

Precise thinking



OEMV Family

Installation and Operation

User Manual

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Manufactured and protected under U.S. Patent:

PAC Correlator

#6,243,409 B1

#5,414,729

Narrow Correlator

#5,101,416

#5,390,207

#5,495,499

#5,809,064

GLONASS

#6,608,998 B1

GALILEO

#6,184,822 B1

Dual Frequency GPS

#5,736,961

Position and Velocity Kalman Filter

#6,664,923 B1

#7,193,559 B2

Anti-Jamming Technology

#5,734,674

RTK Positioning

#6,728,637 B2

#6,664,923 B1



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Notice

The following notices apply to the ProPak-V3, FlexPak-G2-V2, FlexPak-G2-V1G, FlexPak-G2-V1, SMART-V1 and SMART-V1G. An OEMV card might not pass emissions testing by itself. For example, the ProPak-V3 passes regulatory emissions as shown in this Notice. For more information on emissions testing, please refer to the regulatory body in your geographic area. For example, in the US that is the Federal Communications Commission (FCC) and in Europe the Conformité Européenne (CE).

FCC NOTICES

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The SMART-V1, SMART-V1G and FlexPak-G2-V2 comply with the emission limits for a Class A digital device. ProPak-V3, FlexPak-G2-V1G and FlexPak-G2-V1 have been tested and found to comply with the radiated and conducted emission limits for a Class B digital device. The Class B limits are designed to provide reasonable protection against harmful interference in a residential installation.

The equipment listed generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

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



WARNING!:

Changes or modifications to this equipment not expressly approved by NovAtel Inc. could result in violation of Part 15 of the FCC rules and void the user's authority to operate this equipment.

CE NOTICE

The enclosures carry the CE mark.

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

"Hereby, NovAtel Inc. declares that this ProPak-V3, FlexPak-G2-V2, FlexPak-G2-V1G, FlexPak-G2-V1 SMART-V1 and SMART-V1G is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC."

SMART-V1/SMART-V1G Power Warning

Chassis Ground Application

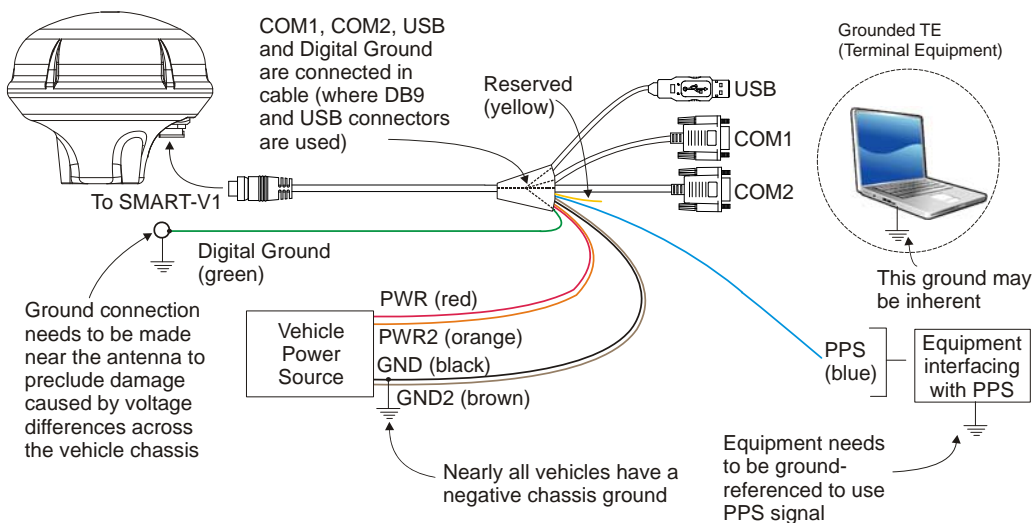


Figure 1: Chassis Ground Application

Floating TE Application

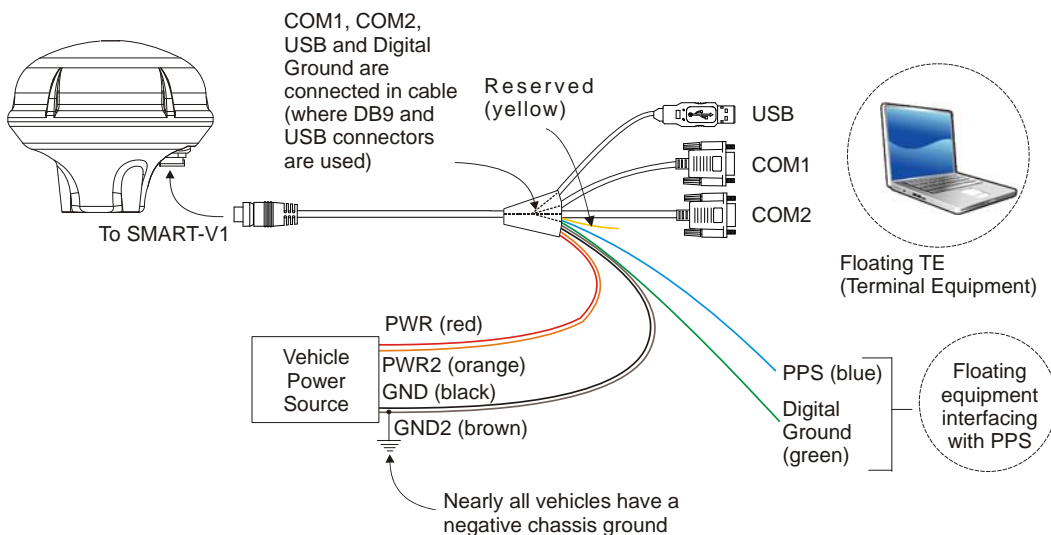


Figure 2: Floating Terminal Equipment (TE) Application

When connecting power to the SMART-V1 or SMART-V1G, it is recommended that you use a battery source. In this case, it is **important** that you tie together the bare wires tagged as GND2 (brown) and GND (black) to the battery's negative terminal. Tie the bare wires tagged as PWR (red) and PWR2 (orange) to the battery's positive terminal.

⚠ WARNING: *If you do not use a battery, you must tie together the bare wires tagged as GND2 (brown), GND (black) and DIGGND (green) to the DC power supply's negative ground connector.*

Failure to tie the appropriate grounds, as explained in this section, may result in your SMART-V1/SMART-V1G 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. Voltages directly applied onto the centre conductor "roll off" and arrive after the shield pulse 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 personnel harm 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 extra-building during a lightning storm.
2. It is not possible to avoid overvoltages 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 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 knocking down 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 reference 6 in *Figure 3, Primary and Secondary Lightning Protection on Page 13.*

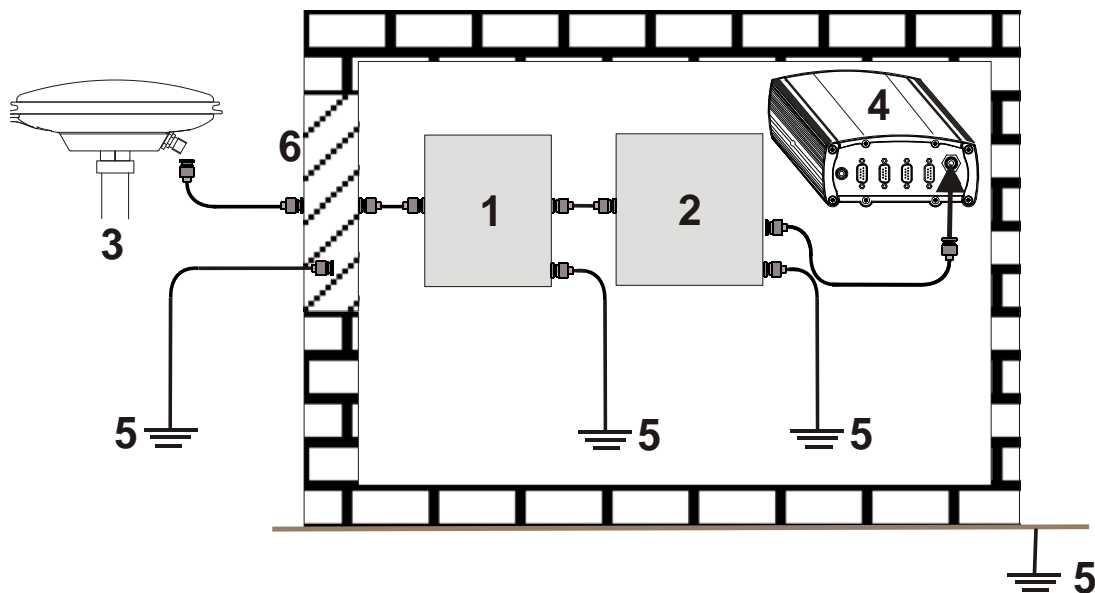


Figure 3: Primary and Secondary Lightning Protection

| Reference | Description | Reference | Description |
|-----------|---------------------------------------|-----------|---|
| 1 | Primary Lightning Protection Device | 4 | OEMV 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 OEMV 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 utilise 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 recognised by their wheeled bin label ().¹

RoHS Notice

The ProPak-V3, FlexPak-G2-V2, FlexPak-G2-V1G, FlexPak-G2-V1, SMART-V1 and SMART-V1G are compliant with the European Union (EU) Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC. (The OEMV-1, OEMV-1G, OEMV-2 and OEMV-3 cards are also compliant.)¹

-
1. Please visit the NovAtel Web site at <http://www.novatel.com/support/weee.htm> for more information on WEEE and RoHS.

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| | | | |
|-------|-----------------------------|----------------|-------------|
| Bank: | HSBC Bank of Canada | US Account # | 788889-002 |
| | 407 - 8 Avenue S.W. | CDN Account # | 788889-001 |
| | Calgary, AB, Canada T2P 1E5 | EURO Account # | 788889-270 |
| | | Transit # | 10029-016 |
| | | Swift | HKBCCATTCAL |

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Web site: <http://www.novatel.com> or write to:

NovAtel Inc.

Customer Service Department

1120 - 68 Avenue NE,

Calgary, Alberta, Canada T2E 8S5

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:

| | |
|---|------------------|
| OEMV Card Receivers | One (1) Year |
| ProPak-V3, FlexPak-G2-V2, FlexPak-G2-V1, FlexPak-G2-V1G, SMART-V1 and SMART-V1G | One (1) Year |
| GPSAntenna™ 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 <http://www.novatel.com> and select *Support / Repair Requests* from the top menu.

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

Customer Service

Firmware *upgrades* are firmware releases, which increase basic functionality of the receiver from one model to a higher level model type. When available, *upgrades* may be purchased at a price, which is the difference between the two model types on the current NovAtel Inc. Price List plus a nominal service charge.

Firmware upgrades are accomplished through NovAtel authorized dealers.

Contact your local NovAtel dealer first for more information. To locate a dealer in your area or if the problem is not resolved, contact NovAtel Inc. directly using one of the following methods:

Call the NovAtel Hotline at 1-800-NOVATEL (U.S. & Canada), or +1-403-295-4900 (international)

Fax: +1-403-295-4901

E-mail: support@novatel.ca

Web site: <http://www.novatel.com>

Write:

NovAtel Inc.
Customer Service Department
1120 - 68 Avenue NE
Calgary, AB
Canada, T2E 8S5



Try our Knowledge Base at <http://www.novatel.com/support/knowledgedb.htm>.

☒ Before contacting Customer Service regarding software concerns, please do the following:

1. Issue a FRESET command
2. Log the following data to a file on your PC for 30 minutes

RXSTATUSB once
RAWEPHEMB onchanged
RANGEB ontime 1
BESTPOSB ontime 1
RXCONFIGA once
VERSIONB once

3. Send the file containing the log to NovAtel Customer Service, using either the NovAtel ftp site at <ftp://ftp.novatel.ca/incoming> or the support@novatel.com e-mail address.
-

If there is a hardware problem that has not been resolved, please send a list of the troubleshooting steps you have taken and their result. See also *Chapter 7, Troubleshooting* on *Page 93*.

Foreword

Thank you for purchasing a NovAtel receiver card. Whether it is stand-alone or in an enclosure, this manual will help you get the hardware operational and provide further general information. Afterwards, the *OEMV Firmware Reference Manual* will be your primary OEMV family command and logging reference source.

Scope

The *OEMV Family Installation and Operation User Manual* contains sufficient information on the installation and operation of the OEMV-1, OEMV-1G, OEMV-2 and OEMV-3 cards to allow you to effectively integrate and fully operate them. Enclosures for the OEMV Family cards, ProPak-V3, FlexPak-G2-V2, FlexPak-G2-V1G, FlexPak-G2-V1 and SMART-V1/SMART-V1G Antenna, are also described in this manual. All are RoHS compliant. Please call your distributor, or NovAtel directly, for updated information on model availability.

After the addition of accessories, user-supplied data communications equipment and a power supply, the receiver is ready to go.

The OEMV family receivers utilize a comprehensive user-interface command structure, which requires communications through its communications (COM) ports. The *OEMV Firmware Reference Manual*, lists and describes the various receiver commands and logs referenced in this manual. Please remember that since each receiver is shipped from the distributor with a customer-specific list of features, such as L-band, Satellite-Based Augmentation System (SBAS) or GLONASS availability, some commands or logs may not be applicable to your model. Other supplementary manuals may be included on CD or as quick start guides to accommodate special models and software features with unique functionality. It is recommended that you keep these documents and CDs together for easy reference. Refer also to the *GNSS Reference Book*, available from our Web site at www.novatel.com.

It is beyond the scope of this manual to provide details on service or repair. Please contact your local NovAtel dealer for any customer-service related inquiries, see *Customer Service* on Page 21.

What's New in Rev 10 of this Manual?

This manual has been revised to include information on our new FlexPak-G2 and our updated notices and power warning.


The DL-V3 has its own user manual. The NovAtel part number of the *DL-V3 User Manual* is *OM-20000119*. There are also new OEMV firmware features, commands and logs in the *OEMV Family Firmware Reference Manual*. Refer to its *What's New* section for more details. The *Positioning Modes of Operation* chapter is no longer part of this manual. Instead, you can find further information in the *Positioning Modes of Operation* application note, available from our Web site at www.novatel.com/support/applicaitonnotes.htm, and our white papers at <http://www.novatel.com/products/whitepapers.htm>.

The most up-to-date version of user manuals, and any related addendum, can be downloaded from the

[Documentation Updates](#) section of the NovAtel Web site at www.novatel.com.

Conventions

Simple conventions are:

 This is a notebox that contains important information before you use a command or log.



This is a usage box that contains additional information or examples.

- A number following 0x is a hexadecimal number.
- In tables where values are missing they are assumed to be reserved for future use.
- ASCII log examples may be split over several lines for readability. In reality only a single [CR][LF] pair is transmitted at the end of an ASCII log.
- The terms OEMV-1, OEMV-1G, OEMV-2 and OEMV-3 will not be used in this manual unless a specific detail refers to it alone. The term receiver will infer that the text is applicable to an OEMV-1, OEMV-1G, OEMV-2 or OEMV-3, either stand-alone or in an enclosure, unless otherwise stated.

Prerequisites

The OEMV-1, OEMV-1G, OEMV-2 and OEMV-3 are OEM products requiring the addition of an enclosure and peripheral equipment before becoming fully functional Global Navigation Satellite Systems (GNSS) receivers. The installation chapters of this document provide information concerning the installation requirements and considerations for the OEMV family cards.

1.1 Overview of the OEMV Family

The OEMV family offers single, dual and triple-frequency GNSS receivers and the first integrated L-band capability without the need for a separate board. The OEMV-based products are GLONASS-enabled and are capable of full code and real-time kinematic (RTK) positioning.

This family is a group of high-performance GNSS receivers capable of receiving and tracking different combinations of GPS L1 C/A, L2C, L2 P(Y) and L5 code and carrier, GLONASS L1 and L2 code and carrier, and L-band (CDGPS and OmniSTAR) on a maximum of 72 channels. SBAS support is standard on all OEMV family receivers. OEMV adaptability offers multi-system, frequency, and size configurations for any application requirement. Refer to the *GNSS Reference Book* for an overview of signal types, available from our Web site at <http://www.novatel.com/support/docupdates.htm>.

Patented Pulse Aperture Correlator (PAC) with multipath mitigation technologies, and a powerful 32-bit processor, enable the OEMV family of receivers 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.

The AdVance RTK engine is supported on all OEMV-based products. This means a lower ambiguity error rate, faster narrow lane convergence (even at long baseline lengths) and more fixes in a wider range of conditions.

In addition, the OEMV family offers system integrators unparalleled flexibility in areas such as configuration and specification of output data and control signals. Multiple software models are available, allowing you to better fit the receiver performance to the application while maintaining the option for a compatible upgrade path.

The RoHS-compliant OEMV family includes the OEMV-1, OEMV-1G, OEMV-2 and OEMV-3 cards, the DL-V3, ProPak-V3, FlexPak-G2-V2, FlexPak-G2-V1G and FlexPak-G2-V1 enclosures, and the SMART-V1/SMART-V1G Antenna. The cards, provided as printed circuit boards, are ideal for custom integration.

1.1.1 Common Features

All OEMV family receivers have the following standard features:

- 14 L1 and 2 SBAS channels
- PAC technology, refer to the *GNSS Reference Book*, available from our Web site at www.novatel.com
- Fast reacquisition
- Fully field-upgradeable firmware
- Low power consumption
- 20 Hz raw data and position output rates
- Two mark inputs for triggering the output of logs on external events

- Auxiliary strobe signals, including a configurable PPS output for time synchronization and mark inputs
- An extensive command and log set for maximum customization
- Outputs to drive external LEDs

1.2 OEMV Cards

The OEMV family cards consist of a single printed circuit board with integrated radio frequency (RF) and digital sections. They are designed for flexibility of integration and configuration. After installation with a power source, mounting structure, GNSS, and data communications equipment, NovAtel's OEMV cards are ready for the most demanding surveying, positioning, and navigation applications.

1.2.1 OEMV-1 Card

The OEMV-1 is a compact, low-power, single frequency L1 GPS card with integrated L-band (OmniSTAR/CDGPS). In addition to the functionality given in *Section 1.1.1* on *Page 24*, the OEMV-1 offers:

- 1 Controller Area Network (CAN) Bus port (without transceiver), 1 USB 1.1 communication port and 2 LV-TTL communication ports
- Integrated L-band (OmniSTAR VBS and CDGPS)
- AdVance RTK 20 cm (RT-20) positioning capability for GPS-only. For more on RTK positioning, refer to the *GNSS Reference Book*, available from our Web site at www.novatel.com.
- Auxiliary strobe signals for status and synchronization
- Software load compatibility with other OEMV family products
- Optional Application Program Interface (API) software for loading a custom application

Included with the OEMV is a wrist-grounding strap to prevent ESD damage when handling the card and a CD containing NovAtel's PC utilities and product documentation.

For technical specifications on the OEMV-1, please see *Section A.2* starting on *Page 99*.

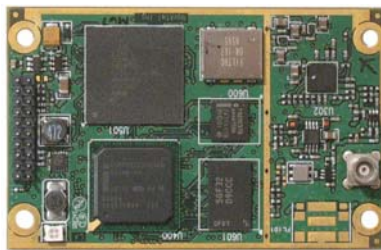


Figure 4: OEMV-1 Card

1.2.2 OEMV-1G Card

The OEMV-1G is a compact, low-power, single frequency L1 GPS + GLONASS card. In addition to the functionality given in *Section 1.1.1* on *Page 24*, the OEMV-1G offers:

- 1 Controller Area Network (CAN) Bus port (without transceiver), 1 USB 1.1 communication port and 2 LV-TTL communication ports
- 12 GLONASS L1 channels
- AdVance RTK 20 cm (RT-20) and **RT2-LITE** positioning capability for GPS + GLONASS. For more on RTK positioning, refer to the *GNSS Reference Book*, available from our Web site at www.novatel.com.
- Auxiliary strobe signals for status and synchronization
- Software load compatibility with other OEMV family products
- Optional Application Program Interface (API) software for loading a custom application

Included with the OEMV-1G is a wrist-grounding strap to prevent ESD damage when handling the card and a CD containing NovAtel's PC utilities and product documentation.

For technical specifications on the OEMV-1G, please see *Section A.3* starting on *Page 105*.



Figure 5: OEMV-1G Card

1.2.3 OEMV-2 Card

The OEMV-2 is a GPS plus GLONASS L1/L2 card that is a drop-in replacement for the OEM4-G2L. In addition to the functionality given in *Section 1.1.1* on *Page 24*, the OEMV-2 offers:

- 14 L2 P(Y) or L2C channels
- 12 GLONASS L1 channels
- 12 GLONASS L2 channels
- AdVance RTK real-time 2 cm (RT-2) positioning capability for GPS-only and GPS + GLONASS
- 2 LV-TTL, 1 RS-232 and 1 USB 1.1 communication ports
- CAN Bus (without transceiver) or a second Event line can be software configured
- An external oscillator input
- Auxiliary strobe signals for status and synchronization
- Temperature monitoring and reporting
- Software load compatibility with other OEMV family products

- Optional Application Program Interface (API) software for loading a custom application

Included with the OEMV is a wrist-grounding strap to prevent ESD damage when handling the card and a CD containing NovAtel's GPS PC utilities and product documentation.

For technical specifications on the OEMV-2, please see *Section A.4* starting on *Page 111*.

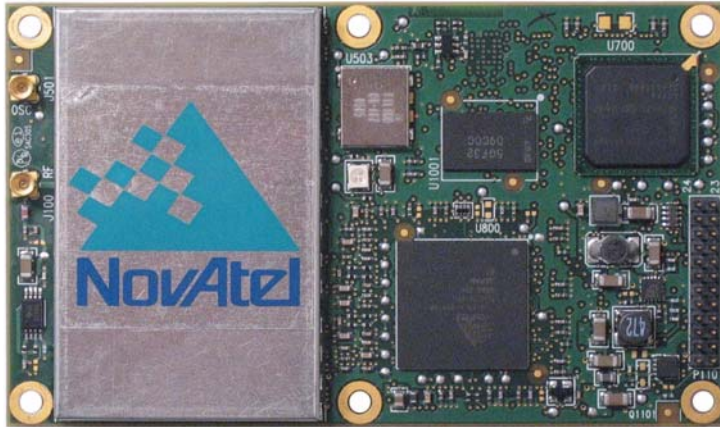


Figure 6: OEMV-2 Card

1.2.4 OEMV-3 Card

The OEMV-3 is a GPS L1/L2/L5 plus GLONASS L1/L2 card that is a drop-in replacement for the OEM4-G2. Triple-frequency capabilities will make the following possible: longer baselines in differential positioning mode due to the reduction of atmospheric errors, faster resolution of carrier-phase ambiguities when performing RTK positioning and enhanced positioning precision due to the additional measurements.

-
- ☒ The OEMV-3 is hardware-capable for tracking L5 but requires a future firmware upgrade to enable L5 positioning. This will be available when a usable number of satellites are in orbit.
-

In addition to the functionality given in *Section 1.1.1* on *Page 24*, the OEMV-3 offers:

- 14 L2 P(Y) or L2C channels
- 12 GLONASS L1 channels
- 12 GLONASS L2 channels
- 6 L5 channels
- Integrated L-band (OmniSTAR VBS, HP or XP and CDGPS)
- AdVance RTK real-time 2 cm (RT-2) positioning capability for GPS-only and GPS + GLONASS
- 2 CAN Bus (including transceivers), 1 RS-232/RS-422, 1 RS-232, 1 USB 1.1 and 1 LV-TTL communication ports

- An external oscillator input
- Auxiliary strobe signals for status and synchronization
- On-board power conversion, eliminating the need for external power conditioning
- Voltage and temperature monitoring and reporting
- Software load compatibility with other OEMV family products
- Increased memory size and processor speed
- Optional Application Program Interface (API) software for loading a custom application

Included with the OEMV is a wrist-grounding strap to prevent ESD damage when handling the card and a CD containing NovAtel's PC utilities and product documentation.

For technical specifications on the OEMV-3 please see *Section A.5* starting on *Page 117*.

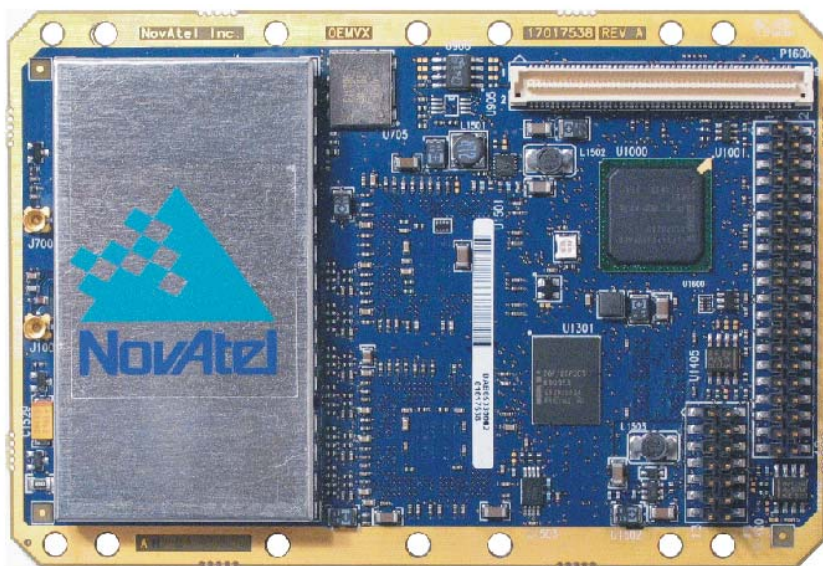


Figure 7: OEMV-3 Card

1.3 OEMV-Based Enclosures

The OEMV-3 can be housed in a ProPak-V3 enclosure to provide a complete receiver solution. The OEMV-2, OEMV-1 and OEMV-1G cards can be housed in a FlexPak-G2 enclosure. The OEMV-1 card can be housed in a SMART-V1 while the OEMV-1G card can be housed in a SMART-V1G.

When connected to an antenna and a power source, the enclosure and associated OEMV card together form a fully functioning GNSS receiver. The enclosures offer protection against environmental conditions and RF interference. In addition, they provides an easy-to-use interface to the card's data, power, and status signals. *Table 1* provides a comparison between the features available on the various enclosures. The sections that follow give details on each of them.

Table 1: Enclosure Features Comparison

| Feature | ProPak-V3 | FlexPak-G2-V2 | FlexPak-G2-V1G | FlexPak-G2-V1 | SMART-V1 | SMART-V1G |
|--|------------------------------------|-------------------|-------------------|------------------------|-------------------------|-------------------------|
| OEM Card Supported | OEMV-3 | OEMV-2 | OEMV-1G | OEMV-1 | OEMV-1 | OEMV-1G |
| Serial Ports | 3 DB-9P connector | 2 DB-9P connector | 2 DB-9P connector | 2 DB-9P connector | 1 Switchcraft connector | 1 Switchcraft connector |
| USB 1.1 | Yes | Yes | Yes | Yes | On select models | Yes |
| Ethernet ^a | No | No | No | No | No | No |
| Strobe Port | DB-9S connector | DB-9S connector | DB-9S connector | DB-9S connector | Switchcraft connector | Switchcraft connector |
| Input (DC) Voltage | +9 to +18 V | +6 to +18 V | +6 to +18 V | +6 to +18 V | +9 to +28 V | +9 to +28V |
| L-band Differential Corrections ^b | OmniSTAR (HP, XP or VBS) and CDGPS | Not available | Not available | OmniSTAR VBS and CDGPS | OmniSTAR VBS and CDGPS | Not available |
| GPS+ GLONASS Positioning | Yes | Yes | Yes | Not available | Not available | Yes |
| AdVance RTK | Yes | Yes | Yes | Yes | Yes | Yes |
| IMU Support with SPAN Firmware Option ^c | Yes | Not available | Not available | Not available | Not available | Not available |

- Refer to the *DL-V3 User Manual*, available from our Web site at <http://www.novatel.com/support/docupdates.htm>, for details on its ethernet configuration option.
- A subscription to the OmniSTAR service, or use of the free CDGPS service, is required. Both services are regional. Refer to the *GNSS Reference Book*, available from our Web site at www.novatel.com, for more details.
- If applicable, refer also to your *SPAN for OEMV User Manual*, available from our Web site.

1.3.1 ProPak-V3

The features of the OEMV-3 are available within the ProPak-V3, see *Figure 8*, and the DL-V3. These enclosures offer GNSS integrators an effective, self-contained system for indoor applications while also providing a rugged, water, shock, and vibration resistant housing for outdoor applications.



Figure 8: ProPak-V3 Enclosure Ends

The ProPak-V3 also offers the following features:

- A rugged waterproof enclosure
- Auxiliary status and synchronization signals
- GNSS antenna and power ports
- Support of peripheral devices, including an Inertial Measurement Unit (IMU) for combined GPS-inertial navigation, refer to the *SPAN for OEMV User Manual*
- An external oscillator connector
- Indicators to provide power and communication status

The following accessories are included with the ProPak-V3:

- Cables:
 - straight through serial
 - null modem serial
 - USB serial
 - 12 V power cable
- A CD containing NovAtel's PC utilities and product documentation

For technical specifications on the ProPak-V3, please see *Section A.6* starting on *Page 125*.

✉ Details on the DL-V3 are in the *DL-V3 User Manual* available from our Web site at:
<http://www.novatel.com/support/docupdates.htm>

1.3.2 FlexPak-G2

NovAtel's FlexPak-G2 is a rugged, waterproof housing for the OEMV-2, OEMV-1G or OEMV-1 engine. As a result, the FlexPak-G2 can deliver centimetre-level positioning in a compact, lightweight

enclosure. The FlexPak-G2-V2 provides dual-frequency positioning with a USB interface and an API option for supporting custom applications. Each FlexPak-G2 receiver has two SBAS channels. FlexPak-G2-V1G is a GPS + GLONASS model. There are also FlexPak-G2-V1 GPS + L-band and FlexPak-G2-V2 GPS + GLONASS models available.

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 inputs
- 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 see *Section A.7 on Page 133*.

☒ The OEMV family's FlexPak-G2 is a drop-in replacement for the FlexPak-V1, V1G and V2. The FlexPak-G2-V2 has flow control capability, the V1 and V1G do not.



Figure 9: FlexPak-G2 Enclosure

1.3.3 SMART-V1 and SMART-V1G

NovAtel's SMART-V1/SMART-V1G is a rugged, self-contained GNSS receiver and antenna. It is specially designed for harsh tracking environments in a number of applications.

The SMART-V1 is available in three side-mount configurations to suit your integration requirements: USB, CAN or RS-422. The SMART-V1G is available with the USB configuration.

The SMART-V1 and SMART -V1G offers the following features:

- A waterproof, shock and dust resistant enclosure
- Environmentally sealed unit is designed to meet or exceed MIL-STD 810
- Low power consumption
- USB support on USB models
- Configurable event input

The SMART-V1 offers the following features:

- Two serial ports (2 RS-232 or 1 RS-232 and 1 RS-422 on RS-422 models)
- CAN Bus support on CAN models
- Integrated L-band capability for OmniSTAR VBS and CDGPS positioning

The SMART-V1G offers the following features:

- Two serial ports (RS-232)
- Integrated GPS+GLONASS positioning

The following accessories are included with the SMART-V1 and SMART-V1G:

- Quick Start Guide
- CD containing an installation program for NovAtel's **CDU** graphical user interface software, other PC utilities and product documentation, including user manuals

Cables are also available as optional accessories. For technical specifications on the SMART-V1/V1G, including optional cables, please see *Section A.8, SMART-V1/SMART-V1G starting on Page 140*.



Figure 10: SMART-V1/SMART-V1G Antenna

In addition to a NovAtel OEMV 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 11*. 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 3, Installation and Setup on Page 36*.

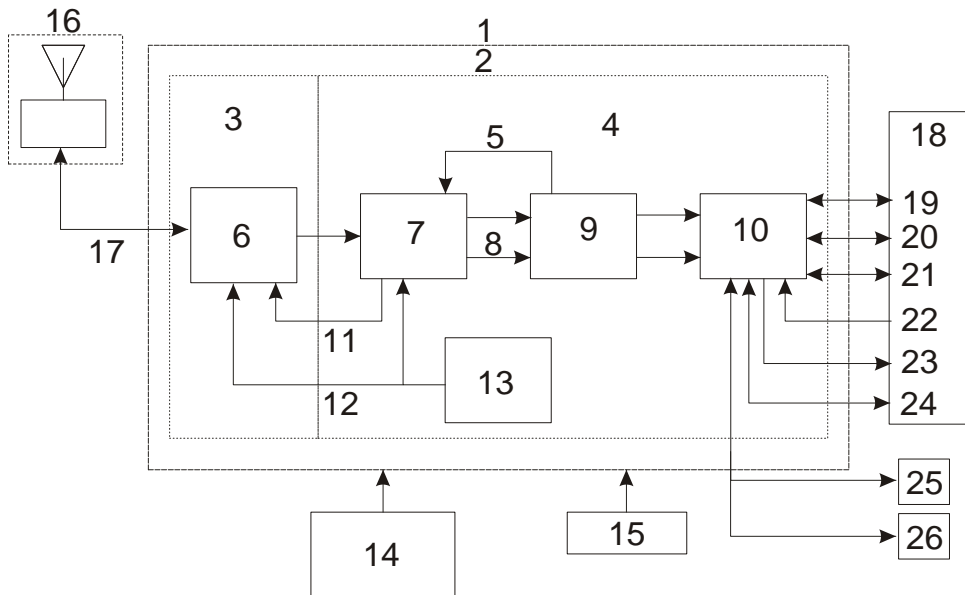


Figure 11: GNSS Receiver System Functional Diagram

| Reference | Description | Reference | Description |
|-----------|------------------|-----------|-----------------------------|
| 1 | Enclosure | 14 | Optional LNA Power |
| 2 | OEMV Card | 15 | Power Supply |
| 3 | RF Section | 16 | GNSS Antenna and LNA |
| 4 | Digital Section | 17 | RF, Coaxial Cable and Power |
| 5 | Controls | 18 | Data and Signal Processing |
| 6 | RF-IF Sections | 19 | COM1 |
| 7 | Signal Processor | 20 | COM2 |
| 8 | Clock | 21 | COM3 |

Continued on Page 34

Continued from Page 33

| | | | |
|----|------------|----|----------------------|
| 9 | 32-Bit CPU | 22 | Input Timing Signal |
| 10 | System I/O | 23 | Output Timing Signal |
| 11 | AGC | 24 | USB Communication |
| 12 | Clock | 25 | CAN Communication 1 |
| 13 | VCTCXO | 26 | CAN Communication 2 |

2.1 OEMV Card

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

2.1.1 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 translation of the incoming RF signal to an Intermediate Frequency (IF) signal usable by the digital section. It also supplies power to the active antenna's LNA through the coaxial cable while maintaining isolation between the DC and RF paths. The RF section can reject a high level of potential interference (for example, MSAT, Inmarsat, cellular phone, and TV sub-harmonic signals).

2.1.2 Digital Electronics Section

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

The digital section performs the translations and calculations necessary to convert the IF analog signals into usable position and status information. It also handles all I/O functions, including the auxiliary strobe signals, which are described in detail in *Section 3.3.1 on Page 45*. For input and output levels please see *Appendix A, Table 21, OEMV-3 Strokes on Page 120, Table 19, OEMV-2 Strokes on Page 114 and Table 15, OEMV-1 Strokes on Page 102*.

2.2 Enclosure and Wiring Harness

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

2.3 GNSS Antenna

The purpose of the GNSS antenna is to convert the electromagnetic waves transmitted by the GNSS satellites into RF signals. An active GNSS antenna is required for the receiver to function properly. NovAtel's active antennas are recommended because of their precise phase centres and robust enclosures.

2.3.1 Optional LNA Power Supply

Power for the antenna LNA is normally supplied by the receiver but not, for example, by the OEMV-2 card. If a different type of antenna is required that is incompatible with this supply, then you could connect an external power source to the receiver. See also *Antenna LNA Power* on Page 49.

2.4 Principal Power Supply

A single external power supply capable of delivering the minimum receiver voltage necessary to operate the receiver. Minimum voltage varies per card, see *Table 3, Voltage Input Range for OEMV* on Page 38 and *Appendix A, Technical Specifications* on Page 98 for details.



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

2.5 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.

This chapter contains instructions and tips to set up your NovAtel receiver to create a GNSS receiver system similar to that described in *Chapter 2, Receiver System Overview on Page 33*.

3.1 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)



CAUTION: When the OEMV family 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*.

3.1.1 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 2 on Page 37*. 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 2: 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 | ✓ | ✓ |

3.1.2 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 (OEMV-1/OEMV-1G) or MMCX (OEMV-2/OEMV-3) and the TNC connectors (NovAtel part #GPS-C002)

Note that a conversion is required between the female MCX connector on the OEMV-1 and OEMV-1G, the male MMCX connector on the OEMV-2, or the male MMCX connector on the OEMV-3, 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 OEMV family receivers are warranted only when used with NovAtel-supplied accessories.

3.1.3 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 98* for more power supply specifications.



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

OEMV Cards

The OEMV card contains a DC to DC converter that is very tolerant to noise and ripple at its input. A tightly regulated input supply to the OEMV-3 card is not required, as long as it falls within the given input range. A tightly regulated input supply to the OEMV-1, OEMV-1G or OEMV-2 card is required. The power supply used for any OEMV card should be capable of 5 W. The voltage input range for each the OEMV cards is given in *Table 3* on *Page 38*.

Table 3: Voltage Input Range for OEMV

| OEMV Card | Power Input Range |
|-----------|-------------------|
| OEMV-1 | +3.3 V DC +5%/-3% |
| OEMV-1G | +3.3 V DC +5%/-3% |
| OEMV-2 | +3.3 V DC +5%/-3% |
| OEMV-3 | +4.5 to +18 V DC |


All members of the OEMV family receivers are designed to prevent internal damage when subjected to a reverse polarity power connection. The OEMV also provides protection for a short duration during over-voltage events. It is recommended that appropriate fuses or current limiting be incorporated as a safety precaution on all power lines used. Use a sufficient gauge of wire to ensure that the voltage at the connector is within the OEMV card's requirements.

ProPak-V3, FlexPak-G2 or SMART Enclosures

The ProPak and FlexPak-G2 enclosures come with a 12V power adapter with a built-in slow-blow fuse (6 A for the ProPak and the FlexPak-G2s) for use with a standard 12 V DC power outlet.

If a different supply is desired, *Table 4* provides the input range and type of connector required to mate with the enclosure's power connector. The supply should be capable of 5 W.

Table 4: Enclosure Power Requirements

| Enclosure | Power Cable Connector Required | Power Input Range |
|----------------------|---|-----------------------------|
| ProPak-V3 | 4-pin LEMO socket connector ^a labelled <i>PWR</i> | +6 to +18 V DC ^a |
| FlexPak-G2-V1/V1G/V2 | 4-pin LEMO socket connector ^a labelled  | +6 to +18 V DC |
| SMART-V1/V1G | 18-pin Switchcraft connector (not labelled) ^b | +9 to +28 V DC |

- a. +9 to +18 V DC when connected to an IMU. If applicable, see the *SPAN Technology User Manual* for more information.
- b. Bare wires on the optional cables are labelled PWR, PWR2, GND and GND2, see also *Table 33* on *Page 147*.

3.2 Installation Overview

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

1. Install the OEMV card in an enclosure with a wiring harness, as described in *Section 3.2.1* on *Page 39*.
2. Mount the GNSS antenna to a secure, stable structure, as described in *Section 3.2.3* on *Page 42*.
3. Connect the GNSS antenna to the receiver using an antenna RF cable, using the information given in *Section 3.2.4* on *Page 43*.
4. Apply power to the receiver, as described in *Section 3.2.5* on *Page 43*.
5. Connect the receiver to a PC or other data communications equipment by following the information given in *Section 3.2.6* on *Page 43*.

3.2.1 Installing an OEMV Card in a Wiring Harness and Enclosure

To install an OEMV card, begin with the following:

1. Ensure you are taking the necessary precautions against ESD, as described in the following section.
2. Mount the OEMV card in a secure enclosure to reduce environmental exposure and RF interference, as described in *Mounting the Printed Circuit Board*.
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 40*.

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 OEMV card. See *Appendix B, Electrostatic Discharge Control (ESD) Practices* starting on *Page 149* for more information on ESD precautions.

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

When you remove the OEMV card 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 OEMV card.**
 - Always hold the OEMV card by its corners or the RF shield, and avoid direct contact with any of the components.
 - Do not let the OEMV card 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 OEMV card.
 - Warranty may be voided if equipment is damaged by ESD.
-
-

Mounting the Printed Circuit Board

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

- mounting of external connectors
- protection from hostile physical environments (for example, rain, snow, sand, salt, water, extreme temperatures)
- electromagnetic shielding to protect from hostile RF environments (for example, nearby transmitters)
- electromagnetic shielding so that the final product itself conforms to RF emissions specifications

☒ Integrator note: The card can not pass emissions testing by itself. It must be in an enclosure. For example, the ProPak-V3 passes regulatory emissions as shown in the *Notice* starting on *Page 9*. For more information on 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 149*)

The OEMV card can be held in place by screws when used in a custom assembly. Please see *Appendix A, Technical Specifications* starting on *Page 98* 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 OEMV 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 *Figures 12, 13 and 14*, the OEMV cards use a 20, 24 or 40-pin header for the data, power, and status signals. The RF input is a female MCX connector. An external oscillator input is available on the OEMV-2 and OEMV-3 dual frequency cards where the oscillator input is also a female MMCX connector. The pin outs for these connectors are specified in *Appendix A, Technical Specifications* starting on *Page 98* for the OEMV-1, OEMV-1G, OEMV-2 and OEMV-3 while their manufacturers' part numbers are in *Section C.4* on *Page 153*.



Figure 12: OEMV-1 and OEMV-1G Connector and Indicator Locations

| Reference | Description |
|-----------|--|
| 1 | J700 power, data, and signal connector (20 pin dual row male connector with a 2 mm straight 2 x 10 header) |
| 2 | LED status indicator |
| 3 | J100 RF signal input and LNA power output (MCX female connector) |

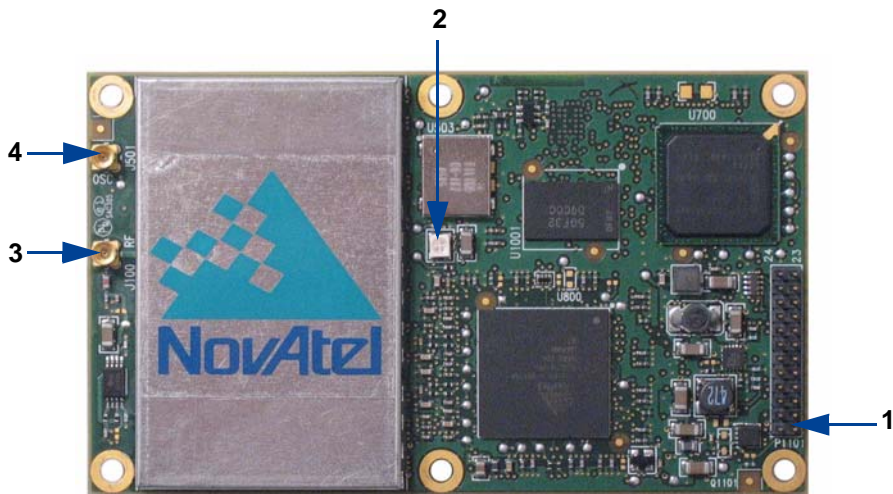


Figure 13: OEMV-2 Connector and Indicator Locations

| Reference | Description |
|-----------|---|
| 1 | P1101 power, data, and signal connector (24 pin dual row male connector with a 2 mm straight 2 x 12 header) |
| 2 | LED status indicator |
| 3 | J100 RF signal input and LNA power output (MMCX female connector) |
| 4 | J501 external oscillator input (MMCX female connector) |

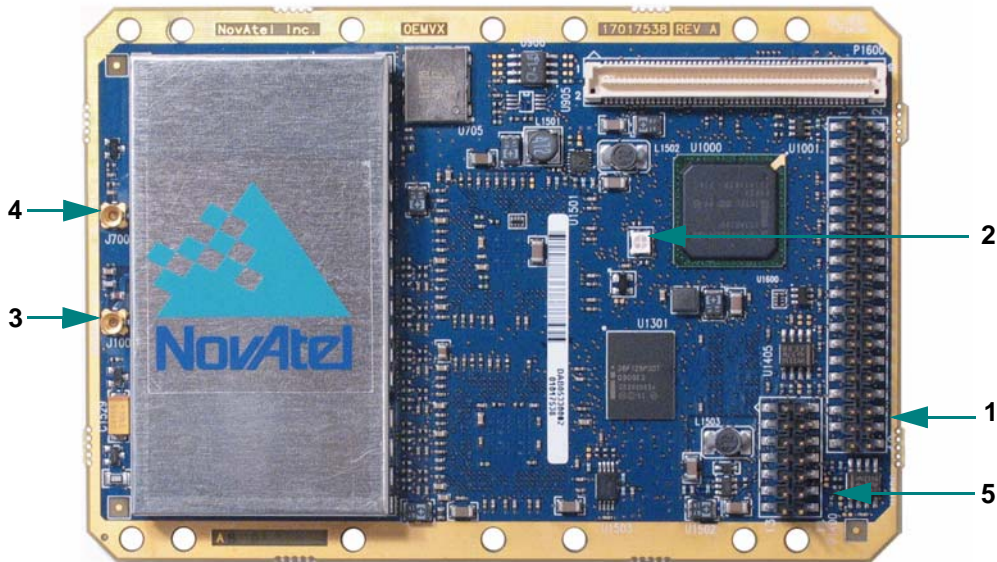


Figure 14: OEMV-3 Connector and Indicator Locations

| Reference | Description |
|-----------|---|
| 1 | P1601 power, data, and signal connector (40 pin dual row male connector with 0.025" square pins and 0.1" spacing) |
| 2 | LED status indicator |
| 3 | J100 RF signal input and LNA power output (MMCX female connector) |
| 4 | J700 external oscillator input (MMCX female connector) |
| 5 | P1400 CAN Bus connector with transceiver |

3.2.2 Mounting Bracket (ProPak-V3 Only)

Along with the ProPak-V3 enclosure, a mounting kit is provided to facilitate mounting the receiver to a surface.

-
- ☒ The mounting kits are not designed for use in high-dynamics/vibration environments. Contact NovAtel if your application needs the ProPak-V3 to be mounted in this type of environment.
-

To install the mounting bracket provided with the ProPak-V3, refer to the instructions provided with the mounting kit. *Page 126* provides the dimension information for the bracket.

3.2.3 Mounting the GNSS Antenna

Once the OEMV 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 3.1.1 on Page 36* 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 on multipath, refer to the *GNSS Reference Book*, available from our Web site at www.novatel.com).
- Mount the antenna on a secure, stable structure capable of safe operation in the specific environment.

3.2.4 Connecting the Antenna to the Receiver

Connect the antenna to the receiver using high-quality coaxial cable, as discussed in *Section 3.1.2 on Page 37*.

The ProPak-V3 and FlexPak-G2 enclosures provide a TNC female connector, which can be connected to the antenna directly with any of NovAtel's coaxial cables. For the OEMV cards, an interconnect adapter cable is required to convert the TNC male end of the coaxial cable to the card's MCX (OEMV-1/OEMV-1G) or MMCX (OEMV-2/OEMV-3) female RF input connector. The location of the RF connector for the each of the OEMV cards is shown in *Appendix A, Technical Specifications* starting on *Page 98*.

The SMART-V1/SMART-V1G is a combined receiver and antenna, therefore no external antenna connection is necessary.

3.2.5 Applying Power to the Receiver

Connect the power supply, set to the voltage given in *Table 3, Voltage Input Range for OEMV on Page 38*, to the wiring harness created previously.

For a ProPak-V3, FlexPak-G2-V1, FlexPak-G2-V1G, FlexPak-G2-V2, SMART-V1 or SMART-V1G, connect a power supply to the power port.

3.2.6 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 available for each of the receiver types, except for the SMART-V1 or SMART-V1G, is given in *Table 5 on Page 44*. Details on the SMART-V1 and SMART-V1G port can be seen in *Table 6*, at the bottom of this page, and its pin-out tables, in *Appendix A on Page 142*, for both USB, CAN and RS-422 models.

However, if desired, on some receivers, the serial ports can be factory configured for either RS-232, RS-422, or LVTTL operation. Consult NovAtel Customer Service for more details. See *Appendix A, Technical Specifications* starting on *Page 98* for data connection details.

Table 5: Default Serial Port Configurations

| Receiver | COM1 | COM2 | COM3 | AUX |
|------------------------------|---|---|--|-----|
| OEMV-1/ OEMV-1G | LVTTTL | LVTTTL | USB D+ (default) | N/A |
| OEMV-2 | RS-232 | LVTTTL | LVTTTL | N/A |
| OEMV-3 | RS-232 / RS-422, see <i>User-Selectable Port Configuration</i> starting on <i>Page 45</i> | Factory-configurable RS-232 \ LVTTTL | LVTTTL | N/A |
| ProPak-V3 | Factory- configurable RS-232 \ RS-422 | RS-232 | Factory- configurable RS-232 \ RS-422 ^a | N/A |
| FlexPak- G2- V1/V1G/V2 | RS-232 | RS-232 / RS-422, see <i>User-Selectable Port Configuration</i> starting on <i>Page 45</i> | Not available | N/A |

a. You must use COM3 instead of AUX to send commands or request logs on the ProPak-V3 AUX port.

Table 6: SMART-V1/SMART-V1G Port Configuration

| Model | Ports |
|-------------------------------|---|
| USB (RS-232 only) | The single port on the USB model of the SMART-V1 or SMART-V1G can be used for COM1, COM2 or USB |
| CAN (RS-232 only) | The single port on the CAN model of the SMART-V1 can be used for COM1, CAN or COM3 |
| RS-422 (RS-232 and RS-422) | The single port on the RS-422 model of the SMART-V1 can be used for RS-422 COM1, RS-232 COM2 or RS-422 COM3 |

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

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

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

The ProPak-V3 and FlexPak-G2 enclosures are Data Terminal Equipment (DTE) so that TXD, RTS and DTR are outputs while RXD, CTS and DCD are inputs. A null modem cable, supplied with the receiver, is required to connect to another DTE like a terminal or a PC, while a straight cable is used to connect to another receiver.

The port settings (bit rate, parity, and so on) are software-configurable. These are further described in *Chapter 4, Operation on Page 51*. See *Appendix A, Technical Specifications* starting on *Page 98* for further information on data communications characteristics.

The SMART-V1/SMART-V1G multi-cable is available in six configurations: two for the USB, two for the CAN (SMART-V1 only) and two for the RS-422 (SMART-V1 only) model. All 6 cables are 3 m in length. *Appendix A, Technical Specifications* starting on *Page 145* illustrates the models, their cable options, pinouts and drawings.

User-Selectable Port Configuration

The FlexPak-G2-V1, FlexPak-G2-V1G and FlexPak-G2-V2 are RS-232/RS-422-selectable through pin 1 of COM2, see *Section A.7.2 on Page 136*.

The ProPak-V3 is not user-selectable but can be factory-configured on both COM1 and COM3 for RS-232 or RS-422 operation, see *Table 24, ProPak I/O Port Pin-Out Descriptions on Page 127*.

The OEMV-3 offers a user-selectable configuration for the COM1 port using the USERIO1 pin. By default, RS-232 is selected as the USERIO1 input is set LOW by an internal pull-down resistor. To select RS-422, apply 3.3 V to USERIO1 on start-up.

Pin 38, on the 40-pin connector, is usually an ERROR indicator, and during normal OEMV card operations is set LOW, but for < 2 s during OEMV card initialization, immediately after applying power to the OEMV card, this pin is set HIGH at 3.3 Volts. It drops to LOW <2 s later when the OEMV card has been fully booted up and the [COMx] prompt is output from the OEMV card on all COM ports.

3.3 Additional Features and Information

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

3.3.1 Strobes

On OEMV family receivers, 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*:

- OEMV-1 pin-out starting on *Page 104*
- OEMV-1G pin-out starting on *Page 110*
- OEMV-2 pin-out starting on *Page 115*
- OEMV-3 pin-out starting on *Page 122*
- ProPak-V3 port pin-out on *Page 127*
- FlexPak-G2-V1/V1G/V2 port pin-out starting on *Page 135*
- SMART-V1/V1G port pin-out starting on *Page 142*

3.3.2 Universal Serial Bus (USB)

OEMV family receivers, along with the accompanying NovAtel USB drivers for Windows 2000 and Windows XP, provide three virtual serial ports over a single USB 1.1 connection using USB D(+) and USB D(-) signals, see *Table 7*.

Table 7: Available USB Signals on Receivers

| Receiver | Pins/Ports |
|-----------------------------|-----------------------------|
| OEMV-1/OEMV-1G | Pin 3 D(-) and Pin 4 D(+) |
| OEMV-2 | Pin 21 D(-) and Pin 22 D(+) |
| OEMV-3 | Pin 3 D(+) and Pin 5 D(-) |
| ProPak-V3 | COM1 Pins 6 D(+) and 9 D(-) |
| FlexPak-G2-V1/ V1G/V2/G2 | USB mini connector |
| SMART-V1/v1G ^a | Pins 10 D(-) and 16 D(+) |

a. USB model only

The three virtual serial ports, identified by the OEMV receiver as USB1, USB2, and USB3, are available to existing Windows applications which use COM ports to communicate (for example, HyperTerminal and **CDU**). 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, along with installation instructions, are available on the OEMV Family CD by selecting *USB Support* from the main menu. You can also check for updates to the drivers or release notes on our Web site at www.novatel.com.



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.

3.3.3 CAN Bus

A Controller Area Network Bus (CAN Bus) is a rugged differential serial bus with a protocol that provides services for processes, data and network management.

CAN Bus is a generic term, as well as referring to a specific standard for several rugged differential bus standards that provide services for processes, data, and network management. NovAtel’s MINOS5 ASIC incorporates a CAN Bus controller and the GPS engine creates and interprets the physical level signals, and low-level messages, that are compatible with the appropriate sections of the J1939 and ISO11783 standards. However, the integrator must be aware that there is no single software standard for such development, and a manufacturer can specify messages that are specific to its equipment without violating the standards. Accordingly, NovAtel allows integrators to support the protocol stack they require, to interface to NovAtel’s device drivers, by incorporating this protocol stack within NovAtel’s Application Program Interface (API). Integrators interested in this option are advised to contact NovAtel Customer Service for further information.

On the OEMV-1, OEMV-1G and OEMV-2 cards, the CAN port is shared with the EVENT2 input, the VARF output on the OEMV-1/ OEMV-1G, and the GPIO signal on the OEMV-2. The OEMV-1, OEMV-1G and OEMV-2 require external CAN transceivers and proper bus terminations. See *Section A.2, OEMV-1 Card on Page 104*, or *Section A.4, OEMV-2 Card on Page 115*, for pin-out information.

The OEMV-3 has two CAN transceivers, CAN1 and CAN2. See *Figure 43, Top-view of 14-Pin CAN Connector on the OEMV-3 on Page 124*. Proper bus termination is required. CAN1 is for slow speed (up to 125 Kb/s) and CAN2 is for high speed (up to 1 Mb/s). Their CAN interface can be accessed using NovAtel's API, but requires that shared signals be disabled in order to avoid conflicts. Refer to the *OEMV Firmware Reference Manual* and, see also, *Table 8 on Page 47*.

CAN Bus signals are not available on ProPak-V3 or FlexPak-G2 receivers. There is a CAN Bus-capable model of the SMART-V1 with its own multi-cable.

☒ CAN Bus functionality is controlled through NovAtel’s optional API software. The API header file includes documentation on using the CAN bus. For example, `oemapi.h`.

Table 8: Available CAN Signals on Receivers

| Receiver | CAN | Pins/Ports |
|--|---------|------------|
| OEMV-1 and OEMV-1G (no transceiver) J700 | CAN1 Tx | Pin 7 |
| | CAN1 Rx | Pin 6 |
| | CAN2 Tx | Pin 20 |
| | CAN2 Rx | Pin 8 |
| OEMV-2 (no transceiver) P1100 | CAN1 Tx | Pin 19 |
| | CAN1 Rx | Pin 7 |
| OEMV-3 (with transceiver) P1400 | CAN1H | Pin 2 |
| | CAN1L | Pin 1 |
| | CAN2H | Pin 6 |
| | CAN2L | Pin 5 |
| SMART-V1 | CANH | Pin 3 |
| | CANL | Pin 4 |

3.3.4 Status Indicators

OEMV family receiver cards have LED indicators that provide the status of the receiver. The OEMV cards have a single indicator, which is shown in *Figure 14 on Page 42* for the OEMV-3. The LED blinks green on and off at approximately 1 Hz to indicate normal operation. If the indicator is red, then the receiver is not working properly. The operation of this indicator is further described in *Section 6.6 on Page 91*.

When a ProPak-V3 is powered, RS-422 configured ports have a solid green LED. RS-232 configured ports flash, or are dark, to correspond with receiving/transmitting information, or not, respectively.

For example, consider a ProPak-V3-424, where the 424 suffix indicates COM1=RS-422, COM2=RS-232, and COM3=RS-422. The COM1 and COM3 LEDs appear solid green, but the COM2 LED is dark or flashing.

The enclosures' status indicators are shown in *Tables 9 and 10*.

Table 9: ProPak-V3 Status Indicators

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

Table 10: FlexPak-G2 Status Indicators

| Indicator | FlexPak-G2-V1/FlexPak-G2-V1G | FlexPak-G2-V2 |
|----------------------------|---|---|
| Antenna/ Position Valid | Solid GREEN with valid position / No error mode | Solid GREEN with valid position / Solid RED indicates a board error |
| COM1 | Flashing GREEN when transmitting data from COM1 / Flashing RED when receiving data on COM1 | Flashing GREEN when transmitting data from COM1 / Flashing RED when receiving data on COM1 |
| COM2 | Flashing GREEN when transmitting data from COM2 / Flashing RED when receiving data on COM2 | Flashing GREEN when transmitting data from COM2 / Flashing RED when receiving data on COM2 |
| Power | Solid RED when +12V applied | Solid RED when +12V applied |

3.3.5 External Oscillator (OEMV-2, OEMV-3 and ProPak-V3 only)

For certain applications requiring greater precision than what is possible using the on-board 20 MHz, voltage-controlled, temperature-compensated crystal oscillator (VCTCXO), you may wish to connect the OEMV to an external, high-stability oscillator. The external oscillator can be either 5 MHz or 10 MHz.

Operation consists of connecting a cable from the external oscillator to the receiver's external oscillator input connector. For the ProPak-V3, the BNC external oscillator port, labelled **OSC**, is used. See *Figure 8, ProPak-V3 Enclosure Ends on Page 30*. For the OEMV-3, an MMCX female connector (J700) is used, as shown in *Figure 14 on Page 42*. On the OEMV-2, the external oscillator connector is J501, see *Figure 13 on Page 41*. The receiver does not have to be powered down during this procedure. If you are handling the OEMV card directly, anti-static practices must be observed.

Once the external oscillator has been installed, the EXTERNALCLOCK command must be issued to define the clock model (for example, cesium, rubidium or ovenized crystal). If the input clock rate is 5 MHz, the EXTERNALCLOCK command must be issued to change the 10 MHz default rate.

3.3.6 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 OEMV cards and is limited to 100mA.

The OEMV family receivers and their LNA capabilities are listed in this section.

OEMV-3

For the OEMV-3 it is possible to supply power to the LNA of an active antenna either from the antenna port of the OEMV-3 card itself or from an external source. The internal antenna power supply of the OEMV-3 cards can produce +4.75 to +5.10 V DC at up to 100 mA; enough for NovAtel's dual-frequency GNSS antennas, so that an additional LNA power supply is not normally required.

If a different antenna is used whose LNA requires voltage capacity beyond what the receiver can produce, then the external LNA power option must be utilized. This simply requires setting an external voltage supply between +5.5 and +18 V DC, 100 mA maximum, and connecting it to pin 40 of the 40-pin connector on the OEMV-3. See also *Appendix A, OEMV-3, LNA_PWR on Page 123*.

In either case, the LNA power is fed to the antenna through the same coaxial cable used for the RF signals (LNA power is enabled by default). The internal LNA power source should be disabled using the ANTENNAPOWER command.

OEMV-2

The OEMV-2 card supplies power to the active antenna LNA from its internal LNA supply only.

OEMV-1 and OEMV-1G

The OEMV-1 and OEMV-1G cards use external LNA power only. Set the external voltage supply between +5.5 and +16 V DC and connect it to pin 1 of the OEMV-1, or OEMV-1G, 20-pin connector. See also *Appendix A, OEMV-1, RF Input / LNA Power Output* on *Page 100* or *OEMV-1G, Page 106*.



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 3, Installation and Setup on Page 36*. The following instructions are based on a configuration such as that shown in *Figure 15*. It is assumed that a personal computer is used during initial operation and testing for greater ease and versatility.

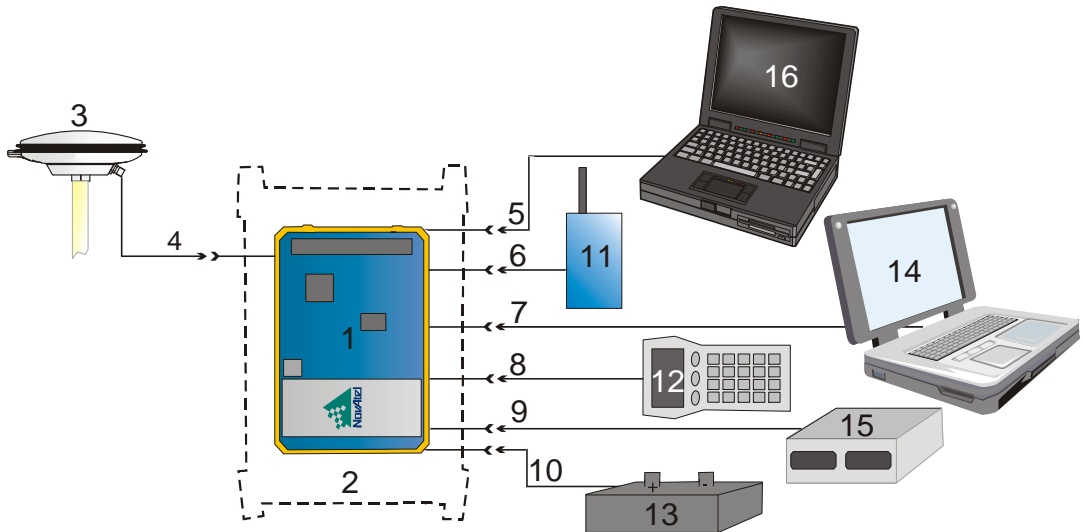


Figure 15: Available OEM Card Connection Interfaces

| Reference | Description | Reference | Description |
|-----------|--------------------------------------|-----------|--|
| 1 | OEMV Card | 10 | Power Input |
| 2 | User-Supplied Enclosure ¹ | 11 | User-Supplied Base Radio |
| 3 | NovAtel GNSS Antenna | 12 | Data Logger or Rover |
| 4 | GNSS Signal (RF Cable) | 13 | External DC Power Source |
| 5 | COM1 Link | 14 | Laptop or PC with NovAtel USB drivers installed |
| 6 | COM2 Link | 15 | External Oscillator |
| 7 | USB Link | 16 | PC or Base Station |
| 8 | COM3 Link | | |
| 9 | External Oscillator Signal | | |

☒ See also *Figure 16 on Page 55* for a base/rover example.

1. Custom or NovAtel

4.1 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 an IBM-compatible 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 *OEMV Firmware Reference Manual* to ensure maximum utilization of the receiver's capabilities.

4.1.1 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, COM2 and COM3 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.

4.1.2 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. Handshaking is not required, although it can optionally be used. Ensure the terminal's communications set-up matches the receiver's RS-232 protocol.

4.1.3 Communicating Using a Personal Computer

An IBM-compatible 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.

4.2 Getting Started

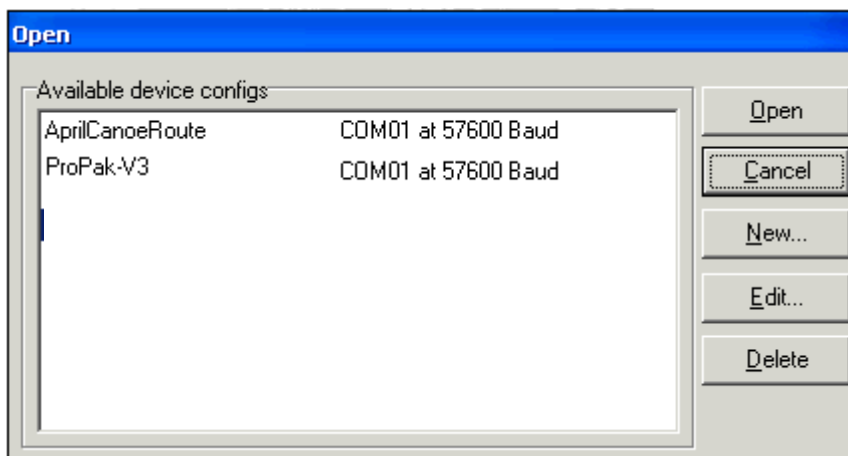
Included with your receiver are NovAtel's **CDU** and Convert programs. **CDU** is a windows-based GUI which allows you to access the receiver's many features without the need for communications protocol or to write special software. The Convert utility is a windows-based utility that allows you to convert between file formats, and strips unwanted records for data file compilation. See *Chapter 5, PC Software and Firmware on Page 68* for more information on these programs and their installation.

4.2.1 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 *OEMV 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 Service* section at the beginning of this manual on *Page 21*.

4.2.2 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 two possible configurations 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 5, PC Software and Firmware* starting on *Page 68* 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,

or

[COM3] *if connected to COM3 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, USB3 or AUX.

-
- ☒ 1. You may also have to wait for output from receiver self tests. For example, on start-up, the OEMV family receiver is set to log the RXSTATUSEVENTA log ONNEW on all ports. See *Section 6.4, RXSTATUSEVENT Log on Page 88* for more details.
 - 2. If you find that **CDU** is unable to locate your OEMV family receiver, it may be that you have previously used the SAVECONFIG command. In this case, try using a different COM port to communicate to the receiver. Once communication has been established, issue a FRESET STANDARD command. You should now be able to use your original communication port again.
 - 3. XCOM1, XCOM2 and XCOM3 virtual ports can be generated by the receiver. However they are unlikely to appear as a port prompt as you cannot connect to these types of ports using **CDU**. Also, they are not available with the COM command but may be used with other commands, such as INTERFACEMODE and LOG. Refer to the *OEMV Firmware Reference Manual* for the virtual ports available and details on the above mentioned logs.
-

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.**

4.3 Transmitting and Receiving Corrections

Corrections can be transmitted from a base station to a rover station to improve position accuracy. 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 be sent correction messages from a base station to calculate differential GNSS positions. An example of a differential setup is given in *Figure 16*.

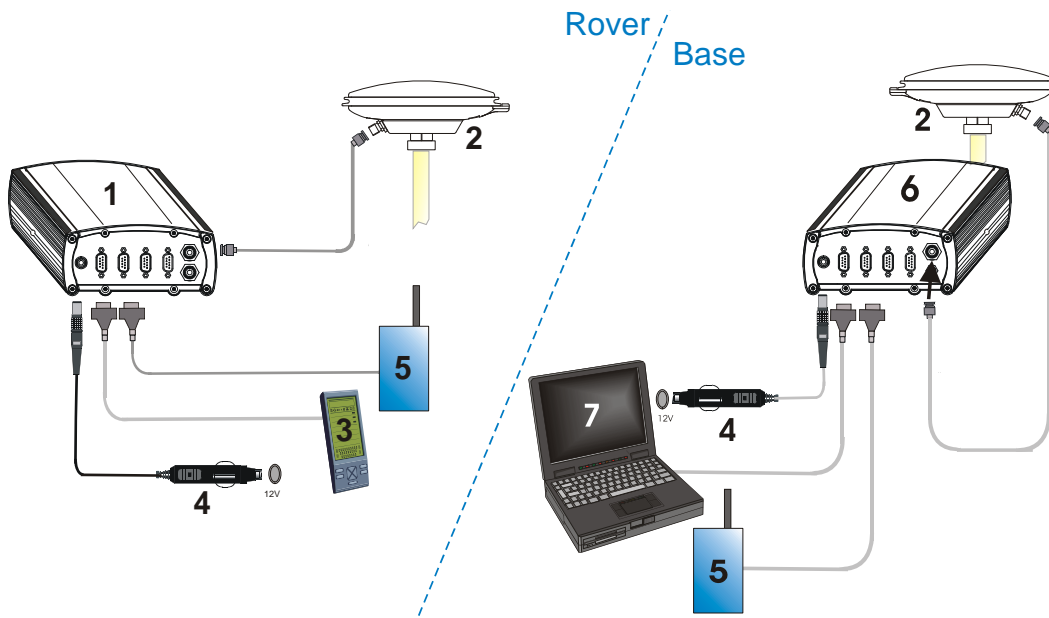



Figure 16: Basic Differential Setup

| Reference | Description |
|-----------|---|
| 1 | A ProPak-V3 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 ProPak-V3 receiver for the base station |
| 7 | User-supplied laptop/PC, for setting up and monitoring, to COM1 |

 Refer also to the *DL-V3 User Manual* for its Bluetooth and Ethernet configuration options.

Errors can be introduced by system biases. For more information on system errors refer to the *GNSS Reference Book*, available from 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 and L-band 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 4.3.1 - 4.3.2* starting on *Page 57*. *Section 4.3.3* gives an example of how to set up your base and rover for GPS + GLONASS RTCA operation.

4.3.1 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      interfacemode com2 none rtca off
           fix position 51.11358042 -114.04358013 1059.4105 (enter your own lat, lon, hgt)
           log com2 rtcaobs ontime 1
           log com2 rtcaref ontime 10
           log com2 rtca1 ontime 5
           log com2 rtcaephem ontime 10 1 (optional)
```

```
RTCM     interfacemode com2 none rtcm off
           fix position 51.11358042 -114.04358013 1059.4105 (enter your own lat, lon, hgt)
           log com2 rtc3 ontime 10
           log com2 rtc22 ontime 10 1
           log com2 rtc1819 ontime 1
           log com2 rtc1 ontime 5
```

```
RTCMV3  interfacemode com2 none rtcmv3 off
           fix position 51.11358042 -114.04358013 1059.4105 (enter your own lat, lon, hgt)
           log com2 rtc1006 ontime 10
           log com2 rtc1003 ontime 1
```

```
CMR+    interfacemode com2 none cmr off
           fix position 51.11358042 -114.04358013 1059.4105 (enter your own lat, lon, hgt)
           log com2 cmrobs ontime 1
           log com2 cmrplus ontime 1 (important to use ontime 1 with cmrplus)
```

```
CMR     interfacemode com2 none cmr off
```



```
fix position 51.11358042 -114.04358013 1059.4105 (enter your own lat, lon, hgt)
log com2 cmrobs ontime 1
log com2 cmrref ontime 10
log com2 cmrdesc ontime 10 1
```

4.3.2 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+)
```

4.3.3 GPS + GLONASS Base and Rover Configuration

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

Base Station:

```
fix position lat lon hgt      (enter your own lat, lon, and hgt values)
com com2 9600 N 8 1 N off
interfacemode com2 none rtca off
log com2 rtcaref ontime 10
log com2 rtcaobs2 ontime 1
log com2 rtcal ontime 5      (optional, enable code-DGPS coverage)
saveconfig      (optional, save configuration to non-volatile memory)
```

Rover Station:

```
com com2 9600 N 8 1 N off
interfacemode com2 rtca none off
log com1 bestposa ontime 1      (optional, view position information)
saveconfig      (optional, save configuration to non-volatile memory)
```

4.3.4 **ALIGN** Heading Master and Remote Configurations

This section shows you how to set up a master station with an **ALIGN**-capable remote receiver for applications that require heading output. Refer to *APN-048*, available from our [Web site](#), for more details on setting up a heading configuration.

Master:

```
interfacemode com2 none rtca off
fix position lat lon hgt           (enter your own lat, lon, and hgt values)
or movingbasestation enable
log com2 rtcaobs2 ontime 1
log com2 rtcaref ontime 10
```

Remote:

```
interfacemode com2 rtca none off
log headinga onchanged           (heading, baseline length, pitch and other data)
log gphdt ontime 1              (NMEA heading formatted log)
hdtoutthreshold 1.0            (optional: control the GPHDT log output)
```

4.3.5 **PDP** and **GLIDE** Configurations

PDP and **GLIDE** position filters can be used for single-point, WAAS, CDGPS, DGPS or VBS positioning.

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, CDGPS, DGPS or VBS are in use. For single point and DGPS, do not issue a SETIONOTYPE command (so it uses L1/L2 or L1 depending on the model). For WAAS, CDGPS and VBS:

```
setionotype grid
```

The rest of the setup is position type and log dependant according to your application. For example, details of the RTKSOURCE, PSRDIFFSOURCE, INTERFACEMODE, COM and other configuration commands are in the [OEMV Firmware Reference Manual](#) available on our Web site.

4.3.6 **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 above. 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:

```
interfacemode com2 novatel novatel
fix position 51.11358042 -114.04358013 1059.4105
log com2 rtm1b 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 4.3.1, Base Station Configuration on Page 56*.
 - 3. Find information on how to send multiple commands and log requests using DOS or Windows, in our [Knowledge Base](#).
 - 4. PSRDIFFSOURCE entries fall back to SBAS (even NONE) for backwards compatibility.
-

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 on SBAS refer to the *GNSS Reference Book*, available from our [Web site](#).

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 *OEMV Firmware Reference Manual*, which describes the various message formats in more detail.

4.4 Enabling SBAS Positioning

OEMV family receivers are capable of SBAS positioning. 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 on SBAS, refer to the *GNSS Reference Book*, available from our [Web site](#).

4.5 Enabling L-band (OEMV-1, OEMV-3 and ProPak-V3)

L-band equipped receivers allow you to achieve sub-metre accuracy. In order to use this positioning mode, you must enable L-band tracking to the Canada-Wide Differential Global Positioning System (CDGPS) or OmniSTAR signal. A subscription to OmniSTAR is required to use the OmniSTAR service. The CDGPS signal is free and available without subscription. For more on L-band positioning, refer to the *GNSS Reference Book*, available from our Web site at www.novatel.com.

To obtain an OmniSTAR subscription, contact OmniSTAR at 1-800-338-9178 or 713-785-5850. If you contact OmniSTAR, you will be asked to provide the receiver's OmniSTAR serial number (which is different from the NovAtel serial number). To obtain the OmniSTAR serial number, enter the following command in a terminal window or the Console window in **CDU**:

```
log lbandinfo
```

The log that is generated displays the L-band serial number in the fifth field following the log header. It is a six digit number in the range 100000 to 9999999. This log also provides the status of your subscription. Refer to the LBANDINFO command for more information.

In order to activate an OmniSTAR subscription, the receiver must be powered and tracking an L-band satellite. When advised by OmniSTAR of the appropriate satellite frequency and data link rate for your location, use the ASSIGNLBAND command to configure your receiver. The CDGPS frequencies are listed below and these can also be used with the ASSIGNLBAND command.

The following are the CDGPS spot beam names and their frequencies (in KHz or Hz):

| | |
|--------------|-----------------------|
| East | 1547646 or 1547646000 |
| East-Central | 1557897 or 1557897000 |
| West-Central | 1557571 or 1557571000 |
| West | 1547547 or 1547547000 |

The following are the OmniSTAR frequencies as of June 2, 2008:

| Coverage Area | Satellite Location (Longitude) | Frequency | Data Rate ^a | L-band | Satellite Name |
|--|--------------------------------|-----------|------------------------|--------|----------------|
| Eastern U.S. ^b | 101 West | 1557.8450 | 1200 | L-band | MSV-E |
| Central U.S. ^b | 101 West | 1557.8350 | 1200 | L-band | MSV-C |
| Western U.S. ^b | 101 West | 1557.8550 | 1200 | L-band | MSV-W |
| North, Central, and South America, including the Caribbean | 98 West | 1535.1375 | 1200 | L-band | AM-SAT |
| Asia, Pacific Islands | 109 East | 1535.1375 | 1200 | L-band | AP-SAT |
| AFRICA | 25 East | 1535.080 | 1200 | L-band | AFSAT |
| East Africa Middle East | 25 East | 1535.1525 | 1200 | L-band | EA-SAT |
| Australia, Far East | 160 East | 1535.185 | 1200 | L-band | OCSAT |

- a. A data (baud) rate of 1200 equals a symbol rate of 2438
- b. Recently changed frequencies - Coverage is Northern Canada to southern Mexico

The following are examples for using either CDGPS and OmniSTAR:

```
assignband cdgps 1547547 4800
assignband omnistar 1536782 1200
```

-
- ☒ 1. In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR, or use of the free CDGPS, service is required. Contact NovAtel for details.
 - OmniSTAR Web site: <http://www.omnistar.com/>
 - CDGPS Web site: <http://www.cdgps.com/>
 - 2. The frequency assignment can be made in Hz or kHz. For example:
 - Hz: assignband omnistar 1536782000 1200
 - kHz: assignband omnistar 1536782 1200
 A value entered in Hz is rounded to the nearest 500 Hz.
-

To confirm you are tracking an L-band signal, log the L-band status information by entering the following command:

```
log lbandstat
```

For example, if you are receiving CDGPS, the fifth field after the header should be 00c2:

```
lbandstat com1 0 43.5 finesteering 1295 149951.671 00000000 976f 34461
<1547546977 46.18 4541.0 0.00 00c2 00f0 0 0 0 8070 0001 0 0 0
```

Refer to the LBANDSTAT command in the *OEMV Firmware Reference Manual* for details. For more on L-band positioning, refer to the *GNSS Reference Book*, available from our Web site at www.novatel.com.

4.6 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, PASSCOM3, PASSXCOM1, PASSXCOM2, PASSXCOM3, PASSUSB1, PASSUSB2, PASSUSB3** and **PASSAUX** are available on OEMV family receivers for logging through serial ports. The AUX port is available on OEMV-3-based products. Refer to the PASSCOMx log for details.

4.7 T Sync Option (OEMV-3-based products only)

This section describes the relationship constraints of the input signal phase when the Time Synchronization Modification (T Sync Mod) option has been added to an OEMV-3 card or ProPak-V3.

The 5, or 10, MHz external oscillator and 1PPS signals must maintain a phase relationship as shown in *Figures 17 and 18 on Page 63*. The 1PPS signal must NOT fall within 5 ns of each of the 4 positions of the 5 MHz sine wave, or within 5 ns of each of the 2 positions of the 10 MHz sine wave.

These are areas of instability and should be avoided.

When an external oscillator is connected, T Sync pulses are sent through hardware on the receiver card and cannot be disabled. You must issue a time-synchronization-enabling command (refer to ADJUST1PPS TIME in the *OEMV Family Firmware Reference Manual*) for the receiver to track properly.

To adjust the phase relationship of the 5, or 10, MHz and 1PPS signals, add additional RF cable to the 5, or 10, MHz line. For example, if using RG58, each 1 metre piece will move the 5, or 10, MHz phase by approximately 5 ns.

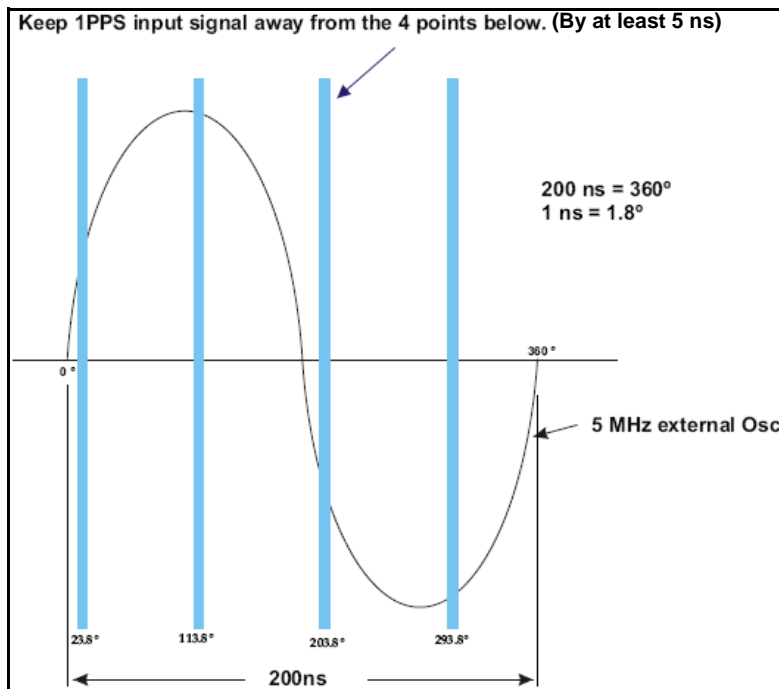


Figure 17: OEMV-3 and ProPak-V3 T Sync 5 MHz and 1PPS

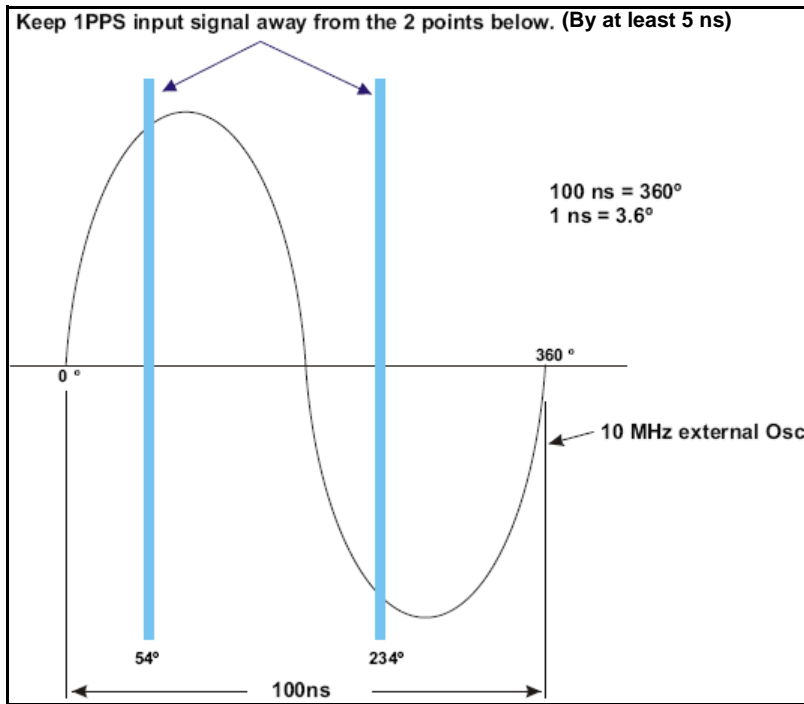


Figure 18: OEMV-3 and ProPak-V3 T Sync 10 MHz and 1PPS

4.8 Transferring Time Between Receivers

The ADJUSTIPPS command is used as part of the procedure to transfer time between receivers. The number of pulses per second (PPS) is always set to 1 Hz with this command. It is typically used when the receiver is not adjusting its own clock and is using an external reference frequency.

The TIMESYNC log is also used to synchronize time between receivers. It contains a time status field that may show COARSE or FINE for example. For a complete list of the time status values and their definitions, please refer to *Section 1.3, GPS Time Status* in the *OEMV Firmware Reference Manual*.

Section 4.8.3 starting on *Page 65* provides details on the time transfer procedure. Definition used in the procedure are in *Section 4.8.2* starting on *Page 65*. Please also refer to the ADJUSTIPPS command and the TIMESYNC log descriptions.

4.8.1 GPS to Receiver Time Synchronization

Synchronization of receiver time with GPS time does not occur until the receiver locks onto its first satellite. The GPS L1 signal has two main streams of data modulated on the carrier. These data streams are the C/A code (1.023 MHz rate) and the P(Y) code (10.23 MHz rate). Additionally, a navigation message (at a 50 Hz rate) contains GPS satellite data including the ephemeris, clock corrections and constellation status. This navigation message is encoded on both the C/A and P(Y) codes. The navigation message is transmitted via individual subframes and each subframe is 300 bits in length. With the 50 Hz data bit rate there is a new subframe transmitted every 6 seconds.

✉ Although GLONASS could be used for time synchronization, OEMV receivers use GPS.

4.8.2 Time Definitions

The following are related definitions:

| | |
|-------------|---|
| Coarse Time | Each subframe contains the transmit time of the next subframe in seconds of GPS time of week. After the first subframe is collected and decoded by the receiver, an approximate calculation of the "receiver clock offset" can be made. The receiver clock offset is the difference between GPS time and internal receiver time. The calculation is based on subframe transmit time and the approximate propagation time from the satellite signal to the receiver. The position of the satellite and receiver clock offset are used to re-initialize the seconds counter on the receiver, resulting in receiver/GPS time synchronization. The accuracy of the receiver time is expected to be within 30 milliseconds (ms) of GPS time. This initial synchronization is referred to as coarse time and is indicated by COARSE in the time status field of the TIMESYNC log. |
| Fine Time | Once at least 4 satellites have been acquired to calculate the antenna position, a more accurate estimate of the receiver clock offset is calculated. The new receiver clock offset is used to synchronize the receiver clock even closer to GPS time. This is referred to as fine time and is indicated by FINE or FINESTEERING in the time status field of the TIMESYNC log. Fine time accuracy is a function of the GPS constellation status. For the Standard Position Service (SPS) the time accuracy is specified as 300 ns (1 sigma) assuming that clock steering is enabled. |
| Fine Clock | An OEMV family receiver that is tracking satellites, and has a receiver clock state of FINE or FINESTEERING. |
| Cold Clock | An OEMV family receiver that needs to have its clock synchronized with the Fine receiver. It may have any clock state including UNKNOWN. |
| Warm Clock | An OEMV family receiver that has its clock adjusted to better than 500 ms. Refer to the TIME log to view the clock offset. |

The next section gives procedures for transferring time from a Fine to a Cold/Warm clock receiver.

4.8.3 Procedures to Transfer Time

These procedures are to transfer time between a Fine Clock and a Cold or Warm Clock GPS receiver.

Transfer COARSE time (<10 ms) from a Fine Clock to a Cold Clock GPS receiver

1. Connect a COM port from the Fine Clock to the Cold Clock (for example, COM2 on the Fine Clock receiver to COM3 on the Cold Clock receiver). Configure both ports to the same baud rate and handshaking configurations.
2. Issue this command to the Fine Clock receiver: `log com2 timesyncb ontime 1`
3. Issue this command to the Cold Clock receiver: `adjust1pps time`

When the Cold Clock receiver receives the TIMESYNC log, it sets its clock allowing for a 100 ms transfer delay.

Transfer FINE time (<50 ns) from a Fine Clock to a Cold Clock GPS receiver

1. Connect a COM port from the Fine Clock to the Cold Clock receiver (for example, COM2 on the Fine Clock receiver to COM3 on the Cold Clock receiver). Configure both ports to the same baud rate and handshaking configurations.
2. Issue this command to the Fine Clock receiver: `log com2 timesyncb ontime 1`
3. Connect the 1PPS signal of the Fine Clock receiver to the mark 1 input (Event1) of the Cold Clock receiver.
4. Issue this command to the Cold Clock receiver: `adjust1pps markwithtime`

When the Cold Clock receiver receives the 1PPS event from the Fine Clock receiver, it checks to see if it has received a valid TIMESYNC log within 200 ms of the last 1PPS event. If so, it sets the Cold Clock receiver clock to the time of the Fine Clock receiver. See *Figure 19* on *Page 67*.

Transfer FINE time from a Fine Clock to a Warm Clock GPS receiver

1. Connect the 1PPS signal of the Fine Clock receiver to the mark 1 input (Event1) of the Warm Clock receiver.
2. Issue this command to the Warm Clock receiver: `adjust1pps mark`

The phase of the Warm Clock receiver clock is adjusted by the fractional measurement of the Fine Clock receiver's 1PPS mark input event. In other words, it synchronizes the Warm Clock receiver's 1PPS to the incoming 1PPS of the Fine Clock receiver. It does NOT adjust the 1 second Time of Week (TOW) counter or the receiver's Week Number. This procedure is used to make small corrections to the Warm Clock receiver's clock.

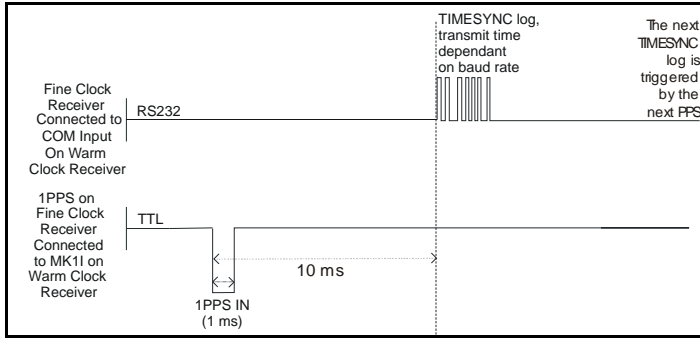


Figure 19: 1PPS Alignment

☒ In *Figure 20*, the examples are for the transfer of time. If you need position, you must be tracking satellites and your receiver must have a valid almanac.

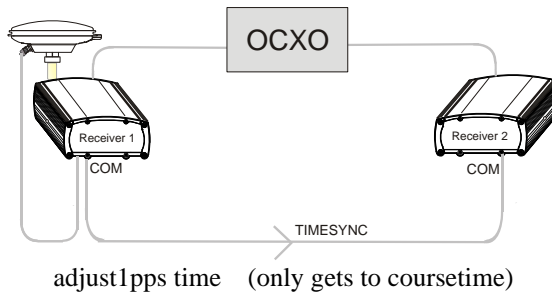
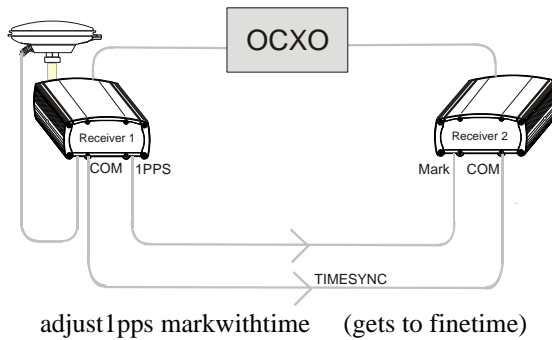
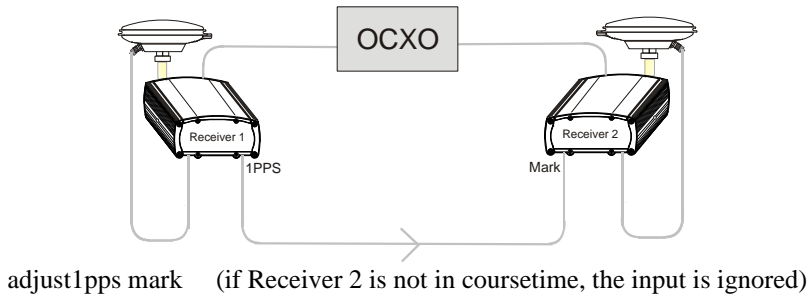


Figure 20: ADJUST1PPS Connections

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.

5.1 CDU/Convert Installation

The CD accompanying this manual contains the Windows applications **CDU** (Control and Display Unit) and Convert. The DL Explorer is part of CDU. They are installed via a standard Install Shield set-up application. Also included on the CD 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 CD supplied by NovAtel or from our Web site:

1. Start Microsoft Windows.
2. Place the NovAtel CD in your CD-ROM drive. 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 on the CD drive 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 at:

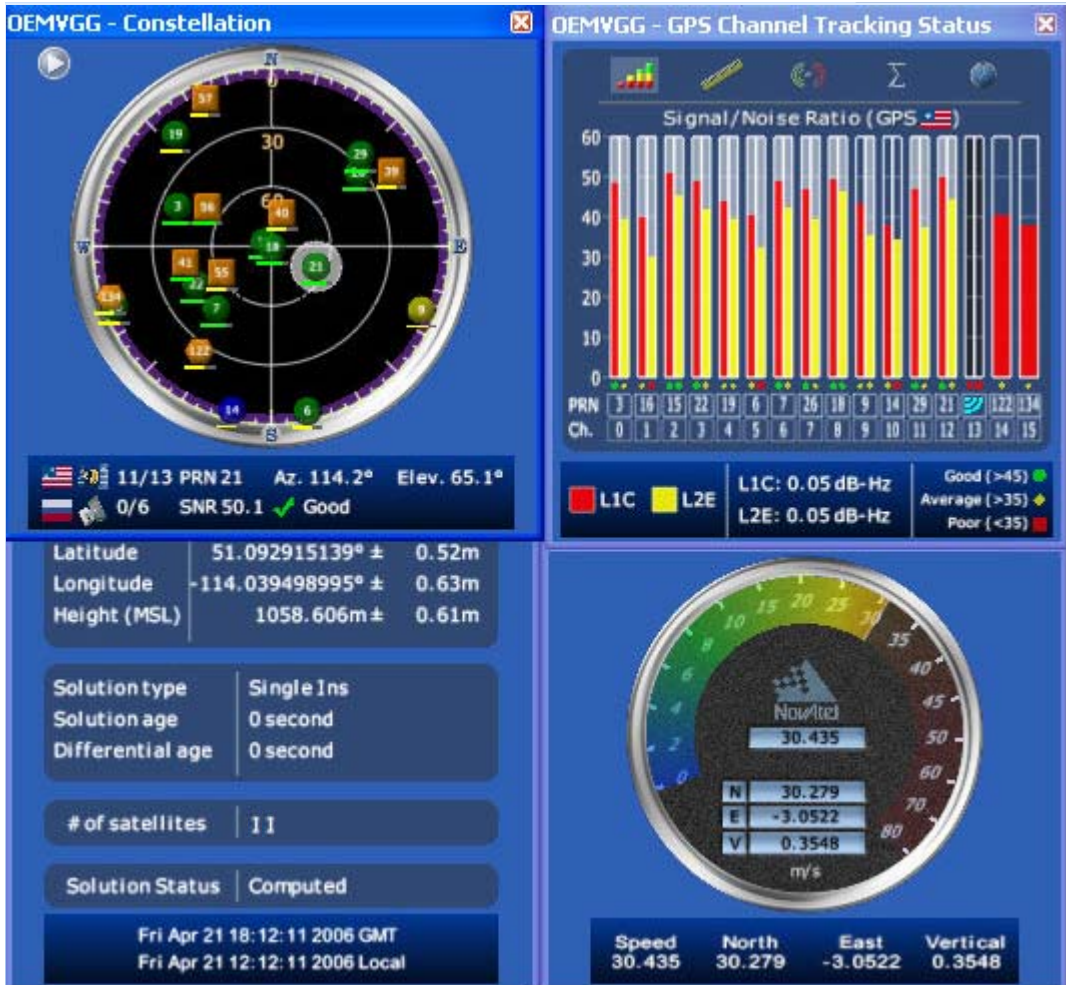
<http://www.novatel.com/support/fwsupdates.htm>

5.2 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 4.2.2, Communicating with the Receiver Using CDU* starting on *Page 53*.

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



Most windows have a popup menu accessible by right clicking on 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.

Each of the satellites being tracked are represented with icons according to their satellite system as follows:

- Circular for GPS
- Square for GLONASS
- Hexagon 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 verses 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-click in the Position window to that 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 centre 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.



- **Doppler 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!: Ensure all other windows are closed in CDU when entering the SAVECONFIG command in the Console window.



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:** There are two wizards available: RTK and SPAN.

The Real Time Kinematic (RTK) wizard takes you through the steps needed to set up your RTK system. You must have an RTK-capable receiver model or the wizard does not continue past its opening page.

The SPAN wizard takes you through the steps needed to set up your Synchronized Position Attitude Navigation (SPAN) system. You must have a SPAN-capable receiver model, or the wizard does not continue past its opening page. The SPAN wizard can help with the alignment or calibration of a SPAN system.



To display a wizard window, if you have the necessary receiver model, select SPAN Wizard or RTK Wizard from the Tools menu or select one of their buttons in the Window Toolbar.

5.3 Convert

Convert is a 32-bit Windows application and is shown in *Figure 21*. 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.

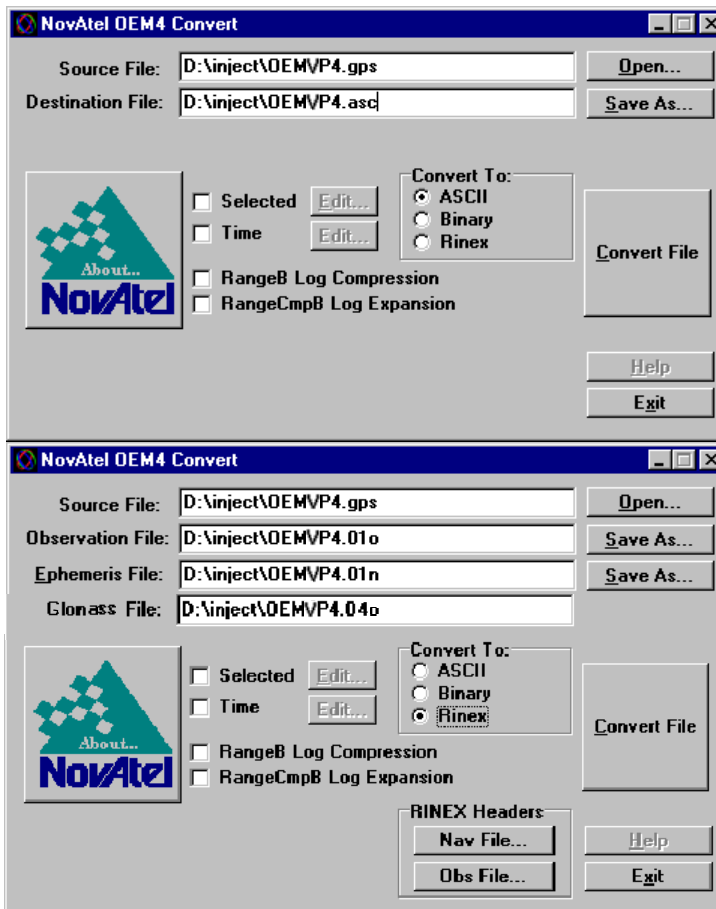


Figure 21: Convert Screen Examples

5.3.1 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.

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>.

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 ssssdfff.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 21, Convert Screen Examples on Page 74*, 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 11, NovAtel Logs for Rinex Conversion on Page 76*.

Table 11: NovAtel Logs for Rinex Conversion

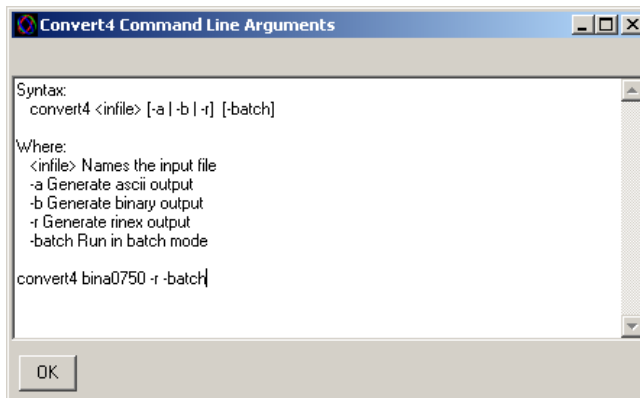
| NovAtel OEMV Family Log | Recommended Trigger |
|--|---------------------|
| RANGEA/B, or RANGECMPA/B | ontime 15 |
| BESTPOSA/B, or PSRPOSA/B, or RTKPOSA/B, or MARKPOSA/B | once |
| IONUTCA/B | onchanged |
| RAWEPHEMA/B | onchanged |
| GLORAWEPHEMA/B | onchanged |
| VERSIONA/B ^a | once |
| SITEDEFA/B ^b | once |

- 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 21 on Page 74*.
- Available on DL-V3 receivers, refer to the *DL-V3 User Manual*. Information from this log overrides data entered into the Marker Name, Marker Number, Antenna Type and Antenna Delta H fields using the OBS file button of the RINEX Headers section.

5.3.2 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 22*.

**Figure 22: 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 5.3.1, Rinex Format on Page 74*.

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.

5.4 USB Drivers Installation

The NovAtel USB PC Driver Kit contains the following:

| | |
|----------------|---|
| ngpsser.sys | This driver provides a virtual serial port for each USB port of the receiver. |
| ngpsusb.sys | This driver connects the virtual serial ports to the USB stack. |
| novatelusb.exe | 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 shortcut is added to the Start Menu under Programs/OEMV PC Software/NovAtel USB Configuration Utility. |

These drivers have not been certified by Microsoft's Windows Hardware Quality Lab (WHQL). Depending on your computer's Driver Signing Policy, Windows may refuse to install this driver or may display a warning. See *Section 5.4.1, Windows Driver Signing* for details.

5.4.1 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 80*.

5.4.2 Windows XP Installation

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

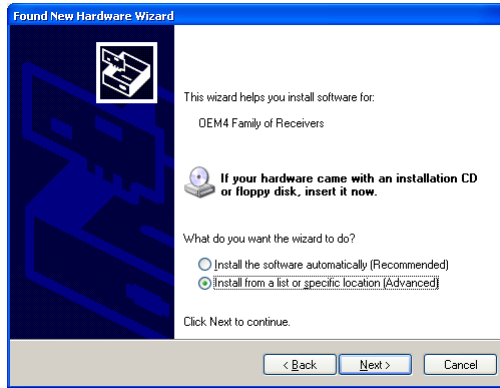
After connecting the NovAtel GPS receiver to a USB port on the PC, the Found New Hardware wizard appears.



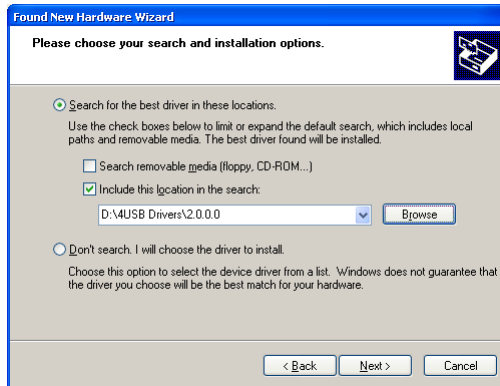
1. The screens displayed in this section, from Windows XP, may vary from what you see and depend on your operating system.
2. During the driver installation you may see a Window Logo testing warning if you skipped the steps in *Section 5.4.1, Windows Driver Signing on Page 77*. Our USB drivers are compatible with Microsoft Windows operating systems. Please click on *Continue Anyway* if you see a warning like this:



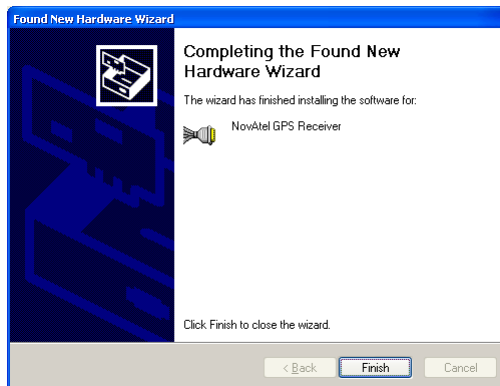
1. Click on *No, not this time* and then click on *Next*.
2. Select the *Install from a list or specific location (Advanced)* field and click on *Next*.



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 on the supplied OEMV family CD. Then click on *Next*.



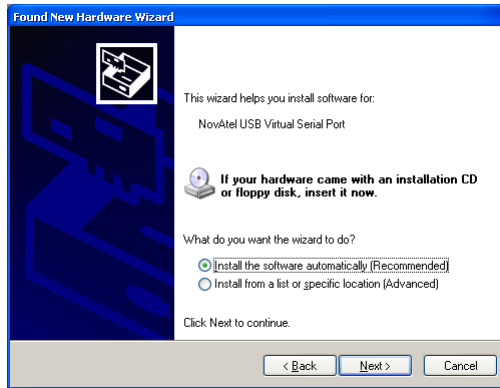
4. Click on *Finish* to complete the driver installation.



After installing the NovAtel USB driver, Windows detects the OEMV-2 or OEMV-3 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.
-

5.4.3 Windows 2000 Installation

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

After connecting the NovAtel GPS 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 5.4.2, Windows XP Installation* starting on *Page 78*).

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, for example, on the supplied OEMV family CD: USB Drivers\Install
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 assign three new COM port numbers.
-

5.5 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 GPS 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 Service section, *see Page 21*, at the beginning of this manual.

When you call, be sure to have available your receiver model number, serial number, and program 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 (for example, upgrading from an OEMV-3-L1 to an OEMV-3-RT2 on firmware version 3.000), you can use the AUTH command with the issued auth-code.

If you are upgrading to a higher firmware revision level (for example, upgrading an OEMV-3-RT2 firmware version 3.000 to OEMV-3-RT2 firmware version 3.100), you will need to transfer new program firmware to the OEMV family receiver using the WinLoad utility program. As WinLoad and the upgrade file are generally provided in a compressed file format, you will also be given a decompression password. WinLoad and the upgrade files can be found on NovAtel's FTP site at <http://www.novatel.com>, 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.
-

5.5.1 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 OEMV family model available within the same revision level as your current model (for example, upgrading from an OEMV-3-L1 to an OEMV-3-RT2 on firmware version 3.000). This command only functions in conjunction with a valid auth-code assigned by Customer Service.

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 OEMV family receiver and establish communications over a serial port (see *Chapter 4, Operation on Page 51*)
- 2) Issue the LOG VERSION command to verify the current firmware model number, revision level, 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 hhhh,hhh,hhh,hhh,hhh,model# where the h characters are an ASCII hexadecimal code, and the model# would be ASCII text

Example:

```
auth 17cb,29af,3d74,01ec,fd34,l112lrvrt2
```

Once the AUTH command has been executed, the OEMV family receiver will reboot itself. Issuing the LOG VERSION command will confirm the new upgrade model type and version number.

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

5.5.2 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 (for example, upgrading an OEMV-3-RT2 firmware version 3.000 to OEMV-3-RT2 firmware version 3.100). 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 OEMV family receiver via its COM1, COM2 or COM3 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 (<http://www.novatel.com>), or via e-mail (support@novatel.ca). If transferring is not possible, the file can be mailed to you on floppy disk. For more information on how to contact NovAtel Customer Service please see *Page 21* at the beginning of this manual.

You will need at least 1 MB of available space on your hard drive. 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 with password protection; Customer Service will provide you with the required password. 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 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 OEMV family cards. The main screen is shown in *Figure 23* on *Page 84*.

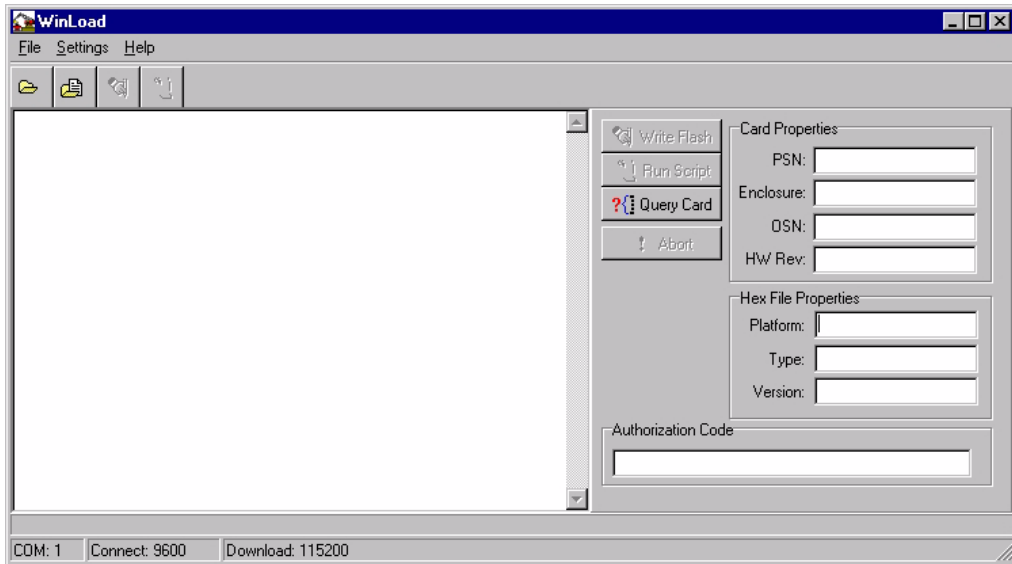


Figure 23: Main Screen of WinLoad

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 24, WinLoad's Open Dialog on Page 84*.

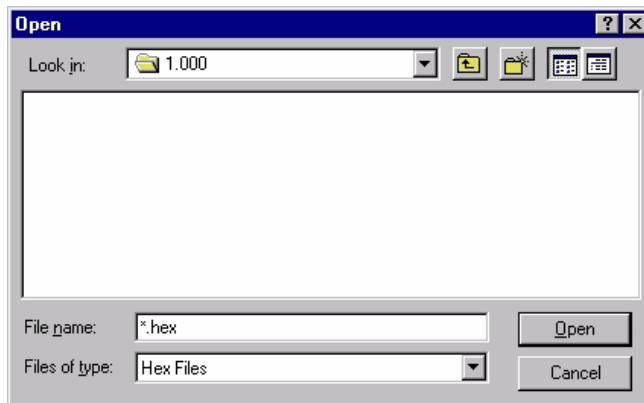


Figure 24: WinLoad's Open Dialog

Once you have selected your file, the name should appear in the main display area and in the title bar, see *Figure 25*.

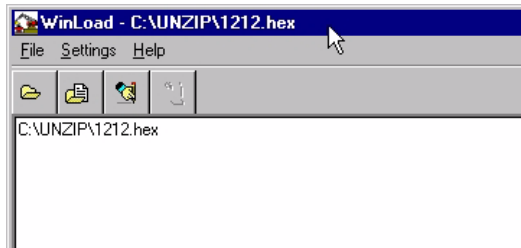


Figure 25: Open File in WinLoad

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 dropdown list and the baud rate from the Download Baudrate dropdown list. The baud rate should be as high as possible (the default of 115200 is preferred).

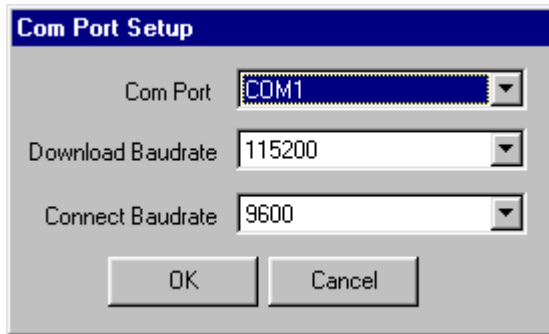


Figure 26: COM Port Setup

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 84.
3. Make sure the file path and file name are displayed in main display area, see *Figure 25, Open File in WinLoad* on Page 85.
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 27*.

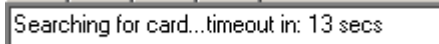


Figure 27: Searching for Card

6. When the Authorization Code dialog opens, see *Figure 28*, enter the auth code and select OK

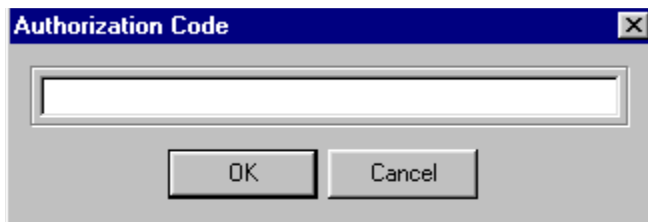


Figure 28: Authorization Code Dialog

7. The receiver should finish downloading and reset. The process is complete when "Done." is displayed in the main display area, see *Figure 29*.

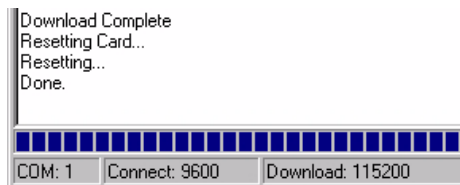


Figure 29: Upgrade Process Complete

8. Close WinLoad.

This completes the procedure required to upgrade an OEMV family receiver.

6.1 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. ERROR strobe signal (see *Section 3.3.1, Strokes on Page 45*)
3. RXSTATUSEVENT log
4. RXSTATUS log
5. Status LED

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

When a fatal event occurs (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, the error strobe is driven high, 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.

6.2 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, turn off the antenna, and disable the RF hardware, 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 OEMV family receiver for your specific needs.

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

6.3 Error Strobe Signal

The error strobe signal is one of the I/O strobes and is driven low when the receiver is operating normally. When the receiver is in the error state and tracking is disabled, the error strobe is driven high. This can be caused by a fatal error or by an unusual receiver status indication that the user has promoted to be treated like a fatal error. Once on, the error status will remain high until the cause of the error is corrected and the receiver is reset. See also *Section 3.3.1, Strobes on Page 45*.

6.4 RXSTATUSEVENT Log

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

On start-up, the OEMV family 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 *OEMV Firmware Reference Manual* for a more detailed description of this log.

6.5 RXSTATUS Log

6.5.1 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 30*.

```

<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 30: 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 31.

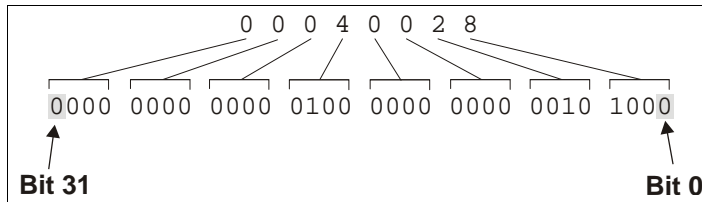


Figure 31: Reading the Bits in the Receiver Status Word

If the receiver status word indicates a problem, please also see Section 7.1, *Examining the RXSTATUS Log* on Page 95.

6.5.2 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 in 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, turn off the antenna, and disable the RF hardware. 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 6.5.6, *Set and Clear Mask for all Status Code Arrays* on Page 91).

The error word is the first field after the log header in the RXSTATUS log, as shown in the example in Figure 32, 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 32: Location of Receiver Error Word

Here is another example of a receiver error word. The numbering of the bits is shown in *Figure 33*.

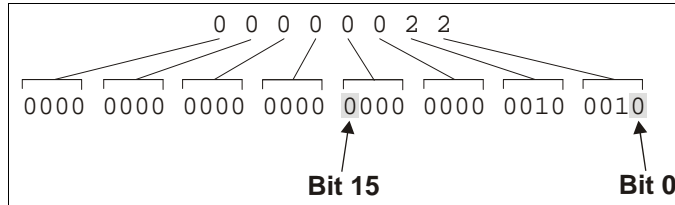


Figure 33: Reading the Bits in the Receiver Error Word

Refer to the RXSTATUS and the RXSTATUSEVENT logs in the *OEMV Firmware Reference Manual* for more detailed descriptions of these logs. If the receiver error word indicates an error, please also see *Section 7.1, Table 13, Resolving a Receiver Error Word on Page 95*.

6.5.3 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.

6.5.4 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.

6.5.5 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 *OEMV Firmware Reference Manual* for a more detailed description of this log.

6.5.6 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 *OEMV Firmware Reference Manual* for a more detailed description.

6.6 Status LEDs

6.6.1 OEMV Cards

The diagnostic LED provided on the OEMV family 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 92*, 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.

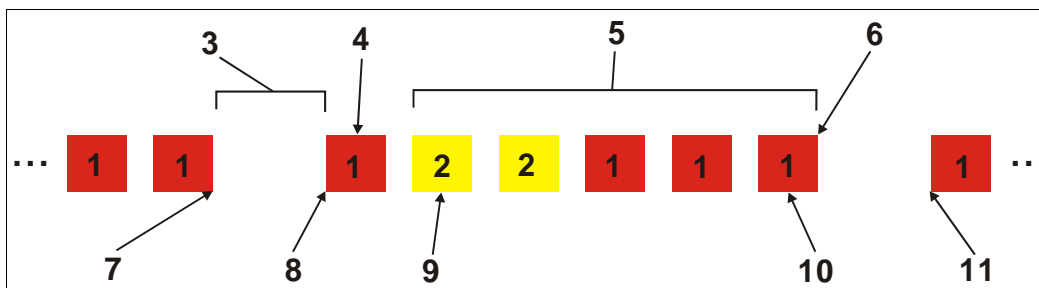


Figure 34: Status LED Flash Sequence Example

| 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, refer to the *Unit Conversion* section of the *GNSS Reference Book*, available from our Web site at www.novatel.com. Refer also to the RXSTATUS log, and its tables 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 7.1, Examining the RXSTATUS Log, Page 95*.

If the problem is not resolved after using this troubleshooting guide, or after trying our Knowledge Base at <http://www.novatel.com/support/knowledgedb.htm>, contact NovAtel Customer Service, see *Page 21*.

Table 12: Troubleshooting based on Symptoms

| Symptom | Related Section |
|--|--|
| The receiver is not properly powered | Check for and switch a faulty power cable. See <i>Section 3.1.3, Power Supply Requirements, Page 37</i> and <i>Section 3.3.3, CAN Bus, Page 46</i> . |
| The receiver cannot establish communication | Check for and switch faulty serial cables and ports. See <i>Section 3.3.3, CAN Bus, Page 46</i> and <i>Section 6.6, Status LEDs, Page 91</i> . Refer also to the COMCONFIG log in the <i>OEMV 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 3.1.1, Selecting a GNSS Antenna, Page 36</i> , <i>Section 3.1.2, Choosing a Coaxial Cable, Page 37</i> , <i>Section 3.2.4, Connecting the Antenna to the Receiver, Page 43</i> , <i>Section 3.3.6, Antenna LNA Power, Page 49</i> 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 http://www.novatel.com/about_gps/glossary.htm |
| No data is being logged | See <i>Section 3.3.3, CAN Bus, Page 46</i> , and <i>Section 4.1, Communications with the Receiver, Page 52</i> . |
| 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>OEMV Firmware Manual</i> . See also <i>Section 3.3.3, CAN Bus, Page 46</i> . |

Continued on Page 94

| Symptom | Related Section |
|--|--|
| A command is not accepted by the receiver | Check for correct spelling and command syntax. See <i>Section 4.1, Communications with the Receiver, Page 52</i> and refer to the FRESET command in the <i>OEMV Firmware Reference Manual</i> . |
| Differential mode is not working properly | See <i>Section 4.3, Transmitting and Receiving Corrections, Page 55</i> and refer to the COMCONFIG log in the <i>OEMV Firmware Reference Manual</i> . |
| There appears to be a problem with the receiver's memory | Refer to the NVMRESTORE command in the <i>OEMV 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 98</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 4.1.1, Serial Port Default Settings, Page 52</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>OEMV 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 3.1.2, Choosing a Coaxial Cable, Page 37</i> and the jamming symptom in this table. |

7.1 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 *OEMV Firmware Reference Manual* for details on this log and on how to read the receiver error word and status word. *Tables 13 and 14 on pages 95 to 97* give you actions to take when your receiver has an error flag in either of these words.

Table 13: 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 Service as described on <i>Page 21</i> |
| 5 | Check the VERSION log |
| 6 | Issue a FRESET command |
| 7 | See <i>Section 3.1.3, Power Supply Requirements, Page 37</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 99</i> |
| 10 | Contact Customer Service as described on <i>Page 21</i> |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | |

Table 14: 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 13, Resolving a Receiver Error Word</i> on Page 95. |
| 1 | Check temperature ranges in the ENVIRONMENTAL table sections of <i>Appendix A, Technical Specifications</i> starting on Page 99. |
| 2 | See <i>Section 3.1.3, Power Supply Requirements, Page 37</i> . |
| 3 | See <i>Section 3.1.1, Selecting a GNSS Antenna, Page 36, Section 3.1.2, Choosing a Coaxial Cable, Page 37, Section 3.2.4, Connecting the Antenna to the Receiver, Page 43, Section 3.3.6, Antenna LNA Power, Page 49</i> 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 http://www.novatel.com/about_gps/glossary.htm . |
| 4 | |
| 5 | |
| 6 | |
| 7 | See <i>Section 4.1.1, Serial Port Default Settings, Page 52</i> . |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 14 | Move the receiver away from any possible jamming sources. |
| 15 | See <i>Section 3.1.2, Choosing a Coaxial Cable, Page 37</i> and move the receiver away from any possible jamming sources. |
| 16 | Move the receiver away from any possible jamming sources. |
| 17 | See <i>Section 3.1.2, Choosing a Coaxial Cable, Page 37</i> 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 http://www.novatel.com/about_gps/glossary.htm |
| 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 http://www.novatel.com/about_gps/glossary.htm |
| 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>OEMV Firmware Reference Manual</i> . |

Continued on Page 97

| Bit Set | Action to Resolve |
|---------|--|
| 21 | None. This bit simply indicates if clock steering has been manually disabled. Refer also to the FRESET command in the <i>OEMV 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>OEMV Firmware Reference Manual</i> . |
| 23 | None. This bit indicates whether or not the phase-lock-loop is locked when using an external oscillator. Refer also to the FRESET command in the <i>OEMV Firmware Reference Manual</i> . |
| 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>OEMV 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>OEMV Firmware Reference Manual</i> . |

Appendix A Technical Specifications

A.1 OEMV Family Receiver Performance

PERFORMANCE (Subject To GPS System Characteristics)

| | | |
|---------------------------------------|---------------------|--|
| Position Accuracy ^a | Standalone: | |
| | L1 only | 1.8 m RMS |
| | L1/L2 | 1.5 m RMS |
| | SBAS ^b | 0.6 m RMS |
| | CDGPS ^b | 0.6 m RMS |
| | DGPS | 0.45 m RMS |
| | RT-20 | 0.20 m RMS |
| | RT-2 | 1 cm + 1 ppm RMS |
| | OmniSTAR: | |
| | VBS | 0.7 m RMS (OEMV-1 and OEMV-3 only) |
| | XP | 0.15 m RMS (OEMV-3 only) |
| | HP | 0.10 m RMS (OEMV-3 only) |
| | Post Processed | 5 mm + 1 ppm RMS |
| Time To First Fix | Hot: | 35 s (Almanac and recent ephemeris saved and approximate position) |
| | Cold: | 60 s (No almanac or ephemeris and no approximate position or time) |
| Reacquisition | | 0.5 s L1 (typical) |
| | | 1.0 s L2 (typical) (OEMV-2 and OEMV-3 only) |
| Data Rates | Raw | |
| | Measurements: | 20 Hz (50 Hz optional) |
| | Computed | |
| | Position: | 20 Hz (50 Hz optional) |
| | OmniSTAR HP | |
| Position: | 20 Hz (OEMV-3 only) | |
| Time Accuracy ^{a,c} | | 20 ns RMS |
| | | |
| Velocity Accuracy | | 0.03 m/s RMS |
| Measurement Precision | C/A code phase | 6 cm RMS |
| | L1 carrier phase: | |
| | Differential | 0.75 mm RMS |
| | L2 P code | 25 cm RMS (OEMV-2 and OEMV-3 only) |
| | L2 carrier phase: | |
| | Differential | 2 mm RMS (OEMV-2 and OEMV-3 only) |
| 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 OEMV-1 Card

| PHYSICAL | |
|----------------------------|---|
| Size | 46 mm x 71 mm x 10.3 mm with connectors |
| Weight | 21.5 grams |
| NOVATEL PART NUMBER | |
| Generic OEMV-1 | 01017753 |

MECHANICAL DRAWINGS

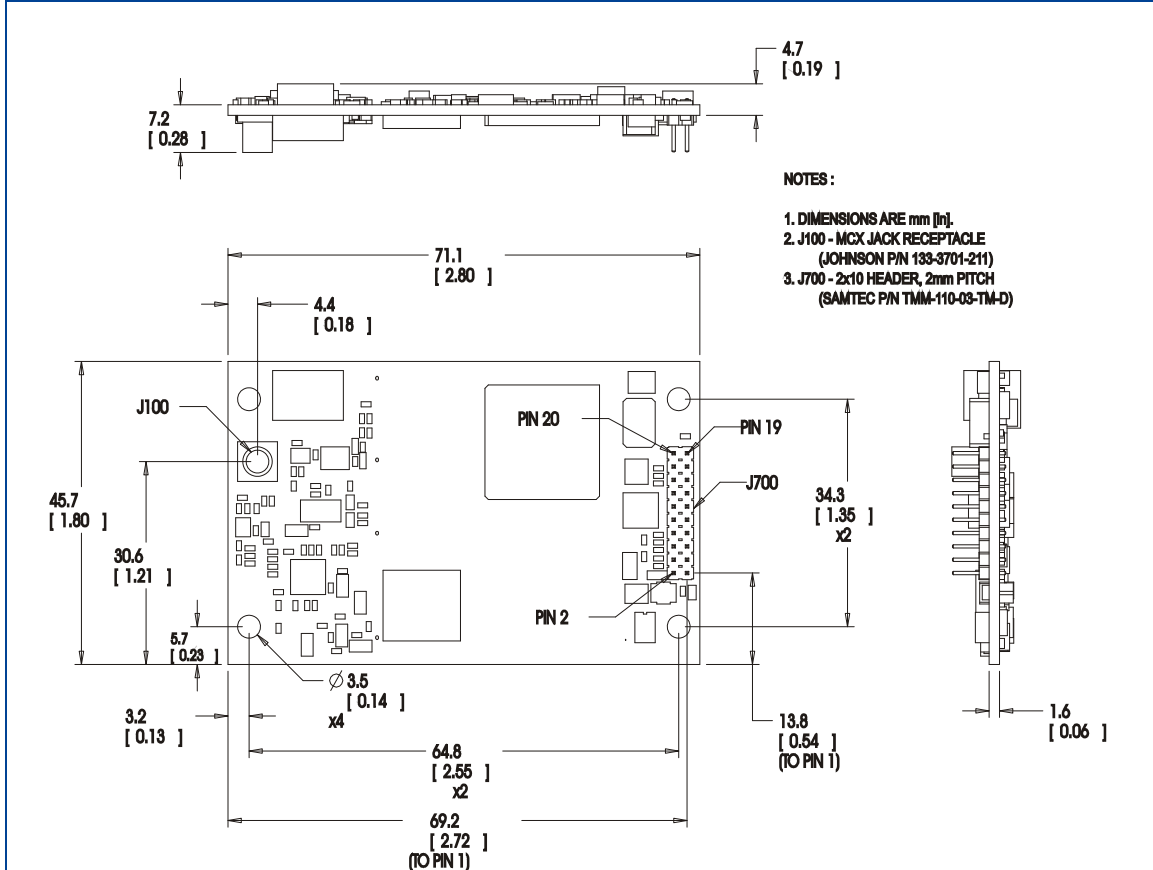


Figure 35: OEMV-1 Board Dimensions

| ENVIRONMENTAL | |
|-----------------------|----------------------------------|
| Operating Temperature | -40°C to +85°C |
| Storage Temperature | -45°C to +95°C |
| Humidity | Not to exceed 95% non-condensing |
| Random Vibe | RTCA D0-160D (4g) |
| Bump/Shock | MIL-STD 810F (40g) |
| Continued on Page 100 | |

| POWER REQUIREMENTS | |
|---|--|
| Voltage | +3.3 V DC +5%/-3% |
| Allowable Input Voltage Ripple | 100 mV p-p (max.) |
| Power Consumption | 1.1 W (GPS only) 1.6 W (GPS + L-band) <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. |
| In-Rush Power Consumption | 7.2 A for less than 60 μ s |
| RF INPUT / LNA POWER OUTPUT | |
| Antenna Connector | MCX female, 50 Ω nominal impedance (See <i>Figure 35</i> on <i>Page 99</i>) |
| Acceptable RF Input Level | -80 to -105 dBm |
| RF Input Frequencies | GPS L1: 1575.42 MHz OmniSTAR or CDGPS: 1525 to 1560 MHz |
| LNA Power External (Optional Input) Output to antenna | +5.5 to +16 V DC, 100 mA max. (user-supplied) +4.75 to +5.10 V DC @ 0 - 100 mA <hr/> <input checked="" type="checkbox"/> Apply power to the OEMV-1 on pin 1 within the +5.5 to +16 V DC range. The card regulates a constant 5 V output on the RF connector. See also <i>Section 2.3.1</i> on <i>Page 35</i> . |
| INPUT/OUTPUT DATA INTERFACE | |
| COM1 | |
| Electrical format | LVTTTL |
| Bit rates ^a | 300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 bps |
| Signals supported | COM1_Tx and COM1_Rx |
| COM2 | |
| Electrical format | LVTTTL |
| Bit rates ^a | 300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 bps |
| Signals supported | COM2_Tx and COM2_Rx |
| COM3 | |
| Electrical format | LVTTTL ^{b c d} |
| Bit rates ^a | 300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 bps |
| Signals supported | COM3_Tx and COM3_Rx |

Continued on the following page.

| CAN BUS^{e f g} | |
|--------------------------------|--|
| Electrical format | LVTTTL (requires external CAN transceiver) |
| Bit rates | 500 kb/s maximum. CAN Bus throughput is determined by slowest device on the bus. |
| Signals supported | CAN1 is on Pins 6 and 7. CAN2 is on Pins 8 and 20. ^g |
| USB | |
| Electrical format | Conforms to USB 1.1 |
| Bit rates | 5 Mb/s maximum |
| Signals supported | USB D (+) and USB D (-) |

- a. 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, 460800 bps, and 921600 bps.
- b. Upon power-up, USB is enabled and COM3 is disabled by default. Multiplexed I/O allows you to switch between USB and COM3.
- c. The receiver cannot prevent the host system from enumerating USB while using COM3 on the OEMV-1. This is due to the plug-and-play nature of USB. **Do not connect a USB cable while using COM3.**
- d. Enable COM3 using the following commands:

```
MARKCONTROL MARK1 DISABLE
INTERFACEMODE COM3 NOVATEL NOVATEL
SAVECONFIG
```

FRESET clears this command, disabling COM3 and enabling USB (the factory default setting).

- e. CAN1_RX and CAN1_TX are multiplexed with VARF and EVENT2, respectively. The default behavior is that EVENT2 is active. For VARF, refer to the FREQUENCYOUT command.
- f. CAN Bus behavior must be asserted through the NovAtel API software. See *Section 3.3.3, CAN Bus on Page 46* for further details.
- g. See also *Figure 36 on Page 104* and its table.

Table 15: OEMV-1 Strokes

| Strokes | Default Behavior | Input/Output | Factory Default | Comment ^a |
|---------------------------|------------------|---------------------------------|-----------------|---|
| Event1 (Mark 1) | Multiplexed 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 |
| Event2 (Mark 2) | Multiplexed 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 MARK2POS and MARK2TIME logs.) 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). VDD is 3.3V. |
| VARF (Variable Frequency) | Multiplexed pin | Output | Active low | A programmable variable frequency output ranging from 0 - 20 MHz (refer to the FREQUENCYOUT command). |
| RESETIN | Dedicated pin | Input | Active low | Reset LVTTTL signal input from external system; active low, > 20 μ s duration |
| 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, period and pulsewidth can be configured using PPSCONTROL command. |

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

Table 16: OEMV-1 Strobe Electrical Specifications

| Strobe | Sym | Min (V) | Typ (V) | Max (V) | Current (mA) | Conditions |
|--|-----------------|---------|---------|---------|--------------|-------------------|
| Event1 (Mark 1) Event2 (Mark2) PPS | V _{IL} | | | 0.8 | 4 | VDD = 3.3 V; 85°C |
| | V _{IH} | 2.0 | | | 12 | VDD = 3.3 V; 85°C |
| PV VARF | V _{OL} | | | 0.4 | 4 | VDD = 3.3 V; 85°C |
| | V _{OH} | 3.0 | | | 12 | VDD = 3.3 V; 85°C |
| RESETIN | V _{IL} | | | 0.8 | 4 | VDD = 3.3 V; 85°C |
| | V _{IH} | 2.3 | | | 13.8 | VDD = 3.3 V; 85°C |

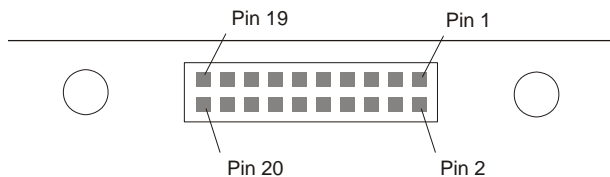


Figure 36: Top-view of 20-Pin Connector on the OEMV-1

| Signal | Behavior ^a | Descriptions | Pin |
|---------------------|-----------------------|---|-----|
| LNA_PWR | Input DC | Power supply for external antenna LNA | 1 |
| V _{IN} | Input DC | DC power supply for card | 2 |
| USB D (-) | Bi-directional | USB interface data (-) | 3 |
| USB D (+) / COM3_Rx | Multiplexed | Multiplexed pin behavior default: USB D (+) | 4 |
| RESETIN | See strobcs | Card reset | 5 |
| VARF / CAN1_Rx | Multiplexed | Multiplexed pin behavior, see strobcs default: VARF | 6 |
| Event2 / CAN1_Tx | Multiplexed | Multiplexed pin behavior, see strobcs default: Event2 | 7 |
| CAN2_RX | Bi-directional | CAN Bus dedicated port | 8 |
| Event1 / COM3_Tx | Multiplexed | Multiplexed pin behavior, see strobcs 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 | See strobcs | Output indicates 'good solution' or valid GPS position when high | 17 |
| GND | Ground | Digital Ground | 18 |
| PPS | See strobcs | Pulse output synchronized to GPS Time | 19 |
| CAN2_TX | Bi-directional | CAN Bus dedicated port | 20 |

- a. A bi-directional Transient Voltage Suppressor (TVS) device is included between 3.3V and ground. Input/Output (I/O) lines are protected by TVS devices. Series resistance is included for the following I/O lines: COM1/COM2/COM3 Tx and Rx, RESETIN, Event1 and Event2. Lines that do not have series resistance include: CAN1_Tx, CAN1_Rx, CAN2_Tx, CAN2_Rx, USB D (+) and USB D (-).

A.3 OEMV-1G Card

| PHYSICAL | |
|---------------------|--|
| Size | 46 mm x 71 mm x 9.8 mm with connectors |
| Weight | 21.5 grams |
| NOVATEL PART NUMBER | |
| Generic OEMV-1G | 01017967 |

MECHANICAL DRAWINGS

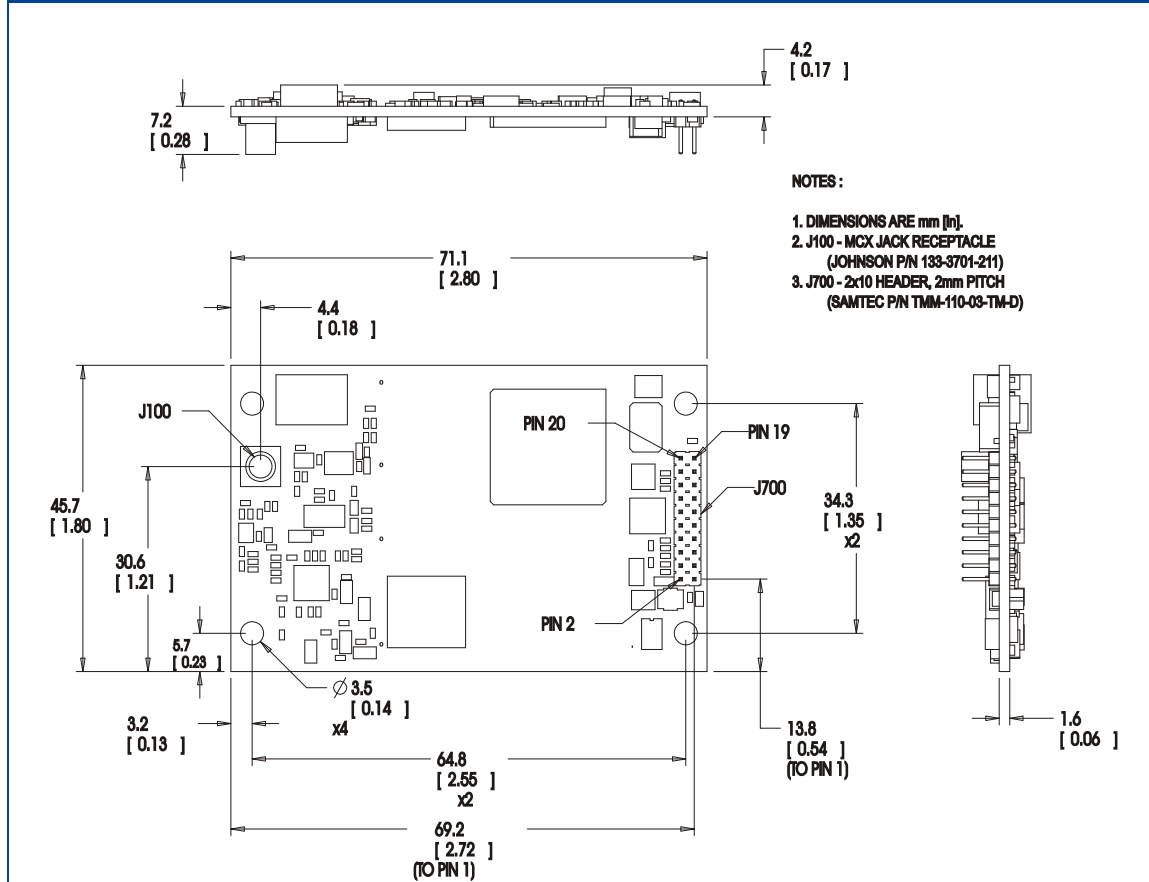


Figure 37: OEMV-1G Board Dimensions

| ENVIRONMENTAL | |
|-----------------------|----------------------------------|
| Operating Temperature | -40°C to +85°C |
| Storage Temperature | -45°C to +95°C |
| Humidity | Not to exceed 95% non-condensing |
| Random Vibe | RTCA D0-160D (4g) |
| Bump/Shock | MIL-STD 810F (40g) |

Continued on Page 106

| POWER REQUIREMENTS | |
|---|--|
| Voltage | +3.3 V DC +5%/-3% |
| Allowable Input Voltage Ripple | 100 mV p-p (max.) |
| Power Consumption | <p>1.1 W (GPS + GLONASS)</p> <hr/> <p><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.</p> <hr/> |
| In-Rush Power Consumption | 7.5 A for less than 60 μ s |
| RF INPUT / LNA POWER OUTPUT | |
| Antenna Connector | MCX female, 50 Ω nominal impedance (See <i>Figure 37</i> on <i>Page 105</i>) |
| 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 +13) Channel spacing 562.5 kHz |
| LNA Power External (Optional Input) Output to antenna | <p>+5.5 to +16 V DC, 100 mA max. (user-supplied) +4.75 to +5.10 V DC @ 0 - 100 mA</p> <hr/> <p><input checked="" type="checkbox"/> Apply power to the OEMV-1 on pin 1 within the +5.5 to +16 V DC range. The card regulates a constant 5 V output on the RF connector. See also <i>Section 2.3.1</i> on <i>Page 35</i>.</p> <hr/> |
| INPUT/OUTPUT DATA INTERFACE | |
| COM1 | |
| Electrical format | LVTTTL |
| Bit rates ^a | 300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 bps |
| Signals supported | COM1_Tx and COM1_Rx |
| COM2 | |
| Electrical format | LVTTTL |
| Bit rates ^a | 300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 bps |
| Signals supported | COM2_Tx and COM2_Rx |
| COM3 | |
| Electrical format | LVTTTL ^{b c d} |
| Bit rates ^a | 300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 bps |
| Signals supported | COM3_Tx and COM3_Rx |

Continued on the following page.

| CAN BUS ^{e f g} | |
|---------------------------------|--|
| Electrical format | LVTTL (requires external CAN transceiver) |
| Bit rates | 500 kb/s maximum. CAN Bus throughput is determined by slowest device on the bus. |
| Signals supported | CAN1 is on Pins 6 and 7. CAN2 is on Pins 8 and 20. ^g |
| USB | |
| Electrical format | Conforms to USB 1.1 |
| Bit rates | 5 Mb/s maximum |
| Signals supported | USB D (+) and USB D (-) |

- a. 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.
- b. Upon power-up, USB is enabled and COM3 is disabled by default. Multiplexed I/O allows you to switch between USB and COM3.
- c. The receiver cannot prevent the host system from enumerating USB while using COM3 on the OEMV-1G. This is due to the plug-and-play nature of USB. **Do not connect a USB cable while using COM3.**
- d. Enable COM3 using the following commands:

```
MARKCONTROL MARK1 DISABLE
INTERFACEMODE COM3 NOVATEL NOVATEL
SAVECONFIG
```

FRESET clears this command, disabling COM3 and enabling USB (the factory default setting).

- e. CAN1_RX and CAN1_TX are multiplexed with VARF and EVENT2, respectively. The default behavior is that EVENT2 is active. For VARF, refer to the FREQUENCYOUT command.
- f. CAN Bus behavior must be asserted through the NovAtel API software. See *Section 3.3.3, CAN Bus* on *Page 46* for further details.
- g. See also *Figure 38* on *Page 110* and its table.

Table 17: OEMV-1G Strokes

| Strokes | Default Behavior | Input/Output | Factory Default | Comment ^a |
|---------------------------|------------------|---------------------------------|-----------------|---|
| Event1 (Mark 1) | Multiplexed 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 |
| Event2 (Mark 2) | Multiplexed 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 MARK2POS and MARK2TIME logs.) 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). 3.3 V. |
| VARF (Variable Frequency) | Multiplexed pin | Output | Active low | A programmable variable frequency output ranging from 0 - 20 MHz (refer to the FREQUENCYOUT command). |
| RESETIN | Dedicated pin | Input | Active low | Reset LVTTTL signal input from external system; active low, > 20 μ s duration |
| 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, period and pulsewidth can be configured using PPSCONTROL command. |

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

Table 18: OEMV-1G Strobe Electrical Specifications

| Strobe | Sym | Min (V) | Typ (V) | Max (V) | Current (mA) | Conditions |
|--|-----------------|---------|---------|---------|--------------|-------------------|
| Event1 (Mark 1) Event2 (Mark2) PPS | V _{IL} | | | 0.8 | 4 | VDD = 3.3 V; 85°C |
| | V _{IH} | 2.0 | | | 12 | VDD = 3.3 V; 85°C |
| PV VARF | V _{OL} | | | 0.4 | 4 | VDD = 3.3 V; 85°C |
| | V _{OH} | 3.0 | | | 12 | VDD = 3.3 V; 85°C |
| RESETIN | V _{IL} | | | 0.8 | 4 | VDD = 3.3 V; 85°C |
| | V _{IH} | 2.3 | | | 13.8 | VDD = 3.3 V; 85°C |

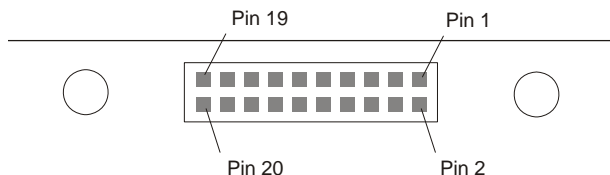


Figure 38: Top-view of 20-Pin Connector on the OEMV-1G

| Signal | Behavior ^a | Descriptions | Pin |
|---------------------|-----------------------|--|-----|
| LNA_PWR | Input DC | Power supply for external antenna LNA | 1 |
| V _{IN} | Input DC | DC power supply for card | 2 |
| USB D (-) | Bi-directional | USB interface data (-) | 3 |
| USB D (+) / COM3_Rx | Multiplexed | Multiplexed pin behavior default: USB D (+) | 4 |
| RESETIN | See strobcs | Card reset | 5 |
| VARF / CAN1_Rx | Multiplexed | Multiplexed pin behavior, see strobcs default: VARF | 6 |
| Event2 / CAN1_Tx | Multiplexed | Multiplexed pin behavior, see strobcs default: Event2 | 7 |
| CAN2_RX | Bi-directional | CAN Bus dedicated port | 8 |
| Event1 / COM3_Tx | Multiplexed | Multiplexed pin behavior, see strobcs 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 | See strobcs | Output indicates 'good solution' or valid GPS position when high | 17 |
| GND | Ground | Digital Ground | 18 |
| PPS | See strobcs | Pulse output synchronized to GPS Time | 19 |
| CAN2_TX | Bi-directional | CAN Bus dedicated port | 20 |

- a. A bi-directional Transient Voltage Suppressor (TVS) device is included between 3.3V and ground. Input/Output (I/O) lines are protected by TVS devices. Series resistance is included for the following I/O lines: COM1/COM2/COM3 Tx and Rx, RESETIN, Event1 and Event2. Lines that do not have series resistance include: CAN1_Tx, CAN1_Rx, CAN2_Tx, CAN2_Rx, USB D (+) and USB D (-).

A.4 OEMV-2 Card

| PHYSICAL | |
|----------------------------|--|
| Size | 60 mm x 100 mm x 11.4 mm with connectors |
| Weight | 56 grams |
| NOVATEL PART NUMBER | |
| Generic OEMV-2 | 01017646 |
| OEMV-2G | 01017647 |

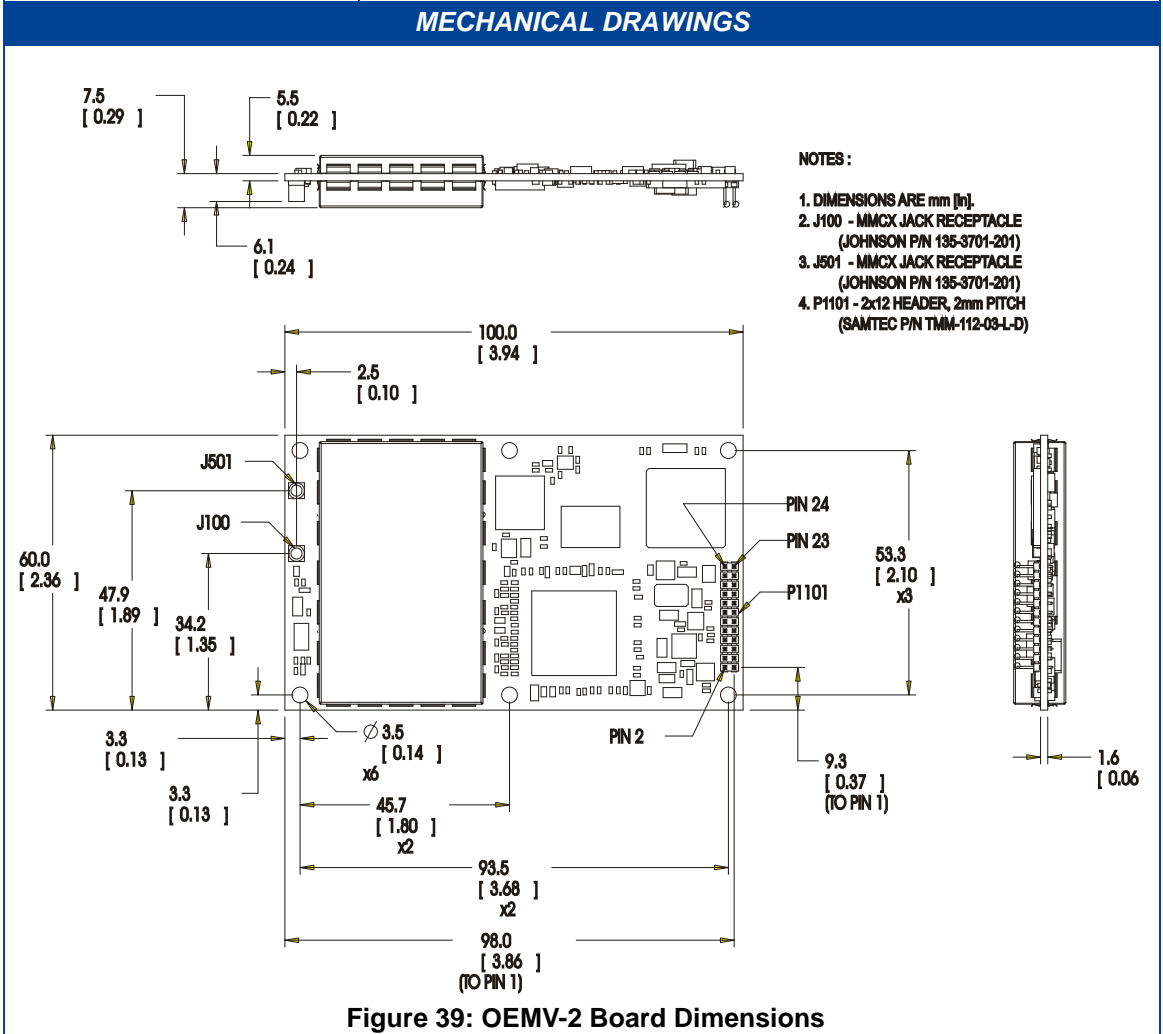


Figure 39: OEMV-2 Board Dimensions

| ENVIRONMENTAL | |
|---|--|
| Operating Temperature | -40°C to +85°C |
| Storage Temperature | -45°C to +95°C |
| Humidity | Not to exceed 95% non-condensing |
| Random Vibe | MIL-STD 810F (7.7g) |
| Sine Vibe | SAEJ1211 (4g) |
| Bump/Shock | IEC 68-2-27 (30g) |
| POWER REQUIREMENTS | |
| Voltage | +3.3 V DC +5%/-3% |
| Allowable Input Voltage Ripple | 100 mV p-p (max.) |
| Power Consumption | 1.2 W (GPS only) 1.6 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. |
| In-Rush Power Consumption | 22 A for less than 30 μ s |
| RF INPUT / LNA POWER OUTPUT | |
| Antenna Connector | MMCX female, 50 Ω nominal impedance (See <i>Figure 39 on Page 111</i>) |
| Acceptable RF Input Level | -80 dBm to -105 dBm |
| RF Input Frequencies | GPS L1: 1575.42 MHz GPS L2: 1227.60 MHz GLONASS L1: 1602.0 MHz for Fk=0 where k = (-7 to +13) Channel spacing 562.5 kHz GLONASS L2: 1246.0 MHz for Fk=0 where k = (-7 to +13) Channel spacing 437.5 kHz |
| LNA Power Internal | (See <i>Section 2.3.1 on Page 35</i>) +4.75 to +5.10 V DC @ 0 - 100 mA (output from card; only option) |
| EXTERNAL OSCILLATOR INPUT | |
| Connector | MMCX female (See <i>Figure 41 on Page 117</i>) Connections between the MMCX and an external oscillator, or interface board, must be impedance controlled. To accomplish this, use 50 ohm coaxial cable and 50 ohm connectors. |
| External Clock Input (Refer to the EXTERNALCLOCK command) | Frequency: 5 MHz or 10 MHz Input Impedance: 50 Ω nominal Input VSWR: > 200.0: 1 Signal Level: 0 dBm minimum to +13.0 dBm maximum Frequency Stability: \pm 0.5 ppm maximum Wave Shape: Sinusoidal |

Continued on the following page.

| INPUT/OUTPUT DATA INTERFACE | |
|------------------------------------|--|
| COM1 | |
| Electrical format | RS-232 |
| Bit rates ^a | 300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400, 460800, 921600 bps |
| Signals supported | COM1_Tx, COM1_Rx, RTS1, CTS1 |
| COM2 | |
| Electrical format | LVTTTL |
| Bit rates ^a | 300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 bps |
| Signals supported | COM2_Tx, COM2_Rx, RTS2, CTS2 |
| COM3 | |
| Electrical format | LVTTTL ^{b c d} |
| Bit rates ^a | 300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 bps |
| Signals supported | COM3_Tx, COM3_Rx |
| CAN BUS ^e | |
| Electrical format | LVTTTL ^b (requires external CAN transceiver) |
| Bit rates | 500 kb/s maximum. CAN Bus throughput is determined by slowest device on the bus. |
| Signals supported | CAN1 is on Pins 7 and 19 ^{f g} |
| USB | |
| Electrical format | Conforms to USB 1.1 |
| Bit rates | 5 Mb/s maximum |

- a. 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, 460800 bps, and 921600 bps.
- b. COM3 is the default. COM3_Tx and COM3_Rx are multiplexed with CAN1_Tx and GPIO, AND CAN1_Rx AND EVENT2.
- c. Upon power-up, COM3 (COM3_Tx and COM3_Rx) is enabled by default unless the default is overridden by a changed configuration, previously saved using the SAVECONFIG command. When COM3 is enabled, CAN1, GPIO0 and EVENT2 are not available. USB is always available.
- d. Enable COM3 using the INTERFACEMODE command. GPIO on Pin 19 is configured by the MARKCONTROL command.
- e. CAN Bus behavior must be asserted through the NovAtel API software. See *Section 3.3.3, CAN Bus* on *Page 46* for further details.
- f. See also *Figure 40* on *Page 115* and its table.
- g. Driven by an open collector source when configured as GPIO

Table 19: OEMV-2 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 |
| Event2 (Mark 2) ^b | Multiplexed 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 MARK2POS and MARK2TIME logs. 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) | VARF0: Dedicated pin VARF1: Multiplexed pin | Output | Active low | A programmable variable frequency output ranging from 0 - 20 MHz (refer to the FREQUENCYOUT command). |
| RESETIN | Dedicated pin | Input | Active low | Reset LVTTTL signal input from external system; active low, > 20 μ s duration |
| 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, period and pulsewidth can be configured using PPSCONTROL command. |
| ERROR | Dedicated pin | Output | Active high | See <i>Chapter 6, Built-In Status Tests</i> starting on <i>Page 87</i> |

- a. The commands and logs shown in capital letters (for example, MARKCONTROL) are discussed in further detail in the *OEMV Family Firmware Reference Manual*.
- b. PIN 7 on the OEMV-2 defaults to a COM3_RX line but you can configure it back to the original Event2 signal, if needed, using the MARKCONTROL command. Before Event2 can be enabled, the COM3 lines must first be disabled by using the INTERFACEMODE COM3 NONE NONE command. Similarly, Event2 must be disabled before you can enable COM3.

Table 20: OEMV-2 Strobe Specifications

| Strobe | Sym | Min (V) | Typ (V) | Max (V) | Current (mA) | Conditions |
|--|-----------------|---------|---------|---------|--------------|-------------------|
| Event1 (Mark 1) Event2 (Mark2) PPS | V _{IL} | | | 0.8 | 4 | VDD = 3.3 V; 85°C |
| | V _{IH} | 2.0 | | | 12 | VDD = 3.3 V; 85°C |
| PV VARF ERROR | V _{OL} | | | 0.4 | 4 | VDD = 3.3 V; 85°C |
| | V _{OH} | 3.0 | | | 12 | VDD = 3.3 V; 85°C |
| RESETIN | V _{IL} | | | 0.8 | 4 | VDD = 3.3 V; 85°C |
| | V _{IH} | 2.3 | | | 13.8 | VDD = 3.3 V; 85°C |

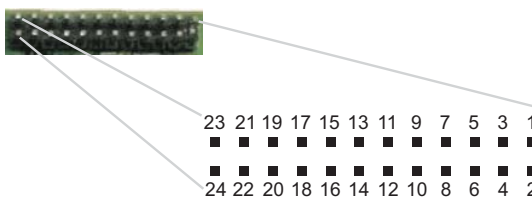


Figure 40: Top-view of 24-Pin Connector on the OEMV-2

| Signal | Behavior ^{a b} | Descriptions | Pin |
|---------------------------|-----------------------------|--|-----|
| GPIO | Reserved but safe to ground | | 1 |
| Reserved, do not use | | | 2 |
| VARF0 | See strobcs | Variable frequency out | 3 |
| PPS | See strobcs | Pulse output synchronized to GPS Time | 4 |
| VCC | Input DC | Card power | 5 |
| VCC | Input DC | Card power | 6 |
| Event2/CAN1_Rx or COM3_Rx | Multiplexed | Multiplexed pin behavior ^c default: COM3_Rx | 7 |
| Event1 | See strobcs | Input trigger | 8 |
| ERROR | See strobcs | Card error, see <i>Chapter 6, Built-In Status Tests</i> | 9 |
| PV | See strobcs | Output indicates valid GPS position when high | 10 |
| CTS2/VARF1 | Input | Clear to Send for COM 2 input or variable frequency default: CTS2 | 11 |
| RESETIN | See strobcs | Card reset | 12 |
| RTS2 | Output | Request to Send for COM 2 output | 13 |

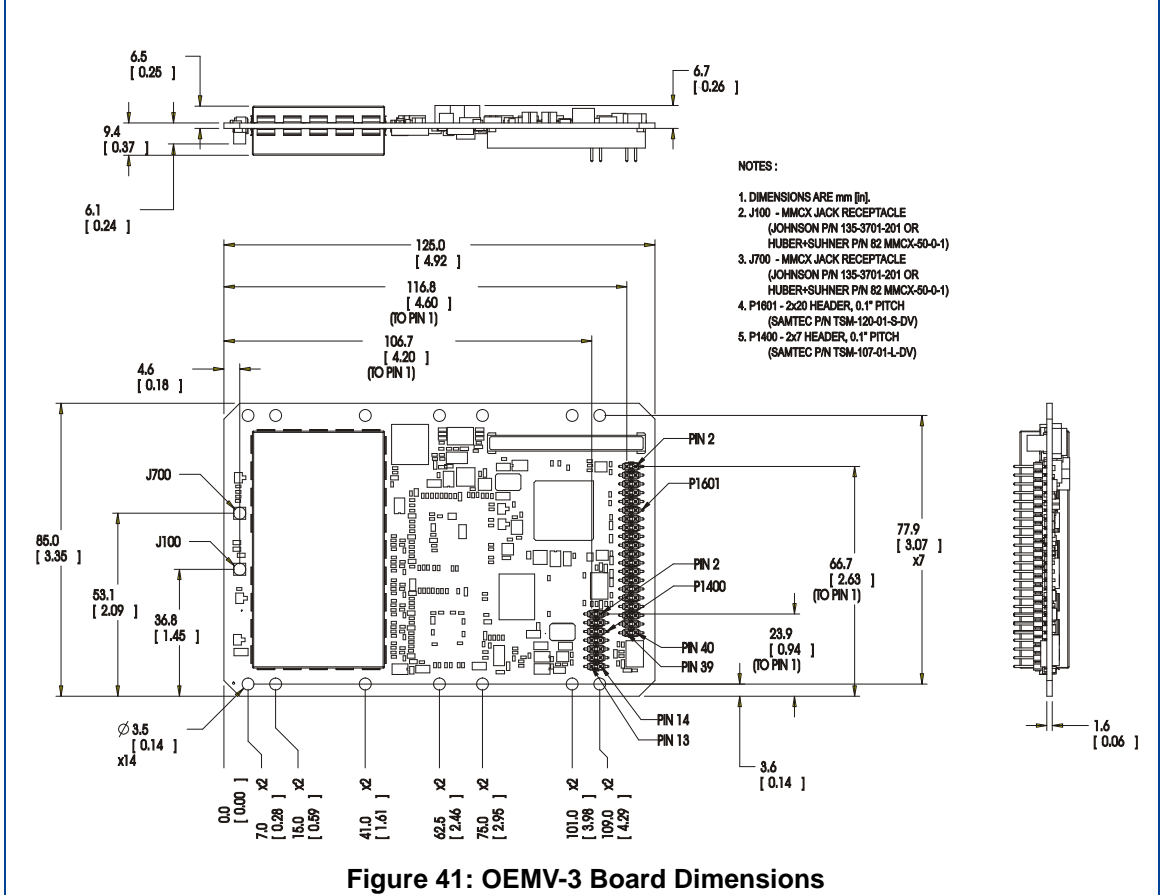
Continued on the following page.

| Signal | Behavior ^a | Descriptions | Pin |
|-------------------------|-----------------------|---|-----|
| COM2_Rx | Input | Received Data for COM 2 input | 14 |
| CTS1 | Input | Clear to Send for COM 1 input | 15 |
| COM2_Tx | Output | Transmitted Data for COM 2 output | 16 |
| RTS1 | Output | Request to Send for COM 1 output | 17 |
| COM1_Rx | Input | Received Data for COM 1 input | 18 |
| GPIO0, CAN1_Tx, COM3_Tx | Multiplexed | Multiplexed pin behavior ^d default: COM3_Tx | 19 |
| COM1_Tx | Output | Transmitted Data for COM 1 output | 20 |
| USB D (-) | Bi-directional | USB interface data (-) | 21 |
| USB D (+) | Bi-directional | USB interface data (+) | 22 |
| GND | Ground | Digital Ground | 23 |
| GND | Ground | Digital Ground | 24 |

- a. There is no TVS between 3.3 V and ground. All other I/O signal lines have TVS protection. Series resistance is included for the GPIO0 and RESETIN lines.
- b. For strobes, see *Table 19 on Page 114*
- c. PIN 7 on the OEMV-2 defaults to a COM3_RX line but you can configure it back to the original Event2 signal, if needed, using the MARKCONTROL command. Before Event2 can be enabled, the COM3 lines must first be disabled by using the INTERFACEMODE COM3 NONE NONE command. Similarly, Event2 must be disabled before you can enable COM3.
- d. PIN 19 on the OEMV-2 defaults to a COM3_TX line but the GPIO0, used by a custom application via the API, can be enabled when the application wants to use it. Before GPIO0 can be enabled, the COM3 lines must first be disabled by using the INTERFACEMODE COM3 NONE NONE command. Similarly, GPIO0 must be disabled before you can enable COM3. The *Application Program Interface (API) User Manual* is available through Customer Service if you have an API-capable receiver model.

A.5 OEMV-3 Card

| PHYSICAL | |
|----------------------------|--|
| Size | 85 mm x 125 mm x 14.3 mm with connectors |
| Weight | 85 grams |
| NOVATEL PART NUMBER | |
| Generic OEMV-3 | 01017726 |
| MECHANICAL DRAWINGS | |



| ENVIRONMENTAL | |
|---|--|
| Operating Temperature | -40°C to +85°C |
| Storage Temperature | -45°C to +95°C |
| Humidity | Not to exceed 95% non-condensing |
| Random Vibe | MIL-STD 810F (7.7g) |
| Sine Vibe | SAEJ1211 (4g) |
| Bump/Shock | IEC 68-2-27 (30g) |
| POWER REQUIREMENTS | |
| Voltage | +4.5 to +18.0 V DC |
| Allowable Input Voltage Ripple | 100 mV p-p (max.) |
| Power Consumption | 2.1 W (GPS only), 2.4 W (GPS + L-band) 2.8 W (GPS + GLONASS), 3.1 W (GPS + GLONASS + L-band) <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. |
| In-Rush Power Consumption | 21 A for less than 70 μ s |
| RF INPUT / LNA POWER OUTPUT | |
| Antenna Connector | MMCX female, 50 Ω nominal impedance (See <i>Figure 41</i> on <i>Page 117</i>) |
| Acceptable RF Input Level | -80 dBm to -105 dBm |
| RF Input Frequencies (MHz) | GPS L1: 1575.42 MHz GPS L2: 1227.60 MHz GPS L5: 1176.45 MHz GLONASS L1: 1602.0 MHz for Fk=0 where k = (-7 to +13) Channel spacing 562.5 kHz GLONASS L2: 1246.0 MHz for Fk=0 where k = (-7 to +13) Channel spacing 437.5 kHz OmniSTAR or CDGPS: 1525 to 1560 MHz |
| LNA Power Internal External (Optional Input) | (See <i>Section 2.3.1</i> on <i>Page 35</i>) +4.75 to +5.10 V DC @ 0 - 100 mA (output from card, default) +5.5 to +18 V DC, 100 mA max. (user-supplied) |
| EXTERNAL OSCILLATOR INPUT | |
| Connector | MMCX female (See <i>Figure 41</i> on <i>Page 117</i>) |
| External Clock Input (Refer to the EXTERNALCLOCK command) | Frequency: 5 MHz or 10 MHz Input Impedance: 50 Ω nominal Input VSWR: 2.0:1 Signal Level: 0 dBm minimum to +13.0 dBm maximum Frequency Stability: \pm 0.5 ppm maximum Wave Shape: Sinusoidal |

Continued on the following page.

| INPUT/OUTPUT DATA INTERFACE | |
|-------------------------------------|---|
| COM1 | |
| Electrical format | User-selectable. Defaults to RS-232 but can be configured for RS-422. See <i>Page 45</i> for more details or GPIO if configured by the MARKCONTROL command. |
| Bit rates ^a | 300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400, 460800, 921600 bps |
| Signals supported | COM1_Tx, COM1_Rx, RTS1, CTS1 for RS-232 or COM1_Tx (+), COM1_Tx (-), COM1_Rx (+), COM1_Rx (-) for RS-422 |
| COM2 | |
| Electrical format | RS-232 |
| Bit rates ^a | 300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 bps |
| Signals supported | COM2_Tx, COM2_Rx, RTS2, CTS2, DTR2, DCD2 |
| COM3 | |
| Electrical format | LVTTTL ^b |
| Bit rates ^a | 300, 1200, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 bps |
| Signals supported | COM3_Tx, COM3_Rx, RTS3, CTS3 |
| CAN BUS ^c | |
| Electrical format | CANBUS ^{c d} |
| Bit rates | 500 kb/s maximum. CAN Bus throughput is determined by slowest device on the bus. |
| CAN1 signals supported ^e | CAN Bus 1(with transceiver), see also <i>Figure 43, Top-view of 14-Pin CAN Connector on the OEMV-3 on Page 124</i> |
| CAN2 signals supported ^e | CAN BUS 2 (with transceiver), see also <i>Figure 43 on Page 124</i> |
| USB | |
| Signals supported | USB D(+), USB D(-) |

- a. 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, 460800 bps, and 921600 bps.
- b. Upon power-up, EVENT2 is enabled and GPIO1 is disabled unless the default is overridden by a changed configuration, previously saved using the SAVECONFIG command. GPIO1 is configured by the MARKCONTROL command.
- c. CAN Bus behavior must be asserted through the NovAtel API software. See *Section 3.3.3, CAN Bus on Page 46* for further details.
- d. CANBUS transceivers are populated on the OEMV-3 card.
- e. See also *Figure 42 on Page 122* and its table.

Table 21: OEMV-3 Strobes

| Strobes | Default Behavior | Input/Output | Factory Default | Comment ^a |
|---------------------------|------------------|---------------------------------|-----------------|---|
| MSR (Measure Output) | Dedicated pin | Output | Active low | 1 ms pulse, leading edge is synchronized with internal GNSS measurements. The MSR signal is not user-configurable. Up to 20 Hz. |
| 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 |
| Event2 (Mark 2) | Multiplexed 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 MARK2POS and MARK2TIME logs.) 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 ranging from 0 - 20 MHz (refer to the FREQUENCYOUT command). |
| RESETOUT | Dedicated pin | Output | Active low | 140 ms duration |
| RESETIN | Dedicated pin | Input | Active low | Reset LVTTTL signal input from external system; active low, > 20 μ s duration |
| 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, period and pulsewidth can be configured using PPSCONTROL command. |
| ERROR | Dedicated pin | Output | Active high | See <i>Chapter 6, Built-In Status Tests</i> starting on <i>Page 87</i> |

Continued on the following page.

| Strobes | Default Behavior | Input/Output | Factory Default | Comment ^a |
|--------------|------------------|--------------|-----------------|--|
| STATUS_RED | Dedicated pin | Output | Active high | Status output which is high, or pulses, to indicate that the OEMV-3 card is not working properly. ^b |
| STATUS_GREEN | Dedicated pin | Output | Active high | Status output which pulses to indicate that the OEMV-3 card is working properly. ^b |

- a. The commands and logs shown in capital letters (for example, MARKCONTROL) are discussed in further detail in the *OEMV Family Firmware Reference Manual*.
- b. See also *Section 6.6, Status LEDs* starting on *Page 91* of this manual.

Table 22: OEMV-3 Strobe Specifications

| Strobe | Sym | Min (V) | Typ (V) | Max (V) | Current (mA) | Conditions |
|--|-----------------|---------|---------|---------|--------------|-------------------|
| Event1 (Mark 1) Event2 (Mark2) PPS | V _{IL} | | | 0.8 | 4 | VDD = 3.3 V; 85°C |
| | V _{IH} | 2.0 | | | 12 | VDD = 3.3 V; 85°C |
| PV MSR VARF ERROR STATUS_RED STATUS_GREEN RESETOUT | V _{OL} | | | 0.4 | 4 | VDD = 3.3 V; 85°C |
| | V _{OH} | 3.0 | | | 12 | VDD = 3.3 V; 85°C |
| RESETIN | V _{IL} | | | 0.8 | 4 | VDD = 3.3 V; 85°C |
| | V _{IH} | 2.64 | | | 15.6 | VDD = 3.3 V; 85°C |

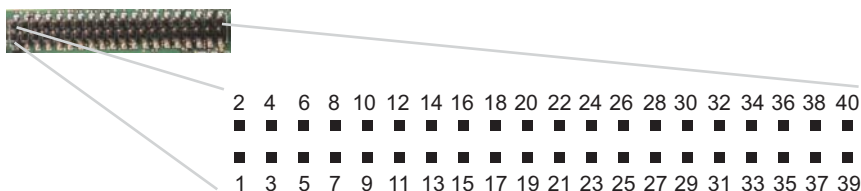


Figure 42: Top-view of 40-Pin Connector on the OEMV-3

| Signal | Behavior | Descriptions | Pin |
|-------------------------|----------------|---|-----|
| V _{IN} | Input DC | Card power | 1 |
| PV | See strobos | Output indicates a valid GPS position when high | 2 |
| USB D (+) | Bi-directional | USB interface data (+) | 3 |
| GND | Ground | Digital Ground | 4 |
| USB D (-) | Bi-directional | USB interface data (-) | 5 |
| GND | Ground | Digital Ground | 6 |
| PPS | See strobos | Pulse output synchronized to GPS Time | 7 |
| GND | Ground | Digital Ground | 8 |
| VARF | See strobos | Variable frequency out | 9 |
| GND | Ground | Digital Ground | 10 |
| Event1 | See strobos | Input trigger | 11 |
| GND | Ground | Digital Ground | 12 |
| STATUS_RED | See strobos | Indicates the OEMV-3 card is not working properly when high or pulsing. | 13 |
| CTS1/ COM1_Rx (-) | See COM Ports | COM1 input Clear to Send for RS-232 / Received Data (-) for RS-422 | 14 |
| COM1_Tx/ COM1_Tx (+) | See COM Ports | COM1 output Transmitted Data for RS-232 / Transmitted Data (+) for RS-422 | 15 |
| RTS1/ COM1_Tx (-) | See COM Ports | COM1 output Request to Send for RS-232 / Transmitted Data (-) for RS-422 | 16 |
| COM1_Rx/ COM1_Rx(+) | See COM Ports | COM1 input Received Data for RS-232 / Received Data (+) for RS-422 | 17 |
| CTS3 | Input | Clear to Send for COM 3 | 18 |
| COM3_Tx | Output | Transmitted Data for COM 3 | 19 |
| DCD2 | Input | Data Carrier Detected for COM 2 | 20 |
| COM3_Rx | Input | Received Data for COM 3 | 21 |
| RTS3 | Output | Request to Send for COM 3 | 22 |
| DTR2 | Output | Data Terminal Ready for COM 2 | 23 |
| CTS2 | Input | Clear to Send for COM 2 | 24 |
| COM2_Tx | Output | Transmitted Data for COM 2 | 25 |
| RTS2 | Output | Request to Send for COM 2 | 26 |

Continued on the following page.

| Signal | Behavior | Descriptions | Pin |
|--------------|-------------|--|-----|
| COM2_Rx | Input | Received Data for COM 2 | 27 |
| STATUS_GREEN | See strobes | Indicates the OEMV-3 card is working properly when pulsing at 1 Hz. | 28 |
| GPIO_USER0 | Reserved | Do not use. 10 kΩ pull-down resistor internal to OEMV-3. | 29 |
| USERIO1 | Input | COM1 port configuration selector. 10 kΩ pull-down resistor internal to OEMV-3. (At startup, tie high to set COM1 to RS-422 or leave open for RS-232. See <i>Page 45</i> for more details.) | 30 |
| Event2/GPIO1 | See strobes | Input trigger default: EVENT2 | 31 |
| MSR | See strobes | Pulse synchronized to GNSS measurements | 32 |
| RESETIN | See strobes | Card reset | 33 |
| GPAI | Analog | General purpose analog input (refer to the RXHWLEVELS log). The voltage range is 0.0 to 2.75 V DC. | 34 |
| RESETOUT | See strobes | Reset TTL signal output to external system; active low. | 35 |
| GND | Ground | Digital Ground | 36 |
| GPIO_FR | Reserved | Do not use. 10 kΩ pull-up resistor internal to OEMV-3. | 37 |
| ERROR | See strobes | Indicates fatal error when high | 38 |
| * | Reserved | Do not use. | 39 |
| LNA_PWR | Output DC | Optional external power to antenna other than a standard NovAtel GPSAntenna (see also <i>Antenna LNA Power on Page 49</i>). | 40 |

☒ To create a common ground, tie together all digital grounds (GND) with the ground of the power supply.

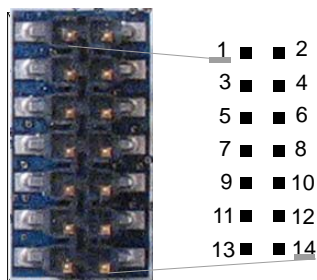


Figure 43: Top-view of 14-Pin CAN Connector on the OEMV-3

| Signal | Descriptions | Pin |
|--------|--|-----|
| CAN1L | CAN1 low | 1 |
| CAN1H | CAN1 high | 2 |
| GND | Digital Ground | 3 |
| GND | Digital Ground | 4 |
| CAN2L | CAN2 low | 5 |
| CAN2H | CAN2 high | 6 |
| GND | Digital Ground | 7 |
| GND | Digital Ground | 8 |
| NC | Not Connected | 9 |
| NC | Not Connected | 10 |
| GPIO | Reserved. 10 k Ω pull-down resistor internal to OEMV-3. | 11 |
| GPIO | Reserved. 10 k Ω pull-down resistor internal to OEMV-3. | 12 |
| NC | Not Connected | 13 |
| NC | Not Connected | 14 |

☒ For strobe signal descriptions, please see *Section 3.3.1, Strokes* on Page 45.

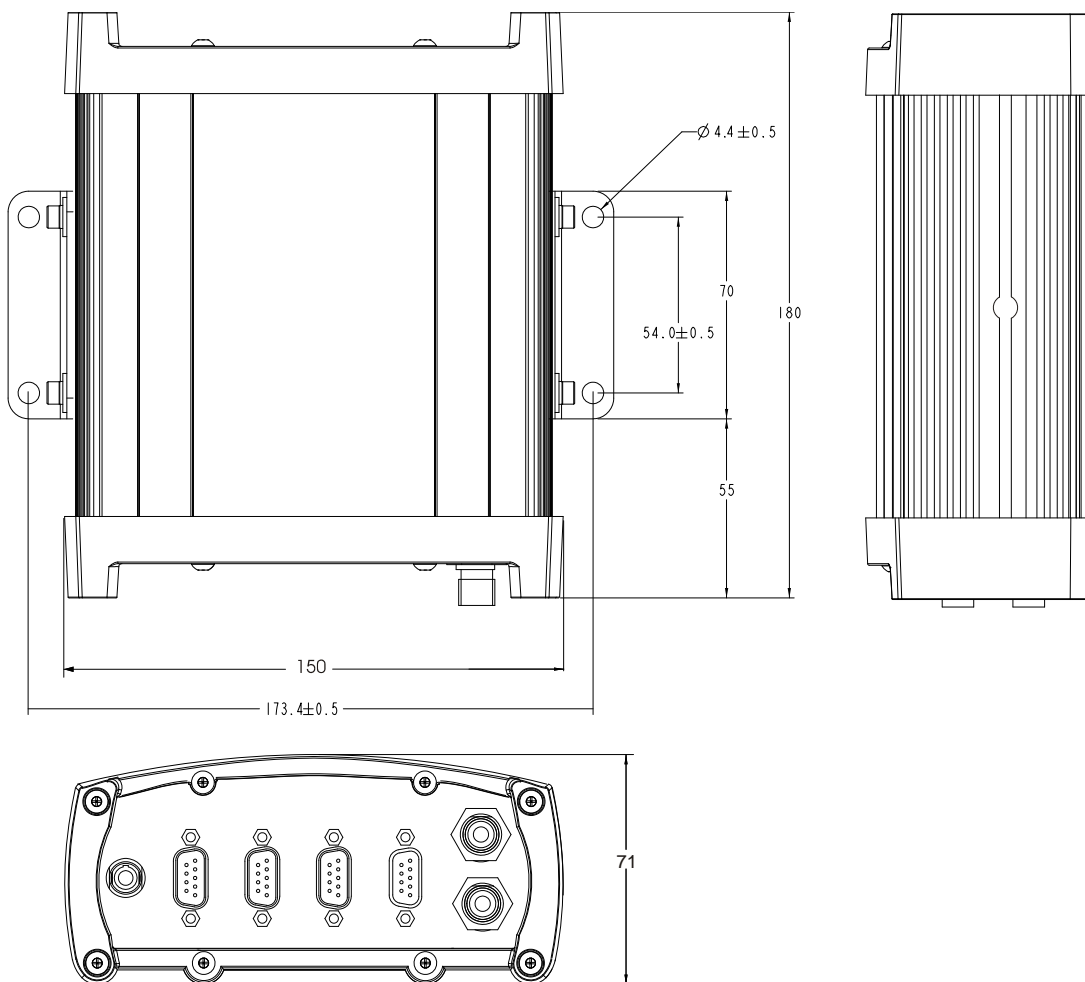
A.6 ProPak-V3

| INPUT/OUTPUT CONNECTORS | |
|-----------------------------------|---|
| Antenna Input | TNC female jack, 50 Ω nominal impedance +4.75 to +5.10 V DC, 100 mA max (output from ProPak-V3 to antenna/LNA) |
| PWR | 4-pin LEMO connector +6 to +18 V DC at 2.8 W (typical) ^{a b} In-rush power consumption: 19 A for less than 80 μ s |
| COM1 COM2 AUX I/O OSC | DB9P connector DB9P connector DB9P connector ^c DB9S connector BNC connector (external oscillator) |
| NOVATEL PART NUMBER | |
| ProPak-V3 | RS-232: 01017629 RS-422: 01017751 |
| PHYSICAL | |
| Size | 185 x 150 x 71 mm |
| Weight | 1.0 kg maximum (including OEMV-3 card) |
| ENVIRONMENTAL | |
| Operating Temperature | -40°C to +75°C |
| Storage Temperature | -45°C to +95°C |
| Humidity | Not to exceed 95% non-condensing |
| Tested to these standards: | MIL-STD-810F 512.4 Procedure 1 Waterproof Immersion IEC 60529 IPX7 Waterproof MIL-STD-810F 509.4 Salt Spray MIL-STD-810F 510.4 Sand and Dust IEC 68-2-27Ea Shock (non-operating) MIL-STD-202G 214A Vibration (random) SAE J/211 4.7 Vibration (sinusoidal) FCC Part 15/ EN55022 Class B Emissions EN 61000-6-2 Immunity EN60950 Safety |

- a. For SPAN applications, this becomes +9 to +18 V DC
- b. When tracking GPS satellites
- c. The AUX port on the ProPak-V3 supports input from an IMU. If applicable, refer also to your *SPAN User Manual*. You must use COM3 instead of AUX to send commands or request logs on the ProPak-V3 AUX port.

DIMENSIONS

a



- a. All dimensions are in millimetres, 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.6.1 Port Pin-Outs

Table 23: ProPak-V3 Serial Port Pin-Out Descriptions

| Connector Pin No. | COM1 ^a | | COM2 | AUX | |
|-------------------|-------------------|-------------|-------------|---------|-------------|
| | RS-232 | RS-422 | RS-232 Only | RS-232 | RS-422 |
| 1 | Reserved | Reserved | N/C | N/C | N/C |
| 2 | COM1_Rx | COM1_Rx (+) | COM2_Rx | COM3_Rx | COM3_Rx (+) |
| 3 | COM1_Tx | COM1_Tx (+) | COM2_Tx | COM3_Tx | COM3_Tx (+) |
| 4 | N/C | N/C | POUT | POUT | POUT |
| 5 | GND | GND | GND | GND | GND |
| 6 | D (+) | D (+) | N/C | N/C | N/C |
| 7 | RTS1 | COM1_Tx (-) | RTS2 | RTS3 | COM3_Tx (-) |
| 8 | CTS1 | COM1_Rx (-) | CTS2 | CTS3 | COM3_Rx (-) |
| 9 | D (-) | D (-) | N/C | N/C | N/C |

a. When a ProPak-V3 is powered, RS-422 configured ports have a solid green LED. RS-232 configured ports flash, or are dark, to correspond with receiving/transmitting information, or not, respectively.

Table 24: ProPak I/O Port Pin-Out Descriptions

| Connector Pin No. | Signal Name | Signal Descriptions |
|-------------------|-------------|---|
| 1 | VARF | Variable frequency out |
| 2 | PPS | Pulse per second |
| 3 | MSR | Mark 1 output |
| 4 | EVENT1 | Mark 1 input |
| 5 | PV | Valid position available |
| 6 | EVENT2 | Mark 2 input, which requires a pulse longer than 150 ns. 10K ohm pull down resistor internal to the ProPak-V3. Refer also to the MARKCONTROL command in the <i>OEMV Firmware Reference Manual</i> . |
| 7 | _RESETOUT | Reset TTL signal output to an external system. Active low. |
| 8 | ERROR | Indicates a fatal error when high. |
| 9 | GND | Digital ground |

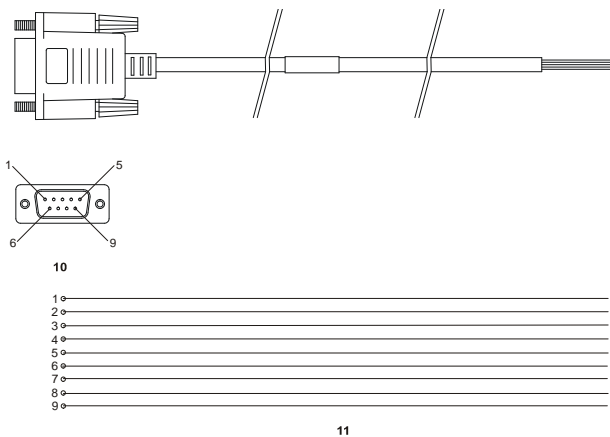
☒ For strobe signal descriptions, please see *Section 3.3.1, Strokes on Page 45*.

A.6.1.1 Cables

A.6.1.2 I/O Strobe Port Cable (NovAtel part number 01017660)

The strobe lines on the ProPak-V3 can be accessed by inserting the male DB9P 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 44*.

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 | MSR | Red |
| 4 | Event1 | Orange |
| 5 | PV | Yellow |

| I/O Port Pin | I/O Port Signal | I/O Port Cable Wire Color |
|--------------|-----------------|---------------------------|
| 6 | Event2 | Green |
| 7 | _RESETOUT | Blue |
| 8 | ERROR | Violet |
| 9 | GND | White/Grey |

Reference

10

Description

DB9P (male) connector

Reference

11

Description

9-conductor cable

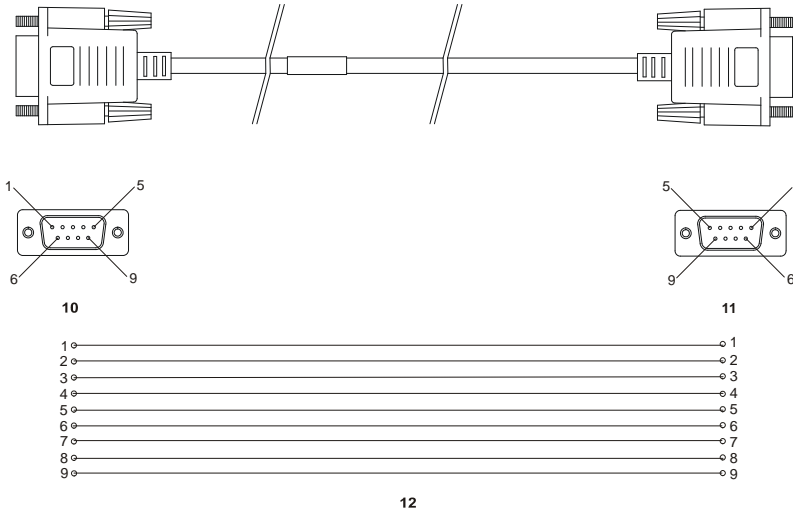


Figure 44: ProPak-V3 I/O Strobe Port Cable

A.6.1.3 Straight Through Serial Cable (NovAtel part number 01017659)

This cable can be used to connect the ProPak-V3 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 45*.

This cable is RoHS compliant.



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

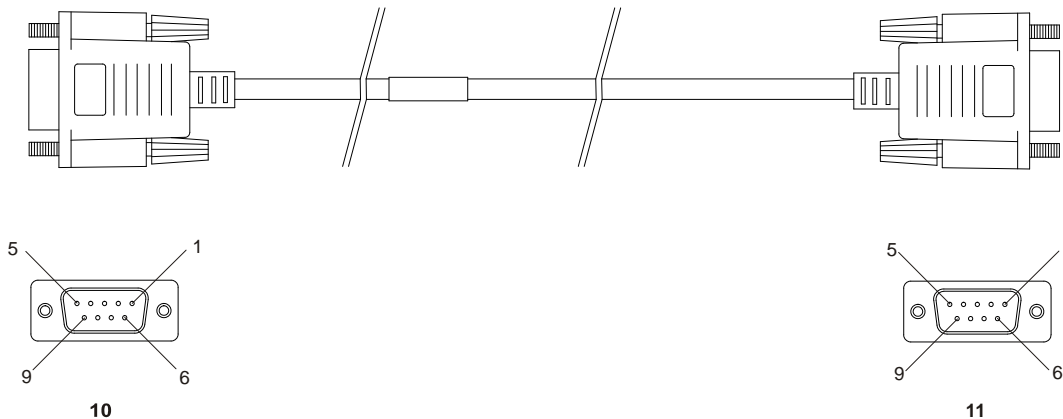


Figure 45: ProPak-V3 Straight Through Serial Cable

A.6.1.4 Null Modem Cable (NovAtel part number 01017658)

This cable supplied with the ProPak-V3, see *Figure 46*, provides an easy means of communications with a PC. The cable is equipped with a 9-pin connector at the receiver end which can be plugged into the *COM1*, *COM2*, or *AUX* port. At the PC end, a 9-pin connector is provided to accommodate a PC serial (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 46: ProPak-V3 Null Modem Cable

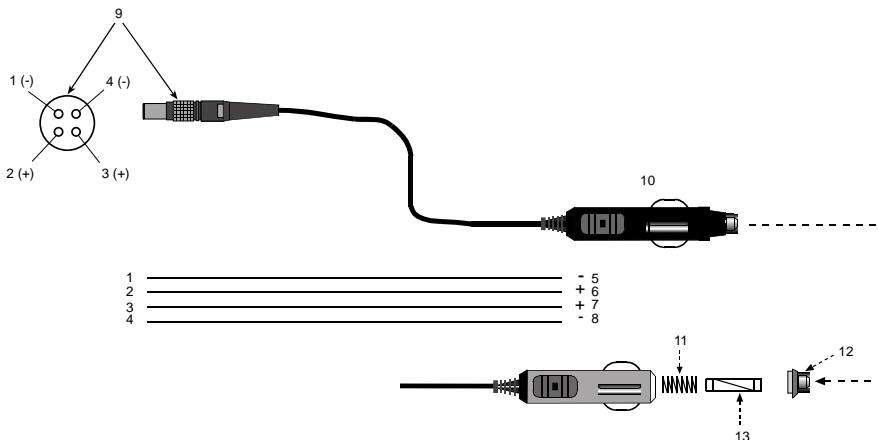
A.6.1.5 12V Power Adapter Cable (NovAtel part number 01017663)

The power adapter cable supplied with the ProPak-V3, see *Figure 47*, provides a convenient means for supplying +12 V DC while operating in the field.

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 back panel of the ProPak-V3.

This cable is RoHS compliant.

For alternate power sources please see *Section 3.1.3 on Page 37*.



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



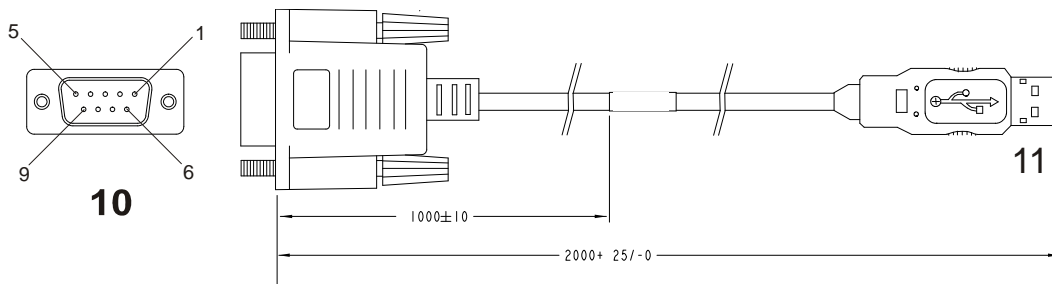
Figure 47: ProPak-V3 Power Cable

1. For SPAN applications this becomes +9 to +18 V DC

A.6.1.6 USB Serial Cable (NovAtel part number 01017664)

The USB cable illustrated in *Figure 48* provides a means of interfacing between the COM1 port on the ProPak-V3 and another serial communications device, such as a PC. At the ProPak-V3 end, the cable is equipped with a DB9 connector, which plugs directly into a COM port. At the other end, a USB connector is provided.

This cable is RoHS compliant.



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

| Reference | Description |
|-----------|----------------------|
| 10 | Female DB9 connector |
| 11 | USB connector |



Figure 48: USB Serial Cable

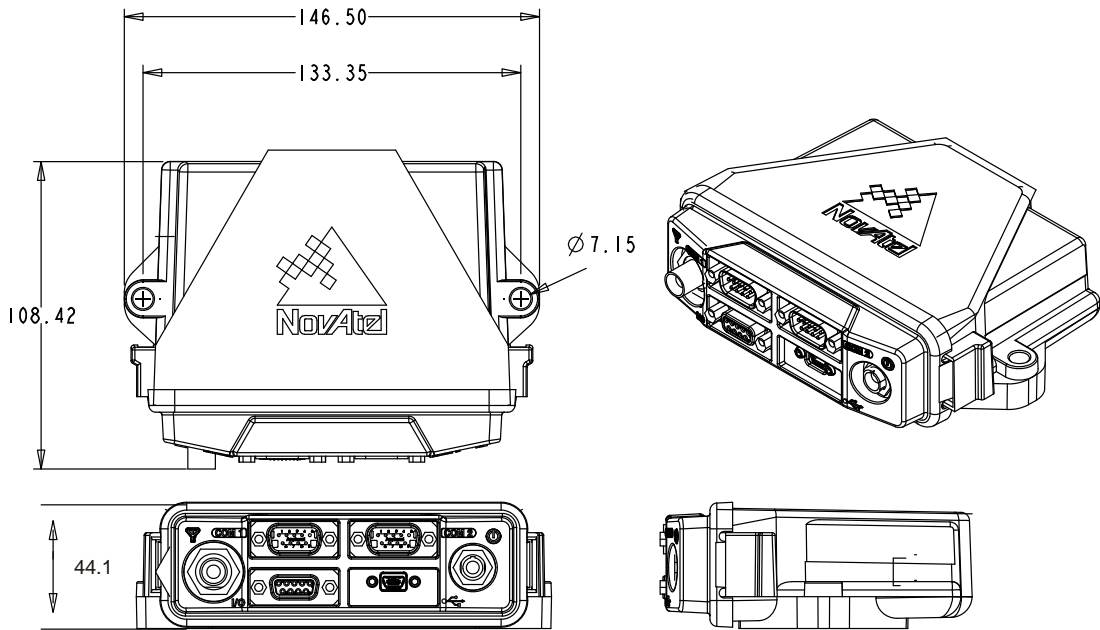
A.7 FlexPak-G2-V1, FlexPak-G2-V1G and FlexPak-G2-V2

| 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 to antenna/ LNA) |
| PWR | 4-pin LEMO +6 to +18 V DC In-rush power consumption: FlexPak-G2-V2: 13 A for less than 80 μs; FlexPak-G2-V1/V1G: 12 A for less than 80 μs |
| COM1 | 9-pin DB9 |
| COM2 | 9-pin DB9 ^a |
| NOVATEL PART NUMBER | |
| FlexPak-G2-V1 | 01018401 |
| FlexPak-G2-V1G | 01018403 |
| FlexPak-G2-V2 | 01018405 |
| 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 +85°C |
| Storage Temperature | -40°C to +85°C |
| Humidity | Not to exceed 95% non-condensing |
| Waterproof | To IEC 60529 IP X7 |

- a. Normally RS-232 but can be dynamically changed to RS-422 by setting pin 1 high (3V3 to Vin) on the COM2 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 for this change to take effect.

DIMENSIONS

a



- a. All dimensions are in millimetres, 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.7.1 Port Pin-Outs

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

Table 25: FlexPak-G2 Port Pin-Out Descriptions

| Connector Pin No. | COM1 | COM2 | |
|-------------------|------------------|-------------------|-------------------|
| | RS-232 | RS-232 | RS-422 |
| 1 | N/C | Select 232/422 | Select 232/422 |
| 2 | COM1_Rx | COM2_Rx | COM2_Rx+ |
| 3 | COM1_Tx | COM2_Tx | COM3_Tx+ |
| 4 | N/C | POUT ^a | POUT ^a |
| 5 | GND | GND | GND |
| 6 | N/C | PGND | PGND |
| 7 | RTS ^b | COM2-RTS | COM2_Tx- |
| 8 | CTS ^b | COM2-CTS | COM2_Rx- |
| 9 | N/C | N/C | N/C |

- a. Current is limited to 1A.
- b. The FlexPak-G2 is a drop-in replacement for the FlexPak-V1, V1G and V2. The FlexPak-G2-V2 has flow control capability, the V1 and V1G do not.

Table 26: FlexPak-G2 I/O Port Pin-Out Descriptions

| Connector Pin No. | Signal Name | Signal Descriptions |
|-------------------|--------------------|--|
| 1 | VARF | Variable frequency out |
| 2 | PPS | Pulse per second |
| 3 | GPIO ^a | Reserved |
| 4 | EVENT1 | Mark 1 input |
| 5 | PV | Valid position available |
| 6 | EVENT2 | Mark 2 input, which requires a pulse longer than 150 ns. 10K ohm pull down resistor internal to the FlexPak-G2. Refer also to the MARKCONTROL command in the <i>OEMV Firmware Reference Manual</i> . |
| 7 | N/C | N/C |
| 8 | ERROR ^a | Indicates a fatal error when high. |
| 9 | GND | Digital ground |

- a. Only available on FlexPak-G2-V2.

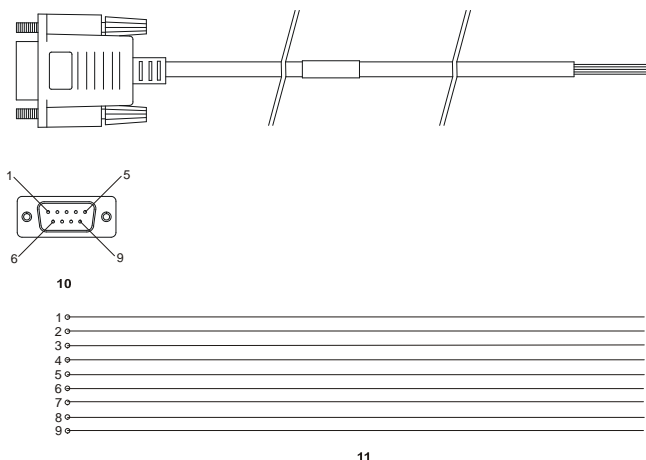
☒ See also Section 3.3.1, Strokes on Page 45.

A.7.2 Cables

A.7.2.1 I/O Strobe Port Cable (NovAtel part number 01017660)

The strobe lines on the FlexPak-G2 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 49*.

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 | GPIO | Red |
| 4 | Event1 | Orange |
| 5 | PV | Yellow |

| I/O Port Pin | I/O Port Signal | I/O Port Cable Wire Color |
|--------------|-----------------|---------------------------|
| 6 | Event2 | Green |
| 7 | N/C | Blue |
| 8 | ERROR | Violet |
| 9 | GND | White/Grey |

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

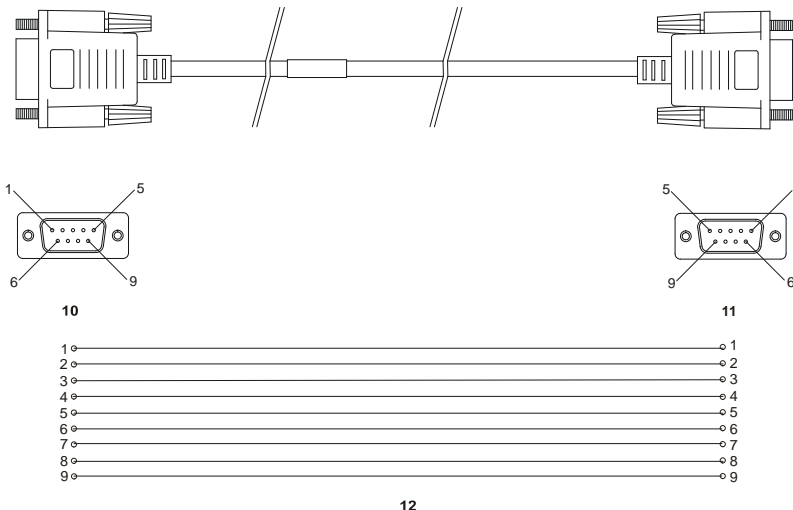


Figure 49: FlexPak-G2 I/O Strobe Port Cable

A.7.2.2 Straight Through Serial Cable (NovAtel part number 01017659)

This cable can be used to connect the FlexPak-G2 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 50*.

This cable is RoHS compliant.



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

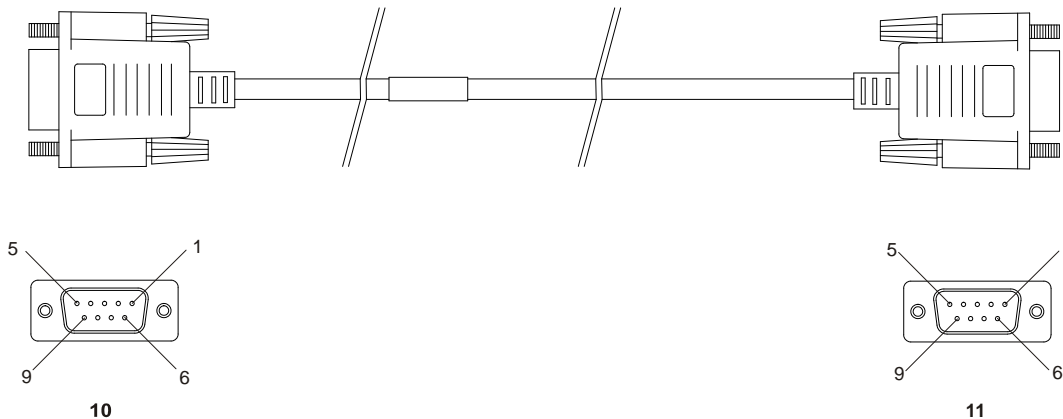


Figure 50: FlexPak-G2 Straight Through Serial Cable

A.7.2.3 Null Modem Cable (NovAtel part number 01017658)

This cable supplied with the FlexPak-G2, see *Figure 51*, 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 51: FlexPak-G2 Null Modem Cable

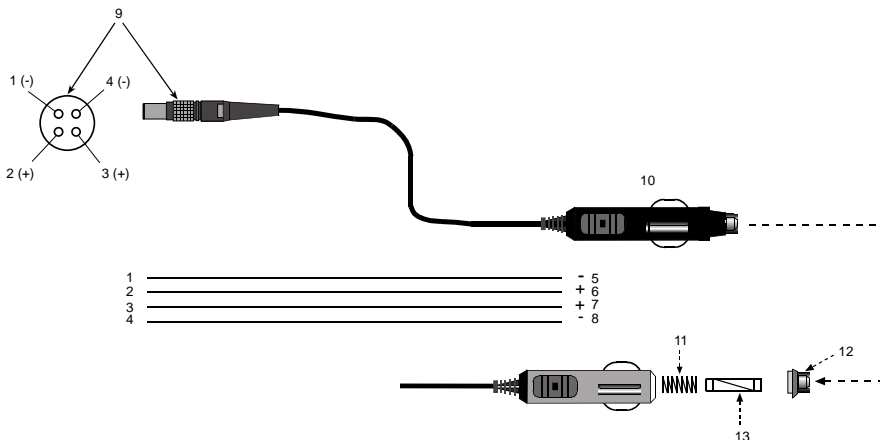
A.7.2.4 12V Power Adapter Cable (NovAtel part number 01017663)

The power adapter cable supplied with the FlexPak-G2, see *Figure 52*, 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.

For alternate power sources please see *Section 3.1.3 on Page 37*.



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



Figure 52: FlexPak-G2 Power Cable

1. For SPAN applications this becomes +9 to +18 V DC

A.8 SMART-V1/SMART-V1G

INPUT/OUTPUT CONNECTORS

WARNING!: It is important that you read the *SMART-V1/SMART-V1G Power Warning* on Page **10** of the *Notice* section.

Switchcraft Connector Part Number: EN3P18M26 (see Section C.4 on Page 153 for the mating part #)

| | |
|---|---|
| USB model port (SMART-V1 or SMART-V1G) | 18-pin Switchcraft RS-232 +9 to +28 V DC 1.8 W (typical) power consumption |
|---|---|

| | |
|-----------------------------------|---|
| CAN model port (SMART-V1 only) | 18-pin Switchcraft RS-232 +9 to +28 V DC 1.8 W (typical) power consumption |
|-----------------------------------|---|

| | |
|--------------------------------------|---|
| RS-422 model port (SMART-V1 only) | 18-pin Switchcraft RS-422 +9 to +28 V DC 1.8 W (typical) power consumption |
|--------------------------------------|---|

| | |
|---------------------------|--------------------------------|
| In-Rush Power Consumption | 15 A for less than 250 μ s |
|---------------------------|--------------------------------|

NOVATEL PART NUMBER

| | | | |
|-----------------------|--------------------------------|------------------|---------------|
| SMART-V1 SMART-V1G | USB: 01017755 USB: 01018011 | RS-422: 01018012 | CAN: 01017756 |
|-----------------------|--------------------------------|------------------|---------------|

PHYSICAL

| | |
|------|---|
| Size | 114.3 mm Diameter x 95.6 mm Height (4.5" Diameter x 3.76" Height) |
|------|---|

| | |
|--------|--|
| Weight | 525 g maximum excluding cable (1.16 lb.) |
|--------|--|

| | |
|-----------------|---|
| Mounting System | 1-14 UNS threads x 1" deep and/or 3 x 10-32 UNF screws |
|-----------------|---|

ENVIRONMENTAL

| | |
|-----------------------|----------------------------------|
| Operating Temperature | -40°C to +75°C (-40°F to +167°F) |
|-----------------------|----------------------------------|

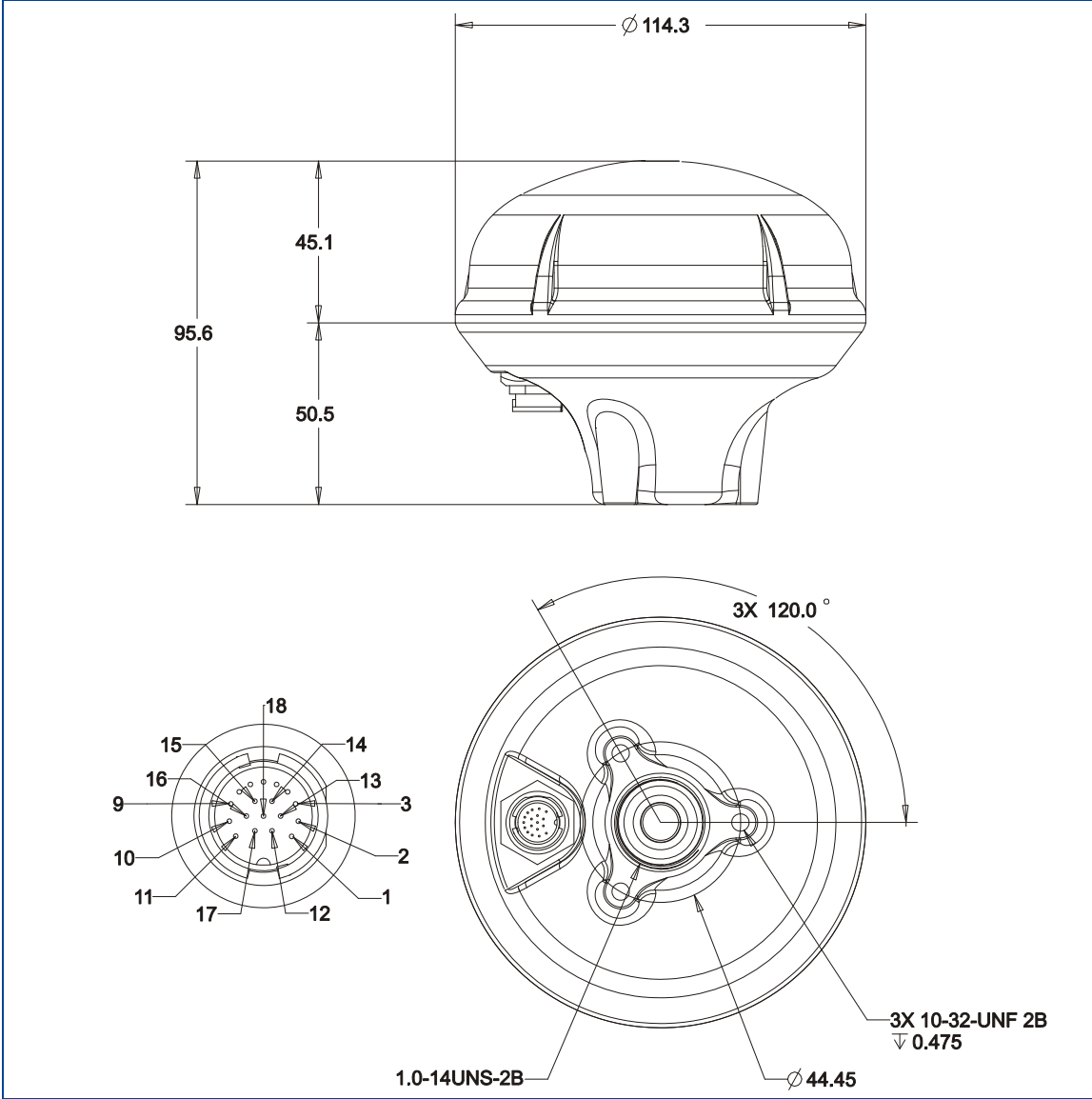
| | |
|---------------------|----------------------------------|
| Storage Temperature | -55°C to +90°C (-67°F to +194°F) |
|---------------------|----------------------------------|

| | |
|----------|----------------------------------|
| Humidity | Not to exceed 95% non-condensing |
|----------|----------------------------------|

| | | |
|-------------------------------|---|--------------|
| Tested to all these standards | Waterproof/Immersion 512.4 Procedure I | MIL-STD-810F |
| | Salt Spray 509.4 | MIL-STD-810F |
| | Sand and Dust 510.4 | MIL-STD-810F |
| | Shock 516.5 | MIL-STD-810F |
| | Vibration (Random) 514.5 C17 | MIL-STD-810F |
| | Vibration (Sine) | SAE EP455 |

| ANTENNA ELECTRICAL SPECIFICATIONS | | | |
|--|-----------------|------------------|-------------------|
| Impedance: | 50 Ω | Polarization: | R.H.C.P. |
| LNA gain: | 25 dB (typical) | Frequency Range: | 1555 MHz ± 30 MHz |
| Axial Ratio: | 3.0 dB (max.) | Noise Figure: | 2.0 dB (max.) |

DIMENSIONS ^{a b}



- a. All dimensions are in millimetres, 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.
- b. ∅ indicates a diameter and ∇ indicates a depth.

A.8.1 Port Pin-Outs

The pin numbering for the SMART-V1/SMART-V1G USB port followed by the SMART-V1 CAN and SMART-V1 RS-422 models, is described in the tables that follow.

Table 27: SMART-V1/SMART-V1G USB Model Port Pin-Out Descriptions

| Switchcraft RS-232 | |
|--------------------|-------------|
| Pin | Function |
| 1 | PWR |
| 2 | GND |
| 3 | TX2 |
| 4 | RX2 |
| 5 | TX1 |
| 6 | RX1 |
| 7 | NC |
| 8 | NC |
| 9 | Reserved |
| 10 | USB D (-) |
| 11 | Digital GND |
| 12 | PPS |
| 13 | NC |
| 14 | NC |
| 15 | NC |
| 16 | USB D (+) |
| 17 | PWR2 |
| 18 | GND2 |

☒ See also *Section 3.3.1, Strokes on Page 45.*

Table 28: SMART-V1 CAN Model Port Pin-Out Descriptions

| Switchcraft RS-232 | |
|--------------------|-------------|
| Pin | Function |
| 1 | PWR |
| 2 | GND |
| 3 | CAN H |
| 4 | CAN L |
| 5 | TX1 |
| 6 | RX1 |
| 7 | NC |
| 8 | NC |
| 9 | Reserved |
| 10 | Reserved |
| 11 | Digital GND |
| 12 | PPS |
| 13 | TX3 |
| 14 | RX3 |
| 15 | NC |
| 16 | NC |
| 17 | PWR2 |
| 18 | GND2 |

Table 29: SMART-V1 RS-422 Model Port Pin-Out Descriptions

| Switchcraft RS-422 | |
|--------------------|-------------|
| Pin | Function |
| 1 | PWR |
| 2 | GND |
| 3 | TX2 |
| 4 | RX2 |
| 5 | TX1 (-) |
| 6 | RX1 (+) |
| 7 | TX1 (+) |
| 8 | RX1 (-) |
| 9 | Reserved |
| 10 | Reserved |
| 11 | Digital GND |
| 12 | PPS |
| 13 | TX3 (-) |
| 14 | RX3 (+) |
| 15 | TX3 (+) |
| 16 | RX3 (-) |
| 17 | PWR2 |
| 18 | GND2 |

A.8.2 Optional Cables

Each SMART-V1/SMART-V1G is available with its own multi-cable in a USB (NovAtel part number 01017893) format. The SMART-V1 is also available in CAN (NovAtel part number 01017894) or RS-422 (NovAtel part number 01018017) format. These cables are also available with no connectors at the DB-9 end (NovAtel part numbers 01017923, 01017922, or 01018024 respectively) but with tin-terminated ends. All 6 cables have an 18-pin Switchcraft connector at one end and are 5 m in length.

Section A.8.2.1 contains SMART USB multi-cable information, Section A.8.2.2 on Page 146 contains SMART-V1 CAN multi-cable information while Section A.8.2.3 on Page 147 contains SMART-V1 RS-422 multi-cable information. Figures 53 and 54 on Page 148 show cable examples.

☒ Switchcraft cable connector pin numbers are labelled on the connectors.

A.8.2.1 18-Pin Switchcraft to USB Multi-Cable (NovAtel part number 01017893)

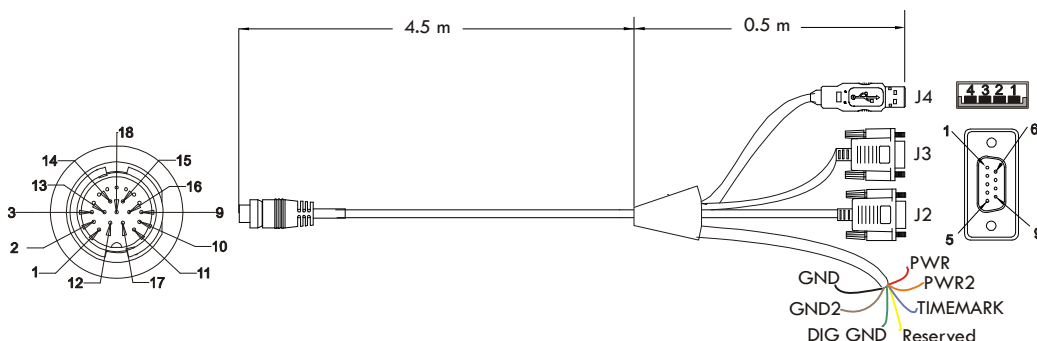


Table 30: USB Multi-Cable Connector Pin-Outs

| J1 Switchcraft Pin | Signal | J2 DB-9 socket Pin | Signal | J3 DB-9 socket Pin | Signal | J4 USB A Pin | Signal |
|---|-------------|---|-------------|--------------------|-------------|--------------|-------------|
| 1 | PWR | 1 | NC | 1 | NC | 1 | NC |
| 2 | GND | 2 | TX1 | 2 | TX2 | 2 | USB D (-) |
| 3 | TX2 | 3 | RX1 | 3 | RX2 | 3 | USB D (+) |
| 4 | RX2 | 4 | NC | 4 | NC | 4 | Digital GND |
| 5 | TX1 | 5 | Digital GND | 5 | Digital GND | | |
| 6 | RX1 | 6 | NC | 6 | NC | | |
| 7 | NC | 7 | NC | 7 | NC | | |
| 8 | NC | 8 | NC | 8 | NC | | |
| 9 | Reserved | 9 | NC | 9 | NC | | |
| 10 | USB D (-) | ☒ See also Table 33 on Page 147 for the optional USB cable's bare tagged wire colors. | | | | | |
| 11 | Digital GND | | | | | | |
| 12 | PPS | | | | | | |
| 13 | TX3 | | | | | | |
| 14 | RX3 | | | | | | |
| 15 | NC | | | | | | |
| 16 | USB D (+) | | | | | | |
| 17 | PWR2 | | | | | | |
| 18 | GND2 | | | | | | |
| <p>WARNING!: It is important that you read the <i>SMART-V1/SMART-V1G Power Warning</i> on Page 10 of the Notice section.</p> | | | | | | | |

A.8.2.2 18-Pin Switchcraft to CAN Multi-Cable (NovAtel part number 01017894)

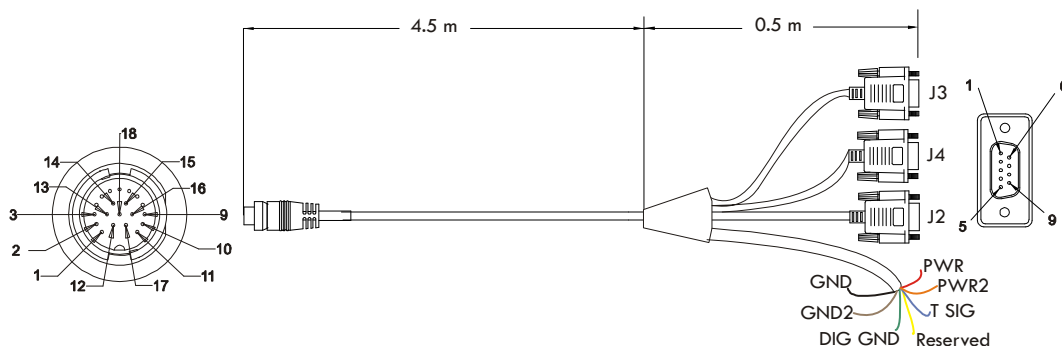


Table 31: CAN Multi-Cable Connector Pin-Outs

| J1 Switchcraft | | J2 DB-9 socket | | J3 DB-9 plug | | J4 ^a DB-9 socket | |
|----------------|-------------|---|-------------|--------------|-------------|-----------------------------|-------------|
| Pin | Signal | Pin | Signal | Pin | Signal | Pin | Signal |
| 1 | PWR | 1 | NC | 1 | NC | 1 | NC |
| 2 | GND | 2 | TX1 | 2 | CANH | 2 | TX3 |
| 3 | CANH | 3 | RX1 | 3 | CANL | 3 | RX3 |
| 4 | CANL | 4 | NC | 4 | NC | 4 | NC |
| 5 | TX1 | 5 | Digital GND | 5 | Digital GND | 5 | Digital GND |
| 6 | RX1 | 6 | NC | 6 | NC | 6 | NC |
| 7 | NC | 7 | NC | 7 | NC | 7 | NC |
| 8 | NC | 8 | NC | 8 | NC | 8 | NC |
| 9 | Reserved | 9 | NC | 9 | NC | 9 | NC |
| 10 | Reserved | <input checked="" type="checkbox"/> See also <i>Table 33</i> on <i>Page 147</i> for the optional USB cable's bare tagged wire colors. | | | | | |
| 11 | Digital GND | | | | | | |
| 12 | PPS | | | | | | |
| 13 | TX3 | | | | | | |
| 14 | RX3 | | | | | | |
| 15 | NC | | | | | | |
| 16 | NC | | | | | | |
| 17 | PWR2 | | | | | | |
| 18 | GND2 | | | | | | |
| | | | | | | | |

- a. J4 (COM3) defaults to USB for the OEMV-1. In order to enable a COM3 serial connection, issue the following commands:

```
MARKCONTROL MARK 1 DISABLE
INTERFACEMODE COM3 NOVATEL NOVATEL
SAVECONFIG
```

See also the table section *INPUT/OUTPUT DATA INTERFACE* for the OEMV-1 starting on *Page 100*.

A.8.2.3 18-Pin Switchcraft to RS-422 Multi-Cable (NovAtel part number 01018017)

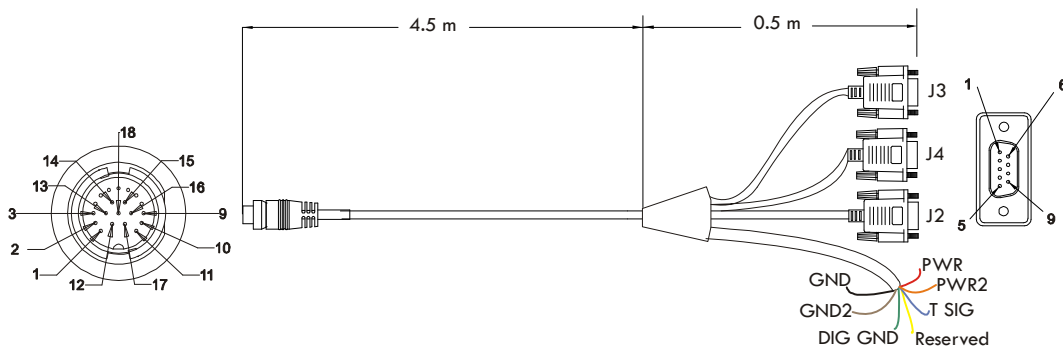


Table 32: RS-422 Multi-Cable Connector Pin-Outs

| J1 Switchcraft | | J2 DB-9 socket | | J3 DB-9 socket | | J4 DB-9 socket | |
|----------------|-------------|---|-------------|----------------|-------------|----------------|-------------|
| Pin | Signal | Pin | Signal | Pin | Signal | Pin | Signal |
| 1 | PWR | 1 | NC | 1 | NC | 1 | NC |
| 2 | GND | 2 | TX1 (-) | 2 | CANH | 2 | TX3 (-) |
| 3 | TX2 | 3 | RX1 (+) | 3 | CANL | 3 | RX3 (+) |
| 4 | RX2 | 4 | NC | 4 | NC | 4 | NC |
| 5 | TX1 (-) | 5 | Digital GND | 5 | Digital GND | 5 | Digital GND |
| 6 | RX1 (+) | 6 | NC | 6 | NC | 6 | NC |
| 7 | TX1 (+) | 7 | TX1 (+) | 7 | NC | 7 | TX3 (+) |
| 8 | RX1 (-) | 8 | RX1 (-) | 8 | NC | 8 | RX3 (-) |
| 9 | Reserved | 9 | NC | 9 | NC | 9 | NC |
| 10 | Reserved | ☒ See also <i>Table 33</i> for the optional CAN cable's bare tagged wire colors. <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> | | | | | |
| 11 | Digital GND | | | | | | |
| 12 | PPS | | | | | | |
| 13 | TX3 (-) | | | | | | |
| 14 | RX3 (+) | | | | | | |
| 15 | TX3 (+) | | | | | | |
| 16 | RX3 (-) | | | | | | |
| 17 | PWR2 | | | | | | |
| 18 | GND2 | | | | | | |

WARNING!: It is important that you read the *SMART-VI/SMART-VIG Power Warning* on *Page 10* of the *Notice* section.

Table 33: USB, CAN or RS-422 Multi-Cables Bare Tagged Wire Colors

| Color | Function |
|--------|-------------|
| Red | PWR |
| Orange | PWR2 |
| Blue | T SIG |
| Yellow | Reserved |
| Green | Digital GND |
| Brown | GND2 |
| Black | GND |



Figure 53: SMART-V1/SMART-V1G Optional USB Multi-Cable



Figure 54: SMART-V1 Optional CAN or RS-422 Multi-Cable

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 34 provides some background information on static-accumulating materials.

Table 34: 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 GPS receiver. Should you require assistance or need to order additional components, please contact your local NovAtel dealer or Customer Service representative.

C.1 ProPak-V3

| Part Description | NovAtel Part |
|---|--------------|
| I/O strobe cable (Figure 44 on Page 128) | 01017660 |
| Straight through serial data cable (Figure 45 on Page 129) | 01017659 |
| Null modem serial data cable (Figure 46 on Page 130) | 01017658 |
| Power cable: LEMO 4-pin socket to 12V power outlet plug (Figure 47 on Page 131) | 01017663 |
| USB serial cable (Figure 48 on Page 132) | 01017664 |

C.2 FlexPak-G2-V2, FlexPak-G2-V1G and FlexPak-G2-V1

| Part Description | NovAtel Part |
|---|--------------|
| I/O strobe cable (Figure 49 on Page 136) | 01017660 |
| Straight through serial data cable (Figure 50 on Page 137) | 01017659 |
| Null modem serial data cable (Figure 51 on Page 138) | 01017658 |
| Power cable: LEMO 4-pin socket to 12V power outlet plug (Figure 52 on Page 139) | 01017663 |
| USB A to mini B Cable | 60323078 |

C.3 Accessories

| Part Description | NovAtel Part |
|--|---------------------|
| OEMV Family Compact Disc with PC utilities | 01017716-VER1 |
| OEMV Family Installation and Operation User Manual | OM-20000093 |
| OEMV Family Firmware Reference Manual | OM-20000094 |
| SMART-V1/SMART-V1G multi-cable USB (2 DB-9, 1 USB and 7 bare tagged wire ends) | 01017893 |
| SMART-V1 multi-cable CAN (3 DB-9, and 7 bare tagged wire ends) | 01017894 |
| SMART-V1 multi-cable RS-422 (3 DB-9, and 7 bare tagged wire ends) | 01018017 |
| SMART-V1/SMART-V1G multi-cable USB variant (all bare tagged-wire ends) | 01017923 |
| SMART-V1 multi-cable CAN variant (all bare tagged-wire ends) | 01017922 |
| SMART-V1 multi-cable RS-422 variant (all bare tagged-wire ends) | 01018024 |
| 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 |

Continued on the following page.

| Part Description | | NovAtel Part |
|--|--|------------------|
| | 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 |
| AC Adapter 120/240VAC | 15 Watts, 12 V DC adapter & USA electrical chord | 40023106 |
| Power cable: LEMO 4-pin socket to 12V power outlet plug (<i>Figure 52 on Page 139</i>) | | 01017663 |

C.4 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 |
|--|--|-----------------|--------------------|
| ProPak-V3 Power Cable (<i>Figure 47 on Page 131</i>) | 4-pin socket connector | LEMO | FGG.0B.304.CLAD52Z |
| FlexPak-G2-V1/V1G/V2 Cables (<i>Figure 52 on Page 139</i>) | 4-pin socket connector | LEMO | FGG.0B.304.CLAD52Z |
| SMART-V1/V1G: USB, CAN or RS-422 Model Cables | 18-pin plug connector on multi-cable | Switchcraft | EN3C18F26 |
| OEMV-1/1G Card (<i>Figure 35 on Page 99</i>) | J100 - MCX JACK RECEPTACLE RF signal input and LNA power output | JOHNSON | 133-3701-211 |
| | J700 - 2x10 HEADER, 2mm PITCH Power, data, and signal connector | SAMTEC | TMM-110-03-TM-D |
| OEMV-2 Card (<i>Figure 39 on Page 111</i>) | J100 - MMCX JACK RECEPTACLE RF signal input and LNA power output | JOHNSON | 135-3701-201 |
| | J501 - MMCX JACK RECEPTACLE External oscillator input | JOHNSON | 135-3701-201 |
| | P1101 - 2x12 HEADER, 2mm PITCH Power, data, and signal connector | SAMTEC | TMM-112-03-L-D |
| OEMV-3 Card (<i>Figure 41 on Page 117</i>) Note the alternates for J100 and J700. | J100 - MMCX JACK RECEPTACLE RF signal input and LNA power output | JOHNSON | 135-3701-201 |
| | | HUBER+SUHNER | 82 MMCX-50-0-1 |
| | J700 - MMCX JACK RECEPTACLE External oscillator input | JOHNSON | 135-3701-201 |
| | | HUBER+SUHNER | 82 MMCX-50-0-1 |
| | P1601 - 2x20 HEADER, 0.1" PITCH Power, data, and signal connector | SAMTEC | TSM-120-01-S-DV |
| P1400 - 2x7 HEADER, 0.1" PITCH CAN Bus with transceiver | SAMTEC | TSM-107-01-L-DV | |

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