GPStation™

User Manual

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NovAtel Inc. warrants that its Global Positioning System (GPS) products are free from defects in materials and workmanship, subject to the conditions set forth below, for the following periods of time:

GPStation Series	One (1) Year
GPSAntenna Series	One (1) Year
Cables and Accessories	Ninety (90) Days
Software Support	One (1) Year

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There are no user serviceable parts in the GPStation 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.

> You must obtain a **RETURN MATERIAL AUTHORIZATION** (**RMA**) number by calling GPS Customer Service at 1-800-280-2242 or 403-295-4900 before shipping any product to NovAtel or Dealer.

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 all original diskettes along with the defective product in the original packaging to avoid electrostatic and/or shipping damage.

ANY ATTEMPT TO OPEN THE GPStation CASE WILL IMPAIR THE WATER-RESISTANT QUALITIES OF THE ENCLOSURE, AND VOID THE WARRANTY.

CUSTOMER SERVICE

If you require customer service, please provide the following information along with a detailed description of the problem when you call or write:

Serial No._____ Model No. _____

Software Release No. _____

Date Purchased:_____

Purchased from: _____

User name: _____ Title: _____

Company: _____

Address:_____

City:_____ Prov/State: _____

Zip/Postal Code: _____ Country: _____

Phone #:_____ Fax #: _____

E-mail:_____

GPStation interface: Computer type: _____ Operating Shell: _____

Other interface used:_____

Please provide a complete description of any problems you may be experiencing, or the nature of your inquiry (attach additional sheets if needed):

_____

_____

_____

_____

_____

You may photocopy and fax this page, call, or mail the above information to the address listed below.

For customer support, contact the NOVATEL GPS Hotline at **1-800-280-2242** or **403-295-4900**; send a fax to **403-295-4901**; send e-mail to **support@novatel.ca**, visit our web site at **www.novatel.ca;** or write to:

> **NovAtel Inc.**
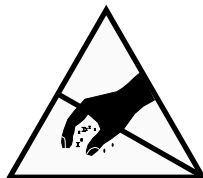> **GPS Customer Service**
> **1120 - 68th Avenue N.E.**
> **Calgary, Alberta, Canada**
> **T2E 8S5**

FCC NOTICE

FCC approval (Class A digital device) is pending.

CAUTION !

Handle with Care

Use Anti-Static Precautions

FOREWORD

Scope

This manual provides sufficient information for the initial set-up and operation of the GPStation; its focus is on the user's perspective for integration, evaluation, and operation purposes. It is beyond the scope of this manual to provide service or repair details. Please contact your NovAtel Customer Service Centre for any customer-service problems or inquiries.

The following documents have been supplied to provide you additional valuable reference information:

- *GPSCard Command Descriptions Manual* - a description of the GPSCard commands and logs available to the user. It is written in generic form so as to accommodate all models of GPSCard-based receivers.

- *WinSat Graphical Interface Program User Manual* - a description of the user-interface software included with all GPSCard receivers.

Other supplementary manuals may be included to accommodate special models and software features with unique functionality. These documents are to be considered as companion manuals, and should be kept together to allow easy reference from one to the other. For example, a reference in this manual to a command or logging activity may require you to consult the *GPSCard Command Descriptions Manual* for a deeper understanding of the full contents and usage of that particular command or log.

Prerequisites

The GPStation requires the addition of peripheral equipment before it can become fully functional. *Section 2, Hardware Configuration*, provides information concerning installation requirements and considerations.

The GPSCard, mounted within the GPStation, utilizes a comprehensive user interface command structure which requires communications through its serial communications ports (COM1 and COM2). To utilize the built-in command structure to its fullest potential, it is recommended that some time be taken to review and become familiar with *Sections 2* through *6* of the *Command Descriptions Manual* before the initial operation.

1 INTRODUCTION

The NovAtel GPStation is a high-performance, reliable GPS receiver with a built-in high-stability oscillator. As such, it is intended for use as a differential GPS base station as well as other demanding positioning applications.

The GPStation is intended to be used with the following NovAtel accessories:

- Model 501 GPSAntenna
- Model A030 Choke-ring Ground Plane - to reduce the effects of multipath reception
- Model C005, C015, or C030 (5, 15 or 30 m length) coaxial cable - to connect the GPSAntenna to the GPStation

After the addition of these accessories, together with user-supplied data communications equipment and a power supply, the GPStation will be ready for use.

FEATURES

The GPStation includes the following features:

- GPS receiver
  - rugged, water and dust-resistant enclosure (see *Figure 1*)
  - modified NovAtel OEM2 GPSCard with GPStation software
  - two serial communication ports and a strobe port
- high-stability Oven-Controlled Crystal Oscillator (OCXO)
- one straight and one null-modem serial-data cable
- one I/O strobe cable
- an AC/DC converter, and power cables
- NovAtel *WinSat* graphical user interface software and user manual

Figure 1   Photograph of GPStation

The GPStation features a 12-channel, parallel tracking, C/A (Coarse Acquisition) code GPS receiver operating on the L1 (1575.42 MHz) frequency. Each dedicated channel independently tracks the code and carrier phase of a GPS satellite in view. The GPStation incorporates NovAtel's patented Narrow Correlator technology that achieves pseudorange accuracy with near P-code performance and provides the industry's most robust resistance against errors introduced by multipath signals. The improved pseudorange accuracy reduces the time required for ambiguity resolution when carrier phase measurements are being made and substantially improves the receiver's performance in differential mode. The custom-

built, proprietary correlator chip combined with a high performance, 32-bit CPU is capable of generating satellite code and carrier phase data at a rate of up to 20 times per second, and computing up to 10 position solutions per second - among the highest rates found in the industry. Exceptional acquisition and re-acquisition times are also a standard feature of this high-performance receiver.

The GPStation is available in two models whose features are summarized in *Table 1*:

Table 1   Feature Summary - GPStation Models

General	GPSTN	GPSTNM
12 parallel tracking channels	✓	✓
Narrow Correlator spacing	✓	✓
2 configurable RS-232C serial data ports	✓	✓
Fast re-acquisition	✓	✓
Field-programmable for firmware upgrades	✓	✓
Multipath Elimination Technology	N/A	✓
High-stability OCXO	✓	✓
Data Logging Rates		
Computed Data: Position, speed, direction, & clock offset @ **10 / sec**	✓	✓
Measured Data: Pseudorange & carrier phase @ **20 / sec**	✓	✓
Output Data Log Formats		
NovAtel-proprietary ASCII and binary	✓	✓
NMEA 0183 Ver. 2.0	✓	✓
RINEX Ver. 2	✓	✓
RTCM SC-104 Rel. 2.0 Types: **1, 3, 9, 16, 59N**	✓	✓
RTCA/DO-217 Types: **1**	✓	✓
Positioning Modes of Operation		
Single point	✓	✓
Waypoint navigation	✓	✓
Differential (using pseudorange corrections)	✓	✓
Receiver Control		
Clock drift correction	✓	✓
Ability to save receiver configuration settings, & almanac	✓	✓
Reset (hardware or firmware activated)	✓	✓
Serial port control	✓	✓
Datum (table or user-definable)	✓	✓
Magnetic variation correction	✓	✓
Undulation (table or user-definable)	✓	✓
Satellite elevation cutoff control	✓	✓
Position, height & velocity constraints	✓	✓
Satellite lockout control	✓	✓
Satellite health control	✓	✓
Strobes		
Mark input (position & time)	✓	✓
1 PPS timing output (for GPS time synchronization)	✓	✓
Measurements strobe	✓	✓
User-defined frequency output pulse train	✓	✓
Solution status output	✓	✓

The high-stability Oven-Controlled Crystal Oscillator (OCXO) ensures highly accurate pseudorange and carrier measurements for DGPS, real-time kinematic (with an RT-20 enabled remote station), and post-processing applications.

The enclosure measures 320 mm x 130 mm x 60 mm, weighs 1.5 kg and is constructed of extruded aluminum. It is sealed by two end-caps which are connected by five mounting screws.

NOTE 1:   The unit is sealed to provide protection against adverse environmental conditions. Any attempt to open the enclosure will impair its water-resistant qualities and void the warranty.

NOTE 2:   Although the GPStation has a rugged enclosure, it is neither intended for kinematic applications nor designed to withstand high levels of vibration or shock. Any of these conditions would impair the stability of the OCXO.

NovAtel leads the industry in state-of-the-art GPS receiver design. We believe our GPStation product line will meet your high expectations. Future products and enhancements from NovAtel are aimed at helping you to maintain that level of satisfaction.

CONNECTIONS AND INDICATORS

The GPStation features front and rear end-caps (*Figures 2 & 3*), each with appropriate indicator lights and connectors. The front end-cap indicator light glows *red* if power is present, then *green* when a valid position is computed.

Figure 2   GPStation Front End-cap

On the rear end-cap there are connections for the I/O strobe signals, COM1 & COM2 serial ports, power input, and RF input from the GPSAntenna. There is a LED above each serial port connector. If a LED glows *red*, data is being received by the GPStation on that port, while if a LED glows *green*, data is being transmitted by the GPStation on that port.

Figure 3   GPStation Rear End-cap

2 *HARDWARE CONFIGURATION*

Installing the GPStation is a straightforward process. As shown in *Figure 4*, a minimum configuration is established with the following set-up:

- Set up the GPSAntenna and optional choke-ring ground plane
- Route and connect coaxial cable between the GPSAntenna and GPStation.
- Connect an RS232 communication interface to one of the serial ports of the GPStation. The supplied null modem cables are intended for RS232 communications only.
- Connect the output of the power adapter to the input power jack of the GPStation.

Figure 4   Typical GPStation Installation Configuration
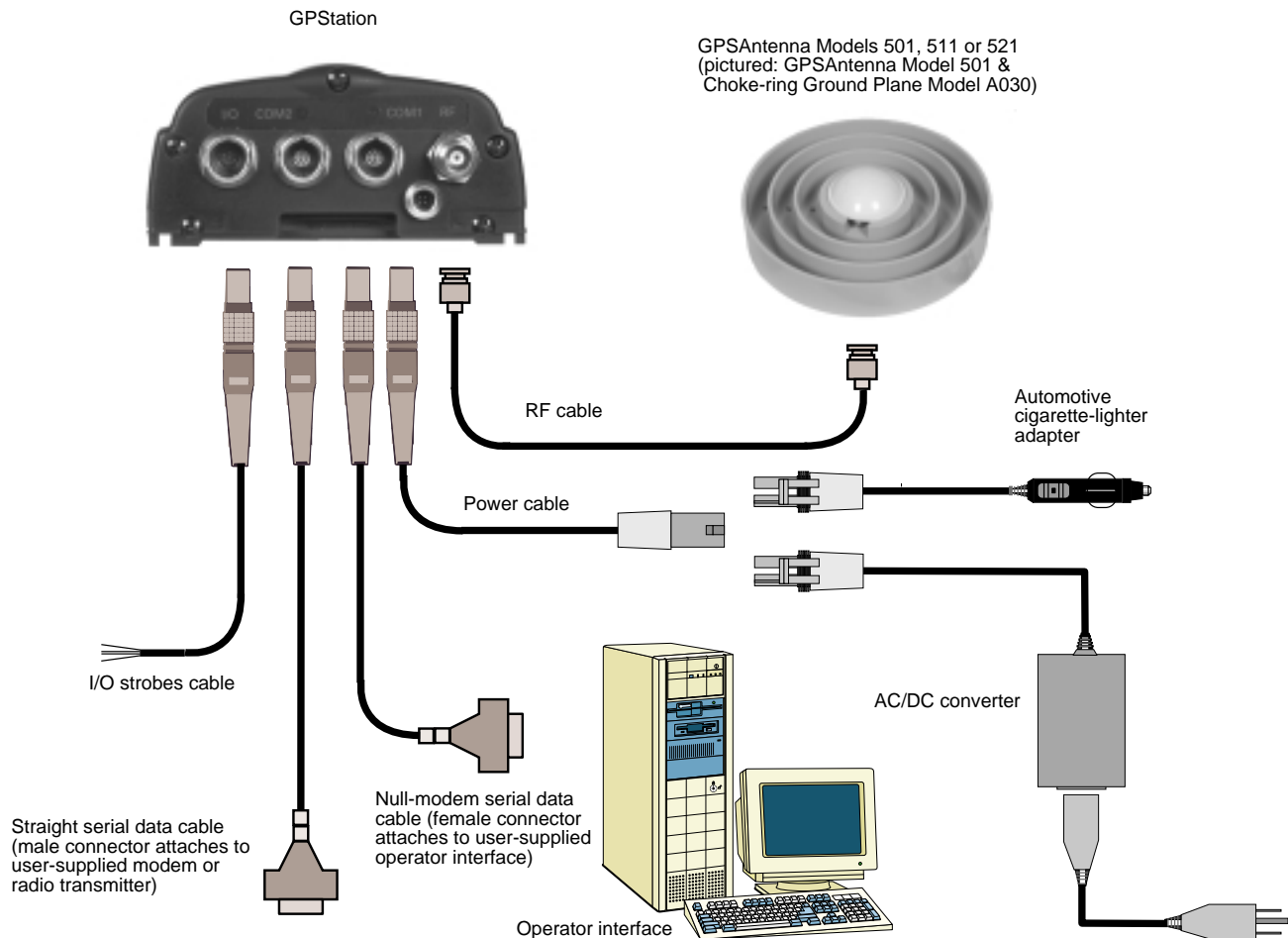
CABLE CONNECTION CONSIDERATIONS

The connectors that are used to mate the cables to the GPStation have a locking mechanism which requires careful insertion and removal. Observe the following when handling the cables.

- To insert a cable, make certain you are using the appropriate cable for the port – the COM1/COM2 serial port cable has a different connector (10 pin) than the I/O cable (8 pin).
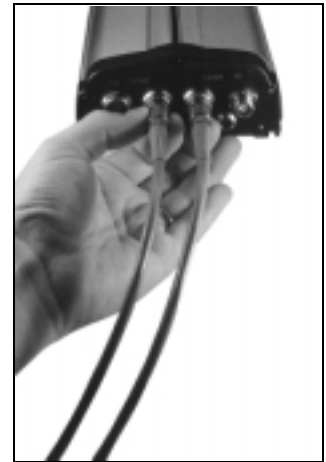- Line up the red dot on the connector shell with the red index mark on the socket.
- Insert the connector until it seats with a click; it is now locked in place.
- To remove a cable, grasp the connector by the knurled ring and pull (see illustration). DO NOT PULL DIRECTLY ON THE CABLE.

GPSAntenna CONSIDERATIONS

The purpose of the antenna is to convert the electromagnetic waves transmitted by the GPS satellites at the L1 frequency (1575.42 MHz) into electrical signals.

The GPStation has been designed for use with the NovAtel Model 501 GPSAntenna as a means of ensuring the highest-precision positioning accuracy. The Model 501 uses low-profile microstrip technology and include band-pass filtering and an LNA which is powered directly by the GPStation. It offers exceptional phase-center stability as well as a significant measure of immunity against multipath interference. To reduce multipath reception even further, the GPSAntenna can be mounted on an optional NovAtel Choke Ring Ground Plane (refer to the *GPSAntenna Model 501 User Manual* for more details).

The 501's low-noise amplifier (LNA) boosts the power of the incoming signals by 23 dB to compensate for cable losses; if the losses are greater than this, excessive signal degradation will occur and the GPStation may not be able to meet its performance specifications. The 501 has an environmentally-sealed radome.

NOTE: The performance specifications of the GPStation are guaranteed only when it is used with a NovAtel-supplied antenna.

When installing the antenna, select a location with a clear view of the sky to the horizon so that each satellite above the horizon can be tracked without obstruction. The location should also be one that minimizes the effect of multipath (for a discussion on multipath, please refer to the chapter on "Multipath Elimination Technology" in the *GPSCard Command Descriptions Manual)*. Ensure that the antenna is securely mounted on a stable structure that will not sway or topple.

ANTENNA CABLE CONSIDERATIONS

The RF cable that you require will depend on the specific antenna selected for use in your system and the distance between the antenna and the GPStation. NovAtel offers high-quality coaxial cable in the following lengths: 5 m (Model C005), 15 m (Model C015), and 30 m (Model C030); these come with a TNC male connector at each end. Should your application require the use of cable longer than 30 m, contact your NovAtel GPS Customer Service representative and request *Application Note APN-003*, *"Extended-Length Antenna Cable Runs"* before you proceed.

The GPSAntenna Model 501 can compensate for up to 23 dB of cable loss; if this limit is exceeded, excessive signal degradation will occur and the GPStation may not be able to meet its performance specifications.

While there may be other coaxial cables on the market which might also serve the purpose, please note that the performance specifications of the GPStation are guaranteed only when it is used with NovAtel-supplied RF cables.

NOTE: The coaxial cable should be connected to the antenna and GPStation before system power is turned on. If the antenna cable becomes disconnected from the antenna or GPStation, remove power from the GPStation before reconnecting the cable; this will prevent the GPStation's antenna current-limiting circuit from unnecessarily activating.

POWER SUPPLY CONSIDERATIONS

The GPStation incorporates a DC-to-DC power converter providing filtering, automatic reset circuit protection, and voltage regulation. It accepts a single input voltage between the range of +10 to +36 V DC. The power input is reverse polarity protected. Refer to the *Power Requirements* section of *Appendix A* for further information.

The DC output of the autoranging AC/DC converter will meet the GPStation's requirements for an input of 110 - 220 V AC.

NOTE: Operating the GPStation outside the specified input voltage range may result in damage to the GPStation, and/or unreliable data.

INPUT POWER CABLES

As shown in *Figure 5*, there are three power cables supplied with the GPStation:

1.   4-pin LEMO socket connector to 2-pole plug connector (NovAtel p/n 01016380)
2.   2-pole socket connector to cigarette-lighter plug with built-in 2 amp fuse (NovAtel p/n 01016446)
3.   2-pole socket connector to AC/DC converter, and AC power cord (NovAtel p/n 01016447)

These cables allow you to power the GPStation from either an AC source or an automotive DC source. For field replacement of either the LEMO connector or the 2-pole connectors, please consult *Appendix B* for a list of the manufacturers' part numbers.

<div align="center">***Figure 5   Power Cables***</div>
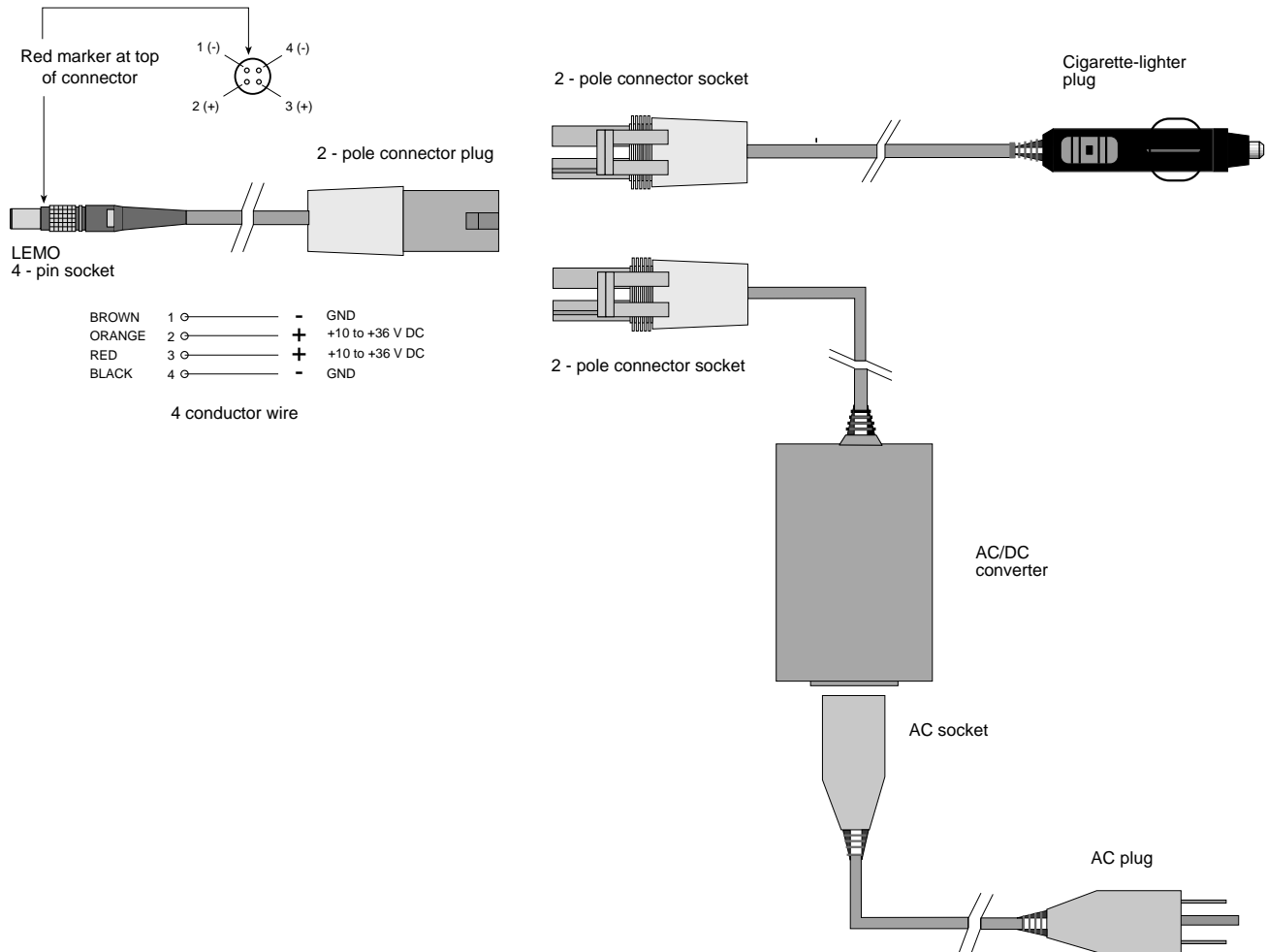
SERIAL DATA CABLES

Two serial data cables are supplied to connect the GPStation to a PC or modem. They are described as follows:

- straight cable: 10-pin LEMO plug to 9-pin D-connector (DE9P plug); see *Figure 6* & *Table 2*. This is used to connect the GPStation to a modem or radio transmitter to propagate the differential corrections. Its NovAtel part number is 01016383.

- null-modem cable: 10-pin LEMO plug to 9-pin D-connector (DE9S socket); see *Figure 7* & *Table 3*. This is used to connect the GPStation to a serial (RS232) communication port on a terminal or computer. Its NovAtel part number is 01016329.

The 10-pin plug on each cable can be plugged into either the COM1 or COM2 port on the GPStation.

For field replacement of the LEMO connector, please consult *Appendix B* for the manufacturer's part number.

Figure 6   Straight Serial Port Cable

Red marker at top of connector

LEMO 10 pin plug

S1   S5

S6   S9

DE9P (male)

BROWN 1	1
BLACK 2	2
RED 3	3
ORANGE 4	4
YELLOW 5	5
GREEN 6	6
BLUE 7	7
VIOLET 8	8
GRAY 9	9
WHITE 10	
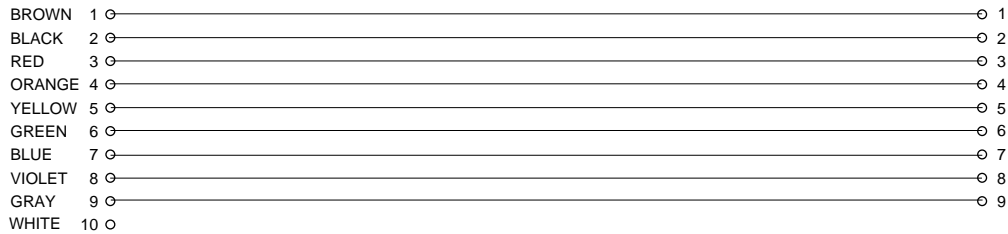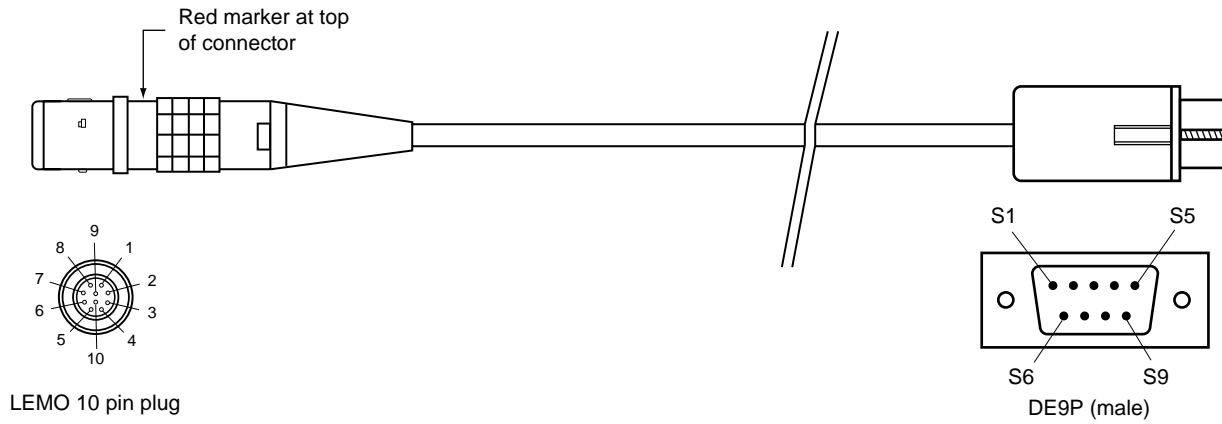
10-conductor cable

Table 2   Straight Cable Pin Configurations

LEMO Pin No.	RS232 Signal	Wire Color Code	DE9P Pin No.
Pin 1	DCD	Brown	Pin 1
Pin 2	RXD	Black	Pin 2
Pin 3	TXD	Red	Pin 3
Pin 4	DTR	Orange	Pin 4
Pin 5	GND	Yellow	Pin 5
Pin 6	DSR	Green	Pin 6
Pin 7	RTS	Blue	Pin 7
Pin 8	CTS	Violet	Pin 8
Pin 9	NULL	Gray	Pin 9
Pin 10		White (Not used)	

Figure 7   Null Modem Serial Port Cable

Red marker at top
of connector

S5   S1

S9   S6

LEMO 10 pin plug

DE9S (female)

BROWN 1		BROWN
BLACK 2		RED
RED 3		BLACK
ORANGE 4		GREEN
YELLOW 5		YELLOW
GREEN 6		ORANGE
BLUE 7		VIOLET
VIOLET 8		BLUE
GRAY 9		GRAY
WHITE 10		

10-conductor cable
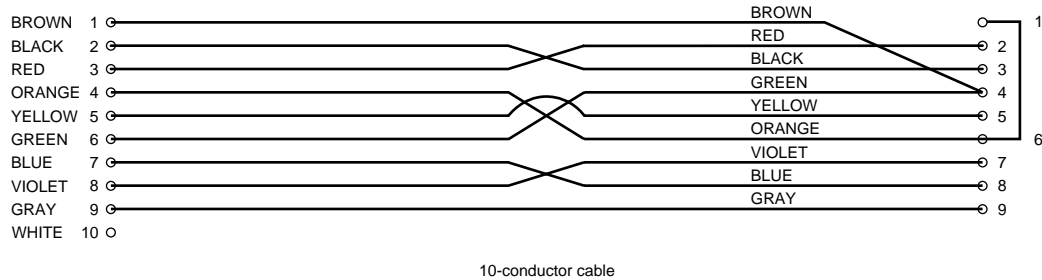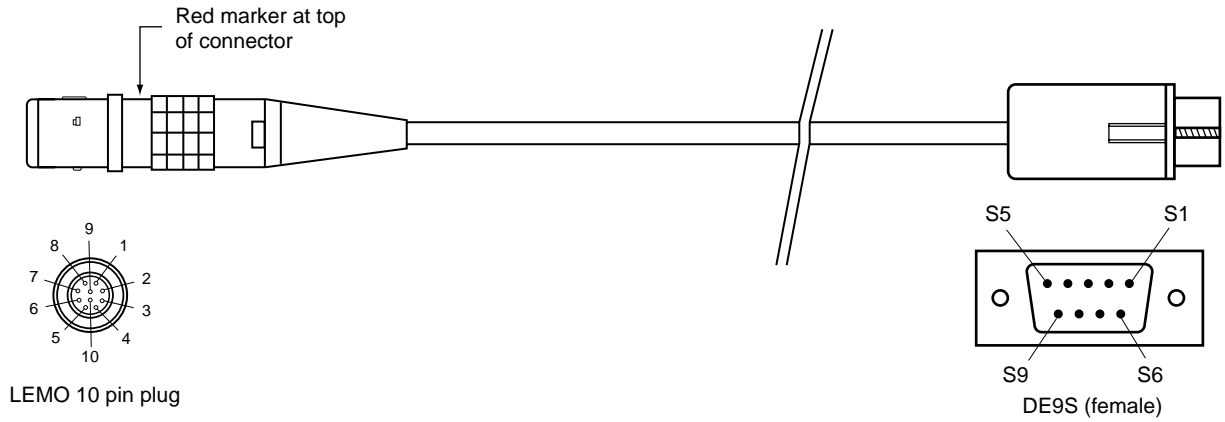
Table 3   Null Modem Cable Pin Configurations

LEMO Pin No.	RS232 Signal	Wire Color Code	DE9S Pin No.
Pin 1	DCD	Brown	Pin 4
Pin 2	RXD	Black	Pin 3
Pin 3	TXD	Red	Pin 2
Pin 4	DTR	Orange	Pin 6
Pin 5	GND	Yellow	Pin 5
Pin 6	DSR	Green	Pin 4
Pin 7	RTS	Blue	Pin 8
Pin 8	CTS	Violet	Pin 7
Pin 9	NULL	Gray	Pin 9
Pin 10		White (Not used)	Pin 1 jumpered to Pin 6

I/O STROBE PORT CABLE

The I/O strobe lines can be accessed by inserting the 8-pin LEMO connector of the I/O strobe port cable (NovAtel p/n 01016330) into the I/O port. *Figure 8* and *Table 4* contain wiring and pin-out information on this cable. The other end of the cable is provided without a connector so that the user can provide an application-specific one; the jacket insulation is cut away slightly from the end but the insulation on each wire is intact. The *Input/Output Strobes* section of *Appendix A* contains a specification of each I/O strobe signal.

For field replacement of the LEMO connector, please consult *Appendix B* for the manufacturer's part number.

Figure 8   I/O Port Cable

LEMO 8-pin socket

BROWN	1	VARF
BLACK	2	1PPS
RED	3	MKO
ORANGE	4	MKI
YELLOW	5	STATUS
GREEN	6	GND
BLUE	7	GND
WHITE	8	GND

8 conductor wire
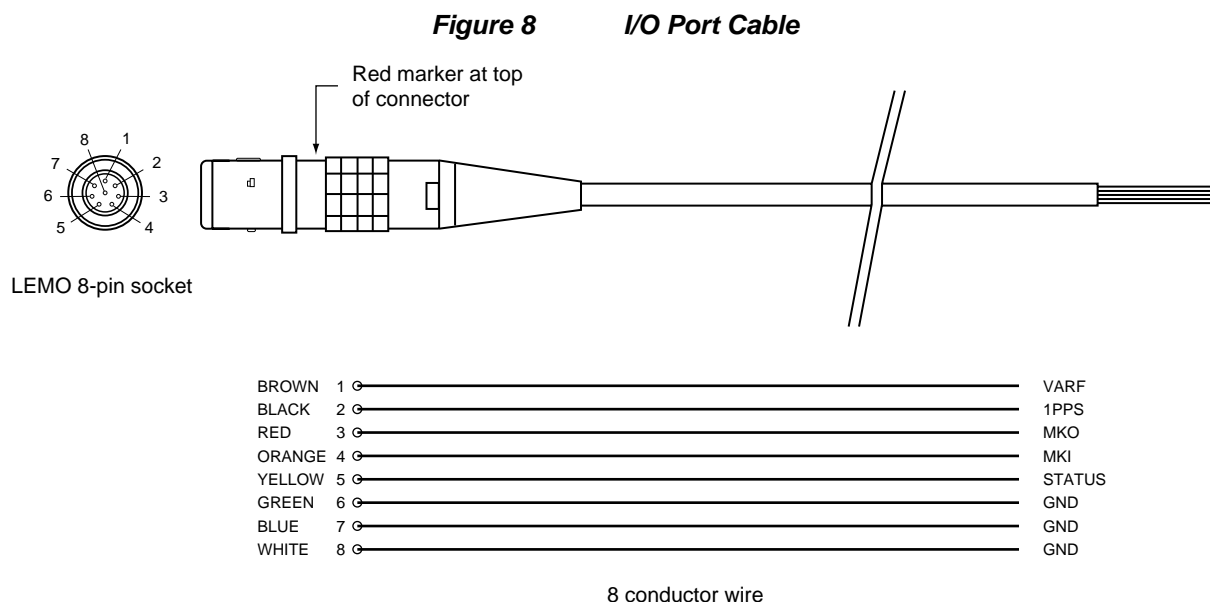
Table 4   I/O Port Pin-out Description

LEMO Pin Number	Pin Description	Wire Color Code
Pin 1	VARF, variable frequency	Brown
Pin 2	1 PPS, one pulse per second	Black
Pin 3	MSR, measure output	Red
Pin 4	MKI, mark input	Orange
Pin 5	STATUS , valid solutions available	Yellow
Pin 6	GND	Green
Pin 7	GND	Blue
Pin 8	GND	White

Note that the STATUS line is used to toggle the valid-position LED on the front end-cap between *red* (power on) and *green* (valid position).

USER-SUPPLIED RADIO OR MODEM

When using the GPStation as a DGPS base station, it needs to be connected to user-supplied equipment that will propagate the differential corrections to remote stations. Whether this equipment is a modem that sends the corrections over telecommunication channels, or radio transmitting equipment that sends the corrections through an atmospheric path, the only requirement is that it have an RS-232C serial data interface through which data can be exchanged with either the COM1 or COM2 port of the GPStation.

NOTE: When using radio transmitting equipment, please ensure that you comply with all applicable government regulations (such as obtaining a license, and obtaining approval before operating a transmitter or setting up an antenna near an airport).

When using a radio transmitter to disseminate the differential corrections, keep in mind that its maximum "line-of-sight" range will primarily be influenced by the effective radiated power (determined, in turn, by the transmitter's power output, the gain of its antenna, and any losses in the transmitting subsystem), the height of the transmitting antenna, and the height of the receiving antenna. The documentation supplied with the radio equipment should contain the information needed to design an effective radio network.

OVEN-CONTROLLED CRYSTAL OSCILLATOR (OCXO)

The built-in, high-stability OCXO enables the GPStation to generate highly accurate differential corrections. The *OCXO* section of *Appendix A* summarizes the operating characteristics of this oscillator. It is important to remember that the OCXO requires 3-5 minutes after power-up to stabilize its temperature; differential corrections should not be sent until after this stabilization has occurred. The GPStation power requirements increase when the OCXO heater switches on; see the *Power Requirements* section of *Appendix A*.

NOTE: The accuracy of the OCXO is impaired by vibration and shock, so it is essential that the GPStation be at rest on a stable and secure surface during operation. The GPStation has rubber feet in order to reduce the effect of vibration.

3 OPERATION

Before using the GPStation for the first time, ensure that you have set up your system as recommended in *Section 2*. The following instructions are based on a configuration such as that shown in *Figure 9*. It is assumed that a personal computer is used during the initial operation and testing for greater ease and versatility. Furthermore, it should be understood that communication between the GPStation and a computer is achieved by virtue of the GPS firmware which resides within the GPStation.

Figure 9   Typical Operational Configuration
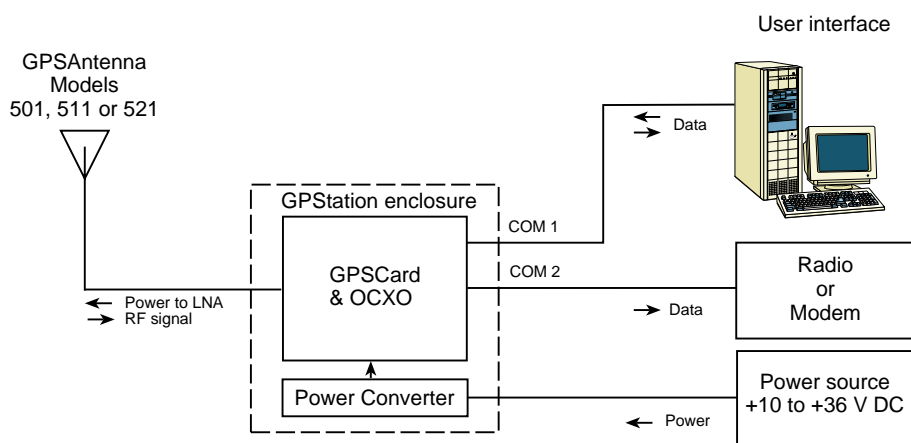
OCXO WARM-UP

Each time the GPStation is powered up, allow 3-5 minutes for temperature stabilization of the OCXO to occur before beginning base-station transmissions. This will ensure that the differential corrections sent to remote stations are of the highest accuracy.

COMMUNICATIONS WITH THE GPSTATION

Communication with the GPStation is straightforward, and consists of issuing commands through the COM1 or COM2 port from an external serial communications device. This could be either a terminal or an IBM-compatible PC that is directly connected to a GPStation serial port using a null-modem cable. Further information on the GPSCard commands and logs can be found in the *GPSCard Command Descriptions Manual*.

SERIAL PORT DEFAULT SETTINGS

For communication to occur, both the GPStation and the PC or terminal have to be configured properly. The GPStation's default port settings are as follows:

- RS232C protocol, 9600 bits per second, no parity, 8 data bits, 1 stop bit, no handshaking, echo off

Changing the default settings requires the use of the *COMn* command, which is described in the *GPSCard Command Descriptions Manual*. It is recommended that the user become thoroughly familiar with the commands and logs to ensure maximum utilization of the GPStation's capabilities.

NOTE: Although the GPStation can operate at bit rates as low as 300 bps, this may not always be desirable. For example, if several data logs are active (i.e. 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 and cause an error condition in the receiver status.

COMMUNICATING USING A REMOTE TERMINAL

One method of communicating with the GPStation is through a remote terminal. The GPStation has been pre-wired to allow proper RS232C interface with a data terminal. To communicate with the terminal, the GPStation only requires the RX, TX, and GND lines to be used; handshaking is not required, although it can optionally be used. Ensure that the terminal's communications set-up matches the GPStation RS232C protocol.

### COMMUNICATING USING A PERSONAL COMPUTER

An IBM-compatible PC can be set up to emulate a remote terminal as well as provide the added flexibility of creating multiple-command batch files and data logging storage files. Any standard communications software package that emulates a terminal can be used to establish bi-directional communications with the GPStation.

One can create command batch files using any text editor; these can then be directed to the serial port that is connected to the GPStation using a communications software package. This is discussed in greater detail later in this chapter.

GETTING STARTED

Included with your GPStation are NovAtel's *WinSat* and *Convert* programs, together with a user manual for them. *WinSat* is a Windows-based graphical user interface which allows one to interact with the GPStation without struggling with communications protocol or writing special software. *WinSat* automatically recognizes the model of GPStation being used and adjusts the displays accordingly. *Figure 10* shows a sample *WinSat* screen. *Convert* is a Windows-based utility that allows you to convert between file formats, and strips unwanted records for data file compilation.

Figure 10   Sample WinSat Screen
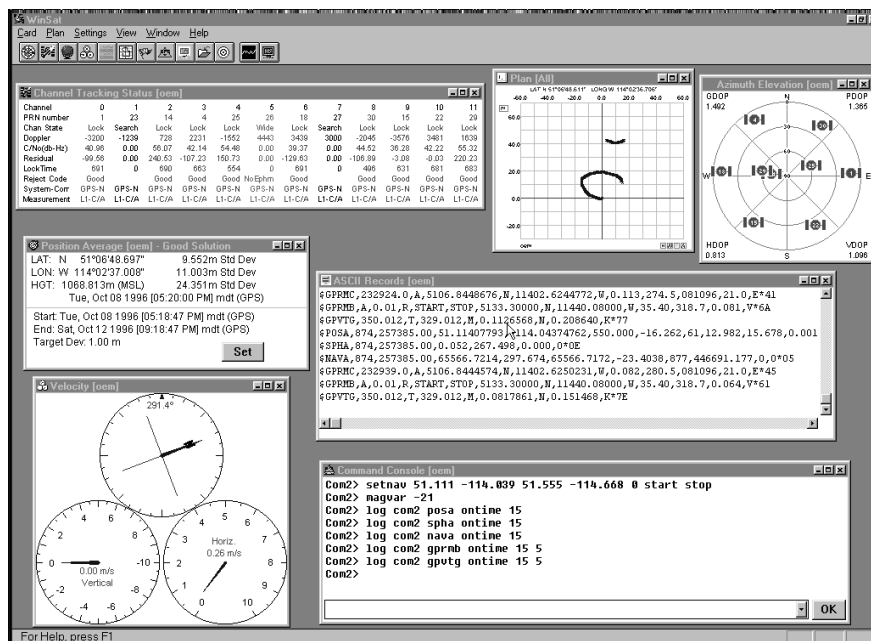
WinSat is provided to facilitate the user's interaction with the GPStation. However, it certainly is possible to communicate with the GPStation through DOS or a Windows-based communications program; this is discussed in greater detail later in this section.

BOOT-UP

The GPStation's software resides in read-only memory. As such, the unit "self-boots" upon power-up and undergoes a complete self-test. If an error condition is detected during a self-test, the self-test status would change; this self-test status information can be viewed in the RGEA/B/C and RVSA/B data output logs (please refer to the *GPSCard Command Descriptions Manual*). If a persistent error develops, please contact NovAtel Customer Service.

When the GPStation is first powered up, no activity information is transmitted from the COM ports except for the port prompt; the screen on an external data communications device will display one of these two messages:

Com1> *if connected to COM1 port*,

or

Com2> *if connected to COM2 port*

Either prompt indicates that the GPStation is ready and waiting for command input.

Commands are typed at the interfacing terminal's keyboard, and sent after pressing the terminal's *Return* or *Enter* key.

NOTE: Most valid commands do not echo a response to a command input; the indication that they have been accepted is a return of the port prompt from the GPStation. VERSION, HELP and ? are the only commands that provide a data response other than the port prompt.

Example:

An example of no echo response to an input command is the FIX HEIGHT command. It can be entered as follows:

```
COM2>fix height 550 [Return]
COM2>
```

The above example illustrates command input to the GPStation COM 2 port which sets the GPStation antenna height as fixed to 550 m above sea level and causes position solutions to be constrained as 2D with height fixed. However, your only confirmation that the command was actually accepted is the return of the **COM2>** prompt.

If a command is incorrectly entered, the GPStation will respond with "Invalid Command Name" (or a more detailed error message) followed by the port prompt.

After initial boot up, you may find the following logs useful for observing the GPStation activities. While *WinSat* is the easiest way to do this, you can also use DOS or a Windows-based communications program; examples of both are provided below.

- Use the RCCA log to list the default command settings. After the GPStation has been operational for a while, the RCCA log will be useful for indicating status of all current command settings. Displaying the RCCA log after a RESET will show the saved configuration (see the description of the SAVECONFIG command for more information).
- Use the ETSA log to monitor the channel tracking status.
- Use the SATA log to observe the satellite specific data.
- Use the POSA log to observe the current computed position solutions.
- Use the DOPA log to monitor the dilution of precision of the current satellite constellation.
- Use the RVSA log to monitor the receiver status.
- Use the HELP command to list all available commands.
- Use the HELP LOG command to list all available logs.

Refer to the *Command Descriptions Manual* for procedures and explanations related to data logging.

DOS

One way to initiate multiple commands and logging from the GPStation is to create DOS boot-up command files relating to specific functions. This will save time when you want to duplicate test situations and minimize set-up time. Any convenient text editor can be used to create command text files.

Example:

For this example, consider a situation where a PC's appropriately-configured COM1 port is connected to the GPStation's COM1 port, and where a remote terminal is connected to the GPStation's COM2 port. The PC user wishes to monitor the GPStation's activity; the following command file could be used to do this.

1.   Open a text editor on the PC and type in the following command sequences:

```
log com2 sata ontime 15
log com2 etsa ontime 15
log com2 rvsa ontime 60 5
log com2 posa ontime 15
log com2 dopa ontime 15
```

2.   Save this with a convenient file name (e.g. C:\GPS\BOOT1.TXT) and exit the text editor.

3.   Use the DOS *copy* command to direct the contents of the BOOT1.TXT file to the PC's COM1 port:

```
C:\GPS>copy boot1.txt com1
1 files(s) copied
C:\GPS>
```

4.   The GPStation is now initialized with the contents of the BOOT1.TXT command file, and logging is directed from the GPStation's COM2 port to the remote terminal.

WINDOWS 3.1 OR HIGHER

As any text editor or communications program can be used for these purposes, the use of Windows 95 is described only as an illustration. The following example shows how the Windows 95 accessory programs *Notepad* and *HyperTerminal* can be used to create a hypothetical waypoint navigation boot-file on a PC, and send it to the GPStation. It is assumed that the PC's serial port COM1 is connected to the GPStation's COM1 port, and that a remote terminal is connected to the GPStation's COM2 port.

Example:

1.   Open *Notepad* and type in the following command text:

```
setnav 51.111 -114.039 51.555 -114.666 0 start stop
magvar -21
log com1 posa ontime 15
log com1 spha ontime 15
log com1 nava ontime 15
log com2 gprmb ontime 15 5
log com2 gpvtg ontime 15 5
log com2 rcca ontime 60
```

2.   Save this with a convenient file name (e.g. C:\GPS\BOOTNAV1.TXT) and exit *Notepad*.

3. Ensure that the *HyperTerminal* settings are correctly set up to agree with the GPStation communications protocol; these settings can be saved (e.g. C:\GPS\OEMSETUP.HT) for use in future sessions. You may wish to use XON / XOFF handshaking to prevent loss of data.

4. From the ***Transfer*** menu, use the ***Send text file*** selection to locate this file to be sent to the GPStation. Once you double-click on the file or select *Open*, then *HyperTerminal* will send the file to the GPStation.

The above example initializes the GPStation with origin and destination waypoint coordinates and sets the magnetic variation correction to -21 degrees. The POSA, SPHA, and NAVA logs have been set to output from the GPStation COM1 port at intervals of once every 15 seconds, whereas the GPRMB and GPVTG NMEA logs have been set to be logged out of the GPStation COM2 port at intervals of 15 seconds and offset by five seconds. The RCCA log has been set to output every 60 seconds from the GPStation COM2 port.

4   *FIRMWARE UPGRADES & UPDATES*

The GPStation stores its program firmware in non-volatile memory, which allows the user to perform firmware upgrades and updates without having to return the GPStation to the factory. New firmware can be downloaded to the GPStation through a serial port, 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 NovAtel GPS Customer Service via any of the methods described in the *Customer Service* section at the beginning of this manual. A Customer Service Representative will assist you in selecting the best upgrade option that suits your specific GPS needs.

When you call, be sure to have available your GPStation model number, serial number, and program revision level. This information is printed on the original shipping box as well as on the back side of the GPStation itself. You can also verify the information by issuing the 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, Customer Service will issue to you an authorization code (*auth-code*). The auth-code is required to unlock the new features according to your authorized upgrade/update model type.

There are two procedures to choose from, depending on the type of upgrade/update you require:

1. If you are *upgrading* to a higher performance model at the same firmware revision level (e.g. upgrading from a GPSTN Rev. 3.42, to a GPSTNM Rev. 3.42), you can use the $AUTH special command.

2. If you are *updating* to a higher firmware revision level of the same model (e.g. updating a GPSTN Rev. 3.42 to a higher revision level of the same model), you will need to download new program firmware to the GPStation using the *Loader* utility program. As the *Loader* and update programs are generally provided in a compressed file format, you will also be given a file decompression password. The *Loader* and update files can be found on NovAtel's BBS or FTP site, or can be sent to you on floppy disk or by e-mail.

Customer Service will provide you with all the information which you require to update or upgrade your receiver.

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 GPStation model available within the same revision level as your current model (e.g., upgrading from a GPSTN Rev. 3.42, to a GPSTNM Rev. 3.42). This command will only function in conjunction with an auth-code assigned by GPS Customer Service.

The upgrade can be performed directly from *WinSat*'s Command Line Screen, or from any other communications program. The procedure is as follows:

1) Power-up the GPStation and establish communications over a serial port (see *Section 3, Operation*)

2) Issue the 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,gpstnm
```

Once the $AUTH command has been executed, the GPStation will reboot itself. Issuing the VERSION command will confirm the new upgrade model type and version number.

UPDATING USING THE "LOADER" UTILITY

Loader is required (instead of the $AUTH command) when updating previously released firmware with a newer version of program and model firmware (e.g., updating a GPSTN Rev. 3.42 to a higher revision level of the same model). *Loader* is a DOS utility program designed to facilitate program and model updates. Once *Loader* 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 downloaded to the GPStation.

DOWNLOADING FIRMWARE FILES

To proceed with your program update, you must first acquire the latest firmware revision. You will need a file with a name such as OEMXYZ.EXE (where XYZ is the firmware revision level). This file is available from NovAtel's GPS Bulletin Board (403-295-4206) or FTP site (ftp.novatel.ca), or via e-mail (gps@novatel.ca). If downloading is not possible, the file can be mailed to you on floppy disk.

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 (e.g., `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*] -s[*password*]

where

|	
filename	is the name of the compressed file (but not including the .EXE extension)
-s	is the password command switch
password	is the password required to allow decompression

Example:
```
oem342 –s12345678
```

The self-extracting archive will then generate the following files:

- LOADER.EXE *Loader* utility program
- LOADER.TXT Instructions on how to use the *Loader* utility
- XYZ.BIN Firmware version update file, where XYZ = program version level (e.g. 342.BIN)

USING THE LOADER UTILITY

The *Loader* utility can operate from any DOS directory or drive on your PC. The program is comprised of three parts: *Program Card* (authorization procedure), *Setup* (communications configuration) and *Terminal* (terminal emulator). The main screen is shown in *Figure 11.*

Figure 11   Main screen of LOADER program
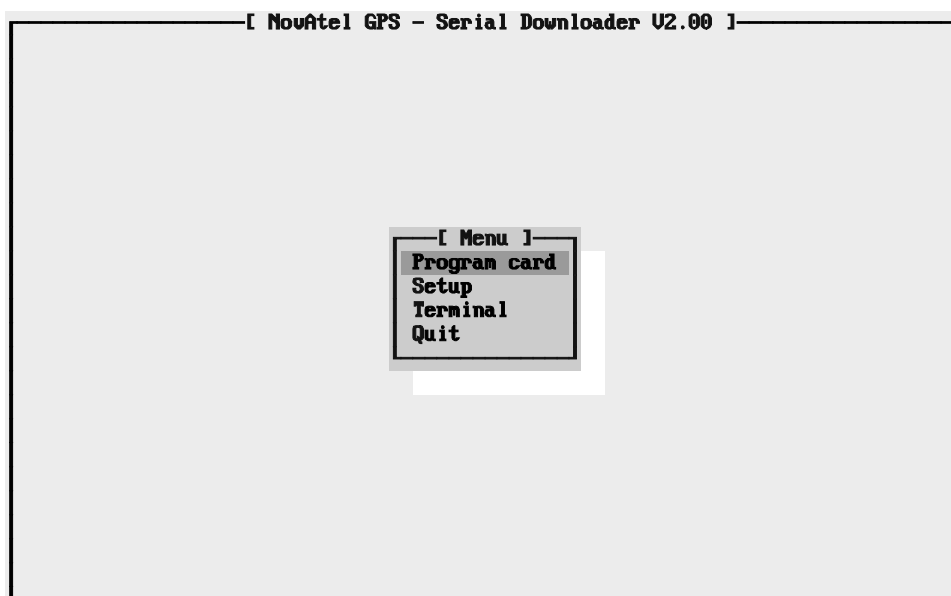
If you are running *Loader* for the first time, be sure to access the *Setup* menu (step 3 below) before proceeding to *Program Card* (step 4 below); otherwise, you can go directly from step 2 below to step 4. The procedure is as follows:

1. Turn off power to the GPStation.

2. Start the *Loader* program.

3. From the main menu screen, select **Setup** to configure the serial port over which communication will occur (default: COM1) , and the data transfer rates for both programming (default: 115 200 bits per second) and terminal emulation (default: 9600 bps). To minimize the time required, select the highest serial bit rate your PC can reliably support. *Loader* will verify and save your selections in a file named LOADER.SET, and return to the main menu screen.

4. From the main screen, select **Program Card.**

5. Select the disk drive (e.g., A, B, C, D) in which the update file (e.g. 342.BIN) is located. Select the path where the update program file is located (e.g., C:\GPS\LOADER); the directory from which you started *Loader* is the default path. Select the required update file (e.g. 342.BIN).

6. At the prompt, enter your update auth-code (e.g. 17b2,32df,6ba0,92b5,e5b9,gpstnm).

7. When prompted by the program, turn on power to the GPStation. *Loader* will automatically establish communications with the GPStation. The time required to transfer the new program data will depend on the bit rate which was selected earlier.

8. When the download is complete, use the terminal emulator in *Loader (*select `Terminal`*)*, or any other one, to issue the VERSION command; this will verify your new program version number. When using the terminal emulator in *Loader*, a prompt does not initially appear; you need to enter the command first, which then produces a response, after which a prompt will appear.

9. Exit *Loader* (select `Quit`).

This completes the procedure required for field-updating a GPStation.

A *TECHNICAL SPECIFICATIONS*

PHOTOGRAPHS

Figure 12   GPStation Side View

Figure 13   GPStation Front End-cap View

Figure 14   GPStation Rear End-cap View

PHYSICAL	
Size:	320 mm x 130 mm x 60 mm
Weight:	1.5 kg
ENVIRONMENTAL	
Operating Temperature	-25° C to +40° C
Storage Temperature	-40°C to +85°C
Resistance Characteristics	Dust tight, water tight
Altitude	5000 m (may operate above this altitude in a controlled environment, however, is not certified as such)
Humidity	95% non-condensing
VIBRATION	
	The GPStation is not rated for vibration because of its effect on the OCXO.
ACCELERATION (DYNAMICS)	
Acceleration	4 g maximum (sustained tracking)
POWER REQUIREMENTS	
Voltage	+10 to +36 V DC
Power	11 W (typical) when OCXO heater off; 16 W when OCXO heater is on
RF INPUT / LNA POWER OUTPUT	
Connector on GPStation	TNC female
RF Input	1575.42 MHz
Power Output to LNA	4.0 - 5.0 V DC @ 10 - 25 mA (current limit 35 mA). **Note**: if the antenna draws current above or below these limits, the self-test status code will be set to zero. Refer to the RVSA log for more information.
OCXO	
Frequency	20.473 MHz
Ageing	5×10^{-10} per day, 1×10^{-7} per year
Phase Noise	1 Hz: -80 dBc/Hz
	10 Hz: -110 dBc/Hz
	100 Hz: -140 dBc/Hz
	1 kHz: -150 dBc/Hz
	10 kHz: -155 dBc/Hz
INPUT/OUTPUT DATA INTERFACE	
Dual RS-232C Serial	Bit rates: 300, 1200, 4800, 9600, 19200, 57600, 115200 bps (9600 bps default)
Signals supported	TX, RX, RTS, CTS, DTR, DSR, DCD
Electrical format	EIA RS232C Standard

PERFORMANCE *(Subject To GPS System Characteristics)*	
Frequency	1575.42 MHz (L1)
Codes tracked	C/A code (SPS)
Channels	12 independent tracking channels
Time to First Fix	< 70 s typical (cold start: no initial time, almanac or position required) assuming stabilized OCXO temperature
Re-acquisition	3 s typical
Computed Data Update Rate	$\leq$ 10 solutions per second
Measured Data Update Rate	$\leq$ 20 data records per second
Pseudorange Position Accuracy (real-time)	**Stand-alone:** 15 m CEP (SA off), GDOP < 2 40 m CEP (SA on) **Differential using two *R-option* Performance Series GPSCards (GDOP<4):** < 0.75 m CEP < 1.00 m SEP
Pseudorange Code Measurement Accuracy	10 cm RMS, 3 minutes, no multipath, C/N_O > 44 dB-Hz 30 cm RMS in multipath environment with choke ring ground plane
Single Channel Carrier Phase Measurement Accuracy	2 mm RMS, C/N_O > 44 dB-Hz Loop BW = 15 Hz
Differential Channel Carrier Phase Measurement Accuracy	0.5 mm RMS, 1 second smoothed, no multipath, C/N_O > 44 dB-Hz
Height Measurements	$\leq$ 18,288 m (due to export licensing restrictions)
Velocity Measurements	$\leq$ 515 m/s (due to export licensing restrictions)
Velocity Accuracy	0.05 m/s (SA off); 0.20 m/s (SA on)
Time Accuracy (relative)	50 ns (SA off); 250 ns (SA on)

INPUT/OUTPUT STROBES	
VARF Output	A programmable variable frequency output ranging from 156 Hz - 10.23 MHz (refer to FREQUENCY_OUT command), with pulse width = 49 ns. This is a normally high, active low pulse. The time between pulses may vary by as much as 49 ns jitter.
PPS Output	A one-pulse-per-second time synchronization output. This is a normally high, active low pulse (200 µs) where the falling edge is the reference.
Measure Output	20 pulses-per-second output, normally high, active low where the pulse width is 200 µs. The falling edge is the receiver measurement strobe.
Mark Input	An input mark (negative pulse > 55 ns), time tags output log data to the time of the falling edge of the mark input pulse (refer to LOG command syntax - ONMARK). This line is TTL or contact-closure compatible.
Status Output	Indicates a valid GPS position solution is available. A high level indicates a valid solution or that the FIX POSITION command has been set.

Table 4 contains I/O port pin-out information. The electrical specifications of the strobe signals are as follows:

Output	Voltage:	Standard TTL levels
	Sink Current:	64 mA
	Source Current:	15 mA
Input	Voltage:	Standard TTL levels
	Current:	≤ 5 mA

B *GPStation REPLACEMENT PARTS*

The following lists describe the replacement parts available for the GPStation system. Should you require assistance or need to order additional components, please contact your NovAtel Customer Service representative.

Part Description	NovAtel Part Number
I/O strobes cable	01016330
Null-modem serial data cable	01016329
Power cable #1 (LEMO 4-pin socket to 2-pole plug)	01016380
Power cable #2 (2-pole socket to cigarette-lighter plug)	01016446
Power cable #3 (2-pole socket to AC/DC converter, c/w AC power cord)	01016447
Straight serial data cable	01016383

Part Description	LEMO Part Number
4-pin socket connector on power cable	FGJ.0B.304.CNLD52Z
8-pin socket connector on I/O cable	FGL.1K.308.CLLC45Z
10-pin plug connector on both serial data cables	FGG.1K.310.CLAC55Z

Part Description	Dominion Automotive Part Number
2-pole plug connector: male connector body	DA 762158
2-pole plug connector: male plug	DA 762150
2-pole plug connector: grommet	DA 762152
2-pole socket connector: female connector body	DA 762159
2-pole socket connector: female socket	DA 762151
2-pole socket connector: grommet	DA 762152

We Would Like To Hear From You...

NovAtel Inc. is committed to providing you, our valued customer, with quality products and customer service.

We would appreciate hearing from you. Please take a few moments to think about the questions below, then respond through any of the methods listed in the *Customer Service* section at the beginning of this manual. At NovAtel, we value your input.

- Which products have you purchased from NovAtel GPS?

    Receivers: GPStation _____

    GPSCard: OEM Series _____   PC Series _____   GPSAntenna: _____

    Accessories: _____ Other: _____

- Are you satisfied with the performance of these products: Yes   No

    Please explain.

- Are you satisfied with the level of customer service provided?   Yes   No

    Please explain.

- What influenced you to purchase NovAtel GPS products?

- Do you have any comments concerning this User Manual?

- Are there any new features or products that you would like to see from NovAtel GPS?

- Do you have any other comments or suggestions?

Your name_____Company_____

Address/phone number _____

_____

NOTES

NOTES

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