ProPak™

User Manual

ProPak

User Manual

Publication Number:	OM-20000011	
Revision Level:	2	97/03/11

This manual is a companion to the GPSCard Command Descriptions Manual, OM-20000008.

The ProPak User Manual reflects features provided in other NovAtel products, including AG-20 , GPSDredger , and Hydrographic Surveyor .

Proprietary Notice

ProPak , GPSCard, GPSAntenna, GPSolution, RT-20 and Narrow Correlator are trademarks of NovAtel Inc.

Microsoft, MS, MS-DOS, and Windows are registered trademarks of Microsoft Corporation.

LEMO is a registered trademark of LEMO S.A.

IBM and PC are registered trademarks of International Business Machines Corporation.

Belden is a registered trademark of Belden Inc.

TABLE OF CONTENTS

TABLES

FIGURES

WARRANTY POLICY

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:

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

Date of sale shall mean the date of the invoice to the original customer for the product. NovAtel's responsibility respecting this warranty is limited solely to product replacement or product repair at an authorized NovAtel location only. Determination of replacement or repair will be made by NovAtel personnel or by technical personnel expressly authorized by NovAtel for this purpose.

THE FOREGOING WARRANTIES DO NOT EXTEND TO (I) NONCONFORMITIES, DEFECTS OR ERRORS IN THE PRODUCTS DUE TO ACCIDENT, ABUSE, MISUSE OR NEGLIGENT USE OF THE PRODUCTS OR USE IN OTHER THAN A NORMAL AND CUSTOMARY MANNER, ENVIRONMENTAL CONDITIONS NOT CONFORMING TO NOVATEL'S SPECIFICATIONS, OR FAILURE TO FOLLOW PRESCRIBED INSTALLATION, OPERATING AND MAINTENANCE PROCEDURES, (II) DEFECTS, ERRORS OR NONCONFORMITIES IN THE PRODUCTS DUE TO MODIFICATIONS, ALTERATIONS, ADDITIONS OR CHANGES NOT MADE IN ACCORDANCE WITH NOVATEL'S SPECIFICATIONS OR AUTHORIZED BY NOVATEL, (III) NORMAL WEAR AND TEAR, (IV) DAMAGE CAUSED BY FORCE OF NATURE OR ACT OF ANY THIRD PERSON, (V) SHIPPING DAMAGE; OR (VI) SERVICE OR REPAIR OF PRODUCT BY THE DEALER WITHOUT PRIOR WRITTEN CONSENT FROM NOVATEL.

IN ADDITION, THE FOREGOING WARRANTIES SHALL NOT APPLY TO PRODUCTS DESIGNATED BY NOVATEL AS BETA SITE TEST SAMPLES, EXPERIMENTAL, DEVELOPMENTAL, PREPRODUCTION, SAMPLE, INCOMPLETE OR OUT OF SPECIFICATION PRODUCTS OR TO RETURNED PRODUCTS IF THE ORIGINAL IDENTIFICATION MARKS HAVE BEEN REMOVED OR ALTERED.

THE WARRANTIES AND REMEDIES ARE EXCLUSIVE AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, WRITTEN OR ORAL, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE ARE EXCLUDED.

NOVATEL SHALL NOT BE LIABLE FOR ANY LOSS, DAMAGE OR EXPENSE ARISING DIRECTLY OR INDIRECTLY OUT OF THE PURCHASE, INSTALLATION, OPERATION, USE OR LICENSING OR PRODUCTS OR SERVICES. IN NO EVENT SHALL NOVATEL BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND OR NATURE DUE TO ANY CAUSE.

There are no user serviceable parts in the ProPak 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 ESD and shipping damage.

ANY ATTEMPT TO OPEN THE ProPak 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. _____ Authorization No. _____

Date Purchased: _____

Purchased from: _____

User name: _____ Title: _____

Company: _____

Address: _____

City: _____ Prov/State: _____

Zip/Postal Code: _____ Country: _____

Phone #: _____ Fax #: _____

GPSCard 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.

Contact your local NovAtel dealer for more information. To locate a dealer in your area, contact the NovAtel GPS Hotline by phone at **1-800-280-2242** or 403-295-4900, by fax at **403-295-4901**, by e-mail to **support@novatel.ca**, over the worldwide web at **http://www.novatel.ca**, or by mail to:

> **NovAtel Inc.**
> **GPS Customer Service**
> **1120 68 Avenue NE**
> **Calgary, Alberta, Canada**
> **T2E 8S5**

SOFTWARE UPDATE REQUEST FORM

If you require a software upgrade/update, please fill in this form, photocopy and fax the information to NovAtel Customer Service along with a copy of your proof of purchase. The GPS Hotline and fax numbers are listed at the front of this manual in the "Customer Service" section.

Customer Name: _____

Company: _____

Mailing Address: _____

                                      _____

                                      _____

                                      _____

Telephone Number: _____

Fax Number: _____

GPSCard Model: _____

Serial Number: _____

Software Version: _____

Date of Purchase: _____

How would you like to receive the upgrade files:
       ___ e-mail: _____

       ___ ftp: _____

       ___ BBS: _____

       ___ mail or courier: _____

 Signature: _____

Date: _____

NOTICE

The United States Federal Communications Commission (in 47 CFR 15) has specified that the following notices be brought to the attention of users of this product.

"This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case you will be required to correct the interference at his own risk."

"Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment."

IMPORTANT: In order to maintain compliance with the limits of a Class A digital device, it is required to use properly shielded interface cables (such as Belden #9539 or equivalent) when using the serial data ports, and double-shielded cables (such as Belden #9945 or equivalent) when using the I/O strobe port.

CAUTION !

Handle with Care
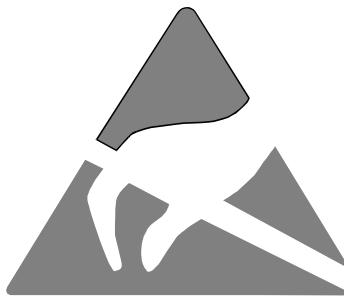
Use Anti-Static Precautions

FOREWORD

Scope

This manual provides sufficient information for initial set-up and operation of the ProPak.

Accompanying this manual is the *Command Descriptions Manual*, which is intended to be a reference manual dedicated to the multitude of GPSCard commands and logs. The *Command Descriptions Manual* has been written in generic form so as to accommodate all models of GPSCard receivers, regardless of series type. Other supplementary manuals may be included to accommodate special models and software features with unique functionality. One example is the *GPSolution Graphical Interface Program*, which is separate user interface software included with all GPSCard receivers and has a separate user manual. Therefore, these manuals are to be considered as companion manuals and should be kept together at all times for easy reference from one to the other. For example, in the *Operation* section of this manual, a command or logging activity may be referred to that requires you to consult the *Command Descriptions Manual* to further understand the full contents and usage of that particular command or log.

The focus of this manual 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 standard for measurements throughout this document is metric (SI) units. There is an appendix to help with any conversions to imperial measurements (*see Appendix B*).

Prerequisites

The ProPak requires the addition of peripheral equipment before it can become a fully functional GPS receiver. *Section 2, Installation*, provides information concerning installation requirements and considerations.

The GPSCard, mounted within the ProPak, 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 operating the ProPak receiver.

1 *INTRODUCTION*

The NovAtel ProPak, (*see Figure 1*), has been designed for the GPS navigation or positioning systems built around the NovAtel GPSCard. The ProPak is a rugged, reliable GPS receiver for adverse environments. The kit provides the following features:

- a rugged mounting enclosure
- one GPSCard
- built-in power converter
- internal PCB interconnect backplane
- an external automobile cigarette lighter power adapter
- two serial communication ports and a strobe port with cables
- mounting bracket

Figure 1   ProPak

The GPSCard, contained within the ProPak, operates based on a patented C/A code correlation 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 on-board processor measures and provides data and solutions at rates that are the highest found in the industry. Exceptional acquisition and re-acquisition times allow this receiver to operate in environments where very high dynamics and frequent interruption of signals can be expected.

NovAtel's GPSCard receiver module offers the developer unparalleled flexibility in areas such as configuration selection, remote control, and in the specification of output data and control signals. The available selection of models is based on a common building block, allowing you to fit the receivers more exactly to the application while maintaining the option for a compatible upgrade path. Accessories such as an antenna choke ring, and a selection of antennas make implementation a faster, less expensive and more reliable task.

NovAtel leads the industry in state-of-the-art GPS receiver design and we believe our GPSCard product line will help place your application ahead of the competition. Future products and product enhancements from NovAtel are aimed at helping you to maintain that lead.

DESCRIPTION OVERVIEW

The ProPak unit is a rugged water, shock and vibration resistant housing designed for outdoor applications. **Any attempt to open the case will impair the water-resistant qualities of the enclosure, and void the warranty.**

The enclosure measures 245 mm x 130 mm x 62 mm, weighing approximately 1.2 kg and is constructed of extruded aluminum. Each end of the enclosure is sealed with an end plate (front end-cap, back end-cap) and the unit is closed with five mounting screws. Add power, I/O data communications equipment (DCE), external antenna, and the ProPak is ready for the most demanding surveying, positioning, or navigation applications.

Inside the ProPak is a GPSCard - a multi-channel parallel tracking, C/A code (Coarse Acquisition) 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 and can provide a pseudorange accuracy within 10 cm. The NovAtel custom proprietary correlator chip combined with a high performance 20 MHz 32-bit CPU is capable of measuring and outputting satellite code and carrier phase data at a rate of up to 20 times per second and can compute up to 10 position solutions per second.

The GPSCard modules are built on a compact printed circuit board utilizing surface mount manufacturing technology, measuring only 167 x 100 x 15 mm in size and weighing 175 grams.

CONNECTIONS AND INDICATORS

The ProPak features front and rear end-caps, (*see Figures 2 and 3*), each with appropriate indicator lights and connectors. Rear end-cap connections for COM1, COM2, strobes, GPSAntenna , and power input are provided. There are two LEDs on the rear end-cap; one for each serial port. Red indicates received data on the port, while Green indicates transmitted data on the port. The front end-cap indicator glows Red when power is on, and Green when a valid position is computed.
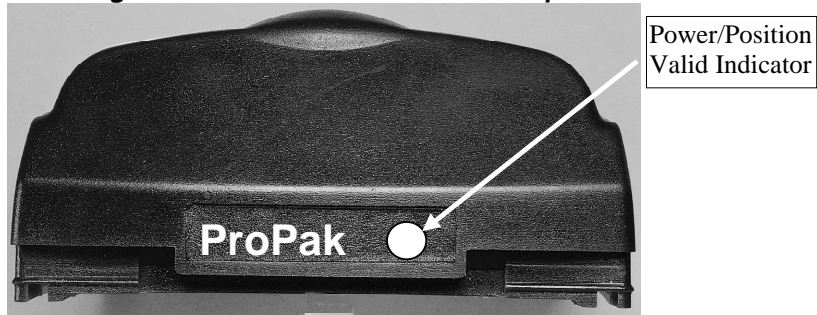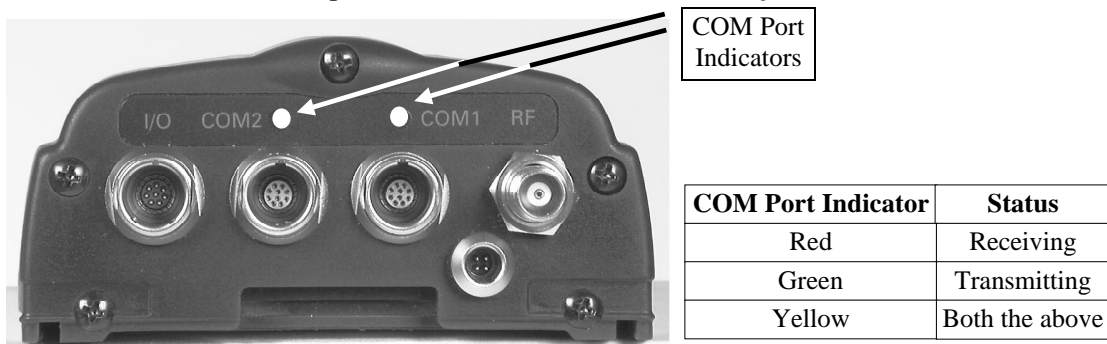

Figure 2   ProPak Front End-Cap

Figure 3   ProPak Rear End-Cap

COM Port Indicator	Status
Red	Receiving
Green	Transmitting
Yellow	Both the above

GPSCARD OEM SERIES FEATURES

The GPSCard is available in numerous models with a multitude of features. *Table 1* summarizes the features of the top of the line GPSCard models. Please feel free to contact a NovAtel GPS Customer Service Representative for further information on GPSCard models available with fewer features

Table 1   ProPak Top-of-the-Line Feature Summary

General	**3151RM**	**RT-20**
Number of Dedicated Channels	12	12
Narrow Correlator Spacing	✔	✔
Number of Serial Ports	2	2
EuroCard Circuit Board	✔	✔
Fast Reacquisition (< 3 seconds typical)	✔	✔
Field Programmable for Software Upgrades (Flash ROM)	✔	✔
MET – Multipath Elimination Technology	✔	✔
Save Almanac to Flash ROM	✔	✔
Data Logging Rates (Maximum)		
Computed Data:		
Position/Speed/Direction/Clock Offset	10/Sec.	5/Sec.
Measured Data:		
Pseudorange/Carrier Phase	20/Sec.	10/Sec. (RT20 mode)
Log Formats		
NovAtel ASCII and Binary Proprietary	✔	✔
NMEA Standard	✔	✔
RTCM Standard: Types 1 and 16 (Tx/Rx)	✔	✔
Types 2 and 9 (Rx only)	✔	✔
Types 3 and 59 (Tx/Rx)	Tx only	✔
RTCA Standard: Type 1 (Tx/Rx)	✔	✔
Positioning Modes of Operation		
Single Point	✔	✔
Waypoint Navigation	✔	✔
Pseudorange Differential (monitor/remote)	✔	✔
Receiver Control		
Save Receiver Configuration Settings (Flash ROM)	✔	✔
Reset (hardware/software activated)	✔	✔
Serial Port Control	✔	✔
Datum - Table or User Definable	✔	✔
Magnetic Variation Correction	✔	✔
Undulation – Table or User Definable	✔	✔
Satellite Elevation Cutoff Control	✔	✔
Position/Height/Velocity Constraint	✔	✔
Satellite Lockout Control	✔	✔
Satellite Health Control	✔	✔
Strobes		
Mark Input - Position/Time	✔	✔
1PPS Timing Output	✔	✔
Measurements Strobe	✔	✔
User Settable Frequency Output	✔	✔
Solution Status Output	✔	✔

2 INSTALLATION

Installing the ProPak is a straightforward process. A minimum configuration is established with the following set-up:

- Setting up the GPSAntenna.
- Routing and connecting the antenna cable between the GPSAntenna and ProPak.
- Connecting an RS232 communication interface to one of the COM ports of the ProPak. (The supplied null modem cables are intended for RS232 communications only.)
- Connecting the output of the power adapter to the input power jack of the ProPak.

CABLE CONNECTION CONSIDERATIONS

The LEMO connectors that are used to connect the cables to the ProPak have a locking mechanism which requires careful installation and removal. Observe the following points when handling the cables.

- To insert the cables, make certain you are using the appropriate cable for the port – the COM1/COM2 serial port cable has a different connector (10 pin) from 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, locking it in place.
- To disconnect the cable, simply grasp the connector by the knurled ring and pull. DO NOT PULL DIRECTLY ON THE CABLES.

Figure 4   Typical ProPak Installation Configuration
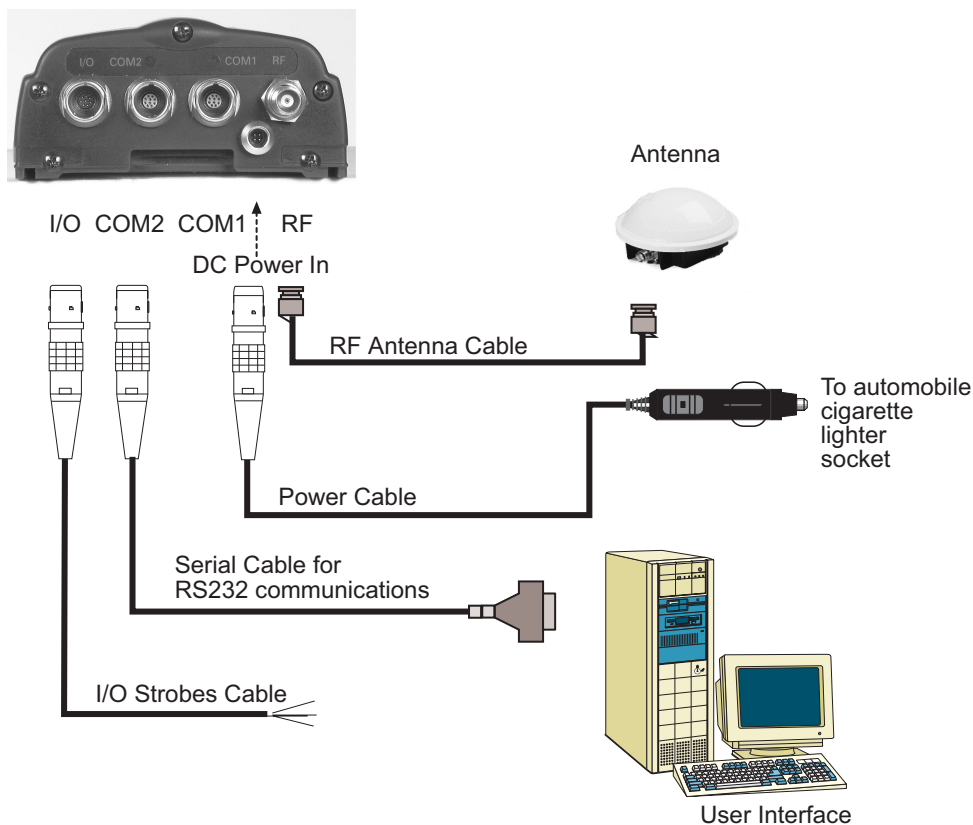
GPSANTENNA

The purpose of the antenna element is to intercept the radio waves transmitted by the GPS satellites. The signal is then coupled to the low noise amplifier (LNA) where it is amplified to overcome the losses incurred by the interconnecting coaxial cable between the antenna and ProPak.

NovAtel offers a variety of GPSAntenna models. All use low profile microstrip technology with built-in LNA and bandpass filtering. The antenna you choose will depend on your particular application, ranging from precise geodetic surveying to avionics, marine, and mobile.

GPS ANTENNA CONSIDERATIONS

Selecting and installing an appropriate antenna system is an important first step before operating your GPS receiver. The antenna you choose for your GPS system will depend on the specific positioning application, such as survey, aviation, marine, mobile, or manpack.

The ProPak has been designed to operate with the NovAtel GPSAntenna models 501, 511, and 521. Though it is possible to operate with other GPS antennas, NovAtel only warrants operation with the above-mentioned models. For further information on GPSAntenna systems and extended length cable runs, contact NovAtel GPS Customer Service and ask for our *"Extended-Length Antenna Cable Runs", Application Note, APN-003*.

For initial testing of the ProPak, we recommend that the GPSAntenna Model 501 be used. It offers exceptional phase center stability as well as improved immunity against multipath reception (> 10 dB rejection of left-hand circular reception). Refer to the *NovAtel GPSAntenna – Model 501 – User Manual* for recommended procedures when installing the Model 501 antenna.

Some important points are mentioned here to keep in mind when installing the antenna system.

- Select an antenna location with a clear view of the sky to the horizon so that each satellite above the horizon can be tracked without obstruction.
- Ensure that the antenna is mounted on a secure stable platform or structure. The mounting structure should be stable enough to withstand unexpected high wind gusts.
- If geodetic survey quality positioning is required, with reduced multipath reception, while maintaining a stable phase center, the NovAtel GPSAntenna Model 501 is recommended. If greater multipath reduction is of high importance, install the GPSAntenna on the NovAtel Choke Ring Ground Plane. Refer to the *GPSAntenna Model 501 User Manual* for more details.

ANTENNA CABLE CONSIDERATIONS

The antenna coaxial cable that you require will depend on the specific antenna selected for use in your system and the distance between the antenna and the ProPak. NovAtel offers a variety of antenna coaxial cables to meet your GPSAntenna installation requirements. Should you require additional coaxial cable, contact your NovAtel GPS Customer Service representative for specific model details.

NovAtel provides optional coaxial cables in the following lengths:

- 5 metre antenna cable(TNC male/TNC male)
- 15 metre antenna cable (TNC male/TNC male)
- 30 metre antenna cable (TNC male/TNC male)

Though it is possible to use other high quality antenna cables, only NovAtel-supplied coaxial cables are warranted for use with the ProPak.

REMEMBER: The coaxial cable should be connected to the antenna and ProPak before system power is turned on. If for any reason the cable is disconnected from the antenna or ProPak, you must turn off power before reconnecting the cable. This is to prevent the ProPak antenna current-limiting circuit from unnecessarily activating.

GPSCARD INTERNAL MOUNT

The GPSCard is mounted in resilient molded card guides located in each side of the mounting enclosure. This arrangement provides shock and vibration resistance for the card. The unit is sealed to provide protection against adverse environmental conditions, therefore **any attempt to open the case will impair the water-resistant qualities of the enclosure, and void the warranty**.

INTERNAL POWER CARD

The internal power card is a DC to DC power converter providing multiple output voltages, filtering, automatic reset circuit protection, and voltage regulation for the ProPak. It will accept a single input voltage between the range of +10 to +36 VDC and converts it to +5, +12, and -12 VDC which the ProPak requires to operate. The power input is reverse polarity protected. Refer to the Technical Specifications for further information.

MOUNTING BRACKET

A mounting kit has been provided to facilitate mounting the ProPak to a surface. The mounting kit includes the following materials:

- four self-tapping screws (#10-16 x ½″ LG)
- two wood screws (#10 x ¾″ LG)
- four flat screws (M3 x 8, 90° countersink)
- aluminum mounting plate (see *Appendix A, Figure 15* for exact dimensions)

First, the mounting plate needs to be attached to the ProPak enclosure. As shown in *Figure 5*, there are two channels running the length of the bottom of the ProPak enclosure. In each of these channels there are two rectangular nuts, held in place by grub screws. These four nuts are factory-positioned so that the mounting plate can be attached to the ProPak enclosure using the four flat screws. Please ensure that the four flat screws are mounted from the countersunk side of the mounting plate.

Once the plate has been attached to the ProPak enclosure, the entire assembly can then be mounted onto a surface using either the four self-drilling screws through the screw-mount holes, or the two tapping screws through the quick-mount holes.

NOTE: This mounting kit is not designed for use in high-dynamics or high-vibration environments. Contact NovAtel Customer Service if your application requires the ProPak to be mounted in these types of environments.

Figure 5   Mounting Plate

Thread for flat screw
Rectangular nut
Grub screw

Channel
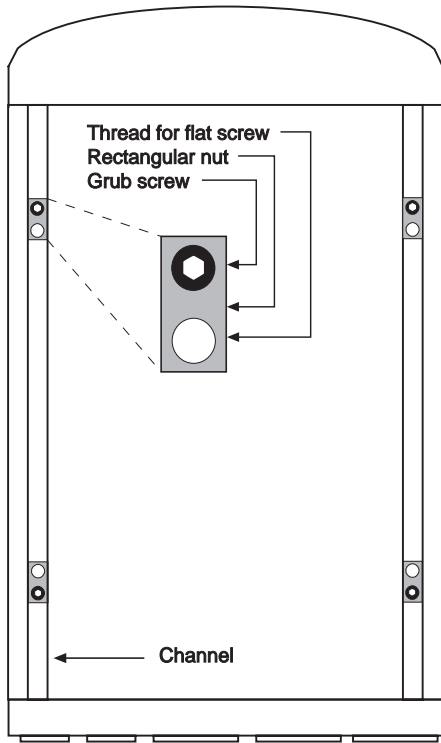
Back of receiver enclosure

Quick-mount holes to mount
assembly to surface using wood
screws.

Holes to mount plate to enclosure
using flat screw

Holes to mount assembly to a
surface using self-tapping screws
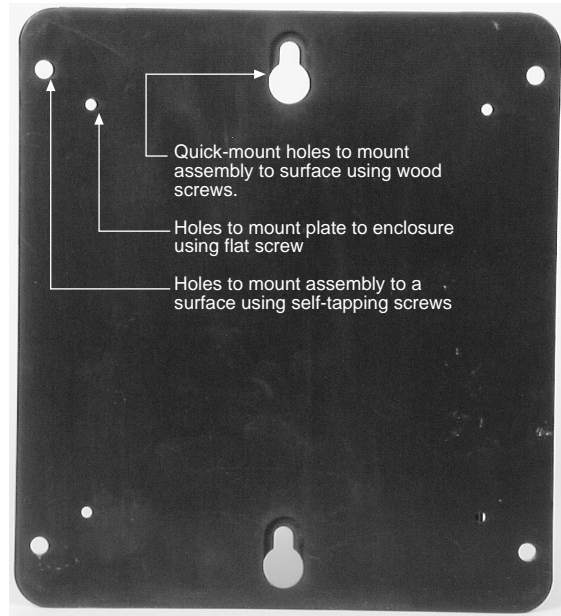
Front of mounting plate

INPUT POWER CABLE

The power cable, *Figure 6*, supplied allows you to connect a DC power source of your choice. It is conveniently equipped with an automobile cigarette lighter power adapter for supplying +12 VDC while operating from an automobile. The output from the power adapter utilizes a 4-pin LEMO connector (LEMO part number: FGJ.0B.304.CNLD52Z). The input power cable is fuse protected and has been charged from 4 amp to 2.5 amp.

Figure 6   Automobile Cigarette Lighter Power Cable
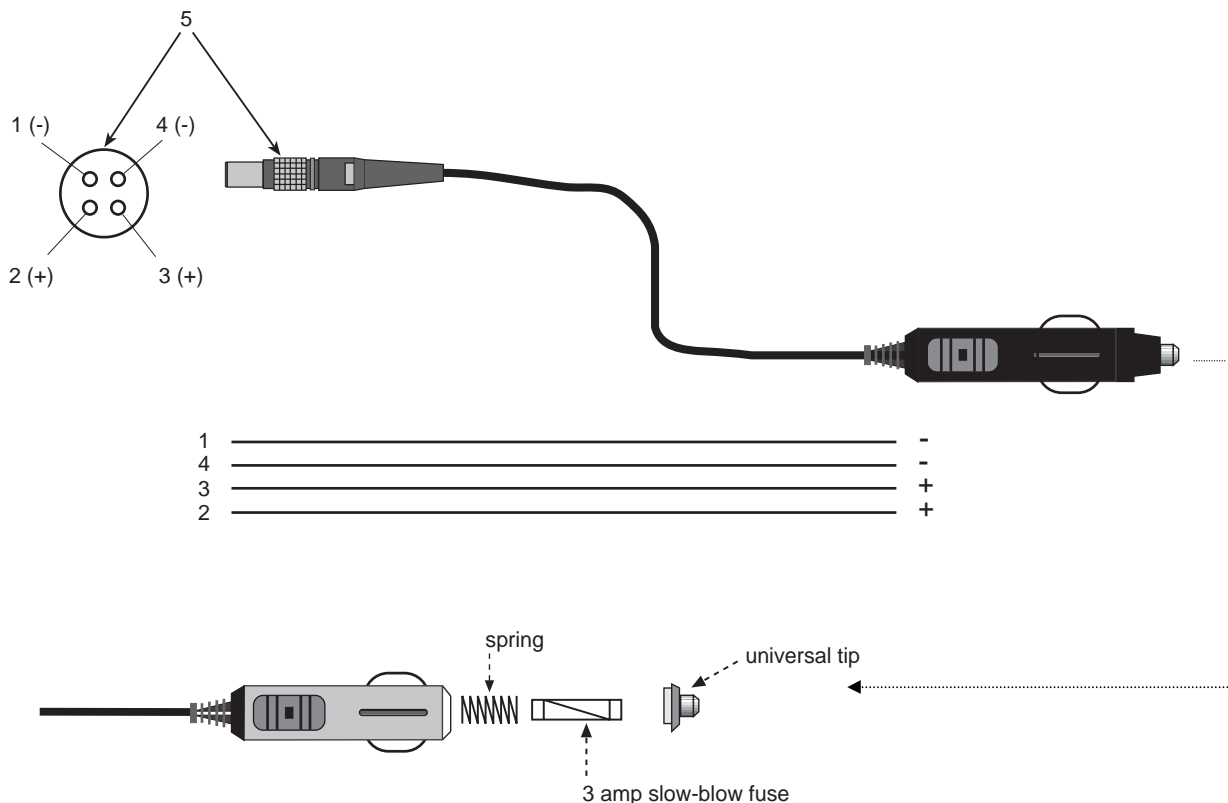
The cigarette lighter adapter is equipped with a 3 Amp slow-blow fuse, located inside the adapter tip. The tip can be unscrewed to allow replacement of the fuse, if necessary. To ensure optimum performance when replacing the fuse first spring load the fuse. The adapter has an LED on its side panel to indicate that power is connected

If an alternative power source is preferred, the cigarette lighter power adapter can be removed. When the adapter is cut off, and the cable stripped, it will be observed that two leads are provided for each positive (+) and negative (–) connection (*see Figure 6*). This allows for parallel power sources, such as dual batteries. The DC power source must be in the range from +10 to +36 VDC. Refer to *Power Requirements* in *Appendix* A for a summary   (Note that additional accessories may be ordered from NovAtel Customer Service if desired.) See *Table 2, 3* and *4* for pinout configurations.

SERIAL DATA CABLES

Two serial data cables are supplied to connect the ProPak II 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 7 & *Table 2.* This is used to connect the ProPak II to a modem or radio transmitter to propagate differential corrections. Its NovAtel part number is 01016383.
- null-modem cable: 10-pin LEMO plug to 9-pin D-connector (DE9S socket); see *Figure 8 & Table* 3. This is used to connect the ProPak II to a serial (RS232C) 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 ProPak II.

For field replacement of the LEMO connector, please consult *Appendix B* for a list of the manufacturers' part numbers.

Figure 7   Straight Serial Port Cable

Red marker at top of connector

LEMO 10 pin plug

DE9P (male)

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

10-conductor cable
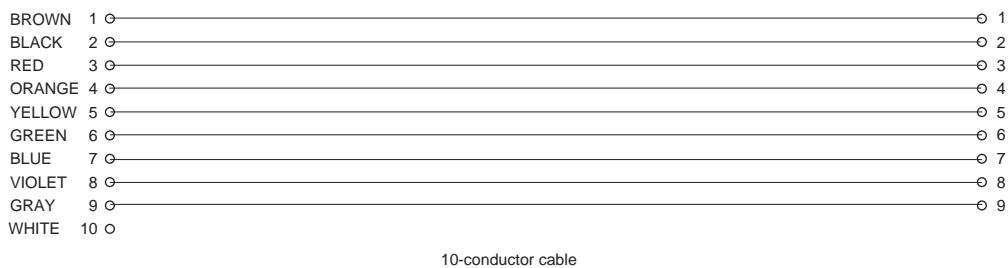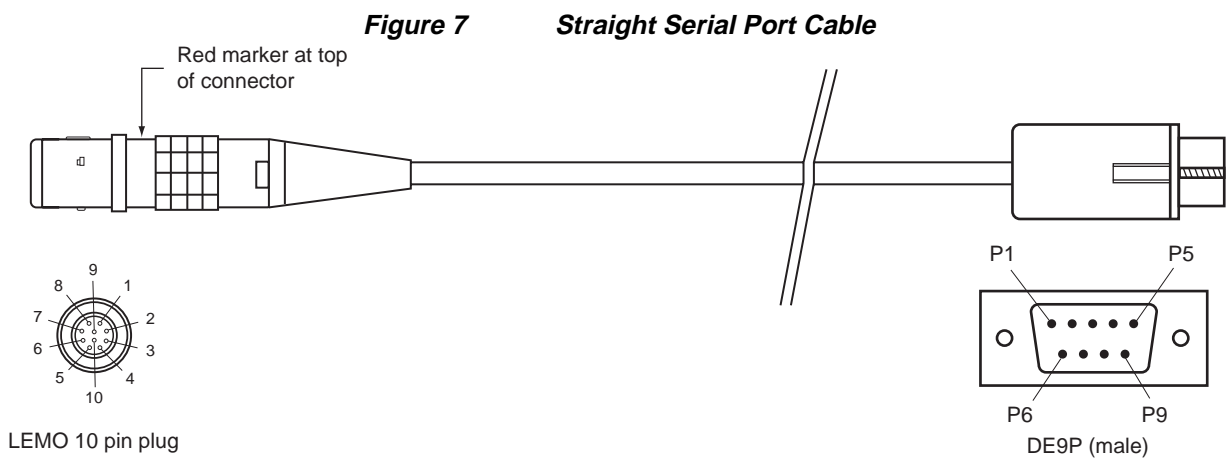
Table 2   Straight Cable Pin Configurations

LEMO Pin No.	RS232C 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 8   Null Modem Serial Port Cable

Red marker at top of connector

LEMO 10 pin plug

S5   S1

S9   S6

DE9S (female)

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

BROWN
RED
BLACK
GREEN
YELLOW
ORANGE
VIOLET
BLUE
GRAY

10-conductor cable
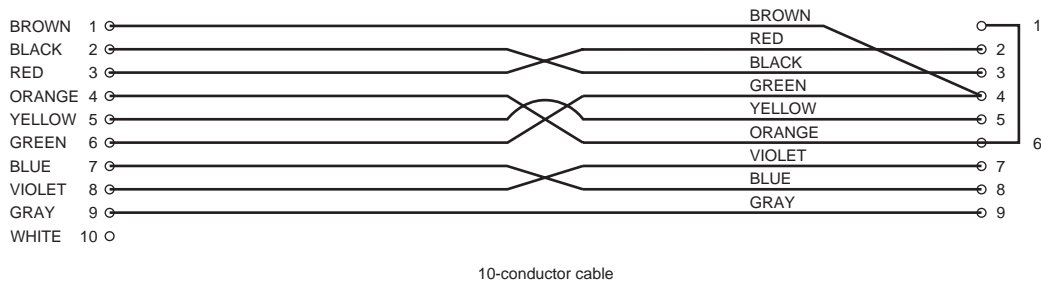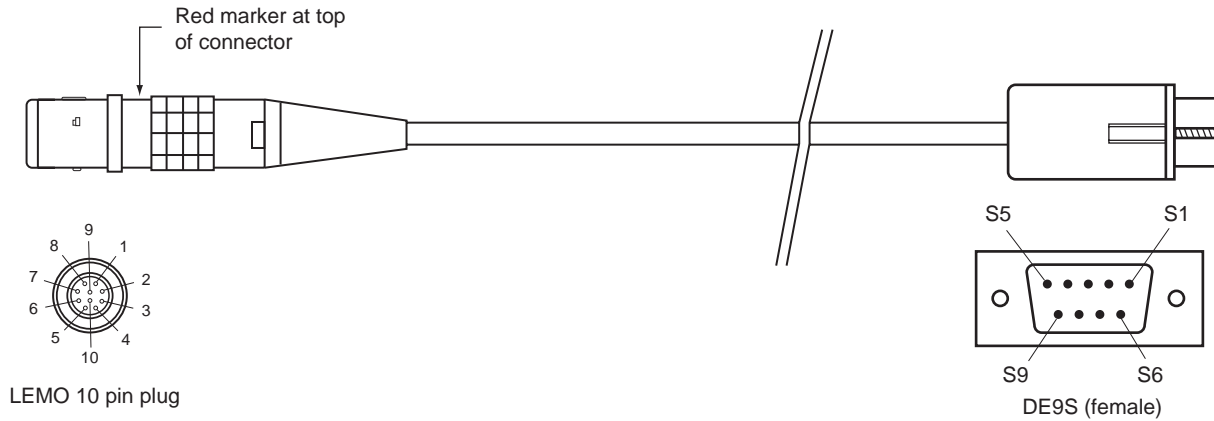
Table 3   Null Modem Cable Pin Configurations

LEMO Pin No.	RS232C 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 ProPak I/O Strobe lines are available on the ProPak back end-cap from the 8 pin LEMO connector (LEMO part number: FGL.1K.308.CLLC45Z), see *Figure 9*. Please see Appendix A (Technical Specifications) for a list of the pinouts and descriptions for each of the I/O strobes along with electrical specifications.

Figure 9   *I/O Strobe Port Cable*
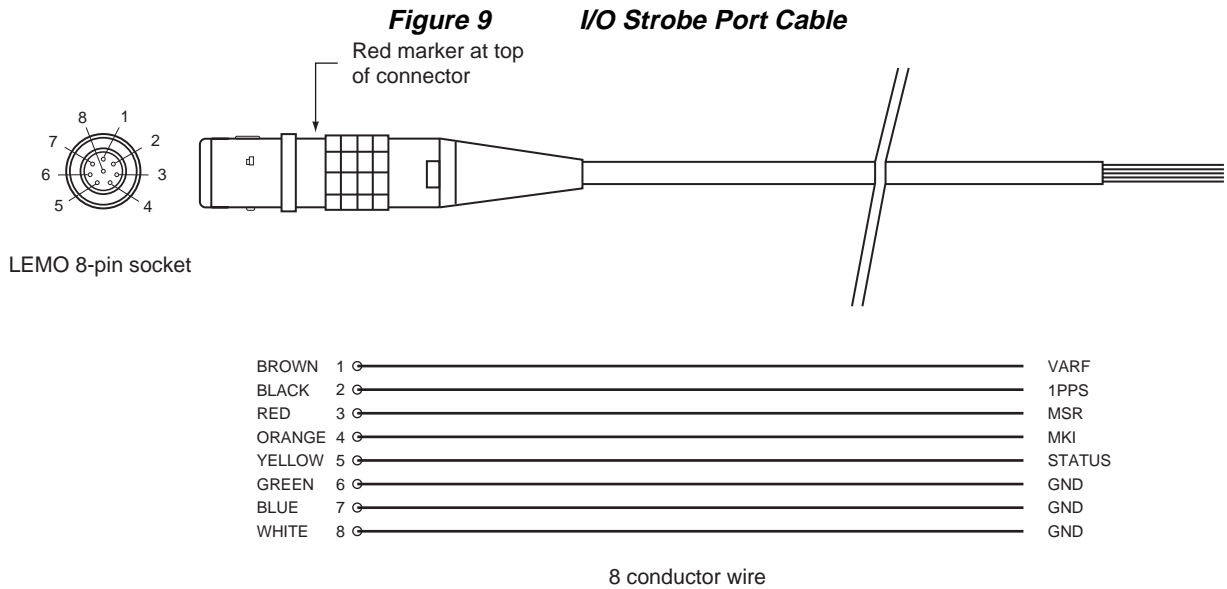
Table 4   *I/O PORT PINOUT (ProPak Receiver)*

LEMO Pin Number	Pin Description	Color Code
Pin 1	VARF, variable frequency	Brown
Pin 2	1PPS, one pulse per second	Black
Pin 3	MKO, mark 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

This is the same line used to turn on/off the valid position LED light on the panel,
i.e., switching between red (power on) and green (valid position).

3 | *OPERATION*

Before operating the ProPak for the first time, ensure that you have followed the installation instructions in *Section 2*. *Figure 10* below illustrates a typical operational configuration for the ProPak. It will be assumed that initial operation and testing of the ProPak will be while using a personal computer to allow greatest ease and versatility of testing. Furthermore, it should be understood that communication between the ProPak and the computer is achieved by virtue of the GPS software which resides on the GPSCard residing within the ProPak.

Figure 10   Typical Operational Configuration
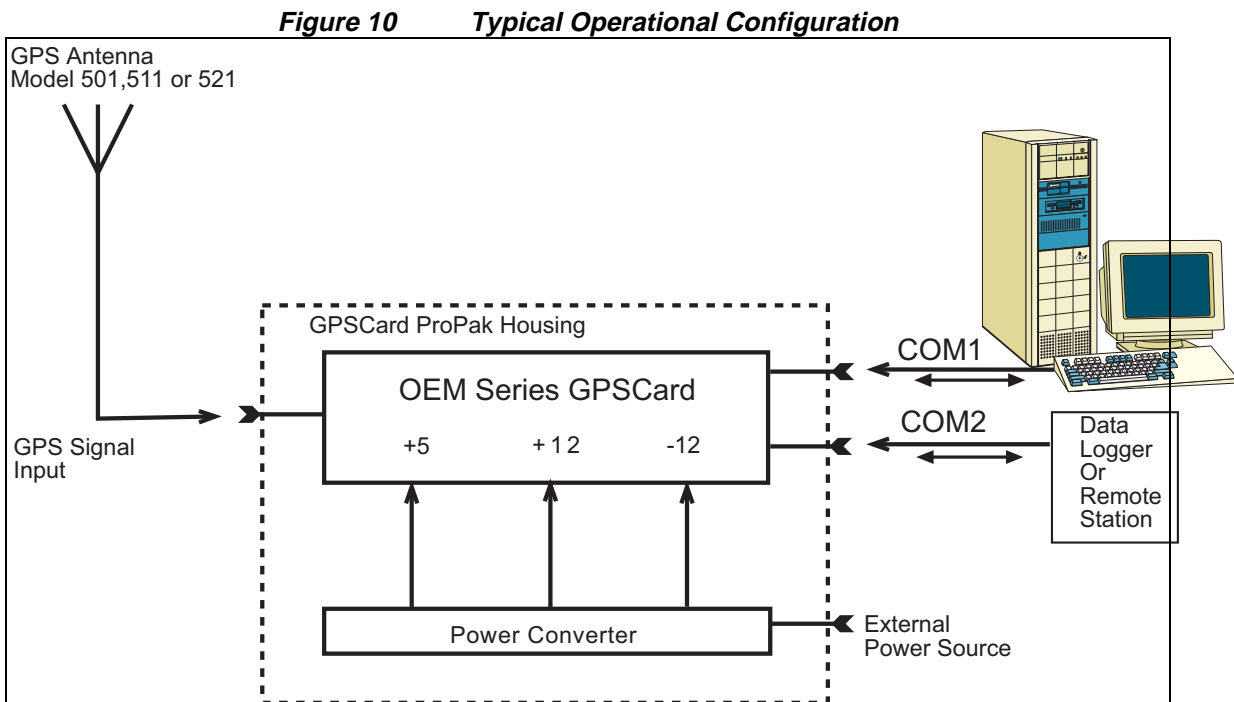
GETTING STARTED

At this point, it is assumed that your ProPak is configured similar to the above illustration and is now ready for operation.

REMEMBER: If you plan to track satellites upon power-up, the GPSAntenna coaxial cable should be connected to both the ProPak and GPSAntenna before power is turned on. This is because connecting the antenna to the ProPak after power up may cause the "internal" antenna LNA power source to current-limit, shutting off power to the GPSAntenna. If this occurs, you will then be required to turn off the ProPak input power and then back on again.

COM PORT DEFAULT SETTINGS

Because the ProPak communicates with the user designed command controller via the COM1/COM2 serial ports, ensure that both units are configured properly for initial communications before power-up of the ProPak. The ProPak COM ports are defaulted to operate with the following protocol settings:

- RS232
- 9600 Baud
- No Parity
- 8 Bits
- 1 Stop Bit
- No Hand Shaking
- Echo Off

BOOT-UP

The boot-up and initial operating software/firmware is resident in the ProPak Flash/ROM memory. Therefore, there is no requirement to download operating software. Just turn on power, wait one moment for self-boot, and the ProPak is now ready for command input.

There are two initial start-up indicators to let you know that the ProPak is operating normally.

Your external DTE (data terminal equipment) screen will display one of the following prompts:

Com1> *if you are connected to COM1 port*,

or

Com2> *if you are connected to COM2 port*

The ProPak is now <u>ready for command input</u> from either or both COM ports.

INITIAL COMMUNICATIONS WITH THE ProPak

Communicating with the ProPak is a straightforward process and is accomplished by issuing desired commands to the COM1 or COM2 ports from an external serial communications device. For your initial testing and communications with the ProPak, you will probably be using either a remote terminal (DTE) or an IBM-PC compatible that is directly connected to a ProPak COM port using a null modem cable.

At this point it is recommended that you become thoroughly familiar with the *Command Descriptions Manual* to ensure maximum utilization of the ProPak's capabilities.

To change the default communication settings, such as baud rate, you need to utilize the *COMn* command as described in *Section 2, Command Descriptions* of the *Command Descriptions Manual*.

COMMUNICATING USING A REMOTE TERMINAL

A convenient and easy method of communicating with the ProPak is to use a remote terminal (DTE). Ensure that the terminal's communications set-up matches the ProPak RS232 protocol.

When the ProPak is first powered up, no activity information is transmitted from the COM ports except for the **COM1>** or **COM2>** prompt described in the *Boot-up* section above.

Commands are directly input to the ProPak using your interfacing terminal's keyboard (after pressing the terminal's *Return* key). It should be noted that most commands do not echo a response to a command input. Your indicator that the command has actually been accepted is a return of the **COM1>** or **COM2>** prompt from the ProPak, depending on which COM port accepted the command. Note that "VERSION" and "HELP" are the only commands that do provide a data response other than the COM port prompt.

Examples:

Using your interfacing terminal, if you type the command VERSION and then press the [Return] key, this will cause the ProPak to echo the ProPak version information. If you type HELP and press [Return], the ProPak will respond with a listing of all available commands.

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

    COM1>**fix height 550** [Return]

    COM1>

The above example illustrates command input to the ProPak COM1 port which sets the ProPak antenna height as fixed to 550 metres 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 **COM1>** prompt.

If a command is erroneously input, the ProPak will respond with the "Invalid Command Option" response followed by the COM1> prompt.

After initial boot up, you may find the following logs useful for observing the ProPak activities:

• Use the RCCA log to list the default command settings. After the ProPak has been operational for a while, the RCCA log will be useful for indicating status of all current command settings. Your ProPak is equipped with the SAVECONFIG option; displaying the RCCA log after a RESET will show the saved configuration.

• Use the CTSA 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 RCSA log to monitor the receiver status.

• Use the HELP command to list all available commands.

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

COMMUNICATING USING A PERSONAL COMPUTER

Using an IBM-compatible PC is a versatile method of interfacing to the ProPak. Your PC can be set up to emulate a remote terminal using the PC's COM serial ports as well as provide the added flexibility of creating multiple command batch files and data logging storage files. Some possible methods of communicating to the ProPak using the PC are:

• Any standard communications software package that emulates a terminal can be used to establish bi-directional communications with the ProPak.

• You can create command batch files using any convenient text editor such as the DOS text editor "Edit" or the Microsoft Windows "Notepad".

• Command files previously created can be redirected to the PC's COM port that is connected to the ProPak. This can be executed using DOS or a DOS-based communications software package.

• Microsoft Windows 3.1 incorporates a terminal emulator ("Terminal") that can be used to create command macros or to select previously created command files to be directed to the COMn port.

Included with your ProPak is a disk containing the setup file to install the NovAtel GPSolution and FILE CONVERTER programs. GPSolution is a Windows graphical user interface which exploits the multitude of features provided by the ProPak, allowing you to explore the GPSCard's many features without struggling with communications protocol or writing make-do software.

The FILE CONVERTER Utility is a Windows program which has been developed as a companion to the ProPak output logging functions. The program allows you to convert between NovAtel ASCII and binary records, and RINEX files, and strips unwanted records for data file compilation.

For further information about installation and operation of the GPSolution and FILE CONVERTER programs, refer to their on-line help.

CREATING COMMAND TEXT FILES

A quick and convenient way to initiate multiple commands and logging from the ProPak is to create 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, it will be assumed that the PC is connected to ProPak COM1 port and that a remote terminal is connected to the ProPak COM2 port. Before you begin, ensure that the PC COM port has been set up to match the ProPak communications protocol.

Immediately following power-up of the ProPak, you may want to monitor receiver activity. The following command file may be useful to quickly initialize logging.

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

   ```
   log com2 sata ontime 15
   log com2 ctsa ontime 15
   log com2 rcsa ontime 60 5
   log com2 posa ontime 15
   log com2 dopa ontime 15
   ```

2. Save the command text to a convenient file name (e.g. BOOT1.TXT) and exit the editor.

3. You can now use the DOS "Copy" command to redirect the contents of the BOOT1.TXT file to the PC COMn port which is connected to the ProPak.

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

4. The ProPak is now initialized with the contents of the BOOT1.TXT command file and logging is directed from the ProPak COM2 port to the connected remote terminal.

COMMUNICATING USING MICROSOFT WINDOWS 3.1

If your PC has Microsoft Windows 3.1, you may find that it offers a convenient method of communicating with the ProPak. With Windows you can use its accessory program "Notepad" to create command text files and then use the Windows "Terminal" program to establish two-way communications between your PC and the ProPak.

As any text editor or communications program can be used for these purposes, the use of Windows is described only for example purposes.
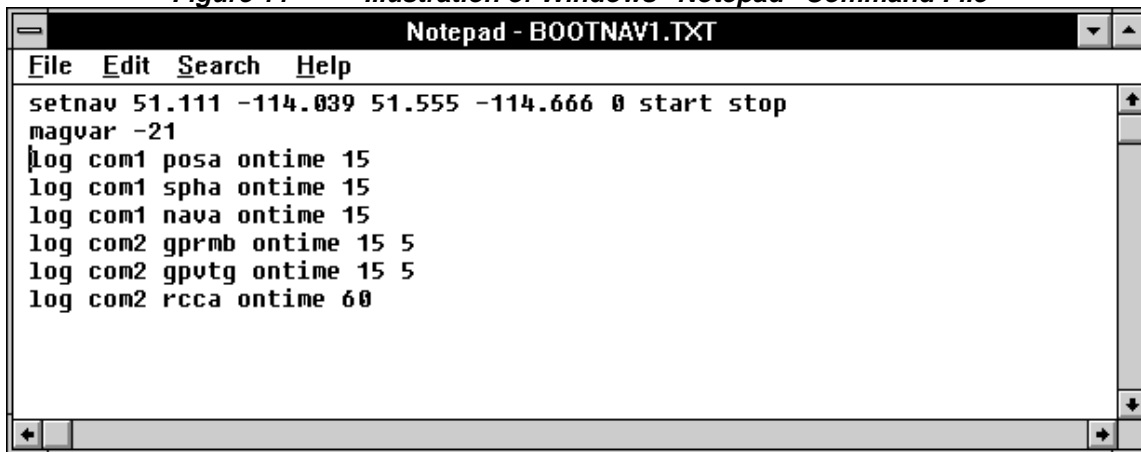
The following paragraphs will give examples of how "Notepad" and "Terminal" may be utilized to create a hypothetical navigation boot-file. It will be assumed that the PC serial port is connected to the ProPak COM1 port and a remote terminal is connected to the ProPak COM2 port.

Example Navigation Command File Using Windows "Notepad" (see Figure 11)

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 the command text as a convenient file name (e.g., bootnav1.txt) and exit the editor.

Figure 11   Illustration of Windows "Notepad" Command File

Once this file is saved, it can be called up at any time to initialize the ProPak for waypoint navigation. Using the text editor can be a very useful method of creating many different operational command and logging initializing scenarios.

Transferring The Command File From Windows "Terminal" To The ProPak

1. Ensure that "Terminal" is correctly set up to agree with the ProPak communications protocol using the **Settings** menu. Once you are satisfied with the Terminal settings, you can save the Terminal set-up with the **File Save As** selection (e.g., OEMSETUP.TRM). This way each time Terminal is started, if you use the **File Open** menu option, then select OEMSETUP.TRM, Terminal will be correctly set up for each communications testing session.

2. Access the **Transfer** menu and use the **Send text file** selection to locate the file you wish to send to the ProPak (e.g. BOOTNAV1.TXT). Once you double-click on the file or select OK, Terminal will send the file to the ProPak.

Terminal will display the text file contents as it is output to the ProPak. *Figure 12* illustrates an example of what you can expect to see on the PC's screen.

The above example initializes the ProPak 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 ProPak 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 ProPak 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 ProPak COM2 port.

Figure 12   Illustration Using Windows "Terminal" Communications
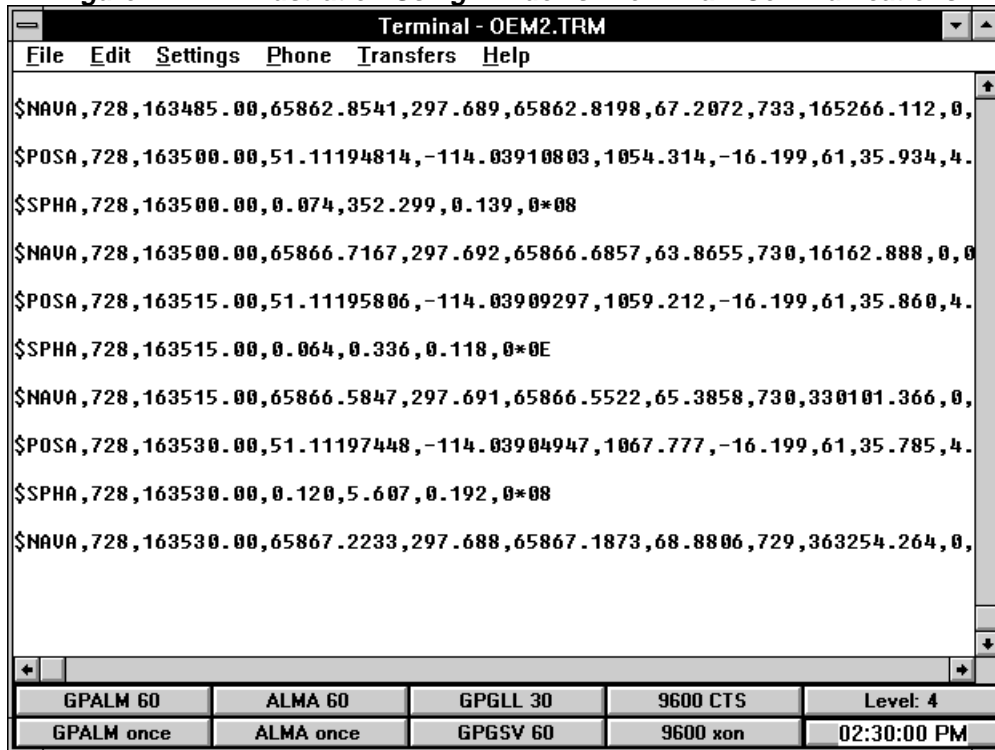
It is worth noting the Function Key buttons at the bottom of Terminal's window. These can be set up to be used as macro command keys for issuing individual commands with a single click of the mouse pointer.

The Buttons can be edited individually from the Terminal **Settings** menu (**Function Keys...**). This is a very convenient method of issuing commands to the ProPak for your lab testing sessions. Note that ^m^d transmits a carriage return/line feed. (Refer to *Figure* 13 for an illustration of Terminal's Function Key settings.)

Figure 13   Illustration of Setting Windows Terminal Button Commands
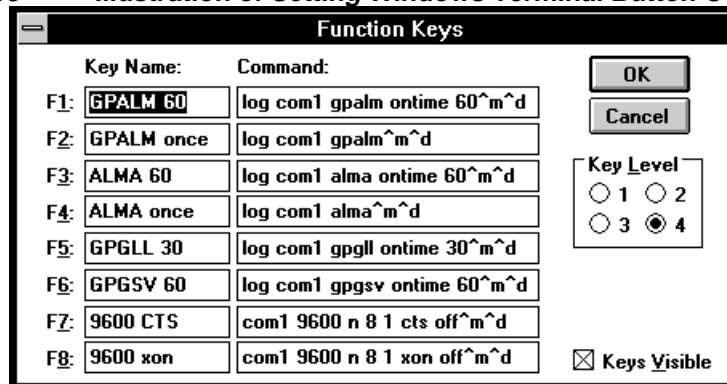
It is important to remember to save your Terminal File Settings if you wish to retain the Button setting for future sessions. This will ensure the communications settings are saved as well. It is also recommended that the ProPak and Windows Terminal be set for **xon/xoff handshaking** as loss of data may occur otherwise.

4   *FIRMWARE UPGRADES & UPDATES*

The ProPak stores its program firmware in non-volatile memory, which allows you to perform firmware upgrades and updates without having to return the ProPak to the factory. New firmware can be downloaded to the ProPak 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 ProPak 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 ProPak 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 ProPak 3911RM rev 3.30 to, a higher revision level of the same model, 3951RM rev 3.30), 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 ProPak 3951RM rev 3.30, to a ProPak 3951RM rev 3.34), you will need to download new program firmware to the ProPak 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 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 ProPak model available within the same revision level as your current model (e.g., upgrading from a ProPak 3911RM rev 3.30, to a ProPak 3951RM rev 3.31). This command will only function in conjunction with a valid auth-code assigned by GPS Customer Service.

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

1) Power-up the ProPak 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,rt20
```

Once the $AUTH command has been executed, the ProPak 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 ProPak 3951RM rev 3.30 to, a higher revision level of the same model, a ProPak 3951RM rev 3.34). *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 ProPak.

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 (403-295-4902) or FTP site (ftp.novatel.ca), or via e-mail (support@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:

```
oem330 -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. 330.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 14*.

Figure 14   Main screen of LOADER program

```
┌─────────────────[ NovAtel GPS - Serial Downloader V2.00 ]─────────────────┐
│                                                                           │
│                                                                           │
│                                                                           │
│                                                                           │
│                          ┌───────[ Menu ]───────┐                         │
│                          │ Program card         │                         │
│                          │ Setup                │                         │
│                          │ Terminal             │                         │
│                          │ Quit                 │                         │
│                          └──────────────────────┘                         │
│                                                                           │
│                                                                           │
│                                                                           │
│                                                                           │
│                                                                           │
└───────────────────────────────────────────────────────────────────────────┘
```
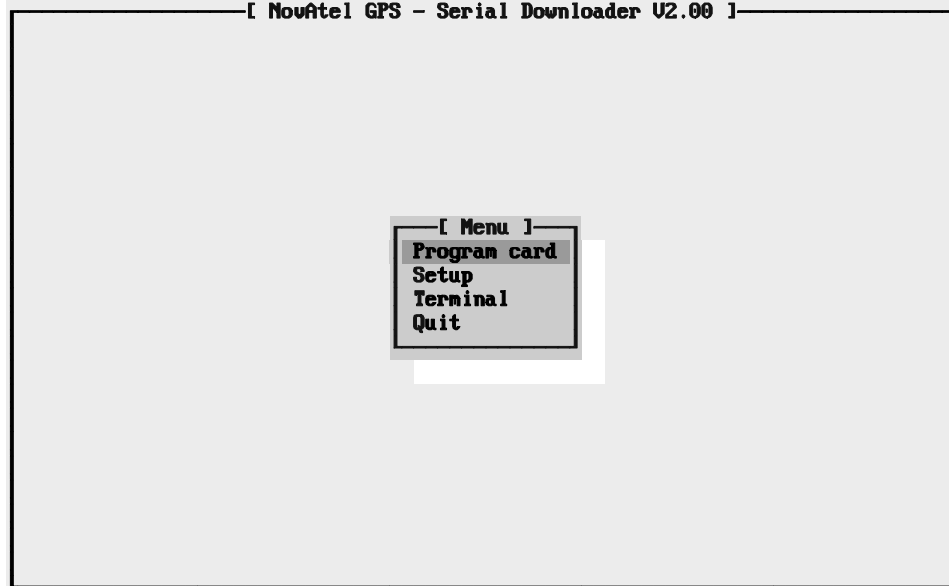
If you are running *Loader* for the first time, be sure to access the *Setup* menu (step 3 below) before proceeding to *Program Card* (step 4 below); otherwise, you can go directly from step 2 below to step 4. The procedure is as follows:

1.   Turn off power to the ProPak.

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. 330.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. 330.BIN).

6.   At the prompt, enter your update auth-code (e.g. 17b2,32df,6ba0,92b5,e5b9,3951RM).

7.   When prompted by the program, turn on power to the ProPak. *Loader* will automatically establish communications with the ProPak. 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 ProPak.
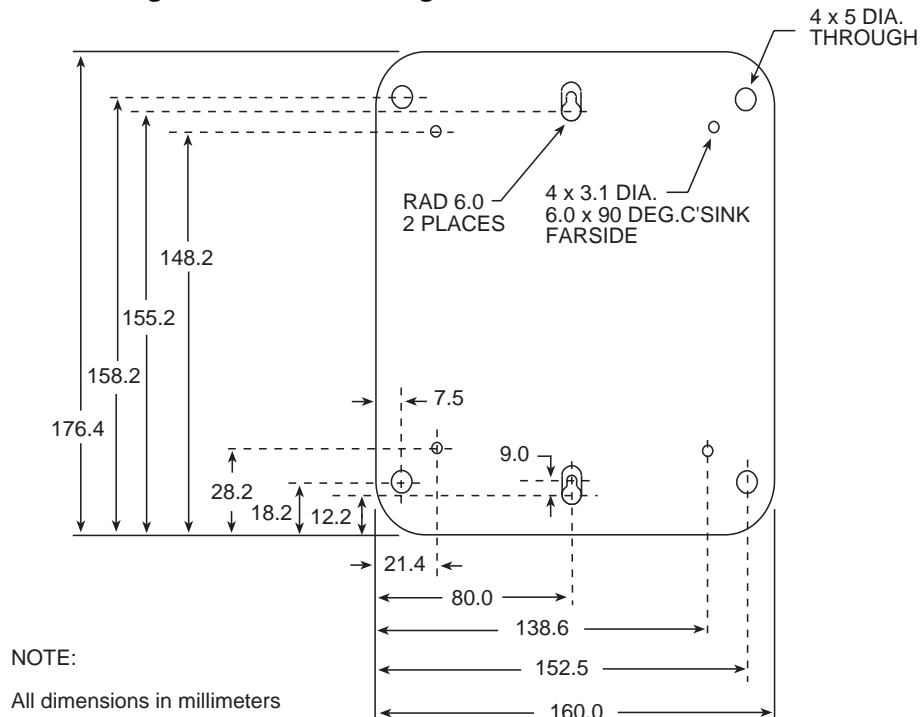
A   Technical Specifications

PHYSICAL	
Size:	245 mm x 130 mm x 62 mm
Weight:	Approximately 1.2 kg

ENVIRONMENTAL	
Operating Temperature:	0° C to +50° C
	-40° C to +65° C (optional)
Storage Temperature:	-40°C to +85°C
Humidity:	95% non-condensing
Altitude:	5,000 metres [May operate above 5,000 metres in a controlled environment, however is not certified as such.]
Resistance characteristics:	Dust tight, water tight

VIBRATION		
Operational:	10 Hz - 55 Hz	5 g
	55 Hz - 150 Hz	2 g
	150 Hz - 500 Hz	1 g

ACCELERATION	
Acceleration:	4g maximum (sustained tracking)

POWER REQUIREMENTS	
Input Voltage:	+10 to +36 V_{DC}
Power:	8 W typical
Power Protection:	Self-resettable circuit-breaker, reverse polarity-protected, current-limits at 1.4 A

PERFORMANCE *(Subject To GPS System Characteristics)*	
Frequency:	L1, 1575.42 MHz
Code tracked:	C/A Code (SPS)
Channels:	12 independent tracking channels
Time to First Fix:	< 70 seconds typical (cold start: no initial time, almanac, or position required)
Re-acquisition:	3 seconds typical
Computed Data Update Rate:	up to 10 solutions per second (model and configuration dependent)
Measured Data Update Rate:	up to 20 data records per second (model and configuration dependent)
Pseudorange Position Accuracy: (real-time)	**Standalone:** 　15 metres CEP (SA off), GDOP < 2 　40 metres CEP (SA on) **Differential with RTCM Standard Reference Station:** 　1-5 metres CEP **Differential between two R option Performance Series cards with GDOP < 4** 　CEP $\leq$ 1.25 metres 　SEP $\leq$ 1.85 metres 　**With Choke Ring ground plane:** 　　　**Standard Series (Standard Correlator)** 　　　　CEP 2 - 5 metres 　　　**Performance Series (Narrow Correlator)** 　　　　CEP 0.75 metre 　　　　SEP < 1.00 metre **RT-20 Series (RT-20 Mode)** 　< 0.20 metre CEP nominal (refer to the GPSCard Command Descriptions Manual for complete specifications of RT-20 mode)
Pseudorange Measurement Accuracy:	10 cm RMS, 3 minutes, no multipath, C/N_0 > 44 dBHz 25 cm RMS in multipath environment with Choke Ring
Velocity Accuracy:	0.03 m/s nominal (differential) 0.20 m/s nominal (single point)
Single Channel Phase Accuracy:	3 mm RMS, C/N_0 >44 dBHz Loop BW = 15 Hz
Differential Channel Phase Measurement Accuracy:	0.75 mm RMS, 1 second smoothed, no multipath, C/N_0 > 44 dBHz
Time Accuracy (relative):	50 nanoseconds (SA off) 250 nanoseconds (SA on)
Height Limit:	Up to 18,288 metres (60,000 feet) maximum [In accordance with export licensing the card is restricted to < 60,000feet.]
Velocity Limit:	Up to 515 metres per second maximum [In accordance with export licensing the card is restricted to less than 1000 NMi/hr. (515 m/sec)]
INPUT/OUTPUT DATA INTERFACE	
Dual Serial:	Baud rates: 300 baud to 115.2 Kbaud user selectable Default: 9600 baud (COM1 and COM2)
Electrical format:	RS232

INPUT/OUTPUT STROBES	
VARF Output:	A software programmable variable frequency output ranging from 156 Hz to 10.23 MHz (refer to FREQUENCY_OUT command.) The pulse width is one cycle of 20.473 MHz (49 nsec). This is a normally high, active low pulse. The time between pulses may vary by as much as 49 ns jitter.
1PPS Output:	A one-pulse-per-second Time Sync output. This is a normally high, active low pulse (200 µs) where the falling edge is the reference.
Measure Out:	1, 10 or 20 pulses-per-second output, normally high, active low where the pulse width is 200 µs. The falling edge is the receiver measurement strobe. (Rate is model-dependent.)
Mark Input:	An input mark (negative pulse > 55 nsec), 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 fix position has been set.
The electrical specifications of the strobe signals are as follows:			

Output:	Voltage	(High)	> 2.0 V_{DC}
		(Low)	< 0.55 V_{DC}
	Sink Current		64 mA
	Source Current		-15 mA
Mark Input:	Voltage	(High)	> 2.0 V_{DC} and < 5.0 V_{DC}
		(Low)	< 0.8 V_{DC}
	Current		< 5 mA maximum

Figure 15   Mounting Bracket Drill Holes - Dimensions

B   Some Common Unit Conversions

Distance

1 international foot = 0.3048 metres
1 statute mile = 1609.7 metres
1 nautical mile = 1852 metres
1000 metres (m) = 1 kilometre (km)
100 centimetres (cm) = 1000 millimetres (mm) = 1 metre (m)

Temperature

degrees Celcius = (5/9) x (degrees Fahrenheit - 32)

Volume

1 litre (l) = 0.88 quart
1000 cubic centimetre (cc) = 1 litre (l)

Weight

1 gram (g) = 0.04 ounce
1 pound = 0.45359 kilograms (kg)
1000 gram (g) = 1 kilogram (kg)

NovAtel Inc.
1120 68 Avenue NE
Calgary, Alberta, Canada T2E 8S5
GPS Hotline: (403) 295-4900
GPS Fax: (403) 295-4901
E-mail: support@novatel.ca
Website: http://www.novatel.ca

Recyclable

Printed in Canada
on recycled paper