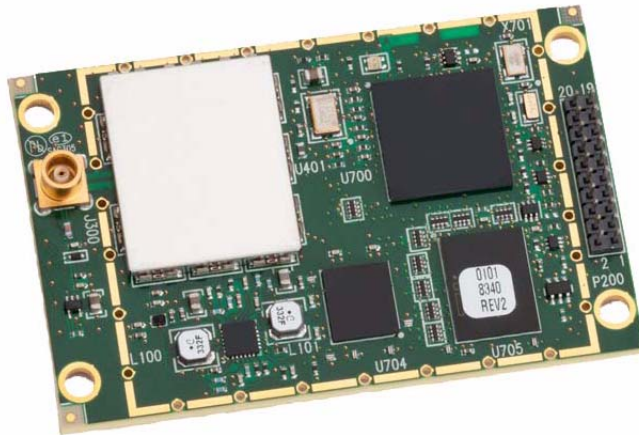




A Precise Positioning Technology Company



OEMStar™

Installation and Operation

User Manual



OEMStar Receiver - Installation and Operation User Manual

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Table of Contents

Terms and Conditions	8
Software License	11
Notice	13
Customer Support	17
Firmware Updates and Model Upgrades	19
Warranty	20
Foreword	21
1 Introduction	23
1.1 Overview of the OEMStar™	23
1.1.1 OEMStar Standard Features	23
1.2 OEMStar Receiver	24
1.2.1 Radio Frequency (RF) Section	24
1.2.2 Digital Electronics Section	25
1.3 OEMStar Receiver System Overview	25
1.4 OEMStar Receiver	27
1.5 Enclosure and Wiring Harness	27
1.6 GNSS Antenna	27
1.6.1 Optional LNA Power Supply	27
1.7 Principal Power Supply	27
1.8 Data Communications Equipment	27
1.9 OEMStar Enclosures	28
1.9.1 FlexPak-G2™	28
2 Installation and Setup	29
2.1 Additional Equipment Required	29
2.1.1 Selecting a GNSS Antenna	29
2.1.2 Choosing a Coaxial Cable	30
2.1.3 Power Supply Requirements	31
2.1.4 Installing an OEMStar Card in a Wiring Harness and Enclosure	32
2.1.5 Mounting the GNSS Antenna	35
2.1.6 Connecting the Antenna to the Receiver	35
2.1.7 Applying Power to the Receiver	35
2.1.8 Connecting Data Communications Equipment	35
2.2 Additional Features and Information	36
2.2.1 Strokes	36
2.2.2 Universal Serial Bus (USB)	36
2.2.3 Status Indicators	36
2.2.4 Antenna LNA Power	37
3 Operation	38
3.1 Communications with the Receiver	39
3.1.1 Serial Port Default Settings	39
3.1.2 Communicating Using a Remote Terminal	39

3.1.3 Communicating Using a Personal Computer	39
3.2 Getting Started	40
3.2.1 Starting the Receiver	40
3.2.2 Communicating with the Receiver Using CDU	40
3.3 Transmitting and Receiving Corrections.....	42
3.3.1 Base Station Configuration	43
3.3.2 Rover Station Configuration.....	43
3.3.3 GPS + GLONASS Base and Rover Configuration.....	44
3.3.4 PDP and GLIDE Configurations.....	45
3.3.5 Configuration Notes	45
3.4 Enabling SBAS Positioning	46
3.5 Pass-Through Logging	47
4 PC Software and Firmware	48
4.1 CDU/Convert Installation	48
4.2 CDU.....	49
4.3 Convert.....	54
4.3.1 RINEX Format.....	55
4.3.2 Convert Command Line Switches.....	56
4.4 USB Drivers Installation	57
4.4.1 Windows Driver Signing	57
4.4.2 Windows XP Installation	58
4.4.3 Windows 2000 Installation	60
4.5 Firmware Upgrades.....	61
4.5.1 Upgrading Using the AUTH Command.....	61
4.5.2 Updating Using the WinLoad Utility	62
5 Built-In Status Tests	67
5.1 Overview	67
5.2 Receiver Status Word	67
5.3 RXSTATUSEVENT Log	68
5.4 RXSTATUS Log	68
5.4.1 Overview	68
5.4.2 Error Word	69
5.4.3 Status Code Arrays.....	70
5.4.4 Receiver Status Code	70
5.4.5 Auxiliary Status Codes.....	70
5.4.6 Set and Clear Mask for all Status Code Arrays	70
5.5 Status LED	71
5.5.1 OEMStar Cards.....	71
6 Troubleshooting	73
6.1 Examining the RXSTATUS Log	75
A Technical Specifications	78
OEMStar Receiver Performance	78
OEMStar/OEMStar-RA Card Physical and Electrical	79
FlexPak-G2-Star	87
Port Pin-Outs	89
Cables	90

B Electrostatic Discharge Control (ESD) Practices	95
Overview	95
Handling ESD-Sensitive Devices	95
Prime Static Accumulators	96
Handling Printed Circuit Boards	97
C Replacement Parts	98
Accessories	98
Manufacturers' Part Numbers	98

Figures

1	Primary and Secondary Lightning Protection	15
2	OEMStar Receiver	24
3	GNSS Receiver System Functional Diagram	26
4	FlexPak-G2 Enclosure	28
5	OEMStar Connector and Indicator Locations	34
6	Available OEM Card Connection Interfaces	38
7	Basic Differential Setup	42
8	Convert Screen Examples	54
9	Convert Command Line Arguments	56
10	Main Screen of WinLoad	63
11	WinLoad's Open Dialog	64
12	Open File in WinLoad	64
13	COM Port Setup	65
14	Searching for Card	65
15	Authorization Code Dialog	65
16	Upgrade Process Complete	66
17	Location of Receiver Status Word	68
18	Reading the Bits in the Receiver Status Word	68
19	Location of Receiver Error Word	69
20	Reading the Bits in the Receiver Error Word	69
21	Status LED Flash Sequence Example	72
22	OEMStar Board Dimensions	79
23	OEMStar-RA Board Dimensions	80
24	OEMStar/OEMStar-RA Board Keep-Out Zone	81
25	Top-view of 20-Pin Connector on the OEMStar	85
26	FlexPak-G2-Star I/O Strobe Port Cable	90
27	FlexPak-G2-Star Straight Through Serial Cable	91
28	FlexPak-G2-Star Null Modem Cable	92
29	FlexPak-G2-Star Power Cable	93
30	Power Connection - Alternate Power Source	94

Tables

1	NovAtel GNSS Antenna Models	30
2	NovAtel Logs for Rinex Conversion	56
3	Troubleshooting based on Symptoms.....	73
4	Resolving a Receiver Error Word.....	75
5	Resolving an Error in the Receiver Status Word.....	76
6	OEMStar Strokes	83
7	OEMStar Input/Output Electrical Specifications	84
8	FlexPak-G2-Star Port Pin-Out Descriptions	89
9	FlexPak-G2-Star I/O Port Pin-Out Descriptions	89
10	Static-Accumulating Materials.....	96

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	407 - 8 Avenue S.W.	CDN Account #	788889-001
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10. Customer Support: For Software UPDATES and UPGRADES, and regular customer support, contact the NovAtel GPS Hotline at 1-800-NOVATEL (U.S. or Canada only), or +1-403-295-4900, Fax +1-403-295-4901, e-mail to support@novatel.ca,

Web site: www.novatel.com or write to:

NovAtel Inc.

Customer Service Department

1120 - 68 Avenue NE,

Calgary, Alberta, Canada T2E 8S5

OEMStar Warnings

WARNING: The LNA power pin (pin 1 of the 20-pin connector) can handle a maximum voltage of **5.25 VDC**.



The USB port (pins 3 and 4 of the 20-pin connector) must not be connected to an external voltage supply.

Notes:

This is different from all other OEMV and Superstar II products which are equipped with a 5V voltage regulator on the board.

Superstar II users should ensure that pin 3 is not connected to an external voltage supply. For example, VBATT.

Failure to adhere to this warning, may result in your OEMStar card becoming permanently damaged and void your warranty.

WARNING: Pin 3 of the OEMStar is used for the USB D- signal. Pin 4 of the OEMStar is used for the USB D+ signal.



Note: This is different from the Superstar II product which uses pin 3 (VBATT) for external battery backup. Superstar II users who want to integrate the OEMStar card into existing designs must not apply any external voltage to pin 3 and must remove the VBATT connection.

Failure to adhere to this warning, may result in your OEMStar card becoming permanently damaged and void your warranty.

Lightning Protection Notice

What is the hazard?

A lightning strike into the ground causes an increase in the earth's potential causing a high voltage potential between the centre conductor and shield of the coax cable. A voltage surge induced onto the center conductor lags the voltage induced onto the shield, producing a high voltage potential between the centre conductor and shield of the coax cable.

Hazard Impact

A lightning strike causes the ground potential in the area to rise to dangerous levels resulting in harm to personnel or destruction of electronic equipment in an unprotected environment. It also conducts a portion of the strike energy down the inner conductor of the coax cable to the connected equipment.



WARNING: *Only qualified personnel, electricians as mandated by the governing body in the country of installation, may install lightning protection devices.*

Actions to Mitigate Lightning Hazards

1. Do not install the external antenna lines during a lightning storm.
2. It is not possible to avoid over-voltages caused by lightning, but a lightning protection device may be used to shunt a large portion of the transient energy to the building ground reducing the over-voltage condition as quickly as possible.
3. Primary lightning protection must be provided by the operator/customer according to local building codes as part of the extra-building installation.
4. To ensure compliance with clause 7 "Connection to Cable Distribution Systems" of EN 60950-1, Safety for Information Technology Equipment, a secondary lightning protection device must be used for in-building equipment installations with external antennas. The following device has been approved by NovAtel Inc.:

- Polyphaser - Surge Arrestor DGXZ+24NFNF-A

If this device is not chosen as the primary lightning protection device, the device chosen must meet the following requirements:

- UL listed, or equivalent, in country of installation (for example, TUV, VDE and so on) for lightning surge protection
 - The primary device must be capable of limiting an incoming surge to 10kV
5. The shield of the coaxial cable entering the building should be connected at a grounding plate at the building's entrance. The lightning protection devices should have their chassis grounded to the same ground near to the building's entrance.
 6. The primary and secondary lightning protections should be as close to the building's entrance as possible. Where feasible they should be mounted onto the grounding plate itself. See also *Figure 1, Primary and Secondary Lightning Protection* on the following page.

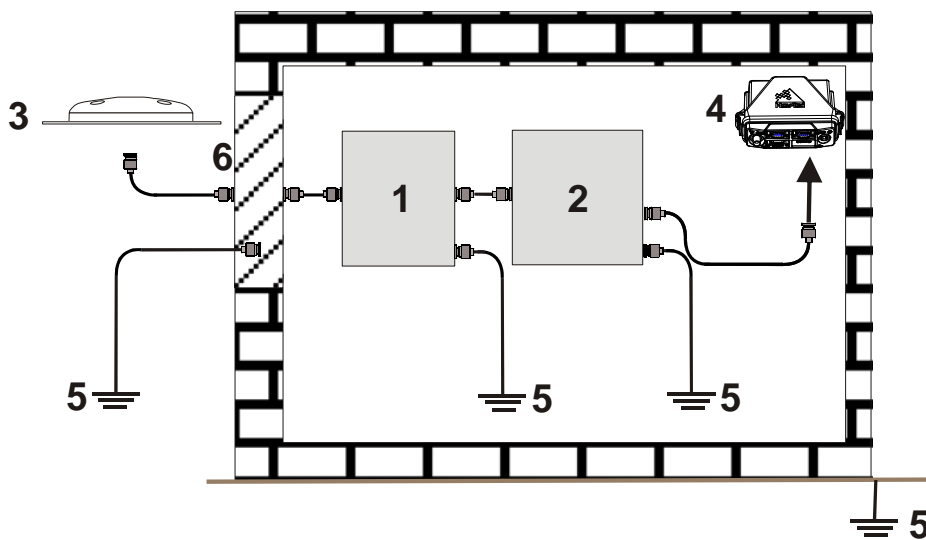


Figure 1: Primary and Secondary Lightning Protection

Reference	Description	Reference	Description
1	Primary Lightning Protection Device	4	GNSS Receiver
2	Secondary Lightning Protection Device	5	To Ground
3	External Antenna	6	Grounding plate or grounding point at the building's entrance


☒ Acceptable choices for Earth Grounds, for central buildings, are:

- Grounded interior metal cold water pipe within five feet (1.5 m) of the point where it enters the building
- Grounded metallic service raceway
- Grounded electrical service equipment enclosure
- Eight-foot grounding rod driven into the ground (only if bonded to the central building ground by #6, or heavier, bonding wire)

These installation instructions are the minimum requirements for receiver and antenna installations. Where applicable, follow the electrical codes for the country of installation. Examples of country codes include:

- USA National Electrical Code (NFPA 70)
- Canada Canadian Electrical Code (CSA C22)
- UK British Standards Institute (BSI 7671)

WEEE Notice

If you purchased your OEMStar family product in Europe, please return it to your dealer or supplier at the end of its life. The objectives of the European Community's environment policy are, in particular, to preserve, protect and improve the quality of the environment, protect human health and utilize natural resources prudently and rationally. Sustainable development advocates the reduction of wasteful consumption of natural resources and the prevention of pollution. Waste electrical and electronic equipment (WEEE) is a regulated area. Where the generation of waste cannot be avoided, it should be reused or recovered for its material or energy. WEEE products may be recognized by their wheeled bin label ().¹

RoHS Notice

The OEMStar is compliant with the European Union (EU) Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.¹

-
1. Please visit the NovAtel Web site at www.novatel.com through *Products / WEEE and RoHS* for more information about WEEE and RoHS.

NovAtel Knowledge Base

If you have a technical issue, browse to the NovAtel Web site at www.novatel.com then select *Support / Helpdesk and Solutions / Search Known Solutions*. Through this page, you can search for general information about GNSS and other technologies, information about NovAtel hardware and software, and installation and operation issues.

Before Contacting Customer Support

Before contacting NovAtel Customer Support about a software problem perform the following steps:

1. Log the following data to a file on your PC for 15 minutes:

```
RXSTATUSB once
RAWEPHEMB onchanged
RANGEB ontime 1
BESTPOSB ontime 1
RXCONFIGA once
VERSIONA once
TRACKSTATB ontime 1
GLORAWEPHEMB onchanged1
```

2. Send the file containing the log to NovAtel Customer Support, using either the NovAtel FTP site at *Support / Firmware/Software and Manuals / Access FTP Site* on the NovAtel Web site at www.novatel.com or through the support@novatel.com e-mail address.
3. You can also issue a FRESET command to the receiver to clear any unknown settings.

The FRESET command will erase all user settings. You should know your configuration and be able to reconfigure the receiver before you send the FRESET command.

If you are having a hardware problem, send a list of the troubleshooting steps taken and results.

Contact Information

Use one of the following methods to contact NovAtel Customer Support:

Call 1-800-NOVATEL (U.S. & Canada) or +1-403-295-4900 (international)

1.For GLONASS channel configuration.

Fax: +1-403-295-4901

E-mail: support@novatel.com

Web site: www.novatel.com

Write: NovAtel Inc.

Customer Support Department

1120 - 68 Avenue NE

Calgary, AB

Canada, T2E 8S5

Firmware Updates and Model Upgrades

Firmware *updates* are firmware releases, which include fixes and enhancements to the receiver functionality. Firmware updates are released on the Web site as they become available. Model *upgrades* enable features, such as GLONASS and GLIDE®, on the receiver and may be purchased through NovAtel authorized dealers.

Contact your local NovAtel dealer first for more information. To locate a dealer in your area visit *Where to Buy | Dealers* on the NovAtel Web site at www.novatel.com or contact NovAtel Customer Support directly.

Refer to *Firmware Upgrades on page 61* for instructions on using the WinLoad program to upgrade your receiver.

Warranty

NovAtel Inc. warrants that its products are free from defects in materials and workmanship, subject to the conditions set forth below, for the following periods of time, from the date of sale:

OEMStar™ Card Receivers	One (1) Year
GPS Antenna Series	One (1) Year
Cables and Accessories	Ninety (90) Days
Computer Discs	Ninety (90) Days
Software Warranty	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, or in the case of software, provision of a software revision for implementation by the customer. Determination of replacement or repair will be made by NovAtel personnel or by technical personnel expressly authorized by NovAtel for this purpose.

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There are no user serviceable parts in the NovAtel 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.

Foreword

About this Manual

Thank you for purchasing a NovAtel OEMStar receiver card. Whether the receiver is stand-alone or installed in an enclosure, this manual provides the information you will need to get the hardware integrated and operational. The following table provides a chapter by chapter description of the components of the manual.

Proprietary Notice	Restrictions on the use of OEMStar hardware, software and manuals. Summary of trademarks and U.S. patents.
Notices	Summary of regulations applicable to the receiver.
Terms and Conditions (of Sale)	
Software License	
Warranty	
Customer Support	Guidelines for contacting NovAtel Customer Support.
Foreword	Organization and scope of the manual, and conventions used.
Chapter 1 Introduction	Overview of the OEMStar family and cards.
Chapter 2 Installation and Setup	Physical integration and configuration of OEMStar cards.
Chapter 3 Operation	Operating the OEMStar cards once they are installed.
Chapter 4 PC Software and Firmware	Using NovAtel PC utilities to configure and monitor the OEMStar card (CDU), convert data file formats (Convert4), update firmware and upgrade models.
Chapter 5 Built-in Status Tests	Using built-in receiver tests to monitor system performance.
Chapter 6 Troubleshooting	Diagnose system problems.
Appendix A Technical Specifications	OEMStar performance specifications, and product line physical, environmental and electrical specifications.
Appendix B ESD Practices	Recommended practices for handling ESD-sensitive devices.
Appendix C Replacement Parts	NovAtel accessories and part numbers.
Index	




Related Documents and Information

After the OEMStar hardware is operational, the *OEMStar Firmware and Reference Manual* will become your primary source for command and log information. Each receiver has a specific set of features, such as raw data output or GLONASS support, so some commands and logs may not be supported by your model. Refer also to the Support page on our Web site at www.novatel.com for new documents and documentation updates.

It is beyond the scope of this manual to provide details on OEMStar service and repair. Please contact your local NovAtel dealer for any customer-service related inquiries, as outlined in *Customer Support* on page 17.

Conventions

The following conventions have been used in this manual:

	<p>Note that provides information to supplement or clarify the accompanying text.</p>
 CAUTION:	<p>Caution that a certain action, operation or configuration may result in incorrect or improper use of the hardware.</p>
 WARNING!:	<p>Warning that a certain action, operation or configuration may result in regulatory noncompliance, safety issues or equipment damage.</p>

1.1 Overview of the OEMStar™

The OEMStar is a precision receiver that tracks GPS L1 and GLONASS L1 signals. It is hardware form-factor compatible with NovAtel's Superstar II, OEMV-1, OEMV-1G, and OEMV1-DF receivers. The OEMStar also uses Space Based Augmentation System (SBAS) corrections from services such as the Wide Area Augmentation System (WAAS) and the European Geostationary Navigation Overlay Service (EGNOS).

The OEMStar accepts a nominal input voltage between 3.3 and 5.0 VDC (minimum 3.1 to maximum 5.25 VDC) and uses NovAtel's OEMV-style command interface.

The OEMStar provides 14 channels of combined GPS L1 and GLONASS L1 code and carrier phase tracking. Channel configurations can be tailored to suit individual customer requirements by using a software command. Position, velocity and time information is available at up to a maximum update rate of 10 Hz, with a 1 PPS (Pulse Per Second) accuracy of 20 ns.

☒ The timing accuracy for GPS is 20ns.

NovAtel's patented Pulse Aperture Correlator (PAC) with multipath mitigation technologies, and a powerful 32-bit embedded processor, enable the OEMStar to offer multipath-resistant processing at high data update rates. Excellent acquisition and re-acquisition times allow the receivers to operate in environments where very high dynamics and frequent interruption of signals can be expected.

1.1.1 OEMStar Standard Features

The OEMStar has the following standard features:

- 14 L1 channels, 2 of these can be used for SBAS channels
- PAC technology (refer to the Knowledge and Learning page in the Support section of our Web site at www.novatel.com)
- Fast reacquisition
- Fully field-upgradeable firmware
- Low power consumption
- 10 Hz raw data and position output rates
- One mark input for triggering the output of logs on external events
- Auxiliary strobe signals, including a configurable PPS output for time synchronization
- An extensive command and log set for maximum customization
- Outputs to drive external LEDs

1.2 OEMStar Receiver

The OEMStar receiver consists of a single printed circuit board assembly with integrated radio frequency (RF) and digital sections. It is designed for flexibility of integration and configuration. After installation with a power source, mounting structure, GNSS antenna, and data communications equipment, NovAtel's OEMStar receivers are ready for the most demanding surveying, positioning, and navigation applications.

The OEMStar is a compact, low-power, single frequency L1 GPS + GLONASS receiver. In addition to the functionality given in *Section 1.1.1* on page 23, the OEMStar offers:

- 1 USB 2.0 communication port and 2 LV-TTL serial ports
- Auxiliary strobe signals for status and synchronization
- Software load compatibility with other NovAtel OEMV family products

☒ When handling the OEMStar, you should use a wrist-grounding strap to prevent ESD damage. For more information, see *Appendix B* on page 95.

Download the most current versions of NovAtel's PC utilities and product documentation from www.novatel.com.

For technical specifications on the OEMStar, please see *Section A.2* starting on page 79.

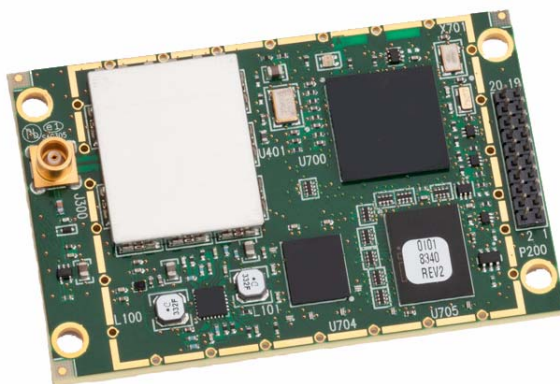


Figure 2: OEMStar Receiver

1.2.1 Radio Frequency (RF) Section

The receiver obtains a filtered and amplified GNSS signal from the antenna via the coaxial cable. The RF section performs the down-conversion of the incoming RF signal to an Intermediate Frequency (IF) signal. The IF signal then undergoes analog-to-digital conversion to get digitized into a stream of samples that can be used by the digital section. It also distributes 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).

1.2.2 Digital Electronics Section

The digital section of the receiver receives the digital samples of the down-converted, amplified GNSS signal and processes them to obtain a GNSS solution (position, velocity and time). The digital section consists of a high-performance baseband processor with integrated signal processing logic, memory, control and configuration logic, serial peripheral devices, and supporting circuitry.

The digital section performs the calculations necessary to convert the digital samples of the IF 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 2.2.1* on page 36. For input and output levels please see *Appendix A*.

1.3 OEMStar Receiver System Overview

In addition to a NovAtel OEMStar card, a complete GNSS receiver system typically contains four other major components:

- A custom enclosure and wiring harness
- A GNSS antenna (and optional LNA power supply)
- A power supply
- Data communications equipment

The overall system is represented in *Figure 3*. A brief description of the Radio Frequency (RF) and Digital Electronics sections follow the figure. The components listed earlier are also described. Details of installation and set up are provided in *Chapter 2, Installation and Setup* on Page 29.

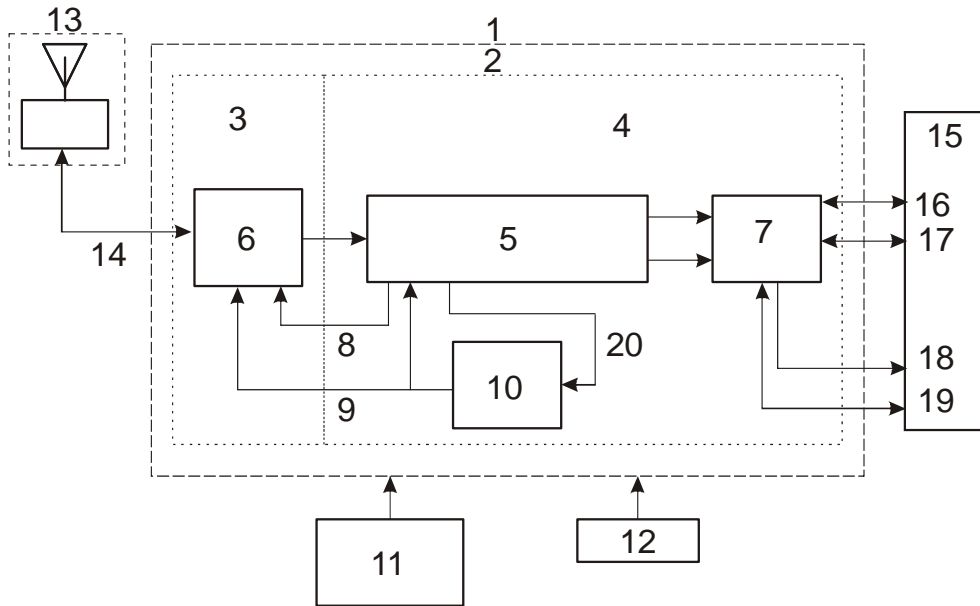


Figure 3: GNSS Receiver System Functional Diagram

Reference	Description	Reference	Description
1	Enclosure	12	Power Supply
2	OEMStar Card	13	GNSS Antenna and LNA
3	RF Section	14	RF, Coaxial Cable and Power
4	Digital Section	15	User Interface
5	GNSS Processor	16	COM1
6	RF-IF Sections	17	COM2
7	System I/O	18	1PPS
8	AGC	19	USB Communication
9	Clock	20	Oscillator Steering
10	VCTCXO		
11	Optional LNA Power		

1.4 OEMStar Receiver

NovAtel's OEMStar receivers consist of a radio frequency (RF) and a digital electronics section.

1.5 Enclosure and Wiring Harness

An enclosure is necessary to protect the OEMStar card from environmental exposure and RF interference. A user-supplied wiring harness is also required to provide an interface to the OEMStar card's antenna and power inputs and data and status signals.

1.6 GNSS Antenna

The purpose of the GNSS antenna is to convert the electromagnetic waves transmitted by the GNSS satellites into RF signals. An active antenna with low noise figure is required for the receiver to achieve the best performance. NovAtel's active antennas are recommended because of their precise phase centers and robust enclosures.

1.6.1 Optional LNA Power Supply

When an active GNSS antenna is used in a system with the OEMStar receiver card, then an external power supply is required to power the LNA circuit of the antenna assembly. In the case when a passive antenna is used, then the additional power supply is not needed. See also *Antenna LNA Power* on Page 37.

1.7 Principal Power Supply

A single external power supply capable of delivering the minimum receiver voltage necessary to operate the receiver. Minimum voltage for the card, see *Appendix A, Technical Specifications* on page 78 for details.

WARNING: The LNA power pin (pin 1 of the 20-pin connector) can handle a maximum voltage of **5.25 VDC**.



Note: This is different from all other OEMV and SSII products which are equipped with a 5V voltage regulator on the board.

Failure to adhere to this warning, may result in your OEMStar card becoming permanently damaged and void your warranty.

1.8 Data Communications Equipment

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

1.9 OEMStar Enclosures

The OEMStar should be housed in an enclosure to provide a complete receiver solution. When connected to an antenna and a power source, the enclosure and card form a fully functioning GNSS receiver. Enclosures offer protection against environmental conditions and RF interference. In addition, they provides an interface to the card's data, power, and status signals. This section includes information on NovAtel enclosures available.

1.9.1 FlexPak-G2™

NovAtel's FlexPak-G2 is a rugged, waterproof housing for the OEMStar, OEMV-2, OEMV-1G or OEMV-1 receiver. The FlexPak-G2-Star™ is a GPS + GLONASS model.

The FlexPak-G2 offers the following features:

- A waterproof, shock and dust resistant enclosure
- Low power consumption
- Two serial ports (COM1 is RS-232 and COM2 is RS-232/RS-422)
- USB support
- PPS output
- Configurable event input
- Indicators for position, communication status and power

The following accessories are included with the FlexPak-G2:

- 12 V power adapter cable
- Data cables
 - null modem serial
 - USB
 - 12V power adapter
 - I/O Cable
- A CD containing NovAtel's PC utilities and product documentation

For technical specifications on the FlexPak-G2, please refer to *Appendix A.3, FlexPak-G2-Star* on page 87.



Figure 4: FlexPak-G2 Enclosure

This chapter contains instructions and tips to set up your NovAtel receiver to create a GNSS receiver system similar to that described in *Chapter 3, Receiver System Overview* on page 37.

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
- A NovAtel GNSS antenna
- A quality coaxial cable (and interconnect adapter cable as necessary)
- Data communication equipment capable of serial communication
- A serial cable (if not included with the receiver)
- A power supply
- A power cable (if not included with the receiver)
- Wrist-grounding strap to prevent ESD damage (for more information, see *Appendix B* on page 95)



CAUTION: When the 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* on page 20 and *Notices* on page 14.

2.1.1 Selecting a GNSS 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 GNSS antenna models, as indicated in *Table 1* on page 30. All include band-pass filtering and an LNA. The GNSS 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. The ANT-A72GA-TW-N, ANT-C2GA-TW-N, ANT-A72GLA4-TW-N, ANT-35C1GA-TW-N, ANT-26C1GA-TBW-N, ANT-35C50P1GLA-TW-N, GPS-702L, GPS-701-GG, GPS-702-GG, GPS-701-GGL and GPS-702-GGL are RoHS compliant.

Table 1: NovAtel GNSS Antenna Models

Models	Frequencies Supported	GPS	GLONASS
701, 35C1GA-TW-N, 26C1GA-TBW-N	L1 only	✓	✗
702, A72GA-TW-N, C2GA-TW-N	L1 and L2	✓	✗
702L, A72GLA4-TW-N	L1 and L2 plus L-band	✓	✗
701GGL, 35C50P1GLA-TW-N	L1 plus L-band	✓	✓
701GG	L1 only	✓	✓
702GGL	L1 and L2 plus L-band	✓	✓
702GG	L1 and L2	✓	✓

2.1.2 Choosing a Coaxial Cable

An appropriate coaxial cable is one that matches the impedance of the antenna and receiver being used (50 ohms), and whose line loss does not exceed 10.0 dB. If the limit is exceeded, excessive signal degradation occurs and the receiver may not be able to meet its performance specifications. NovAtel offers a variety of coaxial cables to meet your GNSS 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)
- 22 cm interconnect adapter cable between the MCX and the TNC connectors (NovAtel part #GPS-C002)

☒ A conversion is required between the female MCX connector on the OEMStar and the female TNC connector on NovAtel's GNSS antennas.

Your local NovAtel dealer can advise you about your specific configuration. If your application requires the use of cable longer than 30 m, refer to the application note *RF Equipment Selection and Installation* on our Web site at www.novatel.com, or you can obtain it directly from NovAtel.

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 OEMStar receivers only qualify for NovAtel's warranty when used with NovAtel-supplied accessories.

2.1.3 Power Supply Requirements

This section contains information on the requirements for the input power to the receiver. See *Appendix A, Technical Specifications* starting on page 78 for more power supply specifications.

WARNING: The LNA power pin (pin 1 of the 20-pin connector) can handle a maximum voltage of **5.25 VDC**.



The USB port (pins 3 and 4 of the 20-pin connector) must not be connected to an external voltage supply

Notes:

This is different from all other OEMV and Superstar II products which are equipped with a 5V voltage regulator on the board.

Superstar II users should ensure that pin 3 is not connected to an external voltage supply. For example, VBATT.

Failure to adhere to this warning, may result in your OEMStar card becoming permanently damaged and void your warranty.

OEMStar receivers

The OEMStar 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 required. The power supply used for any OEMStar card should be capable of 5W (5V @ 1A or 3.3V @ 1.5A). The voltage input range for each the OEMStar is +3.1 VDC to 5.25 VDC.

All OEMStar receivers are designed to prevent internal damage when subjected to a reverse polarity power connection. 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 OEMStar's requirements.

Installation Overview

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

1. Install the OEMStar receiver in an enclosure with a wiring harness, as described in *Section 2.1.4* on page 32.
2. Mount the GNSS antenna to a secure, stable structure, as described in *Section 2.1.5* on page 35.
3. Connect the GNSS antenna to the receiver using an antenna RF cable, using the information given in *Section 2.1.6* on page 35.
4. Apply power to the receiver, as described in *Section 2.1.7* on page 35.
5. Connect the receiver to a PC or other data communications equipment by following the information given in *Section 2.1.8* on page 35.

2.1.4 Installing an OEMStar Card in a Wiring Harness and Enclosure

To install an OEMStar receiver, begin with the following:

1. Ensure you are taking the necessary precautions against ESD, as described in the following section.
2. Mount the receiver in a secure enclosure to reduce environmental exposure and RF interference, as described in *Mounting the Printed Circuit Board*, in the following section.
3. Prepare a wiring harness to interface to the receiver's data, status, and power signals using the information given in *Preparing the Data, Signal & Power Harness* starting on page 33.

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 an OEMStar receiver. See *Appendix B, Electrostatic Discharge Control (ESD) Practices* starting on page 95 for more information about ESD precautions.

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

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



CAUTION

- **Always wear a properly grounded anti-static wrist strap when handling the OEMStar receiver.**
 - Always hold the OEMStar by its corners or the RF shield, and avoid direct contact with any of the components.
 - Do not let the OEMStar 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 OEMStar receiver.
 - Warranty may be voided if equipment is damaged by ESD.
-
-

Mounting the Printed Circuit Board

The OEMStar receiver is an OEM product 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
-

☒ Integrator note: The receiver can not pass emissions testing by itself. It must be in an enclosure. For example, the FlexPak-G2 passes regulatory emissions. For more information about the FlexPak-G2, refer to the *OEMV Installation and Operation User Guide* found on our Web site at www.novatel.com through *Support / Firmware/Software and Manuals*. For more information about emissions testing, please refer to the regulatory body in your geographic area. For example, in North America that is the Federal Communications Commission (FCC) and in Europe the Conformité Européenne (CE).

- protection from ESD (see *Appendix B, Electrostatic Discharge Control (ESD) Practices* starting on page 95)

The OEMStar receiver can be held in place by screws when used in a custom assembly. Please see *Appendix A, Technical Specifications* starting on page 78 for mechanical drawings.

Preparing the Data, Signal & Power Harness

The wiring harness serves the following interconnect functions:

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

For all cards, 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*, the OEMStar card uses a 20 pin header for the data, power, and status signals. The RF input is a female MCX connector. The pin outs for this connector is specified in *Appendix A, Technical Specifications* starting on *page 78*. Manufacturers' part numbers are in *Section C.2* on *page 98*.

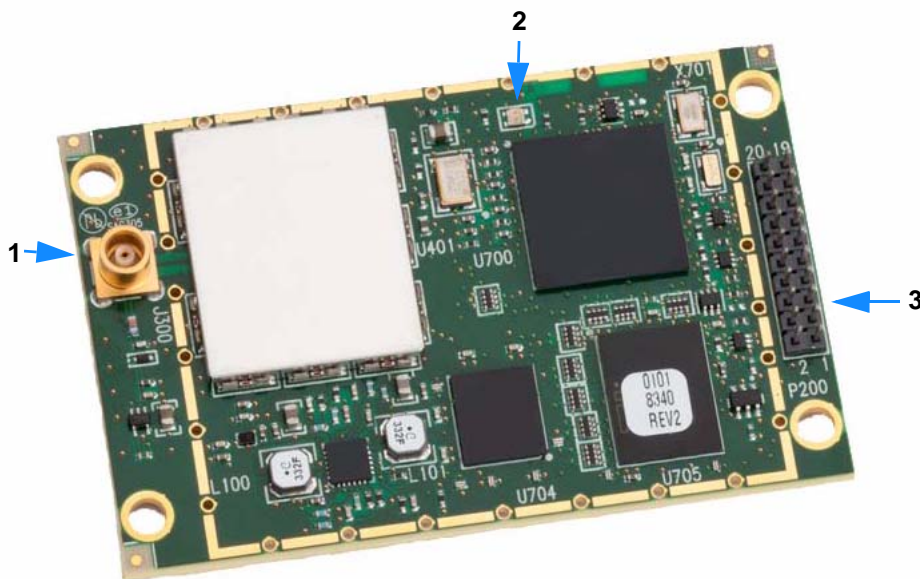


Figure 5: OEMStar Connector and Indicator Locations

Reference	Description
1	J300 RF signal input and LNA power output (MCX female connector)
2	LED status indicator
3	P200 power, data, and signal connector (20 pin dual row male connector with a 2 mm straight 2 x 10 header)

2.1.5 Mounting the GNSS Antenna

Once the OEMStar card is installed in a wiring harness and enclosure, the antenna to be used with the receiver must be mounted. The GNSS receiver has been designed to operate with any of the NovAtel single-frequency or dual-frequency GNSS antenna models. See *Section 2.1.1* on *page 29* 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.
- Mount the antenna on a secure, stable structure capable of safe operation in the specific environment.

2.1.6 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 30*.

The OEMStar receiver requires an interconnect adapter cable to convert the TNC male end of the coaxial cable to the card's MCX female RF input connector. The location of the RF connector for the OEMStar card is shown in *Appendix A, Technical Specifications* starting on *page 78*.

2.1.7 Applying Power to the Receiver

Connect the power supply, set to the voltage given in *Section 2.1.3* on *page 31*, to the wiring harness created previously. When removing power from the receiver, it is recommended to wait at least 30 seconds before reapplying power.

2.1.8 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. The default configuration for the OEMStar is the following:

- COM1 and COM2: LVTTTL

On many of the receivers, extra control lines are provided on COM2 for use with modems or other differential correction data links.

The FlexPak-G2 enclosures are Data Terminal Equipment (DTE) so that TXD is output while RXD is input. A null modem cable, supplied with the receiver, is required to connect to another DTE such as a terminal or a PC or another receiver, while a straight-through cable is required to connect to a DCE such as a data radio.

☒ OEMStar card COM ports do not support the RTS, DTR, CTS and DCD outputs and inputs.

The port settings (bit rate, parity, and so on) are software-configurable. These are further described in

Chapter 3, Operation on page 38. See Appendix A, *Technical Specifications* starting on page 78 for further information on data communications characteristics.

2.2 Additional Features and Information

This section contains information on the additional features of the OEMStar receiver, which may affect the overall design of your receiver system.

2.2.1 Strobes

On the OEMStar receiver, a set of inputs and outputs provide status and synchronization signals. These signals are referred to as strobes. 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. Pin-out information can also be found in *Appendix A, Technical Specifications* starting on page 78.

2.2.2 Universal Serial Bus (USB)

The OEMStar receiver USB device port (pins 3 [D-] and 4 [D+] of the interface header), along with the accompanying NovAtel USB drivers for Windows 2000 and Windows XP, provides virtual serial ports over a single USB 2.0 connection using USB D(+) and USB D(-) signals.

The three virtual serial ports, identified by the OEMStar receiver as USB1, USB2, and USB3, are available to existing Windows applications which use COM ports to communicate. For example, a terminal program. The NovAtel USB drivers assign COM port numbers sequentially following any existing ports on the PC. For example, if a PC has COM1 and COM2 ports, the NovAtel USB drivers assign COM3 to USB1, COM4 to USB2, and COM5 to USB3.

☒ Typically, a PC has several physical USB ports. The assignment of COM port numbers is tied to a USB port on the PC. This allows you to switch receivers without Windows assigning new COM ports. However, if you connect the receiver to a different physical USB port, Windows detects the receiver's presence on that USB port and assigns three new COM port numbers.

The NovAtel USB Configuration Utility installed with the NovAtel USB drivers allows you to change the COM port numbers assigned to the virtual serial ports. The USB drivers are available from our Web site at www.novatel.com through *Support | Firmware/Software and Manuals*.

CAUTION



The USB ports are particularly sensitive to damage from Electrostatic Discharge (ESD). It is therefore recommended that conductors attached to the USB D+ and D- signal pins are not left unterminated.

2.2.3 Status Indicators

The OEMStar receiver has a single indicator, which is shown in *Figure 5* on page 34. 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 5.5* on *page 71*.

2.2.4 Antenna LNA Power

Receiver RF input gain requirements are easily met when using NovAtel antennas and coaxial cables. NovAtel antennas employ a built-in, low-noise amplifier (LNA), which typically provides 26 dB of gain to the received satellite signal. The power to the antenna LNA is provided through the center conductor of the receiver's RF port. To achieve the required input gain to the receiver, NovAtel coaxial cables have been designed to exhibit no more than 6 dB loss. Antenna supply over-current protection is provided on the OEMStar and is limited to 150mA.

OEMStar uses external LNA power only. It is VERY important to note that the OEMStar receiver does not include an internal regulator circuit to fix the LNA supply voltage to a specific level. The OEMStar card simply distributes the externally supplied power via a current limiting switch. Use extreme care to set the voltage supply between 3.1 and 5.25 VDC and connect it to pin 1 of the OEMStar 20-pin connector. Applying an external voltage greater than 5.25VDC will damage the card and void your warranty. See also *Appendix A, RF Input / LNA Power Output* on *page 82*.



CAUTION *NovAtel guarantees its performance specifications only when using NovAtel antennas.*

Before operating the receiver for the first time, please ensure that you have followed the installation instructions in *Chapter 2, Installation and Setup* on page 29. The following instructions are based on a configuration such as that shown in *Figure 6*. It is assumed that a personal computer is used during initial operation and testing for greater ease and versatility.

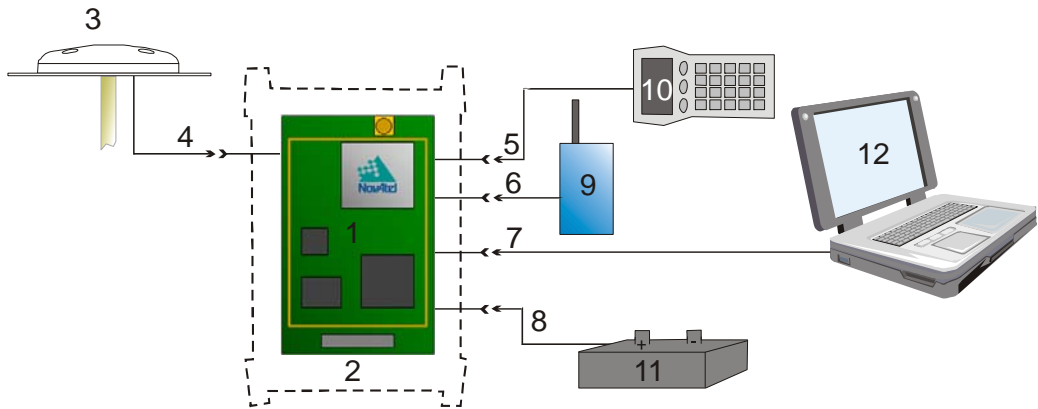


Figure 6: Available OEM Card Connection Interfaces

Reference	Description	Reference	Description
1	OEMStar Card	8	Power Input
2	Enclosure ¹	9	User-Supplied Base Radio
3	NovAtel GNSS Antenna	10	Data Logger or Rover
4	GNSS Signal (RF Cable)	11	External DC Power Source
5	COM1 Link	12	Laptop or PC with NovAtel USB drivers installed
6	COM2 Link		
7	USB Link		

☒ See also *Figure 7* on page 42 for a base/rover example.

1. Custom or NovAtel

3.1 Communications with the Receiver

Communication with the receiver typically consists of issuing commands through the communication ports from an external serial communications device. This could be either a terminal or a PC that is directly connected to the receiver serial port using a null modem cable. If you are using an RTK radio it connects to the receiver's COM port by means of the radio serial cable supplied with the receiver. It is recommended that you become thoroughly familiar with the commands and logs detailed in the *OEMStar Firmware Reference Manual* found on our Web site at www.novatel.com through *Support / Firmware/Software and Manuals* to ensure maximum utilization of the receiver's capabilities.

3.1.1 Serial Port Default Settings

The receiver communicates with your PC or terminal via a serial port. For communication to occur, both the receiver and the operator interface have to be configured properly. The receiver's COM1 and COM2 default port settings are as follows:

- 9600 bps, no parity, 8 data bits, 1 stop bit, no handshaking, echo off

Changing the default settings requires using the *COM* command.

The data transfer rate you choose determines how fast information is transmitted. Take for example a log whose message byte count is 96. The default port settings allows 10 bits/byte (8 data bits + 1 stop bit + 1 framing bit). It therefore takes 960 bits per message. To get 10 messages per second then requires 9600 bps. Please also remember that even if you set the bps to 9600 the actual data transfer rate is lower and depends on the number of satellites being tracked, data filters in use, and idle time. It is therefore suggested that you leave yourself a margin when choosing a data rate (115200 is recommended for most applications).

CAUTION:

Although the receiver can operate at data transfer rates as low as 300 bps, this is not desirable. For example, if several data logs are active (that is, a significant amount of information needs to be transmitted every second) but the bit rate is set too low, data will overflow the serial port buffers, cause an error condition in the receiver status and result in lost data.

3.1.2 Communicating Using a Remote Terminal

One method of communicating with the receiver is through a remote terminal. The receiver has been pre-wired to allow proper RS-232 interface with your data terminal. To communicate with the terminal the receiver only requires the RX, TX, and GND lines to be used. Ensure the terminal's communications set-up matches the receiver's RS-232 protocol.

3.1.3 Communicating Using a Personal Computer

A PC can be set up to emulate a remote terminal as well as provide the added flexibility of creating multiple-command batch files and data logging storage files. Any standard communications software package that emulates a terminal can be used to establish bidirectional communications with the receiver, for example, Hyperterminal or our own graphic user interface (GUI) program, CDU. All data is sent as raw 8-bit binary or ASCII characters.

3.2 Getting Started

NovAtel's CDU and Convert programs can be downloaded from our Web site at www.novatel.com. CDU is a windows-based GUI which allows you to access the receiver's many features without the need for communications protocol or to write special software. The Convert utility is a windows-based utility that allows you to convert between file formats, and strips unwanted records for data file compilation. See *Chapter 4, PC Software and Firmware on page 48* for more information about these programs and their installation.

☒ The latest CDU is available to download from our Web site at www.novatel.com through *Support | Firmware/Software and Manuals | Product Updates | OEMStar PC Utilities*.

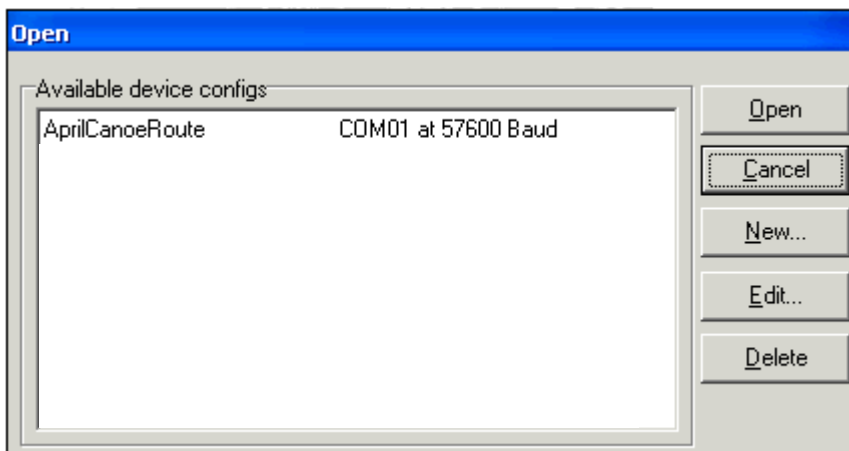
Please use CDU version 3.7.0.4 and higher for OEMStar.

3.2.1 Starting the Receiver

The receiver's software resides in flash memory. When first powered, it undergoes a complete self-test. If an error condition is detected during a self-test, the self-test status word changes. This self-test status word can be viewed in the header of any data output log. Refer to the chapter on *Messages* in the *OEMStar Firmware Reference Manual* for header information. If a persistent error develops, please contact your local NovAtel dealer first. If the problem is still unresolved, please contact NovAtel directly through one of the methods listed in the *Customer Support* section at the beginning of this manual on *page 17*.

3.2.2 Communicating with the Receiver Using CDU

Launch the CDU program and select *Device | Open* from its main menu. The *Open Configuration* window appears. The following example shows an *Open Configuration* window with a configuration already set up. Your configurations may be different or you may have none at all, in which case, the *Open Configuration* window is empty.



Refer to CDU's help file by selecting the *Help | Contents* menu. See also *Chapter 4, PC Software and*

Firmware starting on page 48 for descriptions of the CDU windows available from the *View* menu. Ensure you can see the *Console* and *ASCII Messages* windows by selecting them from the *View* menu.

When the receiver is first turned on, no data is transmitted from the COM ports except for the port prompt. The Console window displays a port name:

[COM1] *if connected to COM1 port,*

[COM2] *if connected to COM2 port,*

Any of the above prompts indicate that the receiver is ready and waiting for command input. The screen may display other port names for other port types, for example USB1, USB2, or USB3.

-
- ☒ 1. You may also have to wait for output from receiver self tests. For example, on start-up, the OEMStar receiver is set to log the RXSTATUSEVENTA log ONNEW on all ports. See *Section 5.3, RXSTATUSEVENT Log on page 68* for more details.
 - 2. If you find that CDU is unable to locate your receiver, it may be that you have previously used the SAVECONFIG command. In this case, try using a different COM port to communicate with the receiver. Once communication has been established, issue a FRESET STANDARD command. You should now be able to use your original communication port again.
-

Commands are typed at the interfacing computing device's keypad or keyboard, and executed after issuing a carriage return command which is usually the same as pressing the <Enter> key.

An example of a response to an input command is the FIX POSITION command. It can be as:

```
[COM2] fix position 51.11635 -114.0383 1048.2 [carriage return]
<OK
```

where [COM2] is the port prompt, followed by the command you enter from your keypad or keyboard and [carriage return] indicates that you should press the <Enter> key.

The above example illustrates command input to the base receiver's COM2 port which sets the position of the base station receiver for differential operation. Confirmation that the command was actually accepted is the appearance of <OK>.

If a command is entered incorrectly, the receiver responds with:

```
<INVALID MESSAGE ID                (or a more detailed message)
```



WARNING!: Ensure the Control Panel's Power Settings on your PC are not set to go into Hibernate or Standby modes. Data will be lost if one of these modes occurs during a logging session.

3.3 Transmitting and Receiving Corrections

Corrections can be transmitted from a base station to a rover station to improve position accuracy.

-
- ☒ The OEMStar can receive RTCM, RTCA, CMR, CMR+, RTCM 2.3 and RTCM 3.0 corrections to resolve DGPS solutions. With the DGPS_TX model upgrade, the OEMStar can transmit non-carrier phase RTCM and RTCA corrections. Contact your local NovAtel dealer for more information. To locate a dealer in your area contact NovAtel Inc.
-

The base station is the GNSS receiver which is acting as the stationary reference. It has a known position and transmits correction messages to the rover station. The rover station is the GNSS receiver which does not know its exact position and can accept correction messages from a base station to calculate differential GNSS positions. An example of a differential setup is given in *Figure 7*.

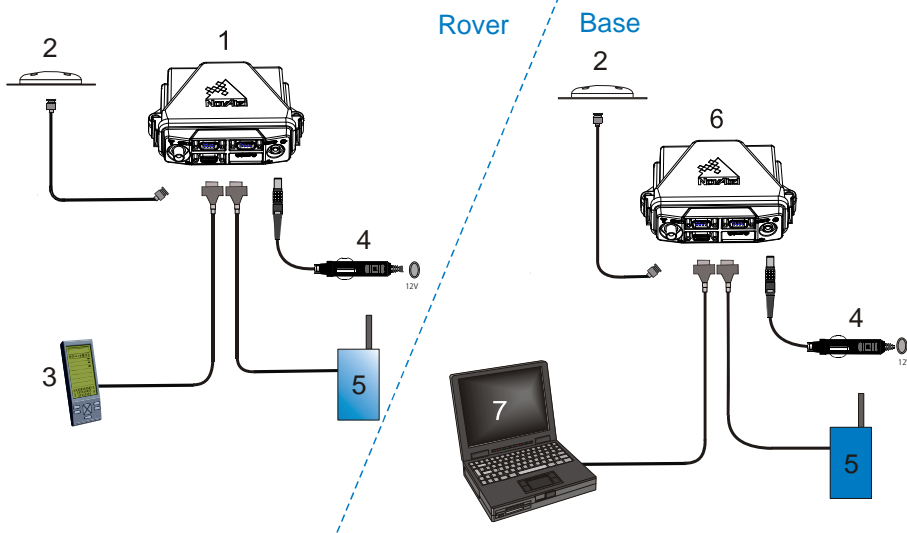


Figure 7: Basic Differential Setup

Reference	Description
1	A FlexPak-G2 ¹ receiver for the rover station
2	NovAtel GNSS antenna
3	User-supplied data storage device to COM1
4	User-supplied power supply
5	User-supplied radio device to COM2
6	A FlexPak-G2 receiver for the base station
7	User-supplied laptop/PC, for setting up and monitoring, to COM1

1. For more information about the FlexPak-G2, please refer to the *OEMV Family Installation and Operation User Guide* found on our Web site at www.novatel.com through *Support | Firmware/Support and Manuals*.

Errors can be introduced by system biases. For more information about system errors please refer to the Knowledge and Learning page in the Support section of our Web site at www.novatel.com. In most cases you need to provide a data link between the base station and rover station (two NovAtel receivers) in order to receive corrections. SBAS corrections can be accomplished with one receiver and are exceptions to the base/rover concept. Generally a link capable of data throughput at a rate of 9600 bits per second, and less than 4.0 s latency, is recommended.

Once your base and rover are set up, you can configure them as shown in the configuration examples that follow in *Sections 3.3.1 - 3.3.2* starting on *page 43*. *Section 3.3.3* gives an example of how to set up your base and rover for GPS+GLONASS DGPS operation with RTCM.

3.3.1 Base Station Configuration

At the base station, enter the following commands:

```
interfacemode port rx_type tx_type [responses]
fix position latitude longitude height(enter your own lat,
lon, and hgt values)
log port message [trigger [period]]
```

For example:

```
RTCA      pdpfilter disable
           interfacemode com2 none rtca off
           fix position 51.11358042 -114.04358013 1059.4105
           (enter your own lat, lon, hgt)
           log com2 rtca1 ontime 5
           log com2 rtcaephem ontime 10           (optional)
```

```
RTCM      pdpfilter disable
           interfacemode com2 none rtcm off
           fix position 51.11358042 -114.04358013 1059.4105
           (enter your own lat, lon, hgt)
           log com2 rtcml ontime 5
```

3.3.2 Rover Station Configuration

At the rover station, enter:

```
interfacemode port rx_type tx_type [responses]
```

For example:

```
RTCA      interfacemode com2 rtca none off
RTCM      interfacemode com2 rtcm none off
```

```

RTCMV3      interfacemode com2 rtcmv3 none off
CMR+       interfacemode com2 cmr none off
CMR        interfacemode com2 cmr none off      (same as CMR+)

```

3.3.3 GPS + GLONASS Base and Rover Configuration

This section shows you how to set up your base and rover OEMStar GPS + GLONASS-enabled receivers for GPS + GLONASS DGPS corrections operation:

Base Station:

```

pdpfilter disable
fix position lat lon hgt          (enter your own lat, lon, and hgt values)
com com2 115200 N 8 1 N off
interfacemode com2 none rtcn off
log com2 rtcn1 ontime 5
log com2 rtcn31 ontime 5 1
saveconfig                       (optional, save configuration to non-volatile memory)

```

Rover Station (DGPS positions):

```

com com2 115200 N 8 1 N off
interfacemode com2 rtcn none off
log com1 bestposa ontime 1      (optional, view position information)
saveconfig                       (optional, save configuration to non-volatile memory)

```

3.3.4 PDP and GLIDE Configurations

PDP and GLIDE position filters can be used for single-point, WAAS or DGPS. For more information about PDP and GLIDE, please refer to our Web site at www.novatel.com through *Support / Helpdesk & Solutions / Search Known Solutions*.

-
- ☒ GLIDE is an optional feature. Please contact your local NovAtel dealer for more information.
To locate a dealer in your area contact NovAtel Inc.

By default, PDP is enabled on the OEMStar.

To reset the PDP or GLIDE filter:

```
pdpfilter reset
```

To enable the PDP filter:

```
pdpfilter enable
```

Ensure you issue the PDPFILTER command before the PDPMODE command. Set the PDP type and kinematic type according to the application. For most kinematic applications:

```
pdpmode relative dynamic or pdpmode relative auto
```

The rest of the configuration depends on whether single point, WAAS or DGPS are in use. For single point and DGPS, do not issue a SETIONOTYPE command (so it uses L1).

For WAAS:

```
setionotype grid
```

The rest of the setup is position type and log dependent according to your application. For example, details of the RTKSOURCE, PSRDIFFSOURCE, INTERFACEMODE, COM and other configuration commands are in the *OEMStar Firmware Reference Manual* available on our Web site at www.novatel.com.

3.3.5 Configuration Notes

For compatibility with other GNSS receivers, and to minimize message size, it is recommended that you use the standard form of RTCA, RTCM, RTCMV3 or CMR corrections as shown in the base and rover examples in Section 3.3.1 and Section 3.3.2. This requires using the INTERFACEMODE command to dedicate one direction of a serial port to only that message type. When the INTERFACEMODE command is used to change the mode from the default, NOVATEL, you can no longer use NovAtel format messages.

If you wish to mix NovAtel format messages and RTCA, RTCM, RTCMV3 or CMR messages on the same port, you can leave the INTERFACEMODE set to NOVATEL and log out variants of the standard correction messages with a NovAtel header. ASCII or binary variants can be requested by simply appending an "A" or "B" to the standard message name. For example on the base station:

```

pdpfilter disable
interfacemode com2 novatel novatel
fix position 51.11358042 -114.04358013 1059.4105
log com2 rtcmlb ontime 2

```

-
- ☒ 1. Interface mode must be set to NovAtel for the receiver to issue logs with an a or b suffix.
 - 2. Using the receiver in this mode consumes more CPU bandwidth than using the native differential messages as shown in *Section 3.3.1, Base Station Configuration* on page 43.
 - 3. Find information about how to send multiple commands and log requests using DOS or Windows from the Knowledge and Learning section of our Web site at www.novatel.com through *Support / Helpdesk & Solutions / Search Known Solutions*.
 - 4. PSRDIFFSOURCE entries fall back to SBAS (except NONE) for backwards compatibility. When DGPS corrections are interrupted or no longer available, the receiver will use available SBAS corrections instead, as long as SBASCONTROL has been enabled and the receiver is actively tracking SBAS satellites. The receiver will not use SBAS corrections when PSRDIFFSOURCE is set to NONE.
-

At the rover, you can leave the INTERFACEMODE default settings (interfacemode com2 novatel novatel). The rover recognizes the default and uses the corrections it receives with a NovAtel header.

The PSRDIFFSOURCE and RTKSOURCE commands set the station ID values which identify the base stations from which to accept pseudorange or RTK corrections respectively. They are useful commands when the rover station is receiving corrections from multiple base stations. For more information about SBAS please refer to the Knowledge and Learning page in the Support section of our Web site at www.novatel.com.

At the base station it is also possible to log out the contents of the standard corrections in a form that is easier to read. These larger variants have the correction fields broken out into standard types within the log, rather than compressed into bit fields. This can be useful if you wish to modify the format of the corrections for a non-standard application, or if you wish to look at the corrections for system debugging purposes. These variants have "DATA" as part of their names (for example, RTCADATA1, RTCMDATA1, CMRDATAOBS, and more). Refer also to the *OEMStar Firmware Reference Manual*, which describes the various message formats in more detail.

3.4 Enabling SBAS Positioning

OEMStar receivers are capable of SBAS positioning which is disabled by default. SBAS positioning requires a channel configuration that includes SBAS channels. For example: `SELECTCHANCONFIG 2` (this results in 12 GPS L1 and 2 SBAS L1).

This positioning mode is enabled using the SBASCONTROL command. On a simulator, you may want to leave the *testmode* parameter off or specify NONE explicitly. The following commands are typically used to enable WAAS and other SBAS modes, for example EGNOS, respectively:

```
sbascontrol enable waas  
sbascontrol enable egnos
```

For more information about SBAS, please refer to the Knowledge and Learning page in the Support section of our Web site at www.novatel.com.

3.5 Pass-Through Logging

The pass-through logging feature enables the GNSS receiver to redirect any ASCII or binary data that is input at a specified COM port or, if available, USB port to any specified receiver COM or USB port. This capability, in conjunction with the SEND command, can allow the receiver to perform bi-directional communications with other devices such as a modem, terminal, or another receiver.

There are several pass-through logs. **PASSCOM1**, **PASSCOM2**, **PASSUSB1**, **PASSUSB2**, and **PASSUSB3** are available on OEMStar receivers for logging through serial ports. Refer to the PASSCOMx log in the *OEMStar Firmware Reference Manual* for details.

4.1 CDU/Convert Installation

Visit the [Firmware and Software Updates](#) section of the NovAtel Web site, www.novatel.com, for the most recent versions of the PC software and receiver firmware.

The Windows applications CDU (Control and Display Unit) and Convert are installed via a standard Install Shield set-up application. Also included with CDU is sample source code, to aid development of software for interfacing with the receiver, and product documentation.

These applications utilize a database in their operations so the necessary components of the Borland Database Engine (BDE) are installed as well as the necessary database tables and an alias for the database. The install set-up application does all this automatically so you have only to select where you would like the applications installed on your PC. It is strongly recommended that you close all applications before installing CDU and Convert. You must close any applications that may be using the BDE before installing. The install set-up modifies the BDE configuration so that it can recognize the new CDU and Convert.

The software operates from your PC's hard drive. You will need to install the software from the NovAtel Web site at www.novatel.com.

1. Start Microsoft Windows.
2. If the setup utility is not automatically accessible, follow these steps:
 - a. Select Run from the Start menu.
 - b. Select the Browse button.
 - c. Locate Setup.exe and select Open.
 - d. Select OK to run the setup utility.
3. Advance through the steps provided by the setup utility.

When the installation is complete, click on a program icon to launch the application.

☒ The latest CDU is available to download from our Web site www.novatel.com through *Support / Firmware/Software and Manuals / Product Updates / OEMStar PC Utilities*.

Please use CDU version 3.7.0.4 and higher for OEMStar.

4.2 CDU

CDU is a 32-bit Windows application. The application provides a graphical user interface (GUI) to allow you to set-up and monitor the operation of the NovAtel receiver by providing a series of windows whose functionality is explained in this section. A help file is included with CDU. To access the file, select *Contents* from the *Help* menu.


See also *Section 3.2.2, Communicating with the Receiver Using CDU* starting on page 40.

The rest of this section shows the CDU windows from the *View* menu and their descriptions.



Most windows have a pop-up menu accessible by right-clicking the window with the mouse. They provide a way to customize the window by changing the font or to print the window contents. Some of the windows have access to the Options dialog which contains further settings for certain windows.

- **Constellation Window:** The Constellation window displays each satellite being tracked by the receiver. When you select a satellite, the window shows details of its PRN, Signal to Noise Ratio

(SNR), azimuth and elevation. Concentric circles from 0° to 90° represent elevations from the horizon to directly overhead, respectively. The azimuth is mapped on a compass relative to true North. The colored rings indicate the lowest elevation cut-off angles at which satellites are tracked and can be changed or viewed via the  button.

The satellites being tracked are represented with the following icons according to their satellite system:

- Circular for GPS
- Square for GLONASS
- Hexagonal for SBAS

There are also information icons and values at the bottom of the window:

- The number of GPS/GLONASS satellites used in the solution versus the number being tracked. For example, 0/5 next to the Russian flag means that while the receiver is tracking 5 GLONASS satellites, none are currently used in the position solution.
- Satellite PRN number Azimuth and elevation angle values
- Signal to Noise Ratio (SNR) value and indicator

The PRN of the satellite is displayed on the icon and color-coding is used to indicate the status of the satellite or the tracking channel. Click on a satellite to display information on that satellite.

When a valid position has been achieved, dilution of precision (DOP) values can be viewed in the DOP window.



Open this window by selecting Constellation Window from the View menu or by clicking its button in the Window Toolbar.

- **Channel Tracking Status Window:** The Channel Tracking Status window displays key information for each of the receiver's processing channels, including the PRN of the satellite being tracked by that channel, the Signal to Noise Ratio, Pseudorange measurements, Doppler values, Residuals measurements and Lock Time from the satellite.

The TRACKSTAT log provides the data for many of the fields listed in this window. The number of channels displayed depends on the model of your receiver and the bars are color-keyed to indicate the frequency type on the channel.



Open these windows by selecting Tracking Status Window GPS/GLONASS from the View menu or by selecting the American and Russian flag buttons in the Window Toolbar.

- **Position Window:** The Position window displays:
 - The receiver's latitude, longitude and height
 - The Solution Type, also known as Position Type

- The solution or differential age (number of seconds the current solution has been valid). Normally this represents the latency in the correction data.
- The number of satellites used in the solution
- The Solution Status
- The receiver's date and time (GMT and local)



Open this window by selecting Position Window from the View menu or its button in the Window Toolbar.

Right-clicking in the Position window enables you to set the PC clock to the receiver's time, change the font used to display the position data or set the units through the Options dialog box.

- **Velocity Window:** The Velocity window displays vertical and horizontal speed and direction. The numeric displays within the dial, and the velocity values below the dial, show the vector velocity as well as the vertical, North, and East velocity components. If necessary, the scale in the dial increases so that you have room to accelerate.



Open this window by selecting Velocity Window from the View menu or its button in the Window Toolbar.

- **Compass Window:** The direction dial is a compass that displays the direction of motion of the receiver over ground and its elevation (both in degrees). The white arrow indicates the elevation value on the vertical scale down the center of the dial. The black arrow on the outer rim of the dial indicates the Track Over Ground value. Both the track over ground and elevation angles are also shown at the bottom of the Compass window.



Open this window by selecting Compass Window from the View menu or its button in the Window Toolbar.

- **INS Window:** If applicable, please refer to your SPAN User Manual for more on INS. Information in the INS Position, Velocity, Attitude window is only available if you have an INS-capable receiver model.

The dial is a graphical display of the Roll, Pitch and Azimuth values indicated by an arrow on each axis.



Open this window by selecting INS Window from the View menu or its button in the Window Toolbar.

- **Plan Window:** The Plan window provides real-time graphic plotting of the current position of each connected device. The latitude and longitude shown at the bottom of the window indicate

the receiver's reference position, which is used as the center of the grid system. The receiver's subsequent positions, shown with a yellow + marker, are given relative to this initial starting point. The current position is shown with a red + marker.

The buttons at the top of the window provide options for controlling the plan display:

- Zoom in or out of the Plan window
- View all configurations or center in on the active configuration
- Select a grid or circular display
- Show/Hide history
- Delete all history (no undo)



To open this window, select Plan Window from the View menu or select its button in the Window Toolbar.



- **DOP Window:** A value representing the uncertainty of the position solution based on the current satellite geometry. The lower the value, the greater the confidence in the solution.

In the DOP window, DOP is displayed in the following forms:

- | | |
|--------|---|
| • GDOP | Geometric DOP: Uncertainty of all parameters (latitude, longitude, height, clock offset) |
| • PDOP | Position DOP: Uncertainty of the three-dimensional parameters (latitude, longitude, height) |
| • HDOP | Horizontal DOP: Uncertainty of the two-dimensional parameters (latitude, longitude) |
| • VDOP | Vertical DOP: Uncertainty of the height |
| • TDOP | Time DOP: Uncertainty of the clock offset |

- **Console Window:** This window allows the user to communicate directly to the receiver through the serial port. It is essentially a terminal emulator with added receiver functionality. Commands can be issued to the receiver via the command editor (at the bottom of the window) and sent by pressing the Enter button or simply pressing <Enter> on the keyboard. The command editor has recall functionality similar to DosKey whereby pressing the up arrow on the keyboard will move backward through the previously issued commands and pressing the down arrow will move forward through the previously issued commands. This allows the user to scroll through previously issued commands and then press the <Enter> key to issue that command again.

Feedback from the receiver is displayed in the ASCII Messages or Console window depending on the format of the message (ASCII or Abbreviated ASCII respectively).



WARNING!: Before you enter the SAVECONFIG command through the Console window, make sure all other CDU windows are closed; otherwise, the configuration of logs that have been activated to populate these windows will also be saved.



This window automatically opens when CDU is first connected to a receiver. To bring the window to the front, select Console Window from the View menu or click its button in the Window Toolbar.

- **Logging Control Window:** The Logging Control window provides a graphical interface for:
 - Initiating data logging to a file
 - Initiating logging to the receiver's serial ports
 - Specifying a time window for data logging
 - Stopping logging
 - Editing log settings



To display the Logging Control window, select Logging Control Window from the Tools menu or select its button in the Window Toolbar.



WARNING!: Ensure the Power Settings on your PC are not set to go into Hibernate or Standby modes. Data will be lost if one of these modes occurs during a logging session. Refer to CDU's online Help for more information.

- **ASCII Messages Window:** This window displays ASCII formatted NovAtel logs.



To display the ASCII Messages window, select ASCII Messages Window from the View menu or select its button in the Window Toolbar.

- **Wizards:** The Pseudorange/Delta phase (PDP) Wizard is available to the OEMStar.

Pseudorange/Delta-phase provides a filtered position and velocity solution based on assumed vehicle dynamics. The advantage of this approach is smoother solution output and greater solution availability. The Pseudorange/Delta-phase Wizard help you configure your PDP filter and is accessible from the Tools menu.

-
- The PDP filter is enabled by default.
-

4.3 Convert

Convert is a 32-bit Windows application and is shown in *Figure 8*. Convert will accept GPS file formats and convert them to ASCII, Binary or RINEX format. The application also allows the user to screen out particular logs by selecting the desired logs from the list of available logs. This feature is useful for screening particular logs out of large data files in either ASCII or Binary formats.

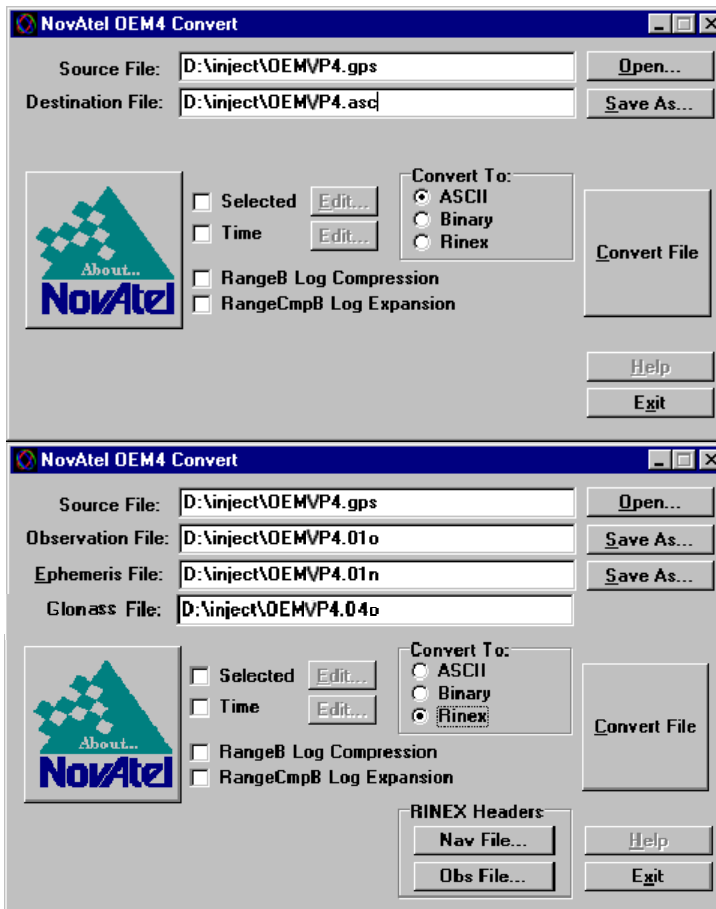


Figure 8: Convert Screen Examples

4.3.1 RINEX Format

The Receiver-Independent Exchange (RINEX¹) format is a broadly-accepted, receiver-independent format for storing GPS data. It features a non-proprietary ASCII file format that can be used to combine or process data generated by receivers made by different manufacturers.

The Convert4 utility can be used to produce RINEX files from NovAtel receiver data files.

Although RINEX is intended to be a receiver-independent format, there are many optional records and fields. Please keep this in mind when combining NovAtel and non-NovAtel RINEX data.

When converting to RINEX, two files are produced - a RINEX observation file and a RINEX navigation file. A third GLONASS file is produced if the data contains GLONASS observations. The default names of these files conform to the RINEX Version 2.10 recommended naming convention of sssdddf.yyt, where:

ssss	4 character station name - Convert4 uses the first four characters of the <infile> parameter as the station ID
ddd	day of year
f	file sequence number within the day - Convert4 sets this to zero
t	file type: o for the observation and n for the navigation file

Selecting the RINEX field, see *Figure 8, Convert Screen Examples on page 54*, in the Convert To section causes the:

1. *Destination File:* field to be replaced by the *Observation File:* and *Ephemeris File:* fields. Note that Observation File refers to the RINEX OBS file while Ephemeris File refers to the RINEX NAV file.
2. *RINEX Headers* buttons to appear allowing you to supply additional information that appears in the header records of the RINEX output files (for example, Company Name, Marker Name and Marker Number).

For best results, the NovAtel receiver input data file should contain the logs as in *Table 2, NovAtel Logs for Rinex Conversion on page 56*.

-
1. For further information on RINEX Version 2.10 file descriptions, you may wish to consult the U.S. National Geodetic Survey Web site at <http://www.ngs.noaa.gov/CORS/Rinex2.html>.

Table 2: NovAtel Logs for Rinex Conversion

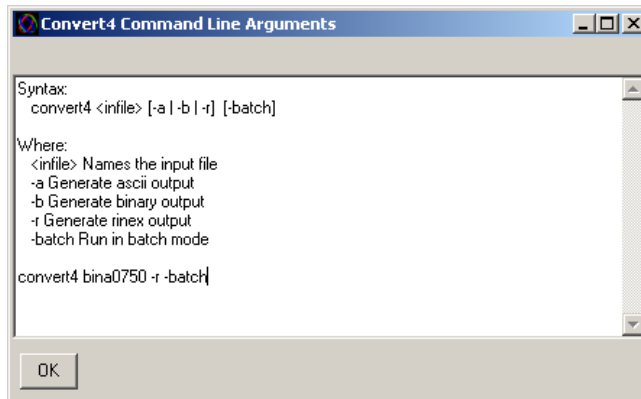
NovAtel OEMStar Log	Recommended Trigger
RANGEA/B, or RANGECMPA/B	ontime 15
BESTPOSA/B, or PSRPOSA/B, or MARKPOSA/B	once
IONUTCA/B	onchanged
RAWEPHEMA/B	onchanged
GLORAWEPHEMA/B	onchanged
VERSIONA/B ^a	once

- a. Information from this log overrides data entered into the Receiver Number, Type and Version fields using the OBS file button of the RINEX Headers section, see *Figure 8* on *page 54*.

4.3.2 Convert Command Line Switches

Convert4 supports several command-line switches to facilitate batch processing. To access its Command Line Arguments window, open a command prompt window (select Accessories | Command Prompt from the Start menu). Change directory (cd) to the directory on your hard drive that Convert4 is stored. Type the following: `convert4 -h`

The Convert4 Command Line Arguments window appears as shown in *Figure 9*.

**Figure 9: Convert Command Line Arguments**

The name of the output file is the same as the input file when converting to ASCII or binary formats. The file extension, however, is altered to indicate the format of the data:

- *.asc for ASCII
- *.bin for binary

When converting to RINEX, the output files are named according to the RINEX Version 2.10 naming convention, see *Section 4.3.1, RINEX Format* on page 55.

The `-batch` arguments suppress the window display and convert the specified file automatically.

-
- When converting to RINEX in batch mode, the navigation and observation file header information from the most recent interactive Convert session is used.
-

4.4 USB Drivers Installation

The NovAtel USB PC Driver Kit contains the following:

<code>ngpsser.sys</code>	This driver provides a virtual serial port for each USB port of the receiver.
<code>ngpsusb.sys</code>	This driver connects the virtual serial ports to the USB stack.
<code>novatelusb.exe</code>	This utility allows you to control which Windows COM ports are assigned to each USB port of the receiver. This utility can also be used to uninstall the drivers when newer versions are available. During installation, a short-cut is added to the Start Menu under Programs/NovAtel PC Software/NovAtel USB Configuration Utility.

-
- Depending on your computer's Driver Signing Policy, Windows may refuse to install the driver or may display a warning. See *Section 4.4.1, Windows Driver Signing* for details.
-

4.4.1 Windows Driver Signing

Depending on how your administrator has configured your computer, Windows 2000 and Windows XP either ignore device drivers that are not digitally signed, display a warning when they detect device drivers that are not digitally signed (the default), or prevent you from installing device drivers without digital signatures.

Since the current version of NovAtel USB drivers are not digitally signed, the computer's policy must be either Ignore or Warn to enable the drivers to be installed.

To change the Driver Signing Policy on your computer:

1. Double-click on System in the Control Panel.
2. Select the Hardware tab.
3. Click on the Driver Signing button
4. Select either Ignore or Warn in the File signature verification box.
5. Click on OK to accept the new policy.
6. Click on OK again to close the System Properties dialog.
7. Unplug the NovAtel receiver USB cable, plug it back in and follow the installation instructions described in either the *Windows XP Installation* section or the *Windows 2000 Installation* section starting on page 60.

4.4.2 Windows XP Installation

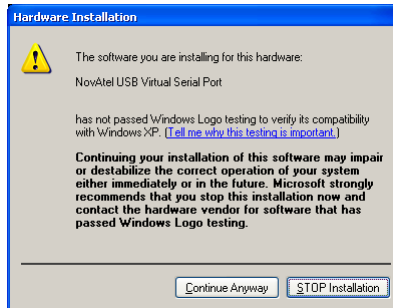
If upgrading drivers, uninstall the older version using the NovAtel USB Configuration tool located in the Start Menu under Program Files | NovAtel PC Software. If you have not installed NovAtel USB drivers before, the NovAtel USB Configuration tool will not be there until you install them.

After connecting the NovAtel GNSS receiver to a USB port on the PC, the Found New Hardware wizard appears.

-
- ☒ 1. The screens displayed in this section, from Windows XP, may vary from what you see and depend on your operating system.

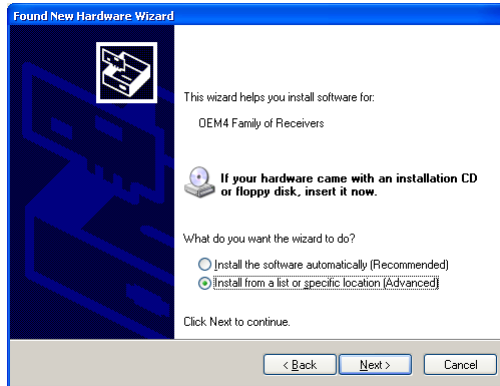


2. During the driver installation you may see a Window's warning if you skipped the steps in *Section 4.4.1, Windows Driver Signing on page 57*. Our USB drivers are compatible with Microsoft Windows operating systems. Please click on *Continue Anyway* if you see a warning like this:

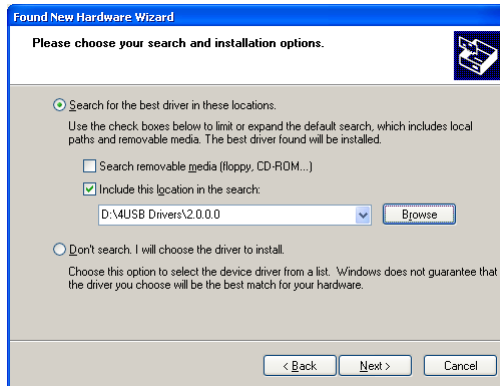


-
1. Click on *No, not this time* and then click on *Next*.

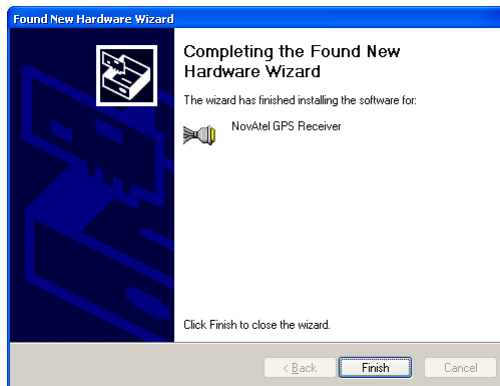
2. Select the *Install from a list or specific location (Advanced)* field and click on *Next*.



3. Clear the *Search removable media* check box, select the *Include this location in the search:* field and Browse to the USB driver install directory. Click on *Next*.



4. Click on *Finish* to complete the driver installation.

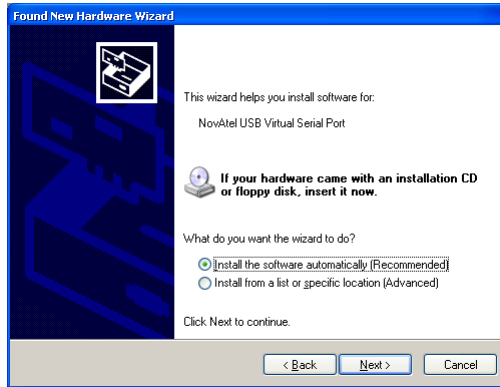


After installing the NovAtel USB driver, Windows detects the receiver's new virtual COM ports and

begins to initialize them. As each port is detected, the Found New Hardware wizard appears.

Complete the following steps for each port:

1. Select the Install the software automatically field (recommended) and click on *Next*.



2. Click on *Finish*.

Installation is complete when no more dialogs appear. The new COM ports corresponding to the receiver's USB1, USB2, and USB3 ports are numbered sequentially following the existing ports in the PC, and are ready to use with any existing application that communicates with the receiver's COM ports.

-
- ☒ The assignment of COM port numbers is tied to the USB port on the PC. This allows you to switch receivers without Windows assigning new COM ports. However, if you connect the receiver to a different USB port, Windows detects the receiver's presence on that USB port and assigns three new COM port numbers.
-

4.4.3 Windows 2000 Installation

If upgrading drivers, uninstall the older version using the NovAtel USB Configuration tool located in the Start Menu under Program Files | NovAtel PC Software.

After connecting the NovAtel GNSS receiver to a USB port on the PC, the Found New Hardware wizard appears. Click on *Next*. (see the example screens and notes in *Section 4.4.2, Windows XP Installation* starting on page 58).

1. Select the Search for a suitable driver for my device field and click on Next.
2. Select the Specify a location field and click on Next.
3. Specify the location using the browse button.
4. Click on OK.
5. Confirm that the driver found is, for example: \USB Drivers\Install\ngpsusb.inf
6. Click on Next.
7. Click on Finish to complete the driver installation.

After installing the drivers, Windows detects the NovAtel receiver's new virtual COM ports and begins to initialize them. Installation is complete when no more dialogs appear. The new COM ports corresponding to the receiver's USB1, USB2, and USB3 ports are numbered sequentially following the existing ports in the PC, and are ready to use with any existing application that communicates with the receiver's COM ports.

-
- ☒ The assignment of COM port numbers is tied to the USB port on the PC. This allows you to switch receivers without Windows assigning new COM ports. However, if you connect the receiver to a different USB port, Windows detects the receiver's presence on that USB port and assigns three new COM port numbers.
-

4.5 Firmware Upgrades

The receiver stores its program firmware in non-volatile memory, which allows you to perform firmware upgrades without having to return the receiver to the distributor. New firmware can be transferred to the receiver through COM1, and the unit will immediately be ready for operation at a higher level of performance.

The first step in upgrading your receiver is to contact your local NovAtel dealer. Your dealer will assist you in selecting the best upgrade option that suits your specific GNSS needs. If your needs are still unresolved after seeing your dealer then you can contact NovAtel directly through any of the methods described in the Customer Support section, see *page 18*, at the beginning of this manual.

When you call, be sure to have available your receiver model number, serial number, and firmware revision level. This information can be found by issuing the LOG VERSION command at the port prompt.

After establishing which new model/revision level would best suit your needs, and having described the terms and conditions, you will be issued an authorization code (auth-code). The auth-code is required to unlock the new features according to your authorized upgrade model type.

To upgrade to a higher performance model at the same firmware revision level you can use the AUTH command with the issued auth-code. If you are upgrading to a higher firmware revision level, you will need to transfer new program firmware to the OEMStar receiver using the WinLoad utility program. As WinLoad and the upgrade file are generally provided in a compressed file format, you may also be given a decompression password. WinLoad and the upgrade files can be found on NovAtel's FTP site at <ftp://ftp.novatel.ca/incoming>, or can be sent to you on disk or by e-mail.

Your local NovAtel dealer will provide you with all the information that you require to upgrade your receiver.

-
- ☒ Updates without direct access to the Serial COM ports of the OEM card or a way of multiplexing the COM port is not recommended and prone to failure.
-

4.5.1 Upgrading Using the AUTH Command

The AUTH command is a special input command which authorizes the enabling or unlocking of the

various model features. Use this command when upgrading to a higher performance OEMStar model available within the same firmware revision level as your current model. This command only functions in conjunction with a valid auth-code assigned by Customer Support.

The upgrade can be performed directly from CDU's Command Line Screen, or from any other communications program. The procedure is as follows:

- 1) Power-up the OEMStar receiver and establish communications over a serial port (see *Chapter 3, Operation on page 38*)
- 2) Issue the LOG VERSION command to verify the current firmware revision level, model number, and serial number.
- 3) Issue the AUTH command, followed by the auth-code and model type. The syntax is as follows:

Syntax:

```
auth auth-code
```

where auth is a special command which allows program model upgrades

auth-code is the upgrade authorization code, expressed as

hhhhhh,hhhhhh,hhhhhh,hhhhhh,hhhhhh,model# where the h characters are an ASCII hexadecimal code, and the model# would be ASCII text

Example:

```
auth x586n3,5jbpb5,8rmh28,9zn9jh,mw5tkr,m6xv1g
```

Once the AUTH command has been executed, the OEMStar receiver will reboot itself. Issuing the LOG VERSION command will confirm the new upgrade model type.

If communicating using CDU, the communication path needs to be closed and re-opened using the Device menu.

4.5.2 Updating Using the WinLoad Utility

WinLoad is required (instead of the AUTH command) when upgrading previously released firmware with a newer version of program and model firmware. WinLoad is a Windows utility program designed to facilitate program and model upgrades. Once WinLoad is installed and running, it will allow you to select a host PC serial port, bit rate, directory path, and file name of the new program firmware to be transferred to the OEMStar receiver via its COM1 or COM2 port. The port chosen must have an RS-232 interface to the PC.

Transferring Firmware Files

To proceed with your program upgrade, you must first acquire the latest firmware revision. You will need a file with a name such as OEMXXXX.EXE (where XXXX is the firmware revision level). This file is available from NovAtel's FTP site found on our Web site at www.novatel.com, or via e-mail (support@novatel.ca). If transferring is not possible, the file can be mailed to you on a CD. For more information about how to contact NovAtel Customer Support please see *page 17* at the beginning of this manual.

For convenience, you may wish to copy this file to a GPS sub-directory (for example,

C:\GPS\LOADER).

The file is available in a compressed format and may include password protection with a password provided by Customer Support. After copying the file to your computer, it 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 (if password protected) to allow decompression

Example:

oem1001 12345678

A windows-based dialog box is provided for password entry.

The self-extracting archive will then generate the following files:

- WinLoad.exe WinLoad utility program
- HowTo.txt Instructions on how to use the WinLoad utility
- WhatsNew.txt Information on the changes made in the firmware since the last revision
- XXXX.hex Firmware version upgrade file, where XXXX = program version level (for example, 1001.hex)

Using the WinLoad Utility

WinLoad is a Windows based program used to download firmware to OEMStar cards. The main screen is shown in *Figure 10 on page 63*.

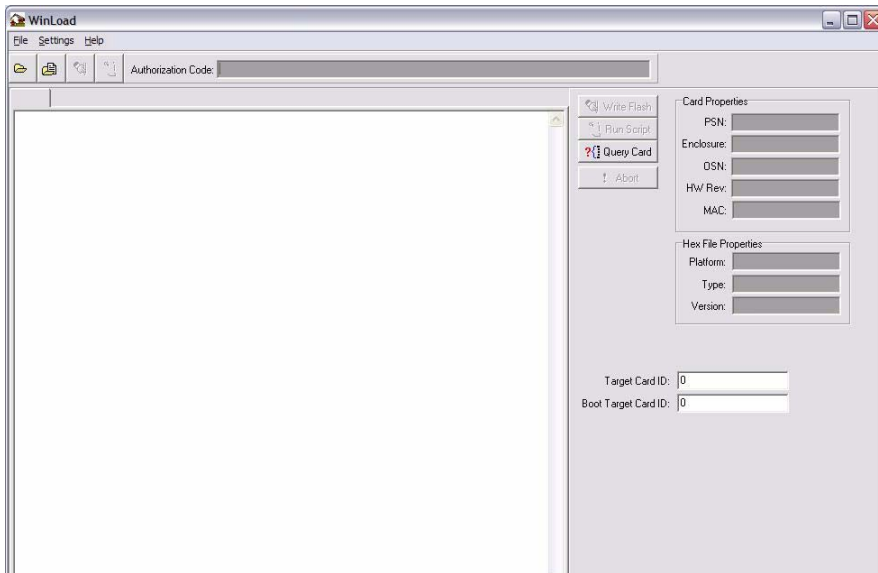


Figure 10: Main Screen of WinLoad

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

Open a File to Download

From the file menu choose Open. Use the Open dialog to browse for your file, see *Figure 11*, WinLoad's Open Dialog on page 64.

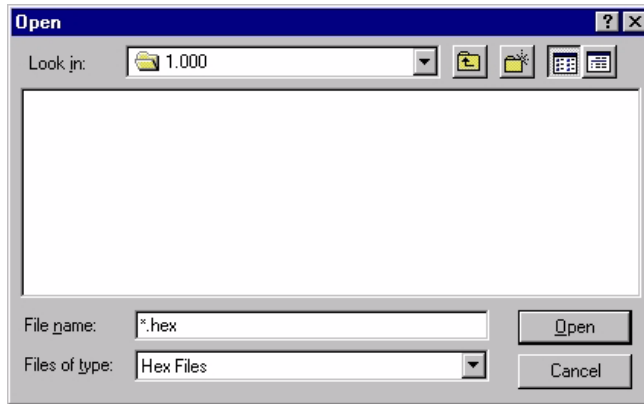


Figure 11: WinLoad's Open Dialog

Once you have selected your file, the name should appear in the main display area and in the title bar, see *Figure 12*.

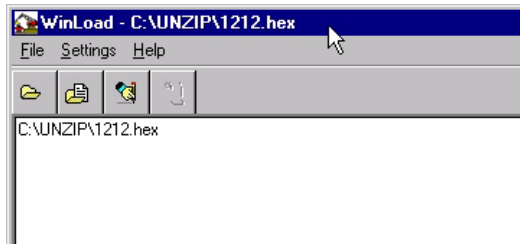


Figure 12: Open File in WinLoad

Communications Settings

To set the communications port and baud rate, select COM Settings from the Settings menu. 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).

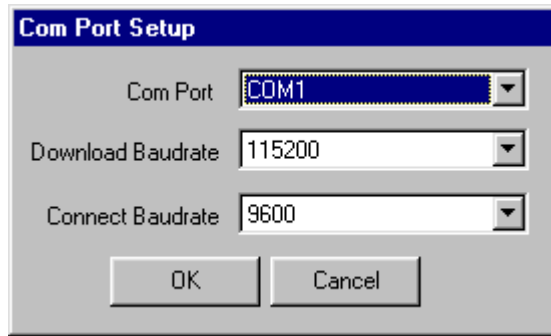


Figure 13: COM Port Setup

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 64*.
3. Make sure the file path and file name are displayed in main display area, see *Figure 12, Open File in WinLoad on page 64*.
4. Click on the Write Flash button to download the firmware.
5. Power down and then power up the receiver when “Searching for card” appears in the main display, see *Figure 14*.



Figure 14: Searching for Card

6. When the Authorization Code dialog opens, see *Figure 15*, enter the auth code and select OK

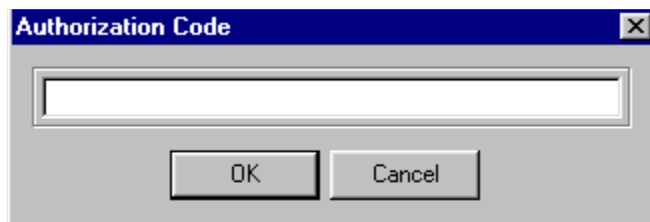


Figure 15: Authorization Code Dialog

7. The receiver should finish downloading and reset. The process is complete when “Done.” is displayed in the main display area, see *Figure 16*.

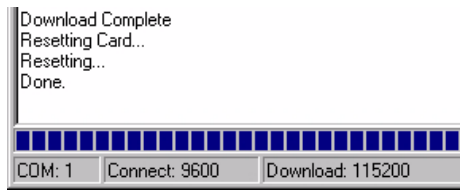


Figure 16: Upgrade Process Complete

8. Close WinLoad.

This completes the procedure required to upgrade an OEMStar receiver.

5.1 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 (included in the header of every message)
2. RXSTATUSEVENT log
3. RXSTATUS log
4. Status LED

In normal operation 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 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 (for example, in the event of a receiver hardware failure), a bit is set in the receiver error word, part of the RXSTATUS log, to indicate the cause of the problem. Bit 0 is set in the receiver status word to show that an error occurred and the LED flashes red and yellow showing an error code. An RXSTATUSEVENT log is generated on all ports to show the cause of the error. 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.

The above two paragraphs describe factory default behavior. Customizing is possible to better suit an individual application. RXSTATUSEVENT logs can be disabled completely using the UNLOG command. RXSTATUSEVENT logs can be generated when a receiver status bit is set or cleared by using the STATUSCONFIG SET and STATUSCONFIG CLEAR commands. Bits in the receiver status word can also be promoted to be treated just like error bits using the STATUSCONFIG PRIORITY command.

5.2 Receiver Status Word

The receiver status word indicates the current status of the receiver. This word is found in the header of all logs and in the RXSTATUS log. In addition the receiver status word is configurable.

The receiver gives the user the ability to determine the importance of the status bits. This is done using the priority masks. In the case of the Receiver Status, setting a bit in the priority mask will cause the condition to trigger an error. This will cause the receiver to idle all channels and turn off the antenna, the same as if a bit in the Receiver Error word is set. Setting a bit in an Auxiliary Status priority mask will cause that condition to set the bit in the Receiver Status word corresponding to that Auxiliary Status.

The STATUSCONFIG command is used to configure the various status mask fields in the RXSTATUSEVENT log. These masks allow you to modify whether various status fields generate errors or event messages when they are set or cleared. This is meant to allow you to customize the

operation of your OEMStar receiver for your specific needs.

Refer to the RXSTATUS log, RXSTATUSEVENT log and STATUSCONFIG command in the *OEMStar Firmware Reference Manual* for more detailed descriptions of these messages.

5.3 RXSTATUSEVENT Log

The RXSTATUSEVENT log is used to output event messages as indicated in the RXSTATUS log.

On start-up, the OEMStar receiver is set to log the RXSTATUSEVENTA log ONNEW on all ports. You can remove this message by using the UNLOG command.

Refer to the RXSTATUSEVENT log in the *OEMStar Firmware Reference Manual* for a more detailed description of this log.

5.4 RXSTATUS Log

5.4.1 Overview

The Receiver Status log (RXSTATUS) provides information on the current system status and configuration in a series of hexadecimal words.

The status word is the third field after the header, as shown in the example in *Figure 17*.

```

<RXSTATUS COM1 0 92.0 UNKNOWN 0 154.604 005c0020 643c 1899
< 00000000 4
< 005c0020 00000000 00000000 00000000
< 00000087 00000008 00000000 00000000
< 00000000 00000000 00000000 00000000
< 00000000 00000000 00000000 00000000
Receiver
Status
Word

```

Figure 17: Location of Receiver Status Word

Each bit in the status word indicates the status of a specific condition or function of the receiver. If the status word is 00000000, the receiver is operating normally. The numbering of the bits is shown in *Figure 18*.

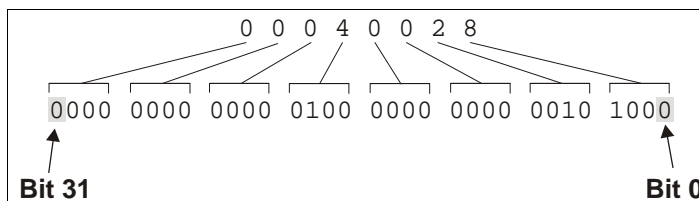


Figure 18: Reading the Bits in the Receiver Status Word

If the receiver status word indicates a problem, please also see *Section 6.1, Examining the RXSTATUS Log* on page 75.

5.4.2 Error Word

The error field contains a 32 bit word. Each bit in the word is used to indicate an error condition. Error conditions may result from damage to the hardware or erroneous data, so the receiver is put into an error state. If any bit in the error word is set, the receiver will set the error strobe line, flash the error code on the status LED, broadcast the RXSTATUSEVENT log on all ports (unless the user has unlogged it), idle all channels and turn off the antenna. The only way to get out of the error state is to reset the receiver.

It is also possible to have status conditions trigger event messages to be generated by the receiver. Receiver Error words automatically generate event messages. These event messages are output in RXSTATUSEVENT logs (see also *Section 5.4.6, Set and Clear Mask for all Status Code Arrays* on page 70).

The error word is the first field after the log header in the RXSTATUS log, as shown in the example in *Figure 19*, or the third from last field in the header of every log.

```

<RXSTATUS COM1 0 92.0 UNKNOWN 0 154.604 005c0020 643c 1899
< 00000000 4
< 005c0020 00000000 00000000 00000000
< 00000087 00000008 00000000 00000000
< 00000000 00000000 00000000 00000000
< 00000000 00000000 00000000 00000000

```

Receiver Error Word

Figure 19: Location of Receiver Error Word

Here is another example of a receiver error word. The numbering of the bits is shown in *Figure 20*.

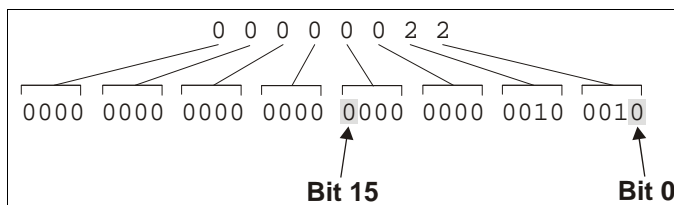


Figure 20: Reading the Bits in the Receiver Error Word

Refer to the RXSTATUS and the RXSTATUSEVENT logs in the *OEMStar Firmware Reference Manual* for more detailed descriptions of these logs. If the receiver error word indicates an error, please also see *Section 6.1, Table 4, Resolving a Receiver Error Word* on page 75.

5.4.3 Status Code Arrays

There are 4 status code arrays – the receiver status word, the auxiliary 1 status, the auxiliary 2 status and the auxiliary 3 status. Each status code array consists of 4, 32 bit words (the status word, a priority mask, a set mask and a clear mask). The status word is similar to the error word, with each of the 32 bits indicating a condition. The mask words are used to modify the behavior caused by a change in one of the bits in the associated status words. Each bit in any of the masks operates on the bit in the same position in the status word. For example setting bit 3 in the priority mask changes the priority of bit 3 in the status word.

5.4.4 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. Unlike the error word bits the receiver will continue to operate, unless the priority mask for the bit has been set. The priority mask bit will change that of the receiver status word into an error bit. Anything that would result from an error bit becoming active would also occur if a receiver status and its associated priority mask bits are set.

5.4.5 Auxiliary Status Codes

The auxiliary status codes are only seen in the RXSTATUS log. The three arrays representing the auxiliary status codes give indication about the receiver state for information only. The events represented by these bits typically do not cause degradation of the receiver performance. The priority mask for the auxiliary codes does not put the receiver into an error state. Setting a bit in the auxiliary priority mask results in the corresponding bit in the receiver status code to be set if any masked auxiliary bit is set. Bit 31 of the receiver status word indicates the condition of all masked bits in the auxiliary 1 status word. Likewise, bit 30 of the receiver status word corresponds to the auxiliary 2 status word, and bit 29 to the auxiliary 3 status word.

Refer also to the RXSTATUS log in the *OEMStar Firmware Reference Manual* for a more detailed description of this log.

5.4.6 Set and Clear Mask for all Status Code Arrays

The other two mask words in the status code arrays operate on the associated status word in the same way. These mask words are used to configure which bits in the status word will result in the broadcast of the RXSTATUSEVENT log. The set mask is used to turn logging on temporarily while the bit changes from the 0 to 1 state. The clear mask is used to turn logging on temporarily while the bit changes from a 1 to a 0 state. Note the error word does not have any associated mask words. Any bit set in the error word will result in the broadcast of the RXSTATUSEVENT log (unless unlogged).

Refer also to the RXSTATUSEVENT log in the *OEMStar Firmware Reference Manual* for a more detailed description.

5.5 Status LED

5.5.1 OEMStar Cards

The diagnostic LED provided on the OEMStar cards blinks green on and off at approximately 1 Hz to indicate normal operation.

Error bits and status bits that have been priority masked, as errors, 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 codes are ordered to have the highest priority condition output first.

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 on *page 72*, 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.

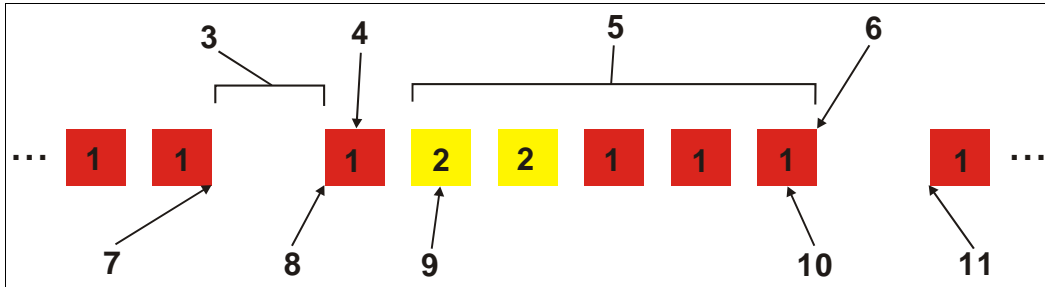


Figure 21: Status LED Flash Sequence Example

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

For a complete hexadecimal to binary conversion list, please refer to the Knowledge and Learning page in the Support section of our Web site at www.novatel.com. Refer also to the RXSTATUS log, and its tables in the *OEMStar Firmware Reference Manual* for more details on this log and receiver error status.

When your receiver appears not to be working properly, often there are simple ways to diagnose and resolve the problem. In many cases, the issue can be resolved within a few minutes, avoiding the hassle and loss of productivity that results from having to return your receiver for repair. This chapter is designed to assist you in troubleshooting problems that occur and includes navigational instructions to bring you to the part of this manual that details resolutions to aid your receiver's operation.

If you are unsure of the symptoms or if the symptoms do not match any of those listed, use the RXSTATUS log to check the receiver status and error words. See *Section 6.1, Examining the RXSTATUS Log*, page 75.

If the problem is not resolved after using this troubleshooting guide, or exploring our Knowledge and Learning page at www.novatel.com through *Support | Helpdesk & Solutions | Search Known Solutions*, contact NovAtel Customer Support, see page 17.

Table 3: Troubleshooting based on Symptoms

Symptom	Related Section
The receiver is not properly powered	Check for and replace a faulty power cable. See <i>Section 2.1.3, Power Supply Requirements</i> , page 31.
The receiver cannot establish communication	Check for and replace faulty serial cables and ports. <i>Section 5.5, Status LED</i> , page 71. Refer also to the COMCONFIG log in the <i>OEMStar Firmware Reference Manual</i> .
The receiver is not tracking satellites	Ensure you have an unobstructed view of the sky from horizon to horizon. Check for and replace a faulty antenna cable. See <i>Section 2.1.1, Selecting a GNSS Antenna</i> , page 29, <i>Section 2.1.2, Choosing a Coaxial Cable</i> , page 30, <i>Section 2.1.6, Connecting the Antenna to the Receiver</i> , page 35, <i>Section 2.2.4, Antenna LNA Power</i> , page 37 and refer to the <i>Time to First Fix</i> and <i>Satellite Acquisition</i> descriptions in the <i>Glossary of Terms</i> on our Web site at www.novatel.com through <i>Support Knowledge and Learning</i> .
No data is being logged	<i>Section 3.1, Communications with the Receiver</i> , page 39.
Random data is being output by the receiver, or binary data is streaming	Check the baud rate on the receiver and in the communication software. Refer to the COMCONFIG log and FRESET command in the <i>OEMStar Firmware Reference Manual</i> .

Continued on page 74

Symptom	Related Section
A command is not accepted by the receiver	Check for correct spelling and command syntax. See <i>Section 3.1, Communications with the Receiver, page 39</i> and refer to the FRESET command in the <i>OEMStar Firmware Reference Manual</i> .
Differential mode is not working properly	See <i>Section 3.3, Transmitting and Receiving Corrections, page 42</i> and refer to the COMCONFIG log in the <i>OEMStar Firmware Reference Manual</i> .
There appears to be a problem with the receiver's memory	Refer to the NVMRESTORE command in the <i>OEMStar Firmware Reference Manual</i> .
An environmental or memory failure. The receiver temperature is out of acceptable range or the internal thermometer is not working	See the ENVIRONMENTAL sections in the tables of <i>Appendix A, Technical Specifications</i> starting on <i>page 78</i> . Move the receiver to within an acceptable temperature range or increase the baud rate.
Overload and overrun problems. Either the CPU or port buffers are overloaded	Reduce the amount of logging. See also <i>Section 3.1.1, Serial Port Default Settings, page 39</i> .
The receiver is indicating that an invalid authorization code has been used	Refer to the Version log, VALIDMODELS log and the MODEL command in the <i>OEMStar Firmware Reference Manual</i> .
The receiver is being affected by jamming	Move the receiver away from any possible jamming sources.
The receiver's automatic gain control (AGC) is not working properly	See <i>Section 2.1.2, Choosing a Coaxial Cable, page 30</i> and the jamming symptom in this table.

6.1 Examining the RXSTATUS Log

The RXSTATUS log provides detailed status information about your receiver and can be used to diagnose problems. Please refer to the *OEMStar Firmware Reference Manual* for details on this log and on how to read the receiver error word and status word. *Tables 4 and 5 on pages 75 to 77* give you actions to take when your receiver has an error flag in either of these words.

Table 4: Resolving a Receiver Error Word

Bit Set	Action to Resolve
0	Issue a FRESET command
1	Issue a FRESET command
2	Issue a FRESET command
4	Contact Customer Support as described on <i>page 17</i>
5	Check the VERSION log
6	Issue a FRESET command
7	See <i>Section 2.1.3, Power Supply Requirements, page 31</i>
8	Issue a NVMRESTORE command
9	Check temperature ranges in the ENVIRONMENTAL table sections of <i>Appendix A, Technical Specifications</i> starting on <i>page 81</i>
10	Contact Customer Support as described on <i>page 17</i>
11	
12	
13	
14	
15	Move the receiver away from any possible jamming sources

Table 5: Resolving an Error in the Receiver Status Word

Bit Set	Action to Resolve
0	Check the Error Word in the RXSTATUS log. See also <i>Table 4, Resolving a Receiver Error Word</i> on page 75.
1	Check temperature ranges in the ENVIRONMENTAL table sections of <i>Appendix A, Technical Specifications</i> starting on page 81.
2	See <i>Section 2.1.3, Power Supply Requirements</i> , page 31.
3	See <i>Section 2.1.1, Selecting a GNSS Antenna</i> , page 29, <i>Section 2.1.2, Choosing a Coaxial Cable</i> , page 30, <i>Section 2.1.6, Connecting the Antenna to the Receiver</i> , page 35, <i>Section 2.2.4, Antenna LNA Power</i> , page 37 and refer to the <i>Time to First Fix</i> and <i>Satellite Acquisition</i> description in the <i>Glossary of Terms</i> on our Web site at www.novatel.com through <i>Support Knowledge and Learning</i> .
4	
5	
6	
7	See <i>Section 3.1.1, Serial Port Default Settings</i> , page 39.
8	
9	
10	
11	
14	Move the receiver away from any possible jamming sources.
15	See <i>Section 2.1.2, Choosing a Coaxial Cable</i> , page 30 and move the receiver away from any possible jamming sources.
16	Move the receiver away from any possible jamming sources.
17	See <i>Section 2.1.2, Choosing a Coaxial Cable</i> , page 30 and move the receiver away from any possible jamming sources.
18	None. Once enough time has passed for a valid almanac to be received, this bit will be set to 0. Also, refer to the <i>Time to First Fix</i> and <i>Satellite Acquisition</i> descriptions in the <i>Glossary of Terms</i> on our Web site at www.novatel.com through <i>Support Knowledge and Learning</i> .
19	None. This bit only indicates if the receiver has calculated a position yet. Refer to the <i>Time to First Fix</i> and <i>Satellite Acquisition</i> descriptions in the <i>Glossary of Terms</i> on our Web site at www.novatel.com through <i>Support Knowledge and Learning</i> .

Continued on page 77

Bit Set	Action to Resolve
20	None. This bit is simply a status bit indicating if the receiver's position has been manually fixed and does not represent a problem. Refer also to the FIX command in the <i>OEMStar Firmware Reference Manual</i> .
21	None. This bit simply indicates if clock steering has been manually disabled. Refer also to the FRESET command in the <i>OEMStar Firmware Reference Manual</i> .
22	None. This bit only indicates if the clock model is valid. Refer also to the FRESET command in the <i>OEMStar Firmware Reference Manual</i> .
23	None. Reserved.
30	None. This bit indicates if any bits in the auxiliary 2 status word are set. The auxiliary 2 word simply provides status information and does not provide any new information on problems. Refer also to the FRESET command in the <i>OEMStar Firmware Reference Manual</i> .
31	None. This bit indicates if any bits in the auxiliary 1 status word are set. The auxiliary 1 word simply provides status information and does not provide any new information on problems. Refer also to the FRESET command in the <i>OEMStar Firmware Reference Manual</i> .

A.1 OEMStar Receiver Performance

-
- ☒ Specifications in this document are subject to change without notice. Please check www.novatel.com for the latest OEMStar technical specifications.
-

PERFORMANCE (Subject To GPS System Characteristics)

Position Accuracy ^a	Standalone:		
	L1 Single Point	1.5 m RMS	
	SBAS ^b	0.7 m RMS	
	DGPS	0.5 m RMS	
Time To First Fix	Hot:	35 s (Almanac and recent ephemeris saved, and approximate position and time entered)	
	Cold:	65 s (No almanac or ephemeris and no approximate position or time)	
Reacquisition	< 1.0 s L1 (typical)		
Data Rates	Raw Measurements:	Up to 10 Hz	
	Computed Position:	Up to 10 Hz	
Time Accuracy ^{ac}	20 ns RMS		
Velocity Accuracy	<0.05 m/s RMS		
Measurement Precision	C/A code phase	GPS: 5 cm	GLONASS: 35 cm
	L1 carrier phase:		
	Differential	GPS: 0.6 mm	GLONASS: 1.5 mm
Dynamics	Velocity	515 m/s ^d	

- a. Typical values. Performance specifications are subject to GPS system characteristics, U.S. DOD operational degradation, ionospheric and tropospheric conditions, satellite geometry, baseline length and multipath effects.
- b. GPS-only
- c. Time accuracy does not include biases due to RF or antenna delay.
- d. In accordance with export licensing.

A.2 OEMStar/OEMStar-RA Card Physical and Electrical

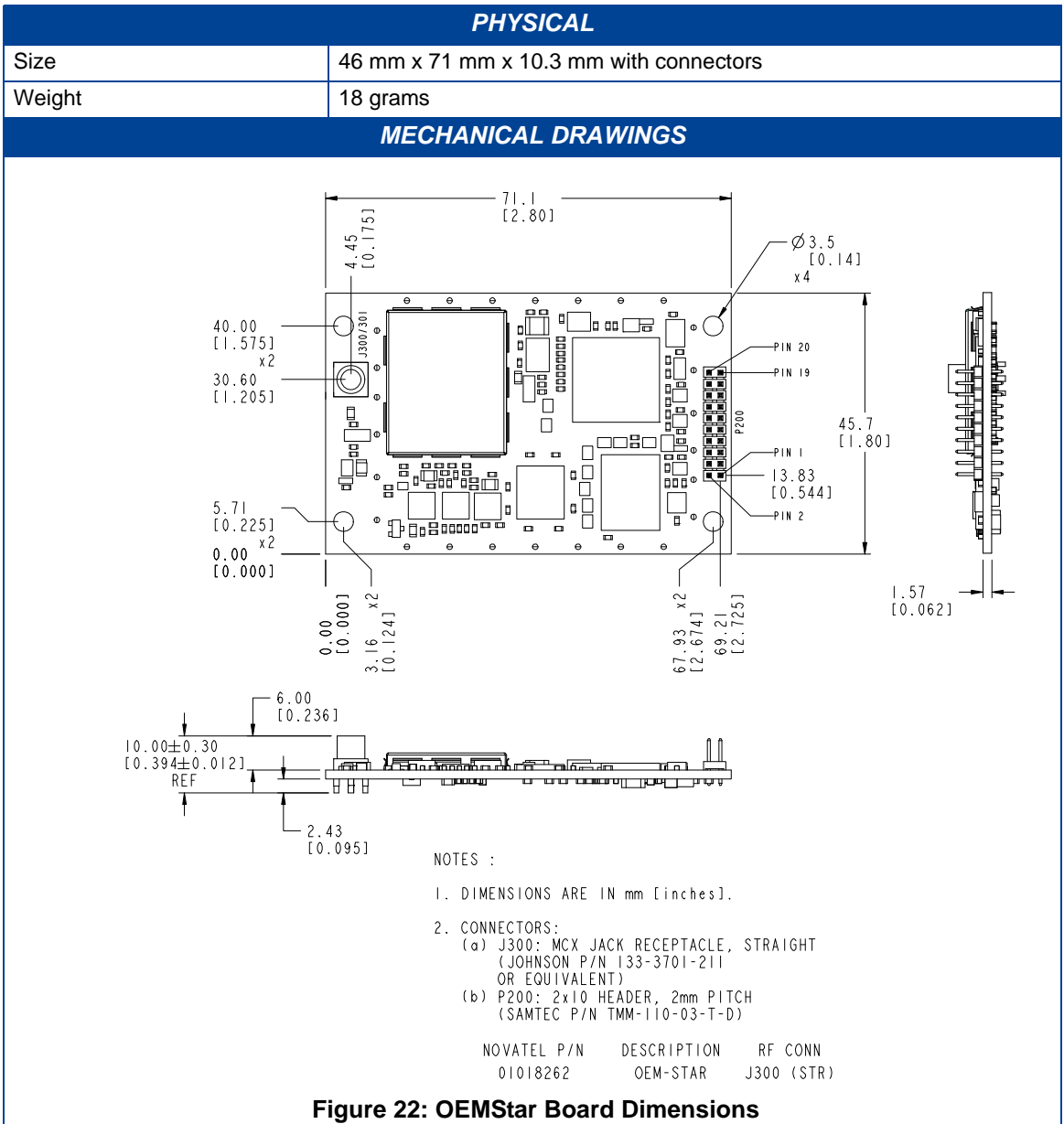
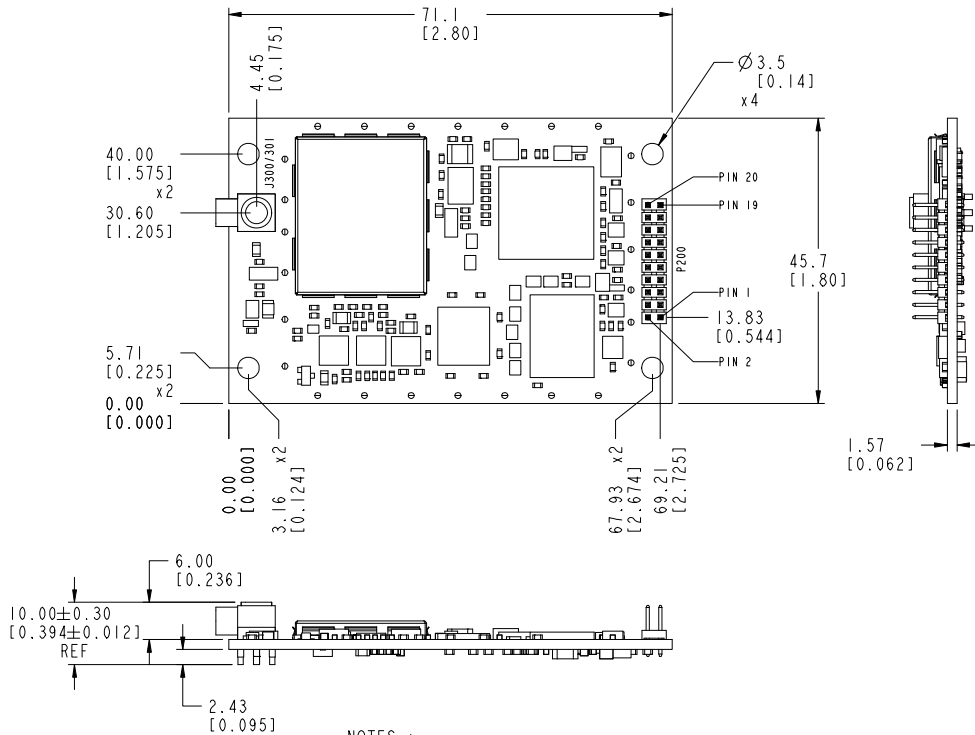


Figure 22: OEMStar Board Dimensions

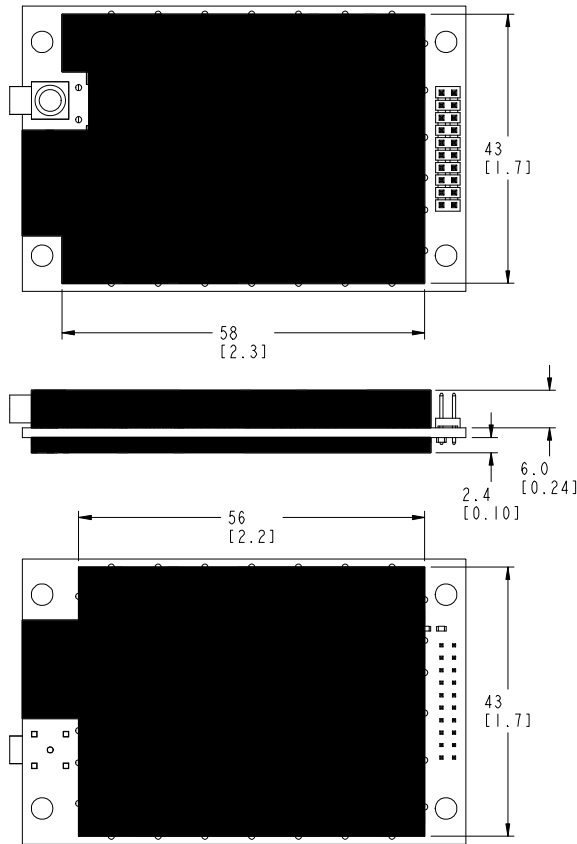


NOTES :

1. DIMENSIONS ARE IN mm [inches].
2. CONNECTORS:
 - (a) J301: MCX JACK RECEPTACLE, RIGHT ANGLE
(JOHNSON P/N 133-3701-316
OR TYCO P/N 5864-5003-10
OR EQUIVALENT)
 - (b) P200: 2x10 HEADER, 2mm PITCH
(SAMTEC P/N TMM-110-03-T-D)

NOVATEL P/N	DESCRIPTION	RF CONN
01018493	OEM-STAR-RA	J301 (RA)

Figure 23: OEMStar-RA Board Dimensions



NOTES:

- 1. RECOMMENDED "KEEP-OUT" AREAS ARE INTENDED FOR NOVATEL CIRCUITRY. NOVATEL RESERVES THE RIGHT TO MODIFY COMPONENTS AND COMPONENT PLACEMENTS INSIDE SHADED KEEP-OUT ZONES, WHILE MAINTAINING DESIGN FORM, FIT, AND FUNCTION.

Figure 24: OEMStar/OEMStar-RA Board Keep-Out Zone

ENVIRONMENTAL	
Operating Temperature	-40°C to +85°C
Storage Temperature	-45°C to +90°C
Humidity	Not to exceed 95% non-condensing
Random Vibe	MIL-STD 810G
Bump/Shock	MIL-STD 810G (40 g)
POWER REQUIREMENTS	
Voltage	+3.1 to 5.25 VDC
Allowable Input Voltage Ripple	100 mV p-p (max.)

Continued on next page

POWER REQUIREMENTS	
Power Consumption^a	0.36 W (GPS only) 0.45 W (GPS+GLONASS) <hr/> <input checked="" type="checkbox"/> Variable values that can change due to the number of satellites in the sky and the firmware version. They are a guide for what you might expect but absolute values are not possible. <hr/>
In-Rush Current	2 A for less than 25 μ s
RF INPUT / LNA POWER OUTPUT	
Antenna Connector	MCX female, 50 Ω nominal impedance (See <i>Figure 23</i> on page 80)
Acceptable RF Input Level	-80 to -105 dBm
RF Input Frequencies	GPS L1: 1575.42 MHz GLONASS L1: 1602.0 MHz for Fk=0 where k = (-7 to+6) Channel spacing 562.5 kHz
LNA Power External (Optional Input) Output to antenna	+3.3 to +5.25 V DC, 100 mA max. (user-supplied) +3.3 to +5.25 V DC @ 0 - 100 mA <hr/> <input checked="" type="checkbox"/> Apply power to the OEMStar on pin 1 within the +3.3 to + 5.25 V DC range. The card distributes this voltage supply and current limits it on the RF connector. See also <i>Section 3.3.1</i> on page 38. <hr/>
INPUT/OUTPUT DATA INTERFACE	
COM1	
Electrical format	LVTTTL
Bit rates ^b	300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 bps
Signals supported	COM1_Tx and COM1_Rx
COM2	
Electrical format	LVTTTL
Bit rates ^b	300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 bps
Signals supported	COM2_Tx and COM2_Rx
USB	
Electrical format	Conforms to USB 2.0
Bit rates	12 Mb/s maximum
Signals supported	USB D (+) and USB D (-)

a. Typical values for 14 channel, 5VDC operation. Power consumption will vary depending upon features selected

b. Baud rates higher than 115,200 bps are not supported by standard PC hardware. Special PC hardware may be required for higher rates, including 230400 bps.

Table 6: OEMStar Strobes

Strobes	Default Behavior	Input/Output	Factory Default	Comment ^a
Event1 (Mark 1)	Dedicated pin	Input Leading edge triggered	Active low	An input mark for which a pulse greater than 150 ns triggers certain logs to be generated. (Refer to the MARKPOS and MARKTIME logs and ONMARK trigger.) Polarity is configurable using the MARKCONTROL command. The mark inputs have 10K pull-up resistors to 3.3 V
PV (Position Valid)	Dedicated pin	Output	Active high	Indicates a valid GPS position solution is available. A high level indicates a valid solution or that the FIX POSITION command has been set (refer to the FIX POSITION command).
VARF (Variable Frequency)	Dedicated pin	Output	Active low	A programmable variable frequency output is 0 or ranges from 80Hz-10 MHz (refer to the FREQUENCYOUT command).
RESETIN	Dedicated pin	Input	Active low	Reset LVTTTL signal input from external system; active low, > 20 μs duration. The RESETIN port may be driven by an external circuit, at least 1 millisecond after power is applied to the card.
PPS	Dedicated pin	Output	Active low	A time synchronization output. This is a pulse where the leading edge is synchronized to receiver-calculated GPS Time. The polarity and period can be configured using the PPSCONTROL command.

a. The commands and logs shown in capital letters (for example, MARKCONTROL) are discussed in further detail in the *OEMStar Family Firmware Reference Manual*.

Table 7: OEMStar Input/Output Electrical Specifications

I/O Line	Sym	Min (V)	Typ (V)	Max (V)	Current (mA)	Conditions ^a
PV VARF	V _{OL}			0.4	4	With on-board I/O supply, VDDIO=3.3V
PPS COM1_TX COM2_TX	V _{OH}	VDDIO-0.4			8	
RESETIN Event 1	V _{IL}			0.8	4	
COM1_RX COM2_RX	V _{IH}	2.0			8	

a. The above characteristics are applicable over the operating temperature range.

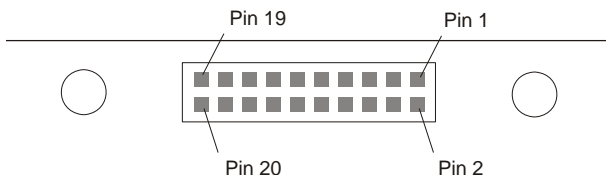


Figure 25: Top-view of 20-Pin Connector on the OEMStar

Signal	Behavior ^a	Descriptions	Pin
LNA_PWR	Input DC	Power supply for external antenna LNA	1
V _{IN} ^b	Input DC	DC power supply for card (see WARNING on the following page)	2
USB D (-)	Bi-directional	USB interface data (-)	3
USB D (+)	Bi-directional	USB interface data (+)	4
RESETIN	See strobos	Card reset	5
VARF	Output	VARF	6
Reserved			7
Reserved			8
Event1	Input	Strobe, see strobos, default: Event1	9
GND	Ground	Digital Ground	10
COM1_Tx	Output	Transmitted Data for COM 1 output	11
COM1_Rx	Input	Received Data for COM 1 input	12
GND	Ground	Digital Ground	13
COM2_Tx	Output	Transmitted Data for COM 2 output	14
COM2_Rx	Input	Received Data for COM 2 input	15
GND	Ground	Digital Ground	16
PV	Output	Output indicates 'good solution' or valid GPS position when high	17
GND	Ground	Digital Ground	18
PPS	See strobos	Pulse output synchronized to GPS Time	19
Reserved			20

- a. The VIN and LNA_PWR inputs are protected against damage or latch-up due to ESD by bi-directional Transient Voltage Suppressor (TVS) devices. Input/Output (I/O) lines are protected by unidirectional TVS devices. Series resistance is included for the following I/O lines: COM1/COM2 Tx and Rx, RESETIN, Event. Lines that do not have series resistance include: USB D (+) and USB D (-).
- b. See **WARNING** on the following page.

WARNING: The LNA power pin (pin 1 of the 20-pin connector) can handle a maximum voltage of **5.25 VDC**.



The USB port (pins 3 and 4 of the 20-pin connector) must not be connected to an external voltage supply.

Notes:

This is different from the OEMV and Superstar II products which are equipped with a 5V voltage regulator on the board.

Superstar II users should ensure that pin 3 is not connected to an external voltage supply. For example, VBATT.

Failure to adhere to this warning, may result in your OEMStar card becoming permanently damaged and void your warranty.

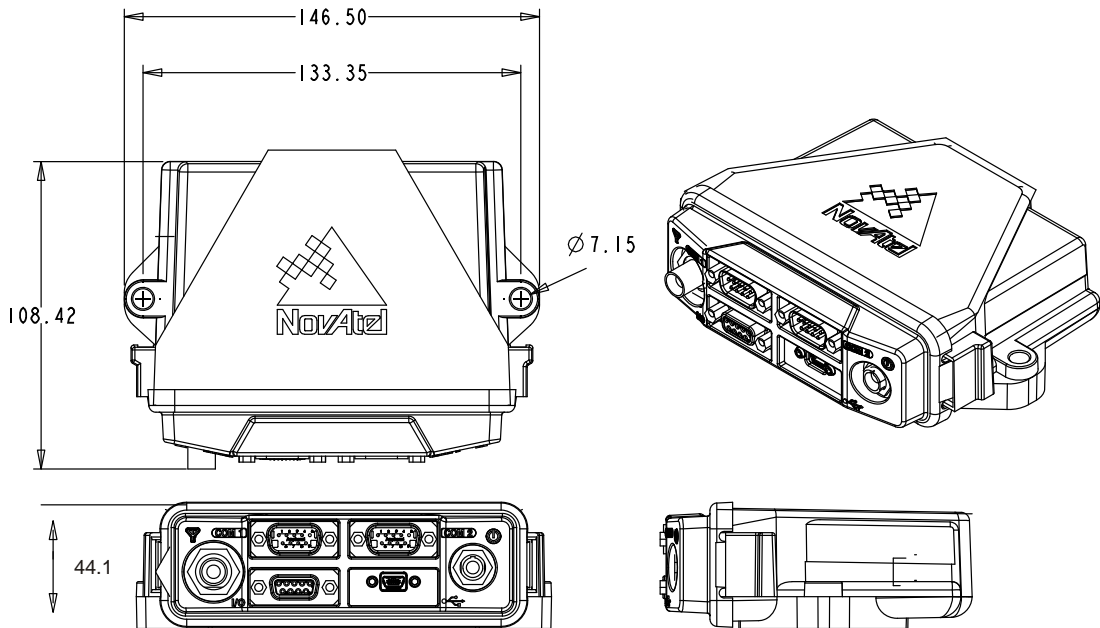
A.3 FlexPak-G2-Star

INPUT/OUTPUT CONNECTORS	
ANT	Waterproof TNC female jack, 50 Ω nominal impedance +4.75 to +5.10 V DC, 100 mA max (output from FlexPak-G2-Star to antenna/LNA)
PWR	4-pin LEMO +6 to +18 V DC Power consumption is 600 mW ^a . Inrush current is 8A.
COM1	9-pin DB9
COM2	9-pin DB9 ^b
PHYSICAL	
Size	45 x 147 x 123 mm
Weight	350 g maximum
Mounting System	Integral flange with two 7 mm (9/32 inch) diameter mounting holes 133 mm (5.25 inches) apart
ENVIRONMENTAL	
Operating Temperature	-40°C to +75°C
Storage Temperature	-40°C to +85°C
Humidity	Not to exceed 95% non-condensing
Waterproof	To IEC 60529 IP X7

- a. +12VDC, GPS only.
- b. Normally RS-232 but can be dynamically changed to RS-422 by setting pin 3 low (to ground) on the I/O DB9 connector. You can switch between RS-232 and RS-422 by changing the state of this pin. You do not have to cycle power on the FlexPak-G2-Star for this change to take effect.

DIMENSIONS

a



- a. All dimensions are in millimeters, please use the *Unit Conversion* section of the *GNSS Reference Book*, available from our Web site at www.novatel.com for conversion to imperial measurements.

A.3.1 Port Pin-Outs

The pin numbering for each of the ports, is described in the following tables.

Table 8: FlexPak-G2-Star Port Pin-Out Descriptions

Connector Pin No.	COM1	COM2	
	RS-232	RS-232	RS-422
1	N/C	N/C	N/C
2	Rx	Rx	Rx+
3	Tx	Tx	Tx+
4	N/C	POUT ^a	POUT ^a
5	GND	GND	GND
6	N/C	N/C	N/C
7	N/C	N/C	Tx-
8	N/C	N/C	Rx-
9	N/C	N/C	N/C

a. Current is limited to 1A.

Table 9: FlexPak-G2-Star I/O Port Pin-Out Descriptions

Connector Pin No.	Signal Name	Signal Descriptions
1	VARF	Variable frequency out
2	PPS	Pulse per second
3	COM2 Select	If N/C, COM2 will be configured as RS232. If connected to Pin 9 (GND), COM2 will be configured as RS422.
4	EVENT1	Mark 1 input
5	PV	Valid position available
6	RESERVED	Reserved
7	N/C	N/C
8	N/C	N/C
9	GND	Digital ground

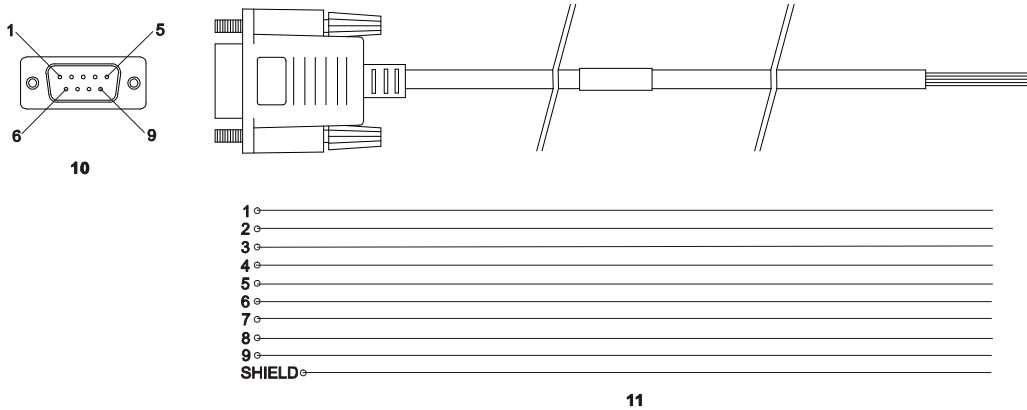
☒ See also Section 2.2.1, Strokes on Page 36.

A.3.2 Cables

A.3.2.1 I/O Strobe Port Cable (NovAtel part number 01018519)

The strobe lines on the FlexPak-G2-Star 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*.

This cable is RoHS compliant.



Wiring Table:

I/O Port Pin	I/O Port Signal	I/O Port Cable Wire Color
1	VARF	Black
2	PPS	Brown
3	N/C	Red
4	Event1	Orange
5	PV	Yellow

I/O Port Pin	I/O Port Signal	I/O Port Cable Wire Color
6	N/C	Green
7	N/C	Blue
8	N/C	Violet
9	GND	White/Grey

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

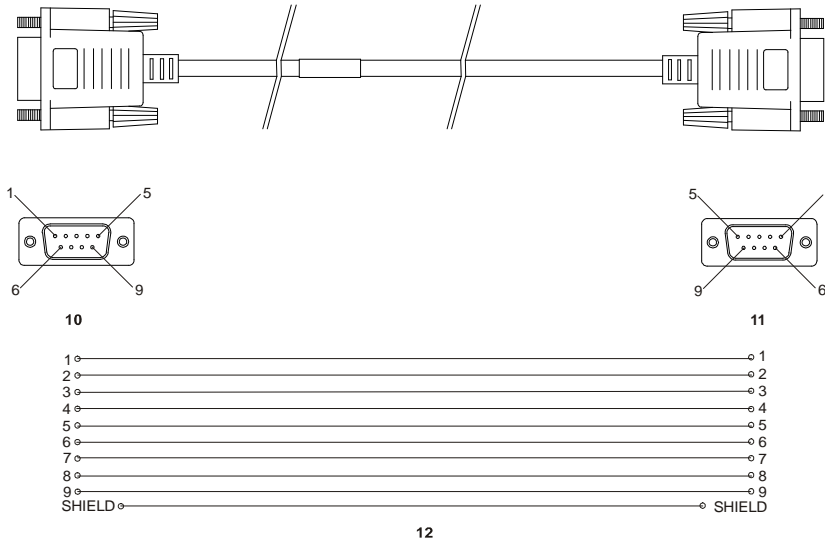


Figure 26: FlexPak-G2-Star I/O Strobe Port Cable

A.3.2.2 Straight Through Serial Cable (NovAtel part number 01018520)

This cable can be used to connect the FlexPak-G2-Star 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 on its connectors). The cable is approximately 2 m in length. See *Figure 27*.

This cable is RoHS compliant.



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

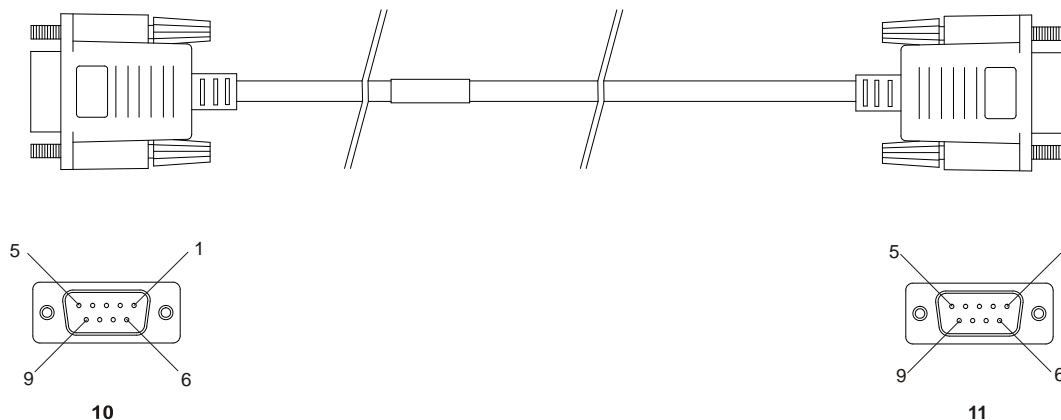


Figure 27: FlexPak-G2-Star Straight Through Serial Cable

A.3.2.3 Null Modem Cable (NovAtel part number 01017658)

This cable supplied with the FlexPak-G2-Star, see *Figure 28*, 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 *COM* or *COM2* port. At the PC end, a 9-pin connector is provided to accommodate a PC serial (RS-232) communication port.

This cable is RoHS compliant.



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 28: FlexPak-G2-Star Null Modem Cable

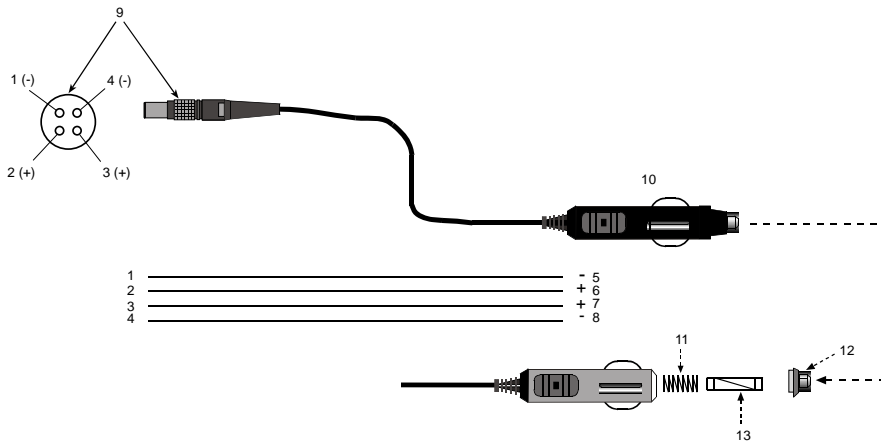
A.3.2.4 12V Power Adapter Cable (NovAtel part number 01017663)

The power adapter cable supplied with the FlexPak-G2-Star, see *Figure 29*, provides a convenient means for supplying +12 V DC. Actual range for the receiver is +6 to +18 VDC.

Input is provided through the standard 12V power outlet. The output from the power adapter utilizes a

4-pin LEMO connector (LEMO part number FGG.0B.304.CLAD52Z) and plugs directly into the PWR input located on the front of the FlexPak-G2.

This cable is RoHS compliant.



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



Figure 29: FlexPak-G2-Star Power Cable



If an alternative power source is preferred, the 12V automotive lighter plug can be cut off from the power adapter cable. The exposed wires can then be tied to a 6-18V supply capable of at least 5W, as follows (and as shown in *Figure 30*):

- Connect the red and orange wires to the positive side of the supply.
- Connect the black and brown wires to the negative side of the supply.

Since the 12V automotive lighter plug on the power adapter cable supplied incorporates a 6A fuse, a user-supplied 6A slow-blow fuse in a suitable holder must be used at the alternate power supply to:

- Protect the power supply wiring.
- Protect the receiver's warranty.

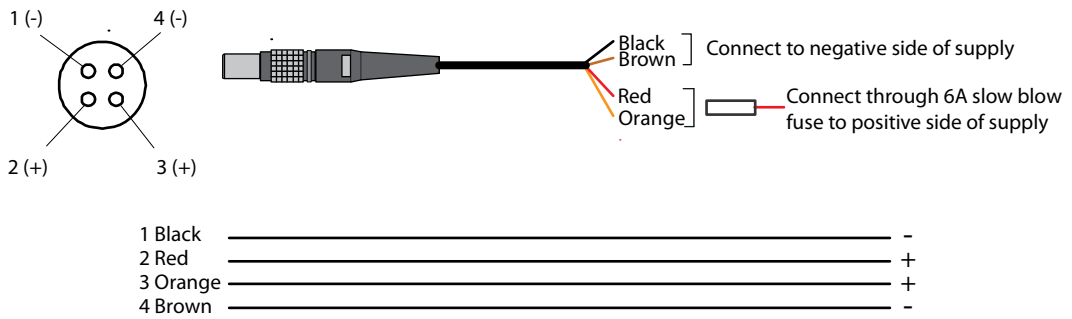


Figure 30: Power Connection - Alternate Power Source

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 a static shielding bag or 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 10 provides some background information on static-accumulating materials.

Table 10: 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.

Appendix C Replacement Parts

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

C.1 Accessories

Part Description		NovAtel Part
OEMStar Installation and Operation User Manual		OM-20000126
OEMStar Firmware Reference Manual		OM-20000127
Optional NovAtel Antennas:	Model 702 (L1/L2)	GPS-702
	Model 701 (L1-only)	GPS-701
	Model 702L (L1/L2/L-band)	GPS-702L
	Model 702GG (L1/L2/GLONASS)	GPS-702-GG
	Model 701GG (L1/GLONASS)	GPS-701-GG
	Model 702GGL (L1/L2/GLONASS/L-band)	GPS-702-GGL
	Model 701GGL (L1/GLONASS/L-band)	GPS-701-GGL
	Model 35C50P1GLA (L1/GLONASS/L-band)	ANT-35C50P1GLA-TW-N
	Model 26C1GA (L1)	ANT-26C1GA-TBW-N
	Model 35C1GA (L1)	ANT-35C1GA-TW-N
	Model A72GLA4 (L1/L2/L-band)	ANT-A72GLA4-TW-N
	Model C2GA (L1/L2)	ANT-C2GA-TW-N
	Model A72GA (L1/L2)	ANT-A72GA-TW-N
Optional RF Antenna Cable:	5 meters	GPS-C006
	15 meters	GPS-C016
	30 meters	GPS-C032
	22 cm interconnect adapter cable	GPS-C002

C.2 Manufacturers' Part Numbers

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

Product	Part Description	Company	Part Number
OEMStar Card (Figure 23 on page 80)	J300 - MCX JACK RECEPTACLE RF signal input and LNA power output	JOHNSON	133-3701-211
	P200 - 2x10 HEADER, 2mm PITCH Power, data, and signal connector	SAMTEC	TMM-110-03-T-D

Index

A

- accuracy
 - positioning 78
- acquisition 23
- antenna
 - active 24, 29
 - cables 30, 98
 - card status 67, 69
 - considerations 35
 - dual-frequency 29
 - input 87
 - models 29, 98
 - single-frequency 29, 35
- anti-static 32, 95–97
- ascii 47, 54
- AUTH command 61
- authorization 62
- auxiliary status 70

B

- base station 46
- baseline 41
- baud rate 39
- bidirectional communication 39
- binary 47, 71
- broadcast, error word 70
- buffer 39

C

- cables
 - antenna 98
 - coaxial 24, 29–30
 - extended cable lengths 30
 - null modem 39
 - serial 39
 - warranty 20
- cautions 32, 36–37
- CDU software 48
- channels 67, 69
- circuit board 24, 97
- coaxial 24, 29–30
- cold start 78

- commands
 - default port settings 39
 - in CDU 52, 61
 - input 41
 - OEMStar communication 39
 - positioning 83
 - pre-configuring 43
- communication
 - bidirectional 39
 - cable 92
 - port 33
- configuration
 - additional equipment 29
 - antenna 30
 - port 39
 - status 67–68
 - typical hardware 38
- connector 34
 - antenna 82, 87
 - input/output 87
 - power 82, 93
- Convert software 54
- copyright 2
- customer service 61

D

DC

- antenna 87
 - path 24
- dealer 61
- default
 - bit rates 82
 - port settings 39
- digital 27, 89
- directional communication 39
- dynamics 23

E

- electrostatic discharge (ESD) 32, 95–97
- e-mail 18
- errors
 - card status 67, 69–70
 - trigger 67

- ESD, *see* electrostatic discharge
- event messages 67–69
- extended cable lengths 30
- F
 - features 22, 40, 61–62
 - firmware reference marker 68
 - firmware updates 19
 - firmware upgrades 61–62
- G
 - GLIDE 45
 - GLONASS 30, 55
 - GPSAntenna 98
 - graphical user interface 49
- H
 - header 70
 - hexadecimal 68, 72
- I
 - I/O 87, 89
 - idle time 39
 - impedance 82, 87
 - input
 - antenna 87
 - commands 41
 - event 89
 - installation 48
- L
 - L-band 30
 - LED 36, 67, 69, 71
 - LNA, *see* low noise amplifier
 - logs
 - CMR 45
 - in CDU 53
 - RTCA 45
 - RTCM 45
 - status 67, 69
 - low noise amplifier (LNA) 27, 82
 - LVTTL 82
- M
 - messages, event 67
 - model upgrades 19
 - modem 47
 - mounting 32
 - multipath 29
- N
 - navigation applications 24
 - Notices 14
 - NovAtel Inc. 2
 - null modem 39
- O
 - operation 38
 - output
 - connector 87
- P
 - parity 35, 39
 - pass-through logs 47
 - polarity 31
 - ports
 - COM 41
 - communication 45
 - RXSTATUSEVENT log 68
 - serial 39
 - position
 - base station 41
 - overview 24
 - power
 - connector 82, 93
 - requirements 81–82
 - supply 29
 - priority mask 67, 70
- R
 - radio frequency (RF) 69
 - GPSAntenna 27
 - overview 24
 - receiver status 67–68, 70
 - redirect data 47
 - replacement parts 98
 - reset 69, 71
 - revision
 - firmware 61
 - manual 2, 102
 - RF, *see* radio frequency
 - RINEX 54–55
 - rover station 46
 - RTK radio 39

S

satellite

- antenna location 35
- records, number of 39
- transmit 27

self-test 40

serial

- cable 39
- number 61
- port 45

signals 23

static 95–97

status mask fields 67

strobe signals 33

support 18, 20

surveying 24

T

technical specifications 78

tests (built-in) 67, 70–71

time

- strobes 33

trigger 67

troubleshooting 73

U

upgrade firmware 17, 61–62

USB 36

- drivers 57–58
- pass-through logging 47
- port 41
- signals 85

V

voltage 81

W

warnings 13–14, 22, 27, 29, 31

warranty 20, 32

Web site 18

windows in CDU 49–53

WinLoad 62

