SMART6-L™
User Manual

OM-20000146 Rev 1 March 2013

SMART6-L User Manual

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Warranty

NovAtel® Inc. warrants that its GNSS products are free from defects in materials and workmanship, subject to the conditions set forth on our web site: http://www.novatel.com/products/warranty/.

Antenna Module	One (1) Year
Cables and Accessories	Ninety (90) Days
Software Warranty	One (1) Year

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To return products, refer to the instructions found under the Return Policy Tab on the Warranty page: http://www.novatel.com/products/warranty/.

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#5,390,207	#6,608,998 B1
#5,495,499	#6,452,560 B2
#5,734,674	#6,728,637 B2
#5,809,064	#6,664,923 B1
#5,414,729	#6,922,167 B2
#5,736,961	#7,250,916
#6,243,409 B1	#7,738,536 B2
#6,184,822 B1	#7,738,606 B2
#6,211,821 B1	#7,885,317 B2
#6,445,354 B1	

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Notice

The following notices apply to the SMART6-L.

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

FCC Notices

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

SMART6-L 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.

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 by 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 SMART6-L
- Increase the separation between the equipment and the SMART6-L
- Connect the equipment to an outlet on a circuit different from that to which the SMART6-L is connected
- Consult the dealer or an experienced radio/TV technician for help

In order to maintain compliance as a Class "B" digital device, shielded cables should be used for the RS-232 serial data ports (Belden 1036A or equivalent) and twisted pair cable should be used for the CAN port (shielded twisted pair will improve CAN performance in electrically harsh environments). I/O signals should be referred to signal ground (connector pin 5) and not power ground (connector pin 9). If I/O signals route to different areas of the vehicle, dedicated signal grounds for I/O should be spliced into a common connection to connector pin 5 at a point close to the SMART6-L.

Industry Canada

SMART6-L Class B digital apparatuses comply with Canadian ICES-003.

SMART6-L appareils numérique de la classe B sont conforme à la norme NMB-003 du Canada.

CE

The enclosures carry the CE mark.

"Hereby, NovAtel Inc. declares that this SMART6-L is in compliance with the essential requirements and other relevant provisions of the R&TTE Directive 1999/5/EC, the EMC Directive 4/108/EC and the RoHS Recast Directive 2011/65/EU."

WEEE

If you purchased your OEM6 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]

1.Visit the NovAtel Web site at www.novatel.com/products/weee-and-rohs/ for more information on WEEE.

Customer Service

NovAtel Knowledge Base

If you have a technical issue, visit the NovAtel support website at www.novatel.com | Support | Helpdesk and Solutions | Knowledge and Forums. Through this page, you can search for general information about SMART® antennas and other technologies, information about NovAtel hardware, software, installation and operation issues.

Before Contacting Customer Support

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

1. Issue the following logging commands to collect data to a file on your computer for 15 minutes:

   LOG VERSIONA ONCE

   LOG RXSTATUSA ONCE

   LOG RXCONFIGA ONCE

   LOG RAWEPHEMA ONNEW

   LOG BESTPOSA ONTIME 1

   LOG RANGEA ONTIME 1

2. 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.

3. You can also issue a `FRESET` command to the receiver to clear any unknown settings.

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

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

Contact Information

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

Call the NovAtel Hotline at 1-800-NOVATEL (U.S. and Canada) or +1-403-295-4500 (international)	
Fax: +1-403-295-4901 E-mail: support@novatel.ca website: http://www.novatel.com	Write:NovAtel Inc. Customer Support Department 1120 - 68 Avenue NE Calgary, AB Canada, T2E 8S5

Conventions

Conventions used in this manual are the following:

	Note that provides information to supplement or clarify the accompanying text.
	Caution that a certain action, operation or configuration may result in incorrect or improper use of the product.
	Warning that a certain action, operation or configuration may result in regulatory noncompliance, safety issues or equipment damage.

- 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 OEM6 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 OEM6 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 *Unit Conversion* available on our Web site at www.novatel.com/support/knowledge-and-learning/.

Chapter 1 Introduction

The SMART6-L is a high performance GNSS receiver and antenna, capable of receiving and tracking different combinations of GNSS L1/L2 code and carrier signals on a maximum of 120 channels. SBAS (Satellite Based Augmentation Systems) includes WAAS (North America), EGNOS (Europe) and MSAS (Japan). SBAS support is standard. Refer to NovAtel's GNSS Book for an overview of each of the above signal types. The SMART6-L rear panel also features Light Emitting Diodes (LEDs) for status indication.

Once properly powered, the SMART6-L begins operating as a fully functional GNSS system. Figure 1 below shows the SMART6-L without connecting cables.

Figure 1: SMART6-L Receiver

1.1 Features and Models

The main features of the SMART6-L are:

- an enhanced high performance GNSS L1/L2 receiver
- a high performance GNSS L1/L2 antenna
- a CAN port
- three (3) RS-232 COM ports
- three (3) LED status indicators
- a water and dust tight enclosure

The SMART6-L is available in several different firmware models whose configurations may include other additional features. Contact NovAtel Sates at www.novatel.com/where-to-buy/contact-us for information regarding available models, upgrading a model to increase feature/functionality or go to http://www.novatel.com/support/firmware-software-and-manuals/firmware-software-updates/ to obtain product updates. Refer to *Chapter 4, **NovAtel Firmware and Software*** for details.

Refer to the OEM6 Installation and Operation Manual for detailed information on receiver communications and operation.

Chapter 2 Installation and Setup

2.1 Additional Equipment Required

In order for the SMART6-L to perform optimally, the following additional equipment is required:

- A computer (user supplied)
- A cable harness for communicating and powering the SMART6-L (NovAtel cable harness 01018999 is available with three dB9 connectors, four bare cables and a SMART6-L connector) or similar
- A fused power supply (user supplied) (refer to *Table 5, Recommended Fuse and Fuse Holders* on *Page 37* for details)

2.1.1 SMART6-L Setup

Complete the following steps to connect and power the SMART6-LT.

1. Mount the SMART6-L on a secure, stable part of a vehicle (i.e., cab roof) with an unobstructed view of the sky from horizon to horizon (refer to *Section 2.1.4 Mounting the SMART6-L on page 13* for details).
2. Establish a physical communication connection between the SMART6-L and the computer. Connect the COM and Power port on the back of the SMART6-L, see Figure 3 below, to a DB-9 serial port on a computer or other data storage devices.

Figure 3: SMART6-L Connector

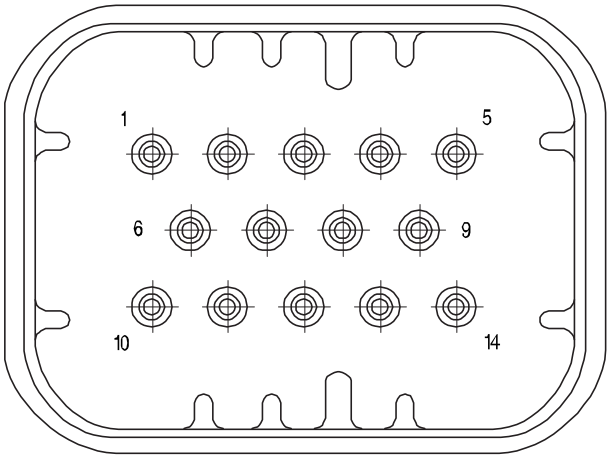


Table 1: SMART6-L Connector Pin-Out

Pin	Use	Pin	Use
1	COM1TxD	8	COM3TxD
2	COM1RxD	9	Power Negative/Return
3	COM2TxD	10	Reserved
4	COM2RxD	11	MKI (Mark Input)
5	Signal Ground (COM/MKI/PPS)	12	PPS (Pulse Per Second) Output
6	CAN+	13	COM3RxD
7	CAN-	14	Power Positive/Source

3. Turn on the power supply to the SMART6-L (the SMART6-L cable is also a power cable). The power LED on the receiver glows red when the SMART6-L is properly powered.

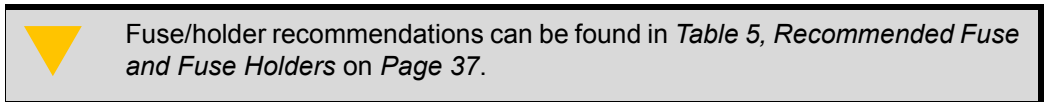
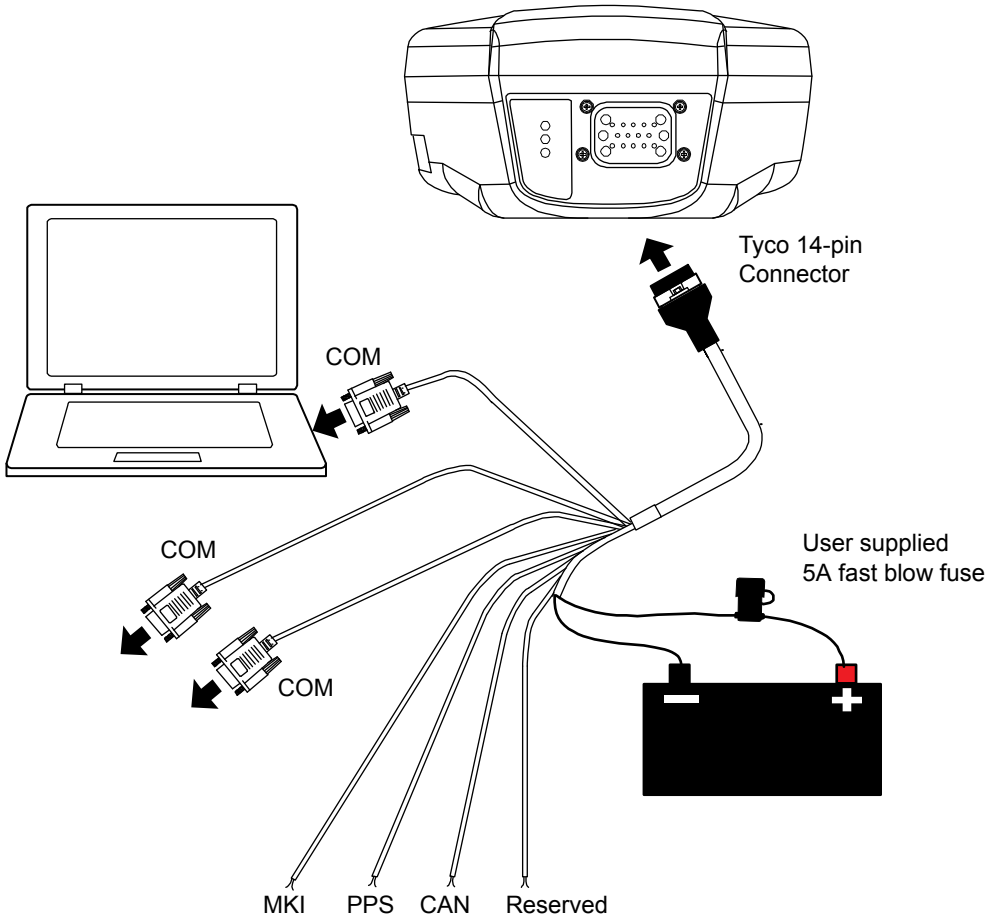


Figure 4: Simplified SMART6-L Setup



Minimum conductor size for all wiring is 0.5 mm/20 AWG. NovAtel recommends tying to ground any floating input lines.

2.1.2 Power Supply Requirements

The SMART6-L requires +8 to +36 VDC input power (refer to *A.2.1 SMART6-L Communication/Power Cable (01018999)* on *page 35* for additional power supply specifications).

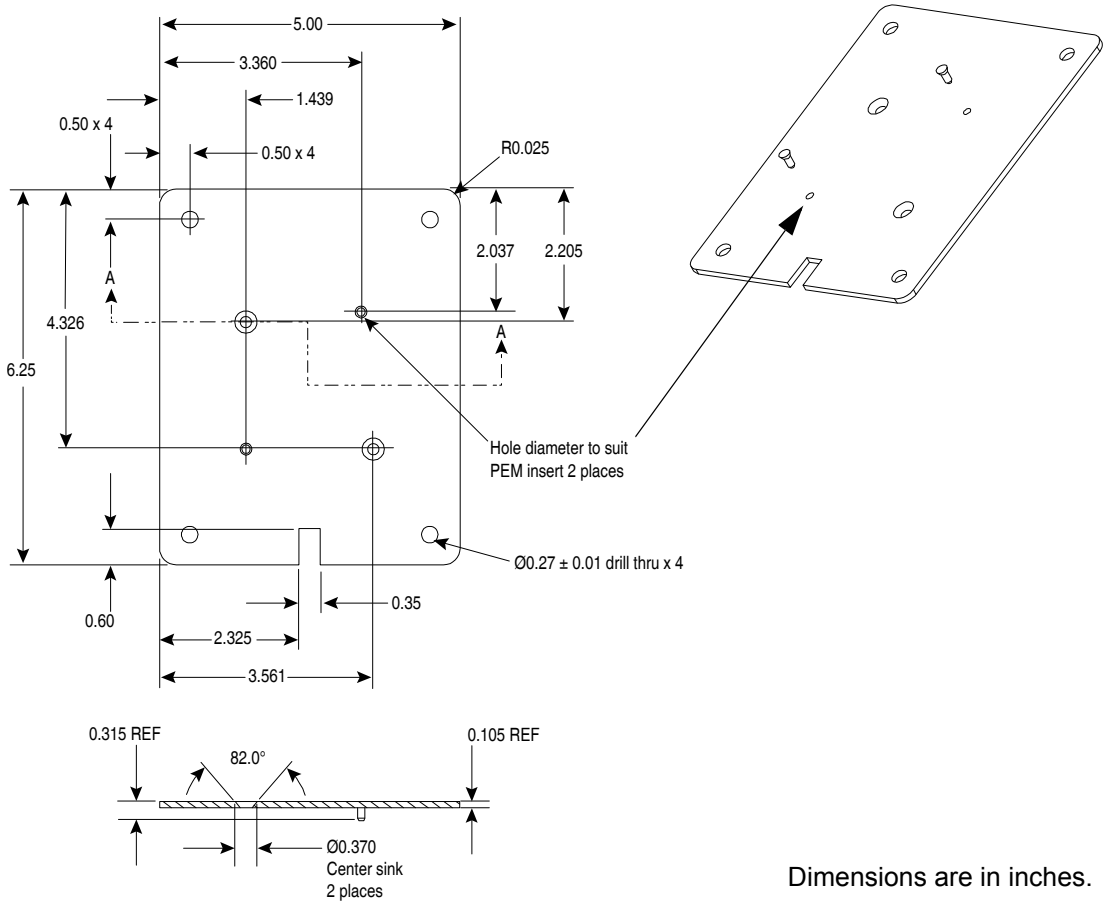
The SMART6-L cable provides power in (BATT+ and power ground (BATT-) bare wires for connecting the SMART6-L to a 12 to 24 V vehicular power system (or equivalent).

The SMART6-L power source must be protected by a 5 A Fast Blow Fuse or damage to wiring may result (not covered by warranty).
If the voltage supplied is above or below the specified range, the receiver suspends operation. If the voltage supplied is above 40 V, the receiver may be permanently damaged, voiding the warranty (refer to *A.2.1 SMART6-L Communication/Power Cable (01018999)* on *page 35)*.

2.1.3 Mounting Plate

An optional mounting plate is available to facilitate mounting the receiver to a surface.

Figure 5: SMART6-L Mounting Plate



Dimensions are in inches.

To install the mounting plate, use the adhesive tape or the mounting holes at each corner of the plate.

2.1.4 Mounting the SMART6-L

Mount on a secure, stable structure capable of safe operation in the specific environment. Typical installation is a vehicle roof, ideally close to the pivot point of the vehicle.

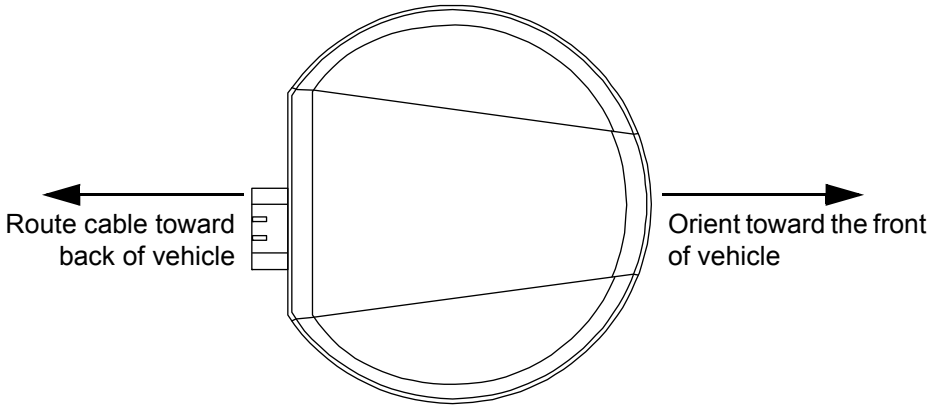
See *2.2 Additional Features and Information* on *page 14* for additional requirements.

The SMART6-L must be rigidly secured to the vehicle to avoid errors caused by vibration and motion.

2.1.5 Physical Installation

The SMART6-L must be mounted with the connector facing the rear of the vehicle (refer to Figure 6).

Figure 6: SMART6-L Orientation



2.1.6 Connecting Data Communications Equipment

To communicate with the receiver for sending commands and obtaining logs, connecting to data communications equipment is required. Refer to *Table 3, SMART6-L Communication/Power Cable Pinouts* on *Page 35* on for more information.

2.2 Additional Features and Information

This section contains information on the additional features of the SMART6-L, which may affect the overall design of the receiver system.

2.2.1 MKI and PPS Strobes

Mark Input (MKI) and Pulse Per Second (PPS) strobes provide status and synchronization signals. PPS is a 3.3 V CMOS output; MKI is a 5 V logic tolerant input.

Pin-out information can also be found on *page 35.*

2.2.2 Status Indicators

LED indicators on the SMART6-L provide the status of the receiver. The table below shows the meaning of the LEDs.

Icon	LED Color	State	Description
✓	Green	Position Valid	Indicates a valid GNSS position solution is available
ⓘ	Yellow	Error	Receiver is in the error state and tracking is disabled Possible cause: - a fatal error - an unusual receiver status indicator, setup to act like a fatal error Note: Error status remains until the cause of the error is corrected and the receiver is reset
− +	Red	Power	Power is on

2.2.3 Controller Area Network (CAN)

The SMART6-L supports the following NMEA2000 Parameter Group Messages (PGN):

- PGN 129029 GNSSPositionData (1 Hz)
- PGN 129025 GNSSPositionRapidUpdate (10 Hz)
- PGN 129026 COGandSOGRapidUpdate (10 Hz)

Table 2: Available CAN Signals on the SMART6-L

CAN	Pins
CANI+	Pin 6
CANI-	Pin 7

The CAN must be activated by entering the `SETCANNAME` command (refer to *B.5 SETCANNAME Sets the CAN name fields* on *page 46*). To have the CAN set up automatically at subsequent start ups, also send the `SAVECONFIG` command.

Chapter 3 Operation

Before operating the SMART6-L for the first time, ensure the installation instructions in *Chapter 2, Installation and Setup* were followed. It is assumed that a personal computer 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 computer connected directly to the receiver serial port using a DB-9 connector on the SMART6-L communication/power cable. If using a radio, connect it to another DB-9 connector on the same communication/power 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 OEM6 Family Firmware Reference Manual to ensure maximum utilization of the receiver's capabilities.

3.1.1 Serial Port Default Settings

The receiver communicates with the computer 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 COM3 default port settings are as follows:

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

Changing the default settings requires using the `COM` command. See *Appendix B.2, COM Configure COM Port* starting on *Page 39* for details.

The data transfer rate chosen determines how fast information is transmitted. For example, outputting 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, 9600 bps is required. Also remember that even if the bps is set 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 a margin is set when choosing a data rate (115200 is recommended for most applications).

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, causing a warning in the receiver status and loss of data.

3.1.2 Communicating Using a Remote Terminal

One method of communicating with the receiver is through a remote terminal. The receiver is pre-wired to allow proper RS-232 interface with the 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 Computer

A computer 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 NovAtel's Graphical User Interface (GUI) program NovAtel Connect™. All data is sent as raw 8-bit binary or ASCII characters.

3.2 Getting Started

NovAtel Connect is a windows based GUI used to access the receiver's many features. Convert is a windows based utility that converts between file formats and strips unwanted records for data file compilation. Both are included in the NovAtel Connect PC Utilities bundle available from: http://www.novatel.com/support/firmware-software-and-manuals/firmware-software-updates/.

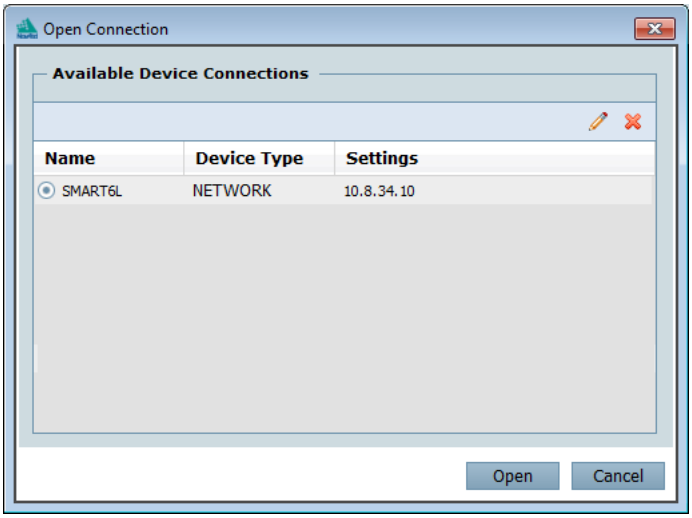
3.2.1 Starting the Receiver

When first powered, the SMART6-L undergoes a complete self-test. If an error condition is detected, the error LED lights. Details on the error can be determined by connecting to the receiver and requesting the RXSTATUS log. Refer to the OEM6 Family Firmware Reference manual for details. If a persistent error develops, contact a local NovAtel dealer first. If the problem remains unresolved, contact NovAtel directly through any of the methods listed in the *Customer Service* section on *page 7*.

3.2.2 Communicating with the Receiver Using NovAtel Connect

Launch the NovAtel Connect program and select *Device* | *Open Connect* from its main menu. The *Open Connection* window appears.

Figure 7: Open Connection Window



Refer to the NovAtel Connect help file or press F1 while the cursor is in a NovAtel Connect window. Ensure the *Console* and *ASCII Messages* windows are open 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 the receiver is ready and waiting for command input.

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

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

```
[COM2] FIX POSITION 51.11635 -114.0383 1048.2 [Carriage Return]
<OK
```

where [COM2] is the port prompt, followed by the command entered and [Carriage Return] is a prompt to press the <Enter> key.

1. You may also have to wait for output from receiver self-tests. For example, on start-up, the OEM6 family receiver, as used in SMART6-L, is set to log the RXSTATUSEVENTA log ONNEW on all ports. Refer to the OEM6 Family Firmware Reference Manual for more details.
2. If NovAtel Connect is unable to locate the OEM6 family receiver, try using a different COM port to communicate to the receiver. Once communication has been established, issue the `FRESET STANDARD` command. You should now be able to use the original communication port again.

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:

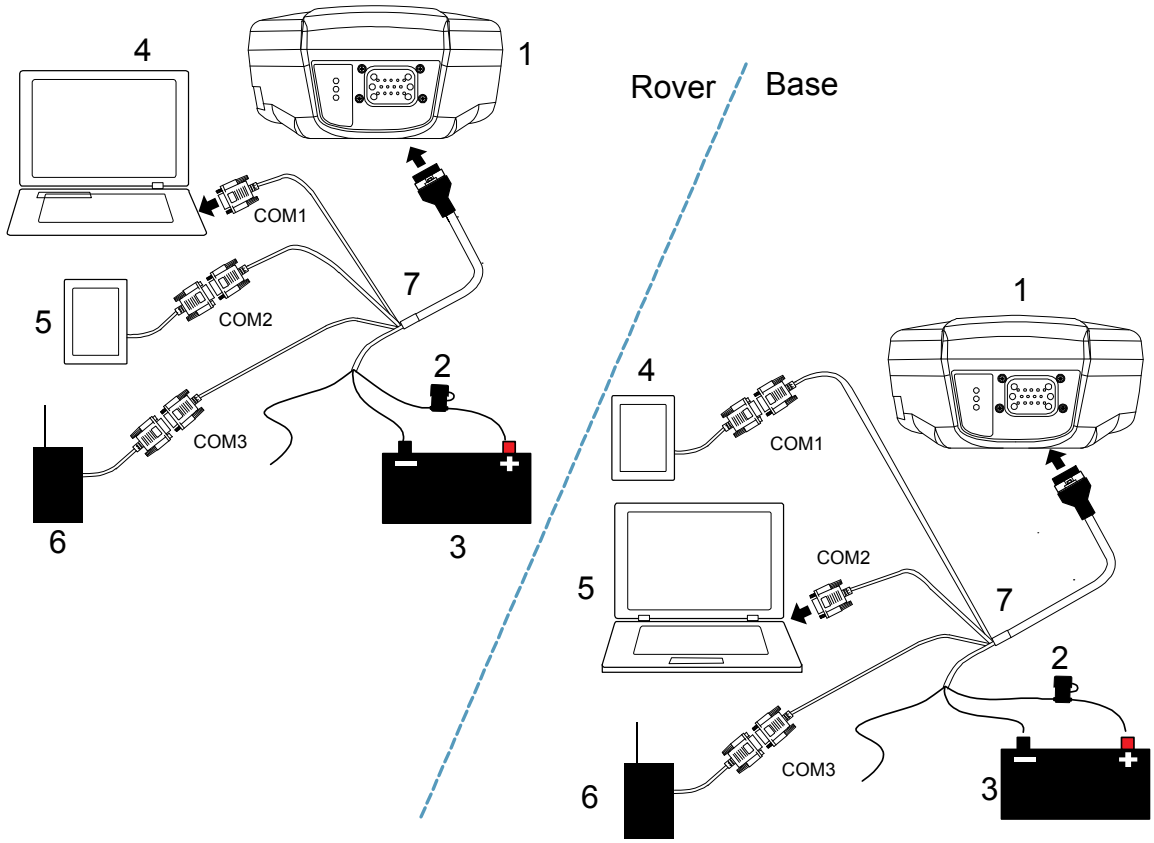
```
<Invalid Message ID          (or a more detailed message)
```

Ensure computers Control Panel's Power Settings are not set to Hibernate or Standby modes. Data is 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 SMART6-L can be used as a base receiver to transmit RTK or DGPS corrections or a rover to receive the same corrections. An example of a differential setup is given in *Figure 7* on *page 17.*

Figure 3: Basic Differential Setup



Reference	Description
1	SMART6-L receiver
2	User supplied 5 A fast blow fuse
3	User supplied power supply, for example a battery
4	User supplied device to COM1
5	User supplied device to COM2
6	User supplied device to COM3
7	User supplied cable or NovAtel 01018999 Communication/Power cable

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

Once the base and rover are set up, configure them as shown in the configuration examples that follow in *Sections 3.3.1 - 3.3.2* starting on *page 20*.

3.3.1 Base Station Configuration

At the base station, enter the following commands:

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

```
com com2 9600 N 8 1 N off
interfacemode com2 none rtca off
fix position 51.11358042 -114.04358013 1059.4105
log com2 rtcaobs ontime 1
log com2 rtcaref ontime 10
log com2 rtca1 ontime 5              (optional for RTK)
log com2 rtcaephem ontime 10 1       (optional)
```

RTCM

```
com com2 9600 N 8 1 N off
interfacemode com2 none rtcm off
fix position 51.11358042 -114.04358013 1059.4105
log com2 rtcm3 ontime 10       (required for RTK)
log com2 rtcm22 ontime 10 1    (optional)
log com2 rtcm1819 ontime 1
log com2 rtcm1 ontime 5
```

RTCMV3

```
com com2 9600 N 8 1 N off
interfacemode com2 none rtcmv3 off
fix position 51.11358042 -114.04358013 1059.4105
log com2 rtcm1006 ontime 10
log com2 rtcm1003 ontime 1
```

CMR+

```
com com2 9600 N 8 1 N off
interfacemode com2 none cmr off
fix position 51.11358042 -114.04358013 1059.4105
log com2 cmrobs ontime 1
log com2 cmrplus ontime 1    (Important to use ontime 1 with cmrplus)
```

CMR

```
com com2 9600 N 8 1 N off
interfacemode com2 none cmr off
fix position 51.11358042 -114.04358013 1059.4105
log com2 cmrobs ontime 1
```

```
log com2 cmrref ontime 10
log com2 cmrdesc ontime 10 1
```

3.3.2 Rover Station Configuration

At the rover station, enter:

```
COM [port] bps [parity[databits[stopbits[handshake[echo[break]]]]]]
interfacemode port rx_type tx_type [responses]
```

For example:

RTCA `interfacemode com2 rtca none off`

RTCM `interfacemode com2 rtcm none off`

RTCMV3 `interfacemode com2 rtcmv3 none off`

CMR+ `interfacemode com2 cmr none off`

CMR `interfacemode com2 cmr none off` *(same as CMR+)*

3.3.3 GPS + GLONASS Base and Rover Configuration

This section shows how to set up a base and rover OEM6 GPS + GLONASS enabled receivers for GPS + GLONASS RTK operation:

Base Station:

```
fix position lat lon hgt                    (enter your own lat, lon, and hgt values)
com com2 9600 N 8 1 N off
interfacemode com2 none rtca off
log com2 rtcaref ontime 10
log com2 rtcaobs2 ontime 1
log com2 rtca1 ontime 5                     (optional, enable code-DGPS coverage)
saveconfig                                  (optional, save configuration to non-volatile memory)
```

Rover Station:

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

3.3.4 Configuration Notes

For compatibility with other GNSS receivers and to minimize message size, it is recommended using 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.

To mix NovAtel format messages and RTCA, RTCM, RTCMV3 or CMR messages on the same port, 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 20*.

At the rover station, 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. These are useful commands when the rover station is receiving corrections from multiple base stations. Refer to NovAtel's GNSS Book for more information on SBAS, available from www.novatel.com.

All PSRDIFFSOURCE entries fall back to SBAS (even NONE) for backwards compatibility (assuming SBAS was enabled).

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 to modify the format of the corrections for a non-standard application or 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 OEM6 Family Firmware Reference Manual detailed descriptions of the various message formats.

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 GL1DE®

SMART6-L contains NovAtel's GL1DE which is a positioning algorithm for single-frequency GPS and GPS/GLONASS applications. GL1DE produces a smooth position output tuned, for applications where time relative accuracy (pass-to-pass) is more important than absolute accuracy. Because of this, it is well suited for agricultural applications.

Multipath signals tend to induce time varying biases and increase the measurement noise on the L1/L2 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.

Dual-Frequency GL1DE

NovAtel's dual-frequency GL1DE technology adds to the superior pass-to-pass performance provided by single-frequency GL1DE. Dual-frequency GL1DE is ideal agricultural and machine guidance applications where relative positioning is critical. Using GL1DE significantly reduces the variation in position errors to less than 1 cm from one epoch to the next. Dual-frequency GL1DE improves the absolute accuracy of the GL1DE position and creates a robust solution resistant to the effects of high ionospheric activity. GL1DE works in all code positioning modes, including single point, DGNSS, SBAS and L-Band (VBS).

Refer to the NovAtel white papers at www.novatel.com/support/knowledge-and-learning/published-papers-and-documents/white-papers/ for more information on *GL1DE*. Also refer to application note "APN-038 Pseudorange/Delta-Phase (PDP) and GL1DE Filters" at www.novatel.com/support/knowledge-and-learning/published-papers-and-documents/application-notes/.

3.4 Recommended Configuration

The following command is recommended to enable CAN:

```
setcanname 305
```

The following command is recommended to enable SBAS (WAAS/GNOS/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, configuration can be saved with the `SAVECONFIG` command. For more information about these commands, refer to the OEM6 Family Firmware Reference Manual, available at www.novatel.com/support/firmware-software-and-manuals/product-manuals-and-doc-updates/.

Chapter 4 NovAtel Firmware and Software

Download the most recent versions of the NovAtel firmware and receiver software from the NovAtel website at www.novatel.com Support/Firmware/Software and Manuals.

OEM6 Firmware and Software

Refer to *4.3.1, Transferring Firmware Files* on *page 26* for descriptions of the Update and OEM versions.

NovAtel Connect PC Utilities Software Bundle

Bundled PC Utilities software includes:

- NovAtel Connect (a GUI interface)
- Connection Import (improves connection profiles)
- Convert (converts receiver data logs into different formats)
- USB Drivers and Window Signing

Refer to the PC Utilities manual on the CD provided with the product and the NovAtel Connect online help for use instructions.

Firmware and Software included

- SoftLoad firmware
- WinLoad software utility

WinLoad and SoftLoad instructions follow.

4.1 Firmware Updates and Model Upgrades

A local NovAtel dealer can provide all the information needed to upgrade or update a receiver. Refer to www.novatel.com/where-to-buy for contact information or contact sales@novatel.com or support@novatel.com directly.

4.1.1 Firmware Updates

Firmware updates are firmware releases that include fixes and enhancements to the receiver functionality. Firmware updates are released occasionally on the NovAtel web site as they become available. New firmware must be loaded into the receiver through one of the COM ports. Once loaded, the receiver reboots and begins operating with the new firmware.

Direct access to a serial COM port on the OEM6 receiver is required.

4.1.2 Model Upgrades

Model upgrades enable purchased receiver features.

Contact a local NovAtel dealer to assist in selecting the upgrade options that best suit your GNSS needs at www.novatel.com/where-to-buy. Contact NovAtel Customer Support www.novatel.com/support or NovAtel Sales to request a temporary upgrade authorization code for trial purposes.

The receiver stores the firmware in Non-Volatile Memory (NVM), which allows model upgrades to be performed without returning the receiver to the dealer. Model upgrades can be applied to the receiver with an authorization code and the AUTH command.

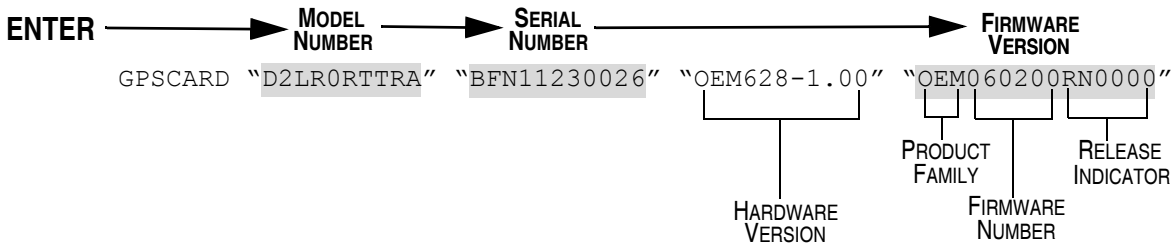
4.2 Authorization Code

An authorization code, commonly known as an auth-code, is required to upgrade and possibly update an OEM6 family receiver. Auth-codes are obtained by contacting NovAtel Customer Support. Upon contact, NovAtel Customer Support requires:

- the receiver model number
- the receiver serial number
- the receiver firmware version

Enter the LOG VERSION command to determine the receiver model, serial number and firmware version.

Example:



After determining the appropriate model and firmware version the authorization code (auth-code) is issued. The auth-code is required to unlock the features on the new model type.

To upgrade to a new model with the same firmware version, use the AUTH command with the issued auth-code (if required), as outlined in *Updating or Upgrading Using the WinLoad Utility*.

To upgrade to a new model with a higher firmware version, the new firmware .HEX file needs to be loaded into the OEM6 receiver using the WinLoad utility program. WinLoad and the firmware .HEX files can be found at www.novatel.com/Support/Firmware/Software and Manuals/Product Updates. Refer to *4.3, Updating or Upgrading Using the WinLoad Utility* on *page 26* for use instructions.

Firmware version OEM060200RN0000 (also known as firmware version 6.200) and later contain the Firmware Signature feature. This firmware feature removes the authorization code dependency on the firmware version and eliminates the need to obtain an auth-code when downloading the latest version of signed firmware.

If updating from a version before 6.200 to a signed 6.200 version, an authorization code is required. Auth-codes are not required when loading signed firmware as long as the previous version was also signed.

In version OEM060200RN0000, the receiver serial number and the software model are built into the signature in the firmware file. Once the 6.200 signed firmware is installed with a signature auth-code, future firmware updates no longer require a new unique auth-code.

The procedure for loading firmware is the same. Refer to *Section 4.5 Upgrading Using the AUTH Command on page 30*.

The Firmware Signature feature simplifies the process of obtaining the latest releases by eliminating the need to obtain an authorization code.

An authorization code is still required if the software model changes for temporary trial upgrades or purchased permanent upgrades.

The new download package includes a signed firmware file type that uses an extension designated as ".shex" (example OEM060200RN0000.shex), as well as the latest Winload utility and What's New file containing firmware update change details.

Prior to firmware version OEM060200RN0000, authorization codes depended on the software model, the firmware version and the serial number of the receiver. The authorization code changed if any of the three items changed. The NovAtel firmware download page contains two firmware versions:

- OEM Version - contains firmware .hex file and the loading utility
- Update Version - contains firmware .hex and .shex files and the loading utility—does not require the user to manually input the authorization code

4.3 Updating or Upgrading Using the WinLoad Utility

WinLoad is the simplest and most common way to update or upgrade an OEM6 receiver.

4.3.1 Transferring Firmware Files

To proceed with an update or possibly an upgrade, obtain the latest version of firmware from the NovAtel website at www.novatel.com/support/firmware-software and manuals.

Types of Firmware Files

The firmware update or upgrade file is one of two types:

- **Update Version (UPDT)** - The update version includes the authorization codes for all OEM6 receivers and receiver model upgrades purchased before the cut-off date[2]. The update version is named UPDTXXXX.EXE, where XXXX is the firmware version. If the receiver or model upgrade was purchased after the cut-off date, the authorization code does not appear in the UPDT file and the OEM version must be used.
- **OEM Version** - Use the OEM version if the receiver or model upgrade was purchased after the cut-off date. When the OEM version is used, NovAtel Customer Service must generate and provide the required authorization code. Authorization codes are obtained by contacting support@novatel.com or at www.novatel.com/Support/.
  The OEM version is named OEMXXXX.EXE, where XXXX is the firmware version.

For convenience, copy the update file to a GNSS sub-directory (for example, C:\GNSS\LOADER).

If the firmware update file is password protected, NovAtel Customer Support provides the required password. After copying the file to a computer, perform the following steps to extract the files:

2. For further information and the exact cut-off date, refer to the NovAtel website at www.novatel.com/Support/Firmware/Software and Manuals/Product Updates/OEM6 Family at the bottom of the page.

Syntax: [filename] [password] (if required)

where filename is the name of the compressed file (but not including the .EXE extension) and password if the password required for extraction.

Example: OEM060000RN0000.hex

In the above example, a window appears asking for a password.

The self-extracting archive produces the following files:

winload.exe	WinLoad utility program
howto.txt	Instructions on how to use the WinLoad utility
whatsnew.rtf	Information on the changes made in the firmware since the last revision
x..x.hex	Firmware version upgrade file, where x..x defines the product name and release (e.g., OEM060000RN0000.hex)

The files are extracted to unzip/program files/NovAtel Inc/x.xxx Full Update Disk, where x.xxx is the firmware version.

NovAtel has an online video tutorial that explains firmware uploading at www.novatel.com/Support/Knowledge and Learning.

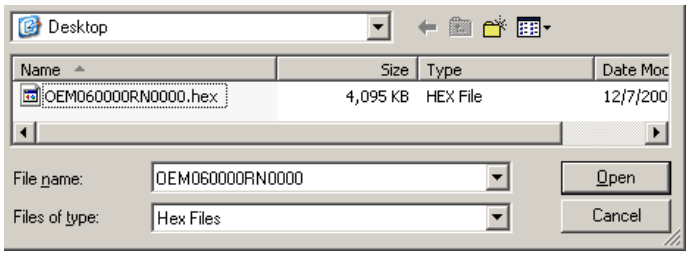
4.3.2 Using the WinLoad Utility

If opening WinLoad for the first time, ensure the file and communications settings are correct.

Open a File to Download

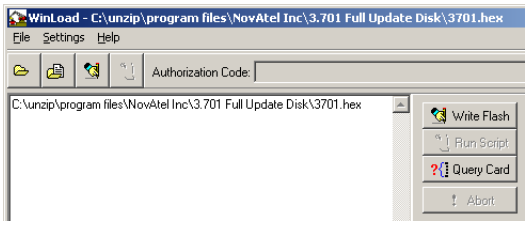
Select File |Open. Navigate to the file to open (*Figure 4)*.

Figure 4: WinLoad's Open Window



When a file is selected, the `filename` appears in the main WinLoad display area and in the title bar (*Figure 5).*

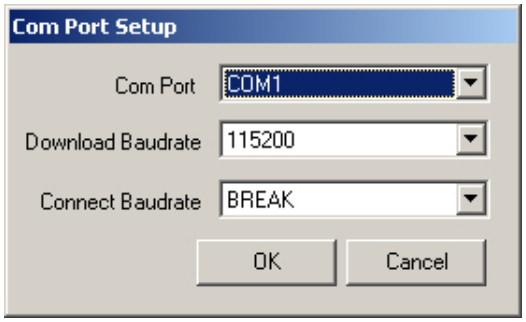
Figure 5: Open File in WinLoad



Communications Settings

To set the communications port and baud rate, select Settings | COM Settings. Choose the computer port to use from the Com Port drop down list and the baud rate from the Download Baudrate drop down list. Set the baud rate as high as possible (the default of 115200 and is preferred).

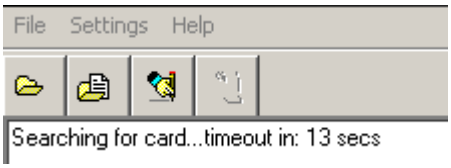
Figure 6: COM Port Setup



Downloading Firmware

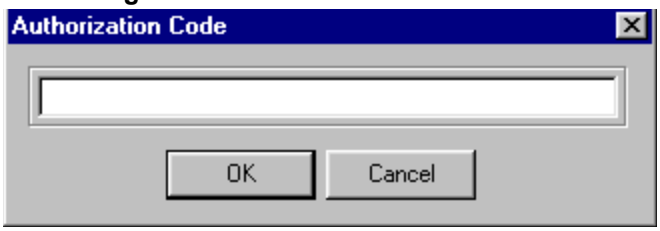
1. Select the file to download according to *Open a File to Download* on *Page 27*.
2. Ensure the file path and name are displayed in main display area (see *Figure 5, Open File in WinLoad* on *Page 27*).
3. Click **Write Flash** to download the firmware.
4. When `Searching for card` appears in the main display, power cycle the receiver.

Figure 7: Searching for Card



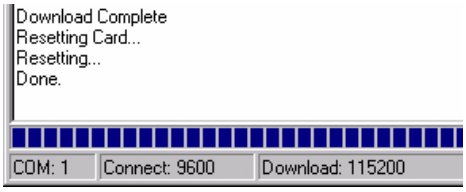
5. If the Authorization Code window appears, enter the auth-code and click **OK**. See *Section 4.2 Authorization Code on page 25* for further information about the Authorization Code.

Figure 8: Authorization Code Window



6. The receiver finishes the download and then resets. The process is complete when `Done` appears in the main display area.

Figure 9: Upgrade Process Complete



7. Close WinLoad.

4.4 Updating using SoftLoad Commands

Use SoftLoad to update an OEM6 family receiver.

Use SoftLoad if automated loading is required or the platform used to communicate with the receiver if not supported by WinLoad.

Refer to *Section Types of Firmware Files on page 26* for details on **updating** versus **upgrading**.

1. Open a connection to any port on the receiver (COM, USB, Ethernet or Virtual COM port with a user Application Programming Interface (API).
2. Request the SOFTLOADSTATUSA log using the following command:
   `LOG SOFTLOADSTATUSA ONCHANGED`.
3. Initialize SoftLoad with a `SOFTLOADRESET` command. This command stops all tracking on the receiver to ensure sufficient memory is available for the loading process. A RXSTATUSEVENTA log reports a SoftLoad In Progress status.
4. Open the *.HEX firmware file or *.SHEX firmware file. *.SHEX files are treated in the same way as *.HEX files.
5. Send each line of the *.HEX or *.SHEX file to the receiver in a `SOFTLOADSREC` command. The S-Records must be enclosed by quotation marks:
   `SOFTLOADSREC "<S-RECORD>"`
6. Send the `SOFTLOADCOMMIT` command.
7. During the loading process, SOFTLOADSTATUSA logs report the load status. Wait for the SOFTLOADSTATUSA to indicate loading is `COMPLETE`.
8. If using standard auth-codes (do not require a firmware signature), send the new auth-code for the receiver with the following special case of the AUTH command:
   `AUTH ADD_DOWNLOAD <auth-code>`

   Signature auth-codes are maintained internally by the receiver and do not need to be re-entered. Refer to *Section 4.2 Authorization Code on page 25* for details on obtaining any auth-code.

9. Reset the receiver by entering `RESET`, `FRESET` or power cycling.
10. Once the receiver resets, the new version of firmware is active.

The SoftLoad process can be cancelled safely at any time during the process using the `RESET` command.

4.4.1 Working with S-Records

- Records beginning with S0, S5 and S7 should be passed to the receiver directly using the SOFTLOADSREC command. These records contain meta data about the firmware image.
- Records beginning with S3 form the actual firmware image and can be converted to SOFTLOADDATA binary commands. Aside from the header, each pair of characters forms the ASCII representation of binary byte. The format is as follows:

S3	LL	AAAAAAAA	DDDDDDDD...DDDDDDDD	CC
				Check Sum. One's compliment of all other bytes
			Little Endian Data. These bytes are copied into the "data" field of the SOFTLOADDATA command	
		4 - Byte Address. Set this as the value of "offset" in the SOFTLOADDATA command		
	Length.This is the hexadecimal number of character pairs to follow in the record. This value minus 4 bytes for the address and 1 byte for the check sum is copied into the "data length" field of the SOFTLOADDATA command			
Header				

- Multiple S3 records can be packaged into a single `SOFTLOADDATA` command as long as the data from one S3 record follows immediately after the previous record, up to a maximum of 4096 bytes of data. That is, the address must equal the previous address plus the previous data length. The "offset" field remains the address of the first S3 record and the "data" and "data length" are updated to include the new data.
- The hex file data may contain many gaps and jumps. For example, in most NovAtel hex files data for address 0x000_00000 is stored near the very end of the file.

4.5 Upgrading Using the AUTH Command

The `AUTH` command authorizes the enabling (unlocking) of model features. The `AUTH` command is used to upgrade a new OEM6 family model, available with the same firmware version as the current model. This command only functions with a valid auth-code assigned by NovAtel Customer Support.

The upgrade can be performed directly through the NovAtel Connect command line or from any other communications program.

> Refer to *Section Types of Firmware Files on page 26* for details on **updating** versus **upgrading**.

4.5.1 Upgrade Procedure

1) Power up the OEM6 family receiver and establish communications (refer to the Quick Start Guide included with the product for instructions).
2) Issue the `LOG VERSION` command to verify the current model, firmware version and serial number (refer to *4.2, Authorization Code* on *page 25* for instructions on obtaining).
3) Issue the `AUTH` command, followed by the auth-code and model type (refer to *Section 4.2 Authorization Code on page 25* for details on obtaining any auth-code). The syntax is as follows:

```
auth <your auth-code here>
```

where auth is a command that enables model upgrades and auth-code is the upgrade authorization code, expressed as follows:

XXXXXX,XXXXXX,XXXXXX,XXXXXX,XXXXXX,MODEL,EXPDATE

where:

1. Each X character is a case-insensitive ASCII character.
2. The MODEL string is a maximum of 15 characters long and represents the model enabled by the auth-code.
3. The EXPDATE string is the auth-code's expiry date, in YYMMDD format

Example:

```
auth 7WBMBK,887CB6,K5J3FH,5DF5P2,42PW8G,D1SB0GTT0,121211
```

When the AUTH command is executed, the OEM6 family receiver reboots. Issuing the LOG VERSION command confirms the new upgrade model type and firmware version number.

If communicating using NovAtel Connect, the communication path must be closed and reopened using the Device menu.

Appendix A Technical Specifications

A.1 SMART6-L Receiver Performance

PERFORMANCE[a]			
Channel Configuration	120 Channels can be configured to track: L1 GPS L2 GPS (optional) L2C GPS (optional) L1 GLONASS (optional) L2 GLONASS (optional) Galileo E1 (optional) BeiDou B1 (optional) SBAS[b] L-Band (optional)		
Horizontal Position Accuracy (RMS)[c]	Single Point	1.5 m	
	Single Point L1/L2	1.2 m	
	SBAS[c]	0.6 m	
	DGPS	0.4 m	
	RT-2™	1 cm + 1 ppm	
	L-Band		
	VBS	0.6 m RMS	
	XP	0.15 m RMS	
	HP	0.1 m RMS	
Measurement Precision (RMS)		**GPS**	**GLO**
	L1 C/A code	4 cm	15 cm
	L1 carrier phase	0.5 mm	1.5 mm
	L2 P(Y) code[d]	8 cm	8 cm
	L2 carrier phase[d]	1.0 mm	1.5 mm
	L2C code[e]	8 cm	8 cm
	L2C carrier phase[e]	1.0 mm	1.5 mm
Maximum Data Rate[f]	Measurements	up to 50 Hz	
	Position	up to 5 Hz	
Time to First Fix	Cold Start[g]	<50 s	
	Hot Start[h]	<35 s	
Signal Reacquisition	L1	0.5 s (typical)	
	L2	1.0 s (typical)	
Time Accuracy	20 ns RMS		
Velocity Accuracy[i]	0.03 m/s RMS		

a. 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.

b. Satellite Based Augmentation Systems (SBAS) include WAAS (North America), EGNOS (Europe) and MSAS (Japan).
c. GPS only.
d. L2 P for GLONASS.
e. L2 C/A for GLONASS.
f. Model specific.
g. Typical value. No almanac or ephemerides and no approximate position or time.
h. Typical value. Almanac and recent ephemerides saved and approximate time entered. For more information, Please refer to the "SETAPPROXTIME" command in the OEM6 Family Firmware Reference Manual found on our Web site at www.novatel.com/support/firmware-software-and-manuals/product-manuals-and-doc-updates/.
i. Export licensing restricts operation to a maximum velocity of 515 metres per second.

A.2 SMART6-L Specifications

INPUT/OUTPUT CONNECTORS	
SMART6-L Communication/ Power	+8 to +36 V DC at 2.9 W [a] For the cable pinouts and drawings, see *Section A.2.1, SMART6-L Communication/Power Cable (01018999)* starting on *Page 35*
Serial Com Ports	RS-232 F Compliant (Rx and Tx signals only)
CAN	SAE J1939/ ISO 11783/ ISO 11898 Compatible
PPS Output	3.3 V CMOS Logic Compatible
MKI Input	3.3 V CMOS Logic/5 V Tolerant
INPUT/ OUTPUT CONNECTOR PROTECTION	
Electrical Conducted/ Coupled disturbance tolerance	ISO 7637-2:2004 Functional Class A: Pulses 2a, 3a, 3b, 4 Functional Class C: Pulses 1, 2b
LED INDICATORS	
	Power, Error and Position Valid Refer to *Section 2.2.2, Status Indicators* starting on *Page 14* for details
Size	80.9 x ϕ155 mm[b]
Weight	<550 g
Mounting	2 x magnetic mount
	4 x M4 screw inserts
	Optional mounting plate
ENVIRONMENTAL [c]	
Operating Temperature	-40°C to +75°C
Storage Temperature	-55°C to +90°C
Humidity	Not to exceed 95% non-condensing
Immersion	MIL-STD-810G Method 512.5 Procedure 1
Shock	MIL-STD-810G Method 516.6
Solar Radiation	EN60950-22 8.2 MIL-STD-810G Method 505.5
Salt Fog	MIL-STD-810G, 509.5
Sand and Dust	MIL-STD-810G, 510.5

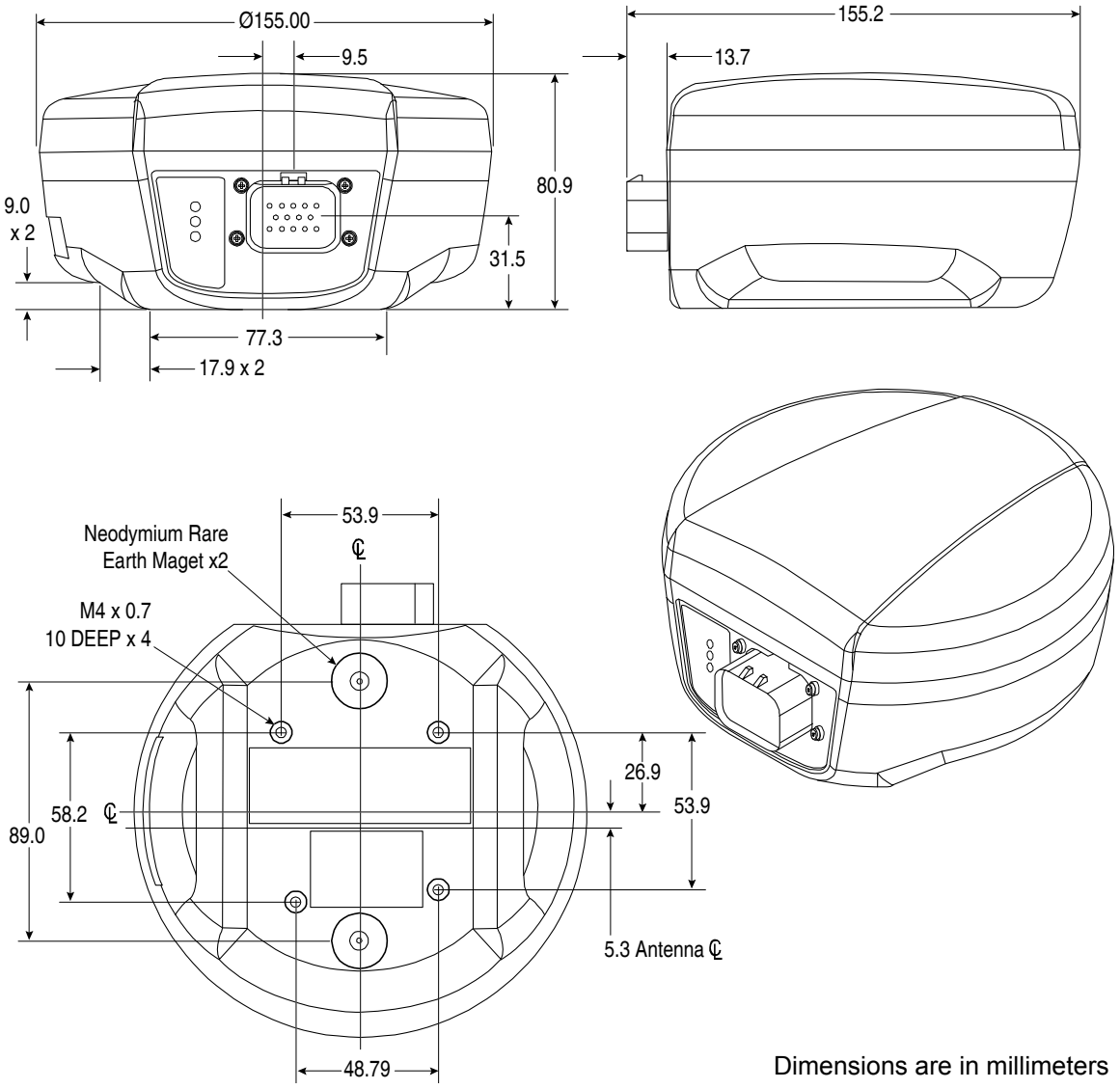
ENVIRONMENTAL [c]	
Vibration	Random: MIL-STD-810G, Method 514.6E-I Sinusoidal: IE 68-2-6 ASAE ER455, 5.15.2 Level 1
Compliance	FCC, IC, CE
Ingress Protection Rating	IP67

a. Power consumption values for GPS L1/L2.

b. ϕ denotes diameter, here and in the *Dimensions* graphic on *page 34.*

c. See also the *Notice* section of this manual starting on *page 7.*

Figure 10: SMART6-L Dimensions



Dimensions are in millimeters

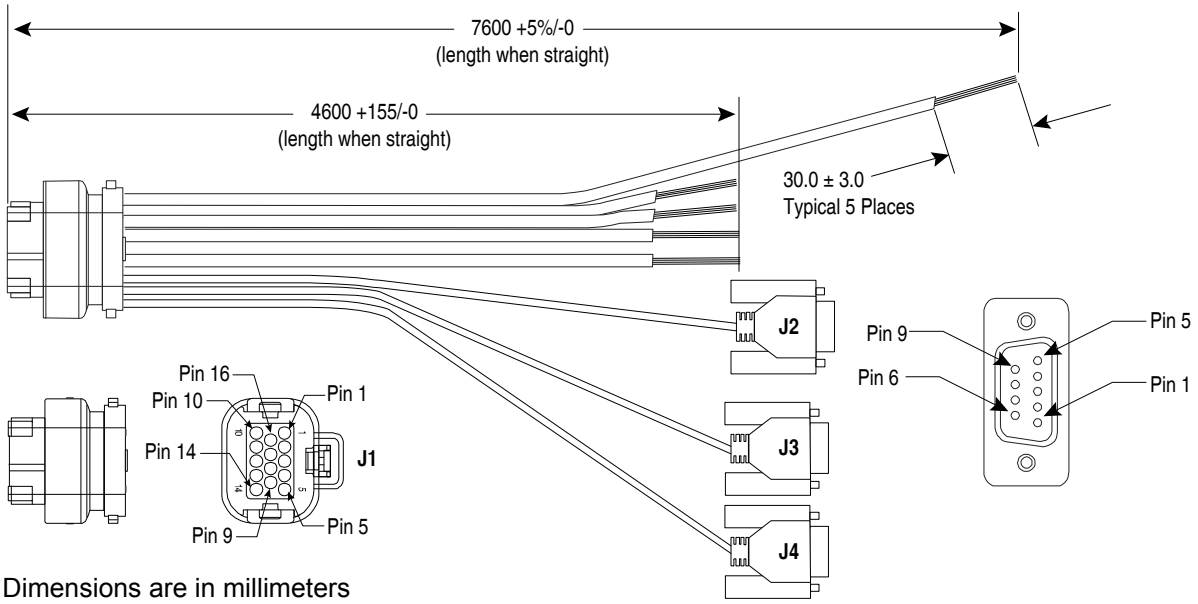
A.2.1 SMART6-L Communication/Power Cable (01018999)

The SMART6-L cable (refer to *Figure 11*), provides a means of supplying power from a battery while operating in the field. The exposed wires (red for positive and black for negative) can then be connected to a 12 or 24 V vehicular power circuit (or equivalent) protected by a 5 A fast blow fuse (user supplied). The cable has three DB-9 connectors to accommodate a computer serial (RS-232) communication port, a modem or radio transmitter to propagate differential corrections (refer to the user supplied modem or radio transmitter user guide for information on its connectors).

In addition, there are a number of bare wires where the outer insulation is cut away but the wires beneath remain intact. See *Table 3* on *page 35* for their pinouts. For more information on mating connectors and part numbers, see *Table 4* on *page 36*.

This cable is RoHS compliant.

Figure 11: SMART6-L Communication/Power Cable



Dimensions are in millimeters

Table 3: SMART6-L Communication/Power Cable Pinouts

Signal Name	J1	J2	J3	J4	Label
COM1_TXD	1	2			
COM1_RXD	2	3			
COM2_TXD	3		2		
COM2_RXD	4		3		
COM3_TXD	8			2	
COM3_RXD	13			3	
COM1 GND	5	5			
COM2 GND	5		5		
COM3 GND	5			5	
MKI GND	5				MKI GND
Reserved	5				Reserved
PULSE PER SECOND GND	5				PPS GND

Signal Name	J1	J2	J3	J4	Label
CANI+	6				CANI+
CANI-	7				CANI-
PWR RET (GND)	9				BATT-
Reserved	10				Reserved
EVENT MARK IN	11				MKI
PPS	12				PPS
PWR INPUT	14				BATT+

A.2.2 SMART6-L Connector and Cable Requirements

Custom cables for installing the SMART6-L can be created using he following guidelines:

- Wire size: must be 0.5 mm-1.25 mm (20-16 AWG)
- Batt+ connection must be protected by 5 A fast blow fuse
- Serial data signals (TxD, RxD, signal ground) must be run in shielded cable. Connect shields to ground at SMART6-L 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

Failure to observe the given cable construction guidelines and fusing requirements in this section may result in damage to the wiring or equipment and voiding the warranty.

NovAtel recommends tying to ground any floating input lines.

The connector used in the SMART6-L 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 SMART6-L. These numbers are provided for information only and are not available from NovAtel as separate parts.

Table 4: SMART6-L Mating Connectors

Product	Part Description	Company	Part Number
SMART6-L mating connector (J1 - *Figure 11* on *page 35*)	14-pin sealed receptacle housing-black	Tyco/AMP	776273-1
Gold plated pins (20-16 AWG) for (J1) SMART6-L connector Gold plated pins for SMART6-L connector/strip	Pins, loose piece	Tyco/AMP	770854-3
	Pins, strip (reel)	Tyco/AMP	770520-3
Seal Plug for unused pins on mating connector. (All connector positions must be populated with a pin or seal plug to achieve the IP-67 rating for the cable connection.)	Seal plug	Tyco/AMP	770678-1

Table 5 details the part numbers for recommended fuses and fuse holders. These numbers are provided for information only and are not available from NovAtel as separate parts.

Table 5: Recommended Fuse and Fuse Holders

Fuse	Recommended Fuse/Fuse Holder		
12 V System Fuse (standard size blade)	ATO Silver Blade Fuse 5 A (32 V)	Littelfuse	0287005
	Or Equivalent		
12 V System Fuse (mini size blade)	Mini Blade Fuse 5 A (32 V)	Littelfuse	0297005
	Or Equivalent		
12 V System Fuse High Reliability, Harsh Environment (standard size blade)	FKS ATO Blade Fuse 5A (80 V)	Littelfuse	166.7000.450
	Or Equivalent		
Inline Fuse Holder, (for standard size blade)	Waterproof ATO Fuse Holder	Littelfuse	FHAC0001
	Or Equivalent		
Inline Fuse Holder, (for mini size blade)	Waterproof Mini Fuse Holder	Littelfuse	0FHM0001
	Or Equivalent		

Appendix B Commands

The SMART6-L firmware implements the OEM6 family command set, documented in the OEM6 Family Firmware Reference Manual. Commonly used SMART6-L commands are summarized in *Table 6* and documented in this appendix.

Table 6: SMART6-L Commands

ASCII Command	Message ID	Description
COM	4	Configure the receiver serial port.
FRESET	20	Factory reset (existing OEM6 commands extended to SMART6-L)
LOG	1	Request logs from the receiver
SETCANNAME	1091	Set the CAN name fields.

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 SMART6-L, an OEM6 based receiver, is capable of processing, refer to the OEM6 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 OEM6 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 OEM6 Family Firmware Reference Manual. Note that all binary data is little-endian byte-ordered.

B.2 COM Configure COM Port

This command is used to configure the receiver's serial ports.

The current COM port configuration can be reset to the default state at any time by sending 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 OEM6 Family Firmware Reference Manual).
- Clear the transmit and receive buffers on the current port.
- Return the current port to its default settings
- Set the interface mode to NovAtel for both input and output (see `INTERFACEMODE` command in the OEM6 Family Firmware Reference Manual).

> Baud rates higher than 115,200 bps are not supported by standard computer hardware. Special computer hardware may be required for higher rates, including 230400 bps, 460800 bps and 921600 bps. Also, some computers 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 COM3 9600 N 8 1 N OFF ON
```

ASCII Example:

```
COM COM1 57600 N 8 1 N OFF ON
```

> Use the COM command before using the `INTERFACEMODE` command on each port.

> 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.

Table 7: COM Serial Port Identifiers

Binary	ASCII	Description
1	COM1	COM port 1
2	COM2	COM port 2
3	COM3	COM port 3
6	THISPORT	The current COM port
8	ALL	All COM ports

Table 8: Parity

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

Table 9: Handshaking

Binary	ASCII	Description
0	N	No handshaking (default)
1	XON	XON/XOFF software 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 7, COM Serial Port Identifiers* on *Page 39*		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 OEM6 based products	ULong	4	H+4
4	parity	See *Table 8, Parity* on *Page 40*		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 9, Handshaking* on *Page 40*		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.3 FRESET Clear Selected Data from NVM and Reset

This command clears data which is stored in non-volatile memory. Such data includes the almanac, ephemeris, and any user specific configurations. The commands, ephemeris, almanac, and L-band related data, excluding the subscription information, can be cleared by using the `STANDARD` target. The model can only be cleared by using the `MODEL` target. The receiver is forced to hardware reset. In addition, values entered using the `CLOCKCALIBRATE` command can only be cleared by using the `CLKCALIBRATION` target.

> `FRESET STANDARD` (which is also the default) causes any commands, ephemeris, GNSS and almanac data previously saved to NVM to be erased.

Abbreviated ASCII Syntax: **Message ID: 20**

```
FRESET [target]
```

Input Example:

```
FRESET COMMAND
```

> If you are receiving no data or random data from your receiver, try the following before contacting NovAtel:
>
> - Verify that the receiver is tracking satellites
> - Check the integrity and connectivity of power and data cables
> - Verify the baud rate settings of the receiver and terminal device (your PC, data logger or laptop)
> - Switch COM ports
>
> Issue a FRESET command

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FRESET header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	target	See *Table 10, FRESET Target* on *Page 42*		What data is to be reset by the receiver (default=STANDARD)	Enum	4	H

Table 10: FRESET Target

Binary	ASCII	Description
0	STANDARD	Resets commands, ephemeris and almanac (default). Also resets all L-Band related data except for subscription information
1	COMMAND	Resets the stored commands (saved configuration)
2	GPSALMANAC	Resets the stored GPS almanac
3	GPSEPHEM	Resets the stored GPS ephemeris
4	GLOEPHEM	Resets the stored GLONASS ephemeris
5	MODEL	Resets the currently selected model
11	CLKCALIBRATION	Resets the parameters entered using the `CLOCKCALIBRATE` command
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
52	PROFILEINFO	Resets the stored profile configurations

B.4 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. The ONTIME trigger option requires the addition of the *period* parameter. See *the* OEM6 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 OEM6 family of receivers can handle 64 logs at a time. If it is more than 64 logs at a time, the receiver responds with an Insufficient Resources error.
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 1 Hz.
4. Use the ONNEW trigger with the MARKTIME or MARKPOS logs.
5. Only the MARKPOS or MARKTIME 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 the ONTIME trigger is used 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 transmitted.

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

```
LOG [port] message [trigger [period [offset [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 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 OEM6 Family Firmware Reference Manual for additional examples.

1. In NovAtel Connect there are two ways to initiate data logging to the receiver's serial ports:
   - the `LOG` command in the *Console* window or
   - use the interface provided in the *Logging Control* window.
2. Only the ASCII/Abbreviated ASCII log table is included in this manual. Refer to the `LOG` command in the OEM6 Family Firmware Reference Manual for binary log details.

Factory Default:

log com1 rxstatuseventa onnew 0 0 hold

log com2 rxstatuseventa onnew 0 0 hold

log com3 rxstatuseventa onnew 0 0 hold

log icom1 rxstatuseventa onnew 0 0 hold

log icom2 rxstatuseventa onnew 0 0 hold

log icom3 rxstatuseventa onnew 0 0 hold

Field	Field Name	ASCII Value	Description	Field Type
1	LOG (ASCII) header	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII or ASCII respectively	-
2	port	See *Table 11, Detailed Serial Port Identifiers* on *Page 45*	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, MK1I	
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. To log data at 1 second after every minute, set the period to 60 and the offset to 1 (default = 0)	Double
7	hold	NOHOLD	Allow log to be removed by the UNLOGALL command (default)	Enum
		HOLD	Prevent log from being removed by the UNLOGALL command	

Table 11: Detailed Serial Port Identifiers

ASCII Port Name	Hex Port Value	Decimal Port Value [a]	Description
NO_PORTS	0	0	No ports specified
COM1_ALL	1	1	All virtual ports for COM port 1
COM2_ALL	2	2	All virtual ports for COM port 2
COM3_ALL	3	3	All virtual ports for COM port 3
THISPORT_ALL	6	6	All virtual ports for the current port
ALL_PORTS	8	8	All virtual ports for all ports
XCOM1_ALL	9	9	All virtual COM1 ports
XCOM2_ALL	10	10	All virtual COM2 ports
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
THISPORT	c0	192	Current COM port, virtual port 0
THISPORT_31	df	223	Current COM port, virtual port 31
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
...			
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.

For detailed information on virtual ports, refer to the `LOG` command in the OEM6 Family Firmware Reference Manual.

B.5 SETCANNAME Sets the CAN name fields

This command sets the CAN device name fields.

Abbreviated ASCII Syntax: **Message ID: 1091**

```
setcanname
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETCANNAME 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	ManufacturerCode			CAN module's Manufacturer Code	ULong	4	H
3	IndustryGroup			Industry group number (default = 2)	ULong	4	H+4
4	DeviceClass			11783-5 Device class (default = 0)	ULong	4	H+8
5	DeviceClassInstance			11783-5 Device class instance (default = 0)	ULong	4	H+12
6	Function			11783-5 Function (default = 23)	ULong	4	H16
7	FunctionInstance			11783-5 Function instance (default = 0)	ULong	4	H+20
8	ECUInstance			11783-5 ECU Instance (default = 0)	ULong	4	H+24
9	PreferredAddress			Device default address on start up (default=28)	ULong	4	H+28
10	Reserved				ULong	4	H+32

Appendix C Logs

C.1 Position Logs

C.1.1 NMEA Logs

The NMEA logs (receiver outputs) supported by the SMART6-L are summarized in Chapter 3 of the OEM6 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 OEM6 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.2* starting on *Page 39*. 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 to output. The information is described in Chapter 3 Data Logs of the OEM6 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.4* starting on *Page 43*.

The above command line operations can also be carried out through NovAtel Connect. Information about configuring the communication port can be found in NovAtel Connect online help. The procedure for adding a NMEA log through the Connect 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 OEM6 Family Firmware Reference Manual, including:

- BESTPOS: This log contains the best available position 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.1.3 VERSION HW and SW Versions and Serial Numbers

The Component Type of the VERSION log, refer to the OEM6 Family Firmware Reference Manual, is extended to include SMART6-L information as in *Table 12*.

Table 12: Component Type

Binary Value[a]	ASCII Value	Description
0	UNKNOWN	Unknown Component
1	GPSCARD	OEM6 GPSCard Component
3	ENCLOSURE	SMART6-L Receiver
8	USERINFO	User application information component
981073925 (0x3A7A0005)	DB_USERAPPAUTO	Auto-starting user application firmware

a. Unused numbers are reserved for future use.

```
[COM1]<VERSION COM1 0 85.0 FINESTEERING 1727 510341.712 00000000 3681 10985
<     1
<          GPSCARD "D2LR0GTTR" "BFN12390111" "OEM628-1.01"
"OEM060210RN0000" "OEM060200RB0000" "2012/Sep/13" "13:46:16"
[COM1]
```

Appendix D Replacement Parts

The following are a list of the replacement parts available for the NovAtel SMART6-L receiver. Should assistance be required or need to order additional components, please contact your local NovAtel dealer or *Customer Service* representative.

D.1 SMART6-L

Table 13: SMART6-L Product

Part Description	NovAtel Part
SMART6-L	01019033
Cable: 14-pin socket to 3 DB-9 connectors, twisted CAN I/O pair, and other bare wire connectors (see *A.2.1 SMART6-L Communication/Power Cable (01018999)* on *page 35*)	01018999
Mounting Plate	70023072

D.2 User Manuals

Table 14: Reference User Manuals

Part Description	NovAtel Part
OEM6 Family Installation and Operation User Manual	OM-20000128
OEM6 Family Firmware Reference Manual	OM-20000129

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