



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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Table of Contents

| | |
|--|-----------|
| Foreword | 16 |
| 1 Introduction | 18 |
| 1.1 Models and Features | 18 |
| 2 Installation and Setup | 20 |
| 2.1 Additional Equipment Required | 20 |
| 2.1.1 SMART-AG Setup | 20 |
| 2.1.2 Installing the PC Utilities | 22 |
| 2.1.3 Power Supply Requirements | 22 |
| 2.1.4 Mounting Plate | 23 |
| 2.1.5 Mounting the SMART-AG | 23 |
| 2.1.6 Connecting Data Communications Equipment | 23 |
| 2.2 Additional Features and Information | 24 |
| 2.2.1 MKI and PPS Strobes | 24 |
| 2.2.2 Status Indicators | 24 |
| 2.2.3 Emulated Radar (ER) | 25 |
| 2.2.4 Controller Area Network (CAN) | 25 |
| 3 Operation | 26 |
| 3.1 Communications with the Receiver | 26 |
| 3.1.1 Serial Port Default Settings | 26 |
| 3.1.2 Communicating Using a Remote Terminal | 27 |
| 3.1.3 Communicating Using a Personal Computer | 27 |
| 3.2 Getting Started | 27 |
| 3.2.1 Starting the Receiver | 27 |
| 3.2.2 Communicating with the Receiver Using CDU | 28 |
| 3.3 Transmitting and Receiving Corrections | 29 |
| 3.3.1 Base Station Configuration | 31 |
| 3.3.2 Rover Station Configuration | 32 |
| 3.3.3 GPS + GLONASS Base and Rover Configuration | 32 |
| 3.3.4 Configuration Notes | 32 |
| 3.3.5 EGNOS | 33 |
| 3.4 <i>GL1DE</i> | 34 |
| 3.5 Recommended Configuration | 34 |
| 4 PC Utilities | 36 |
| 4.1 CDU/Convert Installation | 36 |
| 4.2 CDU | 37 |
| 4.3 Convert | 42 |
| 4.3.1 Rinex Format | 42 |
| 4.3.2 Convert Command Line Switches | 44 |
| 4.4 Firmware Upgrades | 45 |
| 4.4.1 Upgrading Using the AUTH Command | 45 |
| 4.4.2 Updating Using the WinLoad Utility | 46 |
| A Technical Specifications | 51 |

| | |
|--|-----------|
| SMART-AG Receiver Performance | 51 |
| SMART-AG Specifications | 52 |
| B Commands | 58 |
| Syntax Conventions | 58 |
| FRESET Clear Selected Data from NVM and Reset | 59 |
| LOG Request Logs from the Receiver | 60 |
| RADARCFG Configure the ER Output | 65 |
| C Logs | 67 |
| RADARSIGNAL ER Signal and Position Information | 68 |
| VERSION HW & SW Versions and Serial Numbers | 71 |
| D Replacement Parts | 72 |
| SMART-AG | 72 |
| Accessories | 72 |

Tables

| | | |
|----|---|----|
| 1 | SMART-AG Controller Models | 19 |
| 2 | SMART-AG Connector Pin-Out | 21 |
| 3 | SMART-AG LED Status Indicators | 24 |
| 4 | Available CAN Signals on the SMART-AG | 25 |
| 5 | NovAtel Logs for Rinex Conversion | 44 |
| 6 | SMART-AG Cable Pinouts | 55 |
| 7 | SMART-AG Mating Connectors | 56 |
| 8 | Recommended Fuse and Fuse Holders | 57 |
| 9 | SMART-AG Commands in Alphabetical Order | 58 |
| 10 | FRESET Target..... | 59 |
| 11 | Detailed Serial Port Identifiers..... | 63 |
| 12 | Response Modes | 66 |
| 13 | SMART-AG Logs in Alphabetical Order..... | 67 |
| 14 | Position or Velocity Type..... | 69 |
| 15 | Solution Status | 70 |
| 16 | Component Type..... | 71 |

Figures

| | | |
|----|--------------------------------------|----|
| 1 | SMART-AG Receiver | 18 |
| 2 | SMART-AG Connector | 20 |
| 3 | Simplified SMART-AG Setup | 21 |
| 4 | OEMV CD | 22 |
| 5 | SMART-AG Mounting Plate | 23 |
| 6 | Open Configuration Window | 28 |
| 7 | Basic Differential Setup | 30 |
| 8 | Convert Screen Examples | 42 |
| 9 | Convert Command Line Arguments | 44 |
| 10 | Main Screen of WinLoad | 47 |
| 11 | WinLoad's Open Dialog | 48 |
| 12 | Open File in WinLoad | 48 |
| 13 | COM Port Setup | 49 |
| 14 | Searching for Card | 49 |
| 15 | Authorization Code Dialog | 49 |
| 16 | Upgrade Process Complete | 50 |
| 17 | SMART-AG Development Kit Cable | 54 |

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

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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.

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

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Notice

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 NOTICES

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

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

- Re-orient or relocate the 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” 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.

CE NOTICE

The enclosures carry the CE mark.



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


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

Electromagnetic Compatibility (EMC) and Safety

SMART-AG Regulatory Testing

- FCC, Part 15B Radiated Emissions, Class A
- EN 55022 Emissions, Class A
- EN 55024 Immunity
 - EN 61000-4-2 Electrostatic Discharge Immunity
 - EN 61000-4-3 Radiated RF EM Field Immunity Test
 - EN 61000-4-4 Electrical Fast Transient/Burst Test
 - EN 61000-4-6 Conducted Immunity
 - EN 61000-4-8 Magnetic Field Immunity
- EN 60950 Safety of Information Technology Equipment

WEEE Notice

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

RoHS Notice

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.

Customer Service

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 58* and *Logs* starting on *Page 67*.

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 36*. 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.

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 58* 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 21* 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-AG3.

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.

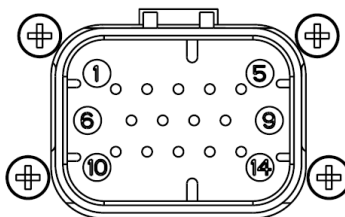



Figure 2: SMART-AG Connector

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.

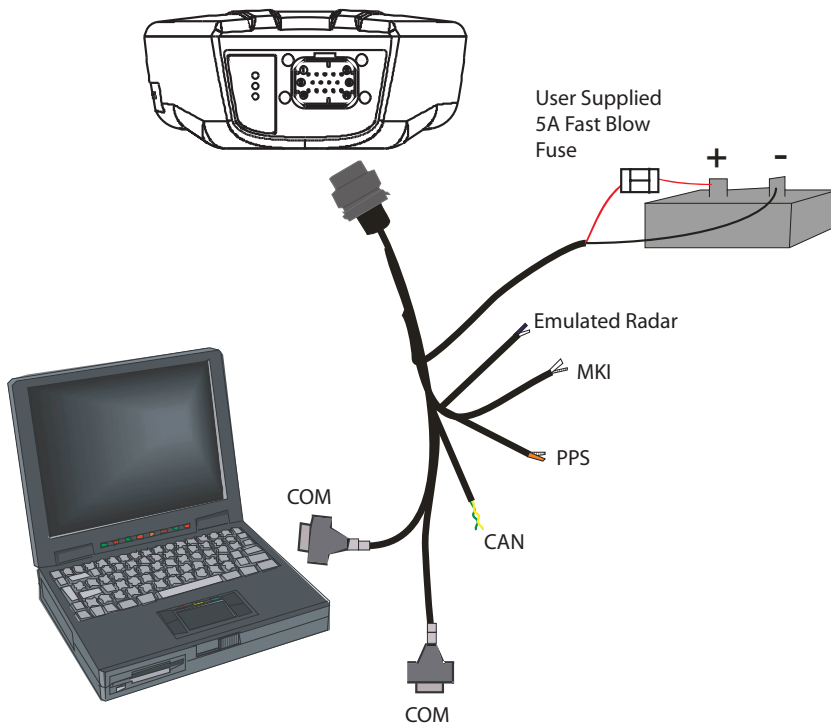



Figure 3: Simplified SMART-AG Setup

 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 52* 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 56*.



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

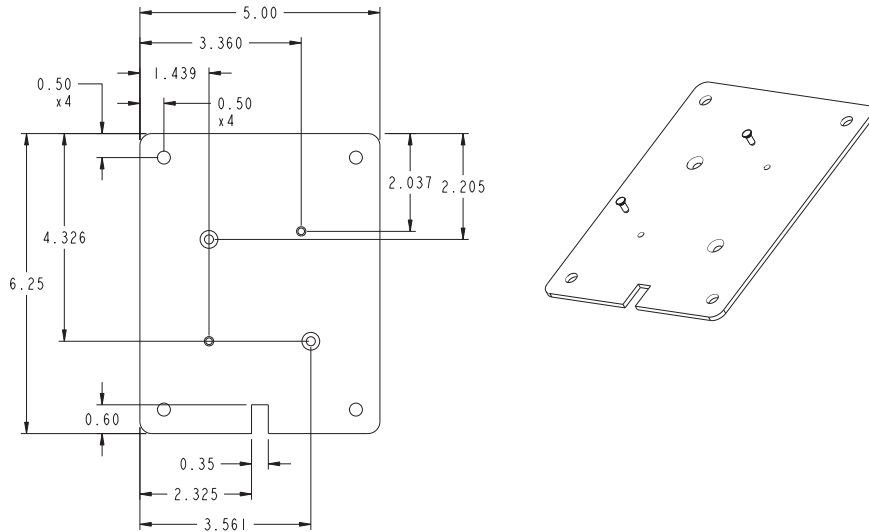


Figure 5: SMART-AG Mounting Plate

☒ 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 55* 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 an SV logic tolerant input.

Pin-out information can also be found on *Page 55*.




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 solid 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.

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 55 for the pin-out details of this cable.

The ER outputs a logic high of supply voltage-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 65 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 |

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 20*. The following instructions are based on a COM port configuration such as that shown in *Figure 7 on Page 30*. 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 21*.

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 15*.

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 6, 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.

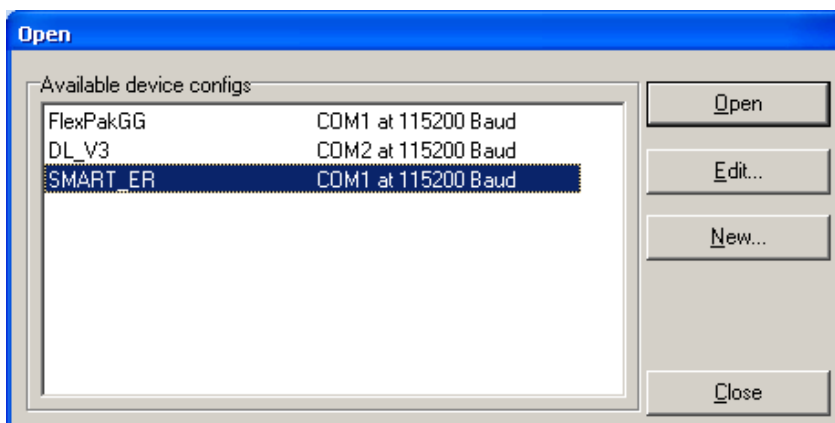


Figure 6: Open Configuration Window

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 RXSTATUSEVENTA 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 I D                (or a more detailed message)
```



WARNING!: 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 7 on Page 30*.

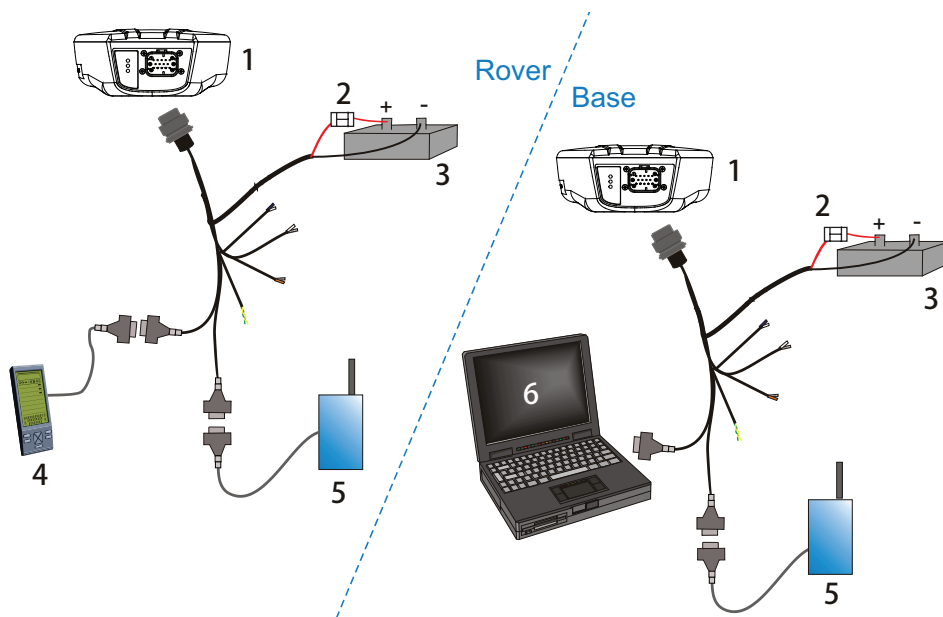


Figure 7: Basic Differential Setup

| 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 31*.

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 rtcm3 ontime 10                 (required for RTK)
            log com2 rtcm22 ontime 10 1             (optional)
            log com2 rtcm1819 ontime 1
            log com2 rtcm1 ontime 5

RTCMV3    interfacemode com2 none rtcmv3 off
            fix position 51.11358042 -114.04358013 1059.4105
            log com2 rtcm1006 ontime 10
            log com2 rtcm1003 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 31*.
-

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 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.

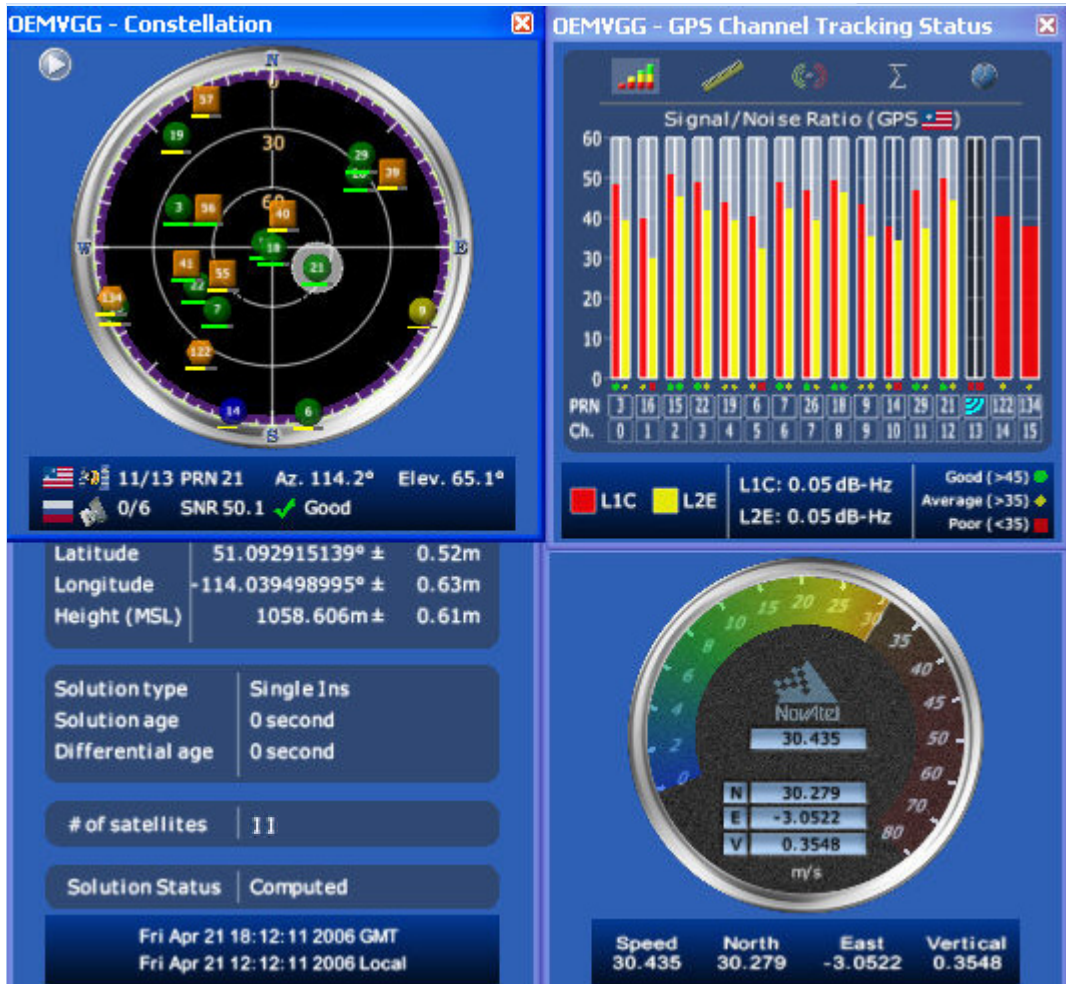
☒ The latest **CDU** is available to download from our Web site at:

<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 8*. 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.

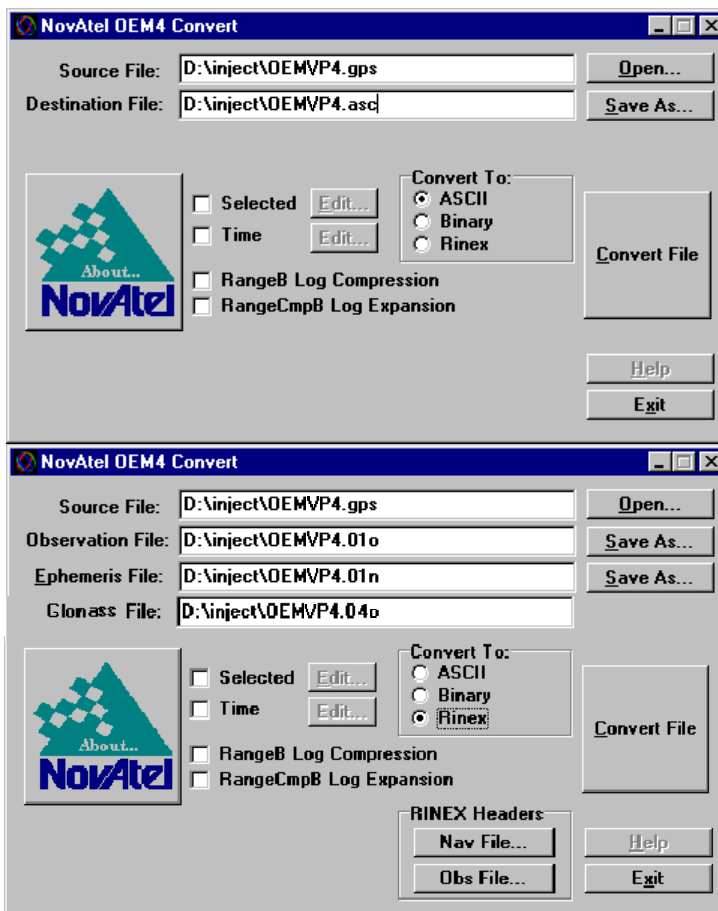


Figure 8: Convert4 Screen Examples

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 8, Convert4 Screen Examples on Page 42*, 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 5, NovAtel Logs for Rinex Conversion on Page 44*.

Table 5: NovAtel Logs for Rinex Conversion

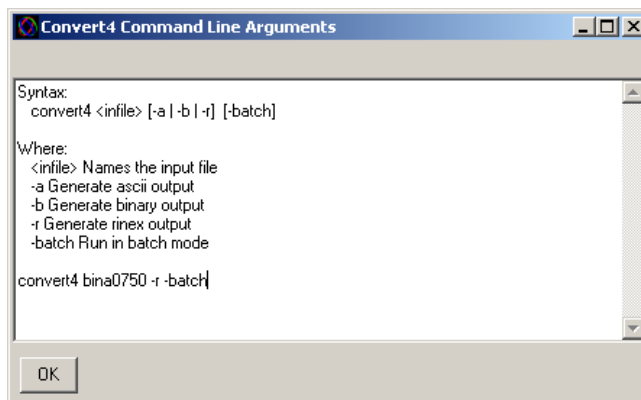
| NovAtel OEMV Family Log | Recommended Trigger |
|--|---------------------|
| RANGEA/B, or RANGECMPA/B | ontime 15 |
| BESTPOSA/B, or PSRPOSA/B, or RTKPOSA/B, or MARKPOSA/B | once |
| IONUTCA/B | onchanged |
| RAWEPHEMA/B | onchanged |
| GLORAWEPHEMA/B | onchanged |
| VERSIONA/B ^a | once |
| SITEDEFA/B ^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 8* on *Page 42*.
- 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 9*.

**Figure 9: 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 42*.

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 15*, 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 on Page 51*)
2. Issue the LOG VERSION command to verify the current firmware model number, revision level, and serial number.
3. Issue the AUTH command, followed by the auth-code and model type. The syntax is as follows:

Syntax:

```
auth auth-code
```

where auth is a special command which allows program model upgrades

auth-code is the upgrade authorization code, expressed as hhhh, hhhh, hhhh, hhhh, hhhh, 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 15* 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 10* on *Page 47*.

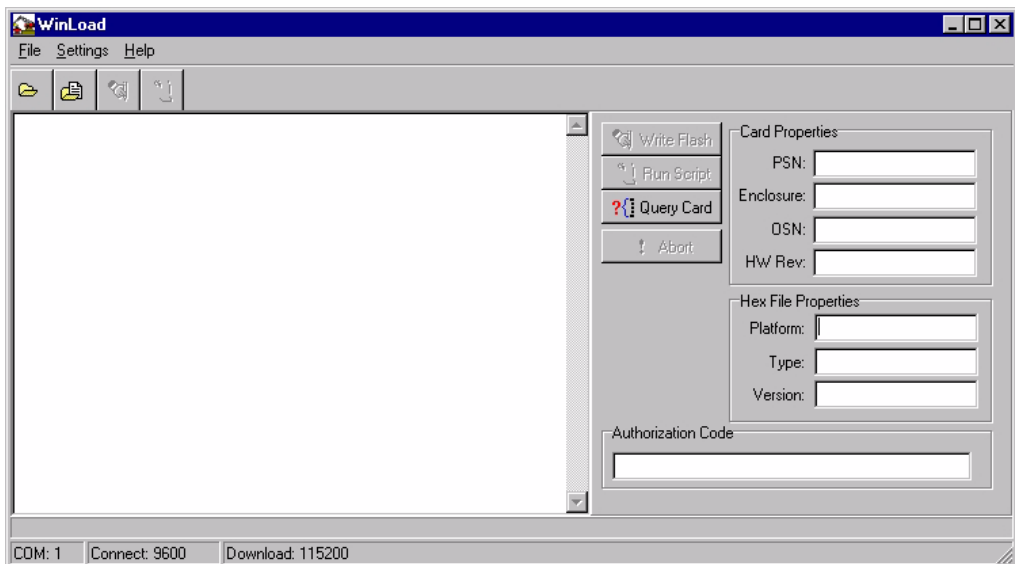


Figure 10: Main Screen of WinLoad

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

Open a File to Download

From the file menu choose *Open*. Use the *Open* dialog to browse for your file, see *Figure 11*, *WinLoad's Open Dialog on Page 48*.

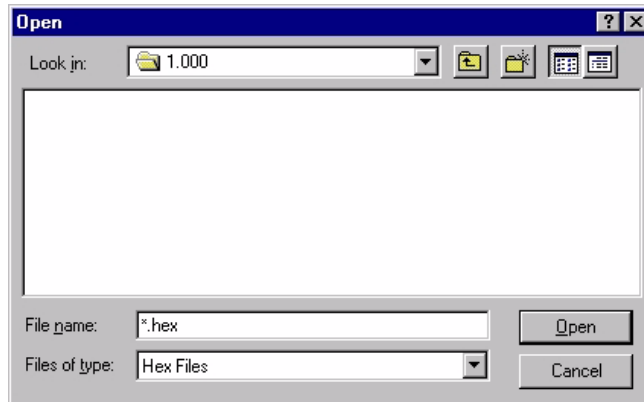


Figure 11: WinLoad's Open Dialog

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

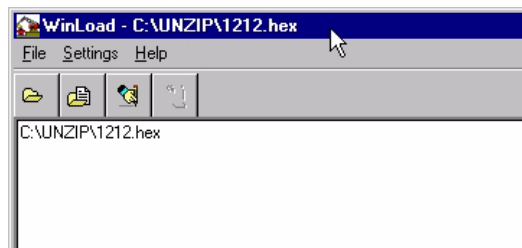


Figure 12: Open File in WinLoad

Communications Settings

To set the communications port and baud rate, select COM Settings from the Settings menu. Choose the port on your PC from the Com Port 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).

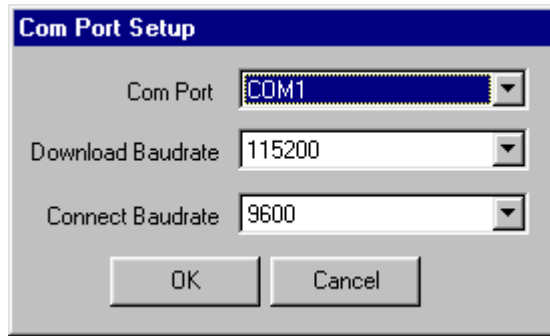


Figure 13: COM Port Setup

Downloading firmware

To download firmware follow these steps:

1. Set up the communications port as described in *Communications Settings above*.
2. Select the file to download, see *Open a File to Download on Page 48*.
3. Make sure the file path and file name are displayed in main display area, see *Figure 12, Open File in WinLoad on Page 48*.
4. Click on the Write Flash button to download the firmware.
5. Power down and then power up the receiver when “Searching for card” appears in the main display, see *Figure 14*.



Searching for card...timeout in: 13 secs

Figure 14: Searching for Card

6. Enter the authorization code and select *OK* when the Authorization Code dialog opens, see *Figure 15*.

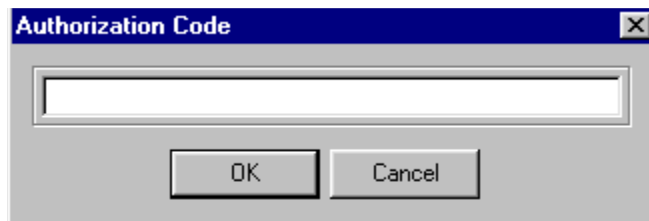


Figure 15: Authorization Code Dialog

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

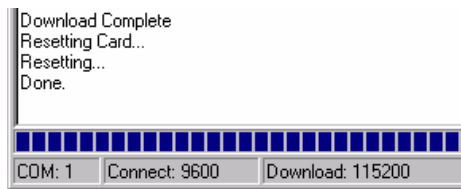


Figure 16: Upgrade Process Complete

7. Close WinLoad.

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

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>.

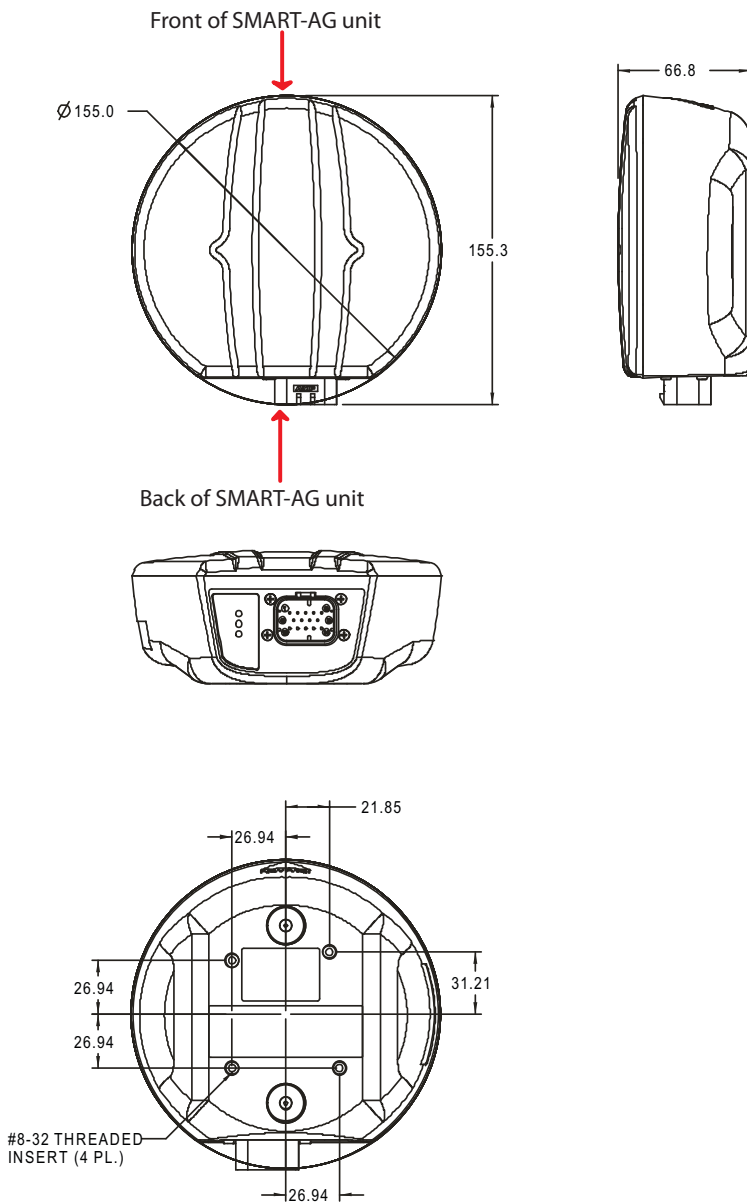
A.2 SMART-AG Specifications

| 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 54</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 24</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 53*.
- 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 17* 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 6* on *Page 55* for their pinouts. For more information on mating connectors and part numbers, see *Table 7* on *Page 56*.

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

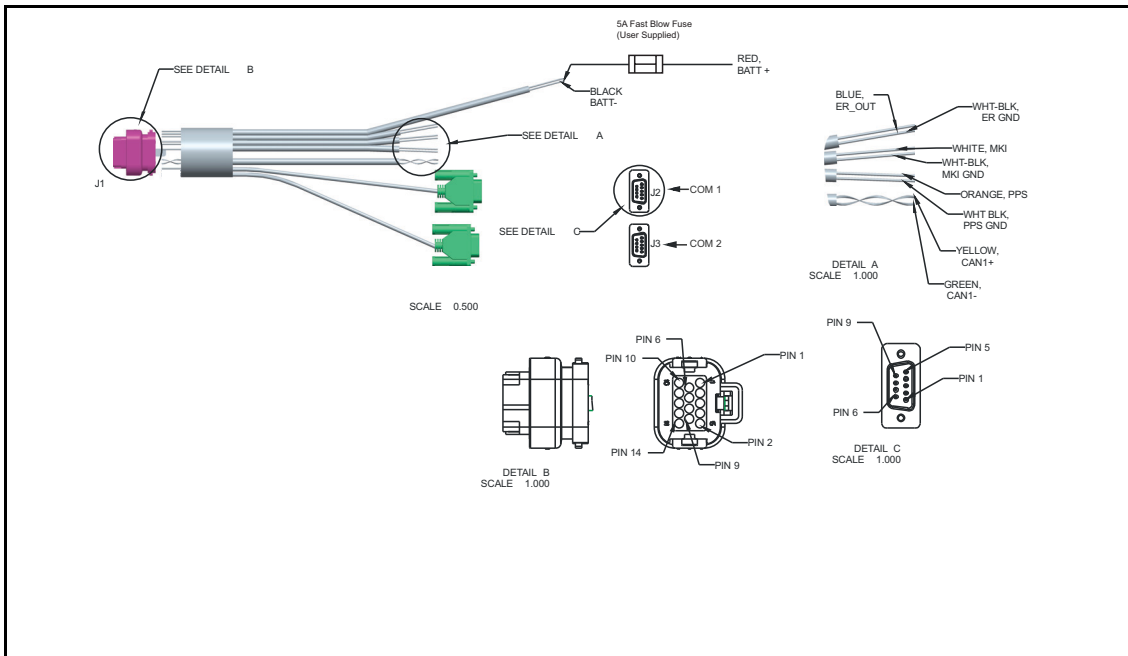


Figure 17: SMART-AG Development Kit Cable

Table 6: 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 7: SMART-AG Mating Connectors

| Product | Part Description | Company | Part Number |
|---|--|--------------|-------------|
| SMART-AG mating connector (Figure 17 on Page 54) | 14-pin sealed receptacle housing-black | Tyco/ AMP | 776273-1 |
| SMART-AG mating connector (Figure 17 on Page 54) | 14-pin sealed receptacle housing-natural | Tyco/ AMP | 776273-2 |
| SMART-AG mating connector (Figure 17 on Page 54) | 14-pin sealed receptacle housing-grey | Tyco/ AMP | 776273-4 |
| SMART-AG mating connector (Figure 17 on Page 54) | 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 8: 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 9*, 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 9: 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 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 10 | | Data to be reset by the receiver | Enum | 4 | H |

Table 10: 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 Table 11, Detailed Serial Port Identifiers on Page 63 | 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 11: 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 |
| <i>Continued on Page 64</i> | | | |

| 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 *OEMV Family Firmware Reference Manual* and **CDU's** Help file.

B.4 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 55* 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 12</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 12: 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 13*, 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 13: 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 15, Solution Status on Page 70</i> | Enum | 4 | H |
| 3 | vel type | Velocity type, see <i>Table 14, Position or Velocity Type on Page 69</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 54</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 14: 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 15: 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 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 16*.

Table 16: 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 17, SMART-AG Development Kit Cable</i> starting on <i>Page 54</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

Index

A

- accuracy
 - position, 29, 51
 - velocity, 51
- almanac, 59
- antenna
 - internal, 18
 - mounting, 23
 - single-frequency, 23
 - specifications, 52
- ascii, 42
- AUTH command, 45
- authorization, 46
- AUX port, 64

B

- base station, 33
- baseline, 29
- baud rate, 26
- bidirectional communication, 27
- Bluetooth, 21
- buffer, 26, 60

C

- cable
 - serial, 26
 - warranty, 10
- Caution, 26
- CDU software, 36, 61, 72
- CMR, 32
- cold start, 51
- COM port, 61
- command, 58
 - CDU, 28
 - communication, 26
 - error message, 29
 - example, 29
 - in CDU, 40, 45
 - interface, 32
 - multiple, 33
 - note, 28

- port, 26
- pre-configure, 31
- prompt, 28
- RTK, 33
- communication
 - bidirectional, 27
 - CDU, 28
 - getting started, 27
 - notice, 13
 - operation, 26
 - PC/laptop, 27
 - physical, 20
 - port, 23, 26
 - remote terminal, 27
- COMVOUT command, 59
- configuration
 - additional equipment, 20
 - base station, 31
 - CDU, 28
 - model, 19
 - port, 26
 - rover station, 32
 - RTK, 33
 - typical hardware, 26
- connector
 - input/output, 52
 - mounting bracket, 23
 - specifications, 52
- Convert software, 42
- copyright, 2
- CPU, 60
- Customer Service, 15, 45

D

- data
 - collect, 24
 - erase, 59
 - format, 58
 - L-band, 59
 - link, 30
 - log, 60–61
 - NVM, 59

- port, 23, 26
- start, 27–28
- storage device, 30
- terminal, 27
- Warning, 29

DC power, 52

dealer, 15, 45

default

- factory, 59
- interface mode, 33
- log, 61
- offset, 62
- period, 62
- port, 26, 60–62
- reset, 59
- trigger, 62

differential

- configuration note, 33
- corrections, 29, 54
- operation, 29
- serial cable, 54
- setup, 30

directional communication, 27

distance exceeded, 70

E

EGNOS, 33

e-mail, 15

Emulated Radar (ER), 25, 65, 68

ESTB, 34

F

features, 19, 27, 45–46

firmware upgrades, 45–46

FRESET command, 59

G

GLIDE, 34

GLONASS, 43

GPSAntenna, 10

graphical user interface, 37

H

handshaking, 26

hardware

- connector, 20
- enclosure, 18
- replace, 72
- required, 20
- setup, 21, 30
- specifications, 53

header, 17

height limit, 70

hexadecimal, 17

hibernate mode, PC, 61

hold, 60, 62

I

identifier, serial port, 63

idle time, 26

input

- command, 28–29
- connector, 52
- differential, 31–32
- mark, 62
- power, 22
- syntax, 58

install, 16

installation, 36

integration, 16

interface

- base or rover, 31–32
- communication, 27
- graphical, 22
- serial, 26

introduction, 18

L

laptop power settings, 61

LED

- front, 18
- power, 21, 24

light emitting diode (LED), *see* LED

log, 32, 60–61, 67

LOG command, 60

logs in CDU, 41

M

memory, 60

message trigger, 62

model, 19

N

note, logging, 60
 Notices, 13
 NovAtel Inc., 2, 15

O

operation, 26
 optionality, 17
 output
 connector, 52
 convention, 17
 log, 61–62
 status, 27–28
 syntax, 58
 overload, 60

P

parity, 26
 PC power settings, 61
 period, 60, 62
 port
 COM, 20, 26, 28, 32
 identifier, 63–64
 interface mode, 31–32
 log, 60–62
 output, 62
 prompt, 28–29
 serial, 26
 settings, 26
 position
 accuracy, 29
 base, 29, 31
 best, 68
 command, 29, 33
 power, 21–22
 pseudorange, 33

R

RADARCFG command, 65
 RADARSIGNAL log, 68
 receiver status, 60
 replacement parts, 72
 reset
 FRESET command, 28, 59
 option, 59

 target, 59
 RESET command, 65
 revision, firmware, 1, 45
 Rinex, 42
 rover station, 33
 RTCA, 32
 RTCM, 31–32
 RTCMV3, 31–32

S

satellite, 23, 26
 self-test, 27, 60
 serial
 cable, 26
 number, 45
 port, 32, 63
 standby mode, PC, 61
 status, receiver, 60
 support, 10, 15
 syntax, 58

T

technical specifications, 51
 time, 60, 62
 trigger, log, 60–61

U

upgrade firmware, 15, 45–46

V

velocity limit, 70
 version, 46

W

Warning
 CE, 14
 FCC, 13
 voltage, 22
 warranty, 10
 Web site, 15
 windows in CDU, 37–41
 WinLoad, 46
 WRITE command/log, 71

