



SMART-AG User Manual

SMART-AG 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 for Velocity Kalman Filter

#6,664,923 B1

Anti-Jamming Technology

#5,734,674

RTK Positioning

#6,728,637 B2

#6,664,923 B1



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

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	407 - 8 Avenue S.W.	CDN Account #	788889-001
	Calgary, AB, Canada T2P 1E5	EURO Account #	788889-270
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		Swift	HKBCCATTCAL

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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:

SMART-AG	One (1) Year
Antenna	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.

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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.

Notices

The following notices apply to the SMART-AG. 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

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.

SMART-AG-PVT, SMART-AG-PVT-G, SMART-AG-PVT-S and SMART-AG-PVT-RT20 have been tested and found to comply with the emission limits for a Class A digital device. The SMART-AG-B and SMART-AG-TB comply with the 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.

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

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

IMPORTANT:

In order to maintain compliance as a Class “A” or Class “B” digital device, shielded cables should be used for the RS-232 serial data ports (Belden 1036A or equivalent) and twisted pair cable should be used for the CAN port (shielded twisted pair will improve CAN performance in electrically harsh environments). I/O signals should be referred to signal ground (connector pin 5) and not power ground (connector pin 9). If I/O signals route to different areas of the vehicle, dedicated signal grounds for I/O should be spliced into a common connection to connector pin 5 at a point close to the SMART-AG.

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.

Industry Canada

SMART-AG-PVT, SMART-AG-PVT-G, SMART-AG-PVT-S and SMART-AG-PVT-RT20 Class A digital apparatuses all comply with Canadian ICES-003.

SMART-AG-PVT, SMART-AG-PVT-G, SMART-AG-PVT-S et le SMART-AG-PVT-RT20 appareils numérique de la classe B sont conforme à la norme NMB-003 du Canada.

SMART-AG-B and SMART-AG-TB Class B digital apparatuses comply with Canadian ICES-003.


SMART-AG-B et SMART-AG-TB appareils numérique de la classe B sont conforme à la norme NMB-003 du Canada.

CE

The enclosures carry the CE mark.

"Hereby, NovAtel Inc. declares that this SMART-AG is in compliance with the essential requirements and other relevant provisions of the R&TTE Directive 1999/5/EC and with the EMC Directive 2004/108/EC."

WEEE

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 recognized by their wheeled bin label ().¹

RoHS

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

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

OEMV Firmware UPGRADES

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 GPS Price List plus a nominal service charge.

WINLOAD

Please refer to the *OEMV Family Installation and Operation User Manual* for instructions on how to use the WinLoad program to upgrade your OEMVcard.

Contact Information

Model 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 GPS Hotline at 1-800-NOVATEL (U.S. & Canada), or 403-295-4900 (international)

Fax: 403-295-4901

E-mail: support@novatel.com

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

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

☒ Before contacting NovAtel 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/laptop for 30 minutes

RXSTATUSA	once
BESTPOSA	ontime 1
RXCONFIGA	once
VERSIONA	once

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

Foreword

Congratulations!

Congratulations on your purchase of the SMART-AG, a GPS L1 plus GLONASS L1 receiver and antenna with exceptional flexibility and performance.

NovAtel is an industry leader in state-of-the-art Global Navigation Satellite Systems (GNSS) receiver design. We believe that our SMART-AG will meet your high expectations, and are working hard to ensure that future products and enhancements maintain that level of satisfaction.

This is your primary hardware and software reference.

Scope

This manual provides sufficient detail on the SMART-AG, to allow you to effectively integrate and fully operate it. The information in this manual is a companion to the OEMV family information in the *OEMV Firmware Reference Manual* and the *OEMV Installation and Operation User Manual*.

After the addition of accessories and a power supply, the SMART-AG is ready to go.

SMART-AG utilizes a comprehensive user-interface command structure, which requires communications through its communications (COM) ports. This manual describes the SMART-AG-specific commands and logs, see *Commands* starting on *Page 64* and *Logs* starting on *Page 73*.

Other supplementary manuals, available on the accompanying CD and on our Web site at <http://www.novatel.com/support/docupdates.htm>, aid you in using the other commands and logs available in the OEMV family of receivers.

PC Utilities are also described, see *Chapter 4* starting on *Page 37*. Integrated with the Control and Display Unit (**CDU**) software, these utilities provide graphical user interfaces for logging to a PC/laptop, upgrading, and converting data types.

Prerequisites

The installation chapters of this document provide information concerning the installation requirements and considerations for SMART-AG. To run the PC software supplied, your personal computer must meet or exceed this minimum configuration:

- Windows compatible mouse or pointing device and SVGA display

Although previous experience with Windows is not necessary to use **CDU**, familiarity with certain actions that are customary in Windows will assist in the usage of the program. This manual has been written with the expectation that you already have a basic familiarity with Windows.

What's New in Rev 4 of this Manual?

This manual has been revised to include information on the following:

- Terrain compensation, see “Terrain Compensation” on page 26.
- Bluetooth®, see “Bluetooth on the SMART-AG Receiver” on page 53.

Conventions

Conventions used in this manual are the following:

☒ This is a notebbox that contains important information.

- The letter H in the *Offset* columns of the commands and logs tables represents the header length for that command or log. Refer to the *OEMV Family Firmware Reference Manual* for ASCII and binary header details.
- The number following 0x is a hexadecimal number.
- Command descriptions' brackets, [], represent the optionality of parameters.
- In tables where values are missing they are assumed to be reserved for future use.
- Status words are output as hexadecimal numbers and must be converted to binary format (and in some cases then also to decimal). For an example of this type of conversion, please refer to the RANGE log in the *OEMV Family Firmware Reference Manual*.

Conversions and their binary or decimal results are always read from right to left. For a complete list of hexadecimal, binary and decimal equivalents, please refer to the *Unit Conversion* section of the *GNSS Reference Book* available on our Web site at <http://www.novatel.com/support/docupdates.htm>.

See also *Section B.1, Syntax Conventions* on *Page 64* for more syntax when entering commands.

The SMART-AG is a high-performance GNSS receiver and antenna, capable of receiving and tracking different combinations of GPS L1 and GLONASS L1 code and carrier signals on a maximum of 36 channels. SBAS (Satellite Based Augmentation Systems) includes WAAS, EGNOS, and MSAS. SBAS support is standard. Refer to the *GNSS Reference Book* for an overview of each of the above signal types, available from our Web site at <http://www.novatel.com/support/docupdates.htm>. The SMART-AG's rear panel also features light emitting diodes (LEDs) for status indication.

Once you connect the SMART-AG to a vehicle, it begins operating as a fully functional GNSS system. *Figure 1* below shows the SMART-AG without connecting cables.



Figure 1: SMART-AG Receiver

1.1 Models and Features

The main features of the SMART-AG are the following:

- an enhanced high performance GPS+GLONASS L1 receiver
- a high performance GPS+GLONASS L1 antenna
- emulated radar output
- a CAN port
- two (2) RS-232 COM ports
- three (3) LED status indicators
- a water and dust tight enclosure

The SMART-AG is available in several different firmware models whose configurations may include other additional features. Some possible configurations can be seen in *Table 1* below.

Table 1: SMART-AG Controller Models

Model Name	Firmware Feature
SMART-AG-PVT	GPS L1 only Autonomous, SBAS, or DGPS 20 Hz positions with emulated radar output
SMART-AG-PVT-G	As above with GLONASS L1
SMART-AG-PVT-S	GPS L1 only Autonomous, SBAS, or DGPS 5 Hz positions with emulated radar output
SMART-AG-RT20	GPS L1 only Autonomous, SBAS, DGPS, or 20 cm RT-20 positions

Refer also to the *OEMV Family Installation and Operation User Manual* for information on receiver communications and operation.

This chapter contains instructions and tips to set up your SMART-AG to create a GNSS receiver system.

2.1 Additional Equipment Required

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

- A PC/laptop (user-supplied)
- A means of communicating with, and powering, the SMART-AG
 - SMART-AG cable (01018256) (included with the receiver Development Kit), NovAtel part number 01018257, see *Figure 3, Simplified SMART-AG Setup* on *Page 22* for COM and power connections

☒ Use a serial COM connection to communicate with the receiver first.

- A fused power supply (user-supplied) or other user equipment

2.1.1 SMART-AG Setup

Complete the following steps to connect and power your SMART-AG.

1. Mount the SMART-AG on a secure, stable part of the vehicle (i.e. cab roof) with an unobstructed view of the sky from horizon to horizon, see *Section 2.1.5, Mounting the SMART-AG* on *Page 23*.
2. Establish a physical communication connection between the SMART-AG and the PC/laptop. Connect the *COM and Power* port on the back of the SMART-AG, see *Figure 2* below, to a DB-9 serial port on a PC, laptop or other data storage device.

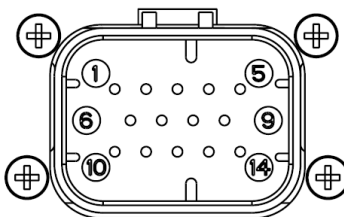



Figure 2: SMART-AG Connector

Table 2: SMART-AG Connector Pin-Out

Pin	Use	Pin	Use
1	COM 1 TxD	8	RESERVED (Do not connect)
2	COM 1 RxD	9	Power Negative/Return
3	COM 2 TxD	10	Emulated Radar Output
4	COM 2 RxD	11	MKI (Mark Input)
5	Signal Ground (COM/ER/MKI/PPS)	12	PPS (Pulse Per Second) Output
6	CAN+	13	RESERVED (Do not connect)
7	CAN-	14	Power Positive/Source

- Turn on the power supply to the SMART-AG (the SMART-AG cable is also a power cable). The power LED  on the back of the receiver glows red when the SMART-AG is properly powered.

✉ Fuse/holder recommendations can be found in *Table 9, Recommended Fuse and Fuse Holders* on page 63

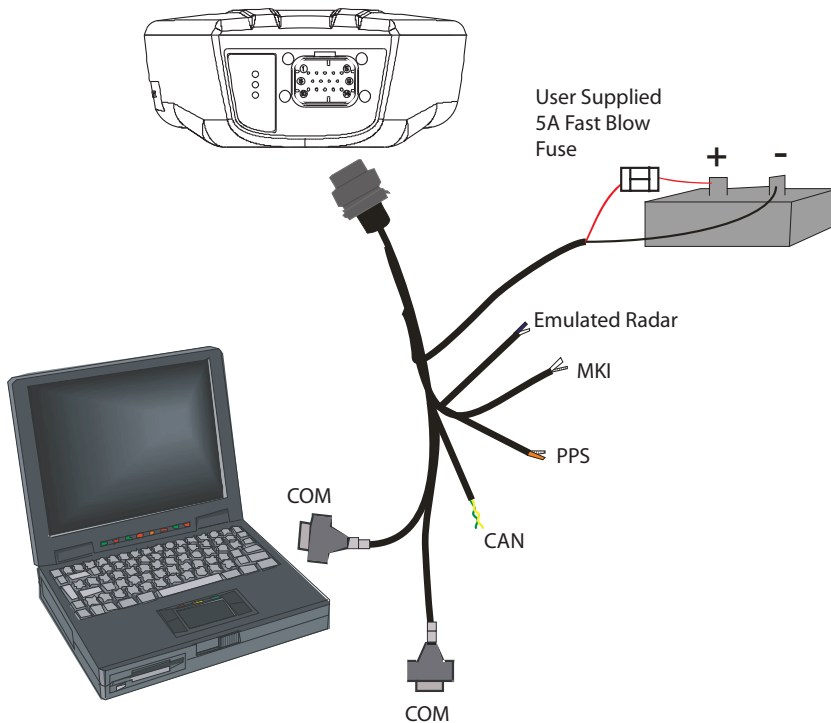


Figure 3: Simplified SMART-AG Setup

-
- ☒ Minimum conductor size for all wiring is 0.5 mm / 20 AWG
-

2.1.2 Installing the PC Utilities

Once the SMART-AG is connected to the PC/laptop and a power supply, install NovAtel's PC Utilities. These include **CDU**, a graphical user interface program.

1. Start up the PC/laptop.
2. Insert the accompanying CD, see *Figure 4* below, in the CD-ROM drive of the computer.
3. Select *Install the OEMV GPS PC Utilities* from the window that is automatically displayed.

-
- ☒ If the window does not automatically open when the CD is inserted, select *Run* from the *Start* menu and select the *Browse* button to locate *Setup.exe* on the CD drive.
-

4. Install the PC Utilities by advancing through the steps provided in the *NovAtel PC Utilities* setup program.



Figure 4: OEMV CD

2.1.3 Power Supply Requirements

The SMART-AG requires +8 to +36 VDC for the input power to the receiver. See *Page 58* for more power supply specifications.

The SMART-AG cable provides power in (with a BATT+ label) and power ground (with a BATT- label) bare wires for connections from the SMART-AG to a 12 to 24V vehicular power system (or equivalent) protected by a 5A Fast Blow Fuse (user supplied). See its cable details starting on *Page 62*.



WARNING!: The SMART-AG power source must be protected by a 5A Fast Blow Fuse or damage to wiring may result (not covered by warranty).

If the voltage supplied is above or below the specified range, the receiver will suspend operation. If the voltage supplied is above 48V, the receiver may be permanently damaged, voiding your warranty.

2.1.4 Mounting Plate

A mounting plate is available to facilitate mounting the receiver to a surface

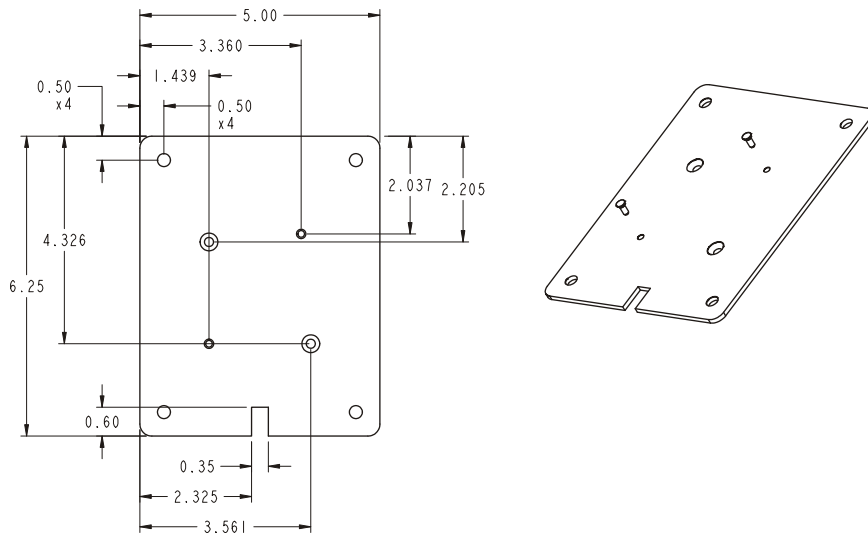


Figure 5: SMART-AG Mounting Plate

☒ All measurements are in inches unless specified otherwise.

To install the mounting plate provided with the SMART-AG Development Kit, use the adhesive tape attached or the mounting holes at each corner of the plate.

2.1.5 Mounting the SMART-AG

The SMART-AG is a single-frequency GNSS receiver and antenna.

When installing the SMART-AG, do the following:

- Choose a location that has a clear view of the sky so that each satellite above the horizon can be tracked without obstruction. For more information, refer to the *GNSS Reference Book* found at <http://www.novatel.com/support/docupdates.htm>.
- Mount on a secure, stable structure capable of safe operation in the specific environment. Typical installation is the tractor cab roof, ideally close to the pivot point of the tractor.

2.1.6 Connecting Data Communications Equipment

To communicate with the receiver by sending commands and obtaining logs, a connection to data communications equipment is required. See the *SMART-AG Cable Pinouts* table on *Page 61* for more information.

2.2 Additional Features and Information

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

2.2.1 MKI and PPS Strobes

An input (MKI) and output (PPS) strobe provide status and synchronization signals. PPS is a 3.3V CMOS output; MKI is a 5V logic tolerant input.

Pin-out information can also be found on *Page 61*.




2.2.2 Status Indicators

LED indicators on the SMART-AG provide the status of the receiver. They represent these categories:

- Position Status
- Position Type
- Power

Table 3 shows the meaning of the LED states in the expected sequence after power is applied.

Table 3: SMART-AG LED Status Indicators

Red	Yellow	Green	Condition
			
Off	Off	Off	Power is not available
On	Off	Off	Power available but no satellites are tracking yet
On	Flashing	Off	Tracking at least one satellite but not a valid position
On	On	Off	Position valid in basic autonomous mode
On	On	On	Position valid in an enhanced accuracy mode (WAAS/EGNOS/MSAS/DGPS or RTK)

Flashing means that the LED is turning on and off at a 1 Hz rate - 0.5 seconds on and 0.5 seconds off.

Debugging:

- If the power is on but the yellow LED doesn't flash within one minute, then no satellites are tracking. There may be excessive blockage or the unit may be defective. Make sure the unit has an unobstructed view of the sky. Try power cycling the unit.
- If the yellow LED is flashing but doesn't progress to solid yellow within one minute, then insufficient satellites are tracking or the signal quality is poor and ephemeris data can't be received. Normally, four satellites are sufficient for a valid position as long as they are widely

distributed in the sky. If it is stuck on blinking yellow, there may be excessive blockage or the unit may be defective. Make sure the unit has an unobstructed view of the sky. Try power cycling the unit.

- If the yellow LED is on, but the green doesn't turn on within five minutes than no SBAS or DGPS positions are available. If you are using SBAS, make sure SBAS is available in your area and that the unit is configured to enable SBAS positions (SBASCONTROL ENABLE). For DGPS, make sure the unit is configured with the correct serial port parameters and to accept the DGPS protocol your area is using and that your data modem is connected and working.
- The green LED blinks when SBAS is detected then it comes on solid when SBAS is enabled. The LED will stay dark if SBAS is not detected.

2.2.3 Emulated Radar (ER)

The SMART-AG outputs an emulated RADAR signal via the bare wires labeled ER GND and ER_OUT on the SMART-AG cable. See *Table 6 on Page 61* for the pin-out details of this cable.

The ER outputs a logic high of supply voltage minus 0.5V minimum and logic low of 0.5V maximum with a rise and fall time of less than 1 ms. Its output references signal GND and provides logic low output until its speed is greater than 1 km/Hr. ER provides an output frequency that represents 36.11 Hz/km/Hr with an effective range from 1 km/Hr to 55 km/Hr for near-horizontal applications. Please see *B.4, RADARCFG Configure the ER Output* starting on *Page 71* for more information.

2.2.4 Controller Area Network (CAN)

NEMA 2000 is a CAN standard created by the National Marine Electronics Association and designed to support networking in marine applications. It functions over a longer physical distance, and supports more physical nodes than ISO 11783. The relationship between NMEA2000 and SAE J1939 is that J1939 *is* the standard, while the NMEA 2000 group has added some new messages (called PGNs or Parameter Group Numbers) and added a new, additional transport protocol called FastPacket. NMEA2000 compliant, for all intents and purposes, means J1939 compliant *plus* support for new NMEA2000 messages. In other word, one cannot have NMEA2000 without J1939 support as well. J1939 is additionally “harmonized” with ISO 11783, a standard for the agriculture industry.

The CAN module is generally not user-interactive. It is activated when a SETCANNNAME command is entered, and after a SAVECONFIG, the CAN module is activated immediately on all subsequent start-ups. The module supports the following NMEA2000 Parameter Group Message (PGN):

- PGN 129029 GNSSPositionData
- PGN 129025 GNSSPositionRapidUpdate
- PGN 129026 COGandSOGRapidUpdate

Table 4: Available CAN Signals on the SMART-AG

CAN	Pins
CANI+	Pin 6
CANI-	Pin 7

2.2.5 Terrain Compensation

The SMART-AG Terrain Compensation feature corrects for errors in position caused by tilting of the vehicle. The SMART-AG senses the vehicle's roll angle and, with the user-entered "height above ground", compensates the position output to give the position under the vehicle rather than at the antenna.

As shown in Figure 6, if an agricultural implement is operating on sloped terrain, the position will be in error by an amount proportional to the tilt angle.

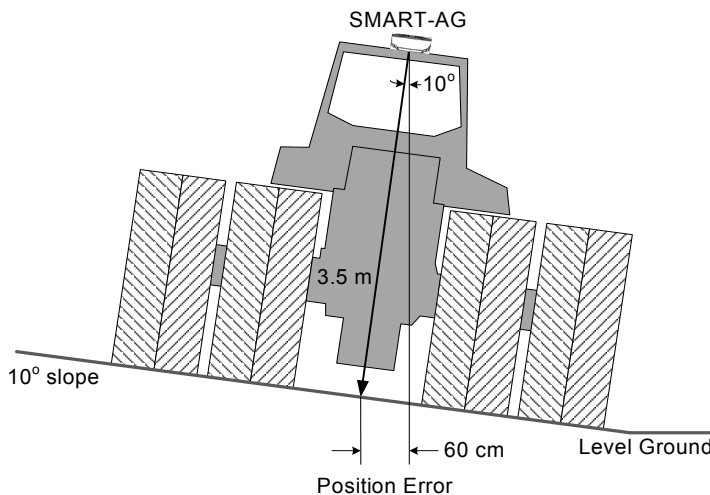


Figure 6: SMART-AG Tilt Feature

If enabled, the SMART-AG determines the tilt and corrects the position data before it is forwarded to the user equipment. In the above example, the tilt is 10 degrees, and the position correction that needs to be applied is 60 cm. Accuracy of the compensation is a function of the accuracy of the measurements of both the height of the SMART-AG above ground and the tilt angle, which will be less than 1 degree.

The Tilt functionality is physically integrated with the SMART-AG, so if Tilt is enabled, it will be used. For accurate Tilt compensation, the SMART-AG should be installed and oriented on the center line of the vehicle. When the SMART-AG is correctly installed and oriented, the cables should line up with the back of the vehicle. The SMART-AG connector can be used as a guide.

Once the SMART-AG is installed, measure the distance from the middle of the SMART-AG (from the bottom of the connector) to the ground and enter this measurement through the command line, as outlined in section 3.5 on page 36. For accurate tilt compensation, the height measurement should be accurate within 2.5 - 5 cm. The error in compensation is proportional to the error in height. If tires become deflated, the vehicle sinks in mud, or if the height is not measured accurately, the tilt correction will be in error.

SMART-AG Tilt functionality works with NMEA (GPGGA for example) and NovAtel (BESTPOS, for example) position logs.

Instructions for setting up and using the Tilt function are outlined in Chapter 3.

Before operating the SMART-AG for the first time, please ensure that you have followed the installation instructions in *Chapter 2, Installation and Setup* starting on *Page 21*. The following instructions are based on a COM port configuration such as that shown in *Figure 8 on Page 31*. It is assumed that a personal computer (PC), or laptop, is used during initial operation and testing for greater ease and versatility.

3.1 Communications with the Receiver

Communication with the receiver typically consists of issuing commands through the communication ports from an external serial communications device. This could be either a terminal or PC/laptop that is directly connected to the receiver serial port using a DB-9 connector on the SMART-AG multi-cable. If you are using a radio, it connects to another DB-9 connector on the same multi-cable by means of the radio serial cable supplied with the radio. 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.

3.1.1 Serial Port Default Settings

The receiver communicates with your PC/laptop or terminal via an RS-232 serial port. For communication to occur, both the receiver and the operator interface have to be configured properly. The receiver's COM1 and COM2 default port settings are as follows:

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

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

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



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

3.1.2 Communicating Using a Remote Terminal

One method of communicating with the receiver is through a remote terminal. The receiver has been pre-wired to allow proper RS-232 interface with your data terminal. To communicate with the terminal, the receiver only requires the RX, TX, and GND lines to be used. Request to Send (RTS)/Clear to Send (CTS) hardware handshaking is not available. Ensure the terminal's communications set-up matches the receiver's RS-232 protocol.

3.1.3 Communicating Using a Personal Computer

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

3.2 Getting Started

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 also *Page 22*.

3.2.1 Starting the Receiver

When first powered, the SMART-AG 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 any of the methods listed in the *Customer Service* section at the beginning of this manual on *Page 16*.

3.2.2 Communicating with the Receiver Using CDU

Launch the **CDU** program and select *Device | Open* from its main menu. The *Open Configuration* window appears. Figure 7, below, 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.

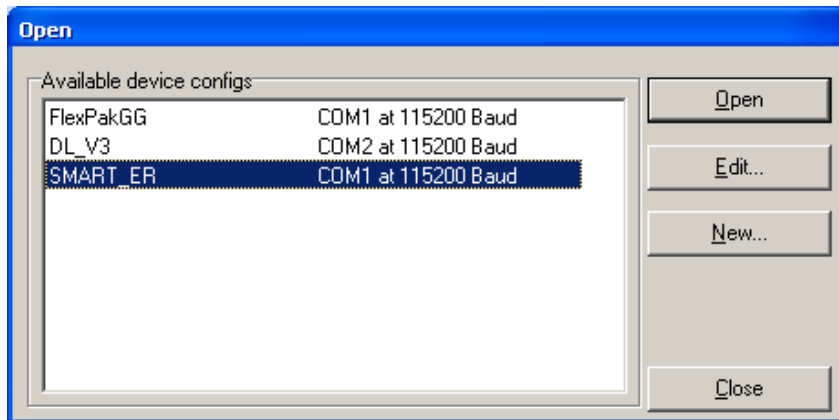


Figure 7: Open Configuration Window

Refer to **CDU**'s help file by selecting the *Help | Contents* 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,*
 or
 [COM2] *if connected to COM2 port,*

Any of the above prompts indicate that the receiver is ready and waiting for command input.

-
- ☒ 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 RXSTATUSVENTA log ONNEW on all ports. Refer to the *OEMV Family Firmware Reference Manual* 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 the command FRESET STANDARD. You should now be able to use your original communication port again.
-

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

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

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

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

The example above illustrates the 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)
```



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

3.3 Transmitting and Receiving Corrections

RTK or DGPS 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. The SMART-AG can be used as a base receiver to transmit RTK or DGPS corrections or a rover to receive the same corrections. An example of a differential setup is given in *Figure 8* on *Page 31*.

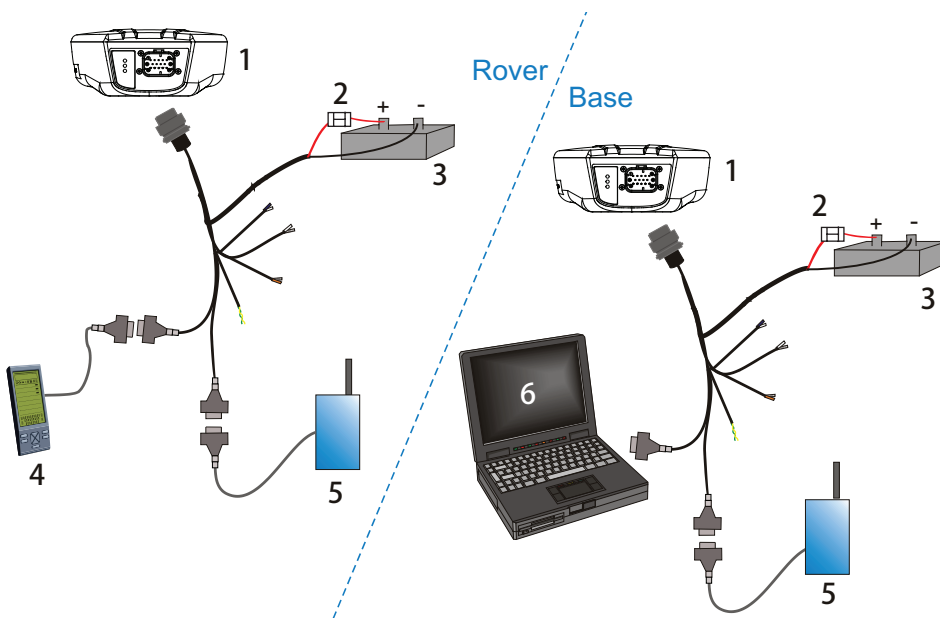


Figure 8: Basic Differential Setup

Reference	Description
1	SMART-AG receiver
2	User-supplied 5A fast blow fuse
3	User-supplied power supply, for example a battery
4	User-supplied device to COM1
5	User-supplied radio device to COM2
6	User-supplied PC/laptop, for setting up and monitoring, to COM1

System biases can introduce errors, refer to our *GNSS Reference Book* found on our Web site at <http://www.novatel.com/support/docupdates.htm> for more information. In most cases you need to provide a data link between the base station and rover station (two NovAtel receivers) in order to receive corrections. SBAS corrections can be accomplished with one receiver and are exceptions to the base/rover concept. Generally a link capable of data throughput at a rate of 9600 bits per second, and less than 4.0 s latency, is recommended.

Once your base and rover are set up, you can configure them as shown in the configuration examples that follow in *Sections 3.3.1 - 3.3.2* starting on *Page 32*.

3.3.1 Base Station Configuration

At the base station, enter the following commands:

```
interfacemode port rx_type tx_type [responses]
fix position latitude longitude height
log port message [trigger [period]]
```

Examples of these commands include the following:

```
RTCA      interfacemode com2 none rtca off
            fix position 51.11358042 -114.04358013 1059.4105
            log com2 rtcaobs ontime 1
            log com2 rtcaref ontime 10
            log com2 rtca1 ontime 5           (optional for rtk)
            log com2 rtcaephem ontime 10 1   (optional)

RTCM     interfacemode com2 none rtcm off
            fix position 51.11358042 -114.04358013 1059.4105
            log com2 rtc3 ontime 10          (required for RTK)
            log com2 rtc22 ontime 10 1      (optional)
            log com2 rtc1819 ontime 1
            log com2 rtc1 ontime 5

RTCMV3   interfacemode com2 none rtcmv3 off
            fix position 51.11358042 -114.04358013 1059.4105
            log com2 rtc1006 ontime 10
            log com2 rtc1003 ontime 1

CMR+    interfacemode com2 none cmr off
            fix position 51.11358042 -114.04358013 1059.4105
            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
            log com2 cmrobs ontime 1
            log com2 cmrref ontime 10
            log com2 cmrdesc ontime 10 1
```


3.3.2 Rover Station Configuration

At the rover station, enter:

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

For example:

```
RTCA      interfacemode com2 rtca none off
RTCM      interfacemode com2 rtcn none off
RTCMV3    interfacemode com2 rtcmv3 none off
CMR+      interfacemode com2 cmr none off
CMR       interfacemode com2 cmr none off      (same as CMR+)
```

3.3.3 GPS + GLONASS Base and Rover Configuration

This section shows you how to set up your base and rover 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 rtca1 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)
```

3.3.4 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 rtcmlb ontime 2
```

-
- ☒ Using the receiver in this mode consumes more CPU bandwidth than using the native differential messages as shown in *Section 3.3.1, Base Station Configuration on Page 32*.
-

At the rover station you can leave the INTERFACEMODE default settings (interfacemode com2 novatel novatel). The rover receiver 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. Refer to the *GNSS Reference Book* for more information on SBAS, available from our Web site at:

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

-
- ☒ All PSRDIFFSOURCE entries fall back to SBAS (even NONE) for backwards compatibility.
-

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 or process. 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.

-
- ☒ Information on how to send multiple commands and log requests using DOS or Windows, can be found on our Web site at <http://www.novatel.com/support/knowledgedb.htm>.
-

3.3.5 EGNOS

EGNOS (European Geostationary Navigation Overlay Service) has been developed to work with existing satellite navigation systems to improve the accuracy of navigation signals. The EGNOS signal is transmitted by two geostationary satellites and covers all of Europe. EGNOS transmits a signal containing information on the reliability and accuracy of the positioning signals sent out by GPS.

ESTB (EGNOS System Test Bed) is a reduced version of EGNOS using dedicated monitoring stations and processing devices. EGNOS and ESTB are two independent systems making use of its own

ground segment infrastructure and different GEOs. EGNOS and ESTB broadcast two different signals.

The ESTB is broadcasted on PRN (pseudorandom number) 126 and EGNOS is broadcasted on PRNs 120 and 124.

Due to the experimental nature of the ESTB, the signals are broadcast without any guarantee of service.

☒ Use of the ESTB signal is not recommended by NovAtel. Use this command to prevent tracking PRN 126: WAAS17 0 1 0 126 255 0 0 0 0 0 0.

EGNOS entered its pre-operational phase in 2006 and at the time of writing is still in test mode and so the signal broadcast by the EGNOS satellites (via PRNs 120 & 124) should be used with caution. By default NovAtel receivers will not use SBAS signals in test mode. If you wish to use these signals you must issue the following command:

```
sbascontrol enable egnos 0 zerototwo
```

More information on the ESTB can be found at <http://www.esa.int/estb>. More information on EGNOS can be found at <http://www.esa.int/egnos>.

3.4 *GLIDE*

SMART-AG contains NovAtel's *GLIDE* which is a positioning algorithms for single frequency GPS and GPS/GLONASS applications. *GLIDE* produces a smooth position output tuned for applications where optimal time relative (pass to pass) accuracy is more important than absolute accuracy. Because of this, it is well suited for agricultural applications.

Multipath signals tend to induce time-varying biases and increase the measurement noise on the L1 pseudorange measurements. Carrier phase measurements are much less susceptible to the effects of multipath. The *GLIDE* algorithm fuses the information from the L1 code and the L1 phase measurements into a Position-Time-Velocity (PVT) solution.

GLIDE includes settings for a dynamic mode, a static mode, and an "auto" mode, where the filtering parameters are automatically adjusted as vehicle velocity varies between stationary and dynamic states.

Refer to our white papers at www.novatel.ca/products/whitepapers.htm for more information on *GLIDE*.

3.5 Tilt

The commands used to configure the Tilt feature are summarized in Table 5.

Table 5: Tilt Commands

Command	Description	Description
l	Set Field Level	For calibration purposes, informs the SMART-AG that the vehicle is located on level ground.
u	Set GPS Sensor Height	For calibration purposes, allows the user to enter the sensor's height above ground, in feet and inches, or metres.
x	Update Flash Values	Update calibration parameters in flash memory.

Tilt commands start with \$PMDT and end with *cksum<crLf> and are described in more detail in Appendix B in section “\$PMDT Configure the Tilt Function”.

As noted, Tilt commands are sent with a checksum, to ensure message integrity in noisy environments. The checksum, which is a two-hex-digit parameter, is calculated by XORing all characters between \$ and *.

Tilt is disabled by default. To enable Tilt:

1. Set the height using the \$PMDT,u,... command
2. Enter \$PMDT,x command to save this height to non-volatile memory. The unit will boot up with the height entered.

To disable Tilt, repeat the above process, but set the height to 0.

3.6 Recommended Configuration

The following command is recommended to enable CAN:

```
setcanname 305
```

The following command is recommended to enable SBAS(WAAS/EGNOS/MSAS) corrections:

```
sbascontrol enable
```

The following commands are recommended to enable *GLIDE*:

```
pdpfilter enable  
pdpmode relative auto
```

NovAtel has registered manufactured ID code 305 with J1939. When complete, your configuration can be saved with the SAVECONFIG command. Refer to the [OEMV Family Firmware Reference Manual](#) and [APN-050 SMART-AG Firmware Release](#) for further details on these commands.

Visit <http://www.novatel.com/support/fwsupdates.htm> for the most recent versions of the PC software and receiver firmware.

4.1 CDU/Convert4 Installation

The CD accompanying this manual contains the Windows applications **CDU** (Control and Display Unit) and Convert4. 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 Convert4. 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 Convert4.

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.

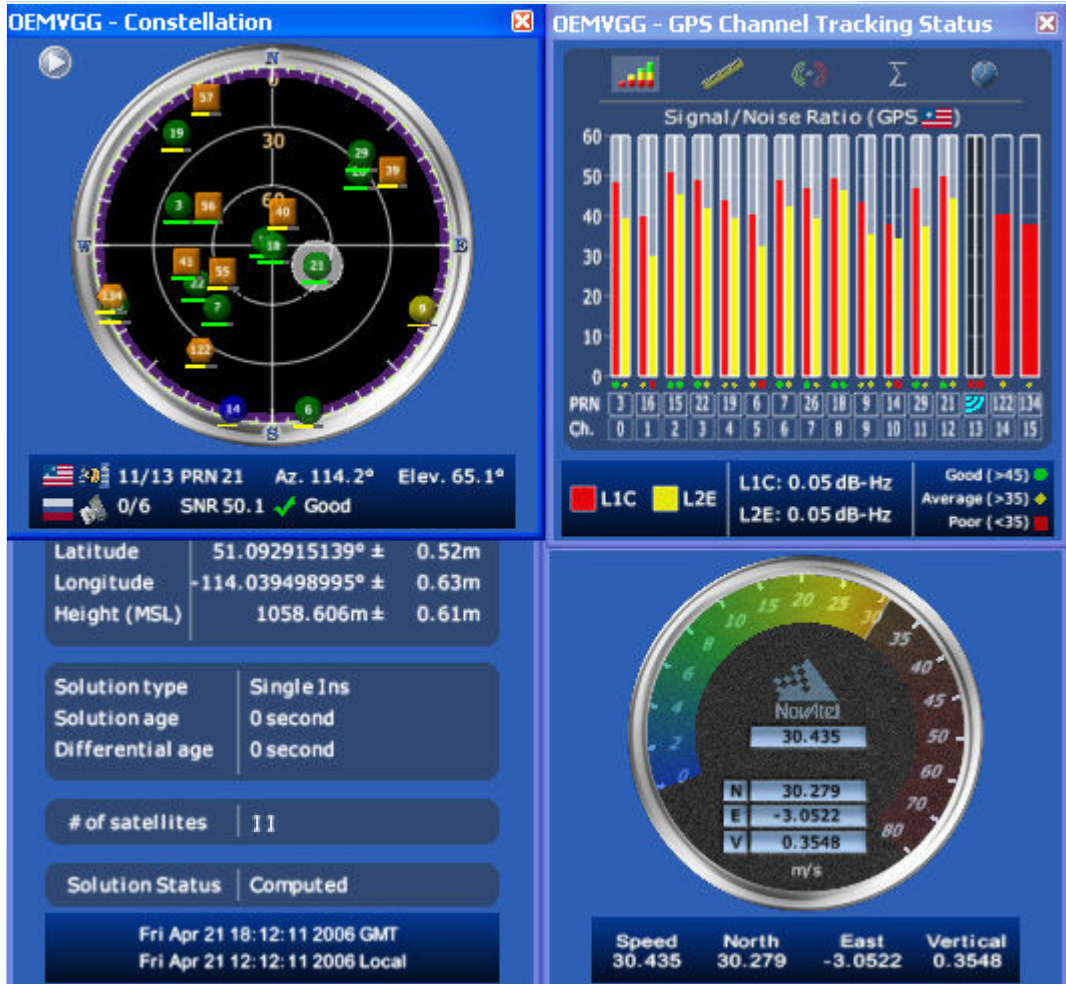
☒ The latest **CDU** is available to download from our Web site at:

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

4.2 CDU


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

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.

4.3 Convert4

Convert4 is a 32-bit Windows application and is shown in *Figure 9*. Convert4 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.

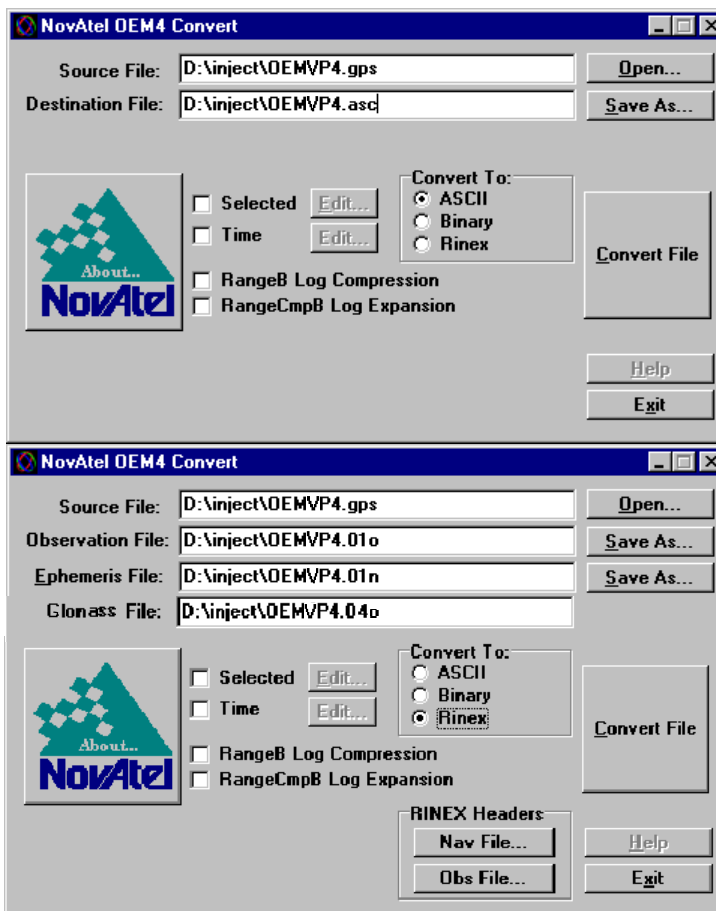


Figure 9: Convert4 Screen Examples

4.3.1 Rinex Format

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

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 9, Convert4 Screen Examples on Page 44*, in the Convert4 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 6, NovAtel Logs for Rinex Conversion on Page 46*.

Table 6: NovAtel Logs for Rinex Conversion

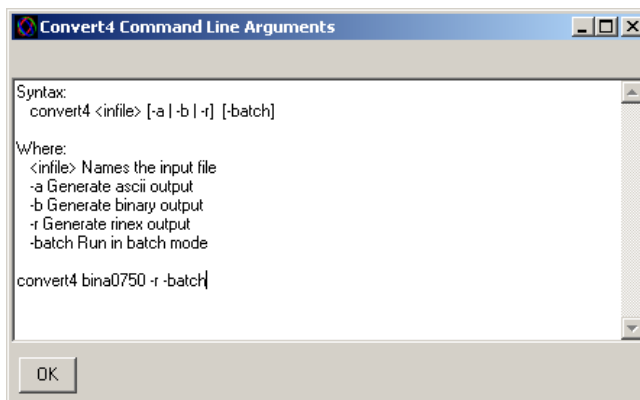
NovAtel OEMV Family Log	Recommended Trigger
RANGEA/B, or RANGECMPA/B	ontime 15
BESTPOSA/B, or PSRPOSA/B, or RTKPOSA/B, or MARKPOSA/B	once
IONUTCA/B	onchanged
RAWEPHEMA/B	onchanged
GLORAWEPHEMA/B	onchanged
VERSIONA/B ^a	once
SITEDEFA/B ^b	once

- a. Information from this log overrides data entered into the Receiver Number, Type and Version fields using the OBS file button of the RINEX Headers section, see *Figure 9* on *Page 44*.
- b. 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.

4.3.2 Convert4 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 10*.

**Figure 10: Convert4 Command Line Arguments**

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

*.asc	for ASCII
*.bin	for binary

When converting to RINEX, the output files are named according to the RINEX Version 2.10 naming convention, see *Section 4.3.1, Rinex Format on Page 44*.

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 Convert4 session is used.

4.4 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, *Page 16*, at the beginning of this manual.

When you call, have your receiver model number, serial number, and program revision level available. 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 a SMART-AG to a SMART-AG-ER on firmware version 3.600), you can use the AUTH command with the issued auth-code.

If you are upgrading to a higher firmware revision level (for example, upgrading a SMART-AG- PVT firmware version 3.600 to SMART-AG-RT-20 firmware version 3.700), 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 by e-mail.

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

4.4.1 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 a SMART-AG to a SMART-AG-ER on firmware version 3.600). 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* in the *OEMV Family Installation and Operation User Manual*)
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,fd34,11smrter
```

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.

4.4.2 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 a SMART-AG- PVT firmware version 3.600 to SMART-AG-RT-20 firmware version 3.700). 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 or COM2 port. The port chosen must have an RS-232 interface to the PC.

Transferring Firmware Files

To proceed with your program upgrade, you must first acquire the latest firmware revision. You will need a file with a name such as OEMXXXX.EXE (where XXXX is the firmware revision level). This file is available from NovAtel's FTP site (<http://www.novatel.com>), or via e-mail (support@novatel.ca). If transferring is not possible, the file can be mailed to you on CD. For more information on how to contact NovAtel Customer Service please see *Page 16* 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 11* on *Page 49*.

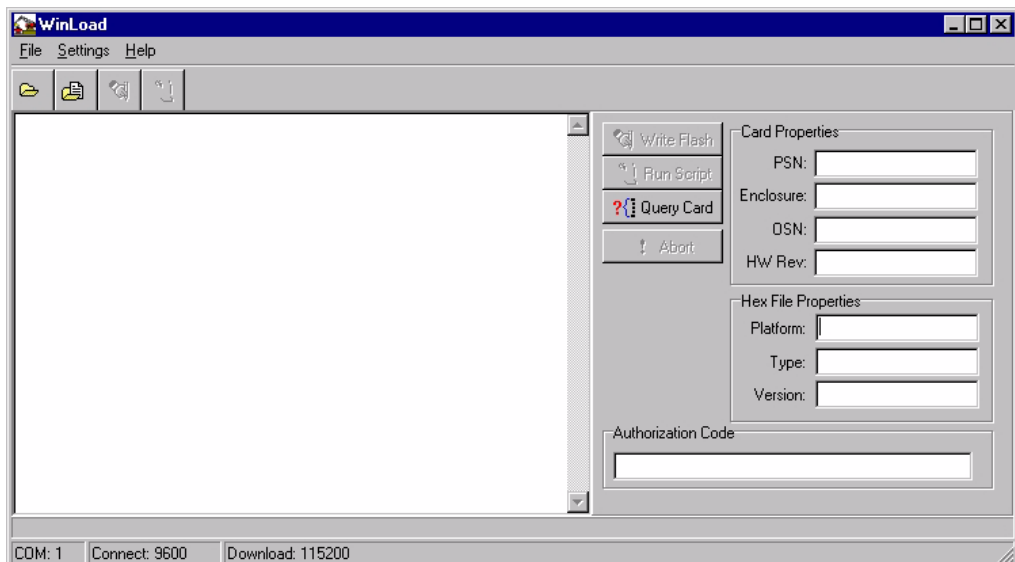


Figure 11: Main Screen of WinLoad

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 12*, *WinLoad's Open Dialog on Page 50*.

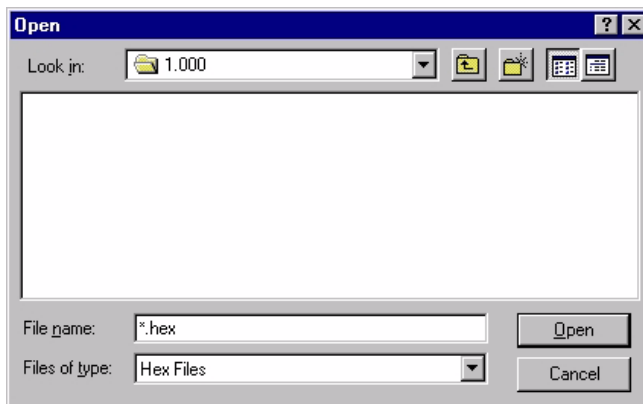


Figure 12: WinLoad's Open Dialog

Once you have selected your file, the name should appear in the main display area and in the title bar, see *Figure 13* below.

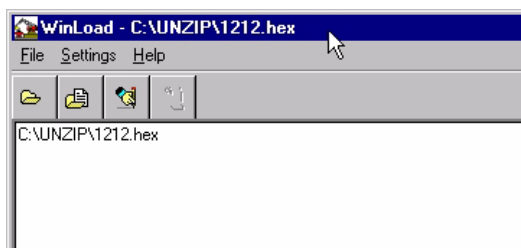


Figure 13: Open File in WinLoad

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).

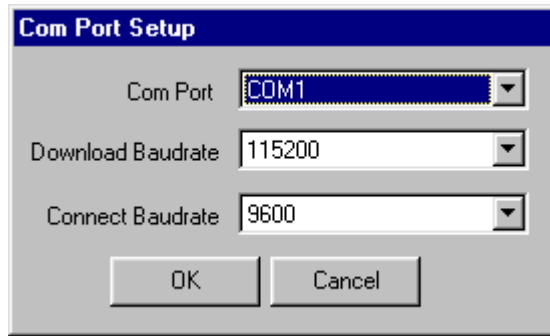


Figure 14: COM Port Setup

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 50*.
3. Make sure the file path and file name are displayed in main display area, see *Figure 13, Open File in WinLoad on Page 50*.
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 15*.



Searching for card...timeout in: 13 secs

Figure 15: Searching for Card

6. Enter the authorization code and select *OK* when the Authorization Code dialog opens, see *Figure 16*.

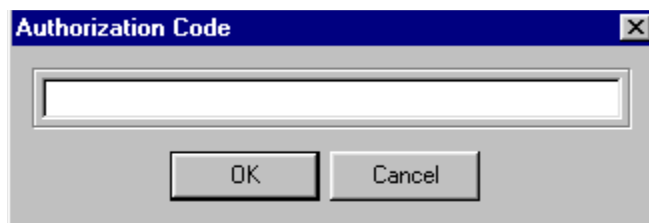


Figure 16: Authorization Code Dialog

The receiver should finish downloading and reset. The process is complete when “Done.” is displayed in the main display area, see *Figure 17*.

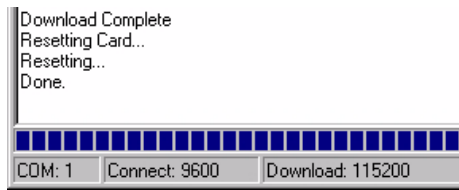


Figure 17: Upgrade Process Complete

7. Close WinLoad.

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

Bluetooth is a wireless radio communication standard designed for use over short ranges (within 10 m). This chapter describes how to:

- Enable *Bluetooth* on the SMART-AG receiver
- Set up a PC/laptop with a *Bluetooth* adaptor
- Locate a *Bluetooth*-enabled SMART-AG in range
- Communicate with the SMART-AG using *Bluetooth*
- Stop communicating with the SMART-AG using *Bluetooth*

5.1 Bluetooth on the SMART-AG Receiver

Bluetooth is automatically configured on the SMART-AG receiver's COM3 port. Once your PC/laptop is configured for *Bluetooth* operation, see the next section, use HyperTerminal or **CDU** to communicate through COM3.

5.2 Set Up a PC/Laptop with a Bluetooth Adaptor

If your PC/laptop is already *Bluetooth*-equipped and ready, proceed to *Section 5.3 on Page 54*

1. With the PC/laptop powered on, install the driver(s) from the disc that came with your *Bluetooth* adapter.
2. Connect the *Bluetooth* adapter. An example of a D-Link USB adapter is shown in *Figure 18*:



Figure 18: Bluetooth Adapter for PC/Laptop

Within two minutes of connecting the USB adapter, the *Bluetooth* icon appears in the Windows task bar as shown in *Figure 19 on page 53*.



Figure 19: Bluetooth Standby: White

Continue on to the next section when you see the white *Bluetooth* icon. If the *Bluetooth* Icon is red, see *Figure 20* below, then the *Bluetooth* installation on your PC/laptop is incorrect and you should return to Step #1.



Figure 20: Bluetooth Error: Red

5.3 Locate a *Bluetooth-Enabled SMART-AG* in Range

- ☒ Ensure that your PC/laptop is equipped with a built in, or external-plug-in, *Bluetooth* adapter and is already configured with the appropriate *Bluetooth* driver.

1. Power on the SMART-AG.
2. Double-click on the *Bluetooth* icon in the task bar, see *Figure 19* on page 53, or select *Programs | My Bluetooth Places* from the *Start* menu in Windows. The *My Bluetooth Places* window opens.
3. Click on the *Search for devices in range* option from the *Bluetooth Tasks* side bar on the left of the *My Bluetooth Places* window. *Bluetooth-enabled* devices within range appear in the *Entire Bluetooth Neighborhood* folder, see *Figure 21* below.

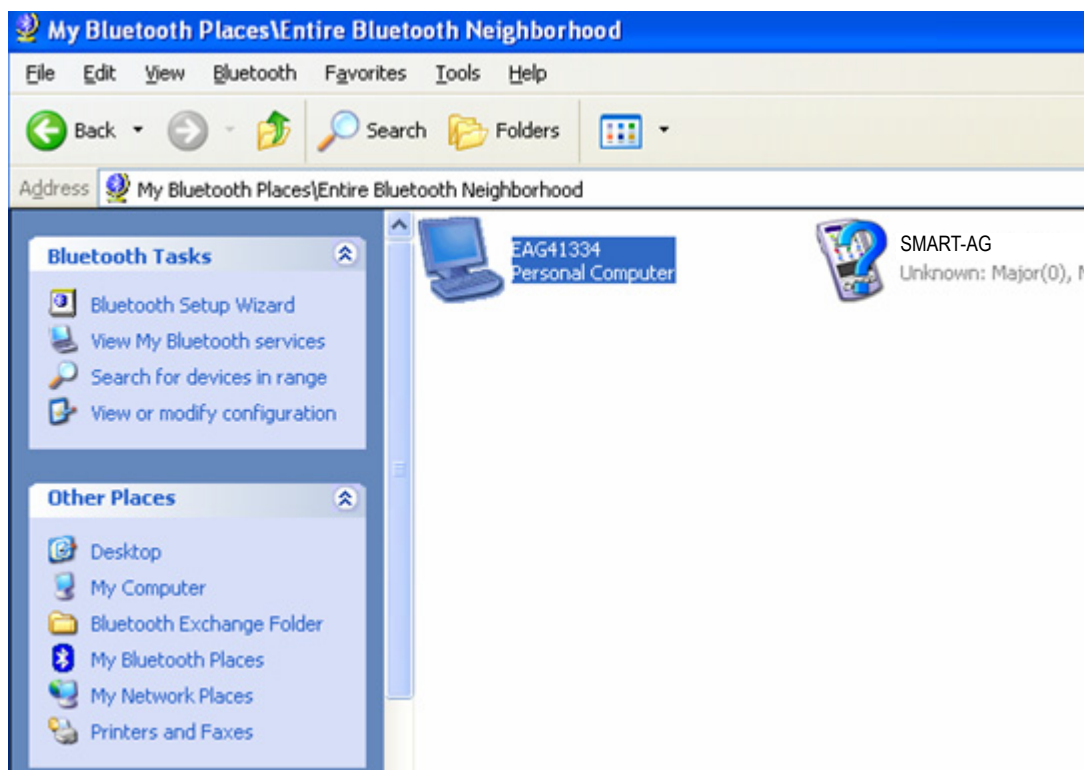


Figure 21: *My Bluetooth Places* Window

5.4 Communicate with the SMART-AG Using *Bluetooth*

1. Double-click on the SMART-AG device icon in the *Entire Bluetooth Neighborhood* window, see *Figure 21* on *page 54*. The PC/laptop searches for available services. If *Bluetooth* is working properly, COM port service appears.
2. Double-click on the COM3 icon. In order to use the serial COM port, the SMART-AG must be paired with the PC/laptop to use the COM3 port. The *Bluetooth PIN Code Request* dialog appears.
3. Enter the SMART-AG default pin number of four zeroes (0000), see *Figure 22* below:

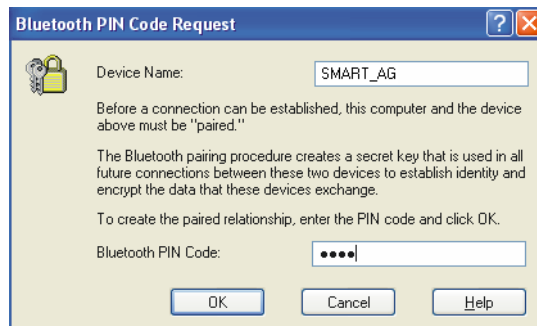


Figure 22: Bluetooth PIN Code Request

If the code is correct, a new *COM* dialog opens to show which PC/laptop COM port has been assigned to the *Bluetooth* link. For example, in *Figure 23*, the PC/laptop port is COM21.

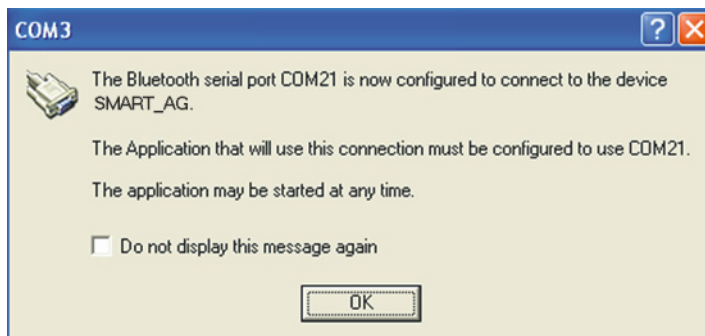


Figure 23: PC/Laptop COM3 Port Assignment

4. Type the following into the command prompt to test if the connection has worked:


```
CPTERM /C##
```

 Where ## is the PC/laptop COM port number assigned in *Step #3*, see *Figure 23* on *page 55*.
5. Type the following VERSION log request into the command prompt to ensure that the connection

works:

LOG VERSION

The *Bluetooth* icon in the task bar turns green when it is connected, see *Figure 24* below.



Figure 24: Bluetooth Connected: Green

5.5 Stop Communicating with the SMART-AG Using *Bluetooth*

1. Double-click on the *Bluetooth* icon in the task bar, see *Figure 19* on page 53, or select *Programs | My Bluetooth Places* from the *Start* menu in Windows. The *My Bluetooth Places* window opens.
2. Click on the *Search for devices in range* option from the *Bluetooth Tasks* side bar on the left of the *My Bluetooth Places* window. *Bluetooth*-enabled devices within range appear in the *Entire Bluetooth Neighborhood* folder, see *Figure 21* on page 54.
3. Double-click on the SMART-AG device icon in the *Entire Bluetooth Neighborhood* window, see *Figure 21* on page 54. The PC/laptop searches for available services. If *Bluetooth* is working properly, COM port service appears.
4. Right-click on the *COM3* icon and select the *Disconnect Serial COM Port* option. A *COM3* dialog box appears, see *Figure 25* on page 56, to confirm that you want to disconnect.

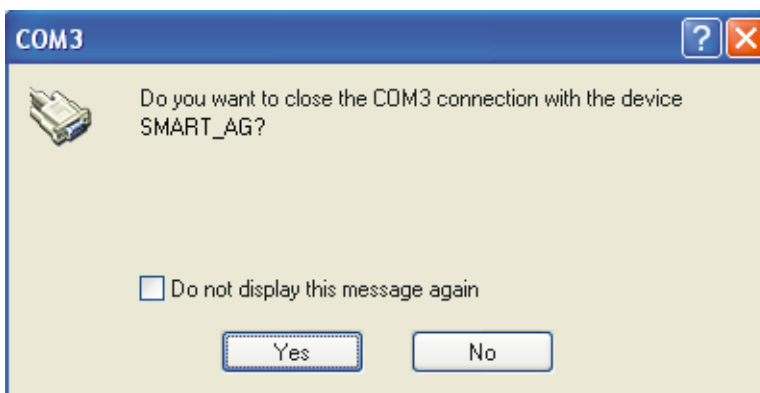


Figure 25: COM3 Disconnect?

5. Click on the *Yes* button in the *COM3* dialog and the SMART-AG's *Bluetooth* is unpaired from your PC/laptop. When the SMART-AG and PC/laptop *Bluetooth* are unpaired, the *Bluetooth* icon in the task bar appears white, see *Figure 19* on page 53.

Appendix A Technical Specifications

A.1 SMART-AG Receiver Performance

PERFORMANCE			
Channel Configuration	14 GPS L1 12 GLONASS L1 (optional) 2 SBAS ^a		
Horizontal Position Accuracy (RMS)^b	Autonomous	Absolute 1.2 m	P2P^c 25 cm
	SBAS^a	0.8 m	18 cm
	DGPS	0.4 m	23 cm
	RT-20^d (optional)	0.2 m	2 cm
Measurement Precision	L1 C/A Code	18 cm RMS	
	L1 Carrier Phase	1.5 mm RMS	
Maximum Data Rate^e	Measurements	20 Hz	
	Position	20 Hz	
Time to First Fix	Cold Start ^f	65 s	
	Hot Start ^g	35 s	
Signal Reacquisition	L1	0.5 s (typical)	
Time Accuracy	20 ns RMS		
Velocity Accuracy^b	0.03 m/s RMS		

- Satellite Based Augmentation Systems (SBAS) include WAAS (North America), EGNOS (Europe) and MSAS (Japan).
- Typical values. Performance specifications subject to GPS system characteristics, US DOD operational degradation, ionospheric and tropospheric conditions, satellite geometry, baseline length, multipath effects and the presence of intentional or unintentional interference sources. Export licensing restricts operation to a maximum velocity of 515 metres per second.
- Typical values with *GL1DE* enabled. "Pass to pass" or time relative position error is the one dimensional horizontal (cross track) position error after 15 minutes or less after an initial convergence of at least 10 minutes.
- Expected accuracy after convergence. RT-20 is independent of *GL1DE*.
- Model specific.
- Typical value. No almanac or ephemerides and no approximate position or time.
- Typical value. Almanac and recent ephemerides saved and approximate time entered. For more information, Please refer to the "SETAPPROXTIME" command in the *OEMV Family Firmware Reference Manual* found on our Web site at <http://www.novatel.com/support/docupdates.htm>.

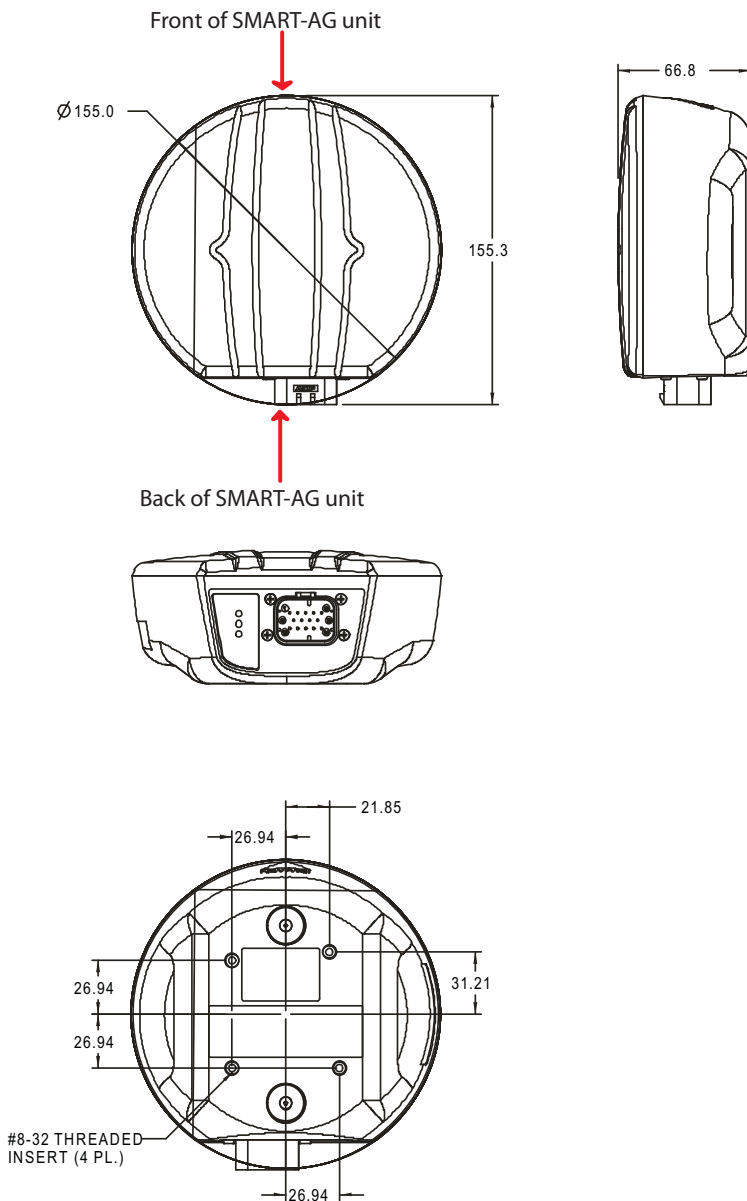
A.2 SMART-AG Specifications

INPUT/OUTPUT CONNECTORS	
SMART-AG COM/PWR	+8 to +36 V DC at 2.5 W (typical while logging) ^a For the cable pinouts and drawings, see <i>Section A.2.1, SMART-AG Power/Communications Development Kit Cable</i> starting on <i>Page 60</i>
Serial Com Ports	RS-232 F Compliant (Rx and Tx signals only)
CAN	SAE J1939/ ISO 11783/ ISO 11898 Compliant
Emulated Radar Output	High= Supply Voltage -0.5V Minimum Low= 0.5V Minimum Load= 3K Ohm Minimum
PPS Output	3.3 V CMOS Logic Compatible
MKI Input	3.3V CMOS Logic/ 5V Tolerant
INPUT/ OUTPUT CONNECTOR PROTECTION	
Electrical Conducted/ Coupled disturbance tolerance	ISO 7637:2002 (Survives all pulse types)
LED INDICATORS	
More details can also be found in <i>Section 2.2.2, Status Indicators</i> starting on <i>Page 25</i>	
PHYSICAL	
Size	155.3 x 66.8 x ϕ 155 mm ^b
Weight	495 g maximum
ENVIRONMENTAL	
Operating Temperature	-40°C to +75°C
Storage Temperature	-55°C to +90°C
Humidity	Not to exceed 95% non-condensing
Immersion	MIL-STD-810F Method 512.4 Procedure 1
Vibration ^c	Random MIL-STD-810F Method 514.5 C17 Sinusoidal IEC 68-2-6 ASAE EP455, 5.15.2 Level 1 Shock MIL-STD-810 F Method 516.5

- a. When tracking GPS satellites.
- b. ϕ denotes diameter, here and in the *Dimensions* graphic on *Page 59*.
- c. See also the *Notice* section of this manual starting on *Page 13*.

DIMENSIONS

a



- a. All dimension are in millimeters, please use the *Unit Conversion* section of the *GNSS Reference Book* found at <http://www.novatel.com/support/docupdates.htm> for conversion to other measurements.

A.2.1 SMART-AG Power/Communications Development Kit Cable

The SMART-AG cable that accompanies the SMART-AG Development Kit, see *Figure 26* below, provides a means of supplying power from a battery while operating in the field. The exposed wires (red for positive and black for negative) can then be connected to a 12 or 24V vehicular power circuit (or equivalent) protected by a 5A fast blow fuse (user supplied). The cable also has two DB-9 connectors. One can accommodate a PC/laptop serial (RS-232) communication port and the other can connect to a modem or radio transmitter to propagate differential corrections (please refer to your user-supplied modem or radio transmitter user guide for more information on its connectors).

In addition, there are a number of bare wires where the outer insulation is cut away but the wires beneath are intact. See *Table 7* on *Page 61* for their pinouts. For more information on mating connectors and part numbers, see *Table 8* on *Page 62*.

This cable is RoHS compliant and its part number is 01018256.

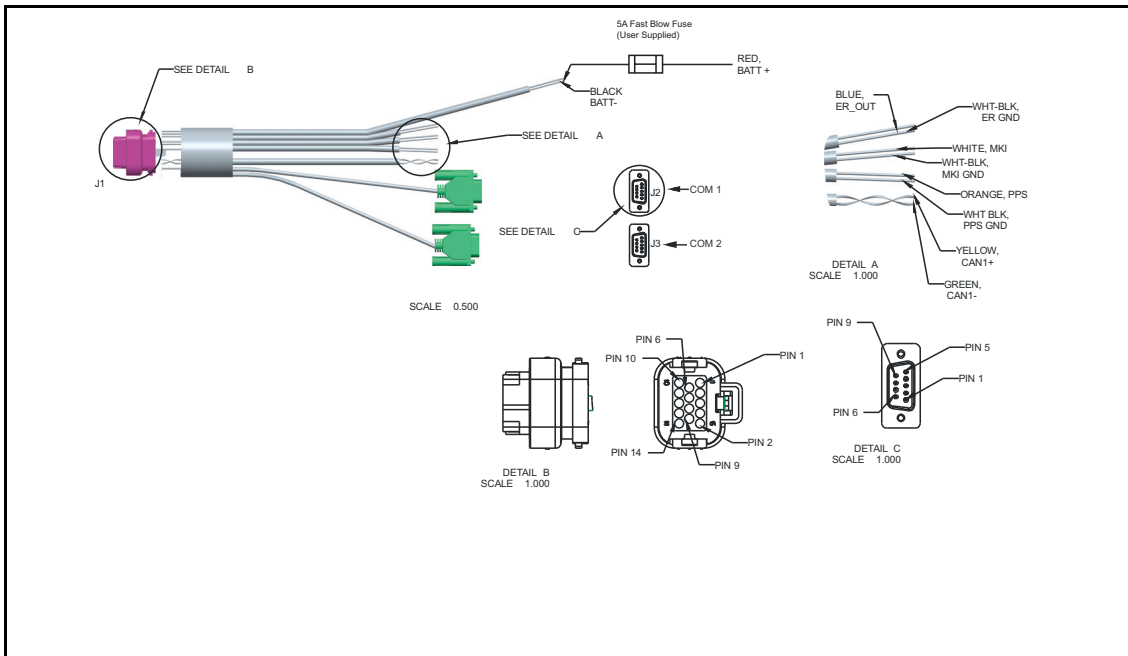


Figure 26: SMART-AG Development Kit Cable

Table 7: SMART-AG Development Kit Cable Pinouts

Color	Signal Name	J1	J2	J3	Label
Red	COM1_TXD	1	2		
White	COM1_RXD	2	3		
Red	COM2_TXD	3		2	
White	COM2_RXD	4		3	
Black	COM1 GND	5	5		
Black	COM2 GND	5		5	
White-Black	MKI GND	5			MKI GND
White-Black	ER GND	5			ER GND
White-Black	PPS GND	5			PULSE PER SECOND GND
Yellow	CANI+	6			CANI +
Green	CANI-	7			CANI -
-	RESERVED	8			
Black	PWR RET (GND)	9			BATT -
Blue	EMULATED RADAR OUT	10			ER_OUT
White	EVENT MARK IN	11			MKI
Orange	PPS	12			PPS
-	RESERVED	13			
Red	PWR INPUT	14			BATT +

A.2.2 SMART-AG Connector and Cable Requirements

Custom cables for installing your SMART-AG can be created using the following guidelines:

- Wire size: must be 0.5 mm-1.25 mm (20-16 AWG)
- Batt + connection must be protected by 5A fast blow fuse
- Serial data signals (TxD, RxD, signal ground) must be run in shielded cable. Connect shields to ground at SMART-AG end only
- CAN signal conductors must be twisted (40 twists/m, 12 twists/ft)
- Use only the recommended mating connectors listed below. Use only gold plated pins



WARNING!: Failure to observe the given cable construction guidelines in this section will result in damage to the wiring (not covered by warranty).

The connector used in the SMART-AG is an “AMPSEAL” dust and water sealed type produced by Tyco. The following part numbers pertain to the mating connector required to make connections to the SMART-AG. These numbers are provided for information only and are not available from NovAtel as separate parts.

Table 8: SMART-AG Mating Connectors

Product	Part Description	Company	Part Number
SMART-AG mating connector (Figure 26 on Page 60)	14-pin sealed receptacle housing-black	Tyco/ AMP	776273-1
SMART-AG mating connector (Figure 26 on Page 60)	14-pin sealed receptacle housing-natural	Tyco/ AMP	776273-2
SMART-AG mating connector (Figure 26 on Page 60)	14-pin sealed receptacle housing-grey	Tyco/ AMP	776273-4
SMART-AG mating connector (Figure 26 on Page 60)	14-pin sealed receptacle housing-blue	Tyco/ AMP	776273-5
Gold plated pins for SMART-AG connector/loose	Pins, loose piece	Tyco/ AMP	770854-3
Gold plated pins for SMART-AG connector/strip	Pins, strip (reel)	Tyco/ AMP	770520-3

Table 9 details the part numbers for recommended fuses and fuse holders. These numbers are provided for information only and are not available from NovAtel as separate parts.

Table 9: Recommended Fuse and Fuse Holders

Fuse	Recommended Fuse/Fuse Holder		
12 V Fuse (standard size blade)	ATO Blade Fuse 5A	Littelfuse	0257005
	<i>Or Equivalent</i>		
12 V Fuse (mini size blade)	Mini Blade Fuse 5A	Littelfuse	0297005
	<i>Or Equivalent</i>		
24V Fuse (standard size blade)	TAC ATO Blade Fuse 5A	Littelfuse	142.6185.450
	<i>Or Equivalent</i>		
24V Fuse (mini size blade)	Mini Blade Fuse 58V 5A	Littelfuse	0997005
	<i>Or Equivalent</i>		
Fuse Holder (standard size blade)	In-line ATO fuse holder	Littelfuse	FHAC0001
	<i>Or Equivalent</i>		
Fuse Holder (mini size blade)	In-line mini fuse holder	Littelfuse	0FHM0001
	<i>Or Equivalent</i>		

Appendix B Commands

The SMART-AG firmware implements the commands in *Table 10*, in addition to the OEMV family command set. The LOG command is available to all OEMV receivers but is an essential command to do any logging. It is included in this appendix for your convenience.

Table 10: SMART-AG Commands in Alphabetical Order

ASCII Command	Message ID	Description
freset	20	Factory reset (Existing OEMV Command extended to SMART-AG)
log	1	Request logs from the receiver (Existing OEMV Command extended to SMART-AG)
radarcfg	8192	Configure the ER signal output (New SMART-AG command)
reset	18	Perform a hardware reset (Existing OEMV Command extended to SMART-AG)

The arguments for each of these commands are described in the following sections.

For a complete listing and description of the other commands that the SMART-AG, an OEMV-1G-based receiver, is capable of processing, refer to the *OEMV Family Firmware Reference Manual*.

B.1 SYNTAX CONVENTIONS

The following rules apply when entering commands, at the command prompt, from a keyboard.

1. Courier font is used to illustrate program output or user input.
2. References to other commands, logs or any of their fields are shown in *italics*.
3. The commands are not case sensitive. For example, you could type either RESET or reset.
4. Except where noted, either a space or a comma can separate commands and their required entries. For example, you could type either `fix position 51.11358042 -114.04358013 1059.4105` or `fix position 51.11358042, -114.04358013, 1059.4105`.
5. At the end of a command, a carriage return is required. For example, press <Enter> or <Return> on your keyboard.
6. Responses are provided to indicate whether or not an entered command was accepted. The format of the response depends on the format of the command. Refer to the *OEMV Family Firmware Reference Manual* for more information.
7. Optional parameters are indicated by square brackets ([]). For commands that contain optional parameters, the value used if the optional parameter is not specified is given in the syntax table for the command.
8. Data format definitions, as specified in the “Format” field, are detailed in the *OEMV Family Firmware Reference Manual*. Note that all binary data is little-endian byte-ordered.

B.2 FRESET Clear Selected Data from NVM and Reset

The OEMV *freset* command is extended to include SMART-AG features. An additional target field, *userdata* (value = 10), resets only the SMART-AG user data NVM, thereby resetting all parameters indicated in this document as “Stored in NVM” to factory defaults. Issuing the *freset* command with the “target” field set to *standard*, resets the userdata NVM as well as OEMV parameters as indicated in the *OEMV Family Firmware Reference Manual*.

-
- ☒ If you issue the FRESET command without any parameters, it is the same as issuing a FRESET STANDARD command.
-

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FRESET header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	target	See Table 11		Data to be reset by the receiver	Enum	4	H

Table 11: FRESET Target

Binary	ASCII	Description
0	STANDARD	Resets commands, ephemeris, and almanac (default). Also resets all L-band related data except for subscription information.
1	COMMAND	Resets the stored commands (saved configuration)
2	GPSALMANAC	Resets the stored GPS almanac
3	GPSEPHEM	Resets the stored GPS ephemeris
4	GLOEPHEM	Resets the stored GLONASS ephemeris
5	MODEL	Resets the currently selected model
10	USERDATA	Reset SMART-AG-only commands
11	CLKCALIBRATION	Resets the parameters entered using the CLOCKCALIBRATE
20	SBASALMANAC	Resets the stored SBAS almanac
21	LAST_POSITION	Resets the position using the last stored position
31	GLOALMANAC	Resets the stored GLONASS almanac

B.3 LOG Request Logs from the Receiver

Many different types of data can be logged using several different methods of triggering the log events. Every log element can be directed to any combination of the three COM ports and three USB ports. The ONTIME trigger option requires the addition of the *period* parameter. See *the OEMV Firmware Reference Manual and the SMART-AG Firmware Reference Manual* for further information and a complete list of data log structures. The *LOG* command tables in this section show the ASCII command format.

The optional parameter [hold] prevents a log from being removed when the UNLOGALL command, with its defaults, is issued. To remove a log which was invoked using the [hold] parameter requires the specific use of the UNLOG command. To remove all logs that have the [hold] parameter, use the UNLOGALL command with the *held* field set to 1.

The [port] parameter is optional. If [port] is not specified, [port] is defaulted to the port that the command was received on.

-
- *
 1. The OEMV family of receivers can handle 30 logs at a time. If you attempt to log more than 30 logs at a time, the receiver responds with an Insufficient Resources error. Each COM port (serial and USB) already has RXSTATUSEVENT log associated with it. This means that with 3 serial ports and 3 USB ports, 6 logs are already accounted for. See the example on the next page.
 2. Maximum flexibility for logging data is provided to the user by these logs. The user is cautioned, however, to recognize that each log requested requires additional CPU time and memory buffer space. Too many logs may result in lost data and degraded CPU performance. Receiver overload can be monitored using the idle-time field and buffer overload bits of the Receiver Status in any log header.
 3. Polled log types do not allow fractional offsets or ONTIME rates faster than 1Hz.
 4. Use the ONNEW trigger with the MARKTIME, MARK2TIME, MARKPOS or MARK2POS logs.

-
5. Only the MARKPOS, MARK2POS, MARKTIME or MARK2TIME logs, and ‘polled’ log types are generated ‘on the fly’ at the exact time of the mark. Synchronous and asynchronous logs output the most recently available data.
 6. If you do use the ONTIME trigger with asynchronous logs, the time stamp in the log does not necessarily represent the time the data was generated, but rather the time when the log is being transmitted.
-

Abbreviated ASCII Syntax:**Message ID: 1**

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

Factory Default:

```
log com1 rxstatureventa onnew 0 0 hold
log com2 rxstatureventa onnew 0 0 hold
log com3 rxstatureventa onnew 0 0 hold
log aux rxstatureventa onnew 0 0 hold
log usb1 rxstatureventa onnew 0 0 hold
log usb2 rxstatureventa onnew 0 0 hold
log usb3 rxstatureventa onnew 0 0 hold
```

Abbreviated ASCII Example 1:

```
log com1 bestpos ontime 7 0.5 hold
```

The above example shows BESTPOS logging to COM port 1 at 7 second intervals and offset by 0.5 seconds (output at 0.5, 7.5, 14.5 seconds and so on). The [hold] parameter is set so that logging is not disrupted by the UNLOGALL command.

To send a log only one time, the trigger option can be ignored.

Abbreviated ASCII Example 2:

```
log com1 bestpos once 0.000000 0.000000 nohold
```

Refer to the *Command Formats* section of the *OEMV Firmware Reference Manual* for additional examples.

-
- * 1. In **CDU** there are two ways to initiate data logging to the receiver's serial ports. You can either enter the LOG command in the *Console* window, or use the interface provided in the *Logging Control* window. Ensure the Power Settings on your PC are not set to go into Hibernate or Standby modes. Data is lost if one of these modes occurs during a logging session.
2. Only the ASCII/Abbreviated ASCII log table is included in this manual. Please refer to the LOG command in the *OEMV Family Firmware Reference Manual* for binary log details.
-

Field	Field Name	ASCII Value	Description	Field Type
1	LOG (ASCII) header	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII or ASCII respectively.	-
2	port	See <i>Table 12, Detailed Serial Port Identifiers on Page 69</i>	Output port (default = THISPORT)	Enum
3	message	Any valid message name, with an optional A or B suffix.	Message name of log to output	Char []
4	trigger	ONNEW	Output when the message is updated (not necessarily changed)	Enum
		ONCHANGED	Output when the message is changed	
		ONTIME	Output on a time interval	
		ONNEXT	Output only the next message	
		ONCE	Output only the current message. (default)	
		ONMARK	Output when a pulse is detected on the mark 1 input, MK11	
5	period	Any positive double value larger than the receiver's minimum raw measurement period	Log period (for ONTIME trigger) in seconds (default = 0)	Double
6	offset	Any positive double value smaller than the period.	Offset for period (ONTIME trigger) in seconds. If you wished to log data at 1 second after every minute you would set the period to 60 and the offset to 1 (default = 0)	Double
7	hold	NOHOLD	Allow log to be removed by the UNLOGALL command (default)	Enum
		HOLD	Prevent log from being removed by the UNLOGALL command	

Table 12: Detailed Serial Port Identifiers

ASCII Port Name	Hex Port Value	Decimal Port Value ^a	Description
NO_PORTS	0	0	No ports specified
COM1_ALL	1	1	All virtual ports for COM port 1
COM2_ALL	2	2	All virtual ports for COM port 2
COM3_ALL	3	3	All virtual ports for COM port 3
THISPORT_ALL	6	6	All virtual ports for the current port
ALL_PORTS	8	8	All virtual ports for all ports
XCOM1_ALL	9	9	All virtual COM1 ports
XCOM2_ALL	10	10	All virtual COM2 ports
USB1_ALL	d	13	All virtual ports for USB port 1
USB2_ALL	e	14	All virtual ports for USB port 2
USB3_ALL	f	15	All virtual ports for USB port 3
AUX_ALL	10	16	All virtual ports for the AUX port ^b
XCOM3_ALL	11	17	All virtual COM3 ports
COM1	20	32	COM port 1, virtual port 0
COM1_1	21	33	COM port 1, virtual port 1
...			
COM1_31	3f	63	COM port 1, virtual port 31
COM2	40	64	COM port 2, virtual port 0
...			
COM2_31	5f	95	COM port 2, virtual port 31
COM3	60	96	COM port 3, virtual port 0
...			
COM3_31	7f	127	COM port 3, virtual port 31
USB	80	128	USB port, virtual port 0
...			
USB_31	9f	159	USB port, virtual port 31
SPECIAL	a0	160	Unknown port, virtual port 0
...			
SPECIAL_31	bf	191	Unknown port, virtual port 31
THISPORT	c0	192	Current COM port, virtual port 0

Continued on Page 70

ASCII Port Name	Hex Port Value	Decimal Port Value ^a	Description
THISPORT_31	df	223	Current COM port, virtual port 31
FILE	e0	224	User-specified file destination, 0 ^c
FILE_1	e1	225	User-specified file destination, 1 ^c
...			
FILE_31	ff	255	User-specified file destination, 31 ^c
XCOM1	1a0	416	Virtual COM1 port, virtual port 0
XCOM1_1	1a1	417	Virtual COM1 port, virtual port 1
...			
XCOM1_31	1bf	447	Virtual COM1 port, virtual port 31
XCOM2	2a0	672	Virtual COM2 port, virtual port 0
XCOM2_1	2a1	673	Virtual COM2 port, virtual port 1
...			
XCOM2_31	2bf	703	Virtual COM2 port, virtual port 31
USB1	5a0	1440	USB port 1, virtual port 0
USB1_1	5a1	1441	USB port 1, virtual port 1
...			
USB1_31	5bf	1471	USB port 1, virtual port 31
USB2	6a0	1696	USB port 2, virtual port 0
...			
USB2_31	6bf	1727	USB port 2, virtual port 31
USB3	7a0	1952	USB port 3, virtual port 0
...			
USB3_31	7bf	1983	USB port 3, virtual port 31
AUX	8a0	2208	AUX port, virtual port 0 ^b
...			
AUX_31	8bf	2239	AUX port, virtual port 31 ^b
XCOM3	9a0	2464	Virtual COM3 port, virtual port 0
...			
XCOM3_31	9bf	2495	Virtual COM3 port, virtual port 31

- a. Decimal port values 0 through 16 are only available to the UNLOGALL command and cannot be used in the UNLOG command, or in the binary message header.
- b. The AUX port is available on OEMV-2-based and OEMV-3-based products.
- c. SMART-AG only. Refer to the *SMART-AG Firmware Reference Manual* and **CDU's** Help file.

B.4 \$PMDT Configure Tilt Compensation

Use this command to configure the Tilt Compensation function.

Syntax

\$PMDT, [command], [parameters]*cksum

Host	Description	Command Format	Tilt Sensor Response
l	Set Field Level	\$PMDT,l,*cksum crlf Example: \$PMDT,l*4D)	Response to the "l" command: \$PMDT,<,Level state set crlf Example: \$PMDT,<,,Level state set
u ^a b	Set GPS Sensor Height	To set the GPS sensor height in feet and inches: \$PMDT,u,,ff,ii,*cksum crlf Example: To set the GPS sensor height to 12 ft 6 in, the command is: \$PMDT,u,,12,6*4D) Note: Feet and inches are entered as integers, You can enter feet and inches, but not feet, inches and metres.	Response to the "u" command: \$PMDT,<,GPS sensor height (inches):nnnnn crlf where nnnnn is a five digit integer, sensor height in inches. In this example, the Tilt Sensor response is: \$PMDT,<,GPS sensor height (inches): 00150
		To set the GPS sensor height in metres: \$PMDT,u,,,,mmm.mmm *cksum crlf Example: To set the GPS sensor height to 3.5 metres, the command is: \$PMDT,u, , , ,3.5*5C	Response to the "u" command: \$PMDT,<,GPS sensor height (inches):nnnnn crlf where nnnnn is a five digit integer, sensor height in inches. In this example, the Tilt Sensor response is: \$PMDT,<,GPS sensor height (inches): 00137
x	Update Flash Values	To update flash values (needs to follow any parameter update that is not done each time you power up): \$PMDT,x,*cksum crlf Example: \$PMDT,c,*59	Response to the "x" command: \$PMDT,<,Flash updated crlf Example: \$PMDT,<,Flash updated

- If all fields in the u command are zero or null, the current height is transmitted without change (with the format shown above).
- If an invalid entry is received (>500 inches), the response is:

\$PMDT,<Max legal height exceeded: nnnnn and will be ignored clrf

For example, if you enter 42 ft 6 in, you will get the following response:

\$PMDT,<,Max legal height exceeded: 00510 and will be ignored

\$PMDT,<,GPS sensor height (inches): 00150

B.5 RADARCFG Configure the ER Output

Use this command to configure the Emulated Radar (ER) output. ER is available through the SMART-AG multi-cable, see *Page 61* for pin-out details.

Syntax

```
radarcfg switch freq_step update_rate resp_mode threshold
```

Message ID = 8192

Field	Data	Description	Bytes	Format	Units	Offset
1	Header	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.		-	-	0
2	switch	Enable or disable radar emulation 0 = ENABLE 1 = DISABLE (default = enable)	4	Enum	none	H
3	freq_step	Frequency step per kilometer per hour. Range: 26.11, 28.12 or 36.11 (default = 26.11)	8	Double	Hz/ kph	H+4
4	update_rate	Specify how often to update radar output Range: 1, 2, 5, 10, 20 (default = 10) ^a	4	Integer	Hz	H+12
5	resp_mode	Specify the time, response mode, over which to average velocity samples, see <i>Table 13</i> . (Default = 300) ^a	4	Integer	none	H+16
6	threshold	The threshold is only applicable when the response mode is set to 2. The response time is 1000 ms when the velocity is greater than this value, otherwise, it is 500 ms. Range: 2-50 kph (default = 5 kph)	8	Double	kph	H+20

- a. The number of samples used for smoothing depends on both the `update_rate` and `resp_mode` parameters. For instance, if the `update_rate` is 5 Hz and the `resp_mode` is 200ms, the number of samples used will be 10.

Table 13: Response Modes

Mode		Description
2000	2000 ms	The time period over which to smooth velocity samples
1000	1000 ms	
500	500 ms (default)	
2	Automatically switches between 1000 and 500 ms	
1	Performs no smoothing	

Example 1 to disable radar emulation:

```
radarcfg disable 26.11 1 1 2
```

Example 2 to set the frequency step to 36.11 Hz/kph:

```
radarcfg enable 36.11 1 1 2
```

Appendix C Logs

The SMART-AG firmware generates the logs in *Table 14*, in addition to those of the OEMV Family log set. Refer to the *OEMV Family Firmware Reference Manual*, which also contains procedures and explanations related to data logging and is available from our Web site at:

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

Table 14: SMART-AG Logs in Alphabetical Order

Message ID	ASCII Log	Description
8193	RADARSIGNAL	Radar signal and position information (New SMART-AG log)
37	VERSION	Hardware versions, software versions, and serial numbers (Existing OEMV log extended to SMART-AG)

C.1 RADARSIGNAL ER Signal and Position Information

This log contains position and Emulated Radar (ER) signal information.

Message ID: 8193

Log Type: Asynch

Recommended Input:

log radarsignala onchanged

ASCII Example 1 (stationary SMART-AG):

```
#RADARSIGNALA,COM1,0,61.5,FINESTEERING,1501,248381.628,00000000,8a1c,3723;
SOL_COMPUTED,WAAS,0.0139,0.00,0.00*f0d580ca
```

ASCII Example 2 (moving SMART-AG):

```
#RADARSIGNALA,COM1,0,42.5,FINESTEERING,1428,206179.600,00000000,baa8,3349;
SOL_COMPUTED,WAAS,0.3315,2,0.3152,473.97,29.62*c1479c20
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RADAR-SIGNAL header	Log header		H	0
2	sol status	Solution status, see <i>Table 16, Solution Status on Page 77</i>	Enum	4	H
3	vel type	Velocity type, see <i>Table 15, Position or Velocity Type on Page 76</i>	Enum	4	H+4
4	speed	Speed over ground (m/s)	Double	8	H+8
4	varf freq	External VARF output frequency (Hz)	Double	8	H+16
5	radar freq	Radar signal frequency (Hz) as output by the Emulated Radar Out signal. See <i>SMART-AG Development Kit Cable starting on Page 60</i> .	Double	8	H+24
6	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+32
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 15: Position or Velocity Type

Type (binary)	Type (ASCII)	Description
0	NONE	No solution
1	FIXEDPOS	Position has been fixed by the FIX POSITION command
2	FIXEDHEIGHT	Position has been fixed by the FIX HEIGHT/AUTO command
8	DOPPLER_VELOCITY	Velocity computed using instantaneous Doppler
16	SINGLE	Single point position
17	PSRDIFF	Pseudorange differential solution
18	WAAS	Solution calculated using corrections from an SBAS
19	PROPAGATED	Propagated by a Kalman filter without new observations
32	L1_FLOAT	Floating L1 ambiguity solution
33	IONOFREE_FLOAT	Floating ionospheric-free ambiguity solution
34	NARROW_FLOAT	Floating narrow-lane ambiguity solution
48	L1_INT	Integer L1 ambiguity solution
49	WIDE_INT	Integer wide-lane ambiguity solution
50	NARROW_INT	Integer narrow-lane ambiguity solution

Table 16: Solution Status

Solution Status		Description
(Binary)	(ASCII)	
0	SOL_COMPUTED	Solution computed
1	INSUFFICIENT_OBS	Insufficient observations
2	NO_CONVERGENCE	No convergence
3	SINGULARITY	Singularity at parameters matrix
4	COV_TRACE	Covariance trace exceeds maximum (trace > 1000 m)
5	TEST_DIST	Test distance exceeded (maximum of 3 rejections if distance > 10 km)
6	COLD_START	Not yet converged from cold start
7	V_H_LIMIT	Height or velocity limits exceeded (in accordance with export licensing restrictions)
8	VARIANCE	Variance exceeds limits
9	RESIDUALS	Residuals are too large
10	DELTA_POS	Delta position is too large
11	NEGATIVE_VAR	Negative variance
12	Reserved	
13	INTEGRITY_WARNING	Large residuals make position unreliable
14-17	Reserved for SPAN-capable receivers	
18	PENDING	When a FIX POSITION command is entered, the receiver computes its own position and determines if the fixed position is valid ^a
19	INVALID_FIX	The fixed position, entered using the FIX POSITION command, is not valid
20	UNAUTHORIZED	Position type is unauthorized - HP or XP on a receiver not authorized for it

- a. PENDING implies there are not enough satellites being tracked to verify if the FIX POSITION entered into the receiver is valid. The receiver needs to be tracking two or more GPS satellites to perform this check. Under normal conditions you should only see PENDING for a few seconds on power up before the GPS receiver has locked onto its first few satellites. If your antenna is obstructed (or not plugged in) and you have entered a FIX POSITION command, then you may see PENDING indefinitely.

C.2 TILT Compensation

Tilt Compensation affects existing logs as follows:

- NovAtel logs that provide the Extended Solution Status field (BESTPOS, BESTXYZ, PDPPOS, and PDPXYZ, all documented in *OEMV Family Firmware Reference Manual*) use the 0x80 bit to flag the fact that Tilt Compensation is being applied.
- For NMEA CPGGA, CPGGARTK, and CPGGALONG logs, the precision of various fields indicates whether the Tilt Compensation is being applied.

C.3 VERSION HW & SW Versions and Serial Numbers

The Component Type of the VERSION log, refer to the *OEMV Family Firmware Reference Manual*, is extended to include SMART-AG information as in *Table 17*.

Table 17: Component Type

Binary Value ^a	ASCII Value	Description
0	UNKNOWN	Unknown Component
1	GPSCARD	OEMV GPSCard Component
3	ENCLOSURE	SMART-AG Receiver
8	USERINFO	User-application information component
981073925 (0x3A7A0005)	DB_USERAPPAUTO	Auto-starting user-application firmware

a. Unused numbers are reserved for future use.

Appendix D Replacement Parts

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

D.1 SMART-AG

Part Description	NovAtel Part
SMART-AG	01018203
Cable: 14-pin socket to 2 DB-9 connectors, twisted CAN I/O pair, and other bare wire connectors (see <i>Section 25, SMART-AG Development Kit Cable</i> starting on <i>Page 60</i>)	01018256
Mounting Plate	70023072

D.2 Accessories

Part Description	NovAtel Part
OEMV Family Compact Disc with PC utilities including CDU	01018235
OEMV Family Installation and Operation User Manual	OM-20000093
OEMV Family Firmware Reference Manual	OM-20000094

☒ The accessories above are also available from www.novatel.com

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