SMART-MR10
User Manual

SMART-MR10 User Manual

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Table of Contents

Tables

Figures

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SMART-MR10	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.

Determination of replacement or repair will be made by NovAtel personnel or by technical personnel expressly authorized by NovAtel for this purpose.

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

Before shipping any material to NovAtel or Dealer, please obtain a Return Material Authorization (RMA) number from the point of purchase. You may also visit our Web site at http://www.novatel.com and select *Support* | *Repair Requests* from the top menu.

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

Notices

The following notices apply to the SMART-MR10. For more information on emissions testing, please refer to the regulatory body in your geographic area; for example, in the US, the Federal Communications Commission (FCC) and in Europe, the Conformité Européenne (CE).

FCC

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

SMART-MR10 has been tested and found to comply with the emission limits for a Class B digital device. The Class B limits are designed to provide reasonable protection against harmful interference in a residential installation. SMART-MR10 has been certified by FCC for use in the 2400 MHz - 2483.5 MHz band (FCC ID # TBD).

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-MR10
- Increase the separation between the equipment and the SMART-MR10
- Connect the equipment to an outlet on a circuit different from that to which the SMART-MR10 is connected
- Consult the dealer or an experienced radio/TV technician for help

IMPORTANT:

In order to maintain compliance as a Class “A” or Class “B” digital device, shielded cables should be used for the RS-232 serial data ports (Belden 1036A or equivalent) and twisted pair cable should be used for the CAN port (shielded twisted pair will improve CAN performance in electrically harsh environments). I/O signals should be referred to one of the two signal grounds (connector pin 9 or connector pin 15) and not power ground (connector pin 2). 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 one of the two signal grounds (pin 9 or pin 15).] at a point close to the SMART-MR10.

WARNING:

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

Industry Canada

SMART-MR10 Class B digital apparatus complies with Canadian ICES-003.

SMART-MR10 appareils numérique de la classe B est conforme à la norme NMB-003 du Canada.

SMART-MR10 has been certified for use in the 2400 MHz - 2483 MHz band by Industry Canada (RSS-210) [IC ID # TBD].

CE

The SMART-MR10 enclosures carry the CE mark.

"Hereby, NovAtel Inc. declares that this SMART-MR10 is in compliance with the essential requirements and other relevant provisions of the R&TTE Directive 1999/5/EC and of the EMC Directive 2004/108/EC."

WEEE

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

RoHS

The SMART-MR10 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 Updates

Firmware updates are firmware releases, which include fixes and enhancements to the receiver functionality. Firmware updates are released occasionally on the Web site as they become available. Model upgrades enable features on the receiver and may be purchased.

OEMV Model Upgrades

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.

WinLoad

Please refer to *PC Software and Firmware, Firmware Upgrades* in the *OEMV Family Installation and Operation User Manual* for instructions on how to use the WinLoad program to upgrade your OEMV receiver.

Contact Information

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-MR10, a smart antenna capable of receiving GPS L1+L2, GLONASS L1+L2, and L-band signals, 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-MR10 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-MR10, 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-MR10 is ready to go.

SMART-MR10 utilizes a comprehensive user-interface command structure, which requires communications through its communications (COM) ports. This manual describes the SMART-MR10-specific commands and logs, see*Commands* starting on *Page 73* and *Logs* starting on *Page 91*. 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 44*. 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 installation requirements and considerations for SMART-MR10. 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 use of the program. This manual has been written with the expectation that you already have a basic familiarity with Windows.

Conventions

The following conventions are used in this manual:

✉ This is a notebox 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.

This symbol indicates an important statement, caution or warning.

See also *Section B.1, Syntax Conventions* on *Page 73* for additional conventions.

Chapter 1 Introduction

The SMART-MR10 is a rugged dual-constellation, dual-frequency smart antenna designed for on-machine applications in the agricultural, construction and industrial market segments.The SMART-MR10 consists of a high-performance GNSS receiver and antenna, capable of receiving and tracking different combinations of GPS+GLONASS L1+L2 code and carrier signals, and L-band signals, on a maximum of 72 channels.

The SMART-MR10 supports the following position modes:

- Autonomous
- SBAS (Satellite Based Augmentation Systems), including WAAS, EGNOS, and MSAS.
- DGPS
- OmniSTAR VBS/HP/XP
- CDGPS
- NovAtel ***GL1DE***®, RT-20®, RT-2™ and RT-2L

For more information about the above, refer to the NovAtel web site at http://www.novatel.com/support.

Once you connect the SMART-MR10 to a vehicle, it begins operating as a fully functional GNSS system. *Figure 1* below shows the SMART-MR10 without connecting cables.

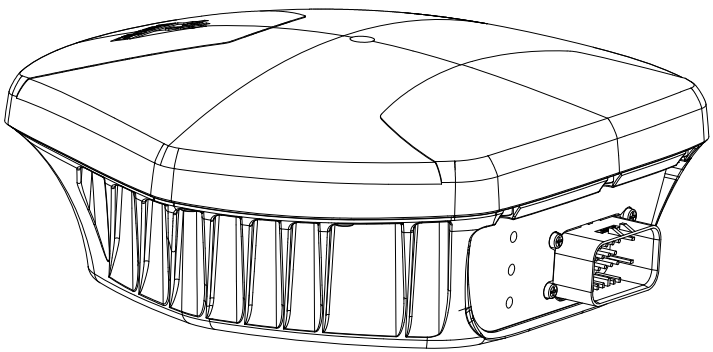


Figure 1: SMART-MR10 Receiver

1.1 SMART-MR10 Features

The main features of the SMART-MR10 are as follows:

- Enhanced high performance GPS+GLONASS L1+L2 and L-band receiver (NovAtel OEMV-3).
- High performance GPS+GLONASS L1+L2 and L-band antenna.
- Emulated Radar output
- CAN port
- Three (3) RS-232 COM ports, one of which can be configured with flow control, or user-

switched to RS422.

- Rugged, water and dust tight enclosure, consisting of a cast aluminum base and plastic radome.
- *Bluetooth*
- Three (3) daylight viewable status LED indicators.
- Range of installation options, including a quick-release mounting plate and a 5m power/data cable with tinned/tagged wires.

1.2 SMART-MR10 Models

The SMART-MR10 is available in several different firmware models whose configurations may include additional features. Available models are summarized in *Table 1* below.

Table 1: SMART-MR10 Controller Models

Model Name	Firmware Feature
SMART-MR10-RT2-G	GPS plus GLONASS 1 cm real-time kinematic positions, RT-2 corrections and raw data, code positions and DGPS, OmniSTAR HP/XP/VBS, CDGPS, SBAS, 20 Hz
SMART-MR10-RT2	GPS 1 cm real-time kinematic positions, RT-2 corrections and raw data, code positions and DGPS, OmniSTAR HP/XP/VBS, CDGPS, SBAS, 20 Hz
SMART-MR10-L1L2-G	GPS plus GLONASS RT-2 corrections and raw data, code positions and DGPS, OmniSTAR HP/XP/VBS, CDGPS, SBAS, 20 Hz
SMART-MR10-L1L2	GPS RT-2 corrections and raw data, code positions and DGPS, OmniSTAR HP/XP/VBS, CDGPS, SBAS, 20 Hz
SMART-MR10-HP	GPS code positions and DGPS, OmniSTAR HP/XP/VBS, CDGPS, SBAS, 20 Hz
SMART-MR10-SBAS	L1L2 SBAS positions, 20 Hz
SMART-MR10-RT20-G	GPS plus GLONASS 20 cm real-time kinematic positions, RT-20 corrections and raw data, code positions and DGPS, OmniSTAR VBS, CDGPS, SBAS, 20 Hz
SMART-MR10-RT20	GPS 20 cm real-time kinematic positions, RT-20 corrections and raw data, code positions and DGPS, OmniSTAR VBS, CDGPS, SBAS, 20 Hz
SMART-MR10-VBS	GPS code positions, and DGPS, OmniSTAR VBS, CDGPS, and SBAS positions, 20 Hz
SMART-MR10-L1-G	GPS plus GLONASS RT-20 corrections and raw data, code positions and DGPS, SBAS, 20 Hz
SMART-MR10-L1	GPS RT-20 corrections and raw data, code positions and DGPS, SBAS, 20 Hz
SMART-MR10-GENERIC	Hardware only, requires a firmware upgrade to produce output

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

Chapter 2 Installation and Setup

This chapter contains instructions and tips for setting up your SMART-MR10.

2.1 Additional Equipment Required

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-MR10
    - SMART-MR10 cable (see *Appendix D Replacement Parts* on *page 98* for part numbers). Refer to *Figure 3, Simplified SMART-MR10 Setup* on *Page 23* 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-MR10 Setup

To connect and power your SMART-MR10:

1. Mount the SMART-MR10 on a secure, stable part of the vehicle (for example, cab roof) with an unobstructed view of the sky from horizon to horizon, see *Section 2.1.5, Mounting the SMART-MR10* on *Page 28*.
2. Establish a physical communication connection between the SMART-MR10 and the PC/laptop. Connect the COM and Power port on the back of the SMART-MR10, see *Figure 2* below, to a DB-9 serial port on a PC, laptop or other data storage device.

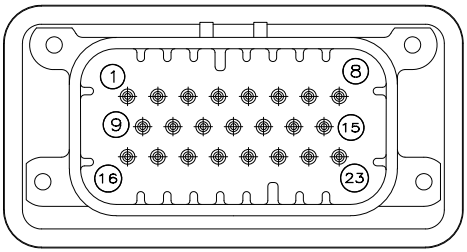


Figure 2: SMART-MR10 Connector

Table 2: SMART-MR10 Connector Pin-Out

Pin	Use	Pin	Use
1	PWR+	13	RESERVED
2	PWR-	14	CHASSIS GROUND
3	CAN1-	15	SIGGND1
4	CAN1+	16	MKI
5	TXD2	17	PPS
6	RXD2	18	ER
7	TXD1	19	MODE[a]
8	RTS1/AUXTX	20	RESERVED
9	SIGGND2	21	RESERVED
10	RESERVED	22	CTS1/AUXRX
11	RESERVED	23	RXD1
12	RESERVED		

a. The SMART-MR10 is RS-232/RS-422-selectable through pin 19 MODE, as shown in *Table 3*.

Table 3: Use of MODE Pin

MODE Pin	Result
Open	Pins 8 and 22 provide RS-232 access to the AUX port and COM1 has no flow control.
Tied Low	Pins 8 and 22 provide TXD1- and RXD1- for COM1 RS-422, and the AUX port (RXD3, TXD3) is not available.
Tied High	Pins 8 and 22 provide RTS1 and CTS1 for COM1 flow control, and the AUX port (RXD3,TXD3) is not available.

3. Turn on the power supply to the SMART-MR10 (the SMART-MR10 cable is also a power cable). The power LED on the back of the receiver glows red when the SMART-MR10 is properly powered.

✉ Fuse/holder recommendations can be found in *Table 10, Recommended Fuses* on *page 72*

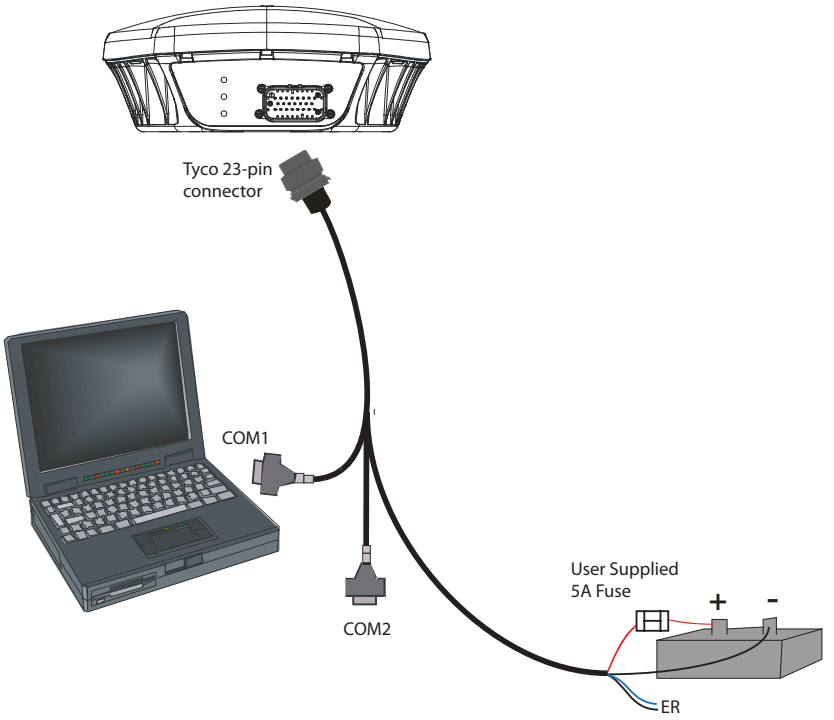


Figure 3: Simplified SMART-MR10 Setup

✉ Minimum conductor size for all wiring is 0.5 mm / 20 AWG.

2.1.2 Installing the PC Utilities

Once the SMART-MR10 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 in the CD-ROM drive of the computer.

✉ You can obtain the latest CDU (and PC utilities) version from the NovAtel Support site at http://www.novatel.com/support/index.htm.

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.

2.1.3 Power Supply Requirements

The SMART-MR10 requires +8 to +36 VDC for the input power to the receiver. See *Page 65* for more power supply specifications.

The SMART-MR10 cable provides power in (with a BATT+ label) and power ground (with a BATT- label) bare wires for connections from the SMART-MR10 to a 12 to 24V vehicular power system (or equivalent) protected by a user-supplied fuse. NovAtel recommends an automotive blade-type fuse, rated for 5A with an operating voltage of more than 36V. For cable details, refer to *Appendix A.2.3, SMART-MR10 Connector and Cable Requirements* starting on *page 72*.

WARNING!:  **The SMART-MR10 power source must be protected by a 5A 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 Plates

Several mounting plate options are available for mounting the SMART-MR10 receiver:

- Universal mounting plate (NovAtel part number 70023085), shown in Figure 4 on *page 25*.
- Mounting plate with AG GPS 262 layout (NovAtel part number 70023086), shown in Figure 5 on *page 26*.
- Pole-mount (NovAtel part number 70023087), shown in Figure 6 on *page 27*.

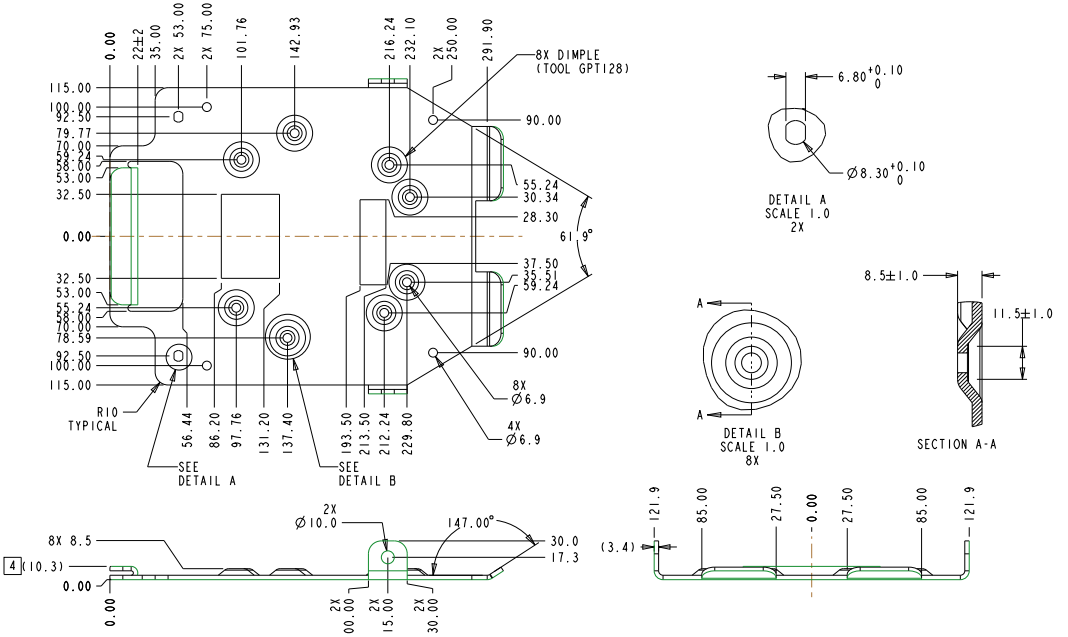


Figure 4: SMART-MR10 Universal Mounting Plate (70023085)

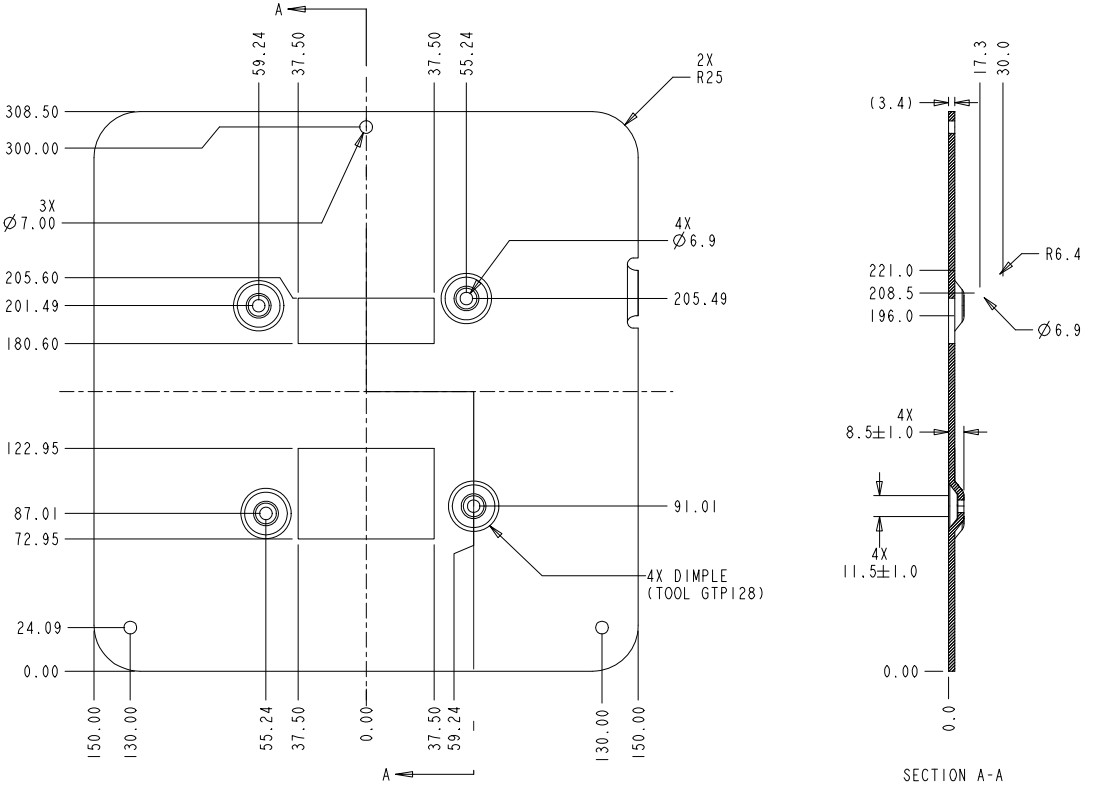


Figure 5: SMART-MR10 AG GPS 262 Layout Mounting Plate (70023086)

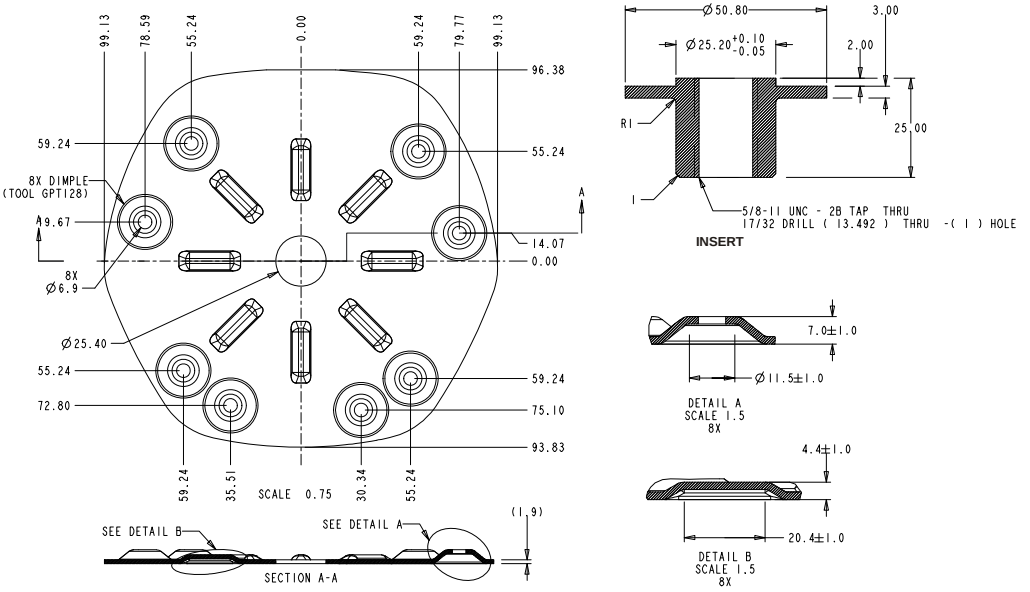


Figure 6: SMART-MR10 Pole Mount (70023087)

✉ All measurements are in millimetres unless specified otherwise.

2.1.5 Mounting the SMART-MR10

When installing the SMART-MR10:

- Choose a location that has a clear view of the sky so that each satellite above the horizon can be tracked without obstruction.
- Mount on a secure, stable structure capable of safe operation in the specific environment. Typical installation is the vehicle roof.

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 *Table 7* on *page 69* for more information.

2.2 Additional Features and Information

This section contains information on additional features of the SMART-MR10, which may affect the overall design of your receiver system.

2.2.1 MKI and PPS Strobes

Input (MKI) and output (PPS) strobes provide status and synchronization signals. PPS is a 3.3V CMOS output; MKI is a 5V-tolerant input. Pin-out information can be found on *Page 69*.

MKI can be used in conjunction with the MARKTIME and MARKPOS logs. For information about these logs, refer to *OEMV Family Firmware Reference Manual*, available on the NovAtel Support Web site at http://www.novatel.com/support/docupdates.htm.

2.2.2 Status Indicators

LED indicators on the SMART-MR10 provide receiver status information:

- Position Status
- Position Type
- Power

Table 4 shows the meaning of the LED states in the expected sequence after power is applied.

Table 4: SMART-MR10 LED Status Indicators

Red	Yellow	Green	Condition
Off	Off	Off	Power is not available. (Red indicator may also not be lit if a boot failure has occurred.)
On	Off	Off	Power available but no satellites are being tracked
On	Flashing	Off	Tracking at least one satellite but not a valid position
On	On	Off	Position valid in basic autonomous mode
On	On	Flashing	SBAS tracking, but not enough data for enhanced solution.
On	On	On	Position valid in an enhanced accuracy mode[a] (WAAS/EGNOS/MSAS/DGPS, OmniSTAR VBS/XP/HP, or RTK)
On	Flashing	Flashing	Fixed position with bad integrity

a. When acting as a reference receiver, all lights on solid indicates a good fixed position.

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 Guidelines:

- If the power is on but the yellow LED doe not 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 does not flash within one minute and power cycling the unit does not fix the problem, request a VERSION log to ensure that the auth code is correct.

  Example of a receiver loaded with an incorrect auth code:

```
<ok
[com1]<version com1 0 72.0 unknown 0 12.387 004c0001 3681 5053
<     3
<         gpscard "invalid authcode" "dhc09401009" "mcagtp-1.00-
    22b" "3.710" "3.002" "2009/dec/30" "11:20:58"
<          db_userappauto "smartag" "0" "" "1.100" "" "2010/jan/
    25" "17:32:44"
<           userinfo "no bt" "" "" "" "" "" ""
[com1]
```

- If the yellow LED is flashing but does not progress to solid yellow within one minute, then insufficient satellites are tracking or the signal quality is poor and ephemeris data can't be received. Normally, four satellites are sufficient for a valid position as long as they are widely

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

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

2.2.3 Emulated Radar (ER)

The SMART-MR10 outputs an emulated radar signal via the bare wires labeled ER GND and ER_OUT on the SMART-MR10 cable. See *Table 9* on *page 72* for the pin-out details of this cable.

The ER outputs a logic high of supply voltage minus 0.5V minimum and logic low of 0.5V maximum with a rise and fall time of less than 1 ms. Its output references signal GND and provides logic low output until its speed is greater than 1 km/hr. ER can be configured to operate at one of three distinct frequencies (26.11, 28.12 or 36.11 Hz/km/hr, with 36.11 Hz/km/hr being the default value) and with an effective range from 1 km/hr to 55 km/hr for near-horizontal applications. See *Appendix B.6 PDPFILTER Enable, disable or reset the PDP filter* on *page 84* for more information.

2.2.4 Controller Area Network (CAN)

NMEA 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 SETCANNAME 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 Messages (PGN):

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

Table 5: Available CAN Signals on the SMART-MR10

CAN	Pins
CAN1+	Pin 3
CAN1-	Pin 4

Chapter 3 Operation

Before operating the SMART-MR10 for the first time, please ensure that you have followed the installation instructions in *Chapter 2 Installation and Setup* starting on *page 21*. The following instructions are based on a COM port configuration such as that shown in Figure 8 on *page 36*. 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-MR10 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 Family 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, COM2 and AUX 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. See *Appendix B.3, COM Configure COM Port* starting on *page 75* for details.

✉ COM1 can be configured as RS422. It can also be configured with flow control. COM3 is not available if COM1 flow control is enabled or if COM1 is configured as RS422. The default configuration, with the MODE pin unconnected, is that COM1 is RS232 with no flow control. SMART-MR10 configuration using the Mode pin is summarized in *Table 3, Use of MODE Pin* on *page 22*.

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. 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

A 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 *2.1.2, Installing the PC Utilities* on *page 23*.

3.2.1 Starting the Receiver

When first powered, the SMART-MR10 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 Family 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 7, below, shows an *Open Configuration* window with three possible configurations already set up. Your configurations may be different or you may have none at all, in which case, the *Open Configuration* window is empty.

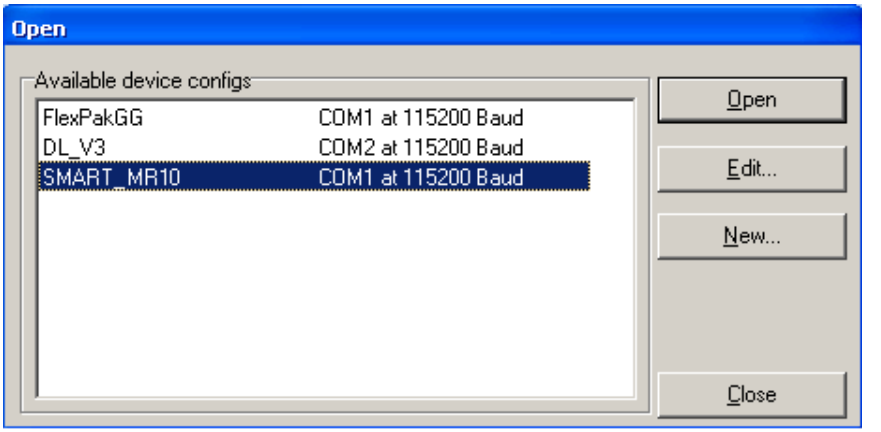


Figure 7: Open Configuration Window

Refer to **CDU**'s help file by selecting the *Help* | *Contents* menu. Ensure you can see the *Console* and *ASCII Messages* windows by selecting them from the *View* menu.

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

[COM1] *if connected to COM1 port*,
or
[COM2] *if connected to COM2 port*,

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

✉ 1. You may also have to wait for output from receiver self tests. For example, on start-up, the OEMV family receiver is set to log the 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, as shown in the following example:

[COM2] fix position 51.11635 -114.0383 1048.2 *[carriage return]*

<OK

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

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

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

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

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-MR10 can be used as a base receiver to transmit RTK or DGPS corrections or a rover to receive the same corrections. An example of differential setup is given in *Figure 8* on *page 36.*

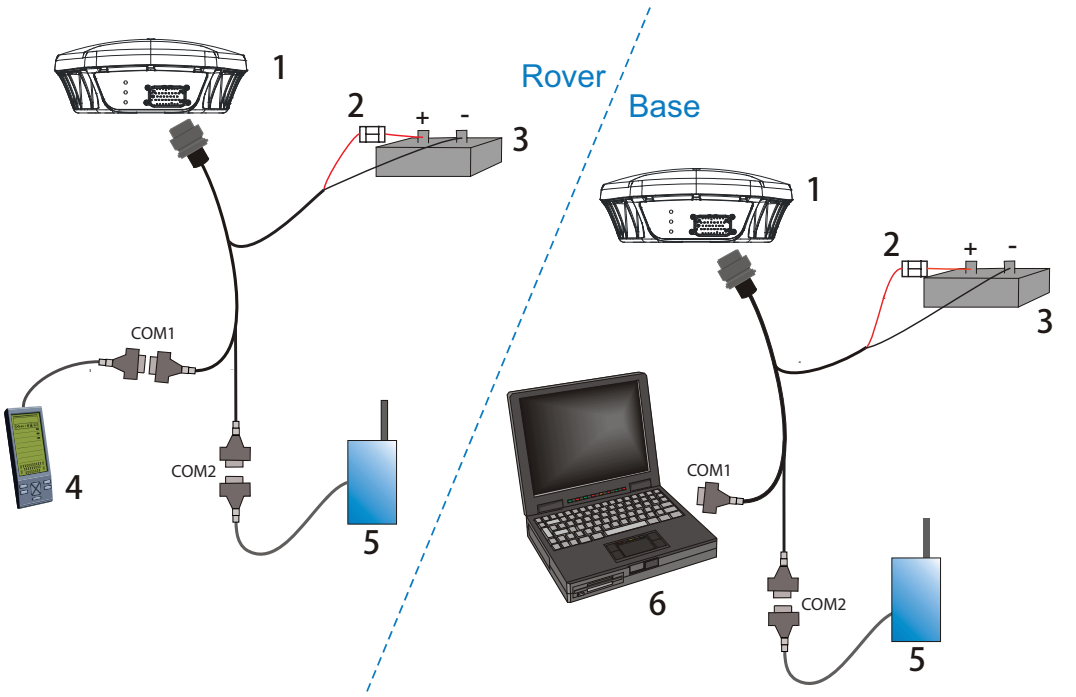


Figure 8: Basic Differential Setup

Reference	Description
1	SMART-MR10 receiver
2	User-supplied 5A 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 the NovAtel web site at http://www.novatel.com/support/ 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. The application of SBAS corrections to a single receiver are an exception 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 outlined in the configuration examples in *3.3.1, Base Station Configuration* on *page 37* and *3.3.2, Rover Station Configuration* on *page 38*.

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 *(enter your own lat, lon, hgt)*
log com2 rtcaobs ontime 1
log com2 rtcaref ontime 10
log com2 rtca1 ontime 5 *(optional, enable code-dgps coverage)*
log com2 rtcaephem ontime 10 1 *(optional)*

RTCAOBS2 `interfacemode com2 none rtca off`
(recommended) fix position 51.11358042 -114.04358013 1059.4105 *(enter your own lat, lon, hgt)*
log com2 rtcaobs2 ontime 1
log com2 rtcaref ontime 10

RTCM V2.3 `interfacemode com2 none rtcm off`
fix position 51.11358042 -114.04358013 1059.4105 *(enter your own lat, lon, hgt)*
log com2 rtcm3 ontime 10
log com2 rtcm22 ontime 10 1
log com2 rtcm1819 ontime 1
log com2 rtcm1 ontime 5 *(optional)*

RTCM V3 `interfacemode com2 none rtcmv3 off`
fix position 51.11358042 -114.04358013 1059.4105 *(enter your own lat, lon, hgt)*
log com2 rtcm1002 ontime 1 *(for L1 only models or cards OEMV1 and OEMV1G)*
log com2 rtcm1004 ontime 1
(for L1/L2 models or cards OEMV1DF, OEMV2G, and OEMV3G)
log com2 rtcm1006 ontime 10
log com2 rtcm1019 ontime 120

RTCM V3 with GLONASS `interfacemode com2 none rtcmv3 off`
(recommended) fix position 51.11358042 -114.04358013 1059.4105 *(enter your own lat, lon, hgt)*
log com2 rtcm1002 ontime 1 *(for L1 only models or cards OEMV1 and OEMV1G)*
log com2 rtcm1004 ontime 1
(for L1/L2 models or cards OEMV1DF, OEMV2G, and OEMV3G)
log com2 rtcm1010 ontime 1 *(for L1 only models or cards OEMV1 and OEMV1G)*
log com2 rtcm1012 ontime 1

(for L1/L2 models or cards OEMV1DF, OEMV2G, and OEMV3G)

log com2 rtcm1006 ontime 10
log com2 rtcm1033 ontime 10
log com2 rtcm1019 ontime 120
log com2 rtcm1020 ontime 120

CMRPLUS (CMR+) `interfacemode com2 none cmr off`

fix position 51.11358042 -114.04358013 1059.4105 *(enter your own lat, lon, hgt)*
log com2 cmrobs ontime 1
log com2 cmrgloobs ontime 1
log com2 cmrplus ontime 1 *(important to use ontime 1 with cmrplus)*

CMR `interfacemode com2 none cmr off`

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

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`

RTCAOBS2 `interfacemode com2 rtca none off`

RTCM V2.3 `interfacemode com2 rtcm none off`

RTCM V3 `interfacemode com2 rtcmv3 none off`

RTCM V3 with GLONASS

`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 115200 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 115200 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 want to mix NovAtel format messages and RTCA, RTCAOBS2, RTCM, RTCMV3, CMR+ 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 rtcm1b 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 37*.

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 Family 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 SBAS (Satellite-Based Augmentation Systems)

A Satellite-Based Augmentation System (SBAS) is a type of geostationary satellite system that improves the accuracy, integrity, and availability of the basic GNSS signals. Accuracy is enhanced through the use of wide area corrections for GNSS orbits and ionospheric errors. Integrity is enhanced by the SBAS network quickly detecting satellite signal errors and sending alerts to receivers to not use the failed satellite. Availability is improved by providing an additional ranging signal to each SBAS geostationary satellite.

OEMV family receivers, including the SMARTR-MR10, are capable of SBAS positioning. This positioning mode is enabled using the SBASCONTROL command. The following command is used to automatically track and use the SBAS service available in the area of operation, for example, WAAS or EGNOS:

```
sbascontrol enable auto
```

For further information on SBASCONTROL, refer to the *OEMV Family Installation and Operation User Manual*, available from the NovAtel Web site.

WAAS (Wide-Area Augmentation System)

The US Federal Aviation Administration (FAA) has developed a Wide Area Augmentation System (WAAS) to provide accurate positioning to the aviation industry. As well as providing the industry with this high quality service, it is available to all other civilian users and markets in North America,

free of charge. Future developments to this system will encompass the L5 signal.

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

The ESTB is broadcast on PRN (pseudorandom number) 126 and EGNOS is broadcast 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 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 GL1DE®

SMART-MR10 contains NovAtel's ***GL1DE***, a positioning algorithm for single frequency GPS and GPS/GLONASS applications. ***GL1DE*** produces a smooth position output tuned for applications where optimal time relative (pass to pass) accuracy is more important than absolute accuracy, making it 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 ***GL1DE*** algorithm fuses the information from the L1 code and the L1 phase measurements into a Position-Time-Velocity (PVT) solution.

GL1DE 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 the NovAtel white papers at www.novatel.ca/products/whitepapers.htm for more information on ***GL1DE***. Refer also to application note "APN-038 Pseudorange/Delta-Phase (PDP) and ***GL1DE*** Filters" at www.novatel.com/support/applicationnotes.htm.

3.5 ALIGN®

3.5.1 ALIGN Heading Master and Remote Configurations

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

Master:

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

Remote:

```
interfacemode com2 rtca none off
log headinga onchanged              (heading, baseline length, pitch and other data)
log gphdt onchanged                 (NMEA heading formatted log)
```

3.6 Emulated Radar (ER)

A typical radar sensor emits radio beams that bounce off the ground, and computes ground speed based on the speed at which objects are passing in front of the sensor. The output of the sensor is a digital pulse, the frequency of which is proportional to the vehicle's ground speed. This is particularly useful for applications such as spraying and planting. The SMART-MR10 eliminates the need for

separate ground-sensing radar equipment by converting the GPS-derived velocity to proportional frequency output. The following emulated radar signal parameters can be configured by the customer:

- Frequency Step: Specifies how the frequency output relates to the vehicle speed.
- Signal Update Rate: Specifies how often the frequency output is updated to match the vehicle speed.
- Response Mode: Specifies how quickly changes in velocity are reflected in the frequency output. Setting a slower response mode reduces spikes (noise) in the velocity but increases latency. Setting a higher response mode reduces latency, but may result in noisier frequency output. Refer to *Appendix B.6, PDPFILTER Enable, disable or reset the PDP filter* starting on *page 84* for more detailed information.

Once it is configured using the RADARCFG command (see page 84), Emulated Radar (ER) data is output through the SMART-MR10 cable (see *Table 7* on *page 69*) and the RADARSIGNAL log (see page 93).

3.7 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 ***GL1DE***:

```
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* for further details on these commands.

Chapter 4 PC Utilities

Visit NovAtel's Web site at http://www.novatel.com/support/fwswupdates.htm for the most recent versions of the PC software and receiver firmware.

4.1 CDU/Convert Installation

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

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

The software operates from your PC's hard drive. You will need to install the software from the CD supplied by NovAtel or from our Web site:

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

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

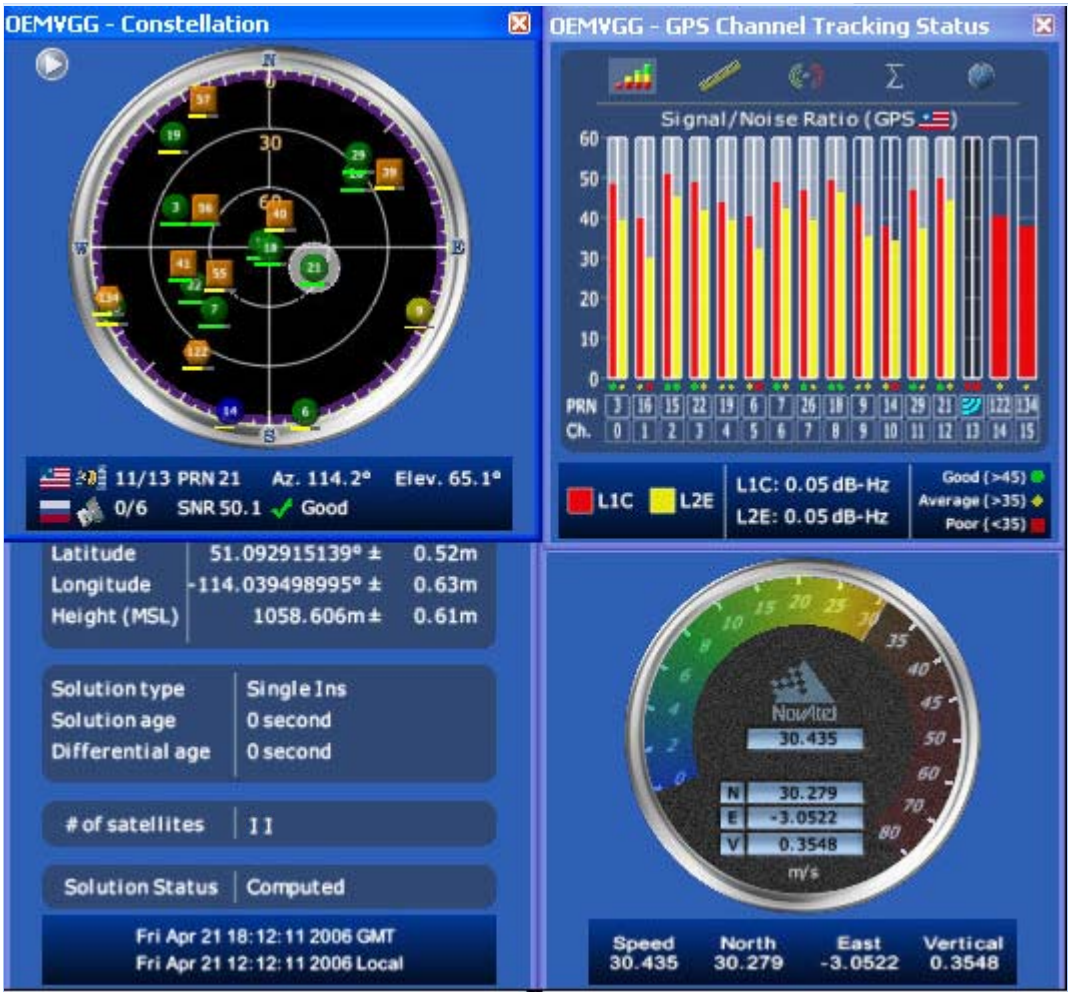
✉ The latest **CDU** is available to download from our Web site at:

http://www.novatel.com/support/fwswupdates.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, 0/6 next to the Russian flag means that while the receiver is tracking 6 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 enable 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, refer to your SPAN User Manual for more on INS. Information in the INS Position, Velocity, Attitude window is only available if you have an INS-capable receiver model.

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

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

- **Plan Window:** The Plan window provides real-time graphic plotting of the current position of each connected device. The latitude and longitude shown at the bottom of the window indicate the receiver's reference position, which is used as the center of the grid system. The receiver's

subsequent positions, shown with a yellow + marker, are given relative to this initial starting point. The current position is shown with a red + marker.

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

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

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

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

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

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

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

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

 ***WARNING!:*** **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 the 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**: Several wizards are available, if you have the necessary receiver model, to assist with various receiver operations. These are available through the Tools menu or, in some cases, through buttons in the toolbar.

  The Position Mode wizard takes you through the steps needed to set up your RTK system. You must have an RTK-capable receiver model or the wizard will not continue past its opening page.

  The SPAN wizards take 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 will not continue past its opening page. The SPAN wizards help with the alignment or calibration of a SPAN system.

  The ALIGN wizard allows you to set up your remote and master so that your remote can receive heading information, if you have an ***ALIGN***-capable receiver.

  The Troubleshooting wizard enables the logging of specific logs for 10 minutes.

  The COM Port wizard retrieves configuration information from your receiver and guides you through COM port and interface mode configurations.

4.3 Convert

Convert is a 32-bit Windows application. It is shown in *Figure 9*. Convert will accept GPS file formats and convert them to ASCII, Binary or RINEX format. The application also allows the user to screen out particular logs by selecting the desired logs from the list of available logs. This feature is useful for screening particular logs out of large data files in either ASCII or Binary formats.

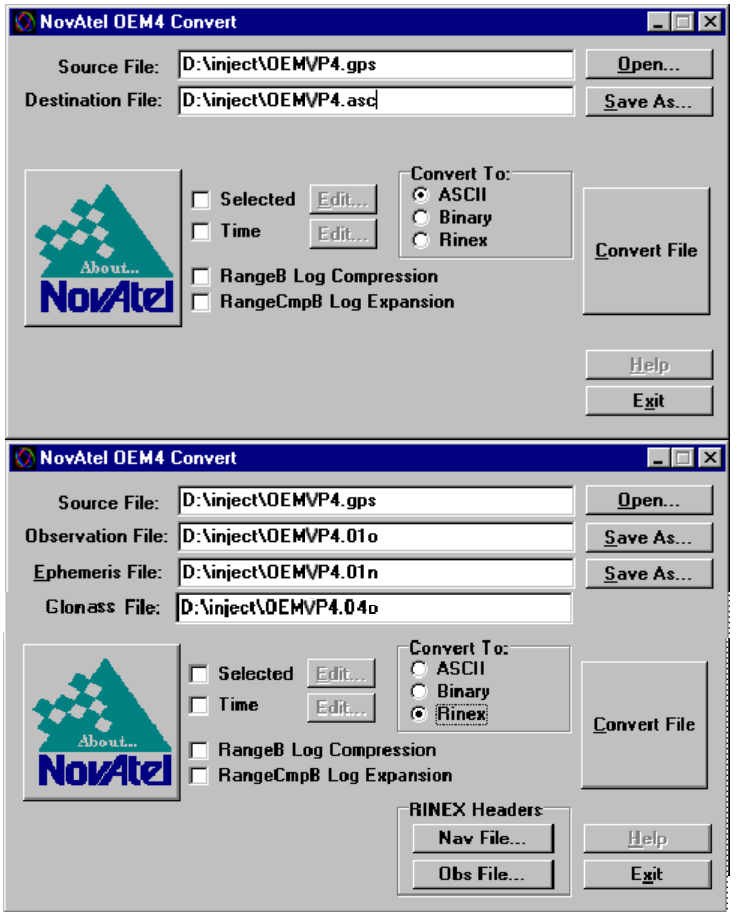


Figure 9: Convert4 Screen Examples

4.3.1 RINEX Format

The Receiver-Independent Exchange (RINEX[1]) 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 ssssdddf.yyt, where:

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

Selecting the RINEX field, see *Figure 9, Convert4 Screen Examples on page 50*, in the Convert4 To section causes the:

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

For best results, the NovAtel receiver input data file should contain the logs as in *Table 6, NovAtel Logs for RINEX Conversion* on *page 51*.

Table 6: NovAtel Logs for RINEX Conversion

NovAtel OEMV Family Log	Recommended Trigger
RANGEA/B, or RANGECMPA/B	ontime 1
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

a. Information from this log overrides data entered into the Receiver Number, Type and Version fields using the OBS file button of the RINEX Headers section, see *Figure 9* on *page 50.*

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 the hard drive on which Convert4 is stored. Type the following: convert4 -h

The Convert4 Command Line Arguments window appears as shown in *Figure 10*.

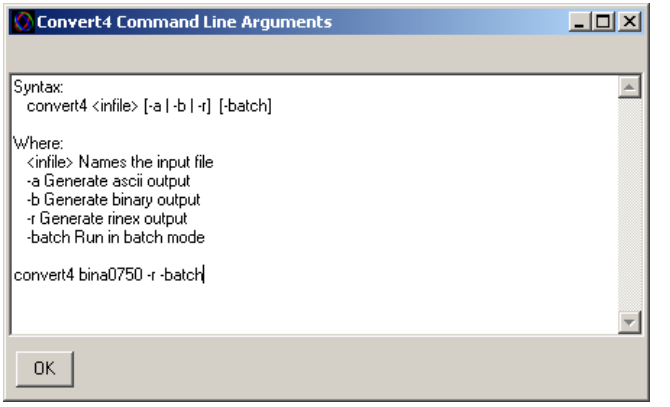


Figure 10: Convert4 Command Line Arguments

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

*.asc for ASCII

*.bin for binary

When converting to RINEX, the output files are named according to the RINEX Version 2.10 naming convention, see *Section 4.3.1, RINEX Format on page 50*.

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, you can use the AUTH command with the issued auth-code.

If you are upgrading to a higher firmware revision level, you will need to transfer new program firmware to the 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. 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 i*n the *OEMV Family Installation and Operation User Manual*).
2. Issue the LOG VERSION command to verify the current firmware model number, revision level, and serial number.
3. Issue the AUTH command, followed by the auth-code and model type. The syntax is as follows:

Syntax:

auth auth-code

where auth is a special command which allows program model upgrades

auth-code is the upgrade authorization code, expressed as hhhh,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,l1smrter

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. 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 11* on *page 55*.

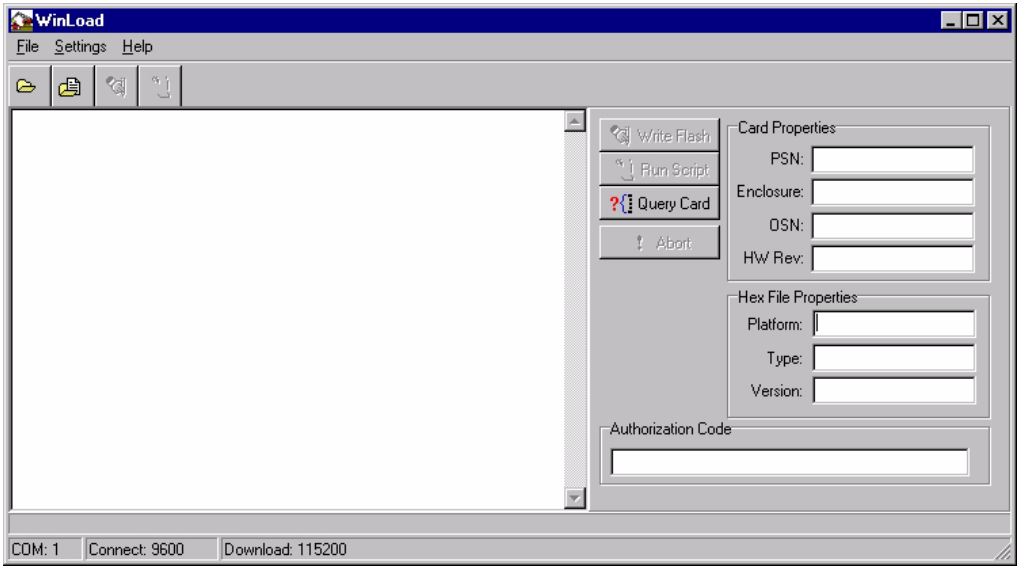


Figure 11: Main Screen of WinLoad

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

Open a File to Download

From the file menu choose *Open*. Use the *Open* dialog to browse for your file, see *Figure 12, WinLoad's Open Dialog on page 56*.

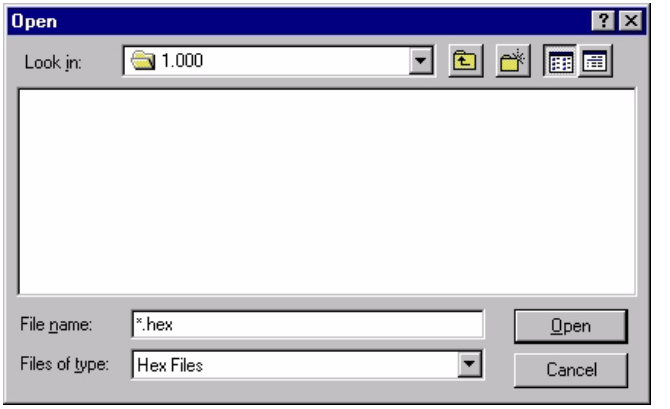


Figure 12: WinLoad's Open Dialog

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

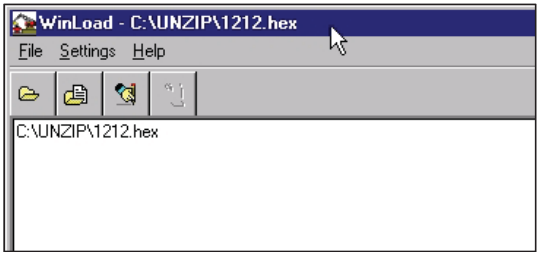


Figure 13: Open File in WinLoad

Communications Settings

To set the communications port and baud rate, select COM Settings from the Settings menu. Choose the port on your PC from the Com Port dropdown list and the baud rate from the Download Baudrate dropdown list. The baud rate should be as high as possible (the default of 115200 is preferred).

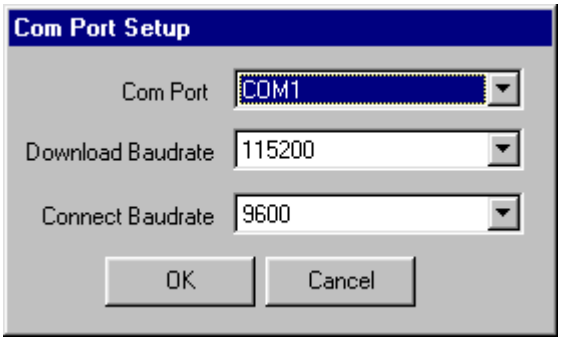


Figure 14: COM Port Setup

Downloading firmware

To download firmware follow these steps:

1. Set up the communications port as described in *Communications Settings* above.
2. Select the file to download, see *Open a File to Download* on *page 56*.
3. Make sure the file path and file name are displayed in main display area, see *Figure 13, Open File in WinLoad* on *page 56*.
4. Click on the Write Flash button to download the firmware.
5. Power down and then power up the receiver when “Searching for card” appears in the main display, see *Figure 15*.

Figure 15: Searching for Card

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

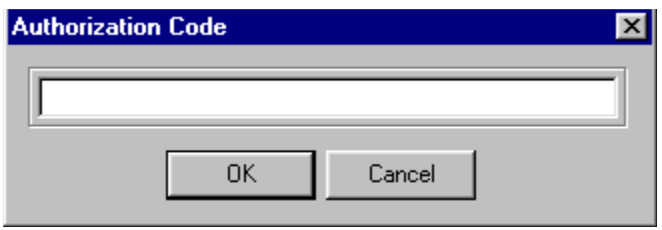


Figure 16: Authorization Code Dialog

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

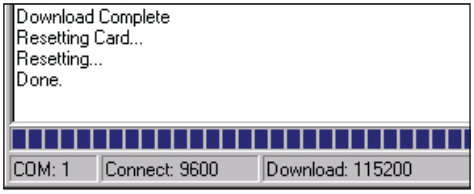


Figure 17: Upgrade Process Complete

7. Close WinLoad.

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

Chapter 5 *Bluetooth*® Configuration

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

- Enable *Bluetooth* on the SMART-MR10 receiver
- Set up a PC/laptop with a *Bluetooth* adaptor
- Locate a *Bluetooth*-enabled SMART-MR10 in range
- Communicate with the SMART-MR10 using *Bluetooth*
- Stop communicating with the SMART-MR10 using *Bluetooth*

5.1 Enable *Bluetooth* on the SMART-MR10 Receiver

The SMART-MR10 *Bluetooth* configuration is illustrated in *Figure 18*:

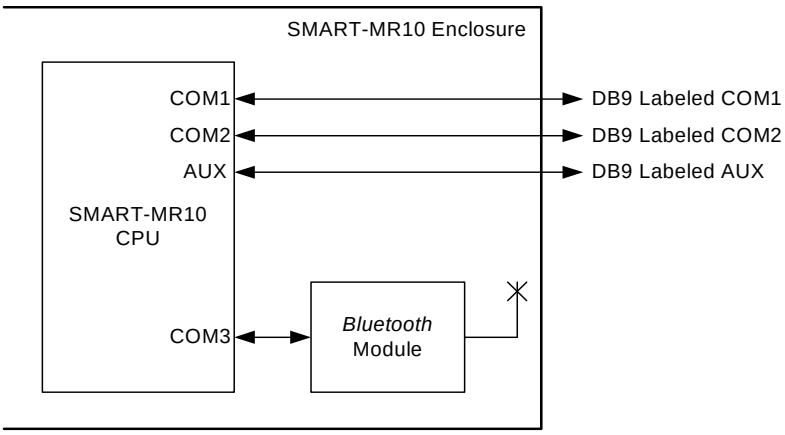


Figure 18: SMART-MR10 *Bluetooth* Configuration

Bluetooth is configured on the SMART-MR10 COM3 port and, by default, is enabled.

✉ If the SMART-MR10 is turned off (or power is removed) then turned back on, the *Bluetooth* mode is returned to the state it was in before power-down, as long as the SAVECONFIG command was issued before the unit was powered off. When you issue a FRESET command, COM3 defaults to *Bluetooth* mode.

If *Bluetooth* has been disabled, you will need to enable it before you can use it. From a PC/laptop, connect to a SMART-MR10 serial port. Open communication with the receiver using HyperTerminal or **CDU**. Refer to *Appendix B.2, BTCONTROL Enable/Disable Bluetooth* starting on *page 74* for further information. Once your PC/laptop is configured for *Bluetooth* operation, you will be able to communicate with the SMART-MR10 through *Bluetooth*.

5.2 Set Up a PC/Laptop with a *Bluetooth* Adaptor

If your PC/laptop is already *Bluetooth*-equipped and ready, proceed to *Section 5.3* on *Page 60*

1. With the PC/laptop powered on, install the driver(s) from the disc that came with your *Bluetooth* adapter.
2. Connect the *Bluetooth* adapter. An example of a D-Link USB adapter is shown in *Figure 19:*

Figure 19: *Bluetooth* Adapter for PC/Laptop

Within two minutes of connecting the USB adapter, the *Bluetooth* icon appears in the Windows task bar as shown in *Figure 20*.

Figure 20: *Bluetooth* Standby: White

Continue on to the next section when you see the white *Bluetooth* icon. If the *Bluetooth* icon is red, as shown in *Figure 21*, the *Bluetooth* installation on your PC/laptop is incorrect and you should return to step #1.

Figure 21: *Bluetooth* Error: Red

5.3 Locate a *Bluetooth*-Enabled SMART-MR10 in Range

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

1. Power on the SMART-MR10.
2. Double-click the *Bluetooth* icon in the task bar, as shown in *Figure 20*, or select *Programs* | *My Bluetooth Places* from the *Start* menu in Windows. The *My Bluetooth Places* window opens.
3. Click the *Search for devices in range* option from the *Bluetooth Tasks* side bar on the left of the *My Bluetooth Places* window. *Bluetooth*-enabled devices within range appear in the *Entire Bluetooth Neighborhood* folder, as shown in *Figure 22*.

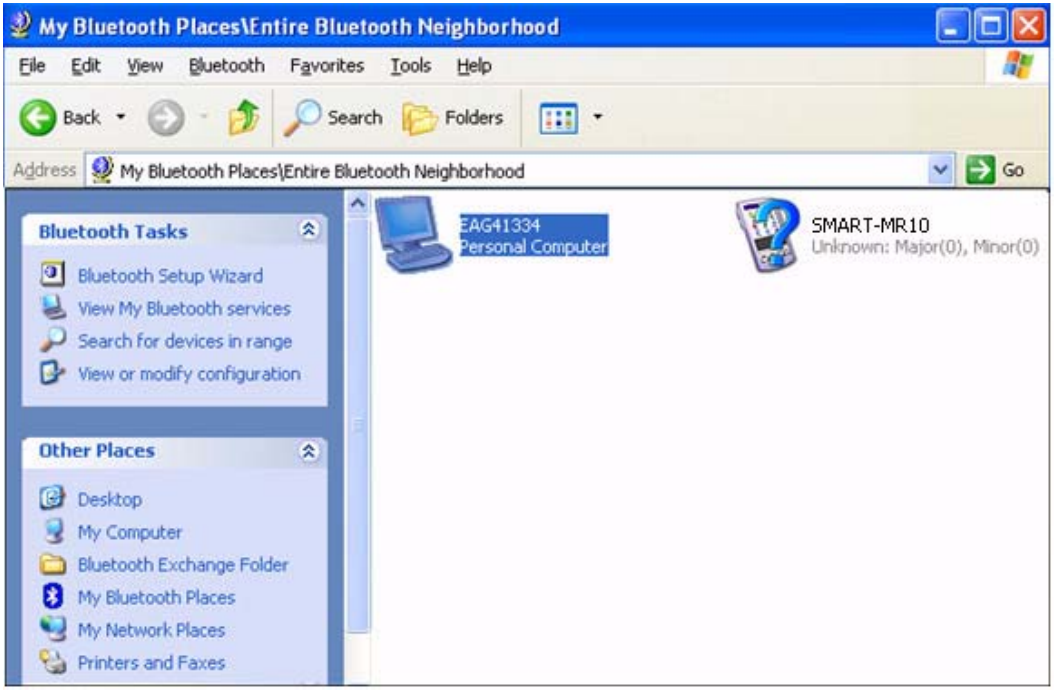


Figure 22: My *Bluetooth* Places Window

5.4 Communicate with the SMART-MR10 Using *Bluetooth*

1. Double-click the SMART-MR10 device icon in the *Entire Bluetooth Neighborhood* window, as shown in *Figure 22*. The PC/laptop searches for available services. If *Bluetooth* is working properly, a COM port service appears.
2. Double-click the COM3 icon. To use the serial COM port, the SMART-MR10 must be “paired” with the PC/laptop to use the COM3 port. The *Bluetooth* PIN Code Request dialog appears.
3. Enter the SMART-MR10 default pin number of four zeroes (0000), as shown in *Figure 23*:

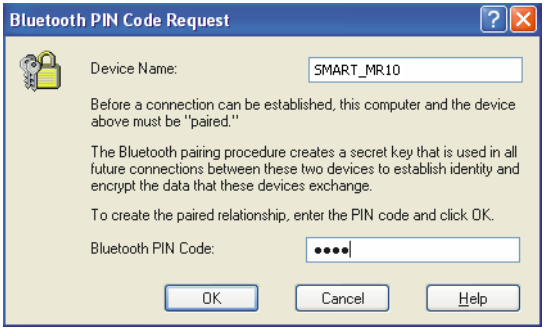


Figure 23: *Bluetooth* PIN Code Request

If the code is correct, a new *COM* dialog opens, showing the PC/laptop COM port that has been assigned to the *Bluetooth* link. For example, in *Figure 24*, the PC/laptop port is COM21.

Figure 24: PC/Laptop COM3 Port Assignment

4. Open a terminal program (HyperTerminal, for example) and configure it to the serial port specified in the *Bluetooth* configuration utility. In the above example, the terminal program must be configured to connect through COM21.
5. Configure the port settings as follows:

   9600 bps, no parity, 8 data bits, 1 stop bit, no handshaking, echo off
6. Through the terminal program, connect to the *Bluetooth* serial port, and verify the connection.
7. Type the following VERSION log request into the command prompt to ensure that the connection works:

   ```
   LOG VERSION
   ```

   The *Bluetooth* icon in the task bar turns green when it is connected, as shown in *Figure 25*.

Figure 25: *Bluetooth* Connected: Green

5.5 Stop Communicating with SMART-MR10 Using *Bluetooth*

1. Double-click the *Bluetooth* icon in the task bar, as shown in *Figure 20* on *page 60*, or select *Programs* | *My Bluetooth Places* from the *Start* menu in Windows. The *My Bluetooth Places* window opens.
2. Click the *Search for devices in range* option from the *Bluetooth Tasks* side bar on the left of the *My Bluetooth Places* window. *Bluetooth*-enabled devices within range appear in the *Entire Bluetooth Neighborhood* folder, as shown in *Figure 22* on *page 61*.
3. Double-click the SMART-MR10 device icon in the *Entire Bluetooth Neighborhood* window. The PC/laptop searches for available services. If *Bluetooth* is working properly, COM port service appears.
4. Right-click the *COM3* icon then select the *Disconnect Serial COM Port* option. A COM3 dialog box appears, as shown in *Figure 26*, requesting confirmation that you want to disconnect.

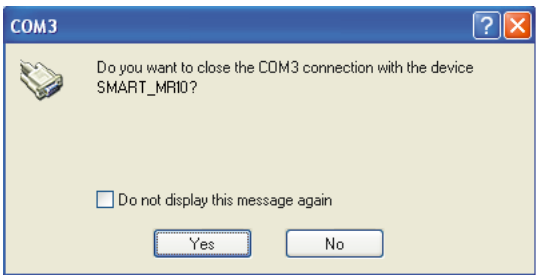


Figure 26: COM3 Disconnect?

5. Click *Yes* in the *COM3* dialog. The SMART-MR10 *Bluetooth* is unpaired from your PC/laptop. When the SMART-MR10 and PC/laptop *Bluetooth* are unpaired, the *Bluetooth* icon in the task bar appears white, as shown in *Figure 20* on *page 60*.

Appendix A Technical Specifications

A.1 SMART-MR10 Receiver Performance

PERFORMANCE			
Channel Configuration	14 GPS L1, 14 GPS L2, 6 GPS L5 12 GLONASS L1, 12 GLONASS L2 (optional) 2 SBAS[a] 1 L-band		
Horizontal Position Accuracy (RMS)[b]	Autonomous (L1) Autonomous (L1/L2) SBAS[a] CDGPS DGPS OmniSTAR VBS XP HP RT-20™[c](optional) RT-2™[c](optional)	1.5 m 1.2 m 0.6 m 0.6 m 0.4 m 0.6 m 0.15 m 0.1 m 0.2 m 1 cm+1 ppm	
Measurement Precision		GPS	GLONASS
	L1 C/A Code	4 cm RMS	15 cm RMS
	L1 Carrier Phase	0.5 mm RMS	1.5 mm RMS
	L2 P(Y) Code	8 cm RMS	8 cm RMS
	L2 Carrier Phase	1.0 mm RMS	1.5 mm RMS
Maximum Data Rate[d]	Measurements Position	20 Hz 20 Hz	
Time to First Fix	Cold Start[e] Hot Start[f]	65 s 35 s	
Signal Reacquisition	L1 L2	0.5 s (typical) 1.0 s (typical)	
Time Accuracy		20 ns RMS	
Velocity Accuracy[b]		0.03 m/s RMS	
Velocity[b]		515 m/s RMS	

a. Satellite Based Augmentation Systems (SBAS) include WAAS (North America), EGNOS (Europe) and MSAS (Japan).

b. 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.

c. Expected accuracy after convergence. RT-20 is independent of GLIDE.

d. Model specific.

e. Typical value. No almanac or ephemerides and no approximate position or time.

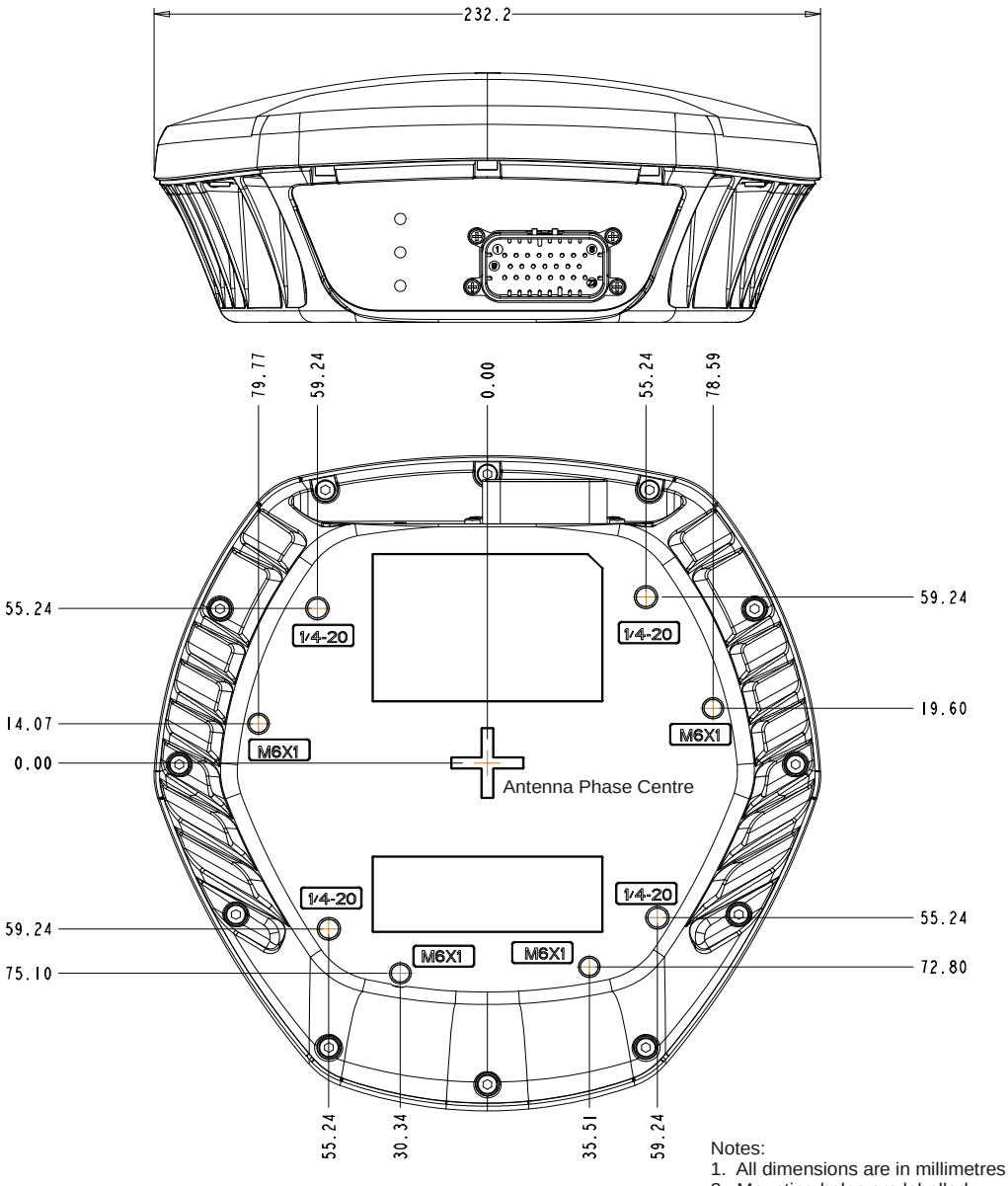
f. Typical value. Almanac and recent ephemerides saved and approximate time entered. For more information, Please refer to the “SETAPPROXTIME” command in the *OEMV Family Firmware Reference Manual* found on our Web site at http://www.novatel.com/support/docupdates.htm.

A.2 SMART-MR10 Specifications

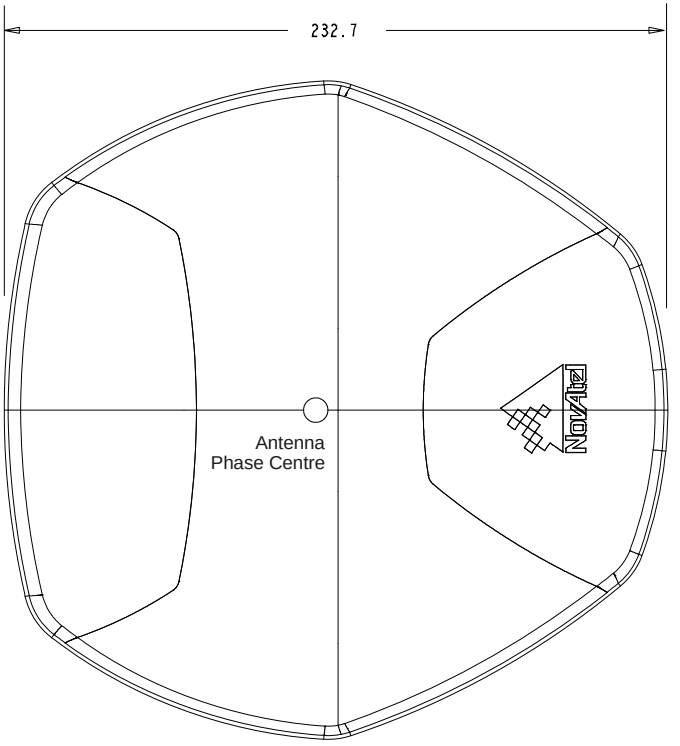
INPUT/OUTPUT CONNECTORS	
SMART-MR10 COM/ PWR	+8 to +36 V DC at 2.5 W (typical while logging) [a] For the cable pinouts and drawings, see *SMART-MR10 Evaluation Cable (Part Number 01018515) starting on page 68* and *SMART-MR10 Streamlined Cable (Part Number 01018526) starting on page 70*.
Serial Com Ports	3 RS-232 serial ports (1 port configurable to RS422) [230,400 bps maximum]
CAN	SAE J1939/ ISO 11783/ ISO 11898 Compliant
Emulated Radar Output	High = Supply Voltage -0.5V Minimum Low = 0.5 V Maximum Load = 3K Ohm Minimum
PPS Output	3.3 V CMOS Logic Compatible
MKI Input	3.3 V CMOS Logic/ 5 V Tolerant
Mode Pin	0 to 36 V DC (depending on the desired configuration, the Mode pin can be left open, connected to ground, or connected to the supply voltage)
INPUT/ OUTPUT CONNECTOR PROTECTION	
Electrical Conducted/ Coupled disturbance tolerance	ISO 7637-2:2004 (Survives all pulse types) ISO 15003 (TBD)
LED INDICATORS	
More details can also be found in *Section 2.2.2, Status Indicators* starting on *Page 28*	
PHYSICAL	
Size	223 mm x 223 mm x 90 mm height
Weight	2.2 kg 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 [b]	Random MIL-STD-810F Method 514.5 C17 Sinusoidal IEC 68-2-6 ASAE EP455, 5.15.2 Level 1 (TBD) Shock MIL-STD-810 F Method 516.5

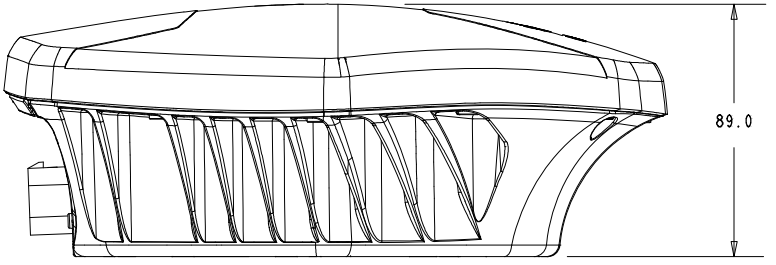
a. When tracking GPS satellites.
b. See also the *Notice* section of this manual starting on *Page 13.*

DIMENSIONS



Notes:
1. All dimensions are in millimetres
2. Mounting holes are labelled according to their size and thread.





Note: All dimensions are in millimetres

A.2.1 SMART-MR10 Evaluation Cable (Part Number 01018515)

The SMART-MR10 evaluation cable provided with the SMART-MR10 Development Kit, is illustrated in *Figure 27* and equipped as follows:

- Exposed power wires (red for positive and black for negative) are connected to a 12 or 24V vehicular power circuit (or equivalent), which must be protected by a user-supplied 5A fuse (NovAtel recommends an automotive blade-type fuse rated for 5A with an operating voltage of more than 36 V).
- Two DB-9 connectors. One of these is normally connected to a PC/laptop serial (RS-232) communication port and another to a modem or radio transmitter, to propagate differential corrections (refer to your user-supplied modem or radio transmitter user guide for more information).
- Four pairs of bare wires, where the outer insulation is cut away but the wires beneath are intact. These are provided for emulated radar, MKI, PPS, and CAN bus. See *Table 7* on *page 69* for their pinouts and use. For more information on mating connectors and part numbers, see *Table 9* on *page 72*.

This cable is RoHS compliant.

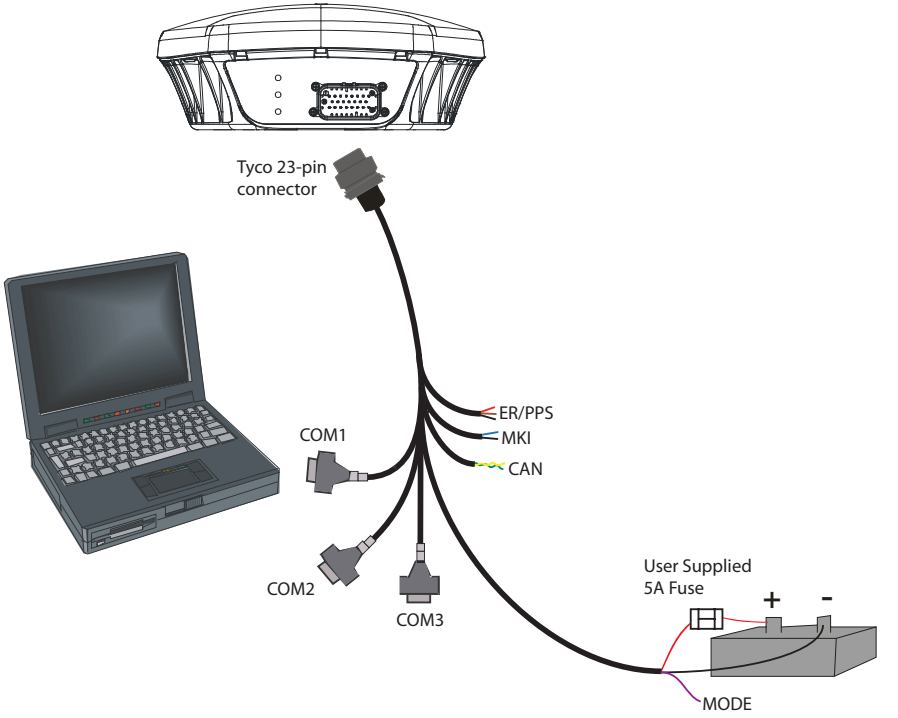


Figure 27: SMART-MR10 Evaluation Cable

Table 7: SMART-MR10 Evaluation Cable Pinouts

TYCO 23-PIN	COM1 D-SUB	COM2 D-SUB	COM3 D-SUB	TINNED LEAD	SIGNAL NAME
1				PWR+	PWR+
2				PWR-	PWR-
3				CAN-	CAN-
4				CAN+	CAN+
5		2			TXD2
6		3			RXD2
7	2				TXD1
8			2		RTS1/AUXTX/TXD3
9				SIGGND2	SIGGND2
10	RESERVED				
11	RESERVED				
12	RESERVED				
13	RESERVED				
14	CHASSIS GROUND[a]				
15	5	5	5	SIGGND1	SIGGND1
16				MKI	MKI
17				PPS	PPS
18				ER	ER
19				MODE	MODE
20	RESERVED				
21	RESERVED				
22			3		CTS1/AUXRX/RXD3
23	3				RXD1

a. Pin 14 is connected to cable shields.

A.2.2 SMART-MR10 Streamlined Cable (Part Number 01018526)

The SMART-MR10 streamlined cable, designed for reduced size and weight, and increased flexibility, provides:

- Connection to a battery while operating in the field. The exposed wires (red for positive and black for negative) can be connected to a 12 or 24V vehicular power circuit (or equivalent), which must be protected by a user-supplied 5A fuse (NovAtel recommends an automotive blade-type fuse rated for 5A with an operating voltage of more than 36 V).
- Two DB-9 connectors. One of these is normally connected to a PC/laptop serial (RS-232) communication port and the other to a modem or radio transmitter to propagate differential corrections (refer to your user-supplied modem or radio transmitter user guide for more information on its connectors).
- One pair of bare wires, where the outer insulation is cut away but the wires beneath are intact, are provided for emulated radar. See *Table 8* on *page 71* for their pinouts. For more information on mating connectors and part numbers, see *Table 9* on *page 72*.

This cable is RoHS compliant.

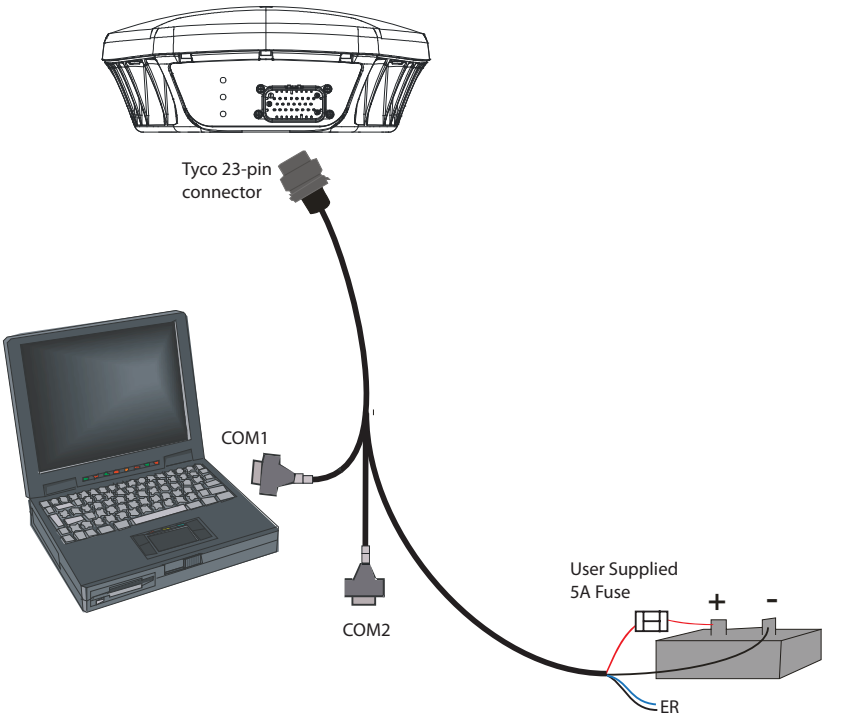


Figure 28: SMART-MR10 Streamlined Cable

Table 8: SMART-MR10 Streamlined Cable Pinouts

TYCO 23-PIN	COM1 D-SUB	COM2 D-SUB	TINNED LEAD	SIGNAL NAME
1			PWR+	PWR+
2			PWR-	PWR-
3	RESERVED			
4	RESERVED			
5		2		TXD2
6		3		RXD2
7	2			TXD1
8	RESERVED			
9			SIGGND2	SIGGND2
10	RESERVED			
11	RESERVED			
12	RESERVED			
13	RESERVED			
14	CHASSIS GROUND[a]			
15	5	5	SIGGND1	SIGGND1
16	RESERVED			
17	RESERVED			
18			ER	ER
19	RESERVED			
20	RESERVED			
21	RESERVED			
22	RESERVED			
23	3			RXD1

a. Pin 14 is connected to cable shields.

A.2.3 SMART-MR10 Connector and Cable Requirements

Custom cables for installing your SMART-MR10 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 (value TBD) fast blow fuse
- Serial data signals (TxD, RxD, signal ground) must be run in shielded cable. Connect shields to ground at SMART-MR10 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-MR10 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-MR10. These numbers are provided for information only and are not available from NovAtel as separate parts.

Table 9: SMART-MR10 Mating Connectors

Product	Part Description	Company	Part Number
SMART-MR10 mating connector (see *Figure 27, SMART-MR10 Evaluation Cable* on *Page 68* and *Figure 28, SMART-MR10 Streamlined Cable* on *Page 70*)	23-pin sealed receptacle housing black	Tyco/ AMP	1-770680-1
Gold plated pins for SMART-MR10 connector/loose	Pins, loose piece	Tyco/ AMP	770854-3
Gold plated pins for SMART-MR10 connector/strip	Pins, strip (reel)	Tyco/ AMP	770520-3

Table 10 details the part numbers for recommended fuses. These numbers are provided for information only and are not available from NovAtel as separate parts.

Table 10: Recommended Fuses

Fuse	Recommended Fuse/Fuse Holder	
Blade Fuse 58V 5A	Littelfuse	142.6185.450
Mini Blade Fuse 58V 5A	Littelfuse	0997005

Appendix B Commands

The SMART-MR10 firmware implements the OEMV family command set, documented in *OEMV Family Firmware Reference Manual*. For convenience, commonly used SMART-MR10 commands are summarized in Table 11 and documented in this appendix.

Table 11: Commonly Used SMART-MR10 Commands in Alphabetical Order

ASCII Command	Message ID	Description
btcontrol	8205	Enable/disable *Bluetooth*.
com	4	Configure the receiver's asynchronous serial ports communications drivers.
freset	20	Clear data stored in non-volatile memory and reset.
log	1	Request logs from the receiver.
pdpfilter	424	Enable, disable or reset the PDP (Pseudorange Delta-Phase) filter.
pdpmode	970	Select the PDP filter mode and dynamics.
radarcfg	8192	Configure the ER signal output.
reset	18	Perform a hardware reset.
sbascontrol	652	Set SBAS test mode and PRN.

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-MR10, an OEMV-3 based receiver, is capable of processing, refer to the *OEMV Family Firmware Reference Manual.*

B.1 SYNTAX CONVENTIONS

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

1. `Courier` font is used to illustrate program output or user input.
2. References to other commands, logs or any of their fields are shown in *italics*.
3. The commands are not case sensitive. For example, you could type either `RESET` or `reset`.
4. Except where noted, either a space or a comma can separate commands and their required entries. For example, you could type either `fix position 51.11358042 -114.04358013 1059.4105` or `fix position 51.11358042, -114.04358013, 1059.4105`.
5. At the end of a command, a carriage return is required. For example, press <Enter> or <Return> on your keyboard.
6. Responses are provided to indicate whether or not an entered command was accepted. The format of the response depends on the format of the command. Refer to the *OEMV Family Firmware Reference Manual* for more information.

7. Optional parameters are indicated by square brackets ([ ]). For commands that contain optional parameters, the value used if the optional parameter is not specified is given in the syntax table for the command.
8. Data format definitions, as specified in the "Format" field, are detailed in the *OEMV Family Firmware Reference Manual*. Note that all binary data is little-endian byte-ordered.

B.2 BTCONTROL Enable/Disable *Bluetooth*

The BTCONTROL command enables or disables the *Bluetooth* module. To ensure no possibility of interference, when the module is disabled it is completely powered down.

Abbreviated ASCII Syntax: **Message ID: 8205**

```
BTCONTROL switch
```

Factory Default:

The *Bluetooth* module is enabled by default.

Example 1 to disable *Bluetooth*:

```
btcontrol disable
```

Example 2 to enable *Bluetooth*:

```
btcontrol enable
```

Field	Data	Description	Binary Bytes	Binary Format	Binary 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 *Bluetooth* 0 = ENABLE 1 = DISABLE (default = ENABLE)	4	Enum	H

✉ 1. If users want the current state of the *Bluetooth* module to persist across receiver resets and power-ups, they should issue a saveconfig command.

2. Changing the *Bluetooth* from disabled to enabled takes several seconds to execute. This means that, even though the user will get an immediate "OK>" response followed by the COM prompt, the *Bluetooth* module may not be ready for communication.

B.3 COM Configure COM Port

This command permits you to configure the receiver's asynchronous serial port communications drivers.

The current COM port configuration can be reset to its default state at any time by sending it two hardware break signals of 250 milliseconds each, spaced by fifteen hundred milliseconds (1.5 seconds) with a pause of at least 250 milliseconds following the second break. This will:

- Stop the logging of data on the current port (see *UNLOGALL* command in the *OEMV Family Firmware Reference Manual*).
- Clear the transmit and receive buffers on the current port.
- Return the current port to its default settings (see Factory Defaults section in Chapter 2 Commands of the *OEMV Family Firmware Reference Manual*).
- Set the interface mode to NovAtel for both input and output (see *INTERFACEMODE* command in the *OEMV Family Firmware Reference Manual*).

✉ Baud rates higher than 115,200 bps are not supported by standard PC hardware. Special PC hardware may be required for higher rates, including 230400 bps, 460800 bps and 921600 bps. Also, some PC's have trouble with baud rates beyond 57600 bps.

Abbreviated ASCII Syntax: **Message ID: 4**

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

Factory Default:

```
com com1 9600 n 8 1 n off on
com com2 9600 n 8 1 n off on
com aux 9600 n 8 1 n off on
```

✉ Do not alter the COM3 port configuration, since COM3 is reserved for *Bluetooth.*

ASCII Example:

```
com com1,57600,n,8,1,n,off,on
```

✉ Watch for situations where the COM ports of two receivers are connected together and the baud rates do not match. Data transmitted through a port operating at a slower baud rate may be misinterpreted as break signals by the receiving port if it is operating at a higher baud rate. This is because data transmitted at the lower baud rate is stretched relative to the higher baud rate. In this case, configure the receiving port to have break detection disabled using the COM command.

WARNING!: **Use the COM command before using the *INTERFACEMODE* command on each port. Turn break detection off using the COM command to stop the port from resetting because it is interpreting incoming bits as a break command.**

Table 12: COM Serial Port Identifiers

Binary[a]	ASCII	Description
1	COM1	COM port 1
2	COM2	COM port 2
3	COM3	COM port 3 (available over *Bluetooth*)
6	THISPORT	Current COM port
16	AUX	AUX port

a. This table lists the commonly used SMART-MR10 COM ports. For a complete list of COM ports, refer to the COM Serial Port Identifiers table in the COM command section of the *OEMV Family Firmware Reference Manual*.

Table 13: Parity

Binary	ASCII	Description
0	N	No parity (default)
1	E	Even parity
2	O	Odd parity

Table 14: Handshaking

Binary	ASCII	Description
0	N	No handshaking (default)
1	XON	XON/XOFF software handshaking
2	CTS	CTS/RTS hardware handshaking

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	COM 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	port	See *Table 12, COM Serial Port Identifiers* on *Page 76*		Port to configure. (default = THISPORT)	Enum	4	H
3	bps/baud	300, 600, 900, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, or 230400		Communication baud rate (bps). Bauds of 460800 and 921600 are also available on COM1 of OEMV-2-based products.	ULong	4	H+4
4	parity	See *Table 13* on *Page 76*		Parity	Enum	4	H+8
5	databits	7 or 8		Number of data bits (default = 8)	ULong	4	H+12
6	stopbits	1 or 2		Number of stop bits (default = 1)	ULong	4	H+16
7	handshake	See *Table 14* on *Page 76*		Handshaking	Enum	4	H+20
8	echo	OFF	0	No echo (default)	Enum	4	H+24
		ON	1	Transmit any input characters as they are received			
9	break	OFF	0	Disable break detection	Enum	4	H+28
		ON	1	Enable break detection (default)			

B.4 FRESET Clear Selected Data from NVM and Reset

This command is extended to include SMART-MR10 features. An additional target field, *userdata* (value = 10), resets only the SMART-MR10 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 15*		Data to be reset by the receiver	Enum	4	H

Table 15: 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-MR10-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.5 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 Family 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 no USB ports, 7 logs are already accounted for, as shown below:

- RXSTATUSEVENT on COM1, COM2, and COM3
- TRACKSTAT, BESTVEL, and PSRXYZ on XCOM1

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 rxstatuseventa onnew 0 0 hold
log com2 rxstatuseventa onnew 0 0 hold
log com3 rxstatuseventa onnew 0 0 hold
log aux rxstatuseventa onnew 0 0 hold
log usb1 rxstatuseventa onnew 0 0 hold
log usb2 rxstatuseventa onnew 0 0 hold
log usb3 rxstatuseventa 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 Family 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 16, Detailed Serial Port Identifiers* on *Page 82*	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, MKI	
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 16: Detailed Serial Port Identifiers

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

Continued on the following page

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. Not available with SMART-MR10.

B.6 PDPFILTER Enable, disable or reset the PDP filter

This command enables, disables or resets the Pseudorange/Delta-Phase (PDP) filter. The main advantages of the Pseudorange/Delta-Phase (PDP) implementation are:

- Smooths a jumpy position
- Bridges outages in satellite coverage (the solution is degraded from normal but there is at least a reasonable solution without gaps)

✉ Enable the PDP filter to output the PDP solution in BESTPOS, BESTVEL and NMEA logs.

✉ Refer to the *Operation* chapter of the *OEMV Installation and Operation Manual* for a section on configuring your receiver for PDP or ***GL1DE*** operation.

GL1DE Position Filter

GL1DE is a mode of the PDP[1] filter which optimizes the position for consistency over time rather than absolute accuracy. This is ideally in clear sky conditions where the user needs a tight, smooth, and consistent output. The ***GL1DE*** filter works best with CDGPS or WAAS. The PDP filter is smoother than a least squares fit but is still noisy in places. The ***GL1DE*** filter produces a very smooth solution with consistent rather than absolute position accuracy. There should be less than 1 cm difference typically from epoch to epoch. ***GL1DE*** also works in single point, DGPS and OmniSTAR VBS modes. See also the PDPMODE command on *page 85*.

Abbreviated ASCII Syntax: **Message ID: 424**

```
pdpfilter switch
```

Factory Default:

```
pdpfilter disable
```

ASCII Example:

```
pdpfilter enable
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PDPFILTER 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	switch	DISABLE	0	Enable/disable/reset the PDP filter. A reset clears the filter memory so that the pdp filter can start over.	Enum	4	H
		ENABLE	1				
		RESET	2				

1. Refer also to our application note on *Pseudorange/Delta-Phase (PDP)*, available on our Web site as APN-038 at http://www.novatel.com/support/applicationnotes.htm

B.7 PDPMODE Select the PDP mode and dynamics

This command allows you to select the mode and dynamics of the PDP filter.

✉ 1. You must issue a *PDPFILTER enable* command before the PDPMODE command. See *PDPFILTER Enable, disable or reset the PDP filter starting on page 84*.

2. If you choose RELATIVE mode (***GL1DE***) while in WAAS or CDGPS mode:

- With an L1-only receiver model, you must force the iono type to GRID in the *SETIONOTYPE* command.
- With an L1/L2 receiver model, you must force the iono type to L1L2 in the *SETIONOTYPE* command.

Abbreviated ASCII Syntax: **Message ID: 970**

```
pdpmode mode dynamics
```

Factory Default:

```
pdpmode normal auto
```

ASCII Example:

```
pdpmode relative dynamic
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PDPMODE 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	mode	NORMAL	0	In relative mode, ***GL1DE***, performance is optimized to obtain a consistent error in latitude and longitude over time periods of 15 minutes or less rather than to obtain the smallest absolute position error. See also *GL1DE Position Filter* on *Page 84*.	Enum	4	H
		RELATIVE	1				
3	dynamics	AUTO	0	Auto detect dynamics mode	Enum	4	H+4
		STATIC	1	Static mode			
		DYNAMIC	2	Dynamic mode			

B.8 RADARCFG Configure the ER output

Use this command to configure the Emulated Radar (ER) output. ER is available through the SMART-MR10 multi-cable, see *page 69* 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 kilometre per hour. Range: 26.11, 28.12 or 36.11 (default = 36.11)	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 *Table 17.* (Default = 500)[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 2000ms, the number of samples used will be 10.

Table 17: 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, update rate to 1 Hz and no smoothing: `radarcfg enable 36.11 1 1 2`

B.9 RESET Performs a hardware reset

This command performs a hardware reset. Following a RESET command, the receiver initiates a cold-start boot up. Therefore, the receiver configuration reverts either to the factory default, if no user configuration was saved, or the last *SAVECONFIG* settings.

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

Abbreviated ASCII Syntax: **Message ID: 18**

```
reset [delay]
```

Example

```
reset 120
```

✉ The RESET command can be used to erase any unsaved changes to the receiver configuration.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RESET 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	delay			Seconds to wait before resetting. (default = 0)	Ulong	4	H

B.10 SBASCONTROL Set SBAS test mode and PRN

This command allows you to dictate how the receiver handles Satellite Based Augmentation System (SBAS) corrections. The receiver automatically switches to Pseudorange Differential (RTCM or RTCA) or RTK if the appropriate corrections are received, regardless of the current setting.

To enable the position solution corrections, you must issue the SBASCONTROL ENABLE command. The GPS receiver does not attempt to track any GEO satellites until you use the SBASCONTROL command to tell it to use either WAAS, EGNOS, or MSAS corrections.

When in AUTO mode, if the receiver is outside the defined satellite system's corrections grid, it reverts to ANY mode and chooses a system based on other criteria.

Once tracking satellites from one system in ANY or AUTO mode, it does not track satellites from other systems. This is because systems such as WAAS, EGNOS and MSAS do not share broadcast information and have no way of knowing each other are there.

The "testmode" parameter in the example is to get around the test mode of these systems. EGNOS at one time used the IGNOREZERO test mode. At the time of printing, ZEROTOTWO is the correct setting for all SBAS, including EGNOS, running in test mode. On a simulator, you may want to leave this parameter off or specify NONE explicitly.

When you use the SBASCONTROL command to direct the GPS receiver to use a specific correction type, the GPS receiver begins to search for and track the relevant GEO PRNs for that correction type only.

You can force the GPS receiver to track a specific PRN using the ASSIGN command. You can force the GPS receiver to use the corrections from a specific SBAS PRN using the SBASCONTROL command.

Disable stops the corrections from being used.

Abbreviated ASCII Syntax: **Message ID: 652**

```
sbascontrol keyword [system] [prn] [testmode]
```

Factory Default:

```
sbascontrol disable auto 0 none
```

Abbreviated ASCII Example 1:

```
sbascontrol enable waas 0 zerototwo
```

✉ NovAtel's OEMV receivers work with SBAS systems including EGNOS (Europe), MSAS (Japan) and WAAS (North America)

System Types

ASCII	Binary	Description
NONE	0	Don’t use any SBAS satellites
AUTO	1	Automatically determine satellite system to use (default)
ANY	2	Use any and all SBAS satellites found
WAAS	3	Use only WAAS satellites
EGNOS	4	Use only EGNOS satellites
MSAS	5	Use only MSAS satellites

Appendix C Logs

C.1 Position Logs

C.1.1 NMEA Logs

The NMEA logs (receiver outputs) supported by the SMART-MR10 are summarized in Chapter 3 of the *OEMV Family Firmware Reference Manual* in section "NMEA Standard Logs". The available logs include:

- GPGGA, which outputs a log of position system fix data and undulation. There are variants of GPGGA, specifically:
  - GPGGARTK, which has greater precision than GPGGA but with the loss of the undulation field
  - GPGGALONG, which has both greater precision and the undulation field
- GPVTG, which outputs track made good and ground speed

Each of the available NMEA standard logs is described in more detail in its own section of Chapter 3 of the *OEMV Family Firmware Reference Manual*.

The steps for configuring the receiver output, through the command line are:

1. Configure the communication port using the COM command, described in *Appendix B.3, COM Configure COM Port* on *Page 75*. To set COM port 2 as follows:

Bit Rate	9600
Parity	none
Data Bits	8
Stop Bits	1
Handshaking	None
Echo	Off
Break	On

   enter the following string:

   ```
   com com2 9600 n 8 1 n off on
   ```

2. Select and configure the NMEA string that you want to output. The information is described in Chapter 3 Data Logs of the *OEMV Family Firmware Reference Manual*, in the section for the particular log. For example, to log gpgga (position system fix data and undulation) at 2 Hz, enter the following string:

   ```
   log gpgga ontime 0.5
   ```

You can configure the log to output at various frequencies, as described in *Appendix B.5, LOG Request Logs from the Receiver* on *Page 79*.

The above command line operations can also be carried out through the CDU. Information about configuring the communication port can be found in the CDU online help in Contents > Getting Started > Connecting to the receiver. Information about logging data can be found in Getting Started > Logging Data. The procedure for adding a NMEA log through the CDU is summarized as follows:

1. In the **Logging control** window, click *Logging to one or more of the receiver's serial ports*. The **Add Log** window displays.
2. Beside **Select list**, select *Complete List* or *NMEA List*.
3. Beside **Log to file**, select the NMEA log you want to add.
4. Select the port.
5. Configure the remaining fields then click *Add*.

C.1.2 NovAtel Position Logs

In addition to NMEA logs, NovAtel supports a range of non-NMEA position logs, described in the *OEMV Family Firmware Reference Manual*, including:

- BESTPOS: This log contains the best available position (GPS and GLONASS if available), computed by the receiver, for example:
  ```
  log bestposa ontime 0.5
  ```
- BESTXYZ: This log contains the receiver’s best available position and velocity in ECEF coordinates, for example:
  ```
  log bestxyza ontime 1
  ```

C.2 Other Logs

The SMART-MR10 firmware generates the logs in *Table 18*, 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 18: SMART-MR10 Logs in Alphabetical Order

Message ID	ASCII Log	Description
8193	RADARSIGNAL	Radar signal and position information (new SMART-MR10 log)
37	VERSION	Hardware versions, software versions, and serial numbers (existing OEMV log extended to SMART-MR10)

C.2.1 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-MR10):

```
#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-MR10):

```
#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 *Table 20, Solution Status* on *Page 96*	Enum	4	H
3	vel type	Velocity type, see *Table 19, Position or Velocity Type* on *Page 95*	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 *SMART-MR10 Evaluation Cable starting on Page 68*.	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 19: 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 20: 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.2.2 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-MR10 information as in *Table* .

Table 21: Component Type

Binary Value[a]	ASCII Value	Description
0	UNKNOWN	Unknown Component
1	GPSCARD	OEMV GPSCard Component
3	ENCLOSURE	SMART-MR10 Receiver
8	USERINFO	User-application information component
981073925 (0x3A7A0005)	DB_USERAPPAUTO	Auto-starting user-application firmware

a. Unused numbers are reserved for future use.

For the SMART-MR10, the BT MAC address field has been added, in hexadecimal format, to the USERINFO block, “002166000001” in the following example.

```
[COM1]<VERSION COM1 0 94.5 UNKNOWN 0 156.357 004c0001 3681 5010
<     3
<          GPSCARD "N1GA" "DHC09401037" "MCAGTP-1.00-22B"
           "3.710" "3.002" "2009/Nov/30" "11:08:19"
<          DB_USERAPPAUTO "SmartAg" "0" "" "1.100" ""
           "2009/Nov/27" "13:22:29"
<          USERINFO "LMX9830" "0212" "002166000001" "" "" "" ""
[COM1]
```

In the above example, the firmware is shown as 3.710 and the SMART-MR10 application is shown as 1.100.

Appendix D Replacement Parts

The following are a list of the replacement parts available for your NovAtel SMART-MR10 receiver. Should you require assistance, or need to order additional components, please contact your local NovAtel dealer or Customer Service representative.

D.1 SMART-MR10

Part Description	NovAtel Part
SMART-MR10	01018518
Full connectivity cable [23-pin socket to 3 DB-9 connectors, twisted CAN I/O pair, and other bare wire connectors (see *SMART-MR10 Evaluation Cable (Part Number 01018515) starting on Page 68*)]	01018515
Streamlined cable	01018526
Universal Mounting Plate	70023085
AG GPS 262 Mounting Plate	70023086
Pole Mount	70023087

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

D

E

F

G

H

I

L

M

N

O

P

R

S

T

U

V

W