	403-295-4901
E-mail:	support@novatel.ca
Web site:	www.novatel.com
Write:	Customer Support Dept. NovAtel Inc. 1120 - 68 Avenue NE Calgary, Alberta, Canada T2E 8S5

Firmware Updates

Firmware updates are firmware revisions to an existing model, which improves basic functionality of the GPS receiver.

The process for obtaining firmware updates is discussed in *Chapter 7, Firmware Updates* starting on *Page 135*. If you need further information, please contact NovAtel using one of the methods given above.

Foreword

Scope

This manual contains sufficient information about the installation and operation of the Euro-3 GPSCard to allow you to effectively integrate and fully operate it. There is also information about the EuroPak-3 and EuroPak-3T enclosures. After the addition of accessories, user-supplied data communications equipment and a power supply, the receivers are ready to go.

The Euro-3-based receivers utilize a comprehensive user-interface command structure, which requires communications through its communications (COM) ports. This manual also lists and describes the various receiver commands and logs.

It is beyond the scope of this manual to provide details on service or repair. Please contact your local NovAtel dealer for any customer-service related inquiries, see *Customer Support* on *Page 14*.

For glossary and acronym definitions used within this manual, please refer to the Knowledge and Learning page in the Support section of our Web site at www.novatel.com.

Prerequisites

The Euro-3 card is an OEM product that requires the addition of an enclosure and peripheral equipment before becoming a fully functional GPS receiver. The installation chapters of this document provide information concerning the installation requirements and considerations for the Euro-3 and its enclosures.

Conventions

The conventions used throughout this document are:

- H The letter H in the *Binary Bytes* or *Binary Offset* columns represents the header length for that command or log. The binary header is described in *Section 4.3.3* starting on *Page 48*.
- 0x A number following 0x is a hexadecimal number.
- [] Parameters surrounded by [and] are optional in a command or are required for only some instances of the command depending on the values of other parameters.
- < > Text displayed between < and > indicates the entry of a keystroke in the case of the command or an automatic entry in the case of carriage return <CR> and line feed <LF> in data output.

The term Euro-3 will be used in this manual to refer to the card alone. The term receiver will infer that the text is applicable to a Euro-3, either stand-alone or in an enclosure, unless otherwise stated.

In tables where no values are given, such fields should be assumed to be reserved for future use.

Compliance with GPS Week Rollover

The GPS week rollover issue refers to the way GPS receivers store information regarding the current GPS week. According to the official GPS system specifications document (*ICD-GPS-200*, paragraph 20.3.3.3.1.1), "... 10 bits shall represent the number of the current GPS week...". This means the GPS week is represented by an integer number between 0 and 1023. As GPS time started on Sunday January 6, 1980 at 0:00 hours, week 1023 ended on Saturday August 21, 1999 at 23:59:59.

Per the GPS system specifications document, NovAtel firmware resets the receiver's GPS week number back to zero. Users should be aware of this issue and keep in mind that there may be a compatibility issue when purchasing and using different makes of GPS receivers.

The Euro-3 is a high-performance receiver. The standard Euro-3 includes fourteen channels for tracking L1/L2 GPS signals with NovAtel's patented Narrow Correlator technology and four channels for tracking of L1 GEOs. The MEDLL version provides eight L1/L2 GPS channels and one L1 GEO channel.

This chapter provides information about the features and functionality of the Euro-3 and how it operates in the context of a Satellite Based Augmentation System (SBAS).

1.1 Overview of the Euro-3

The Euro-3 is capable of receiving and tracking the L1 C/A Code, L1 and L2 carrier phase, and L2 P Code (or encrypted Y Code) of up to 14 GPS satellites and four GEO satellites. With a 32-bit processor, the Euro-3-based receivers offer multipath-resistant processing at 1 Hz. Excellent acquisition and re-acquisition times allow the receivers to operate in environments where frequent interruption of signals can be expected.

There is flexibility in areas such as configuration and specification of output data and control signals. Multiple software models are available, allowing you to better fit the receiver to the application while maintaining the option for a compatible upgrade path.

The EuroPak enclosures offer a complete solution, a protective enclosure that provides an interface to the GPSCard's power, data, and status signals.

1.2 Overview of the Clock Card (EuroPak-3T only)

The EuroPak-3T enclosure also includes a 10 MHz clock card. It is a passive clock card in that it has no central processing unit (CPU). The clock card comes with an ovenized crystal oscillator (OCXO). This allows oscillator output from the OSC port. See also *Section 2.3.3, External Oscillator on Page 30*.

1.3 SBAS Overview

A Satellite-Based Augmentation System (SBAS) is a safety-critical system designed to augment the Department of Defense Global Positioning System (GPS) Standard Positioning Service (SPS). SBAS enhances GPS service by providing:

- a ranging function to the SBAS satellites, which improves signal availability and reliability
- GPS signal corrections, which improve accuracy
- integrity monitoring, which improves safety

The primary mission of the SBAS system is to provide a means for air navigation for all phases of flight in the National Airspace System (NAS) from departure, through en route, and approach. The principal functions of SBAS include:

- determining ionospheric corrections
- determining satellite orbits
- determining satellite clock corrections
- determining satellite integrity
- independent data verification
- SBAS message broadcast and ranging
- system operations & maintenance

As shown in *Figure 1 on Page 17*, the SBAS system consists of a series of *Reference Stations* and *Master Stations*, a *Ground Uplink Subsystem*, and *Geostationary Satellites (GEOs)*. The *Reference Stations*, which are

strategically located to provide adequate coverage, pick up GPS satellite data and route it to the *Master Stations*. The *Master Stations* then process the data to determine the signal integrity, signal corrections, and residual errors for each monitored satellite. This information is sent to the *Ground Uplink Subsystem* for transmission to the *GEOs*, which then re-transmits the data on the GPS L1 frequency.

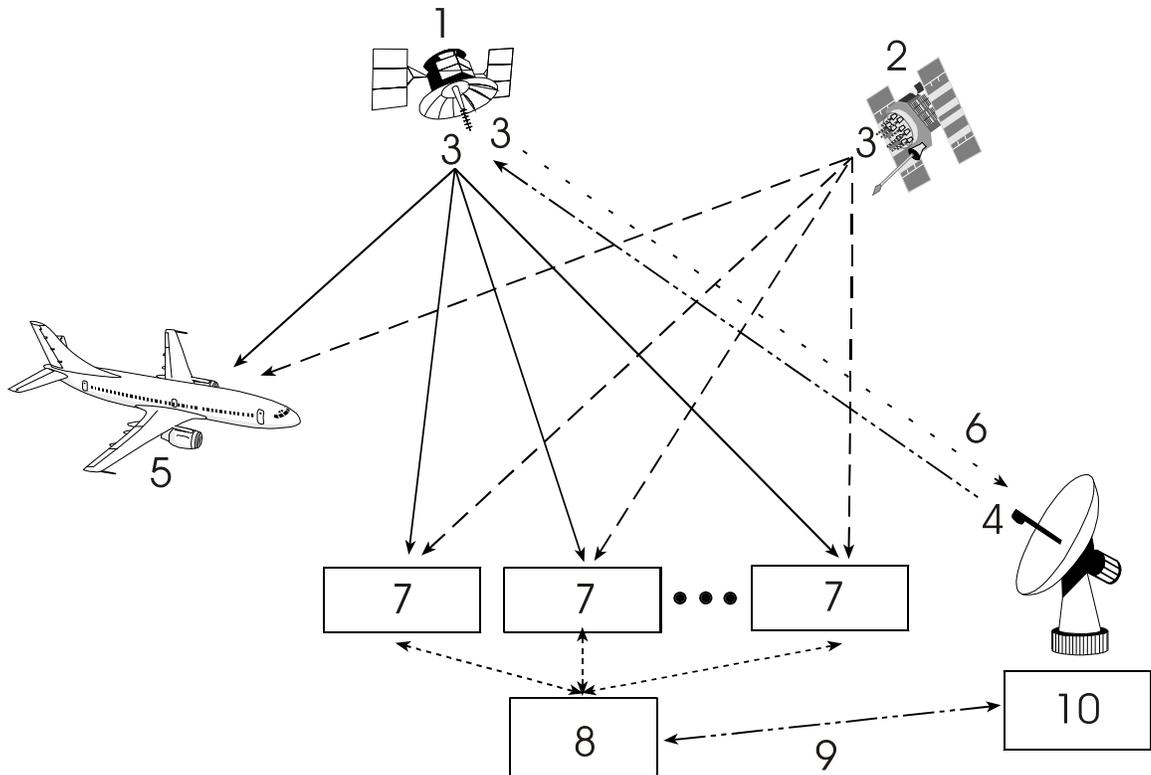


Figure 1: The SBAS Concept

Reference	Description
1	Geo satellite
2	GPS satellite constellation
3	L1 and L2
4	C1 and C2
5	GPS user
6	Integrity data, differential corrections and ranging control
7	Reference station
8	Master station
9	Integrity data, differential corrections, time control and status
10	Ground uplink subsystem

1.4 EuroPak-3 and EuroPak-3T Enclosures

The EuroPak-3 and EuroPak-3T provide a hardware interface between your equipment and the NovAtel Euro-3 GPSCard. Each is a rugged enclosure that provides protection against adverse environments. It has DB-9 connectors to access data and status signals.

The EuroPak-3 and EuroPak-3T offer the following features:

- A mounting enclosure with a PCB interconnect back plane
- Three serial ports provided on three DB-9P connectors
- One Universal Serial Bus (USB) port (shares COM1 DB-9P connector)
- Auxiliary status and synchronization signals
- GPS antenna and input power ports
- Indicators to provide power and communication status

The EuroPak-3 also offers this feature:

- An external oscillator port (input only)

The EuroPak-3T also offers this feature:

- An external oscillator port (output only)

The following accessories are included with the EuroPak-3 and EuroPak-3T:

- 1 12V power cable
- 1 I/O cable
- 1 null modem serial cable
- 1 straight through serial cable
- A CD containing NovAtel's GPS PC utilities and product documentation

For technical specifications on the EuroPak-3 and EuroPak-3T, please see *Appendix A, Technical Specifications* starting on *Page 144*.

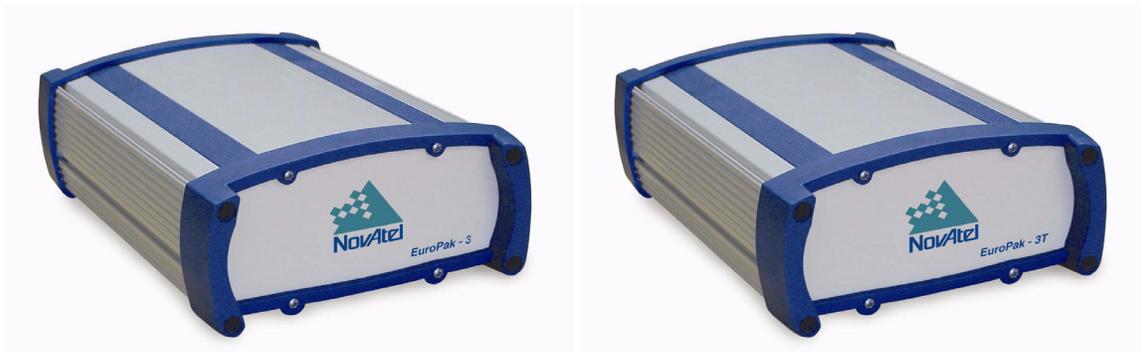


Figure 2: EuroPak-3 and EuroPak-3T Enclosures



Figure 3: EuroPak-3 and EuroPak-3T Rear Panel

1.5 Euro-3 Features

The Euro-3 has been designed with the following features:

- 32 channel “all-in-view” parallel tracking
- cross-correlation detection channel
- bit synchronization check channel
- constant post-correlation noise floor measurement channel
- Fast reacquisition
- Fully field-upgradeable firmware
- Low power consumption
- 1 Hz raw data and position output rates

At a minimum, the following models are available for each receiver:

- L1L2GEO • GRCT • MEDLL
- L1L2GEOT • GRC • MEDLLT

Those models with dual-frequency capabilities make the following possible:

- Longer baselines in differential positioning mode, due to the reduction of atmospheric errors
- Enhanced positioning precision due to the additional measurements
- Support for L1 and L2 GPS signal processing
- Support for L1 GEO signal processing
- Ability to significantly reduce multipath effects on GPS data (MEDLL, see *Section 1.5.2* below)
- GPS signal quality monitoring (SQM) functionality, see *Section 1.5.5* on *Page 20*
- Digital pulse blanking for the L2 signal

The majority of these features are discussed further in the following sections.

1.5.1 GEO Processing

Specific channels in the Euro-3 have the capability to receive and process the SBAS signal provided by *GEOs*. The signal is in-band at L1 and is identified through the use of SBAS-specific PRN numbers. The SBAS message is decoded and separated into its various components. The SBAS message and associated pseudorange are provided as an output.

1.5.2 Multipath Reduction

The Euro-3 with the MEDLL option can achieve a high level of multipath reduction. NovAtel has developed a multipath elimination technology that approaches the theoretical limits of multipath-free GPS signal reception. This patented technology, known as *Multipath Estimating Delay-Lock-Loop* (MEDLL), uses a combination of hardware and software techniques, which together are capable of reducing the combined effects of pseudorange and carrier-phase multipath errors by as much as 90% compared to a system using Narrow Correlator tracking technology alone.

1.5.2.1 Optional MEDLL Technology

MEDLL technology takes advantage of NovAtel's parallel channel Narrow Correlator sampling techniques. MEDLL uses a proprietary coupled correlator sampling technique combined with "maximum likelihood estimation" techniques to break down the received signals into direct path and reflected path components. MEDLL determines the amplitude, delay, and phase angle of both the direct and multipath signals and analyses the signal with the least delay to determine the direct path. All other signals with greater delay are considered to be multipath components and are removed.

☒ MEDLL is running as a monitoring system only and does not close the delay lock loop (DLL).

1.5.3 Cross-Correlation Detection Channel

NovAtel's patent-pending SafeTrak technology is also featured in Euro-3-based products.

The receiver tracks a satellite by replicating the satellite's PRN code and aligning it with the received PRN code. Cross-correlation happens when the receiver is tracking a certain PRN code with an incorrectly replicated PRN code. This is due to the receiver tracking a minor, rather than the required major, correlation peak. The Euro-3 performs a cross-correlation check on channels tracking at low C/No values. The cross-correlation channel aligns its code phase with that of the tracking channel under test. An initial power check between the two channels is made to check alignment and the cross-correlation channel shifts its code phase repeatedly to measure the power. If at any point it determines that the cross-correlation power is within a certain level of the initial power, the channel under test is tracking one of the minor cross-correlation peaks. The tracking channel then re-acquires the satellite to remove the cross-correlation error.

1.5.4 Bit Synchronization

Bit synchronization identifies the location of navigation bit edges with respect to the 1 ms C/A-code epochs. Bit edge detection is based on observing the sign transition between successive 1 ms accumulations that are aligned with the received C/A-code epochs. The bit synchronization is verified by an additional hardware channel and software steering. This additional hardware is configured to generate a stream of 1 ms accumulations until sufficient data has been collected to perform the test. The tracking channel is forced to re-acquire if the results of this test confirms a bit alignment error.

1.5.5 Signal Quality Monitoring

Signal Quality Monitoring (SQM) technology is used to monitor GPS signals in space for anomalous behavior. To do this, the Euro-3 outputs accumulations at the specified correlation function values. It collects accurate accumulation values and outputs them in a timely fashion. The Euro-3 hardware is capable of tracking the correlation function at multiple correlation locations. See also the ALLSQMIINFO and ALLSQMQINFO logs starting on *Page 101* for more information about correlator locations.

1.5.6 Digital Pulse Blanking

Digital pulse blanking involves removing or attenuating pulses in the RF signal that exceed a specified level. The Euro-3 provides digital pulse blanking for the L2 signal path only.

Use the PULSEBLANKING command to enable/disable L2 pulse blanking or to control its sensitivity, see *Page 83*.

1.6 Euro-3 GPSCard

The Euro-3 card consists of a radio frequency (RF) and a digital electronics section.

In addition to the Euro-3, a GPS receiver system typically contains three other major components:

- A GPS antenna (and optional LNA power supply)
- A power supply

Data communications equipment

1.6.1 Radio Frequency (RF) Section

The receiver obtains a filtered and amplified GPS signal from the antenna via the coaxial cable. The RF section performs the translation from the incoming RF signal to an IF signal usable by the digital section. It also supplies power to the active antenna's LNA through the coaxial cable while maintaining isolation between the DC and RF paths. The RF section can reject a high level of potential interference (for example, MSAT,

Inmarsat, cellular phone, and TV sub-harmonic signals).

1.6.2 Digital Electronics Section

The digital section of the receiver, receives a down-converted, amplified GPS signal which it digitizes and processes to obtain a GPS solution (position, velocity and time). The digital section consists of an analog-to-digital converter, a 32-bit micro processor, memory, control and configuration logic, signal processing circuitry, serial peripheral devices, and supporting circuitry.

The digital section performs the translations and calculations necessary to convert the IF analog signals into usable position and status information. It also handles all I/O functions, including the auxiliary strobe signals, which are described in detail in *Section 2.3.1 on Page 29*. For input and output levels please see *Appendix A, Technical Specifications* starting on *Page 144* for the Euro-3.

1.6.3 GPS Antenna

The purpose of the GPS antenna is to receive the GPS/GEO signals in space, to band limit the signal, and to amplify the signal for transmission to the card. An active GPS antenna with an LNA is required for the receiver to function properly. NovAtel's active antennas are recommended.

Power for the antenna LNA is supplied by the receiver.

1.6.4 Principal Power Supply

A single external power supply capable of delivering 10 W is necessary to operate the receiver. See *Page 146* for details.



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.

1.6.5 Data Communications Equipment

A PC or other data communications equipment is necessary to communicate with the receiver and, if desired, to store data generated by the receiver.

This chapter contains instructions and tips to set up your NovAtel receiver to create a GPS receiver system.



WARNING: Complete all installation instructions before applying power to the receiver.

2.1 Additional Equipment Required

In order for the receiver to perform optimally, the following additional equipment is required:

- An interface for power, communications, and other signals and an enclosure to protect against the environment (if your receiver has been purchased as a GPSCard without an enclosure)
- An active GPS antenna
- A quality coaxial cable (and interconnect adapter cable as necessary)
- Data communications equipment capable of serial communications
- A serial cable (if not included with the receiver)
- A power supply
- A power cable (if not included with the receiver)



CAUTION: When the Euro-3 receiver is installed in a permanent location, such as in a building, it should be protected by a lightning protection device according to local building codes. See also *Warranty Policy on Page 13*.

2.1.1 Selecting a GPS Antenna

An active antenna is required because its low-noise amplifier (LNA) boosts the power of the incoming signal to compensate for the line loss between the antenna and the receiver.

NovAtel offers a variety of single and dual-frequency GPS antenna models, as indicated in the table below. All include band-pass filtering and an LNA. The GPS antenna you choose will depend on your particular application. Each of these models offer exceptional phase-center stability as well as a significant measure of immunity against multipath interference. Each one has an environmentally-sealed radome.

Table 1: NovAtel GPS Antenna Models

Models	Frequencies Supported
701	L1 only
702, 532, 533	L1 and L2

2.1.2 Choosing a Coaxial Cable

An appropriate coaxial cable is one that is matched to the impedance of the antenna and receiver being used (50 ohms), and whose line loss does not exceed 10.0 dB. If the line loss limit is exceeded, excessive signal degradation will occur and the receiver may not meet its performance specifications. NovAtel offers a variety of coaxial cables to meet your GPS antenna interconnection requirements, including:

- 5, 15, or 30 m antenna cables with TNC male connectors on both ends (NovAtel part numbers C006, C016 and C032 respectively)

Your local NovAtel dealer can advise you about your specific configuration. Should your application require

the use of cable longer than 30 m you will find the application note *RF Equipment Selection and Installation* at our Web site, www.novatel.com, or you may obtain it from NovAtel Customer Support directly.

High-quality coaxial cables should be used because a mismatch in impedance, possible with lower quality cable, produces reflections in the cable that increase signal loss. Though it is possible to use other high-quality antenna cables, the performance specifications of the Euro-3-based receivers are warranted only when used with NovAtel-supplied accessories.

2.1.3 Power Supply Requirements

This section contains information about the requirements for the input power to the receiver. See *Page 146* for more power supply specifications.



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.

The Euro-3 GPSCard contains a DC to DC converter that is very tolerant to noise and ripple at its input. A tightly regulated input supply to the card is not required, as long as it falls within the given input range. The power supply used should be capable of 10 W. The voltage input range for the Euro-3 GPSCard is +4.5 to +18 VDC.

The receivers are designed to prevent internal damage when subjected to a reverse polarity power connection. They also provide protection from short over voltage events. It is recommended that appropriate fuses or current limiting be incorporated as a safety precaution on all power lines used. Use a sufficient gauge of wire to ensure that the voltage at the connector is within the GPSCard's requirements.

2.1.3.1 EuroPak-3 and EuroPak-3T Enclosures

The EuroPak-3 and EuroPak-3T are supplied with a 12 V power cable with a built-in slow-blow fuse for use with a standard 12 VDC power outlet.

If a different supply is desired, the input range required is +9 to +18 VDC for the EuroPak-3 and +11 to +18 VDC for the EuroPak-3T. The type of connector required to mate with the receiver's power connector is a 4-pin LEMO socket connector labelled PWR. The supply should be capable of 10 W for the EuroPak-3 and 15W for the EuroPak-3T. See *Appendix D, Replacement Parts* on *Page 164* for LEMO connector part numbers.

2.2 Installation Overview

Once you have selected the appropriate equipment, complete the following steps to set up and begin using your NovAtel GPS receiver.

1. If your receiver has been provided as a GPSCard without an enclosure, install the card in an enclosure with a wiring harness, as described in *Section 2.2.1* on *Page 25*.
2. Mount the GPS antenna to a secure, stable structure, as described in *Section 2.2.2* on *Page 27*.
3. Connect the GPS antenna to the receiver using an antenna RF cable, using the information given in *Section 2.2.3* on *Page 27*.
4. Connect the receiver to a PC or other data communications equipment by following the information given in *Section 2.2.4* on *Page 28*.
5. Apply power to the receiver, as described in *Section 2.2.5* on *Page 28*.

Figure 4 on the next page shows a typical set up for an enclosed receiver.

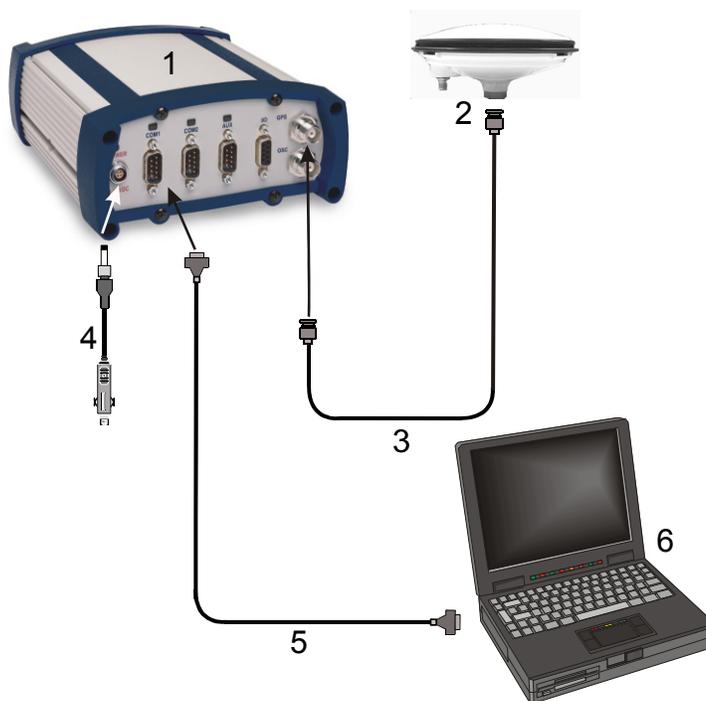


Figure 4: Typical Receiver Installation

Reference	Description
1	Receiver
2	GPSAntenna Model 702 or 701
3	RF Antenna Cable
4	12V Power Cable
5	Null Modem Data Cable (shown) or USB Cable
6	Data Communications Equipment

2.2.1 Installing a GPSCard in a Wiring Harness and Enclosure

To install a GPSCard, begin with the following:

1. Ensure you are taking the necessary precautions against ESD, as described in *Section 2.2.1.1* below.
2. Mount the GPSCard in a secure enclosure to reduce environmental exposure and RF interference, as described in *Section 2.2.1.2* on *Page 26*.
3. Prepare a wiring harness to interface to the receiver’s data, status, and power signals using the information given in *Section 2.2.1.3* on *Page 26*.

2.2.1.1 Electrostatic Discharge (ESD) Precautions

Electrostatic discharge is a leading cause of failure of electronic equipment components and printed circuit boards containing ESD-sensitive devices and components. It is imperative that ESD precautions be followed when handling or installing a GPSCard. Please see *Appendix B, Electrostatic Discharge Control (ESD) Practices* starting on *Page 161* for more information about ESD precautions.

Leave the GPSCard in its static-shielding bag or clamshell when not connected in its normal operating environment. When removing the GPSCard from the ESD protection, follow accepted standard anti-static practices. Failure to do so may cause damage to the GPSCard and void the warranty.

When you remove the GPSCard from the original packing box, it is recommended that you save the box and ESD protection for future storage or shipment purposes.

**WARNING!****Remember:**

- **Always wear a properly grounded anti-static wrist strap when handling the GPSCard.**
 - **Always hold the GPSCard by its corners or the RF shield, and avoid direct contact with any of the components.**
 - **Do not let the GPSCard come in contact with clothing at any time because the grounding strap cannot dissipate static charges from fabrics.**
 - **Failure to follow accepted ESD handling practices could cause damage to the GPSCard.**
 - **Warranty may be voided if equipment is damaged by ESD.**
-
-

2.2.1.2 Mounting the Printed Circuit Board

The Euro-3 GPSCards are OEM products and therefore the printed circuit board is provided without a housing structure. This allows flexibility in creating a mounting environment to suit particular product and marketing requirements. The mounting and enclosure should provide the following:

- mounting of external connectors
- protection from hostile physical environments (for example, rain, snow, sand, salt, water, extreme temperatures)
- electromagnetic shielding to protect from hostile RF environments (for example, nearby transmitters)
- electromagnetic shielding so that the final product itself conforms to RF emissions specifications
- protection from ESD (see *Appendix B, Electrostatic Discharge Control (ESD) Practices* starting on *Page 161*)

The GPSCard can be held in place by screws. Please see *Figure 21, Euro-3 Board Dimensions* on *Page 145* for mechanical drawings.

2.2.1.3 Preparing the Data, Signal & Power Harness

The wiring harness provides the following interconnect functions:

- access to the serial communications ports
- access to input and output timing strobes
- power input(s)
- access to control signals

For all GPSCards, the power, status, and data inputs and outputs are accessed from a single connector. Therefore, the harness must be designed to mate with this connector.

As shown in *Figure 5* on *Page 27*, the Euro-3 uses a 160-pin five-row male connector with 0.1” spacing for the data, power, and status signals. The pin out for this connector is specified after *Figure 22* on *Page 148*. The RF connector is an SMB male jack.

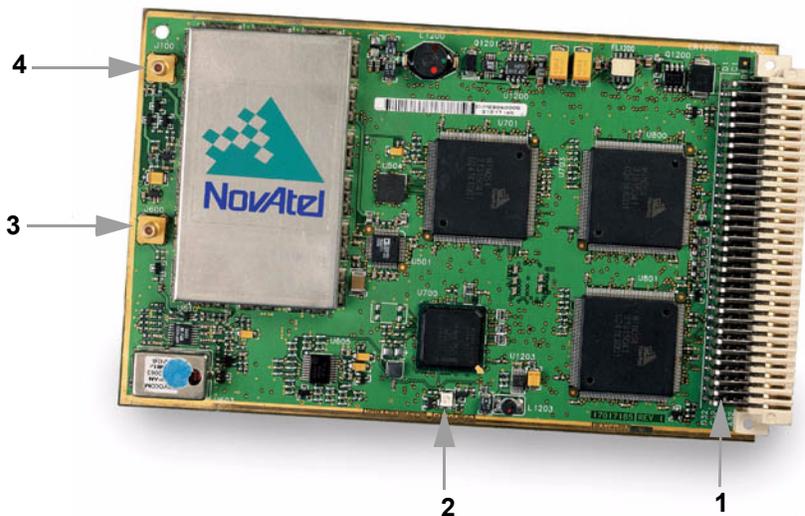


Figure 5: Euro-3 Connector and Indicator Locations

Reference	Description
1	Power, signal and data connector P1200 (male, 160-pin, DIN 41612, right-angle) that connects to user-supplied interface
2	LED status indicator
3	External oscillator input (SMB straight male jack)
4	RF signal input and LNA power output (SMB straight male jack)

2.2.2 Mounting the GPS Antenna

Once the GPSCard is installed in a wiring harness and enclosure, the antenna to be used with the receiver must be mounted. The GPS receiver has been designed to operate with any of the NovAtel single-frequency or dual-frequency GPS antenna models. See *Section 2.1.1 on Page 23* for more information.

When installing the antenna system:

- Choose an antenna location that has a clear view of the sky so that each satellite above the horizon can be tracked without obstruction. For more information about multipath, please refer to the Knowledge and Learning page in the Support section of our Web site at www.novatel.com.
- Choose an antenna location that provides low multipath conditions for the received signal. For example, in the middle of a flat roof. The edge of a roof with visibility to a parking lot is a high multipath environment.
- Mount the antenna on a secure, stable structure capable of safe operation in the specific environment.

2.2.3 Connecting the Antenna to the Receiver

Connect the antenna to the receiver using high-quality coaxial cable, as discussed in *Section 2.1.2 on Page 23*.

The EuroPak-3 and EuroPak-3T provide a TNC female connector, which can be connected to the antenna directly with any of NovAtel’s coaxial cables. For the GPSCards, an interconnect adapter cable is required to convert the TNC male end of the coaxial cable to the card’s SMB straight male jack RF input connector. The location of the RF connector for the GPSCard is shown in *Figure 5* above.

2.2.4 Connecting Data Communications Equipment

In order to communicate with the receiver by sending commands and obtaining logs, a connection to some form of data communications equipment is required, usually a PC computer. The default configuration available for each of the receiver types is given in the table below. See *Page 147 of Appendix A* for data connection details.

Table 2: Default Serial Port Configurations

Receiver	COM1	COM2	COM3	USB1
Euro-3	RS-232/RS-422	RS-232/RS-422	RS-232/RS-422	USB 1.1
EuroPak-3	RS-232	RS-232	RS-232	USB 1.1
EuroPak-3T	RS-232	RS-232	RS-232	USB 1.1

Each port may support some, or all, of the following signals:

- Clear To Send (CTS)
- Transmitted Data (TXD)
- Request To Send (RTS)
- Received Data (RXD)
- Data Carrier Detect (DCD)

Extra control lines are provided on COM2 for use with modems or other differential correction data links.

The EuroPak-3 and EuroPak-3T enclosures are Data Terminal Equipment (DTE) so that TXD, RTS and DTR are outputs while RXD, CTS and DCD are inputs. A null modem cable is required to connect to another DTE like a terminal or a PC.

The RS-232, or RS-422, port settings (bit rate, parity, and so on) are software-configurable. These are further described in *Chapter 3, Operation on Page 38*. See *Table 60, EuroPak-3/3T Serial Port Pin-Out Descriptions on Page 152* for further information about data communications characteristics.

The receiver supports USB communication by connecting COM1 on the receiver to a USB port on the data communications equipment using the USB cable provided.



Figure 6: USB Cable Connection

You must now install NovAtel's USB driver and Virtual Serial Port Utility. See *Section 2.3.6* starting on *Page 31* for details on the USB driver and utility installations.

2.2.5 Applying Power to the Receiver

Connect the power supply, set to the voltage given in *Section 2.1.3* on *Page 24*, to the wiring harness created previously.

For a EuroPak-3 and EuroPak-3T enclosure, connect the power supply to the PWR port.

2.3 Additional Features and Information

This section contains information about the additional features of the Euro-3-based receivers, which may affect the overall design of your receiver system.

2.3.1 Strobes

A set of inputs and outputs that provide status and synchronization signals are provided on the Euro-3. These signals are referred to as strobes. As shown in *Table 3* below, not all strobe signals are provided on all receivers. However, for those products for which strobes are available, you may want to design your installation to include support for these signals.

The Euro-3 has 9 TTL-compatible I/O strobe lines. See *Figure 21, Euro-3 Board Dimensions* on *Page 145*.

The EuroPak-3 and EuroPak-3T enclosures provide strobe signals at their I/O port, as described in *Table 61* on *Page 153*.

Strobe signals include an input and several outputs as described below:

- Mark Input (Event1) A pulse on this input triggers certain logs to be generated. (see *Section 4.2.2, Log Triggers* on *Page 44*).
- Measure Output (MSR) Falling edge is synchronized with internal GPS measurements.
- Pulse Per Second Output (PPS) A pulse for which the trailing edge is synchronized with GPS time.
- Clock Model Valid Output (PV) High when good GPS time solution.
- Error Output (ERROR) High when a receiver hardware failure is detected.
- LED Red Output (STATUS_RED) Hardware failure when on or pulsing.
- LED Green Output (STATUS_GREEN) Normal operation when pulsing at 1 Hz.
- Variable Frequency (VARF) Variable output range from 0 to 20 MHz.

See the *Strobe Electrical Specifications* section starting on *Page 147*, for further information about the strobe signal characteristics.

Table 3: Available Strobe Signals on Receivers

Signal	EVENT1	MSR	PPS	PV	ERROR	STATUS_RED	STATUS_GREEN	VARF
Euro-3	Pin B24	Pin B23	Pin B22	Pin B25	Pin B15	Pin B5	Pin B6	Pin B21
EuroPak-3 and EuroPak-3T	I/O port, pin 4	I/O port, pin 3	I/O port, pin 2	I/O port, pin 5	I/O port, pin 8	Not available	Not available	I/O port, pin 1

2.3.2 Status Indicators

The Euro-3 receivers have LED indicators that provide the status of the receiver. The GPSCards have a single indicator, which is shown in *Figure 5* on *Page 27* for the Euro-3. The LED blinks green on and off at approximately 1 Hz to indicate normal operation. If the indicator is red, then the receiver is not working properly. The operation of this indicator is further described in *Section 8.5* on *Page 142*.

The EuroPak-3 and EuroPak-3T provide the status indicators shown in *Table 4*.

Table 4: EuroPak-3 and EuroPak-3T Status Indicators

Indicator	Indicator Color	Status
COM1	Green	Data is being transmitted from COM1
	Red	Data is being received on COM1
COM2	Green	Data is being transmitted from COM2
	Red	Data is being received on COM2
AUX	Green	Data is being transmitted from COM3
	Red	Data is being received on COM3
PWR	Red	The receiver is powered

2.3.3 External Oscillator

For certain applications requiring greater precision than what is possible using the Euro-3's on-board 20 MHz, voltage-controlled, temperature-compensated crystal oscillator (VCTCXO), you may wish to connect the Euro-3 to an external, high-stability oscillator. The external oscillator can be either 5 MHz or 10 MHz. See the *External Oscillator Input* section on *Page 146* for the full specifications of this signal.

If you do not use the EXTERNALCLOCK command to specify a clock type, see *Page 73*, its default is DISABLE. This means the external clock input is off and the board is using the on-board VCTCXO.

Installation consists of connecting a cable from the external oscillator to the Euro-3's external oscillator input connector.

For the EuroPak-3 and EuroPak-3T the BNC external oscillator port, labeled OSC, is used for input and output signals respectively. See *Figure 3* on *Page 18*.

For the Euro-3, an SMB straight male jack connector is used, as shown in *Figure 5* on *Page 27*. The receiver does not have to be powered down during this procedure. If you are handling the Euro-3 directly, anti-static practices must be observed.

Once an external oscillator has been connected, the EXTERNALCLOCK command, see *Page 73*, must be issued to define the clock model (for example, cesium, rubidium or ovenized crystal) and to set the input clock frequency.

2.3.4 External Antenna LNA Power (Euro-3 GPSCard Only)

For the Euro-3 it is possible to supply power to the LNA of an active antenna either from the antenna port of the GPSCard itself or from an external source. The internal antenna power supply of the GPSCards can produce +5 VDC at up to 150 mA. This meets the needs of NovAtel's dual-frequency GPS antennas, so, in most cases, an additional LNA power supply is not required.

If a different antenna is used whose LNA requires voltage capacity beyond what the receiver can produce, then the external LNA power option must be utilized. This simply requires setting a voltage supply between +8 and +30 VDC, 150 mA maximum, and connecting it to pin 40 of the 40-pin connector on the Euro-3. See also *Appendix A, RF Input and LNA Power* on *Page 146*.

In either case, the LNA power is fed to the antenna through the same coaxial cable used for the RF signals. The internal LNA power source should be disabled using the ANTENNAPOWER command. Refer to *Volume 2* of this manual for more information about this command.

**CAUTION**

No warranty is made that the receiver meets its performance specifications if a non-NovAtel antenna is used.

2.3.5 Mounting Bracket (EuroPak-3 and EuroPak-3T Only)

Along with the EuroPak-3 and EuroPak-3T enclosures, mounting kits have been provided to facilitate mounting the receivers to a surface. This section provides information about how to mount the receivers.

- ☒ The mounting kits are not designed for use in high-dynamics or high-vibration environments. Contact NovAtel Customer Support if your application requires the EuroPak-3 and EuroPak-3T to be mounted in these types of environments.

To install the mounting bracket provided with the EuroPak-3 and EuroPak-3T, refer to the instructions provided with the mounting kit. *Page 159* provides the dimension information for the bracket.

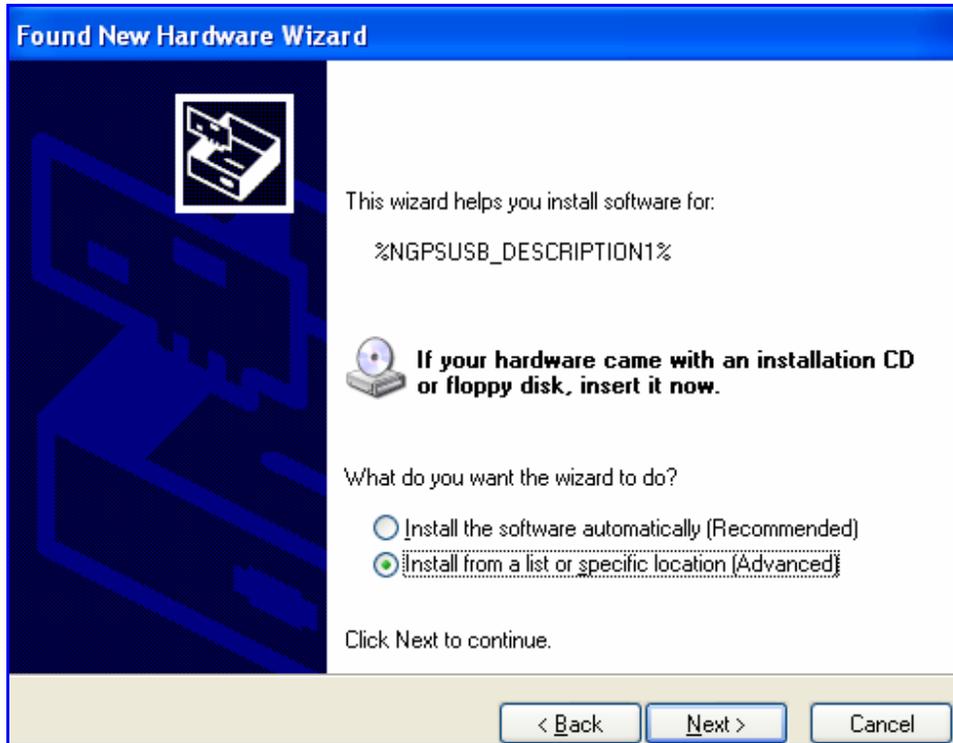
2.3.6 Installing the USB Driver and the USB Virtual Serial Port Utility

Once the EuroPak is connected to the PC, and power supply, install NovAtel's USB Driver and NovAtel's USB Virtual Serial Port utility by advancing through the following steps:

1. Unzip the ZIP file `NovAtel_3000.zip`, on the CD provided, to a local directory (for example, `C:\NovAtel_3000`) on the PC file system.
2. Power up the EuroPak. The PC detects the new USB device connected to it, and prompts "Found New Hardware" (OEM4 Schwarz). The "Found New Hardware Wizard" starts. Install the USB driver (NovAtel GPS Receiver) by advancing through the following steps:
3. Select "No, not this time".

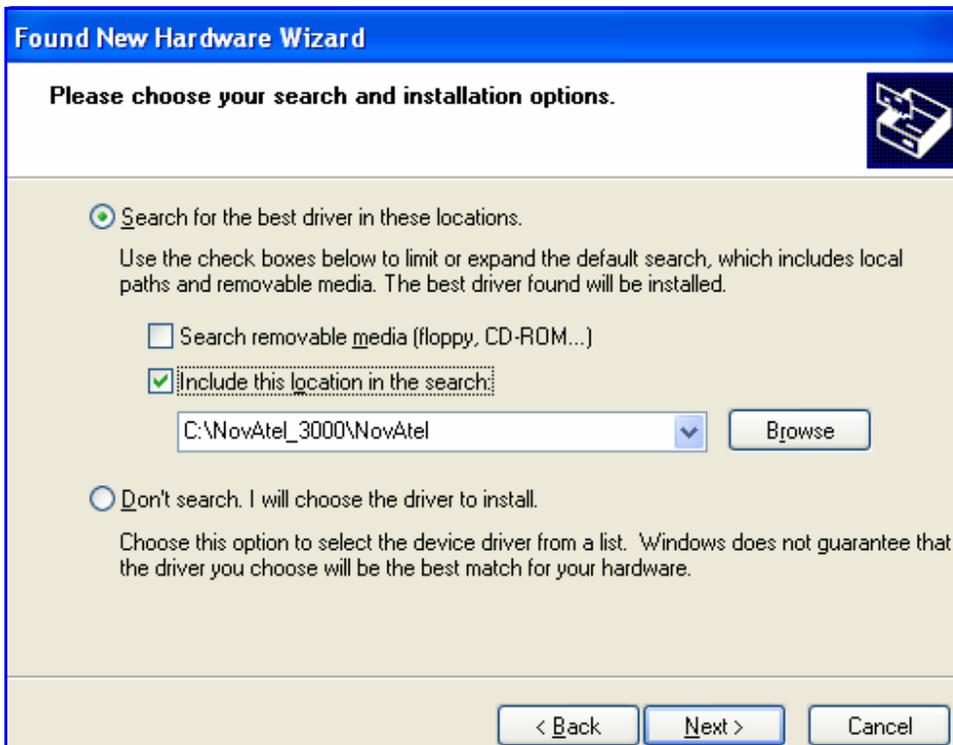


4. Click on the "Next" button.



5. Select "Install from a list or specific location (Advanced)".

6. Click on the "Next" button.



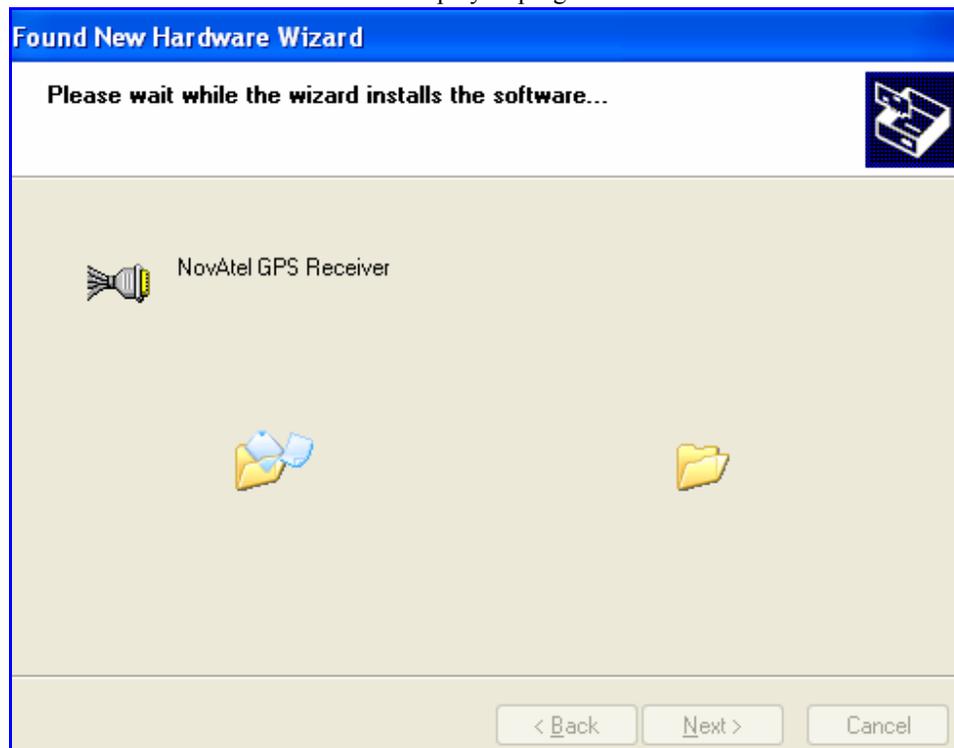
7. Select "Search for the best driver in these locations.".

8. Check the "Include this location in the search:" check box, and click on the 'Browse' button to

browse for the location of the NovAtel USB driver.

9. Click on the "Next" button.

The Found New Hardware Wizard displays a progress window:



10. Click on the "Continue Anyway" button, if the message below appears:



The installation process continues.

11. Click on the "Continue Anyway" button, if the message below appears:



12. Click on the Finish button:

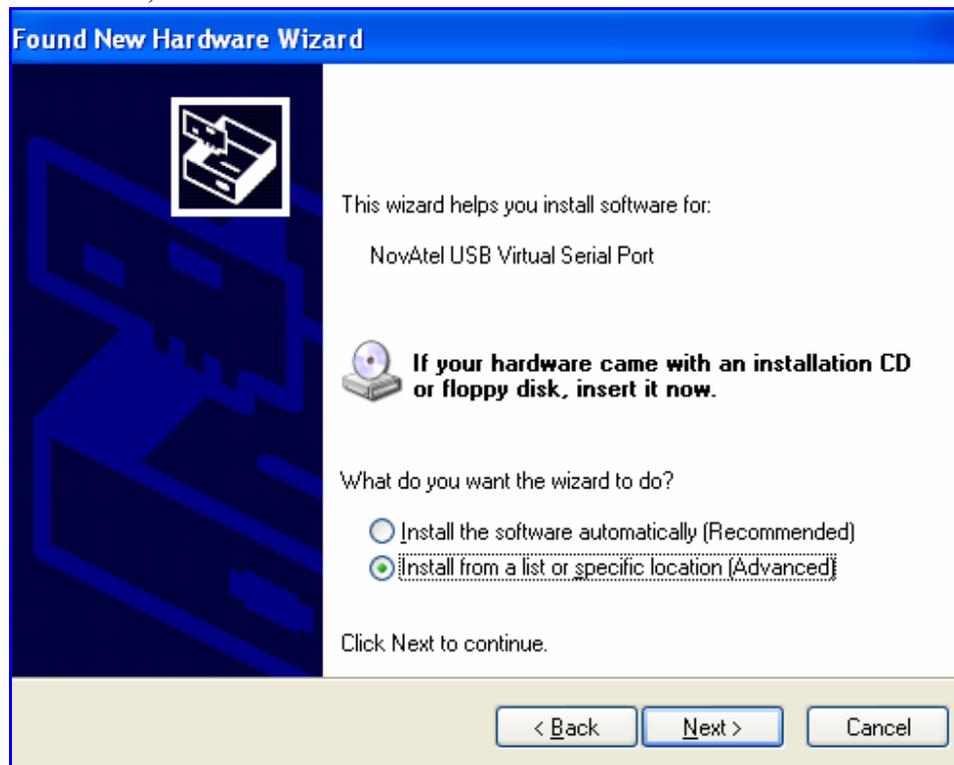


When the system detects the NovAtel USB Virtual Serial Port, the "Found New Hardware Wizard" starts.

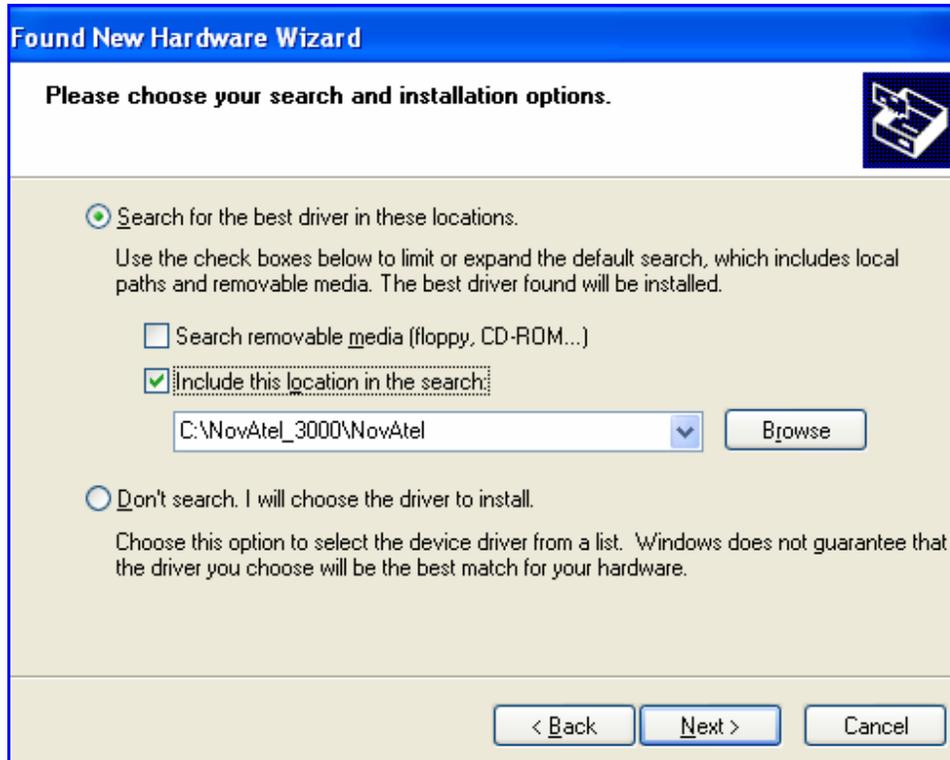
13. Install the driver for the NovAtel USB Virtual Serial Port by advancing through the following steps:



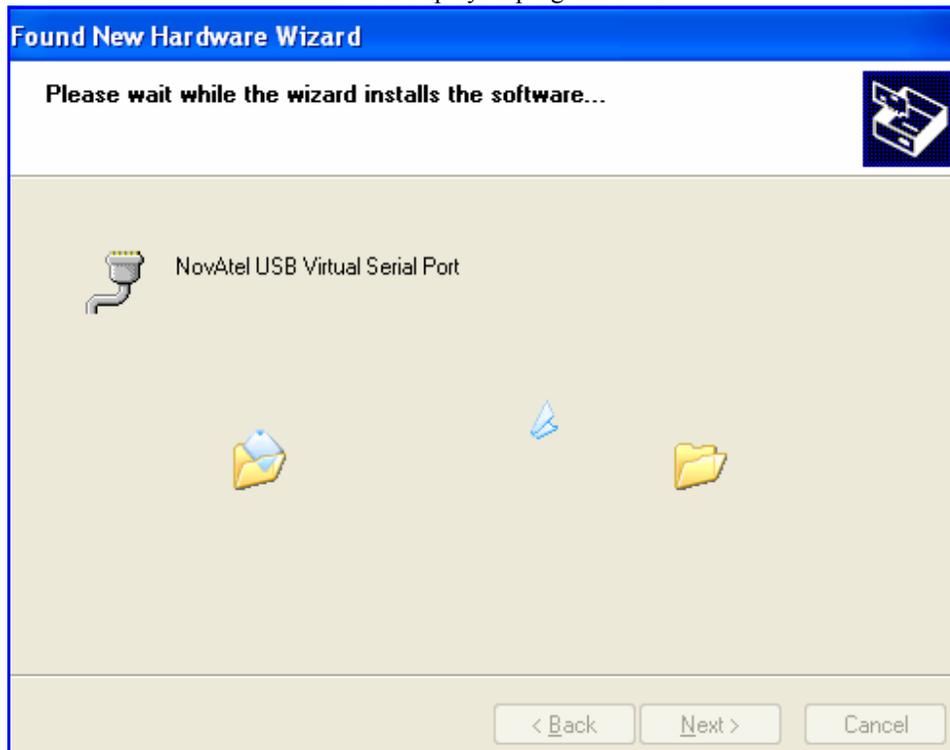
14. Select "No, not this time" and click on the "Next" button.



15. Select "Install from a list or specific location (Advanced)" and click on the "Next" button.



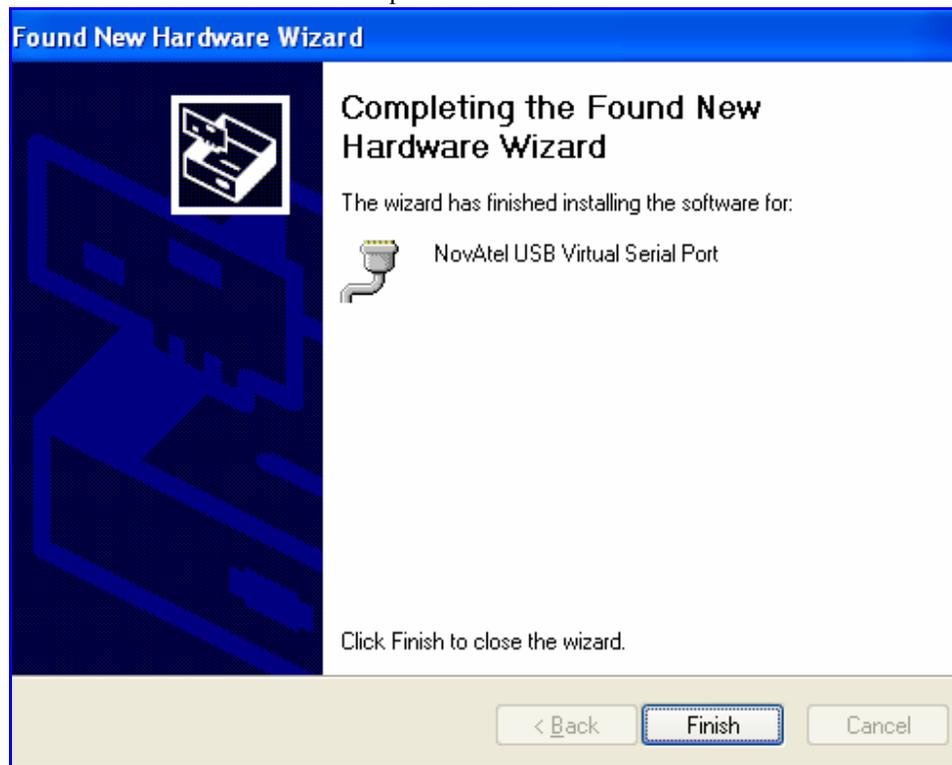
16. Select "Search for the best driver in these locations".
17. Check the "Include this location in the search:" check box, and click on the 'Browse' button to browse for the location of the NovAtel USB driver and click on the "Next" button.
18. The Found New Hardware Wizard displays a progress window:



19. Click on the "Continue Anyway" button, if the message below appears:



20. Click on the Finish button to complete the installation:



Before operating the receiver for the first time, ensure that you have followed the installation instructions in *Chapter 2*. From here on, it will be assumed that testing and operation of the receiver will be performed while using a personal computer (PC), which allows the greatest ease and versatility.

3.1 Pre-Start Check List

Before turning on power to the receiver, ensure that all of the following conditions have been met:

- The antenna is properly installed, powered through coaxial cable, and connected.
- The PC is properly connected using a serial cable, and its communications protocol has been configured to match that of the receiver.

Supply power to the receiver only after all of the above checks have been made. Note that the warm-up process may take several minutes, depending on ambient temperature.

3.2 Boot-up

The receiver's firmware resides in non-volatile memory. After supplying power to the unit, wait a few moments for the self-boot to complete, after which the receiver will be ready for command input.

The initial start-up indicator lets you know that the receiver's main serial port is ready to communicate:

- Your PC will display the following prompt, indicating you are connected through the *COM1* port:

```
[COM1]
```

The receiver has 4 modes of operation including power-up mode:

- Power-Up
- Operational
- Fault
- Maintenance

The receiver is in power-up mode after applying power. While in this mode, all sections of the receivers (for example, encoders, correlators, and so on) are disabled, except for the clock generators and microprocessor interface. During this mode, SW is transferred from Flash to RAM, the 32-bit CRC is verified on the SW load and the Initiated Built In Test (IBIT) is exercised to determine whether the receiver is usable. This mode ends when the functional blocks of the receiver have been enabled, initialized and the IBIT has been successfully executed.

The receiver is in operational mode following power-up mode and before a fault is discovered by the Continuous Built In Test (CBIT). The fault mode is entered when the CBIT detects an error condition.

The receiver is in maintenance mode when it is loading software. Maintenance mode can only be entered via the Power-up mode.

Once you are connected, commands can be entered as explained in *Section 3.3*.

3.3 Communicating with the Receiver

Communicating with the receiver is accomplished by issuing commands, either by an operator or a script, at the [COM1] prompt displayed by the PC.

The commands and logs used by the receiver, as well as the fields within them, follow specific formats, which are specified in *Chapter 4*. The valid commands, which are used to control the operation and data logging of the receiver, are specified in *Chapter 5*. *Chapter 6* provides details on the data logs that can be requested from the receiver. It is to your advantage to become thoroughly familiar with *Chapters 4* through *6* of this manual to ensure maximum utilization of the receiver's capabilities.

Chapter 5 and *Chapter 6* provide the details of the commands and logs used to communicate with the receiver. The sections below give information about using these messages, including the formats they can take and the responses they may provide.

4.1 Entering Commands

The receiver is capable of responding to many different input commands. The commands offer a wide range of flexibility and can be used to control the following:

- The overall status of the receiver
- Input and output functions
- Configuration of a specific channel of the receiver

The following rules apply when entering commands and logs:

1. You must enter commands in *Abbreviated ASCII* format. The name of the command and its parameters are entered.
2. The commands are not case sensitive. For example:

```
FIX POSITION or fix position
```
3. At the end of a command or command string, press <ENTER>.

4.1.1 Command Settings on Power-Up

When the receiver is first powered up, or after an *FRESET* command, all commands revert to the factory default settings.

-
- The *FRESET* command causes all previously stored information saved to non-volatile memory to be erased. This command is detailed in *Section 5.2.14* on *Page 77*.
-

4.1.1.1 Factory Defaults

The factory defaults for the Euro-3 L1L2GEO and MEDLL models are:

```
ANTENNAPOWER ON
CHANCONFIG 14GPS4GEO_1 (this becomes 8GPS1GEO_1M for the MEDLL model)
CLOCKADJUST ENABLE
COM COM1 9600 N 8 1 N OFF ON
COM COM2 9600 N 8 1 N OFF ON
COM COM3 9600 N 8 1 N OFF ON
DLLBW CA 0.2
DLLBW PY 0.2
EXTERNALCLOCK DISABLE (this becomes OCXO 10MHz for the EuroPak-3T)
PLLBW CA 15
PLLBW PY 0.2
ECUTOFF 0
FIX NONE
PULSEBLANKING L2 15
```

```
THRESHOLD 36 20 36 CA GPS
THRESHOLD 33 28 36 CA WAAS
```

The defaults are the same for other models except for:

GRC:

```
ANTENNAPOWER OFF
```

GRCT:

```
ANTENNAPOWER OFF
EXTERNALCLOCK OCXO 10MHZ
CLOCKADJUST DISABLE
```

L1L2GEOT and MEDLLT:

```
CHANCONFIG 14GPS4GEO_1 (this becomes 8GPS1GEO_1M for the MEDLLT model)
EXTERNALCLOCK OCXO 10MHZ
CLOCKADJUST DISABLE
PLLBW CA 3
```

4.1.2 Determining the Current Command Settings

To determine the current command settings of a receiver, request a *RXCOMMANDS* log, which is described in *Section 6.3.15 on Page 120*. This will provide a listing of all commands and their parameter settings. This log provides the most complete information about receiver configuration.

For some commands, including *COM* and *LOG*, multiple parameter sets can exist. For example, the *LOG* command can be entered with one set of parameters to enable logging of the *PSRPOS* log. It can then be entered again with a second set of parameters to configure the receiver to capture the *RANGE* log. When the *LOG* command is entered the second time, the new parameter set does not overwrite the first, it exists in addition to the first set.

4.1.3 Response Formats

The format of the response is dependent on the format of the input command. If the command is input as *Abbreviated ASCII*, the output will be *Abbreviated ASCII*.

Abbreviated ASCII

A leading < followed by the response string, like the example below:

<OK

ASCII

Full header with the message name being identical except ending in an 'R' (for response). The body of the message consists of a 40 character string for the response string.

Example:

```
#PSRPOSA,COM1,0,43.0,FINESTEERING,265,320943.000,00840000,0000,33331;SOL_COMPUTED,  
SINGLE,51.11638529847,-114.03825624352,1045.2359,0.0000,WGS84,1.5908,1.4096,2.3924,"",  
0.000,0.000,10,8,0,0,0,0,0*84ea7b68
```

Binary

Similar to an ASCII response except that it follows the binary protocols:

- Binary header with message type set to response value (for example, 0x82), see *Field 6 in Table 8, Binary Message Header Structure on Page 49*.
- ENUM response ID, see *Table 5, Response Messages on Page 43*.

String containing the ASCII response to match the ENUM response ID above (for example, 0x4F04B = OK)

4.1.4 Response Messages

The receiver is capable of outputting several responses for various conditions. Most of these responses are error messages to indicate when something is not correct. *Table 5 on Page 43* outlines the various response strings and message IDs.

Table 5: Response Messages

String	ID	Meaning
OK	1	Command was received correctly
NOT ENOUGH RESOURCES IN SYSTEM	3	The request has exceeded a limit (for example, the maximum number of logs are being generated)
DATA PACKET DOESN'T VERIFY	4	Data packet is not verified
COMMAND FAILED ON RECEIVER	5	Command did not succeed in accomplishing requested task
INVALID MESSAGE ID	6	The input message ID is not valid
INVALID MESSAGE FIELD = X	7	Field x of the input message is not correct
MESSAGE MISSING FIELD	9	A field is missing from the input message
ARRAY SIZE FOR FIELD X EXCEEDS MAX	10	Field x contains more array elements than allowed
PARAMETER X IS OUT OF RANGE	11	Field x of the input message is outside the acceptable limits
TRIGGER X NOT VALID FOR THIS LOG	14	Input trigger x is not valid for this type of log
NO VALID AUTH CODE FOR THAT MODEL	19	The model attached to the authcode is not valid
CHANNEL IS INVALID	20	The selected log cannot be output at the specified rate
REQUESTED RATE IS INVALID	21	The requested rate is invalid
CHANNELS LOCKED DUE TO ERROR	23	Channels are locked due to error
INJECTED TIME INVALID	24	Injected time is invalid
COM PORT NOT SUPPORTED	25	The COM port is not supported
MESSAGE IS INCORRECT	26	The message is invalid
INVALID PRN	27	The PRN is invalid
MESSAGE TIMED OUT	31	The message has timed out
UNKNOWN COM PORT REQUESTED	33	Unknown COM port requested
HEX STRING NOT FORMATTED CORRECTLY	34	Hex string not formatted correctly
INVALID BAUD RATE	35	The baud rate is invalid
MESSAGE IS INVALID FOR THIS MODEL	36	This message is invalid for this model of receiver
COMMAND ONLY VALID IF IN NVM FAIL MODE	40	Command is only valid if NVM is in fail mode
INVALID OFFSET	41	The offset is invalid
MAX NUMBER OF USER MESSAGES REACHED	78	The maximum number of user messages allowed has been reached
GPS PRECISE TIME IS ALREADY KNOWN	84	GPS precise time is already known

4.2 Logging Data

You can control how the receiver logs data by using the *LOG* command given on *Page 78*. A field within this command allows you to specify which data log from *Chapter 6* to capture. There are some things to be noted however:

1. The receiver can handle 20 logs at a time. If you attempt to log more than 20 logs at a time, the receiver will respond with the error message:

```
Not enough resources in system
```
2. Maximum flexibility for logging data is provided to you by these logs. You are cautioned, however, to recognize that each log requested requires additional CPU time and memory buffer space. Too many logs may result in lost data and degraded CPU performance. Receiver overload can be monitored using the *idle-time* field and the *buffer overrun* bits of the *Receiver Status* field, which are both found in any log header.

When a log is generated, it is sent to the serial port specified by the *port* parameter in the entered *LOG* command.

4.2.1 Log Types

The receiver is capable of generating many different logs. These logs are divided into the following three types:

- Synchronous The data contained in *synchronous* logs is generated on a regular schedule.
- Asynchronous The data in *asynchronous* logs is generated at irregular intervals. If these logs were collected on a regular schedule, there would be a delay in capturing the new data. The result is that changes to the data are not captured the moment they are available.
- Polled The data in *polled* logs is generated only when requested. Typically the data in these logs, such as configuration settings, does not change.

4.2.2 Log Triggers

Each log can be configured for output when a certain condition, or *trigger*, is met. The possible triggers are:

- ONNEW Output a new log whenever the message is updated (not necessarily changed)
- ONCHANGED Output a new log whenever the message has changed
- ONTIME Output a new log at a specified interval (in seconds)
- ONNEXT Output the next message to be generated, only a single log will be generated
- ONCE Output the current, existing message, only a single log will be generated

For each log type described in *Section 4.2.1, Log Types*, only certain triggers are valid. For example, the *ALLSQMIINFO* log is a *polled* log because it does not change. Therefore, it would not make sense to log this kind of data using the *ONCHANGED* or *ONNEW* triggers. The following table outlines the valid triggers for each log type:

Table 6: Log Triggers for Each Log Type

Type	Recommended Triggers	Invalid Triggers
Synchronous	ONTIME	ONNEW ONCHANGED
Asynchronous	ONCHANGED	-
Polled	ONCE	ONNEW ONCHANGED

4.3 Log Formats

The receiver handles all incoming and outgoing NovAtel logs using two different formats:

- *ASCII*
- *Binary*

This allows for some versatility in the way the receiver can be used.

4.3.1 Specifying Log Formats

Logs can be requested in two formats, *ASCII* or *Binary*, described in *Section 4.3* starting below.

To request a log in *ASCII* format, add **A** to the end of the log as shown below.

```
LOG ALMANACA
```

To request a log in *Binary* format, **B** is added to the end of the log name.

```
LOG RANGEB ONTIME 30
```

When issuing *Binary* logs, the output message type is set in the *Message Type* field in the command header, as described in *Table 8* on *Page 49*.

4.3.2 ASCII

The structures of all *ASCII* messages follow the general conventions as noted here:

1. Basic format:

```
#HEADER_PARAMS; PARAM_1, PARAM_2, . . . , PARAM_N* XXXXXXXX [CR] [LF]
```

2. The lead code identifier for each record is '#'. This identifier is followed by the header parameters, as described in *Table 7 on Page 47*.
3. Each log is of variable length depending on the amount of data and field formats.
4. All data fields are delimited by a comma ',' with two exceptions. The first exception is the last header field which is followed by a ';' to denote the start of the data message. The other exception is the last data field, which is followed by a '*' to indicate end of message data.
5. Each log ends with a hexadecimal number preceded by an asterisk and followed by a line termination using the carriage return and line feed characters, for example, *1234ABCD [CR] [LF]. This value is a 32-bit cyclic redundancy check (CRC) of all bytes in the message, excluding the '#' identifier and the asterisk preceding the checksum digits. See *Section 4.4.2.5 on Page 54* for the algorithm used to generate the CRC.
6. An ASCII string is one field and is surrounded by double quotation marks, for example, "ASCII string". If separators are surrounded by quotation marks then the string is still one field and the separator will be ignored, for example, "xxx, xxx" is one field. Double quotation marks within a string are not allowed.
7. If the receiver detects an error parsing an input message, it will return an error response message. Please see *Table 5 on Page 43* for a list of response messages from the receiver.

The *ASCII* message header is formatted as follows:

Table 7: ASCII Message Header Structure

Field	Field Name	Field Type	Description	Ignored on Input
1	sync	Char	Sync character. The <i>ASCII</i> message is always preceded by a single '#' symbol.	N
2	message	Char	The ASCII name of the message. The names of logs are given in <i>Table 39 on Page 92</i> .	N
3	port	Char	The name of the port from which the log was generated. See <i>Table 11 on Page 52</i> .	Y
4	Reserved	ULong	Reserved for internal use	N
5	idle time	Float	The minimum percentage of time that the processor is idle	Y
6	time status	Enum	The quality of the GPS time, as described in <i>Section 4.4.2.4 on Page 53</i> .	Y
7	week	ULong	GPS week number	Y
8	seconds	GPSTime	Seconds from the beginning of the GPS week accurate to the millisecond level	Y
9	receiver status	ULong	An eight digit hexadecimal number representing the status of various hardware and software components of the receiver. This number is described in <i>Table 52 on Page 125</i> .	Y
10	Reserved	ULong	Reserved for internal use	Y
11		ULong		Y
12	;	Char	The ';' character indicates the end of the header	N

Example ASCII Format Log:

```
PSRPOSA,COM1,0,43.0,FINESTEERING,265,320943.000,00840000,
0000,33331;SOL_COMPUTED,SINGLE,51.11638529847,-114.03825624352,
1045.2359,0.0000,WGS84,1.5908,1.4096,2.3924,"",0.000,0.000,10,8,
0,0,0,0,0,0*84ea7b68[CR][LF]
```

4.3.3 Binary

Binary messages are provided as a machine readable format. They are also ideal for applications where the amount of data being transmitted is fairly high. Because of the inherent compactness of binary as opposed to ASCII data, the messages are much smaller. This allows a larger amount of data to be transmitted and received by the receiver's communication ports. The structure of all *Binary* format messages follows the general conventions as noted here:

1. Basic format:

Header	3 sync bytes plus 25 bytes of header information. The header length is variable as fields may be appended in the future. Always check the header length.
Parameters	Variable length binary data
CRC	4 bytes

2. The 3 Sync bytes are always:

Byte	Hex	Decimal
First	AA	170
Second	44	68
Third	12	18

3. The CRC is a 32-bit cyclic redundancy check performed on all data including the header. See *Section 4.4.2.5 on Page 54* for the CRC algorithm.
4. The header is in the format shown in *Table 8 on Page 49*.

Table 8: Binary Message Header Structure

Field	Field Name	Field Type	Description	Binary Bytes	Binary Offset	Ignored on Input
1	sync	Char	Hexadecimal 0xAA	1	0	N
2	sync	Char	Hexadecimal 0x44	1	1	N
3	sync	Char	Hexadecimal 0x12	1	2	N
4	header length	UChar	Length of the header	1	3	N
5	message ID	UShort	Message ID. The message IDs for logs are given in <i>Table 39</i> on <i>Page 92</i> .	2	4	N
6	message type	Char	Message type indicator, as explained in <i>Section 4.2.1</i> on <i>Page 44</i> .	1	6	N
7	port address	Char	The port from which the log was generated. See <i>Table 11</i> on <i>Page 52</i> .	1	7	N
8	message length	UShort	The length in bytes of the body of the message. This does not include the header nor the CRC.	2	8	N
9	sequence	UShort	For multiple related logs. A number that counts down from N-1 to 0 where N is the number of related logs and 0 means it is the last one of the set. Most logs only come out one at a time in which case this number is 0.	2	10	N
10	idle time	Char	The percentage of time that the processor is idle in the last second. Take the time (0-200) and divide by two to give the percentage of time (0-100%).	1	12	Y
11	time status	Enum	The quality of the GPS time, as described in <i>Section 4.4.2.4</i> on <i>Page 53</i>	1 ^a	13	N ^b
12	week	UShort	GPS week number	2	14	N ^b
13	milli-seconds	GPSec	Milliseconds from the beginning of the GPS week	4	16	N ^b
14	receiver status	ULong	32 bits representing the status of various hardware and software components of the receiver. This number is described in <i>Table 52</i> on <i>Page 125</i> .	4	20	Y
15	Reserved	UShort	Reserved for internal use	2	24	Y
16		UShort		2	26	Y

a. This ENUM is not 4 bytes long but, as indicated in the table, is only 1 byte.

b. These time fields are ignored if Field #11, Time Status, is invalid. In this case the current receiver time is used. The recommended values for the three time fields are 0, 0, 0.

4.4 Fields

The commands and logs for the receiver use a variety of field types to convey data. The following sections provide information about the types of fields used and some of the more commonly-used fields.

4.4.1 Field Types

The following table describes the field types used in the commands and logs.

Table 9: Field Types

Type	Binary Size (Bytes)	Description
Char	1	An 8-bit signed integer in the range -128 to +127. This integer value may be the ASCII code corresponding to the specified character. In <i>ASCII</i> or <i>Abbreviated ASCII</i> this comes out as an actual character.
UChar	1	An 8-bit unsigned integer. Values are in the range from +0 to +255. In <i>ASCII</i> or <i>Abbreviated ASCII</i> this comes out as a number.
Short	2	A 16-bit signed integer in the range -32768 to +32767.
UShort	2	A 16-bit unsigned integer in the range +0 to +65535.
Long	4	A 32-bit signed integer in the range -2147483648 to +2147483647.
ULong	4	A 32-bit unsigned integer in the range +0 to +4294967295.
Double	8	64 bits, with 1 for the sign, 11 for the exponent, and 52 for the mantissa. Its range is $\pm 1.7E308$ with at least 15 digits of precision. This is IEEE 754.
Float	4	32 bits, with 1 for the sign, 8 for the exponent, and 23 for the mantissa. Its range is $\pm 3.4E38$ with at least 7 digits of precision. This is IEEE 754.
Enum	4	A 4-byte enumerated type beginning at zero (an unsigned long). In <i>Binary</i> , the enumerated value is output. In <i>ASCII</i> or <i>Abbreviated ASCII</i> , the enumeration label is spelled out.
GPSec	4	Two separate formats that depend on whether the output is requested in <i>Binary</i> or an <i>ASCII</i> format. For <i>Binary</i> the output is in milliseconds and is a long type. For <i>ASCII</i> the output is in seconds and is a float type.
Hex	n	A packed, fixed length (n) array of bytes in <i>Binary</i> but in <i>ASCII</i> or <i>Abbreviated ASCII</i> is converted into 2 character hexadecimal pairs.
String	n	A variable length array of bytes that is null-terminated in the <i>Binary</i> case. The maximum byte length for the field is shown in the row in the log or command table.

4.4.2 Commonly-Used Fields

Some of the more commonly-used fields are discussed in this section.

4.4.2.1 Serial Port Identifiers

The values used to indicate serial ports are given below.

Table 11: Serial Port Identifier Values

ASCII	Binary
COM1	32
COM2	64
COM3	96
USB1	224

4.4.2.2 Message Type Indicator

The *Message Type Indicator* is a byte given in numerous binary format messages and all binary headers. It follows the format in *Table 12* below.

Table 12: Message Type Byte Format

Bit	Description
0-4	Reserved
5-6	Message format, where 00 = <i>Binary</i> 01 = <i>ASCII</i> 10 = <i>Abbreviated ASCII</i> , NMEA 11 = Reserved
7	Response indicator, where 0 = original message 1 = response message. (See <i>Section 4.2</i> on <i>Page 44</i> for more information about logging data.)

4.4.2.3 Message Time Stamps

All NovAtel format messages generated by the receiver have a GPS time stamp in their header. GPS time is referenced to UTC with zero point defined as midnight on the night of January 6, 1980 at 0:00 hours. The time stamp consists of the number of weeks since that zero point, the Euro-3 rolls over, (0 to 1023) and the number of seconds since the last week number change (0 to 603,799). GPS time differs from UTC time since leap seconds are occasionally inserted into UTC but GPS time is continuous. In addition a small error (less than 1 microsecond) can exist in synchronization between UTC and GPS time.

The data in synchronous logs, like the *RANGE* log, are based on a periodic measurement of satellite pseudoranges. The time stamp on these logs is the receiver estimate of GPS time at the time of the measurement. When setting time in external equipment, a small synchronous log with a high baud rate will be accurate to a fraction of a second. A synchronous log with trigger `ONTIME 1` can be used in conjunction with the 1 PPS signal to provide relative accuracy better than 250 ns.

Other log types (asynchronous and polled) are triggered by an external event and the time in the header may not be synchronized to the current GPS time. Logs that contain satellite broadcast data have the transmit time of

their last subframe in the header. In the header of differential time matched logs, the time of the matched reference and local observation that they are based on is given. Logs triggered by a mark event have the estimated GPS time of the mark event in their header. The header of a polled log, like *VERSION*, gives the approximate GPS time when its data was generated.

4.4.2.4 GPS Time Status

All reported receiver times are subject to a qualifying time status. This status gives you an indication of how well a time is known, see *Table 13*:

Table 13: GPS Time Status

GPS Time Status (Decimal)	GPS Time Status (ASCII)	Description
20	UNKNOWN	Time validity is unknown.
60	APPROXIMATE	Time is set approximately.
100	COARSE	This time is valid to coarse precision.
120	COARSESTEERING	Time is coarse set, and is being steered.
130	FREEWHEELING	Position is lost, and the range bias cannot be calculated.
160	FINE	Time has fine precision.
180	FINESTEERING	Time is fine, set and is being steered.
200	SATTIME	Time from satellite. This is only used in logs containing satellite data such as ephemeris and almanac.

There are several distinct states that the receiver will go through:

- UNKNOWN
- COARSE/COARSESTEERING
- FREEWHEELING
- FINE/FINESTEERING

On start up, and before any satellites are being tracked, the receiver can not possibly know the current time. As such, the receiver time starts counting at GPS week 0 and second 0.0. The time status flag is set to UNKNOWN.

If time is input to the receiver using the SETAPPROXTIME command, see *Page 86*, the time status is APPROXIMATE.

After the first ephemeris is decoded, the receiver time is set to a resolution of ± 10 milliseconds. This state is qualified by the COARSE or COARSESTEERING time status flag depending on the state of the CLOCKADJUST switch.

Once a position is known and range biases are being calculated, the internal clock model begins modelling the position range biases and the receiver clock offset.

Modelling continues until the model is a good estimation of the actual receiver clock behavior. At this time, the receiver time is adjusted again, this time to an accuracy of ± 1 microsecond. This state is qualified by the FINE time status flag.

The final logical time status flag depends on whether CLOCKADJUST is enabled or not, see *Page 68*. If CLOCKADJUST is disabled, the time status flag never improves on FINE. The time is only adjusted again to within ± 1 microsecond if the range bias gets larger than ± 250 milliseconds. If CLOCKADJUST is enabled, the time status flag is set to FINESTEERING and the receiver time is continuously updated (steered) to minimize the receiver range bias.

If for some reason position is lost and the range bias cannot be calculated, the time status is degraded to

FREEWHEELING.

4.4.2.5 32-Bit CRC

The *ASCII* and *Binary* message formats all contain a 32-bit Cyclic Redundancy Check (CRC) for data verification. This allows you to ensure that the data received (or transmitted) is valid with a high level of certainty. This CRC can be generated using the following C algorithm:

```
#define CRC32_POLYNOMIAL    0xEDB88320L
/* -----
Calculate a CRC value to be used by CRC calculation functions.
----- */
unsigned long CRC32Value(int i)
{
    int j;
    unsigned long ulCRC;

    ulCRC = i;
    for ( j = 8 ; j > 0; j-- )
    {
        if ( ulCRC & 1 )
            ulCRC = ( ulCRC >> 1 ) ^ CRC32_POLYNOMIAL;
        else
            ulCRC >>= 1;
    }
    return ulCRC;
}
/* -----
Calculates the CRC-32 of a block of data all at once
----- */
unsigned long CalculateBlockCRC32(
    unsigned long ulCount,      /* Number of bytes in the data block */
    unsigned char *ucBuffer ) /* Data block */
{
    unsigned long ulTemp1;
    unsigned long ulTemp2;
    unsigned long ulCRC = 0;

    while ( ulCount-- != 0 )
    {
        ulTemp1 = ( ulCRC >> 8 ) & 0x00FFFFFFL;
        ulTemp2 = CRC32Value( ((int) ulCRC ^ *ucBuffer++ ) & 0xff );
        ulCRC = ulTemp1 ^ ulTemp2;
    }
    return( ulCRC );
}
```

5.1 Functional Listing of Commands

Table 14 lists the commands by function. Please see Section 5.2 starting on Page 58 for a more detailed description of each individual command.

Table 14: Commands By Function

COMMUNICATIONS, CONTROL AND STATUS	
Command	Description
ANTENNAPOWER	Control power to low-noise amplifier (LNA) of an active antenna
COM	Set serial port configuration
LOG	Request a log
UNLOG	Remove a specified log from logging control
UNLOGALL	Remove all logs from logging control

GENERAL RECEIVER CONTROL	
Command	Description
AGCMODE	Control Automatic Gain Control (AGC) functionality
DLLBW	Configure receiver's DLL filter bandwidth
FRESET	Reset receiver to factory default
PLLBW	Configure receiver's phase-lock-loop bandwidths
RESET	Perform a hardware reset

POSITION CONTROL	
Command	Description
FIX	Constrain receiver position

SATELLITE TRACKING AND CHANNEL CONTROL	
Command	Description
ALMANAC	Inject almanac data into the receiver
ASSIGN	Assign individual satellite channel
ASSIGNALL	Assign all satellite channels
ASSIGNL2CODETYPE	Set the receiver to track a specific L2 code type
CHANCONFIG	Set receiver channel tracking configuration
ECUTOFF	Set satellite elevation cut-off angle
SETSATELLITE	Set the health of a satellite PRN
PLLTHRESHOLD	Control PY code signal thresholds
PULSEBLANKING	Enables or disables L2 digital pulse blanking
THRESHOLD	Control signal thresholds for acquisition, tracking, cross-correlation

Continued on Page 56

CLOCK INFORMATION, STATUS, AND TIME	
Command	Description
CLOCKADJUST	Enable or disable adjustments to the internal clock and 1PPS output
EXTERNALCLOCK	Set the parameters for an external clock
SETAPPROXTIME	Set an approximate time

Table 15: Command Summary

Command Name	Message ID	Description	Syntax
AGCMODE	229	Control Automatic Gain Control (AGC) functionality	agcmode <i>frequency mode pulsewidth loadvalue</i>
ALMANAC	73	Inject almanac data into the receiver	See Section 5.2.2 on Page 60.
ANTENNAPOWER	98	Control power to low-noise amplifier of an active antenna	antennapower <i>flag</i>
ASSIGN	27	Assign individual satellite channel to a PRN	assign <i>channel state prn Doppler window</i>
ASSIGNALL	28	Assign all satellite channels to a PRN	assignall <i>system state prn Doppler window</i>
ASSIGNL2CODETYPE	572	Set the receiver to track a specific L2 code type	assignl2codetype <i>prn l2codetype</i>
CHANCONFIG	501	Set receiver channel tracking configuration	chanconfig <i>config</i>
CLOCKADJUST	15	Enable clock adjustments	clockadjust <i>switch</i>
COM	4	Serial port configuration control	com <i>port bps parity databits stopbits handshake echo break</i>
DLLBW	517	Configure receiver's DLL filter bw	dllbw <i>codetype bw</i>
ECUTOFF	50	Set satellite elevation cutoffs	ecutoff <i>angle</i>
EXTERNALCLOCK	230	Set external clock parameters	externalclock <i>clocktype freq [h0 [h1 [h2]]]</i>
FIX	44	Constrain to fixed height, position or velocity	fix <i>type param1 param2 param3</i>
FRESET	20	Clear data stored in non-volatile memory. Followed by a receiver reset	freset
LOG	1	Request logs from receiver	log <i>port message trigger period offset hold</i>
PLLBW	518	Configure receiver's phase-lock-loop bw	pllbw <i>codetype bw</i>
PLLTHRESHOLD	659	Control PY code signal thresholds	pllthreshold <i>lock acqui codetype</i>
PULSEBLANKING	519	Enable/disable L2 digital pulse blanking	pulseblanking <i>frequency threshold</i>
RESET	18	Perform a hardware reset	reset <i>delay</i>
SETAPPROXTIME	102	Set an approximate GPS time	setapproxtime <i>week sec</i>

Continued on Page 57

SETSATELLITE	425	Set the health of a satellite PRN	setsatellite <i>prn health</i>
THRESHOLD	449	Control signal thresholds for acquisition, tracking, cross-correlation	threshold <i>acqui lock [crosscorr] codetype system [sigchan]</i>
UNLOG	36	Remove log from logging control	unlog <i>port datatype</i>
UNLOGALL	38	Remove all logs from logging control	unlogall <i>port</i>

5.2 Command Reference

All syntax strings and command examples given in this section are in the *Abbreviated ASCII* format, unless otherwise indicated. The tables provided show the fields necessary for all formats unless otherwise noted.

☒ As mentioned in *Section 4.1 on Page 40*, all command strings must be followed by <ENTER>.

5.2.1 AGCMODE

☒ This command can fundamentally change the way that the receiver operates. Do not alter the default settings unless you are confident that you understand the consequences.

This command controls the EuroPak-3's Automatic Gain Control (AGC) mechanism, which has two primary functions:

- To perform the analog-to-digital conversions in the receiver's front end.
- Mitigate jamming.

☒ When the AGC mode is disabled, the *Receiver Status* word in the message header, discussed in *Table 52 on Page 125*, will report the AGC as *GOOD* as long as the control metric used in the feedback loop is within 7.5% of the set point.

Table 16: Frequency Values for AGCMODE Command

ASCII	Description
L1	GPS and GEO L1 channels only
L2	GPS L2 channels only

Table 17: AGC Mode Values

ASCII	Description
AUTO	Specifies that the default pulse width and load values should be used.
MANUAL	Specifies that the values specified in the <i>pulsewidth</i> and <i>loadvalue</i> fields should be used.

Syntax:

Message ID: 229

AGCMODE frequency mode [pulsewidth loadvalue]

Field	Field Name	Valid Values		Description	Format	Binary Bytes	Binary Offset
		ASCII	Binary				
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .				H	0
2	frequency	See <i>Table 16 on Page 58</i> .		Specifies which signal type to apply the command to.	Enum	4	H
3	mode	See <i>Table 17 on Page 58</i> .		Specifies whether to use the default or custom values for the pulse width and load value.	Enum	4	H+4
4	pulsewidth	35 to 262144		Pulse width. A value is only required when the <i>mode</i> field is set to MANUAL.	Float	4	H+8
5	loadvalue	35 to 262144		Modulus load value. A value is only required when the <i>mode</i> field is set to MANUAL.	Float	4	H+12

Example:

AGCMODE L1 MANUAL 40 50

5.2.2 ALMANAC

This command provides a means of injecting almanac data into the receiver. The injected almanac is overwritten when a new almanac is received from the satellite constellation.

Syntax:

Message ID: 73

ALMANAC #msg PRN week seconds ecc $\dot{\omega}$ ω_0 ω Mo a_{fo} a_{f1} N A inclangle svconfig

healthprn healthalm antispoof

...

PRN week seconds ecc $\dot{\omega}$ ω_0 ω Mo a_{fo} a_{f1} N A inclangle svconfig healthprn healthalm antispoof

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	# msg	Any valid long value	The number of satellite PRN almanac data sets to follow.	Long	4	H+4
3	PRN	0 to 37, 120 to 138	Satellite PRN number for current message, dimensionless	ULong	4	H+8
4	week	0 to 1023	Almanac reference week (GPS week number)	ULong	4	H+12
5	seconds	0 to 604799	Almanac reference time, seconds into the week	Double	8	H+16
6	ecc	Any valid double value	Eccentricity, dimensionless	Double	8	H+24
7	$\dot{\omega}$	Any valid double value	Rate of right ascension, radians/second	Double	8	H+32
8	ω_0	Any valid double value	Right ascension, radians	Double	8	H+40
9	ω	Any valid double value	Argument of perigee, radians	Double	8	H+48
10	Mo	Any valid double value	Mean anomaly of reference time, radians	Double	8	H+56
11	a _{fo}	Any valid double value	Clock aging parameter, seconds	Double	8	H+64
12	a _{f1}	Any valid double value	Clock aging parameter, seconds/second	Double	8	H+72
13	N	Any valid double value	Corrected mean motion, radians/second	Double	8	H+80
14	A	Any valid double value	Semi-major axis, metres	Double	8	H+88
15	inclangle	Any valid double value	Angle of inclination relative to 0.3π , radians	Double	8	H+96

Continued on Page 61

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
16	SV config	Any valid ulong value	Satellite configuration	ULong	4	H+104
17	health-prn	Any valid ulong value	SV health from subframe 4 or 5	ULong	4	H+108
18	health-alm	Any valid ulong value	SV health from almanac	ULong	4	H+112
19	antispoof	See <i>Table 18</i> on <i>Page 61</i>	Flag for antispoofing	Enum	4	H+116
20...	Next PRN data set, offset = H+4 + (# previous msgs x 112)					

Table 18: Antispoofing Flag Values

ASCII	Description
FALSE	Antispoofing is disabled.
TRUE	Antispoofing is enabled.

5.2.3 ANTENNAPOWER

This command enables or disables the supply of electrical power from the internal (see *Section 2.3.4 on Page 30* for information about supplying power to the antenna) power source of the receiver to the low-noise amplifier (LNA) of an active antenna.

There are several bits in the Receiver Status (see *Table 52, Receiver Status on Page 125*) that pertain to the antenna. These bits indicate whether the antenna is powered (internally or externally) and whether it is open circuited or short circuited.

On startup, the ANTENNAPOWER is set to ON for all software models except for GRC and GRCT, when it is set to OFF.

Abbreviated ASCII Syntax:

Message ID: 98

ANTENNAPOWER flag

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .				H	0
2	flag	OFF	0	Disables internal powering of antenna.	Enum	4	H
		ON	1	Enables internal powering of antenna.			

ASCII Example:

ANTENNAPOWER ON

5.2.4 ASSIGN

-
- ☒ The *ASSIGN* command should only be used by advanced users of GPS.
-

This command may be used to aid in the initial acquisition of a satellite by allowing you to override the automatic satellite/channel assignment and reacquisition processes with manual instructions. The command specifies that the selected tracking channel should search for a specified satellite at a specified Doppler frequency within a specified Doppler window.

The instruction will remain in effect for the specified SV channel and PRN, even if the assigned satellite subsequently sets. If the satellite Doppler offset of the assigned SV channel exceeds that specified by the *window* parameter of the *ASSIGN* command, the satellite may never be acquired or re-acquired. If a PRN has been assigned to a channel and the channel is currently tracking that satellite, when the channel is set to *AUTO* tracking, the channel will immediately idle and return to automatic mode.

To cancel the effects of *ASSIGN*, you must issue the following:

- The *ASSIGN* command with the *state* set to *AUTO*

These will return SV channel control to the automatic search engine immediately.

-
- ☒ 1. Assigning a PRN to an SV channel does not remove the PRN from the search space of the automatic searcher; only the SV channel is removed (that is, the searcher may search and lock onto this PRN on another channel). The automatic searcher only searches for PRNs 0 to 37 for GPS channels and PRNs 120 to 138 for GEO channels.
2. Assigning an SV channel will set the *Channel Assignment* bit to 1 for forced assignment in the *Channel Tracking Status* field of the *RANGE* log. The *RANGE* log is specified in *Section 6.3.11 on Page 113*.
3. The doppler field applies to L1 channels only.
4. The receiver will internally convert to L2 for L2 C/A tracking if the L2 code type has been switched on for that PRN using the *ASSIGNL2CODETYPE* command, see *Page 66*.
-

Syntax:

Message ID: 27

ASSIGN channel [state] [prn[doppler window]]

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	channel	0 to 8 (MEDLL) or 0 to 17 (non-MEDLL)	SV channel number to apply the command to. 0 is the first SV channel and 17 is the last: 0 to 7 for GPS and 8 for GEO or 0 to 13 for GPS and 14 to 17 for GEO. See also <i>CHANCONFIG</i> on <i>Page 67</i> and <i>Tables 62</i> and <i>63</i> on <i>Page 160</i> .	ULong	4	H
3	state	See <i>Table 19</i> below.	Optional desired SV channel state. If a value is not given, the default of <i>ACTIVE</i> is used.	Enum	4	H+4
4	prn	0 to 37, 120 to 138	Optional satellite PRN code from 0 -37 for GPS channels and 120-138 for GEO channels. A value is required only when the <i>state</i> field is set to <i>ACTIVE</i> .	Long	4	H+8
5	doppler	-100 000 to 100 000	Optional current L1 Doppler offset of the satellite specified in the <i>prn</i> field in Hz. NOTE:Satellite motion, receiver antenna motion, and receiver clock frequency error must be included in the calculation of Doppler frequency.	Long	4	H+12
6	window	0 to 10 000	Error or uncertainty in the L1 Doppler estimate given in the <i>doppler</i> field, in Hz. NOTE:This is a \pm value. For example, enter 500 for \pm 500 Hz.	ULong	4	H+16

Examples:

ASSIGN 0 ACTIVE 29 0 2000

ASSIGN 15 120 -250 0

ASSIGN 11 28 -250 0

The first example sets the first SV channel to acquire satellite PRN 29 in a range from -2000 Hz to +2000 Hz until the satellite signal has been detected. SV channel 11 is set to acquire satellite PRN 28 at an offset of -250 Hz only in the third example.

Table 19: Channel State Values

ASCII	Description
IDLE	Set the SV channel to not track any satellites
ACTIVE	Set the SV channel active
AUTO	Tell the receiver to automatically assign PRN codes to channels

5.2.5 ASSIGNALL

☒ The *ASSIGNALL* command should only be used by advanced users of GPS.

This command allows you to override the automatic satellite/channel assignment and reacquisition processes for all channels with manual instructions. This command works the same way as *ASSIGN* except that it affects all SV channels. See also *Tables 62 and 63 on Page 160*.

Syntax:

Message ID: 28

ASSIGNALL [system] [state] [prn[doppler window]]

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	system	See <i>Table 20 on Page 65</i> .	Optional system that SV channel is tracking. If a value is not given, the default of <i>GPS</i> is used.	Enum	4	H
3	state	See <i>Table 19 on Page 64</i> .	Optional desired SV channel state. If a value is not given, the default of <i>ACTIVE</i> is used.	Enum	4	H+4
4	prn	0 to 37, 120-138	Optional satellite PRN code from 0-37 for GPS channels and 120-138 for GEO channels. A value is required only when the <i>state</i> field is set to <i>ACTIVE</i> .	Long	4	H+8
5	doppler	-100 000 to 100 000	Optional current Doppler offset of the satellite specified in the <i>prn</i> field in Hz. NOTE: Satellite motion, receiver antenna motion, and receiver clock frequency error must be included in the calculation of Doppler frequency.	Long	4	H+12
6	window	0 to 10 000	Error or uncertainty in the Doppler estimate given in the <i>doppler</i> field, in Hz. NOTE: This is a \pm value. For example, enter 500 for \pm 500 Hz.	ULong	4	H+16

Example:

ASSIGNALL GPS ACTIVE 29 0 2000

Table 20: Channel System Values

ASCII	Description
GPS	GPS SV channels only
ALL	All channels
WAAS	GEO SV channels only

5.2.6 ASSIGNL2CODETYPE

☒ The *ASSIGNL2CODETYPE* command should only be used by advanced users of GPS.

This command forces the receiver to search for and track only the specified code type for the specified PRN. The default code type for all PRNs is P(Y). If the code type is C/A, the tracking of the L2 C/A signal is independent of the corresponding L1 C/A signal.

Syntax:

Message ID: 572

```
ASSIGNL2CODETYPE prn l2codetype
```

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	prn	0 to 37	Satellite PRN code to apply the command to.	Long	4	H
3	l2codetype	See <i>Table 21</i> below.	The L2 code type the receiver will track for the specified PRN.	Enum	4	H+4

Example:

```
ASSIGNL2CODETYPE 18 CA
```

Table 21: L2 Code Type Values

ASCII	Description
PY	L2 P(Y) code
CA	L2 C/A code

5.2.7 CHANCONFIG

This command changes the channel configuration of the receiver. This will effect the number of channels tracking GPS signals and the number of channels tracking GEO signals. Entering this command will reset the receiver, causing the receiver to initiate a cold-start bootup and reset all data stored in NVM to factory default values (except for the channel configuration). The default configuration is 14GPS4GEO_1 for models without MEDLL and 8GPS1GEO_1M for models with MEDLL. See also *Tables 62 and 63 on Page 160*.

☒ The 8GPS1GEO_1M config value is only available on MEDLL models.

Syntax:

Message ID: 501

CHANCONFIG config

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	config	See <i>Table 22</i> below.	Specifies the channel configuration for the receiver to use.	Enum	4	H

Example:

CHANCONFIG 8GPS1GEO_1M

Table 22: Config Values

ASCII	Description
14GPS4GEO_1	14 GPS L1 L2 channels and 4 GEO L1 channels without MEDLL
18GPS_1	18 GPS L1 L2 channels without MEDLL
8GPS1GEO_1M	8 GPS L1 L2 channels and 1 GEO L1 channel with MEDLL on L1

5.2.8 CLOCKADJUST

All oscillators have some inherent drift. By default the receiver attempts to steer the receiver's clock to accurately match GPS time. If for some reason this is not desired, this behavior can be disabled using the CLOCKADJUST command. The TIME log can then be used to monitor clock drift, see *Page 129*.

-
- ☒ 1. The CLOCKADJUST command should only be used by advanced users of GPS.
 - 2. If the CLOCKADJUST command is ENABLED, and the receiver is configured to use an external reference frequency (set in the EXTERNALCLOCK command, see *Page 73*, for an external clock - TCXO, OCXO, RUBIDIUM, CESIUM, or USER), then the clock steering process will take over the VARF output pins.
 - 3. When disabled, the range measurement bias errors will continue to accumulate with clock drift.
 - 4. Pseudorange, carrier phase and Doppler measurements may jump if the CLOCKADJUST mode is altered while the receiver is tracking.
 - 5. When disabled, the time reported on all logs may be offset from GPS time. The 1PPS output may also be offset. The amount of this offset may be determined from the TIME log, see *Page 129*.
-

Abbreviated ASCII Syntax:

Message ID: 15

CLOCKADJUST switch

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3</i> on <i>Page 45</i> .			H	0	
2	switch	DISABLE	0	Disallow adjustment of internal clock.	Enum	4	H
		ENABLE	1	Allow adjustment of internal clock.			

ASCII Example:

CLOCKADJUST DISABLE

5.2.9 COM

This command permits you to configure the receiver’s asynchronous serial port communications drivers. You can change only the COM options and not the USB1 options.

See *Section 4.1 on Page 40* for a description of the factory defaults.

Syntax:

Message ID: 4

COM [port] bps [parity [databits [stopbits [handshake [echo [break]]]]]]]

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	port	See <i>Table 11 on Page 52</i> .	Serial port to apply the settings to. If no value is supplied, the settings are applied to COM1.	Enum	4	H
3	bps	9600, 19200, 38400, 57600, 115200, or 230400 ^a	Communication baud rate (bps).	ULong	4	H+4
4	parity	See <i>Table 23 on Page 70</i> .	Parity. If not specified, no parity is assumed.	Enum	4	H+8
5	databits	7 or 8	Number of data bits.	ULong	4	H+12
6	stopbits	1 or 2	Number of stop bits.	ULong	4	H+16
7	handshake	See <i>Table 24 on Page 70</i> .	Handshaking	Enum	4	H+20
8	echo	See <i>Table 25 on Page 70</i> .	Echo ability	Enum	4	H+24
9	break	See <i>Table 26 on Page 70</i> .	Break detection	Enum	4	H+28

a. Baud rates higher than 115,200 bps are not supported by standard PC hardware. Special PC hardware is required for higher rates, such as 230,400 bps.

Example:

COM COM3 57600 N 8 1 N OFF ON

Table 23: Parity Values

ASCII	Description
N	No parity
E	Even parity
O	Odd parity

Table 24: Handshaking Values

ASCII	Description
N	No handshaking
XON	XON/XOFF software handshaking
CTS	CTS/RTS hardware handshaking

Table 25: Echo Values

ASCII	Description
OFF	No echo
ON	Transmit any input characters as they are received.

Table 26: Break Values

ASCII	Description
OFF	Disable break detection
ON	Enable break detection

5.2.10 DLLBW

This is the noise equivalent bandwidth command for the DLL filter bandwidth. Upon issuing the command, the locktime for all tracking satellites is reset to zero.

- ☒ 1. The DLLBW command should only be used by advanced users. It may not be suitable for every GPS application. When using DLLBW in a differential mode, the same setting should be used at both the monitor and remote station.
- 2. The greater the DLL bandwidth, the noisier the measurement is.

Syntax:

Message ID: 517

DLLBW codetype bw

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .		H		0
2	codetype	See <i>Table 33 on Page 81</i>	The code type field specifies to which signal type to apply the parameters.	Enum	4	H
3	bw	See <i>Table 27</i> below	Noise equivalent bandwidth of DLL filter in Hz.	Float	4	H+4

Table 27: DLL Bandwidth Values

Frequency	Valid Bandwidth Values
C/A signals	0.001 to 0.5 Hz
P(Y) signals	0.001 to 0.5 Hz

Example:

DLLBW CA 0.01

5.2.11 ECUTOFF

This command sets the elevation cut-off angle for tracked satellites. The receiver will not track a satellite until it rises above the cut-off angle. Tracked satellites that fall below the cut-off angle will no longer be tracked unless they were manually assigned using the *ASSIGN* command.

In either case, satellites below the *ECUTOFF* angle will be eliminated from the internal position and clock offset solution computations.

If the receiver has not yet received an almanac, satellites below the cut-off angle may be tracked.

This command permits a negative cut-off angle, which could be used in these situations:

- the antenna is at a high altitude, and thus can look below the local horizon
- satellites are visible below the horizon due to atmospheric refraction

☒ Care must be taken when using *ECUTOFF* because the signals from lower elevation satellites are travelling through more atmosphere and are therefore degraded.

Syntax:

Message ID: 50

ECUTOFF angle

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	angle	-90.0 to +90.0	Elevation cut-off angle relative to horizon in degrees.	Float	4	H

Example:

ECUTOFF 10.0

5.2.12 EXTERNALCLOCK

Overview

The EXTERNALCLOCK command allows the Euro-3 to operate with an optional external oscillator. You are able to optimally adjust the clock model parameters of the receiver for various types of external clocks.

-
- ☒ 1. This command will affect the interpretation of the CLOCKMODEL log, see *Page 108*.
 - 2. If the EXTERNALCLOCK command is enabled and set for an external clock (TCXO, OCXO, RUBIDIUM, CESIUM, or USER) and the CLOCKADJUST command, see *Page 68*, is ENABLED, then the clock steering process will take over the VARF output pins. If clocksteering is not used with the external oscillator, the clocksteering process must be disabled by using the CLOCKADJUST DISABLE command.
-

There are three steps involved in using an external oscillator:

1. Follow the procedure outlined in *Section 2.3.3 on Page 30* of this manual to connect an external oscillator to your Euro-3 card or EuroPak enclosure.
2. Using the EXTERNALCLOCK command, select a standard oscillator and its operating frequency.
3. Using the CLOCKADJUST command, disable the clocksteering process if external clocksteering is not used.

Theory

An unsteered oscillator can be approximated by a three-state clock model, with two states representing the range bias and range bias rate, and a third state assumed to be a Gauss-Markov (GM) process representing the range bias error generated from satellite clock dither. The third state is included because the Kalman filter assumes an (unmodeled) white input error. The significant correlated errors produced by satellite clock dither are obviously not white and the Markov process is an attempt to handle this kind of short-term variation.

The internal units of the new clock model’s three states (offset, drift and GM state) are meters, meters per second, and meters. When scaled to time units for the output log, these become seconds, seconds per second, and seconds, respectively. Note that the old units of the third clock state (drift rate) were meters per second per second.

The user has control over 3 process noise elements of the linear portion of the clock model. Namely, the h_0 , h_{-1} , and h_{-2} elements of the power law spectral density model used to describe the frequency noise characteristics of oscillators:

$$S_y(f) = \frac{h_{-2}}{f^2} + \frac{h_{-1}}{f} + h_0 + h_1 f + h_2 f^2$$

where f is the sampling frequency and $S_y(f)$ is the clock’s power spectrum. Typically only h_0 , h_{-1} , and h_{-2} affect the clock’s Allan variance and the clock model’s process noise elements.

Usage

Before using an optional external oscillator, several clock model parameters must be set. There are default settings for a voltage-controlled temperature-compensated crystal oscillator (VCTCXO), ovenized crystal oscillator (OCXO), Rubidium and Cesium standard, which are given in *Table 29 on Page 74*. Or, the user may choose to supply customized settings.

Abbreviated ASCII Syntax:

Message ID: 230

EXTERNALCLOCK clocktype [freq] [h0[h1[h2]]]

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .				H	0
2	clocktype	See <i>Table 28 on Page 74</i>		Clock type	Enum	4	H
3	freq	5MHz	0	Optional frequency. If a value is not specified, the default is 5 MHz.	Enum	4	H+4
		10MHz	1				
4	h0	1.0 e-31 to 1.0 e-18		Optional timing standards. These fields are only valid when the USER clocktype is selected.	Double	8	H+8
5	h1	1.0 e-31 to 1.0 e-18			Double	8	H+16
6	h2	1.0 e-31 to 1.0 e-18			Double	8	H+24

ASCII Example:

EXTERNALCLOCK DISABLE

or

EXTERNALCLOCK USER 10MHZ 1.0167E-23 6.87621E-25 8.1762E-26

or

EXTERNALCLOCK TCXO 5MHZ

Table 28: Clock Type

ASCII	Binary	Description
DISABLE	0	Turns the external clock input off, reverts back to the on-board VCTCXO
TCXO	1	Sets the pre-defined values for a VCTCXO
OCXO	2	Sets the pre-defined values for an OCXO
RUBIDIUM	3	Sets the pre-defined values for a rubidium oscillator
CESIUM	4	Sets the pre-defined values for a cesium oscillator
USER	5	Defines custom process noise elements

Table 29: Pre-Defined Values for Oscillators

Clock Type	h ₀	h ₁	h ₂
VCTCXO	1.0 e-21	1.0 e-20	1.0 e-20
OCXO	2.51 e-26	2.51 e-23	2.51 e-22
Rubidium	1.0 e-23	1.0 e-22	1.3 e-26
Cesium	2.0 e-20	7.0 e-23	4.0 e-29

5.2.13 FIX

This command fixes position parameters for the EuroPak-3. For various applications, fixing this value can assist in improving acquisition times and accuracy of position or corrections.

Syntax:

Message ID: 44

FIX type [lat long height]

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	type	See <i>Table 30</i> below.	Fix type	Enum	4	H
3	lat	-90 to +90	Latitude parameter for a fixed position in degrees. Only entered when the fix type is set to <i>POSITION</i> .	Double	8	H+4
4	long	-360 to +360	Longitude parameter for a fixed position in degrees. Only entered when the fix type is set to <i>POSITION</i> .	Double	8	H+12
5	height	-1000 to +20000000	Ellipsoidal height parameter for a fixed position in metres. Only entered when the fix type is set to <i>POSITION</i> .	Double	8	H+20

Example:

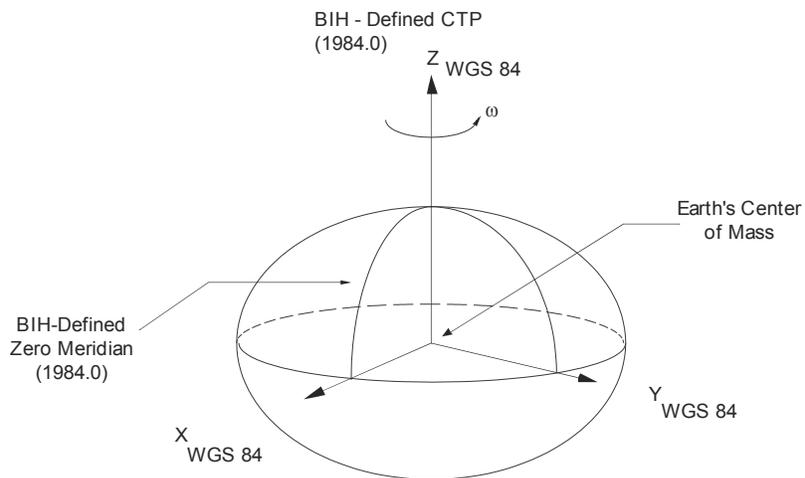
FIX POSITION 51.116381983333 -114.03829231944 1048.215

Table 30: Fix Type Values

ASCII	Description
NONE	Unfix or none. Clears any previous FIX commands.
POSITION	Configures the receiver with its position fixed. The receiver performs all computations based on WGS84, which is illustrated in <i>Figure 7 on Page 76</i> .

- Definitions - *

- Origin = Earth's center of mass
- Z-Axis = Parallel to the direction of the Conventional Terrestrial Pole (CTP) for polar motion, as defined by the Bureau International de l'Heure (BIH) on the basis of the coordinates adopted for the BIH stations.
- X-Axis = Intersection of the WGS 84 Reference Meridian Plane and the plane of the CTP's Equator, the Reference Meridian being parallel to the Zero Meridian defined by the BIH on the basis of the coordinates adopted for the BIH stations.
- Y-Axis = Completes a right-handed, earth-centered, earth-fixed (ECEF) orthogonal coordinate system, measured in the plane of the CTP Equator, 90° East of the X-Axis.



* Analogous to the BIH Defined Conventional Terrestrial System (CTS), or BTS, 1984.0.

Figure 7: The WGS84 ECEF Coordinate System

5.2.14 FRESET

This command clears data which is stored in the receiver's non-volatile memory and restores the receiver to factory default settings. The receiver is forced to hardware reset.

Syntax:

Message ID: 20

FRESET

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header		This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .		H	0
2			Reserved field required for <i>Binary</i> format only. Set to 0 when entering the command in <i>Binary</i> .	Enum	4	H

Example:

FRESET

5.2.15 LOG

Many different types of data can be logged using several different methods of triggering the log events. See *Chapter 6, Data Logs* starting on *Page 91* for further information and a complete list of data log structures.

The *hold* parameter, which is only valid when the *ONTIME* trigger is being used, will prevent a log from being removed when the *UNLOGALL* command is issued. To remove a log which was invoked using the *hold* parameter requires the specific use of the *UNLOG* command.

The *period* and *offset* parameters are only valid when the *ONTIME* trigger is being used as well. For example, to log data at 1 second after every minute you would set the *period* to 60 and the *offset* to 1.

-
- ☒ Maximum flexibility for logging data is provided to you by these logs. You are cautioned, however, to recognize that each log requested requires additional CPU time and memory buffer space. Too many logs may result in lost data and degraded CPU performance. Receiver overload can be monitored using the *Buffer Over-run* bits of the *Receiver Status* word in any log header.
-

Syntax:

Message ID: 1

LOG [port] message [trigger] [period[offset] [hold]]

Field	Field Name	Valid Values		Description	Format	Binary Bytes	Binary Offset
		ASCII	Binary				
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .				H	0
2	port	See <i>Table 11 on Page 52</i> .		Serial port at which to output the log data.	Enum	4	H
3	message	Any valid message name, with a suffix to specify the output format as explained in <i>Section 4.3.1 on Page 45</i> .	Any valid message ID	Log to output	UShort	2	H+4
4	message type	This field is only present in <i>Binary</i> format. See <i>Table 12 on Page 52</i> .		Message type of log.	Char	1	H+6
5		Reserved field required for <i>Binary</i> format only. Set to 0 when entering the command in <i>Binary</i> .			Char	1	H+7
6	trigger	See <i>Table 31 on Page 79</i> .		Trigger, or condition, to generate log on.	Enum	4	H+8
7	period	Any positive double value.		Log period for <i>ONTIME</i> trigger in seconds	Double	8	H+12
8	offset	Any positive double value smaller than the value specified in the <i>period</i> field.		Offset for <i>ONTIME</i> trigger in seconds.	Double	8	H+20

Field	Field Name	Valid Values		Description	Format	Binary Bytes	Binary Offset
		ASCII	Binary				
9	hold	See Table 32 on Page 79.		Flag for whether or not the log is removed by the <i>UNLOGALL</i> command. Valid for <i>ONTIME</i> trigger only.	Enum	4	H+28

Examples:

```
LOG COM1 PSRPOSA ONTIME 7 2.5 HOLD
LOG COM3 PRSPOSA ONCE
```

The first example configures the EuroPak-3 to output the *PSRPOS* log in *ASCII* format to COM1 at 7 second intervals offset by 2.5 seconds (output at 2.5 seconds then 9.5 seconds and so on). The second example log outputs only on COM3.

Table 31: Log Trigger Values

ASCII	Binary	Description
ONNEW	0	Output when the message is updated (not necessarily changed)
ONCHANGED	1	Output when the message is changed
ONTIME	2	Output on a time interval
ONNEXT	3	Output only the next message
ONCE	4	Output only the current message

Table 32: Log Hold Values

ASCII	Binary	Description
NOHOLD	0	Allow log to be removed by the <i>UNLOGALL</i> command
HOLD	1	Prevent log from being removed by the <i>UNLOGALL</i> command

5.2.16 PLLBW

-
- ☒ 1. This command can fundamentally change the way that the receiver operates. Do not alter the default settings unless you are confident that you understand the consequences.
 - 2. The log orders for C/A and P(Y) signals are 3rd order
-

This command sets the following for one or all channels:

- L1 PLL low-pass filter bandwidth
- L2 PLL low-pass filter bandwidth

A time filtered square of the L1 carrier phase tracking loop error signal is used to track the performance of this tracking loop. This value is used as the variance of L1 carrier phase measurements. The threshold specified by this command is compared with the loop variance to determine when the signal tracking lock time is reset. The resetting of the signal lock time is used to indicate that conditions exist in which a cycle slip might occur.

The time filtering that is performed on the loop variance determination is controlled using the third argument of this command. This value is used to compute the first order time constant that provides a noise equivalent bandwidth for the specified bandwidth. The filtering equation used is:

$$\text{new value} = e^{-\Delta T \omega} \times (\text{old data}) + (1 - e^{-\Delta T \omega}) \times (\text{new data})$$

where

ΔT = the PLL sampling rate, and

ω = $4 \times$ filter constant

Syntax:

Message ID: 518

PLLBW codetype bw

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	codetype	See <i>Table 33 on Page 81</i> .	Specifies which signal type the parameters should be applied to.	Enum	4	H
3	bw	See <i>Table 34 on Page 81</i> .	PLL low-pass filter bandwidth in Hz.	Float	4	H+4

Example:

PLLBW PY 1.0

Table 33: Code Type Values

ASCII	Description
CA	GPS and GEO C/A signals
PY	GPS P(Y) signals

Table 34: PLL Bandwidth Values

Frequency	Valid Bandwidth Values
GPS and GEO CA signals	0.5 to 15 Hz
GPS PY signals	0.01 to 1.0 Hz

5.2.17 PLLTHRESHOLD

This command controls signal acquisition and a steady-state-lock threshold for the PY code. The *acqui* and *lock* fields must have values. They set the thresholds for the L2 channel.

Syntax:

Message ID: 659

PLLTHRESHOLD lock acqui codetype

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	lock	0.01-1.00	Steady-state tracking lock threshold in cycles.	Float	4	H
3	acqui	0.01-1.00	Acquisition power threshold in cycles.	Float	4	H+4
4	codetype	PY	Specifies which signal type the parameters should be applied to.	Enum	4	H+8

Example:

PLLTHRESHOLD 0.6 0.05 PY

5.2.18 PULSEBLANKING

☒ The PULSEBLANKING command should only be used by advanced users of GPS.

This command enables or disables digital pulse blanking. By default, the digital pulse blanking is enabled. The sensitivity of the digital pulse blanking may be adjusted using the threshold field. *Figure 8 on Page 84* displays the relationship between the threshold value and the AGC bins.

Syntax:

Message ID: 519

PULSEBLANKING frequency threshold

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	Frequency	L2	Pulse blanking frequency. See <i>Table 35</i> below.	Enum	4	H
3	Threshold	0-15	Pulse blanking threshold. See <i>Table 36</i> below.	Ulong	4	H+4

Examples:

PULSEBLANKING L2 5

Table 35: Frequency Switch

ASCII	Description
L2	GPS L2 frequency

Table 36: Pulse Blanking Threshold

ASCII	Description
0	Disable L2 pulse blanking.
1-15	Enable L2 pulse blanking with thresholds set according to <i>Figure 8 on Page 84</i> .

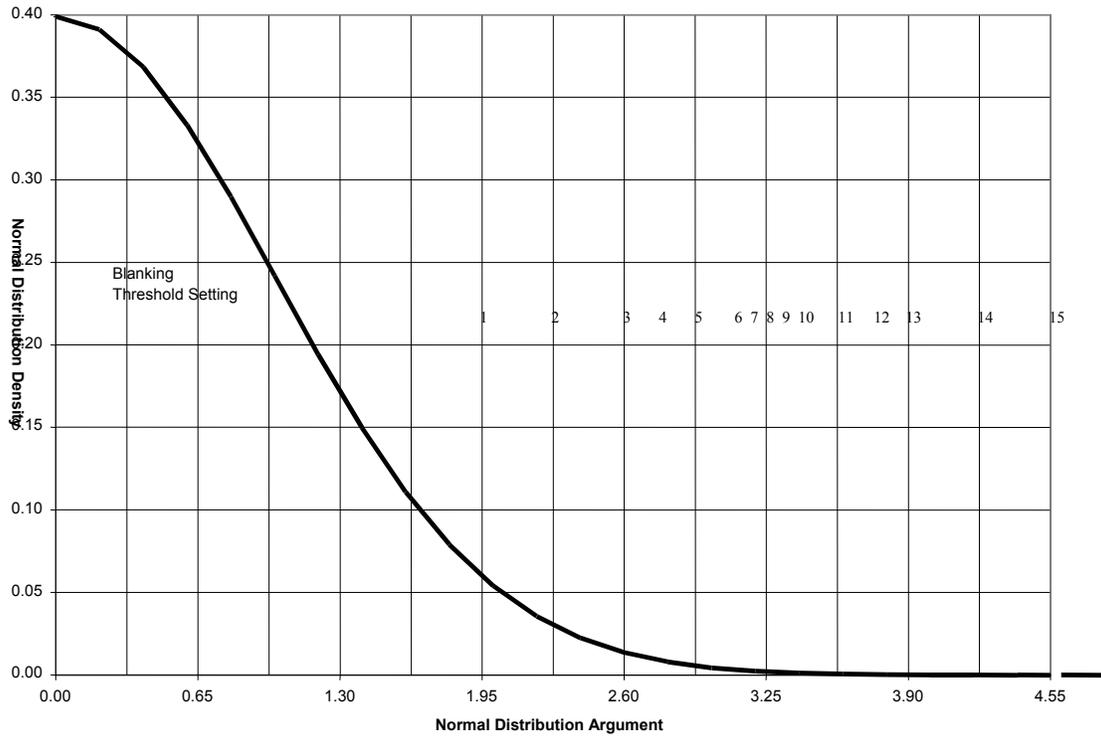


Figure 8: Threshold

5.2.19 **RESET**

This command performs a hardware reset. Following a *RESET* command, the receiver will initiate a cold-start bootup and will retain the most recent receiver configuration.

The optional delay field is used to set the number of seconds the receiver is to wait before resetting.

Syntax:

Message ID: 18

RESET [delay]

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	delay	Any ulong value.	Seconds to wait before resetting. If no value is provided, the default of 0 seconds is assumed.	ULong	4	H

Example:

RESET 5

See also the *FRESET* command.

5.2.20 SETAPPROXTIME

This command sets an approximate time in the receiver. The receiver will use this time as a system time until a GPS coarse time can be acquired. This can be used to improve time to first fix.

This command is only valid if time has not yet been determined by the receiver.

The time entered should be within 10 minutes of the actual GPS time for best results.

Syntax:

Message ID: 102

SETAPPROXTIME week sec

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	week	0-1023	GPS week number	ULong	4	H
3	sec	0-604799	Number of seconds into GPS week	Double	8	H+4

Example:

SETAPPROXTIME 850 425384

5.2.21 SETSATELLITE

Set the health of a PRN to disable it from being tracked, or to enable it.

All satellites are defaulted as enabled.

Syntax:

Message ID: 425

SETSATELLITE prn health

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	prn	0-37, 120-138	A satellite PRN integer number.	Long	4	H
3	health	See <i>Table 37</i> below.	Desired health tracking mode.	Enum	4	H+4

Example:

SETSATELLITE 29 DISABLE

Table 37: Desired Health Values

ASCII	Binary	Description
DISABLE	0	Disable tracking
ENABLE	1	Enable tracking

5.2.22 THRESHOLD

This command controls signal acquisition and steady-state-lock signal thresholds. The *acqui* and *lock* fields must have values. They set the thresholds for the L1 channel.

See also *Table 62* and *Table 63* on *Page 160* for the mapping of signal channels.

-
- If a signal channel is specified, see the optional *sigchan* field below, it overrides the *codetype* and *system* fields. The threshold values are applied to that particular signal channel.
-

Syntax:

Message ID: 449

THRESHOLD *acqui lock crosscorr codetype system* [*sigchan*]

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3</i> on <i>Page 45</i> .			H	0
2	acqui	25-80	Acquisition power threshold in dBHz.	ULong	4	H
3	lock	10-80	Steady-state tracking lock threshold in dBHz.	ULong	4	H+4
4	crosscorr	10-80	Specifies the cross-correlation power threshold in dBHz, at which point, the checks are performed.	ULong	4	H+8
5	codetype	See <i>Table 33</i> on <i>Page 81</i>	Specifies which signal type the parameters should be applied to.	Enum	4	H+12
6	system	See <i>Table 20</i> on <i>Page 65</i>	System that the SV channel is tracking. If a value is not given, the default is GPS.	Enum	4	H+16
7	sigchan	See <i>Table 62</i> and <i>Table 63</i> on <i>Page 160</i>	The parameters should be applied to this signal channel. If specified, this signal channel overrides the <i>codetype</i> and <i>system</i> fields.	Ulong	4	H+20

Example:

THRESHOLD 35 15 25 CA GPS

5.2.23 UNLOG

This command permits you to remove a specific log request from the system.

Syntax:

Message ID: 36

UNLOG [port] datatype

Field	Field Name	Valid Values		Description	Format	Binary Bytes	Binary Offset
		ASCII	Binary				
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .				H	0
2	port	See <i>Section 4.1 on Page 40</i> .		Serial port at which log is being output. If a value is not provided, <i>COM1</i> is assumed.	Enum	4	H
3	datatype	Message name	Message ID	Log to be disabled.	ULong	4	H+4

Example:

UNLOG COM3 PSRPOSA

5.2.24 UNLOGALL

This command disables all logs on the specified port only. All other ports are unaffected.

-
- ☒ This command does not disable logs that have the *HOLD* attribute set. (See the *LOG* command in *Section 5.2.15 on Page 78* for more information about this attribute). To disable logs with the *HOLD* attribute, use the *UNLOG* command.
-

Syntax:

Message ID: 38

UNLOGALL [port]

Field	Field Name	Valid Values	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the <i>Abbreviated ASCII</i> command name. See <i>Section 4.3 on Page 45</i> .			H	0
2	port	See <i>Table 11 on Page 52</i> .	Serial port at which logging is to disabled. If a value is not provided, <i>COM1</i> is assumed.	Enum	4	H
3	Reserved (always 0).			Enum	4	H+4

Example:

UNLOGALL

6.1 Functional Listing of Logs

Table 38 lists the logs by function and provides the type of each log. The valid types are discussed in Section 4.2.1 on Page 44.

Table 38: Logs By Function

Log	Description	Type
GENERAL RECEIVER CONTROL AND STATUS		
AGCSTATS	Automatic gain control status	Synch
ALLSQMDATA	Signal quality monitoring data	Synch
ALLSQMIINFO	I correlator locations	Polled
ALLSQMQINFO	Q correlator locations	Polled
RXCOMMANDS	Receiver configuration information	Polled
RXSECSTATUS	Self-test status	Synch
SYSTEMLEVELS	System hardware levels	Synch
VERSION	Receiver hardware and software version numbers	Polled
POSITION, PARAMETERS, AND SOLUTION FILTERING CONTROL		
PSRPOS	Position data	Synch
CLOCK INFORMATION, STATUS, AND TIME		
CLOCKMODEL	Range bias information	Synch
TIME	Receiver time information	Synch
POST PROCESSING DATA		
RANGE	Satellite range information	Synch
SATELLITE TRACKING AND CHANNEL CONTROL		
ALLMEDLLESTIMATES	MEDLL signal estimate information	Asynch
ALLSQMDATA	Signal quality monitoring data	Synch
ALLSQMI	I accumulation signal quality monitoring data	Asynch
ALLSQMQ	Q signal quality monitoring data	Asynch
ALMANAC	Current decoded almanac data	Asynch
RANGE	Satellite range information	Synch
RAWEPHEM	Raw ephemeris	Asynch
RAWGPSSUBFRAMEWP	Raw subframe data	Asynch
RAWWAASFRAMEWP	Raw SBAS frame data	Asynch
SATVIS	Satellite azimuth and elevation angle data	Synch
TRACKSTAT	Channel tracking information	Synch

6.2 Log Summary

The available logs are listed alphabetically in *Table 39*.

Table 39: Log Summary

Log Name	Message ID	Description
AGCSTATS	630	Automatic gain control status
ALLMEDLLESTIMATES	611	MEDLL signal estimate information
ALLSQMDATA	617	Satellite quality monitoring data
ALLSQMI	632	I accumulation signal quality monitoring data
ALLSQMIINFO	656	I correlator locations
ALLSQMQ	633	Q signal quality monitoring data
ALLSQMQINFO	657	Q correlator locations
ALMANAC	73	Current decoded almanac data
CLOCKMODEL	16	Current clock model matrices
PSRPOS	47	Position data
RANGE	43	Satellite range information
RAWEPHEM	41	Raw ephemeris
RAWGPSSUBFRAMEWP	570	Raw subframe data with parity information
RAWWAASFRAMEWP	571	Raw SBAS frame data with parity information
RXCOMMANDS	579	Receiver configuration information
RXSECSTATUS	638	Self-test status
SATVIS	48	Satellite azimuth and elevation angle data
SYSTEMLEVELS	653	System hardware levels
TIME	101	Receiver time information
TRACKSTAT	83	Channel tracking information
VERSION	37	Receiver hardware and software version numbers

6.3 Log Reference

-
- ☒ For each log, the recommended input command for generating the log is provided. The recommended command is shown in *ASCII* format, unless otherwise specified. An example of the log output, in *ASCII* format, is provided for each recommended input.

All logs are followed by a carriage return and line feed. However, in some of the examples, carriage returns have been inserted in the middle of the log to clearly indicate different data sets.

6.3.1 AGCSTATS Automatic Gain Control Status

This log provides status information for the automatic gain control mechanism and details of the parameters it is currently using.

Log Type: Synch

Message ID: 630

Field	Field Name	Data Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	# RF decks	Number of RF decks reported in this message	Ulong	4	H
3	AGCword	AGC status word (see <i>Table 40</i> on <i>Page 94</i>)	Ulong	4	H+4
4	gain	AGC gain (0 to 99999)	Ulong	4	H+8
5	pulse width	VARF pulse width	Ulong	4	H+12
6	modulus	VARF modulus	Ulong	4	H+16
7	bin1	A/D bin 1 (decimal percentage)	Double	8	H+20
8	bin2	A/D bin 2 (decimal percentage)	Double	8	H+28
9	bin3	A/D bin 3 (decimal percentage)	Double	8	H+36
10	bin4	A/D bin 4 (decimal percentage)	Double	8	H+44
11	bin5	A/D bin 5 (decimal percentage)	Double	8	H+52
12	bin6	A/D bin 6 (decimal percentage)	Double	8	H+60
13	noise floor	Calculated noise floor	Double	8	H+68
14	Reserved		Double	8	H+76
15			Double	8	H+84
16...	Next RF deck, offset = H+ 4 + (#RF *88) Bytes				
variable...	32-bit CRC (ASCII and Binary only)		Hex	4	H+ 4 (#RF*88)

Table 40: AGC Status Word

Bit	Description	Bit = 0	Bit = 1
0	Jam Detected	Jamming Not Present	Jamming Present
1-2	AGC Calibrated	Coarse Calibration = 0 Fine Calibration = 1	
3-5	RF Type	1 = L1, 2 = L2, 3 = Reserved	
6-8	ADC Range indicates which 3 bits of the 8-bit ADC output are currently being used by the receiver.	0 = Bits 7, 6, 5 1 = Bits 7, 5, 4 2 = Bits 7, 4, 3 3 = Bits 7, 3, 2 4 = Bits 7, 2, 1 5 = Bits 7, 1, 0	
9-11	Method of Noise Floor Calculation	1 = AGC 2 = Post Correlation 3 = Reserved	
12-31	Reserved		

Recommended Input:

```
LOG AGCSTATSA ONTIME 10
```

Example Output:

```
#AGCSTATSA,COM1,0,46.0,FINESTEERING,265,320937.829,00840000,
0000,33331;
2,
44A,2698,398,8000,0.0658,0.1322,0.2236,0.2533,0.1974,0.1277,
1033586.375000,0.997492,0.000000,
412,281,281,8000,0.0501,0.1191,0.2345,0.2967,0.2247,0.1371,880681.9
37500,0.999503,0.000000*2959E75E
```

6.3.2 ALLMEDLLESTIMATES MEDLL Signal Estimates

If you have a MEDLL version of the Euro-3, this log provides information about the MEDLL signal estimates being generated. A data set is provided for each tracked satellite and, within each tracked satellite data set, a data set is provided for each signal estimate. The message is updated every second and is therefore best to be logged *ONNEW* or *ONCHANGED*.

Field #5, the test statistic is limited to 0 - 0.99 regardless of the number of signals estimated. The MEDLL test statistic algorithm is as follows:

$$TestStat = \frac{1}{N} \sum_{i=0}^{N-1} \left[\left[I_i - \sum_{j=0}^{K-1} \hat{I}_{i,j} \right]^2 + \left[Q_i - \sum_{j=0}^{K-1} \hat{Q}_{i,j} \right]^2 \right]$$

if $0.99 \leq TestStat$, $TestStat = 0.99$

if more than one signal, for example a multipath signal, is estimated,

$TestStat = TestStat + 1$

where

$\hat{Q}_{i,j}$ and $\hat{I}_{i,j}$ are the estimated Q and I values for each estimated signal

Q_i and I_i are the measured Q and I values

K is the number of estimated signals

N is the number of correlator locations

☒ The Amplitude field, Field #8 in the table below, is always normalized by the first estimate. The first occurrence of the amplitude field for each PRN will be 1.

To apply pseudorange (PSR) and accumulated Doppler range (ADR) corrections for multipath, do the following:

Corrected PSR = PSR + delay (Field #7 below)

Corrected ADR = ADR + phase (Field #9 below)

The PSR and ADR measurements can be found in the RANGE log. PSR is also in the TRACKSTAT log.

Log Type: Asynch

Message ID: 611

Field	Field Name	Data Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	obs	Number of observation data sets to follow	ULong	4	H
3	prn	Satellite PRN being tracked	ULong	4	H+4
4	sigchan	Receiver signal channel	ULong	4	H+8
5	teststat	Test statistic for this estimate process	Float	4	H+12
6	estimates	Number of estimate data sets to follow	ULong	4	H+16
7	delay	Delay of signal estimate (m)	Float	4	H+20
8	amplitude	Amplitude of signal estimate relative to main signal	Float	4	H+24
9	phase	Phase of signal estimate (-1 to +1 in cycles)	Float	4	H+28
10...	Next estimate data set, offset = variable (normally H+ 4 + (# previous obs x 16 + (# previous estimates x 12)))				
variable...	Next observation data set, offset = variable				
variable...	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	variable

Recommended Input:

```
LOG ALLMEDLLESTIMATESA ONNEW
```

Example Output:

```
#ALLMEDLLESTIMATESA, COM1, 0, 60.0, COARSE, 215, 487883.250, 00e40008,  
0000, 33331;  
8,  
23, 12, 1.394975305, 2, -0.250410855, 1.000000000, 0.000762939,  
0.000000000, 0.000000000, 0.000000000,  
14, 10, 1.500047922, 2, -0.214637876, 1.000000000, -0.000061035,  
0.000000000, 0.000000000, 0.000000000,  
20, 8, 1.383500814, 2, 0.107318938, 1.000000000, -0.000274658,  
0.000000000, 0.000000000, 0.000000000,  
1, 4, 1.390916824, 2, 0.214637876, 1.000000000, -0.000579834,  
0.000000000, 0.000000000, 0.000000000,  
30, 2, 1.226275086, 2, -0.965870440, 1.000000000, -0.000701904,  
0.000000000, 0.000000000, 0.000000000,  
25, 28, 1.494421721, 2, 0.071545959, 1.000000000, 0.000000000,  
0.000000000, 0.000000000, 0.000000000,  
11, 24, 1.401616573, 2, 0.071545959, 1.000000000, -0.000152588,  
0.000000000, 0.000000000, 0.000000000,  
5, 30, 1.385931969, 2, 0.107318938, 1.000000000, -0.000427246,  
0.000000000, 0.000000000, 0.000000000*721c4721
```

6.3.3 ALLSQMDATA Signal Quality Monitoring Data

ALLSQMDATA, *ALLSQMIINFO* and *ALLSQMQINFO*, see Section 6.3.5 and Section 6.3.7 starting on Page 101, are for signal quality monitoring (SQM), which is described in Section 1.5.5 on Page 20.

This log provides information about the correlation function and multiple data sets can be provided. A data set is provided for each tracked satellite and, within each tracked satellite data set, a data set is provided for each channel. The message is updated every second and is therefore best to be logged *ONNEW* or *ONCHANGED*.

This information can be used as a means to detect anomalous waveforms in the broadcast signal from the satellite.

Log Type: Synch

Message ID: 617

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See Section 4.3 on Page 45.		H	0
2	svobs	Number of tracked satellite data sets to follow	ULong	4	H
3	prn	Satellite PRN being tracked	ULong	4	H+4
4	sigchan#	Signal channel number of the master hardware channel tracking the satellite	ULong	4	H+8
5	obs	Number of channel data sets to follow	ULong	4	H+12
6	A1sum	Accumulation 1	Long	4	H+8
7	A2sum	Accumulation 2	Long	4	H+12
8	A3sum	Accumulation 3	Long	4	H+16
9	A4sum	Accumulation 4	Long	4	H+20
10	A5sum	Accumulation 5	Long	4	H+24
11	sync	Synchronization flag for channel. See Table 41 on Page 98.	Enum	4	H+28
12...	Next channel data set, offset = H+12 + (# previous prn x (# previous obs x 24))				
variable...	Next satellite data set, offset = variable				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	variable

Recommended Input:

```
LOG ALLSQMDATAA ONNEW
```

Example Output:

```
#ALLSQMDATAA, COM1, 0, 76.5, FINESTEERING, 465, 265309.252, 00000008,
0000, 33331;
8,
17, 4, 2, 16991661, 8282, -1473, 16435627, 15593257, TRUE,
16824362, 16548, 16836828, 15992096, 16002062, TRUE,
26, 6, 2, 5280395, -9710, 3878, 5104527, 4831457, TRUE,
5228061, -8323, 5218907, 4956911, 4961293, TRUE,
9, 8, 2, 8857372, -13543, -4705, 8549598, 8104496, TRUE,
8762825, -723, 8772699, 8305291, 8326387, TRUE,
15, 14, 2, 6405615, 2935, 2488, 6206501, 5889015, TRUE,
6349056, 6495, 6350052, 6036326, 6034364, TRUE,
4, 16, 2, 6292347, -6311, 6167, 6080143, 5739879, TRUE,
6237395, 7988, 6221825, 5896489, 5897003, TRUE,
8, 20, 2, 4475521, 160, -3470, 4314983, 4073641, TRUE,
4431972, 10899, 4434046, 4182840, 4189202, TRUE,
11, 22, 2, 8773572, -18602, -3853, 8458208, 7987682, TRUE,
8680426, 8774, 8689846, 8212008, 8214334, TRUE,
28, 24, 2, 14312056, -23620, -3084, 13813172, 13047876, TRUE,
14160400, -4748, 14168966, 13417814, 13414462, TRUE
*A4390FF1
```

Table 41: Synchronization Flag Values

ASCII	Binary	Description
TRUE	1	Correlators are synchronized with the master channel.
FALSE	0	Correlators are not synchronized with the master channel.

6.3.4 ALLSQMI I Accumulation Signal Quality Monitoring Data

ALLSQMI is for signal quality monitoring (SQM) which is described in *Section 1.5.5 on Page 20*.

This log provides information about the I correlation function. Multiple data sets can be provided. A data set is provided for each tracked satellite and, within each tracked satellite data set, a data set is provided for each correlator. The message is updated every second and is therefore best to be logged ONNEW or ONCHANGED.

This information can be used as a means to detect anomalous waveforms in the broadcast signal from the satellite.

Log Type: Asynch

Message ID: 632

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3 on Page 45</i> .		H	0
2	#svobs	Number of tracked satellite data sets to follow	ULong	4	H
3	prn	Satellite PRN being tracked	ULong	4	H+4
4	sigchan#	Signal channel for the tracked satellite	ULong	4	H+8
5	#accums	Number of accumulation values to follow	Ulong	4	H+12
6	Asum	I Accumulation value	Long	4	H+16
variable	Next channel data set, offset = H + 4 + #svobs(12 + (4 x #accums))				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	variable

Recommended Input:

```
LOG ALLSQMIA ONNEW
```

Example Output:

```
#ALLSQMIA, COM1, 0, 77.5, FINESTEERING, 465, 265326.251, 00000008,
0000, 33331;
8,
17, 4, 8, 15992769, 16423669, 16808489, 16978087, 16812655, 16420665,
15975501, 15561269,
26, 6, 8, 4918622, 5058514, 5188994, 5242268, 5183938, 5059072, 4917114,
4785856,
9, 8, 8, 8266904, 8502555, 8719084, 8810665, 8719538, 8500979, 8262084,
8040467,
15, 14, 8, 5830017, 5990535, 6136885, 6186449, 6133423, 5989559, 5826123,
5679435,
4, 16, 8, 5864633, 6047522, 6209547, 6265714, 6215509, 6061390, 5903329,
5753388,
8, 20, 8, 4196987, 4330468, 4451671, 4500476, 4450889, 4337614, 4210259,
4099840,
11, 22, 8, 8976212, 9251214, 9474104, 9571284, 9482272, 9259946, 8997084,
```

8750832,
28,24,8,13512877,13911754,14266691,14415486,14281405,13935844,13533
057,13154588*7B70B193

The number of satellites and the signal channels tracked will be different for MEDLL receiver models.

6.3.5 ALLSQMIINFO I Correlator Locations

This log provides information about the correlation locations found in the ALLSQMI log, see *Page 99*. An individual message is sent for each configured channel of the receiver. The message contents will be constant for a specific software version.

Log Type: Polled

Message ID: 656

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	#svobs	Number of tracked satellite data sets to follow	ULong	4	H
3	sigchan#	Signal channel for the tracked satellite	ULong	4	H+4
4	Reserved		Ulong	4	H+8
5			Ulong	4	H+12
6	#locations	Number of correlator locations to follow	Long	4	H+16
7	AIxval	Correlator spacing, in C/A code chips, from punctual	Float	4	H+20
variable	Next channel data set, offset = H + 4 + #svobs(16 + (4 x #locations))				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	variable

Recommended Input:

```
LOG ALLSQMIINFOA ONNEW
```

Example Output:

```
#ALLSQMIINFOA,COM1,0,78.0,FINESTEERING,465,265335.337,000000008,
0000,33331;
14,
0,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
2,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
4,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
6,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
8,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
10,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
12,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
14,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
16,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
```

```
18,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
20,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
22,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
24,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000,
26,28,0,8,-0.0767250,-0.0511500,-0.0255750,0.0000000,0.0255750,
0.0511500,0.0767250,0.1023000
*3132FFFE
```

☒ The number of satellites and the signal channels tracked will be different for MEDLL receiver models.

6.3.6 ALLSQMQ Q Signal Quality Monitoring Data

This log provides information about the Q correlation function. Multiple data sets can be provided. A data set is provided for each tracked satellite and, within each tracked satellite data set, a data set is provided for each correlator. The message is updated every second and is therefore best logged ONNEW or ONCHANGED.

Log Type: Asynch

Message ID: 633

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3 on Page 45</i> .		H	0
2	#svobs	Number of tracked satellite data sets to follow	ULong	4	H
3	prn	Satellite PRN being tracked	ULong	4	H+4
4	sigchan#	Signal channel for the tracked satellite	ULong	4	H+8
5	#accums	Number of accumulation values to follow	Ulong	4	H+12
6	Asum	Q accumulation value	Long	4	H+16
Variable	Next channel data set, offset = H + 4 + #svobs(12 + (4 x #accums))				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	variable

Recommended Input:

```
LOG ALLSQMQA ONNEW
```

Example Output:

```
#ALLSQMQA, COM1, 0, 78.0, FINESTEERING, 465, 265344.251, 00000008,
0000, 33331;
8,
17, 4, 2, -1971, 3855,
26, 6, 2, 5176, 6166,
9, 8, 2, -22864, -20263,
15, 14, 2, 13497, 13957,
4, 16, 2, 13646, 24317,
8, 20, 2, 20834, 35078,
11, 22, 2, -86, 16272,
28, 24, 2, -13036, 7862*F340434D
```

The number of satellites and the signal channels tracked will be different for MEDLL receiver models.

6.3.7 ALLSQMQINFO Q Correlator Locations

This log provides information about the correlation locations found in the ALLSQMQ log, see *Page 103*. An individual message is sent for each configured channel of the receiver. The message contents will be constant for a specific software version.

Log Type: Polled

Message ID: 657

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	#svobs	Number of tracked satellite data sets to follow	ULong	4	H
3	sigchan#	Signal channel for the tracked satellite	ULong	4	H+4
4	Reserved		Ulong	4	H+8
5			Ulong	4	H+12
6	#locations	Number of correlator locations to follow	Long	4	H+16
7	AQxval	Correlator spacing, in C/A code chips, from punctual	Float	4	H+20
variable	Next channel data set, offset = H + 4 + #svobs(16 + (4 x #locations))				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	variable

Recommended Input:

```
LOG ALLSQMQINFOA ONNEW
```

Example Abbreviated ASCII Output:

```
ALLSQMQINFO COM1 0 77.0 FINESTEERING 465 265419.193 00000008 0000 33331
14
0 28 0
2 0.0000000 -0.0255750
2 28 0
2 0.0000000 -0.0255750
4 28 0
2 0.0000000 -0.0255750
6 28 0
2 0.0000000 -0.0255750
8 28 0
2 0.0000000 -0.0255750
10 28 0
2 0.0000000 -0.0255750
12 28 0
2 0.0000000 -0.0255750
14 28 0
2 0.0000000 -0.0255750
16 28 0
2 0.0000000 -0.0255750
18 28 0
```

```
2 0.0000000 -0.0255750
20 28 0
2 0.0000000 -0.0255750
22 28 0
2 0.0000000 -0.0255750
24 28 0
2 0.0000000 -0.0255750
26 28 0
2 0.0000000 -0.0255750
```

The number of satellites and the signal channels tracked will be different for MEDLL receiver models.

6.3.8 ALMANAC Decoded Almanac

This log contains the decoded almanac parameters from subframes four and five as received from the satellite with the parity information removed and appropriate scaling applied. Multiple messages are transmitted, one for each SV almanac collected. For more information about Almanac data, refer to the GPS SPS Signal Specification listed at <http://www.arinc.com>.

Log Type: Asynch

Message ID: 73

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	#msg	The number of satellite PRN almanac data sets to follow.	Long	4	H
3	PRN	Satellite PRN number for current message, dimensionless	ULong	4	H+4
4	week	Almanac reference week (GPS week number)	ULong	4	H+8
5	seconds	Almanac reference time, seconds into the week	Double	8	H+12
6	ecc	Eccentricity, dimensionless	Double	8	H+20
7	$\dot{\omega}$	Rate of right ascension, radians/second	Double	8	H+28
8	ω_0	Right ascension, radians	Double	8	H+36
9	ω	Argument of perigee, radians	Double	8	H+44
10	M_0	Mean anomaly of reference time, radians	Double	8	H+52
11	a_{f0}	Clock aging parameter, seconds	Double	8	H+60
12	a_{f1}	Clock aging parameter, seconds/second	Double	8	H+68
13	N	Corrected mean motion, radians/second	Double	8	H+76
14	A	Semi-major axis, meters	Double	8	H+84
15	incl-angle	Angle of inclination relative to 0.3π , radians	Double	8	H+92
16	SV config	Satellite configuration	ULong	4	H+100
17	health-prn	SV health from subframe 4 or 5	ULong	4	H+104
18	health-alm	SV health from almanac	ULong	4	H+108
19	antispoof	Anti-spoofing flag where 0 = FALSE 1 = TRUE	Enum	4	H+112
20...	Next almanac data set, offset = H + 4 + (# previous msg x 112)				
21	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H + 4 + (112 x #msg)

Recommended Input:

LOG ALMANACA ONCHANGED

ASCII Example:

```
#ALMANACA, COM1, 0, 64.5, SATTIME, 235, 508014.000, 00000028, 42F1, 0;
```

```
31,
```

```
1, 1049, 61440.0, 5.10788E-03, -7.8974718E-09, -4.5666114E-01, -1.7361  
153E+00, -9.1286238E-01, 1.1730194E-04, 0.00000000, 1.4584974E-04, 2.  
6560862E+07, 1.7532921E-02, 1, 0, 0, FALSE,
```

```
2, 1049, 61440.0, 1.95422E-02, -8.0917656E-09, 1.5495060E+00, -2.14498  
23E+00, 2.5208892E+00, -1.7547607E-04, -3.6379788E-12, 1.4585339E-04  
, 2.6560419E+07, -8.2930836E-03, 1, 0, 0, FALSE
```

```
...
```

```
30, 1049, 61440.0, 5.61333E-03, -7.9889042E-09, 1.5991652E+00, 1.47591  
91E+00, 2.7901058E+00, -9.5367432E-06, 0.00000000, 1.4585534E-04, 2.6  
560183E+07, 1.9534287E-03, 1, 0, 0, FALSE
```

```
31, 1049, 61440.0, 9.47952E-03, -8.0917656E-09, 2.6421445E+00, 8.05646  
63E-01, 1.9109259E-01, 3.7193298E-05, 0.00000000, 1.4585948E-04, 2.65  
59680E+07, 8.8922949E-03, 1, 0, 0, TRUE
```

```
*fc97918d
```

6.3.9 CLOCKMODEL Current Clock Model Status

The *CLOCKMODEL* log contains the current clock-model status of the receiver.

Monitoring the *CLOCKMODEL* log will allow you to determine the error in your receiver reference oscillator as compared to the GPS satellite reference.

All logs report GPS time not corrected for local receiver clock error. To derive the closest GPS time, subtract the clock offset from the GPS time reported. The clock offset can be calculated by dividing the value of the range bias given in field 6 of the *CLOCKMODEL* log by the speed of light (c).

The following symbols are used throughout this section:

B = Range bias (m)

BR = Range bias rate (m/s)

SAB = Gauss-Markov process representing range bias error due to SA clock dither (m)

The standard clock model now used is as follows:

clock parameters array = [B BR SAB]

covariance matrix =

$$\begin{bmatrix} \sigma_B^2 & \sigma_B \sigma_{BR} & \sigma_B \sigma_{SAB} \\ \sigma_{BR} \sigma_B & \sigma_{BR}^2 & \sigma_{BR} \sigma_{SAB} \\ \sigma_{SAB} \sigma_B & \sigma_{SAB} \sigma_{BR} & \sigma_{SAB}^2 \end{bmatrix}$$

Log Type: Synch

Message ID: 16

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	clock status	Clock model status as computed from current measurement data. See <i>Table 42</i> on <i>Page 110</i> .	Enum	4	H
3	reject	Number of rejected range bias measurements	ULong	4	H+4
4	noise time	GPS time of last noise addition	GPSTime	4	H+8
5	update time	GPS time of last update	GPSTime	4	H+12
6	parameters	Clock correction parameters (a 1x3 array of length 3), listed left-to-right	Double	8	H+16
7				8	H+24
8				8	H+32
9	cov data	Covariance of the straight line fit (a 3x3 array of length 9), listed left-to-right by rows	Double	8	H+40
10				8	H+48
11				8	H+56
12				8	H+64
13				8	H+72
14				8	H+80
15				8	H+88
16				8	H+96
17				8	H+104
18	range bias	Last instantaneous measurement of the range bias (meters)	Double	8	H+112
19	range bias rate	Last instantaneous measurement of the range bias rate (m/s)	Double	8	H+120
20	change	Indicates whether or not there is a change in the constellation. See <i>Table 43</i> on <i>Page 110</i> .	Enum	4	H+128
21	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+132

Recommended Input:

LOG CLOCKMODELA ONTIME 1

Example Output:

```
#CLOCKMODELA, COM1, 0, 43.0, FINESTEERING, 265, 320943.000, 00840000,
0000, 33331;
VALID, 0, 320943.000, 320943.000, -6.022986468e+01, 2.031644576e-01,
-8.706996251e+00, 5.137097514e+01, 1.634750366e-02,
-5.096931554e+01, 1.634750366e-02, 1.975273882e-02, -6.548797429e-03,
-5.096931554e+01, -6.548797429e-03, 5.148202750e+01,
-6.915049843e+01, 2.542941484e-01, FALSE*9d3530cd
```

Table 42: Clock Model Status Values

ASCII	Binary	Description
VALID	0	The clock model is valid
CONVERGING	1	The clock model is near validity
ITERATING	2	The clock model is iterating towards validity
INVALID	3	The clock model is not valid
ERROR	4	Clock model error

Table 43: Constellation Change Flag Values

ASCII	Binary	Description
FALSE	0	There has not been a change in the constellation
TRUE	1	The constellation has changed

6.3.10 PSRPOS Pseudorange Position

This log contains the pseudorange position computed by the receiver, along with three status flags.

Log Type: Synch

Message ID: 47

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	sol status	Solution status. See <i>Table 44</i> on <i>Page 112</i> .	Enum	4	H
3	pos type	Position type. See <i>Table 45</i> on <i>Page 112</i> .	Enum	4	H+4
4	lat	Latitude (decimal degrees)	Double	8	H+8
5	lon	Longitude (decimal degrees)	Double	8	H+16
6	hgt	Height above ellipsoid (m)	Double	8	H+24
7	Reserved		Float	4	H+32
8	datum id#	Datum ID number. This will always be 61 for the WGS84 coordinate system.	Enum	4	H+36
9	lat σ	Latitude standard deviation (m)	Float	4	H+40
10	lon σ	Longitude standard deviation (m)	Float	4	H+44
11	hgt σ	Height standard deviation (m)	Float	4	H+48
12	Reserved		Char[4]	4	H+52
13			Float	4	H+56
14			Float	4	H+60
15	#obs	Number of observations tracked	UChar	1	H+64
16	#GPSL1	Number of GPS L1 ranges used in computation	UChar	1	H+65
17	Reserved		UChar	1	H+66
18			UChar	1	H+67
19			UChar	1	H+68
20			UChar	1	H+69
21			UChar	1	H+70
22			UChar	1	H+71
23	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+72

Recommended Input:

```
LOG PSRPOSA ONTIME 1
```

Example Output:

```
PSRPOSA, COM1, 0, 43.0, FINESTEERING, 265, 320943.000, 00840000,
0000, 33331;
SOL_COMPUTED, SINGLE, 51.11638529847, -114.03825624352, 1045.2359,
0.0000, WGS84, 1.5908, 1.4096, 2.3924, "", 0.000, 0.000, 10, 8, 0, 0, 0, 0, 0, 0
*84ea7b68
```

Table 44: Solution Status Values

ASCII	Binary	Description
SOL_COMPUTED	0	Solution computed
INSUFFICIENT_OBS	1	Insufficient observations
NO_CONVERGENCE	2	No convergence
SINGULARITY	3	Singularity at parameters matrix
CONV_TRACE	4	Covariance trace exceeds maximum (trace > 1000 m)
TEST_DIST	5	Test distance exceeded (maximum of 3 rejections if distance > 10 km)
COLD_START	6	Not yet converged from cold start
V_H_LIMIT	7	Height or velocity limits exceeded (in accordance with COCOM export licensing restrictions)
VARIANCE	8	Variance exceeds limits
RESIDUALS	9	Residuals are too large
DELTA_POS	10	Delta position is too large
NEGATIVE_VAR	11	Negative variance

Table 45: Position Type Values

ASCII	Binary	Description
NONE	0	No solution
FIXEDPOS	1	Position has been fixed by the <i>FIX POSITION</i> command or by position averaging
SINGLE	16	Single point position

6.3.11 RANGE Satellite Range Information

RANGE contains the channel measurements for the currently tracked satellites. When using this log, please keep in mind the constraints noted along with the description.

It is important to ensure that the receiver clock model is valid. This can be monitored by the bits in the *Receiver Status* field of the log header. Large jumps in pseudorange as well as accumulated Doppler range (ADR) will occur as the clock is being adjusted. If the ADR measurement is being used in precise phase processing, it is important not to use the ADR if the *parity known* flag in the *ch-tr-status* field is not set as there may exist a half (1/2) cycle ambiguity on the measurement. The tracking error estimate of the pseudorange and carrier phase (ADR) is the thermal noise of the receiver tracking loops only. It does not account for possible multipath errors or atmospheric delays.

If both the L1 and L2 signals are being tracked for a given PRN, two entries with the same PRN will appear in the range logs. As shown in *Table 46* on *Page 115*, these entries can be differentiated by bits 21-22 of the *ch-tr-status* field, which denote whether the observation is for L1 or L2. This is to aid in parsing data.

Log Type: Synch

Message ID: 43

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	# obs	Number of data sets to follow.	Long	4	H
3	PRN	GPS satellite PRN number of range measurement.	UShort	2	H+4
4	Reserved		UShort	2	H+6
5	psr	Pseudorange measurement (m).	Double	8	H+8
6	psr std	Pseudorange measurement standard deviation (m).	Float	4	H+16
7	adr	Carrier phase, in cycles (accumulated Doppler range).	Double	8	H+20
8	adr std	Estimated carrier phase standard deviation (cycles).	Float	4	H+28
9	dopp	Instantaneous carrier Doppler frequency (Hz).	Float	4	H+32
10	C/N ₀	Carrier to noise density ratio $C/N_0 = 10[\log_{10}(S/N_0)]$ (dB-Hz)	Float	4	H+36
11	locktime	Number of seconds of continuous tracking (no cycle slipping).	Float	4	H+40
12	ch-tr-status	Tracking status. See <i>Table 46</i> on <i>Page 115</i> .	ULong	4	H+44
13...	Next data set, offset = H + 4 + (# previous obs x 44)				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+4+ (#obs x 44)

Recommended Input:

```
LOG RANGEA ONTIME 30
```

Example Output:

```
#RANGEA, COM1, 0, 47.5, FINESTEERING, 265, 320945.000, 00840000,
0000, 33331;
18,
25, 0, 21365981.414, 0.247, -112278988.432, 0.027, -1857.448, 51.6,
171.720, 08105C24,
25, 0, 21365991.461, 0.051, -87490144.701, 0.002, -1447.362, 45.1,
144.960, 01305C2B,
30, 0, 24599287.755, 0.511, -129270124.807, 0.028, -2893.781, 45.2,
169.090, 08105C64,
30, 0, 24599301.065, 0.116, -100729991.869, 0.012, -2254.897, 38.1,
159.960, 01305C6B,
13, 0, 24255239.520, 0.461, -127462146.591, 0.027, 3273.212, 46.1,
169.530, 08105C84,
13, 0, 24255251.295, 0.134, -99321176.839, 0.009, 2550.556, 36.9,
153.460, 01305C8B,
23, 0, 21129930.016, 0.306, -111038530.762, 0.028, 2116.305, 49.7,
172.180, 08105CA4,
23, 0, 21129937.508, 0.046, -86523554.806, 0.003, 1649.069, 46.2,
150.460, 01305CAB,
16, 0, 22799268.596, 0.362, -119810963.733, 0.026, 2946.004, 48.2,
170.260, 08105CC4,
16, 0, 22799279.515, 0.100, -93359218.287, 0.004, 2295.589, 39.4,
138.960, 01305CCB,
4, 0, 24192022.374, 1.267, -127129934.904, 0.041, 1290.381, 42.4,
10.370, 08005504,
1, 0, 20395815.562, 0.222, -107180735.037, 0.026, -775.109, 52.4,
170.630, 08105D24,
1, 0, 20395826.400, 0.053, -83517479.701, 0.002, -603.982, 44.8,
156.960, 01305D2B,
20, 0, 20443446.499, 0.250, -107431037.330, 0.026, -273.030, 51.4,
171.910, 08105D44,
20, 0, 20443456.214, 0.047, -83712520.728, 0.003, -212.752, 45.9,
161.460, 01305D4B,
11, 0, 25112352.659, 0.697, -131966297.666, 0.026, -3191.521, 42.5,
167.690, 08105DA4,
11, 0, 25112365.364, 0.145, -102830904.305, 0.018, -2486.906, 36.1,
155.960, 01305DAB,
122, 0, 40605129.400, 0.729, -213381400.234, 0.028, -5.028, 42.1,
117.076, 8C023E24
*A22AF9AB
```

Table 46: Channel Tracking Status

Nibble #	Bit #	Mask	Description	Range Value
N0	0	0x00000001	Tracking state	0 to 22 See Table 47 on Page 116
	1	0x00000002		
	2	0x00000004		
	3	0x00000008		
N1	4	0x00000010	SV channel number	0-n (0 = first, n = last) n depends on the receiver
	5	0x00000020		
	6	0x00000040		
	7	0x00000080		
N2	8	0x00000100	Phase lock flag	0 = Not locked, 1 = Locked
	9	0x00000200		
	10	0x00000400		
	11	0x00000800		
N3	12	0x00001000	Code locked flag	0 = Not locked, 1 = Locked
	13	0x00002000		
	14	0x00004000		
	15	0x00008000		
N4	16	0x00010000	Satellite system	0 = GPS 1, 3-7 = Reserved 2 = GEO
	17	0x00020000		
	18	0x00040000		
	19	Reserved (always 0)		
N5	20	0x00100000	Grouping ^a	0 = Not grouped, 1 = Grouped
	21	0x00200000		
	22	0x00400000		
	23	0x00800000		
N6	24	0x01000000	Code type	0 = C/A 1 = P 2 = P codeless 3-7 = Reserved
	25	0x02000000		
	26	0x04000000		
N7	27-30	Reserved (always 0)		
	31	0x80000000	Channel assignment	0 = Automatic, 1 = Forced

a. Grouped: Channel has an associated channel (L1/L2 pairs)

Table 47: Tracking State Bit Values

Bit Value	Description
0	C/A idle
1	C/A sky search
2	C/A wide frequency band pull-in
3	C/A narrow frequency band pull-in
4	C/A phase-lock loop
5	C/A reacquisition
6	C/A steering
7	C/A frequency-lock loop
8	P(Y) idle
9	P(Y) P-code alignment
10	P(Y) search
11	P(Y) phase-lock loop

Table 48: Correlator Spacing Bit Values

Bit Value	Description
0	Reserved
1	Standard correlator: spacing > 0.1 chip
2	Narrow correlator: spacing = 0.1 chip
3	Reserved
4	Reserved

6.3.12 RAWEPHEM Raw Ephemeris

This log contains the raw binary information for subframes one, two and three from the satellite with the parity information removed. Each subframe is 240 bits long (10 words - 24 bits each) and the log contains a total 720 bits (90 bytes) of information (240 bits x 3 subframes). This information is preceded by the PRN number of the satellite from which it originated. This message will not be generated unless all 10 words from all 3 frames have passed parity.

Ephemeris data whose Time Of Ephemeris (TOE) is older than six hours will not be shown.

Log Type: Asynch

Message ID: 41

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3 on Page 45</i>		H	0
2	prn	Satellite PRN number	Ulong	4	H
3	ref week	Ephemeris reference week number	Ulong	4	H+4
4	ref secs	Ephemeris reference time (seconds.)	Ulong	4	H+8
5	subframe1	Subframe 1 data.	Hex	30	H+12
6	subframe2	Subframe 2 data.	Hex	30	H+42
7	subframe3	Subframe 3 data.	Hex	32	H+72
8	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+104

Recommended Input:

LOG RAWEPHEMA ONCHANGED

Example Output:

```
#RAWEPHEMA, COM1, 6, 47.5, SATTIME, 265, 320910.000, 00840000, 0000, 33331;
23, 265, 324000,
8B042468772742500075DB788C586F50DAAD6FDBD2934F1A00003D16FBCA0000000
000000000, 8B04246877AA93F8E9327CE98F6B1EF92701F373FE0719A10E19D14F1
A4600000000000000000, 8B042468782FFFF623044B9BFFEA272C59B8276557A4B0B
8FFA4EF930706000000000000000008*28353AD1
```

6.3.13 RAWGPSSUBFRAMEWP Raw Subframe Data

This log contains the raw GPS 300-bit subframes. The subframes will be output even when there are parity failures.

See also *Table 62* and *Table 63* on *Page 160* for the mapping of signal channels.

Log Type: Asynch

Message ID: 570

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	chan	Signal channel number that the frame was decoded on.	ULong	4	H
3	PRN	Satellite PRN number	ULong	4	H+4
4	#parity failures	Number of words that had parity failures.	ULong	4	H+8
5	data	Raw subframe data	Hex[38]	40 ^a	H+12
6	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+52

a. In the *Binary* log case an additional 2 bytes of padding is added to maintain 4 byte alignment.

Recommended Input:

```
LOG RAWGPSSUBFRAMEWPA ONNEW
```

Example Output:

```
#RAWGPSSUBFRAMEWPA,COM1,0,47.5,SATTIME,265,320934.000,00840000,
0000,33331;26,11,0,8B0424F9A1E4DD8571F3949EC3192102D2FF1A84369FA22F
47966A108D7A15F95F905C011A00*B4228756
```


6.3.15 RXCOMMANDS Receiver Configuration

This log outputs all of the current receiver configuration parameters set using the commands in *Chapter 5*. When requested, one RXCOMMANDS log is output for each command type. The embedded message is the most-recent command string entered by you for that command type. If you have not yet entered a command string for that command type, the default configuration values from start-up are provided.

Log Type: Polled

Message ID: 579

Field	Field Name	Data Description	Format	Bytes	Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	command type	Indicates which command the embedded message represents, see <i>Table 49</i> on <i>Page 122</i> .	Int	4	H
3	e msg	Embedded message of the most-recent command string you entered. If a command string has not been entered yet, the default values from start-up will be provided.	Uchar [variable]	variable	H+4
4	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	variable

Recommended Input:

```
LOG RXCOMMANDSA ONCE
```

Example Output:

```
#RXCOMMANDSA,COM1,21,53.5,FINESTEERING,265,320946.651,00840000,
0000,33331;4,COM COM1 115200 N 8 1 N OFF ON*0FF819F3
#RXCOMMANDSA,COM1,20,53.5,FINESTEERING,265,320946.655,00840000,
0000,33331;20,CHANCONFIG 14GPS4GEO_1*BC5D84BD
#RXCOMMANDSA,COM1,19,53.5,FINESTEERING,265,320946.659,00840000,
0000,33331;15,DLLBW CA 0.2000*EB5EFA7E
#RXCOMMANDSA,COM1,18,53.5,FINESTEERING,265,320946.659,00840000,
0000,33331;15,DLLBW PY 0.2000*2681F25A
#RXCOMMANDSA,COM1,17,53.5,FINESTEERING,265,320946.663,00840000,
0000,33331;16,PLLBW CA 15.0000*54FC70C0
#RXCOMMANDSA,COM1,16,53.5,FINESTEERING,265,320946.665,00840000,
0000,33331;16,PLLBW PY 0.2000*7C221DE3
#RXCOMMANDSA,COM1,15,53.5,FINESTEERING,265,320946.667,00840000,
0000,33331;5,ECUTOFF 0.0*2F52B1E5
#RXCOMMANDSA,COM1,14,53.5,FINESTEERING,265,320946.667,00840000,
0000,33331;7,FIX NONE*71B6CEFF
#RXCOMMANDSA,COM1,13,53.5,FINESTEERING,265,320946.669,00840000,
0000,33331;21,PULSEBLANKING L2 15*3CD77038
#RXCOMMANDSA,COM1,12,53.5,FINESTEERING,265,320946.677,00840000,
0000,33331;14,PLLTHRESHOLD 0.24 0.08 PY*29C1CF72
#RXCOMMANDSA,COM1,11,53.5,FINESTEERING,265,320946.680,00840000,
0000,33331;39,DLLORDER GPS 1*09923047
#RXCOMMANDSA,COM1,10,53.5,FINESTEERING,265,320946.683,00840000,
0000,33331;39,DLLORDER WAAS 2*5C3E2DA1
#RXCOMMANDSA,COM1,9,53.5,FINESTEERING,265,320946.686,00840000,
0000,33331;2,ANTENNAPOWER ON*179B84E2
#RXCOMMANDSA,COM1,8,53.5,FINESTEERING,265,320946.689,00840000,
```

```
0000,33331;6,EXTERNALCLOCK DISABLE 0MHZ 0.000000 0.000000
0.000000*F169EA1B
#RXCOMMANDSA,COM1,7,53.5,FINESTEERING,265,320946.692,00840000,
0000,33331;3,CLOCKADJUST ENABLE*382DE842
#RXCOMMANDSA,COM1,6,53.5,FINESTEERING,265,320946.692,00840000,
0000,33331;4,COM COM2 9600 N 8 1 N OFF ON*D49E958E
#RXCOMMANDSA,COM1,5,53.5,FINESTEERING,265,320946.695,00840000,
0000,33331;13,THRESHOLD 36 20 36 CA GPS*172E5E4B
#RXCOMMANDSA,COM1,4,53.5,FINESTEERING,265,320946.699,00840000,
0000,33331;13,THRESHOLD 33 28 36 CA WAAS*30A171AA
#RXCOMMANDSA,COM1,3,53.5,FINESTEERING,265,320946.702,00840000,
0000,33331;4,COM COM3 9600 N 8 1 N OFF ON*51982FE8
#RXCOMMANDSA,COM1,2,53.5,FINESTEERING,265,320946.704,00840000,
0000,33331;0,ASSIGN 17 ACTIVE 122 0 5000*22963FE5
#RXCOMMANDSA,COM1,1,53.5,FINESTEERING,265,320946.706,00840000,
0000,33331;0,ASSIGN 16 ACTIVE 122 0 5000*547CBF8B
#RXCOMMANDSA,COM1,0,53.5,FINESTEERING,265,320946.706,00840000,
0000,33331;0,ASSIGN 14 ACTIVE 134 0 5000*ABDF0471
```

Table 49: Command Type Values

ASCII	BINARY	Description
0	0	ASSIGN command
1	1	ASSIGNALL command
2	2	ANTENNAPOWER command
3	3	CLOCKADJUST command
4	4	COM command
5	5	ECUTOFF command
6	6	EXTERNALCLOCK command
7	7	FIX command
8	8	FRESET command
9	9	LOG command
10	10	RESET command
11	11	SETAPPROXTIME command
12	12	SETSATELLITE command
13	13	THRESHOLD command
14	14	PLLTHRESHOLD command
15	15	DLLBW command
16	16	PLLBW command
17	17	ASSIGNL2CODETYPE command
18	18	Reserved
19	19	AGCMODE command
20	20	CHANCONFIG command
21	21	PULSEBLANKING command
22	22	UNLOG command

6.3.16 RXSECSTATUS Receiver Section Status

This log is used to output the version and status information for the receiver card.

Log Type: Synchronous

Message ID: 638

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	# comp	Number of components (cards, and so on)	Ulong	4	H
3	Type	Component type, see <i>Table 56</i> on <i>Page 134</i>	Enum	4	H+4
4	Reserved		Enum	4	H+8
5	model	Model	Char[16]	16	H+12
6	psn	Product serial number	Char[16]	16	H+28
7	sw version	Firmware software version	Char[16]	16	H+44
8	status word	Receiver status word. See <i>Table 52</i> on <i>Page 125</i> .	Ulong	4	H+60
9	error word	Receiver error word. A value of zero indicates no errors. See <i>Table 50</i> on <i>Page 124</i> .	Ulong	4	H+64
10	aux1stat	Receiver auxiliary 1 status word. See <i>Table 51</i> on <i>Page 124</i> .	Ulong	4	H+68
11...	Next component offset = H + 4 + (#comp x 68)				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+4+ (#comp x 68)

Recommended Input:

```
LOG RXSECSTATUS ONNEW
```

ASCII Example:

```
#RXSECSTATUSA, COM1, 0, 77.5, FINESTEERING, 465, 265287.000, 00000008,
0000, 33331;
1,
GPSCARD, PM, "GRC", "SVM05030043", "2.201A5", 00000008, 00000000, 00400000
*CBBAD115
```

Table 50: Receiver Error

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Dynamic Random Access Memory (DRAM) status	OK	Error
	1	0x00000002	Reserved	OK	Error
	2	0x00000004		OK	Error
	3	0x00000008		OK	Error
N1	4	0x00000010		Electronic Serial Number (ESN) access status	OK
	5	0x00000020	Authorization code status	OK	Error
	6	0x00000040	Reserved	OK	Error
	7	0x00000080	Supply voltage status	OK	Error
N2	8	0x00000100	Reserved	OK	Error
	9	0x00000200	Temperature status (as compared against acceptable limits)	OK	Error
	10	0x00000400	MINOS4 status	OK	Error
	11	0x00000800	PLL RF1 hardware status - L1	OK	Error
N3	12	0x00001000	PLL RF2 hardware status - L2	OK	Error
	13	0x00002000	Reserved	OK	Error
	14	0x00004000		OK	Error
	15	0x00008000	NVM status	OK	Error
N4	16	0x00010000	Stack usage status	OK	Error
	17	0x00020000	Memory usage status	OK	Error
	18	0x00040000	Message queue usage status	OK	Error
	19	0x00080000	Message usage status	OK	Error
N5-N7	Reserved				

Table 51: Receiver Auxiliary 1 Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Reserved		
	1	0x00000002			
	2	0x00000004			
	3	0x00000008			
N1	4	0x00000010	Reserved		
	5	0x00000020			
	6	0x00000040			
	7	0x00000080			
N2	8	0x00000100	OTG243 Port 1 overrun flag	No overrun	Overrun
	9	0x00000200	OTG243 Port 2 overrun flag	No overrun	Overrun
	10	0x00000400	OTG243 Port 3 overrun flag	No overrun	Overrun
	11	0x00000800	Reserved		

Table 52: Receiver Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1			
N0	0	0x00000001	Error flag, see <i>Table 50, Receiver Error on Page 124</i>	No error	Error			
	1	0x00000002	Temperature status	Within specifications	Warning			
	2	0x00000004	Voltage supply status	OK	Warning			
	3	0x00000008	Antenna power status	Powered	Not powered			
N1	4	0x00000010	LNA status	OK	Failure			
	5	0x00000020	Antenna open flag	OK	Open			
	6	0x00000040	Antenna shorted flag	OK	Shorted			
	7	0x00000080	CPU overload flag	No overload	Overload			
N2	8	0x00000100	COM1 buffer overrun flag	No overrun	Overrun			
	9	0x00000200	COM2 buffer overrun flag	No overrun	Overrun			
	10	0x00000400	COM3 buffer overrun flag	No overrun	Overrun			
	11	0x00000800	Reserved					
N3	12	0x00001000						
	13	0x00002000						
	14	0x00004000						
	15	0x00008000						
N4	16	0x00010000						
	17	0x00020000						
	18	0x00040000				Almanac flag	Valid	Invalid
	19	0x00080000				Position solution flag	Valid	Invalid
N5	20	0x00100000	Position fixed flag, see <i>FLX on Page 75</i>	Not fixed	Fixed			
	21	0x00200000	Clock steering status	Enabled	Disabled			
	22	0x00400000	Clock model flag	Valid	Invalid			
	23	0x00800000	External oscillator flag	PLL not locked	PLL locked			
N6	24	0x01000000	Stack warning	OK	Warning			
	25	0x02000000	Memory warning	OK	Warning			
	26	0x04000000	Message queue warning	OK	Warning			
	27	0x08000000	Message block usage warning	OK	Warning			
N7	28	0x10000000	Reserved					
	29	0x20000000						
	30	0x40000000						
	31	0x80000000	AUX1 status event flag	No event	Event			

6.3.17 SATVIS Satellite Visibility

Satellite visibility log with additional satellite information. This log only gives GPS data (no GEO data).

Log Type: Synch

Message ID: 48

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	sat vis	Indicates if the satellite visibility is valid. See <i>Table 53</i> on <i>Page 127</i> .	Enum	4	H
3	comp alm	Indicates if the complete almanac was used. See <i>Table 54</i> below.	Enum	4	H+4
4	#sat	Number of satellite data sets to follow	ULong	4	H+8
5	PRN	GPS satellite PRN number of range measurement (GPS only).	Short	2	H+12
6	Reserved		Short	2	H+14
7	health	Satellite health ^a	ULong	4	H+16
8	elev	Elevation (degrees)	Double	8	H+20
9	az	Azimuth (degrees)	Double	8	H+28
10	true dop	Theoretical Doppler of satellite (Hz)	Double	8	H+36
11	app dop	Apparent Doppler for this receiver (Hz)	Double	8	H+44
12	Next satellite data set, offset = H + 12 + (# previous sat x 40)				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+12+ (#sat x 40)

a. Satellite health values may be found in ICD-GPS-200. To obtain copies of ICD-GPS-200, see the ARINC Web site at <http://www.arinc.com>.

Recommended Input:

```
LOG SATVISA ONTIME 60
```

ASCII Example:

```
#SATVISA,COM1,0,42.0,FINESTEERING,265,320949.000,00840000,
0000,33331;
TRUE,FALSE,8,
1,0,0,73.9,70.8,-773.322,-775.254,20,
0,0,71.0,238.3,-272.360,-274.292,25,
0,0,55.1,65.4,-1855.893,-1857.825,23,
0,0,52.3,283.3,2115.700,2113.769,16,
0,0,29.9,140.0,2943.175,2941.243,13,
0,0,13.9,278.5,3271.579,3269.647,30,
0,0,7.7,30.0,-2890.469,-2892.401,11,
0,0,6.5,215.8,-3189.170,-3191.102*8E2D6ABC
```

Table 53: Satellite Visibility Values

ASCII	Binary	Description
FALSE	0	Satellite visibility is invalid
TRUE	1	Satellite visibility is valid

Table 54: Complete Almanac Flag Values

ASCII	Binary	Description
FALSE	0	Complete almanac was not used
TRUE	1	Complete almanac was used

6.3.18 SYSTEMLEVELS System Hardware Levels

This log contains environmental and voltage parameters for the receiver card.

Log Type: Synchronous

Message ID: 653

Field	Field Name	Data Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3 on Page 45</i> .		H	0
2	# comp	Number of components	Ulong	4	H
3	Type	Component type, see <i>Table 56 on Page 134</i>	Enum	4	H + 4
4	Reserved		Enum	4	H + 8
5	Temp	Board temperature (°C)	Float	4	H + 12
6	Ant current	Approximate internal antenna current (A)	Float	4	H + 16
7	Core volt	1V CPU core voltage (V)	Float	4	H + 20
8	Supply volt	5V supply voltage (V)	Float	4	H + 24
9	RF volt	5V RF supply voltage (V)	Float	4	H+28
10	LNA volt	Internal LNA voltage (V)	Float	4	H+32
11	3.3 V supply	3.3 V supply voltage	Float	4	H+36
12	TCXO control volt	Control voltage for TCXO	Float	4	H+40
13	idle time	Idle time (%)	Float	4	H+44
14	LNA output volt	LNA output voltage (V)	Float	4	H+48
15...	Next component offset = H + 4 + (# comp x 48)				
variable	32-bit CRC (ASCII and Binary only)		Hex	4	H + 4 + (# comp x 48)

Recommended Input:

```
LOG SYSTEMLEVELSA ONTIME 1
```

Example Output:

```
#SYSTEMLEVELSA, COM1, 0, 42.0, FINESTEERING, 265, 320951.000, 00840000,
0000, 33331;
1,
GPSCARD, UNKNOWN, 36.000, 0.043, 1.194, 13.326, 5.001, 1.404, 3.300, 1.469,
42.377, 4.598*C64C995F
```

6.3.19 TIME Time Data

This log is output at the *TIME* port at a maximum rate of 1 Hz and provides the GPS time of the receiver's 1 PPS signal. It also includes the information about the receiver clock offset and the clock model status.

Log Type: Sync

Message ID: 101

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	clock status	Clock model status (not including current measurement data). See <i>Table 42</i> on <i>Page 110</i> .	Enum	4	H
3	offset	Receiver clock offset, in seconds from GPS time. A positive offset implies that the receiver clock is ahead of GPS time. To derive GPS time, use the following formula: GPS time = receiver time - offset	Double	8	H+4
4	offset std	Receiver clock offset standard deviation (s)	Double	8	H+12
5-12	Reserved			24	H+20
13	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+44

Recommended Input:

```
LOG TIMEA ONTIME 1
```

Example Output:

```
#TIMEA, COM1, 0, 42.0, FINESTEERING, 265, 320951.000, 00840000,
0000, 33331;
VALID, -1.964658463E-07, 1.698770041E-07, 0.000000000000,
1985, 2, 6, 17, 9, 11000, INVALID*14D424B8
```

6.3.20 TRACKSTAT Tracking Status

These logs provide channel tracking status information for each of the receiver's channels.

Log Type: Synch

Message ID: 83

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3 on Page 45</i> .		H	0
2	sol status	Solution status. See <i>Table 44 on Page 112</i> .	Enum	4	H
3	pos type	Position type. See <i>Table 45 on Page 112</i> .	Enum	4	H+4
4	cutoff	Primary antenna low elevation cut-off angle	Float	4	H+8
5	# chans	Number of hardware channel data sets to follow	Long	4	H+12
6	PRN	GPS satellite PRN number of range measurement.	Short	2	H+16
7	Reserved		Short	2	H+18
8	ch-tr-status	Channel tracking status. See <i>Table 46 on Page 115</i> .	ULong	4	H+20
9	psr	Pseudorange (m)	Double	8	H+24
10	Doppler	Doppler frequency (Hz)	Float	4	H+32
11	C/No	Carrier to noise density ratio (dB-Hz)	Float	4	H+38
12	locktime	Number of seconds of continuous tracking (no cycle slips)	Float	4	H+42
13	psr res	Pseudorange residual from pseudorange filter (m)	Float	4	H+46
14	reject	Range reject code from pseudorange filter. See <i>Table 55 on Page 132</i> .	Enum	4	H+50
15	psr weight	Pseudorange filter weighting	Float	4	H+54
16...	Next hardware channel data set, offset = H+16 + (# previous chans x 40)				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+16 + (#chans x 40)

Recommended Input:

```
LOG TRACKSTAT ONTIME 1
```

Example Output:

```
#TRACKSTAT, COM1, 0, 55.5, FINESTEERING, 265, 320953.000, 00840000,
0000, 33331; SOL_COMPUTED, SINGLE, 0.000, 32,
19, 0, 08104002, 0.000, -2719.200, 0.047, 0.000, 0.000, NA, 0.000,
0, 0, 01304008, 0.000, 0.000, 0.047, 0.000, 0.000, NA, 0.000,
25, 0, 08105C24, 21368810.458, -1858.905, 51.424, 179.720, 0.286,
GOOD, 0.126,
25, 0, 01305C2B, 21368820.572, -1448.498, 44.705, 152.960, 0.000,
OBSL2, 0.000,
22, 0, 08104041, 0.000, 0.000, 0.047, 0.000, 0.000, NA, 0.000,
```

0, 0, 01304048, 0.000, 0.000, 0.047, 0.000, 0.000, NA, 0.000,
30, 0, 08105C64, 24603694.896, -2895.544, 45.151, 177.090, -0.217,
GOOD, 0.206,
30, 0, 01305C6B, 24603707.664, -2256.268, 37.493, 167.960, 0.000,
OBSL2, 0.000,
13, 0, 08105C84, 24250255.857, 3274.252, 45.985, 177.530, -0.206,
GOOD, 0.227,
13, 0, 01305C8B, 24250267.345, 2551.367, 35.974, 161.460, 0.000,
OBSL2, 0.000,
23, 0, 08105CA4, 21126709.349, 2115.294, 49.551, 180.180, 1.350,
GOOD, 0.242,
23, 0, 01305CAB, 21126716.772, 1648.281, 46.591, 158.460, 0.000,
OBSL2, 0.000,
16, 0, 08105CC4, 22794785.079, 2944.692, 48.000, 178.260, 0.567,
GOOD, 0.238,
16, 0, 01305CCB, 22794795.814, 2294.567, 39.630, 146.960, 0.000,
OBSL2, 0.000,
21, 0, 081040E1, 0.000, 0.000, 0.047, 0.000, 0.000, NA, 0.000,
0, 0, 013040E8, 0.000, 0.000, 0.047, 0.000, 0.000, NA, 0.000,
4, 0, 08105D04, 24190060.883, 1287.093, 42.408, 18.370, 0.000,
NOEPHEMERIS, 0.000,
4, 0, 01304109, 0.000, 1002.929, 0.047, 0.000, 0.000, NA, 0.000,
1, 0, 08105D24, 20396997.146, -776.500, 52.322, 178.630, -0.764,
GOOD, 0.126,
1, 0, 01305D2B, 20397008.146, -605.065, 44.559, 164.960, 0.000,
OBSL2, 0.000,
20, 0, 08105D44, 20443865.099, -276.505, 51.285, 179.910, -1.034,
GOOD, 0.245,
20, 0, 01305D4B, 20443874.713, -215.458, 45.887, 169.460, 0.000,
OBSL2, 0.000,
2, 0, 08104161, 0.000, -1000.000, 0.047, 0.000, 0.000, NA, 0.000,
0, 0, 01304168, 0.000, 0.000, 0.047, 0.000, 0.000, NA, 0.000,
17, 0, 08104181, 0.000, -5000.000, 0.047, 0.000, 0.000,
NA, 0.000, 0, 0, 01304188, 0.000, 0.000, 0.047, 0.000, 0.000, NA, 0.000,
11, 0, 08105DA4, 25117210.733, -3189.786, 42.563, 175.690, -0.299,
GOOD, 0.189,
11, 0, 01305DAB, 25117223.424, -2485.550, 35.292, 163.960, 0.000,
OBSL2, 0.000, 134, 0, 8C0221C2, 0.000, -
716.400, 0.047, 0.000, 0.000, NA, 0.000,
0, 0, 8C0221E0, 0.000, 0.000, 0.047, 0.000, 0.000, NA, 0.000,
122, 0, 8C022202, 0.000, 2542.288, 0.047, 0.000, 0.000, NA, 0.000,
122, 0, 8C023E24, 40605135.646, -2.918, 41.875, 125.076, 0.000,
NOEPHEMERIS, 0.000*FFD043AF

Table 55: Reject Code Values

ASCII	Binary	Description
GOOD	0	Observations are good
BADHEALTH	1	Bad satellite health is indicated by ephemeris data
OLDEPHEMERIS	2	Old ephemeris due to date not being updated during the last 3 hours
ECCENTRICANOMALY	3	Eccentric anomaly error during computation of the satellite's position
TRUEANOMALY	4	True anomaly error during computation of the satellite's position
SATCOORDINATEERROR	5	Satellite coordinate error during computation of the satellite's position
ELEVATIONERROR	6	Elevation error due to the satellite being below the cut-off angle
MISCLOSURE	7	Misclosure too large due to excessive gap between estimated and actual positions
NOEPHEMERIS	9	Ephemeris data for this satellite has not yet been received
INVALIDIODE	10	Invalid IODE (Issue Of Data Ephemeris) due to mismatch between differential stations
LOWPOWER	12	Low power meaning that the satellite is rejected due to low carrier/noise ratio
OBSL2	13	L2 measurements are not being used by the filter
NOIONOCORR	16	No compatible ionospheric correction is available for this particular satellite
BAD_INTEGRITY	17	Bad integrity indicating a large variation between the measured range to the satellite and the theoretical range computed from the ephemeris
N/A	99	No observation (a reject code is not applicable)

6.3.21 VERSION Version Information

This log contains the version information for all components of a system. When using a standard receiver, there will only be one component in the log.

Log Type: Polled

Message ID: 37

Field	Field Name	Description	Format	Binary Bytes	Binary Offset
1	header	This field contains the message header, in <i>ASCII</i> or <i>Binary</i> format. See <i>Section 4.3</i> on <i>Page 45</i> .		H	0
2	# comp	Number of components (cards, etc.)	Long	4	H
3	type	Component type. See <i>Table 56</i> on <i>Page 134</i> .	Enum	4	H+4
4	model	Model	Char[16]	16	H+8
5	psn	Product serial number	Char[16]	16	H+24
6	hw version	Hardware version. See <i>Table 57</i> on <i>Page 134</i> .	Char[16]	16	H+40
7	sw version	Firmware software version. See <i>Table 57</i> on <i>Page 134</i> .	Char[16]	16	H+56
8	boot version	Boot code version. See <i>Table 57</i> on <i>Page 134</i> .	Char[16]	16	H+72
9	comp date	Firmware compile date. See <i>Table 57</i> on <i>Page 134</i> .	Char[12]	12	H+88
10	comp time	Firmware compile time. See <i>Table 57</i> on <i>Page 134</i> .	Char[12]	12	H+100
11...	Next component, offset = H + 4 + (# previous comp x 108)				
variable	32-bit CRC (<i>ASCII</i> and <i>Binary</i> only)		Hex	4	H+4+ (#comp x 108)

Recommended Input:

```
LOG VERSIONA ONCE
```

Example Output:

```
#VERSIONA, COM1, 0, 77.0, FINESTEERING, 465, 265277.071, 000000008,
0000, 33331;
2,
GPSCARD, "GRC", "SVM05030043", "E4G2-2.03-222", "2.201A5", "2.100db",
"2008/Jul/16", "16:53:39",
CPLD, "", "", "CPLD-1", "", "", "", ""*bb6c6991
```

Table 56: Component Type Values

ASCII	Binary	Description
UNKNOWN	0	Unknown Component
GPSCARD	1	Receiver Component
CPLD	8	Complex Programmable Logic Device

Table 57: Version Log Field Formats

Field Name	Field Format	Description
hw version	P-RS-CCC	P = hardware platform (for example, E4G2) R = hardware revision (for example, 2.00) S = processor revision (for example, A) CCC = COM port configuration (for example, 222) ^a
sw version, boot version	P.VRR[Xxxx]	P = platform version number V = major revision number RR = minor revision number X = Special (S), Beta (B), Internal Development (D, A) xxx = number
comp date	YYYY/MM/DD	YYYY = year MM = month DD = day (1 - 31)
comp time	HH:MM:SS	HH = hour MM = minutes SS = seconds

- a. One character for each of the COM ports 1, 2, and 3 where character 2 is for RS-232. Therefore, the example is for a receiver that uses RS-232 for COM1, COM2 and COM3.

The receiver firmware is stored in on-board, non-volatile memory, which allows it to be updated in the field. So that, updating firmware takes only a few minutes instead of several days, which would be required if the receiver had to be sent to a service depot.

When updating to a higher revision level, you will need to transfer the new firmware to the appropriate card using one of NovAtel's firmware loading utilities. *WinLoader* is designed for use with Window-based systems and was developed for use with Unix-based systems.

Below is shown an outline of the procedure for updating your receiver's firmware:

1. Contact the NovAtel Aviation Group.
2. Download update files.
3. Decompress files.
4. Run the firmware loading utility.

7.1 Contacting the NovAtel Aviation Department

The first step in updating the receiver is to contact the NovAtel Aviation Group via any of the methods described in *Customer Support* on *Page 14*.

When you call, be sure to have the EuroPak-3's serial number and program revision level available. This information is printed on the rear panel of the EuroPak-3, as shown in *Figure 9*.



Figure 9: Serial Number and Version Label

You can also verify the information by powering up the receiver and requesting the *VERSION* log.

After conferring with the Aviation Group to establish the required revision level, as well as the terms and conditions of your firmware update, the Aviation Group will issue you an authorization code or *auth-code*. The *auth-code* is required to unlock the receiver features according to your authorized model type.

If it is determined that you will be updating to a higher revision level with the use of the firmware loading utility, the Aviation Group will confirm with you as to the procedures, files, and methods required for using this utility. As the main utility and other necessary files are generally provided in a compressed file format, you will also be given a file decompression password. The utility and update files are available from the Aviation Group by FTP, e-mail, or diskette.

7.2 Downloading the Files

Typically, there are two files required when performing firmware updates on a particular receiver card:

- WINLOAD.EXE (the firmware loading utility program)
- XXXXX.HEX (the firmware update file)

Typical EuroPak-3 firmware files might be named 2100.HEX, for example.

To proceed with your update, you will first need to download the appropriate files from NovAtel's FTP site at <ftp.novatel.ca>, or via e-mail at support@novatel.ca. If downloading is not possible, the files can be mailed to you on diskette.

The files are available in compressed, password-protected file format. The compressed form of the files may have different names than the names discussed above; the Aviation Group will advise you as to the exact names of the files you need. As well, the Aviation Group will provide you with a file de-compression password.

7.3 Decompressing the Files

After copying the compressed files to an appropriate directory on your computer, each file must be decompressed. The syntax for decompression is as follows:

Syntax:

[filename][password]

where filename is the name of the compressed file (but not including the .EXE extension) and password is the password required to allow decompression.

A window-based dialog is provided for password entry.

The self-extracting archive then generates the following files:

WinLoad.exe	WinLoad utility program
HowTo.txt	Instructions on how to use the WinLoad utility
WhatsNew.txt	information about the changes made in the firmware since the last revision
XXXX.hex	Firmware version update file where XXXX = program version level (for example 2000.hex)

7.4 Running the Utility

WinLoad is a windows based program used to download firmware to GPSCards. The main screen is shown in *Figure 10*.

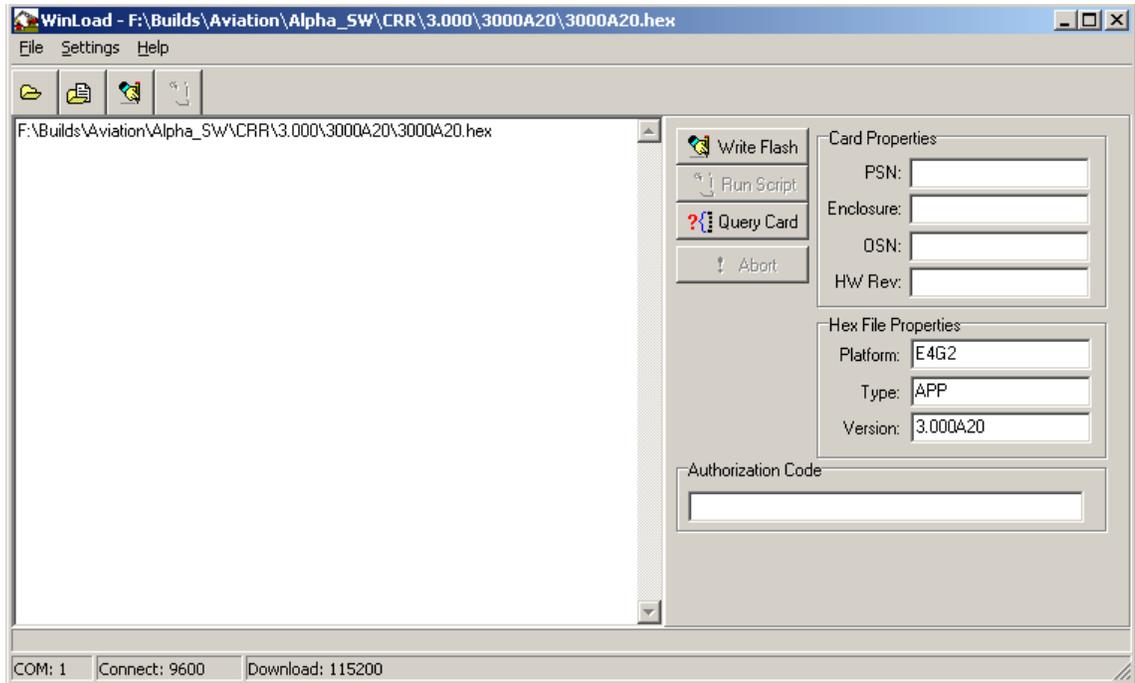


Figure 10: Main Screen of WinLoad

If you are running WinLoad for the first time you will need to make sure the file and communications settings are correct.

7.4.1 Open a File to Download

From the file menu choose Open. Use the Open dialog to browse for your file, see *Figure 11*.

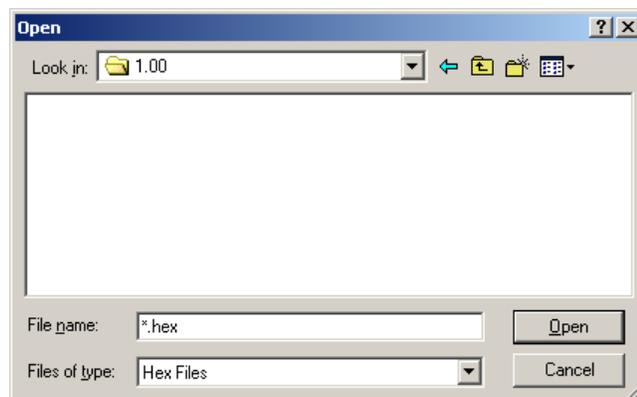


Figure 11: WinLoad's Open Dialog

Once you have selected your file, the name should appear in the main display area and in the title bar, see

Figure 12.

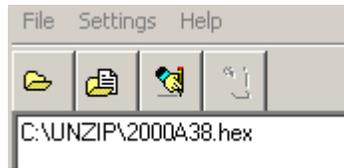


Figure 12: Open File in WinLoad

The *Target Card ID* field allows you to specify which receiver card to update, see *Table 58* below.

Table 58: Target Card Identification

Entry	Description
0	Euro-3 GPSCard

7.4.2 Communications Settings

To set the communications port and baud rate, select COM Settings from the Settings menu, see *Figure 13* on *Page 138*. Choose the port on your PC from the Com Port drop down list and the baud rate from the Download Baudrate drop-down list. The baud rate should be as high as possible (the default of 115200 is preferred).

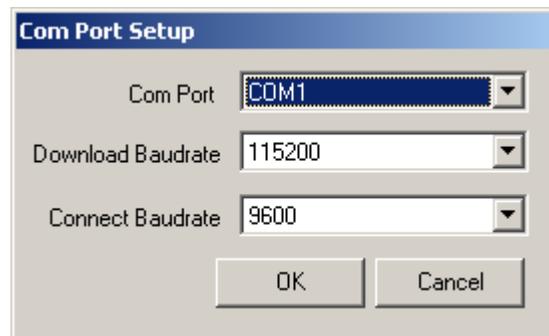


Figure 13: COM Port Setup

7.4.3 Downloading Firmware

To download firmware follow these steps:

1. Set up the communications port as described in *Communications Settings* above.
2. Select the file to download, see *Open a File to Download* on *Page 137*.
3. Make sure the file path and file name are displayed in main display area, see *Figure 12*.
4. Click on the Write Flash button to download the firmware:



5. While WinLoad searches for the card, power cycle the receiver (turn it off and then on again).

You will only be able to access information from the card and download new firmware during the first few seconds after power initiation.

6. WinLoad should be able to locate the card and the hex file should start downloading. When the

Authorization Code dialog opens, see *Figure 14*, enter the auth code and select OK.

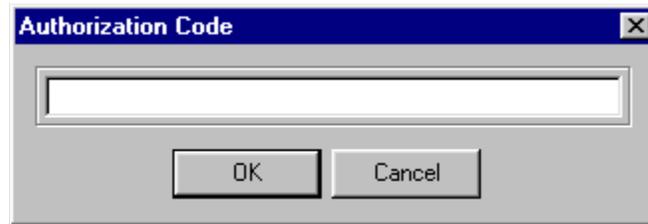


Figure 14: Authorization Code Dialog

7. The receiver should finish downloading and reset. The process is complete when "Done." is displayed in the main display area, see *Figure 15* on *Page 139*.

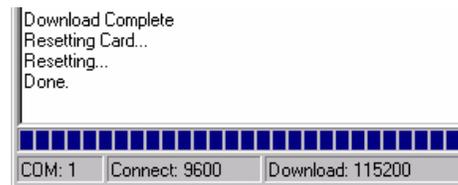


Figure 15: Update Process Complete

8. Close WinLoad.

This completes the procedure required to update a EuroPak-3 receiver.

8.1 Overview

The built in test monitors system performance and status to ensure the receiver is operating within its specifications. If an exceptional condition is detected, the user is informed through one or more indicators. The receiver status system is used to configure and monitor these indicators:

1. Receiver status word
2. Error strobe line
3. RXSECSTATUS log
4. Status LED

In normal operation the error strobe is driven low and the status LED on the receiver flashes green. When an unusual and non-fatal event occurs (for example, there is no valid position solution), a bit is set in the receiver status word. Receiver operation continues normally, the error strobe remains off, and the LED continues to flash green. When the event ends (for example, when there is a valid position solution), the bit in the receiver status word is cleared.

When a fatal event occurs (that is, in the event of a receiver hardware failure), a bit is set in the receiver error word to indicate the cause of the problem. Bit 0 is set in the receiver status word to show that an error occurred, the error strobe is driven high, and the LED flashes red and yellow showing an error code. Receiver tracking is disabled at this point but command and log processing continues to allow you to diagnose the error. Even if the source of the error is corrected at this point, the receiver must be reset to resume normal operation.

8.2 Receiver Status Word

The receiver status word indicates the current status of the receiver. This word is found in the header of all logs. See also *Section 4.3, Log Formats on Page 45*.

8.3 Error Strobe Signal

The error strobe line is one of the I/O strobes and is driven low when the receiver is operating normally. When the receiver is in the error state and tracking is disabled, the error strobe is driven high. This can be caused by a fatal error or by an unusual receiver status indication that the user has promoted to be treated like a fatal error. Once on, the error status will remain high until the cause of the error is corrected and the receiver is reset.

8.4 Receiver Status Log

8.4.1 Overview

The Receiver Status log (RXSECSTATUS) provides information about the current system status and configuration in a series of hexadecimal words. See also *Page 123*.

The status word is the third last field in the RXSECSTATUS log as shown in *Figure 16 on Page 141*. It is also the third last field in the header of every log.

The numbering of the bits is shown in *Figure 19*.

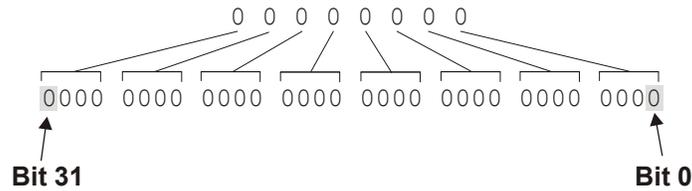


Figure 19: Reading the Bits in the Receiver Error Word

See the RXSECSTATUS log on *Page 123* for more detailed descriptions of this log. If the error word is 00000000, the receiver is not experiencing an error condition. If the receiver error word indicates an error, please also see *Section 8.2, Receiver Status Word* on *Page 140*.

8.4.3 Status Code Arrays

There are 3 status code arrays – the receiver status word, the auxiliary 1 status and the auxiliary 2 status. The status word is similar to the error word, with each of its 32 bits indicating a condition.

8.4.4 Receiver Status Code

The receiver status word is included in the header of all logs. It has 32 bits, which indicate certain receiver conditions. If any of these conditions occur, a bit in the status word is set.

8.4.5 Auxiliary Status Codes

The auxiliary status codes are only seen in the RXSECSTATUS log. The two bits representing the auxiliary status codes give indication about the receiver state for information only. The bits typically do not cause degradation of the receiver performance. Bit 31 of the receiver status word corresponds to the auxiliary 1 status word.

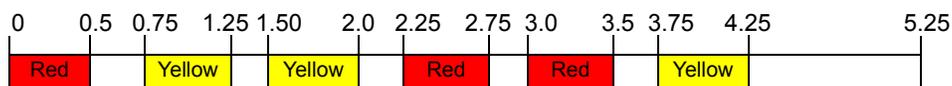
See the RXSECSTATUS log on *Page 123* for a more detailed descriptions of this log.

8.5 Status LED

The diagnostic LED provided on Euro-3 receivers blinks green on and off at approximately 1 Hz to indicate normal operation.

Error bits and status bits, in an error state, will cause the LED to flash a code in a binary sequence. The binary sequence will be a 6 flash (0.5 second on and 0.25 second off per flash) sequence followed by a 1 second delay. The sequence will repeat indefinitely. If there is more than one error or status present, the lowest number will be output.

The first flash in the 6 flash sequence indicates if the code that follows is an error bit or a status bit. Error bits will flash red and status bits will flash yellow. The next 5 flashes will be the binary number of the code (most significant bit first). A red flash indicates a one and a yellow flash indicates a zero. For example, for an error bit 6, the binary number is 00110 so the output sequence would be:



followed by a 1 second delay. The sequence repeats indefinitely until the receiver is reset.

In the example below, the first flash in the sequence is red, which means that a bit is set in the receiver error word. The next five flashes give a binary value of 00111. Converting this value to decimal results in a value of 7. Therefore, bit 7 of the receiver error word is set, indicating there is a problem with the supply voltage of the receiver's power circuitry.

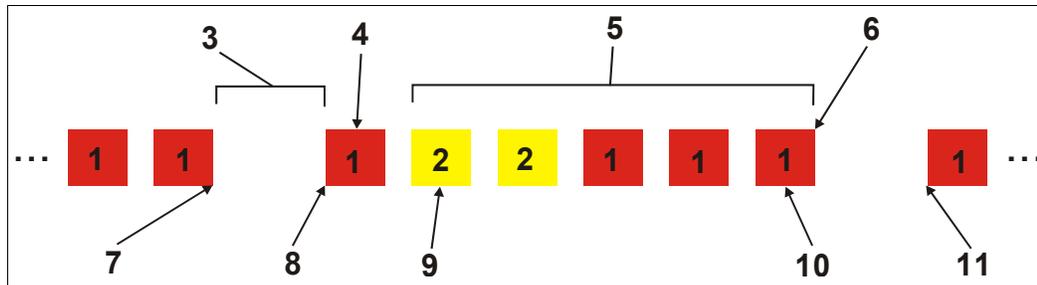


Figure 20: Status LED Flash Sequence Example

Reference	Description
1	Red
2	Yellow
3	1 Second Pause
4	Word Identifier Flash
5	Bit Identifier Flashes
6	End of Sequence
7	End of Previous Sequence
8	Beginning of Sequence
9	Most Significant Bit of Binary Value
10	Least Significant Bit of Binary Value
11	Start of Next Sequence

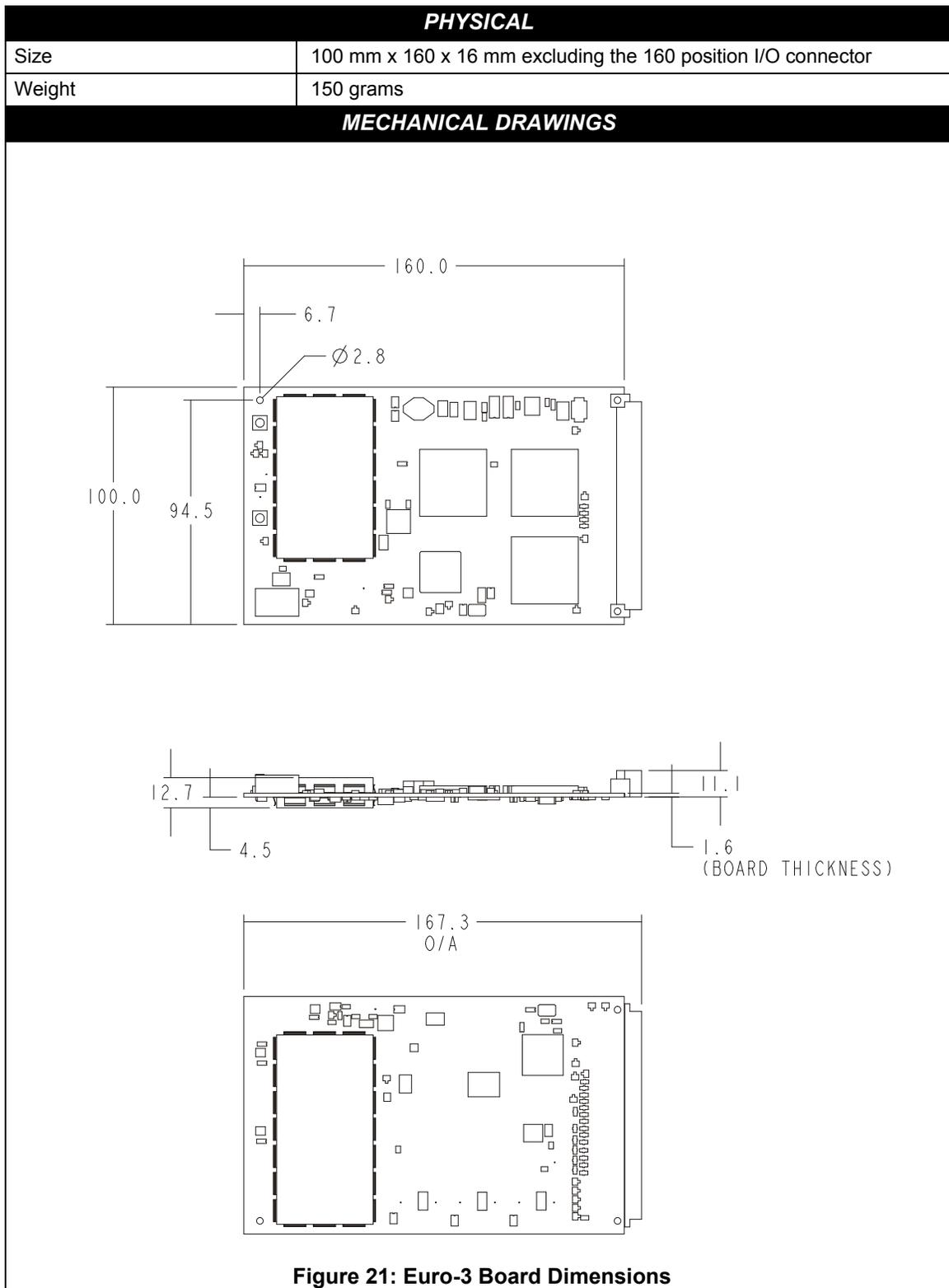
See also the RXSECSTATUS log, and its tables, starting on *Page 123* of this manual for more details on this log and receiver error status.

Table 59: Performance Specifications

PERFORMANCE	
<i>All values subject to GPS system characteristics</i>	
Frequency	L1(1575.42 MHz), L2 (1227.6 MHz)
Codes Tracked	GPS L1-C/A Code GPS L2-C/A Code GPS L2-P(Y) Code SBAS GEO L1-C/A Code GPS SVN (PRN 0-37) GEO SVN (PRN 120-138)
Satellite Tracking Channels	Standard Model 14 L1/L2 GPS + 4 L1 GEO or 18 L1/L2 GPS MEDLL Model 8 L1/L2 GPS + 1 L1 GEO
Position Accuracy (stand-alone)	1.5 m CEP
Pseudorange Measurement Accuracy L1/L2 C/A Narrow L1 C/A GEO L2 P(Y)	10 cm RMS, C/No > 44 dB-Hz, DLL BW = 0.05 Hz 1 m RMS, C/No > 44 dB-Hz, DLL BW = 0.05 Hz 50 cm RMS, C/No > 38 dB-Hz, DLL BW = 0.05 Hz
Single Channel Phase Accuracy L1/L2 C/A L2 P(Y)	3 mm RMS, C/No > 44 dB-Hz, PLL BW = 3 Hz 5 mm RMS, C/No > 38 dB-Hz, PLL BW = 0.2 Hz
C/No Accuracy C/A P(Y)	±2 dB, 30-60 dB-Hz ±4 dB, 34-54 dB-Hz ±8 dB, 24-33 dB-Hz
Raw Data Availability Rate Code Phase, SQM and MEDLL Time Almanac Data	Once per second Once per second < 15 minutes after reset
Time to First Fix	100 seconds (95%) with stabilized internal and external oscillators and initial time, almanac and position.
Re-acquisition L1/L2 C/A L2 P(Y) GEO	5 seconds C/No = 44 dB-Hz 1σ 60 seconds C/No = 38 dB-Hz 1σ 10 seconds C/No = 44 dB-Hz 1σ
Height Measurements	Up to 18,288 metres (60,000 feet) maximum ^a

a. In accordance with export licensing.

A.1 Euro-3 GPSCard



ENVIRONMENTAL	
Operating Temperature	-40°C to +85°C
Storage Temperature	-45°C to +95°C
Humidity	Not to exceed 95% non-condensing
POWER REQUIREMENTS	
Voltage	+4.5 to 18 VDC
Allowable Input Voltage Ripple	50 mV p-p (max.)
Power consumption	6 W (typical)
RF INPUT / LNA POWER OUTPUT	
Antenna Connector	SMB straight (vertical) male jack, 50 Ω nominal impedance
RF Input Frequencies	1575.42 MHz (L1), 1227.60 MHz (L2)
LNA Power	
Internal (Output from card, default)	+5 VDC @ 0 - 100 mA
External (Optional input)	+8 to +30 VDC, 150 mA max. (user-supplied)
EXTERNAL OSCILLATOR INPUT	
Connector	SMB straight (vertical) male jack
External Clock Input	Frequency: 5 MHz or 10 MHz Input Impedance: 50 Ω nominal Input VSWR:2.0:1 Signal Level: 0 dBm minimum to +13.0 dBm maximum Frequency Stability: \pm 0.5 ppm maximum Wave Shape: Sinusoidal

INPUT/OUTPUT DATA INTERFACE	
COM1, COM2 AND COM3	
Electrical format	RS232
Bit rate^a	9600 (default), 19200, 38400, 57600, 115200, 230400 bps
Signals supported	TX, RX, RTS, CTS, DTR, DCD

a.Baud rates higher than 115,200 bps are not supported by standard PC hardware. Special PC hardware is required for higher rates, including 230,400 bps.

INPUT/OUTPUT STROBES	
MSR (Measure Output)	Normally high, active low where the pulse width is 1 ms. The falling edge is the receiver measurement strobe.
Event1 (Mark1 Input)	An input mark (negative pulse > 55 ns), time tags output log data to the time of the falling edge of the mark input pulse.
PV (Position Valid)	Output indicates a 'good solution' or a valid GPS solution when high.
ERROR	Output that Indicates fatal error warning when high.
STATUS_RED	Status output which is high or pulses to indicate that the Euro-3 card is not working properly.
STATUS_GREEN	Status output which pulses to indicate that the Euro-3 card is working properly.
PPS (Pulse Per Second)	Normally high, active low pulse is 1 ms wide @ 1 Hz. Falling edge is used as the reference.
VARF (Variable Frequency)	A variable frequency output ranging from 0 - 20 MHz. This is a normally high, active low pulse.
RESETOUT	Reset TTL signal output to external system; active high.
RESETIN	Reset TTL signal input from external system; active low, > 1 μ s duration.
STROBE ELECTRICAL SPECIFICATIONS	
Output	Voltage: LVTTTL levels Low: minimum 0 VDC and maximum 0.55 VDC @ 24 mA High: minimum 2.4 VDC and maximum 3.6 VDC @ 8 mA
Input	Voltage: LVTTTL levels Low: minimum 0 VDC and maximum 0.8 VDC High: minimum 2.0 VDC and maximum 5.5 VDC

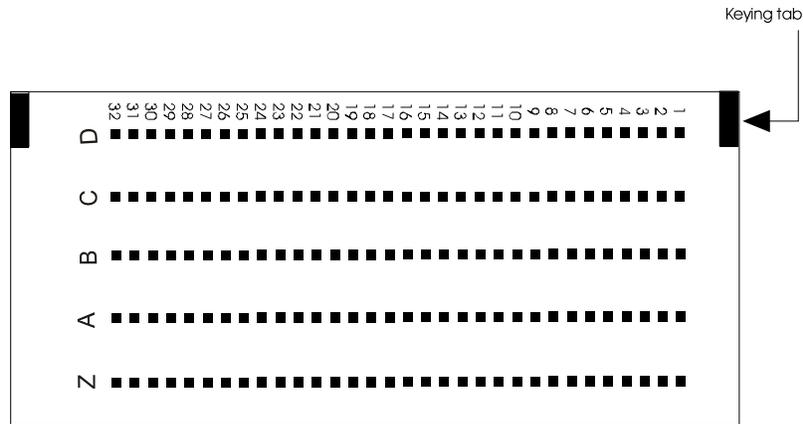


Figure 22: Pin-View of 160-Pin Connector on the Euro-3

Signal	Descriptions	Row A Pin
GND	Power ground	1
4.5-18VIN	Voltage in, +4.5 to +18 VDC	2
MST	Master/Slave card select	3
GND	Digital ground	4
GPIO_USER0	Reserved, internal 10 k Ω pull-down resistor	5
GPIO_USER1	Reserved, internal 10 k Ω pull-down resistor	6
GND	Digital ground	7
RTS1(-)/DTR1	COM1 request to send (-) for RS-422/ data terminal ready output for RS-232	8
TXD1(+)/TXD1	COM1 transmitted data (+) for RS-422/ transmitted data for RS-232	9
RXD1(+)/RXD1	COM1 received data (+) for RS-422/ received data for RS-232	10
RXD1(-)/DCD1	COM1 received data (-) for RS-422/ data carrier detected input for RS-232	11
RTS3(-)/DTR3	COM3 request to send (-) for RS-422/ data terminal ready output for RS-232	12
TXD3(+)/TXD3	COM3 transmitted data (+) for RS-422/ transmitted data for RS-232	13
RXD3(+)/RXD3	COM3 received data (+) for RS-422/ received data for RS-232	14
GND	Digital ground	15
RTS2(-)/DTR2	COM2 request to send (-) for RS-422/ data terminal ready output for RS-232	16
TXD2(+)/TXD2	COM2 transmitted data (+) for RS-422/ transmitted data for RS-232	17
RXD2(+)/RXD2	COM2 received data (+) for RS-422/ received data for RS-232	18
RXD2(-)/DCD2	COM2 received data (-) for RS-422/ data carrier detected input for RS-232	19
TXD3(-)/OUT3	COM3 transmitted data (-) for RS-422/ spare output for RS-232	20
CTS3(-)/DSR3	COM3 clear to send (-) for RS-422/ data set ready for RS-232	21
RXD3(-)/DCD3	COM3 received data (-) for RS-422/ data carrier detected input for RS-232	22
GND	Digital ground	23-31
GPIO_FR	Reserved, internal 10 k Ω pull-up resistor	32

Signal	Descriptions	Row B Pin
GND	Power ground	1
4.5-18VIN	Voltage in, +4.5 to +18 VDC	2
NC	Not connected	3
LNA_PWR	Optional external power to antenna other than a standard NovAtel GPSAntenna (see the ANTENNAPOWER command on Page 62).	4
STATUS_RED	Indicates the Euro-L5 is not working properly when high or pulsing	5

Continued on Page 149

STATUS_GREEN	Indicates the Euro-L5 is working properly when pulsing at 1 Hz	6
SEL1	COM1 RS-232/RS-422 select	7
TXD1(-)/OUT1	COM1 transmitted data (-) for RS-422/ spare output for RS-232	8
CTS1(+)/CTS1	COM1 clear to send (+) for RS-422/ clear to send for RS-232	9
RTS1(+)/RTS1	COM1 request to send (+) for RS-422/ request to send for RS-232	10
CTS1(-)/DSR1	COM1 clear to send (-) for RS-422/ data set ready for RS-232	11
GPAI0	Reserved, internal 19.2 kΩ pull-down resistor	12
CTS3(+)/CTS3	COM3 clear to send (+) for RS-422/ clear to send for RS-232	13
RTS3(+)/RTS3	COM3 request to send (+) for RS-422/ request to send for RS-232	14
ERROR	Indicates fatal error warning	15
TXD2(-)/OUT2	COM2 transmitted data (-) for RS-422/ spare output for RS-232	16
CTS2(+)/CTS2	COM2 clear to send (+) for RS-422/ clear to send for RS-232	17
RTS2(+)/RTS2	COM2 request to send (+) for RS-422/ request to send for RS-232	18
CTS2(-)/DSR2	COM2 clear to send (-) for RS-422/ data set ready for RS-232	19
SEL2	COM2 RS-232/RS-422 select	20
VARF	Variable frequency out	21
PPS	Normally high, active low pulse is 1 ms wide @ 1 Hz Falling edge is used as the reference	22
MKO	Normally high, active low pulse is 1 ms ± 50 ns wide Falling edge is used as the reference	23
MKI	Normally high, active low pulse must exceed 55 ns in duration The falling edge is the reference. LVTTTL (contact closure compatible)	24
PV	Output indicates a 'good solution' or a valid GPS solution when high	25
GPIO_USER2	Reserved, internal 10 kΩ pull-down resistor	26
SEL3	COM3 RS-232/RS-422 select	27
RESETIN	Reset TTL signal input from external system, active low	28
RESETOUT	Reset TTL signal output, active high	29
GPIO_USER3	Reserved, internal 10 kΩ pull-down resistor	30
USB0 D-	USB0 interface data (-)	31
USB0 D+	USB0 interface data (+)	32

Signal	Descriptions	Row C Pin
GND	Power ground	1
4.5-18VIN	Voltage in, +4.5 to +18 VDC	2
GPAI1	Reserved, internal 19.2 kΩ pull-down resistor	3
GPAI2	Reserved, internal 19.2 kΩ pull-down resistor	4
TRST	JTAG test reset	5
TMS	JTAG test mode select	6
TDI	JTAG test data input	7
TDO	JTAG test data output	8
TCLK	JTAG test clock	9
ADC2_L1 I/O	Bit 2 L1 ADC samples	10
ADC1_L1 I/O	Bit 1 L1 ADC samples	11
ADC0_L1 I/O	Bit 0 L1 ADC samples	12
ADC2_L2 I/O	Bit 2 L2 ADC samples	13
ADC1_L2 I/O	Bit 1 L2 ADC samples	14
ADC0_L2 I/O	Bit 0 L2 ADC samples	15
Reserved for future use		16-18
MEDLL_CLK	ADC sample clock	19
IQ_SYNC	IQ alignment	20

Continued on Page 150

MSR	Measurement strobe	21
Reserved for future use		22-23
VBUS1	USB1 BUS Power	24
USB1 D-	USB1 interface data (-)	25
USB1 D+	USB1 interface data (+)	26
USB1D1	USB1 host/device select	27
USB2 D-	USB2 interface data (-)	28
USB2 D+	USB2 interface data (+)	29
USB3 D-	USB3 interface data (-)	30
USB3 D+	USB3 interface data (+)	31
GPIO_USER4	Reserved, internal 10 k Ω pull-down resistor	32

Signal	Descriptions	Row D Pin
GND	Power ground	1
4.5-18VIN	Voltage in, +4.5 to +18 VDC	2
GND	Digital ground	3-32

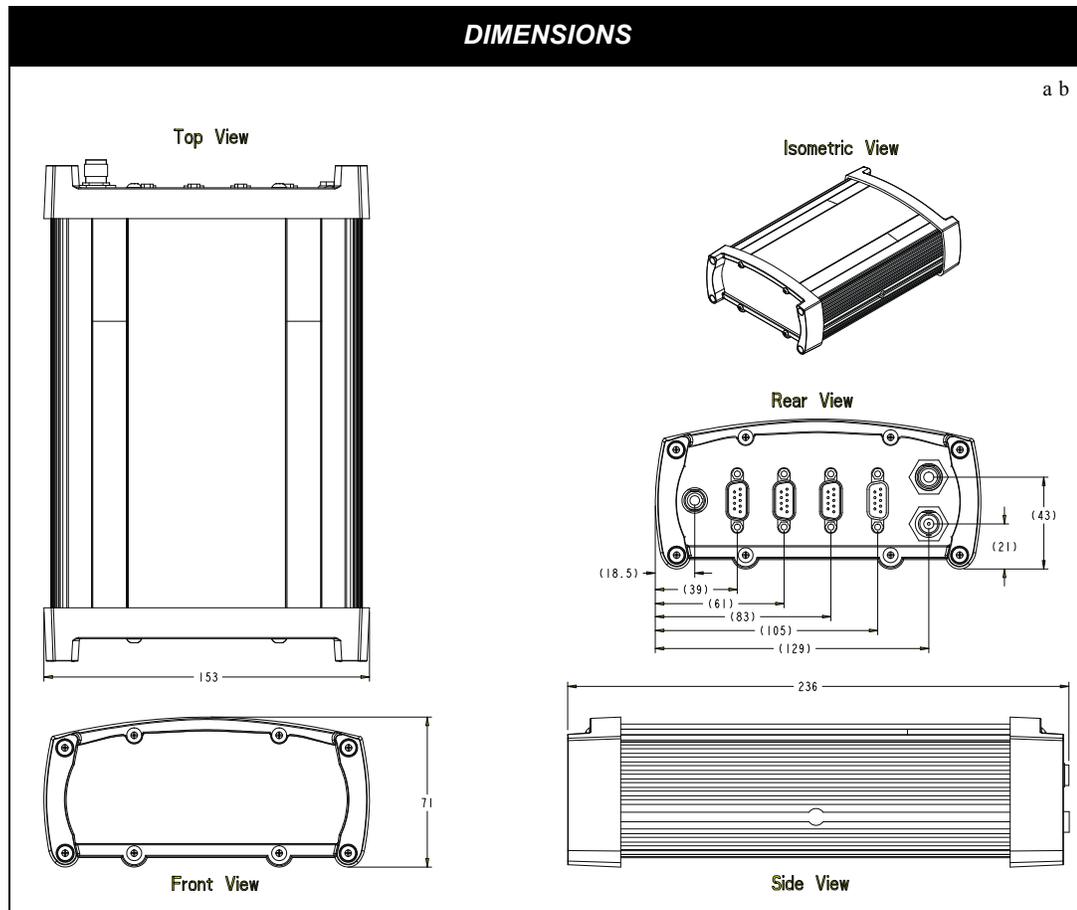
Signal	Descriptions	Row Z Pin
GND	Power ground	1
4.5-18VIN	Voltage in, +4.5 to +18 VDC	2
GND	Digital ground	3-32

-
1. CTS and DSR are inputs while RTS is an output.
2. To create a common ground, tie together all digital grounds (GND) with the ground of the power supply.
-

A.2 EuroPak-3 and EuroPak-3T Enclosures

INPUT/OUTPUT CONNECTORS	
Antenna Input	TNC female jack, 50 Ω nominal impedance +5 VDC, 100 mA max (output from EuroPak-3 to antenna/LNA)
PWR	4-pin LEMO connector EuroPak-3 Input Voltage: +9 to +18 VDC Power Consumption: 6 W (typical) EuroPak-3T Input Voltage +11 to +18 VDC Power Consumption 13 W (typical)
COM1 COM2 USB1 AUX I/O OSC	DB9P connector DB9P connector DB9P connector DB9P connector DB9S connector BNC connector ^a Oscillator input on the EuroPak-3 Input Frequency 5 or 10 MHz ± 0.5 ppm Signal Level 0 to +13 dBm Oscillator output on the EuroPak-3T Output Frequency 10 MHz Signal Level +10 dBm ± 3 dB Phase Noise 0.1 Hz -55 dBc/Hz 1 Hz -95 dBc/Hz 10 Hz -125 dBc/Hz 100 Hz -155 dBc/Hz 1 kHz -165 dBc/Hz 10 kHz -165 dBc/Hz 100 kHz -165 dBc/Hz
PHYSICAL	
Size	236 x 153 x 71 mm
Weight	1.2 kg maximum (including Euro-3 GPSCard)
ENVIRONMENTAL	
Operating Temperature	EuroPak-3: -40°C to +60°C EuroPak-3T: -20°C to +50°C
Storage Temperature	-45°C to +95°C
Humidity	Not to exceed 95% non-condensing

a. The EuroPak-3 provides an external oscillator input on this connector while the EuroPak-3T provides an output from the internal clock.



a.All dimension are in millimetres, please use the *Unit Conversion* section of the *GPS+ Reference Manual* for conversion to imperial measurements.

b. *Page 159* provides the dimension information for the mounting bracket.

A.2.1 Port Pin-Outs

Table 60: EuroPak-3/3T Serial Port Pin-Out Descriptions

Connector Pin No.	COM1	COM2	AUX
1	N/C	N/C	GND
2	RXD1	RXD2	RXD3
3	TXD1	TXD2	TXD3
4	N/C	N/C	N/C
5	GND	GND	GND
6	USB D+	N/C	N/C
7	RTS1	RTS2	RTS3
8	CTS1	CTS2	CTS3
9	USB D-	N/C	N/C

Table 61: EuroPak-3 I/O Port Pin-Out Descriptions

Connector Pin No.	Signal Name	Signal Descriptions
1	VARF	Variable frequency out
2	PPS	Pulse per second
3	MSR	Mark 1 output
4	EVENT1	Mark 1 input
5	PV	Valid position available
6	Reserved	
7	_RESETOUT	Reset TTL signal output to an external system. Active low.
8	ERROR	Indicates a fatal error when high.
9	GND	Digital ground

☒ For strobe signal descriptions, please see *Section 2.3.1, Strokes on Page 29*.

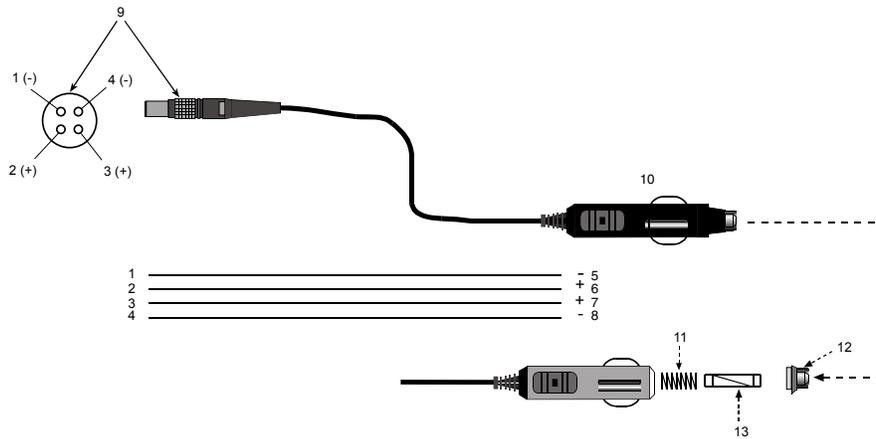
A.2.2 Cables

A.2.2.1 12V Power Adapter Cable (NovAtel part number 01017023)

The power cable supplied with the EuroPak-3 and EuroPak-3T, see *Figure 23*, provides a convenient means for supplying +12 VDC while operating in the field.

Input is provided through the standard 12V power outlet. The output from the power cable utilizes a 4-pin LEMO connector (LEMO part number FGG.0B.304.CLAD52Z) and plugs directly into the *PWR* input located on the back panel of the EuroPak-3 and EuroPak-3T.

For alternate power sources please see *Section 2.1.3 on Page 24*.



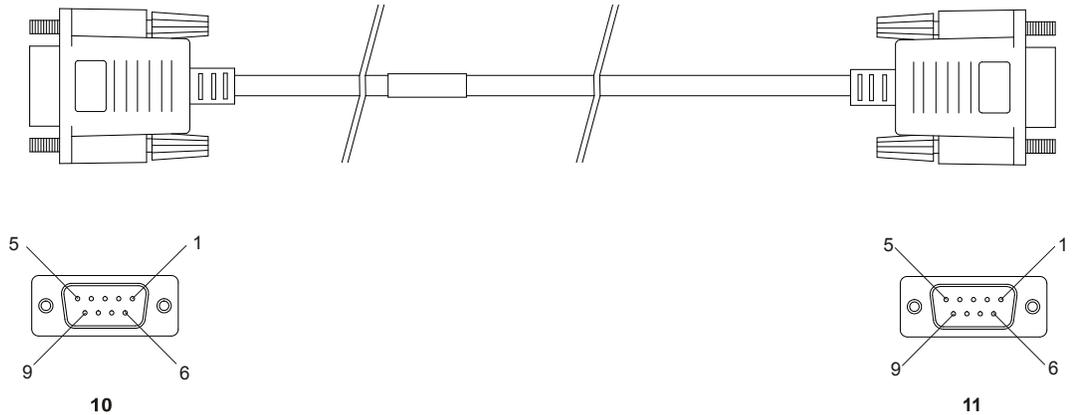
Reference	Description	Reference	Description
1	Black	5	Ground
2	Red	6	+7 to +18 VDC
3	Orange	7	+7 to +18 VDC
4	Brown	8	Ground
9	Connector key marking	12	Universal tip
10	12V plug	13	6 Amp slow-blow fuse
11	Spring		



Figure 23: EuroPak-3 and EuroPak-3T Power Cable

A.2.2.2 Null-Modem Cable (NovAtel part number 60323062)

This cable supplied with the EuroPak-3 and EuroPak-3T, see *Figure 24*, provides an easy means of communications with a PC. The cable is equipped with a 9-pin connector at the receiver end which can be plugged into the *COM1*, *COM2*, or *AUX* port. At the PC end, a 9-pin connector is provided to accommodate a PC serial (RS232) communication port.



Wiring Table:

Connector	Pin Number						
To DB9S (10)	2	3	8	7	4	5	1 & 6
To DB9S (11)	3	2	7	8	1 & 6	5	4

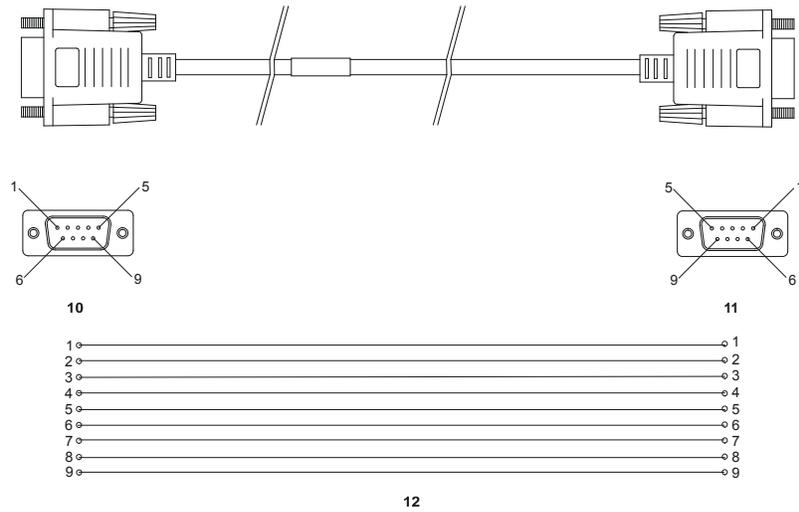
Reference	Description
10	DB9S (Female)
11	DB9S (Female)



Figure 24: EuroPak-3 and EuroPak-3T Null Modem Cable

A.2.2.3 Straight Through Serial Cable (NovAtel part number 60723066)

This cable can be used to connect the EuroPak-3 and EuroPak-3T to a modem or radio transmitter to propagate differential corrections. The cable is equipped with a female DB9 connector at the receiver end. The male DB9 connector at the other end is provided to plug into your user-supplied equipment (please refer to your modem or radio transmitter user guide for more information about its connectors). The cable is approximately 2 m in length. See *Figure 25*.



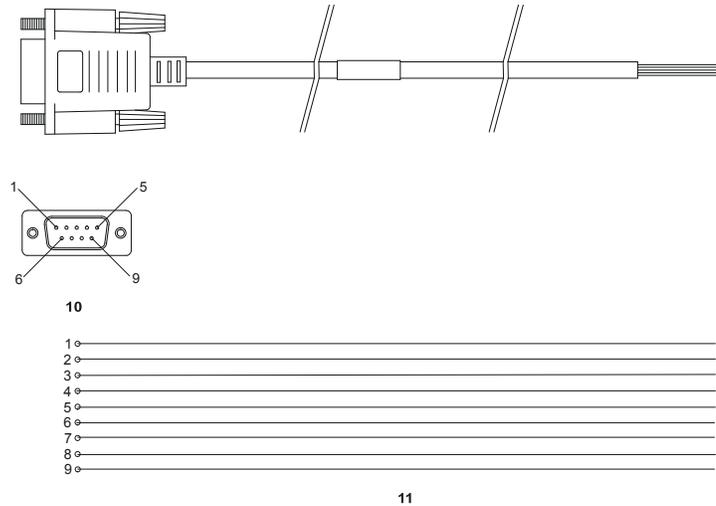
Reference	Description	Reference	Description
10	DB9P (male) connector	12	9-conductor cable
11	DB9S (female) connector		



Figure 25: EuroPak-3 and EuroPak-3T Straight Through Serial Cable

A.2.2.4 I/O Strobe Port Cable (NovAtel part number 60723065)

The strobe lines on the EuroPak-3 and EuroPak-3T can be accessed by inserting the male DB9 connector of the I/O strobe port cable into the I/O port. The other end of this cable is provided without a connector to provide flexibility. The jacket insulation is cut away slightly from the end but the insulation on each wire is intact. The cable is approximately 2 m in length. See *Figure 26*.



Wiring Table:

I/O Port Pin	I/O Port Signal	I/O Port Cable Wire Color	I/O Port Pin	I/O Port Signal	I/O Port Cable Wire Color
1	VARF	Black	6	Reserved	Green
2	PPS	Brown	7	Reserved	Blue
3	Reserved	Red	8	GND	Violet
4	Event1	Orange	9	GND	White/Grey
5	PV	Yellow			

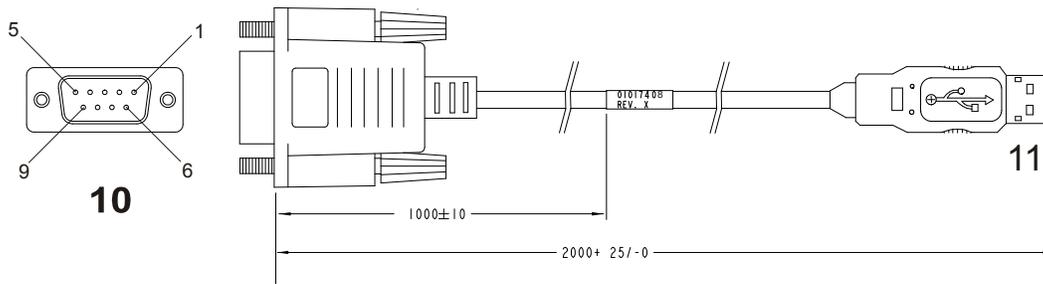
Reference	Description	Reference	Description
10	DB9P (male) connector	11	9-conductor cable



Figure 26: EuroPak-3 and EuroPak-3T I/O Strobe Port Cable

A.2.2.5 USB Serial Cable (NovAtel part number 01017408)

The USB cable shown below provides a means of interfacing between the COM1 port on the EuroPak-3 and another serial communications device, such as a PC. At the EuroPak-3 end, the cable is equipped with a DB9 connector, which plugs directly into a COM port. At the other end, the cable provides a USB connector.



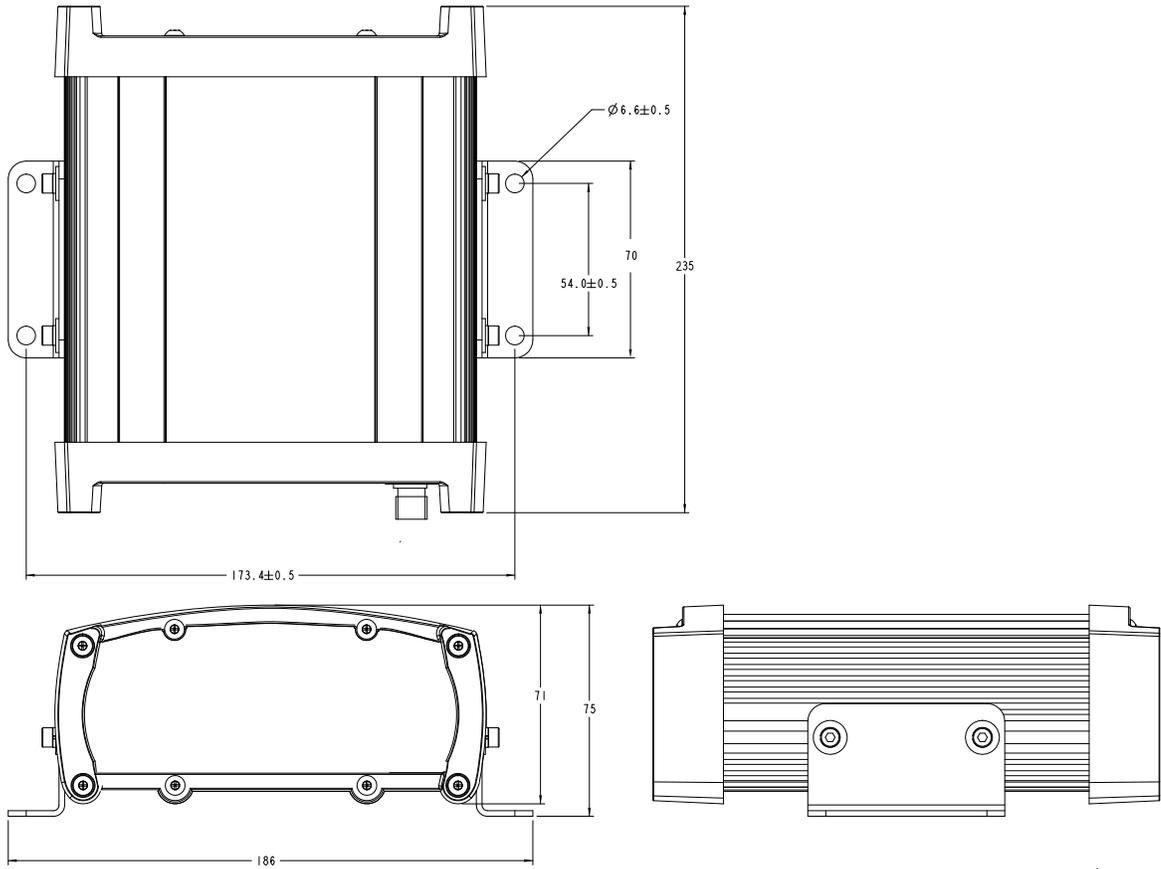
WIRING			
DB9 CONNECTION ON RECEIVER	SIGNAL	SERIES "A" USB PLUG	WIRE COLOR
PIN 5	GND	PIN 4	BLACK
PIN 6	USB D+	PIN 3	GREEN
PIN 9	USB D-	PIN 2	WHITE
INSULATE TO PREVENT SHORT			RED

Reference	Description
10	Female DB9 connector
11	USB connector



Figure 27: USB Serial Cable

A.2.3 Mounting Bracket Dimensions



A.3 Channel Assignments

Table 62 and Table 63 on Page 160 show the mapping of signal channels for both software models.

Table 62: L1L2GEO Model Default Channel Assignments

SV Channel	Signal Channel	SV Type	Code	DLL Type	Frame	Nav Type	Symbol Rate	FEC	Sky Search
0	0, 1	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
1	2, 3	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
2	4, 5	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
3	6, 7	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
4	8, 9	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
5	10, 11	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
6	12, 13	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
7	14, 15	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
8	16, 17	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
9	18, 19	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
10	20, 21	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
11	22, 23	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
12	24, 25	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
13	26, 27	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
14	28	WAAS	L1 C/A	Standard	WAAS	WAAS	500	Yes	Idle
15	29	WAAS	L1 C/A	Standard	WAAS	WAAS	500	Yes	Idle
16	30	WAAS	L1 C/A	Standard	WAAS	WAAS	500	Yes	Idle
17	31	WAAS	L1 C/A	Standard	WAAS	WAAS	500	Yes	Idle

Table 63: L1L2GEO Plus MEDLL Model Default Channel Assignments

SV Channel	Signal Channel	SV Type	Code	DLL Type	Frame	Nav Type	Symbol Rate	FEC	Sky Search
0	0,1	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
1	2,3	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
2	4,5	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
3	6,7	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
4	8,9	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
5	10,11	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
6	12,13	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
7	14,15	GPS	L1 C/A, L2 P(Y)	Narrow	GPS	GPS	50	No	Auto
8	16	WAAS	L1 C/A	Standard	WAAS	WAAS	500	Yes	Idle

B.1 Overview

Static electricity is electrical charge stored in an electromagnetic field or on an insulating body. This charge can flow as soon as a low-impedance path to ground is established. Static-sensitive units can be permanently damaged by static discharge potentials of as little as 40 volts. Charges carried by the human body, which can be thousands of times higher than this 40 V threshold, can accumulate through as simple a mechanism as walking across non-conducting floor coverings such as carpet or tile. These charges may be stored on clothing, especially when the ambient air is dry, through friction between the body and/or various clothing layers. Synthetic materials accumulate higher charges than natural fibers. Electrostatic voltage levels on insulators may be very high, in the order of thousands of volts.

Various electrical and electronic components are vulnerable to electrostatic discharge (ESD). These include discrete components, hybrid devices, integrated circuits (ICs), and printed circuit boards (PCBs) assembled with these devices.

B.2 Handling ESD-Sensitive Devices

ESD-sensitive devices must only be handled in static-controlled locations. Some recommendations for such handling practices follow:

- Handling areas must be equipped with a grounded table, floor mats, and wrist strap.
- A relative humidity level must be maintained between 20% and 80% non-condensing.
- No ESD-sensitive board or component should be removed from its protective package, except in a static-controlled location.
- A static-controlled environment and correct static-control procedures are required at both repair stations and maintenance areas.
- ESD-sensitive devices must be handled only after personnel have grounded themselves via wrist straps and mats.
- Boards or components should never come in contact with clothing, because normal grounding cannot dissipate static charges on fabrics.
- A circuit board must be placed into an anti-static plastic clamshell before being removed from the work location and must remain in the clamshell until it arrives at a static-controlled repair/test center.
- Circuit boards must not be changed or moved needlessly. Handles may be provided on circuit boards for use in their removal and replacement; care should be taken to avoid contact with the connectors and components.
- On-site repair of ESD-sensitive equipment should not be undertaken except to restore service in an emergency where spare boards are not available. Under these circumstances repair station techniques must be observed. Under normal circumstances a faulty or suspect circuit board must be sent to a repair center having complete facilities, or to the manufacturer for exchange or repair.
- Where protective measures have not been installed, a suitable alternative would be the use of a Portable Field Service Grounding Kit (for example, 3M Kit #8501 or #8507). This consists of a portable mat and wrist strap which must be attached to a suitable ground.
- A circuit board in a static-shielding bag or clamshell may be shipped or stored in a cardboard carton, but the carton must not enter a static-controlled area such as a grounded or dissipative bench top or repair zone. Do not place anything else inside the bag (for example, repair tags).
- Treat all PCBs and components as ESD sensitive. Assume that you will damage the PCB or component if you are not ESD conscious.
- Do not use torn or punctured static-shielding bags. A wire tag protruding through the bag could act as a "lightning rod", funneling the entire charge into the components inside the bag.
- Do not allow chargeable plastics, such as binders, within 0.6 m of unshielded PCBs.
- Do not allow a PCB to come within 0.3 m of a computer monitor.

B.3 Prime Static Accumulators

Table 64 provides some background information about static-accumulating materials.

Table 64: Static-Accumulating Materials

Work Surfaces	<ul style="list-style-type: none"> • formica (waxed or highly resistive) • finished wood • synthetic mats • writing materials, note pads, and so on
Floors	<ul style="list-style-type: none"> • wax-finished • vinyl
Clothes	<ul style="list-style-type: none"> • common cleanroom smocks • personal garments (all textiles) • non-conductive shoes
Chairs	<ul style="list-style-type: none"> • finished wood • vinyl • fiberglass
Packing and handling	<ul style="list-style-type: none"> • common polyethylene bags, wraps, envelopes, and bubble pack • pack foam • common plastic trays and tote boxes
Assembly, cleaning, and repair areas	<ul style="list-style-type: none"> • spray cleaners • common solder sucker • common soldering irons • common solvent brushes (synthetic bristles) • cleaning, drying and temperature chambers

B.4 Handling Printed Circuit Boards

ESD damage to unprotected sensitive devices may occur at any time. ESD events can occur far below the threshold of human sensitivity. Follow this sequence when it becomes necessary to install or remove a circuit board:

1. After you are connected to the grounded wrist strap, remove the circuit board from the frame and place it on a static-controlled surface (grounded floor or table mat).
2. Remove the replacement circuit board from the static-shielding bag or clamshell and insert it into the equipment.
3. Place the original board into the shielding bag or clamshell and seal it with a label.
4. Do not put repair tags inside the shielding bag or clamshell.
5. Disconnect the wrist strap.

GPS SPS SIGNAL SPECIFICATION REFERENCE

For copies of the Interface Control Document (ICD)-GPS-200, contact:

ARINC Research Corporation

Address: 2551 Riva Road
Annapolis, MD, USA
21401-7465

Telephone: 410-266-4000

Fax: 410-266-4049

Web site: www.arinc.com

GEODETTIC SURVEY OF CANADA

Geodetic Survey of Canada

Address: 615 Boothe Street
Ottawa, ON, Canada
K1A 0E9

Telephone: (613) 995-4410

Fax: (613) 995-3215

Web site: www.geod.emr.ca

U.S. NATIONAL GEODETTIC SURVEY

NGS Information Services

Address: 1315 East-West Highway
Station 9244
Silver Springs, MD, USA
20910-3282

Telephone: (301) 713-2692

Fax: (301) 713-4172

Web site: www.ngs.noaa.gov

☒ Contact information may be subject to change however they are accurate at the time of publication.

Appendix D

Replacement Parts

The following are a list of the replacement parts available for your NovAtel GPS receiver. Should you require assistance or need to order additional components, please contact your local NovAtel dealer or Customer Support representative.

D.1 EuroPak

Part Description	NovAtel Part
I/O strobe cable (<i>Figure 26 on Page 157</i>)	60723065
Straight through serial data cable (<i>Figure 25 on Page 156</i>)	60723066
Null modem serial data cable (<i>Figure 24 on Page 155</i>)	60715062
DB9 to USB serial data cable (<i>Figure 27 on Page 158</i>)	01017408
Power cable: LEMO 4-pin socket to 12V power outlet plug (<i>Figure 23 on Page 154</i>)	01017023

D.2 Accessories

Part Description	NovAtel Part
EuroPak-3 Compact Disc with PC utilities	01017478
Optional NovAtel GPSAntennas:	
Model 702 (L1/L2 GPS + GLONASS)	GPS-702-GG
Model 701 (L1 GPS + GLONASS)	GPS-701-GG
Model 533 (L1/L2)	ANT-C2GA-TW-N
Model 532 (L1/L2)	ANT-A72GA-TW-N
Optional RF Antenna Cable:	
5 meters	C006
15 meters	C016
30 meters	C032
22 cm interconnect adapter cable	GPS-C002

D.3 Manufacturer's Part Numbers

The following original manufacturer's part numbers are provided for information only and are not available from NovAtel as separate parts:

Part Description	LEMO Part
4-pin socket connector on power cable (<i>Figure 23 on Page 154</i>)	FGG.0B.304.CLAD52Z
10-pin plug connector on serial and null modem cables for LEMO version (<i>Figures 24 and 25 starting on Page 155</i>)	FGG.1K.310.CLAC60Z

Part Description	HARTING Part
160-pin 5-row mating connector (<i>see Figure 22 on Page 148</i>)	02-02-160-1201

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