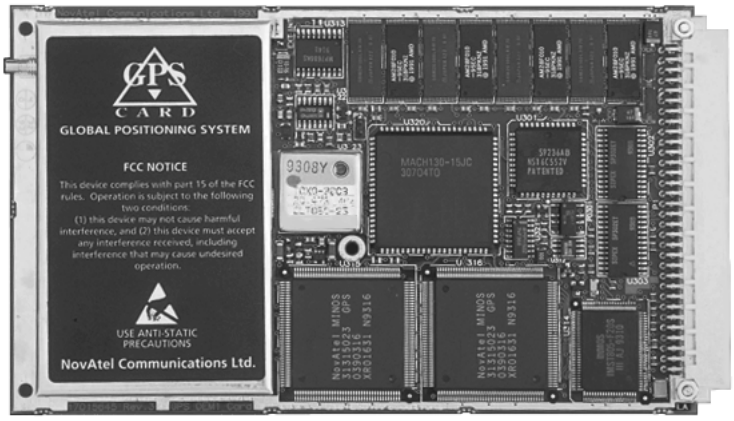
GPSCard™

OEM Series

Installation and Operating Manual



GPSCARD™ OEM SERIES

Installation and Operating Manual

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

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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:

GPSCard™ 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.

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There are no user serviceable parts in the GPSCard 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.

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.

For customer support, contact the NOVATEL GPS Hotline at **1-800-280-2242**, or **403-295-4900**, Fax **403-295-4901**, e-mail to **support@novatel.ca**, or check our website at www.novatel.ca, or write to:

NovAtel Inc.
Customer Service Dept.
1120 - 68th Ave. N.E.
Calgary, Alberta, Canada
T2E 8S5

NOTICE

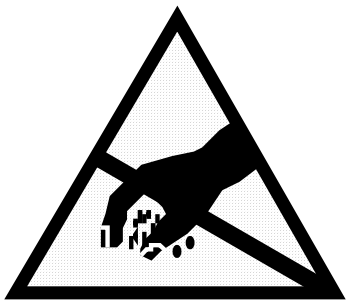
This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, 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 the user will be required to correct the interference at his own risk.

Equipment 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 when using the Strobe Port.

CAUTION !

Handle with Care



Use Anti-Static Precautions

FOREWORD

Scope

The GPSCard™ *OEM Series Installation and Operating Manual* is written for the GPSCard purchaser. In further discussions, the purchaser shall be referred to as the "user".

This manual is dedicated to the installation and initial operation of the OEM Series of GPSCard. It describes the GPSCard in sufficient detail as to allow users to effectively integrate and operate the GPSCard to its fullest potential. The manual is organized into sections, which allow easy access to appropriate information.

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 *WINSAT 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.

This manual is focused on the user's perspective for integration and operation purposes. It is beyond the scope of this manual to provide service or repair details. Please contact your NovAtel Service Centre for any customer service related inquiries.

Prerequisites

The GPSCard is an OEM product requiring the addition of peripheral equipment and enclosure before it can become a fully functional GPS receiver. *Section 3, Installation*, provides information concerning installation requirements and considerations.

The GPSCard 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 GPSCard receiver.

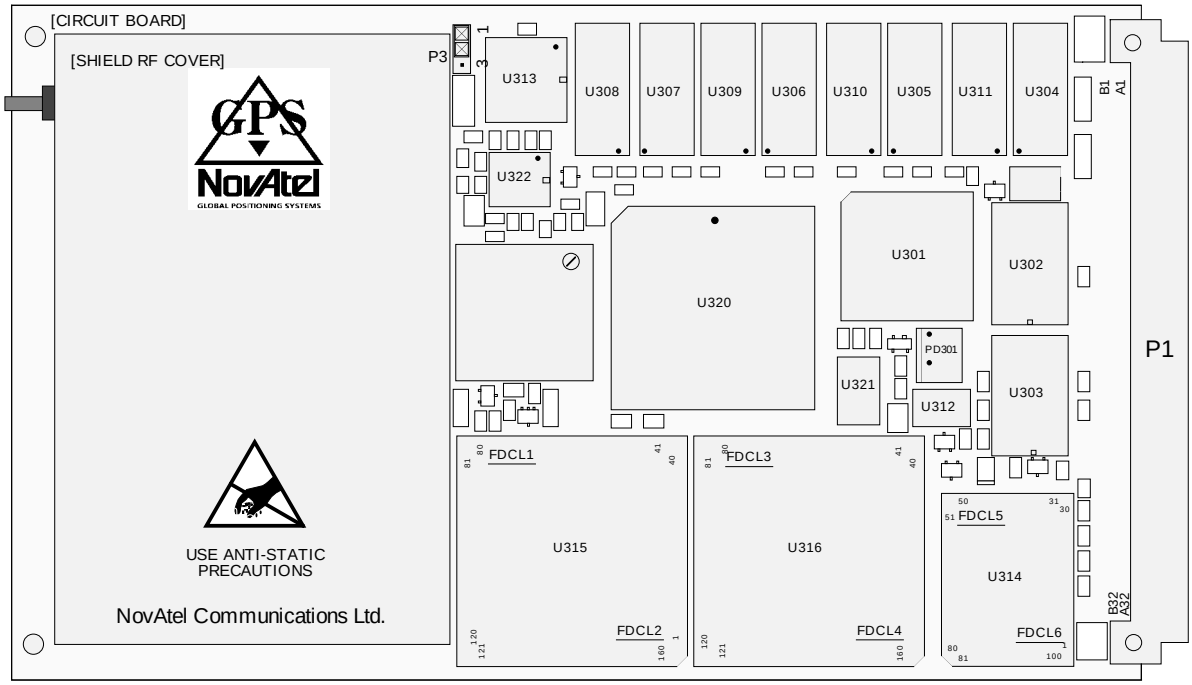
What's New in This Edition

The *Features Summary Chart* in *Section 1* has been updated to accommodate new features added to the top-of-the-line 3151R OEM Series of GPSCard. As well, the chart reflects the newest feature additions of MET (Multipath Elimination Technology) and RT-20 (RTK Carrier Phase Measurement System). The performance specifications particular to MET and RT-20 are addressed in the accompanying *Command Descriptions Manual*. As well, the summary chart includes the RTCA Standard differential data capabilities now available in GPSCards with the "R" options.

1 INTRODUCTION

The NovAtel GPSCard OEM Series receiver is a "Eurocard" implementation of the GPSCard. It is distinguished by meeting the leading performance standards required by the most demanding positioning, survey and navigation applications (free-standing or differential).

Figure 1-1 Illustration of OEM Series GPSCard



A patented C/A code correlation technology 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 OEM 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 OEM models is based on a common building block, allowing the user 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 antennae 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 GPSCard OEM Series are multi-channel parallel tracking, C/A code (Coarse Acquisition) GPS receivers 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 OEM Series 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. Add power, a mounting structure, I/O data communications equipment (DCE), external antenna, and the GPSCard is ready for the most demanding surveying, positioning, or navigation applications.

OPTIONAL ACCESSORIES

The following GPSCard optional accessories are also available from NovAtel Communications Ltd.

- GPSAntenna™ (survey, aircraft, or mobile/manpack models available)
- Choke Ring Ground Plane (for GPSAntenna 501)
- 5, 15, and 30 meter antenna cable
- Coaxial interconnect cable
- GPSCard PowerPak™ (enclosure, power supply and I/O connectors)

Please contact your NovAtel GPS Customer Service Representative for further information regarding any GPSCard options and accessories.

GPSCARD™ OEM SERIES FEATURES

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

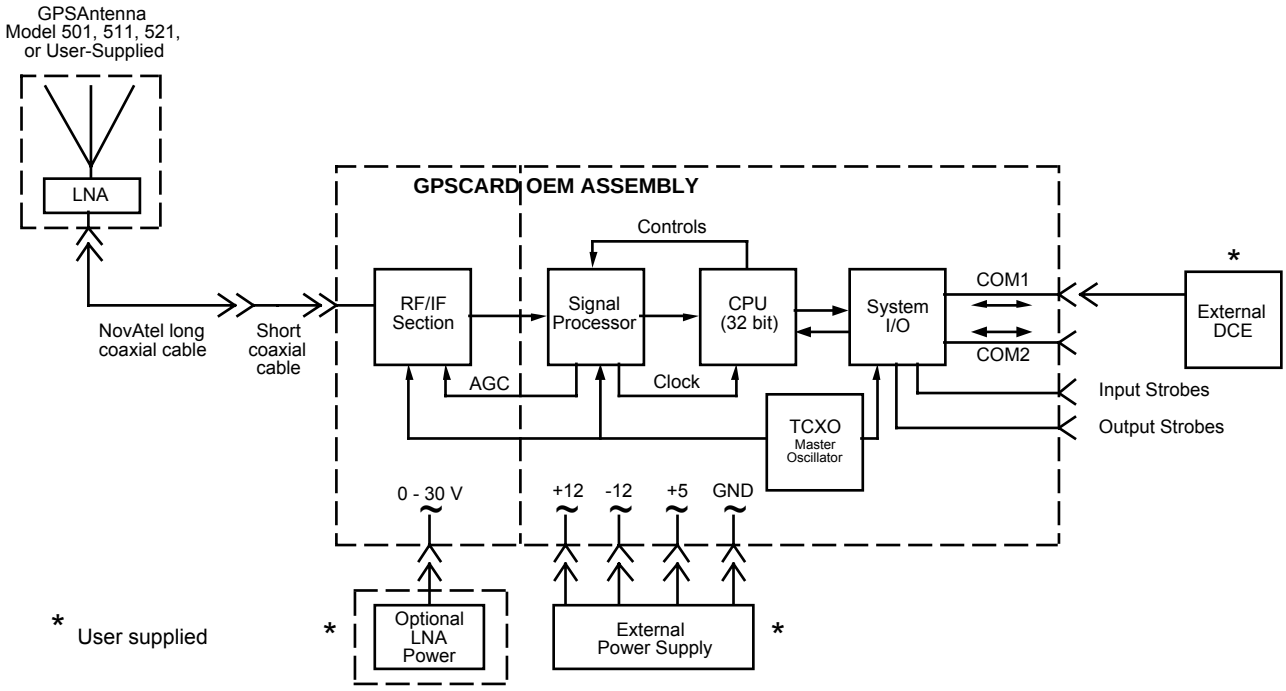
Table 1-1 OEM Series Top-of-the-Line Feature Summary

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	√	√
< 20 cm accuracies with RTK Carrier Phase Position Solutions	—	√
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.	20/Sec.
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)	—	√
RTCA Standard: Type 1 (Tx/Rx)	√	√
Positioning Modes of Operation		
Single Point	√	√
Waypoint Navigation	√	√
Pseudorange Differential (monitor/remote)	√	√
Pseudorange/Carrier Phase Double Differencing (monitor/remote)	—	√
Receiver Control		
Save Receiver Configuration Settings (Flash)	√	√
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 FUNCTIONAL OVERVIEW

The GPSCard OEM modules are composed of two major sections: an RF section and a Digital section. In order for the GPSCard OEM module to function as a complete system, you must also connect an external antenna, external power supply, and external DCE. A brief description of each section follows.

Figure 2-1 OEM Series System Functional Block Diagram



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 GPSCard.

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.

GPSCARD RF/IF SECTION

The GPSCard receives the filtered and amplified RF signal from the GPSAntenna via the external interconnecting coaxial cable. The RF section of the GPSCard serves the following primary functions:

- Filters the RF signal to reduce noise and interference.
- Down-converts the RF signal to an IF (intermediate frequency) range that is suitable for the A/D converter.
- Amplifies the GPS signal to a level suitable to drive the A/D converter in the digital section.

- Accepts automatic gain control (AGC) input from the Digital Signal Processor (DSP) to maintain the IF signal at a constant level.
- Supplies DC voltage to the antenna RF input connector which is used by the GPSAntenna as power input for the LNA (external LNA power can be supplied by changing the P3 jumper plug).

DIGITAL SECTION

The GPSCard digital section consists of three major subsections: Signal Processor, CPU, and System I/O.

The **Signal Processor** contains two NovAtel custom ASIC correlator chips, an analog to digital converter (A/D), and performs the following primary functions:

- Converts the IF signal to a digital format (A/D conversion).
- Independent satellite channel tracking
- C/A code and carrier phase tracking

The **CPU** is the heart of the GPSCard. All of the system control, processing, and positioning intelligence is in the CPU. It consists of both hardware and software components. The CPU is summarized below:

- A 32-bit microprocessor
- Custom Real Time Operating System (RTOS)
- Database management
- I/O control
- Position filtering
- Channel/loop control
- Navigation software

The **I/O** section allows two-way communications and timing strobes between outside devices and the GPSCard. All interfacing and connections to the GPSCard OEM module (with the exception of RF input and optional external oscillator input) is provided through the on-card 64 pin DIN 4162 type B male connector. Pinout descriptions of the 64 pin connector are provided in the *Installation* section of this manual (also see *Appendix B*). A summary of I/O functions is listed below:

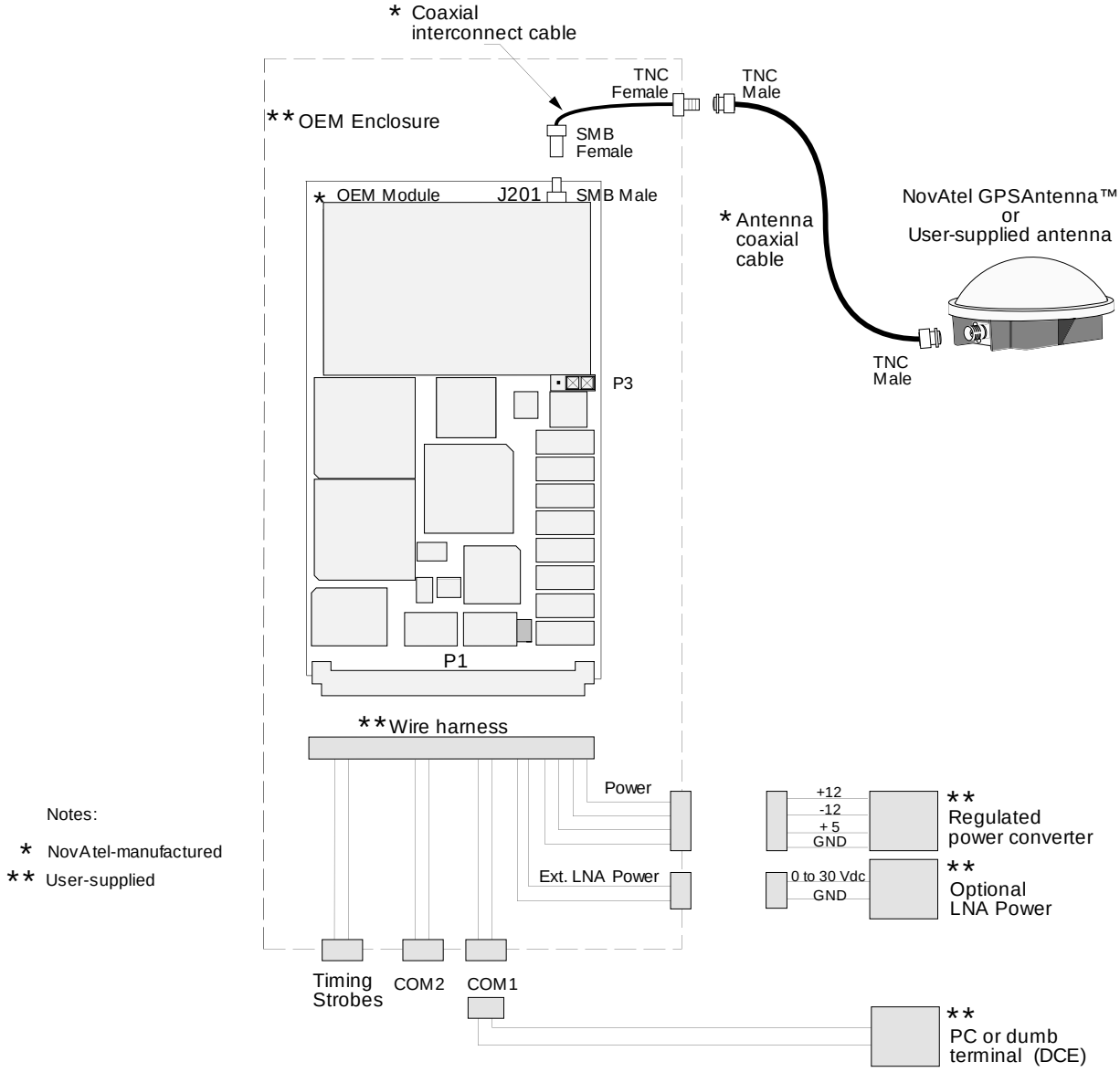
- Provides two serial communication ports for interfacing with outside DCE – EIA RS232/RS422 and NMEA 0183 configurable.
- Selectable baud rates up to 115.2 KBaud (defaults to 9600 baud)
- Provides input and output timing strobe lines.
- Allows user command input.
- Provides a means of output logging of various data types (ASCII and binary formats)

3 INSTALLATION

The GPSCard OEM Series of GPS receivers are OEM products designed for flexibility of integration and configuration. This concept allows the OEM purchaser to custom design their own GPS-based positioning system around the NovAtel GPSCard to suit their application requirements or marketing needs. With this in mind, the user is allowed the freedom to select an appropriate communications interface, power supply system, and preferred mounting configuration or structure.

This section provides sufficient information to allow the OEM user to set up and prepare the GPSCard for initial operation.

Figure 3-1 GPSCard OEM Series Minimum Configuration



MINIMUM CONFIGURATION

In order for the GPSCard to function as a complete system, a minimum equipment configuration is required. The recommended minimum configuration and required accessories are listed below:

- NovAtel GPSCard OEM Series GPSCard
- Any optional NovAtel GPSAntenna model
- NovAtel GPSAntenna coaxial cable
- NovAtel interconnect coaxial cable
- A regulated power supply providing +5 VDC, +12 VDC, and -12 VDC (see *Appendix B* for power regulation specifications)
- A user interface, such as a PC, data communications equipment (DCE), dumb terminal, etc., capable of standard serial communications (RS-232, RS-422)
- A 64 pin 0.1" DIN 41612 type B female connector to wire your own interconnect harness. Power, communications, logging, strobes, etc. use this harness to interface with the GPSCard module.

ANTI-STATIC PRECAUTIONS

Electrostatic discharge (ESD) is the leading cause of failure of electronic equipment components and printed circuit boards containing ESD sensitive devices and components. It is imperative that ESD precautions be followed when handling or installing the NovAtel GPSCard printed circuit board. Refer to *Appendix A* for more information on ESD precautions.

When you remove the GPSCard from the original packing box, it is recommended that you save the box and ESD protective plastic clamshell for future storage or shipment purposes.

REMEMBER !

Always wear a properly grounded anti-static wrist strap when handling the GPSCard.

Always hold the GPSCard by its corners or the RF backplane, and avoid direct contact with any of the components.

Do not let the GPSCard come in contact with clothing at any time because the grounding strap cannot dissipate static charges from fabrics.

Failure to follow accepted ESD handling practices could cause damage to the GPSCard.

Warranty may be voided if equipment is damaged by ESD.

INSTALLATION REQUIREMENTS

Installing the OEM module requires the following steps:

- Mounting or packaging the OEM module in a secure enclosure to reduce environmental exposure, RF interference, and vibration effects
- Prewiring the I/O wire harness and the interfacing 64 pin DIN female connector for power and communications
- Connecting the wiring harness to the OEM module, external power, and external data communications equipment (DCE)
- Installing the GPSAntenna
- Connecting the antenna coaxial cable.

CAUTION: Leave the GPSCard module in its anti-static packaging when not connected in its normal operating environment. When removing the OEM module from the anti-static plastic clamshell, follow accepted standard anti-static practices. Failure to do so may cause damage to the OEM module.

GPSCARD MOUNTING CONSIDERATIONS

Because the GPSCard is an OEM product, the printed circuit board is not enclosed in a housing structure. This allows flexibility in creating a mounting environment to suit your particular product and marketing requirements. Important considerations when developing the encasement are:

- Operating environment exposure (protection against rain, snow, sand, saltwater, extreme temperatures, etc.)
- Vibration conditions (secure mounting for aircraft, marine, mobile, etc.)
- RF shielding (protection from nearby transmitters, must meet federal regulations)
- Mounting of I/O connectors

The GPSCard has provisions for screw mounting, card rails, or a combination of both. See *Appendix B* for mechanical drawing details.

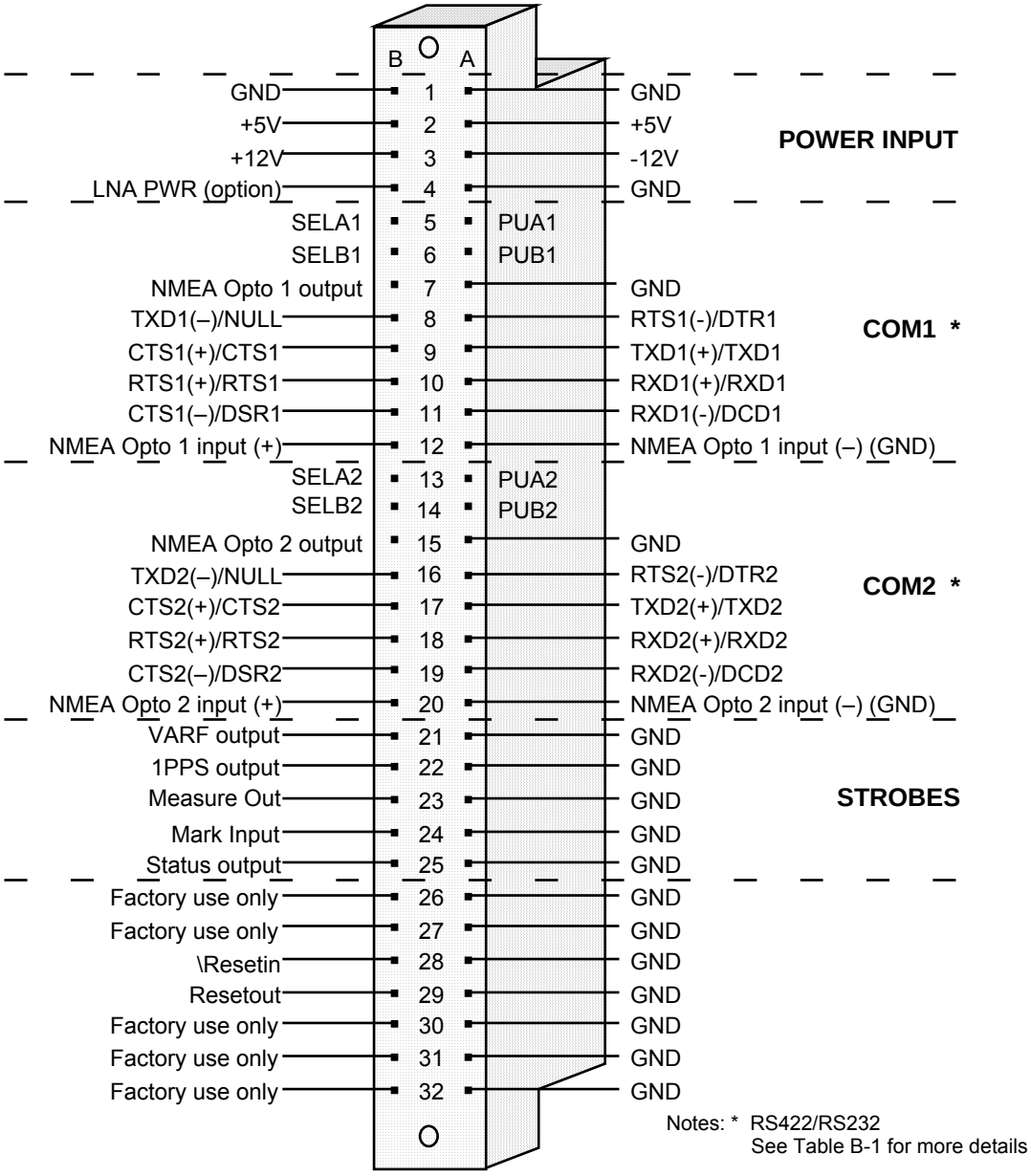
(First time users may want to purchase the GPSCard™ PowerPak™. This kit allows immediate operation of the GPSCard without having to fuss with mounting or wiring considerations.)

FABRICATING THE I/O WIRE HARNESS

A 64 pin 0.1" DIN 41612 type B female connector is required for interconnection with the OEM module. The connectors you choose for interfacing to the power supply, COM ports, and strobes will depend on your external equipment requirements. The wiring harness serves the following I/O interconnect functions:

- Power input to the OEM module
- COM1 and COM2 serial communications port access
- Input and output timing strobes
- Communications protocol selection using jumper wires (RS232, RS422, or NMEA 0183 selectable)

Figure 3-2 I/O 64 Pin Wire Harness Pinout



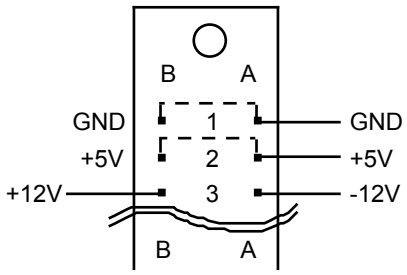
Notes: * RS422/RS232
See Table B-1 for more details

EXTERNAL POWER INPUT

The GPSCard requires three sources of regulated power input: +5VDC, +12 VDC, and -12VDC. Pins 1A and 1B (GND) are internally connected on the GPSCard. Pins 2A and 2B (+5V) are internally connected on the GPSCard as well. It is recommended that appropriate fuses or current limiting be incorporated as a safety precaution on all power lines used. Use sufficient gauge wire to ensure that voltage at the DIN connector is within GPSCard specifications.

Refer to the figure below for external power input connections to the 64 pin wire harness.

Figure 3-3 External Power Connections



SELECTING COMMUNICATIONS PROTOCOL

The GPSCard OEM Series is capable of communications in three electrical formats: EIA RS232, EIA RS422, and NMEA Standard (RS232 or RS422 compatible). COM1 and COM2 are independently configurable for one of the above communications protocol formats. The configuration you use is dependent on connecting appropriate wires onto the I/O wire harness 64 pin female connector.

RS232

RS232 is the **default** configuration for both COM1 and COM2 ports. This means that there are no jumper wires required to operate RS232 protocol. Refer to the figure below for wiring details of RS232 pin-out for COM1 and COM2 ports.

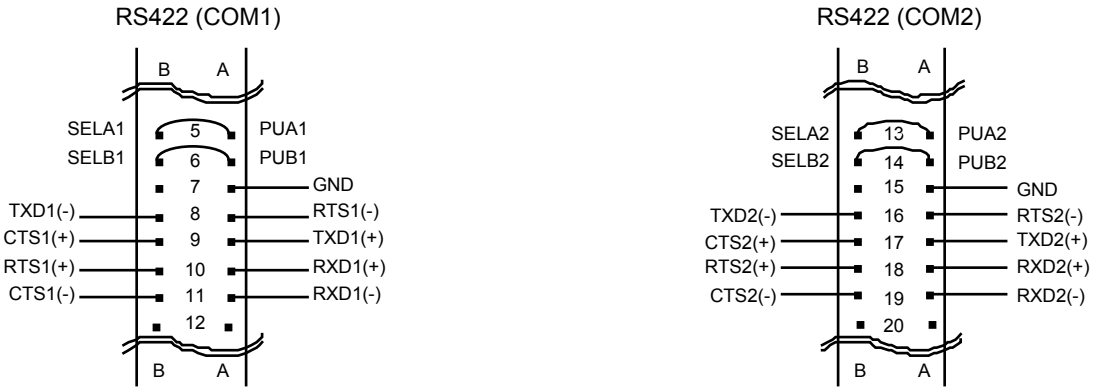
Figure 3-4 RS232 Wiring Pinout

RS422

RS422 protocol is established by installing jumper wires between pins 5A to 5B and pins 6A to 6B for COM1, and pins 13A to 13B and pins 14A to 14B for COM2.

To configure the COM ports for RS422 protocol, refer to the figure below for wiring details.

Figure 3-5 RS422 Wiring Pinout



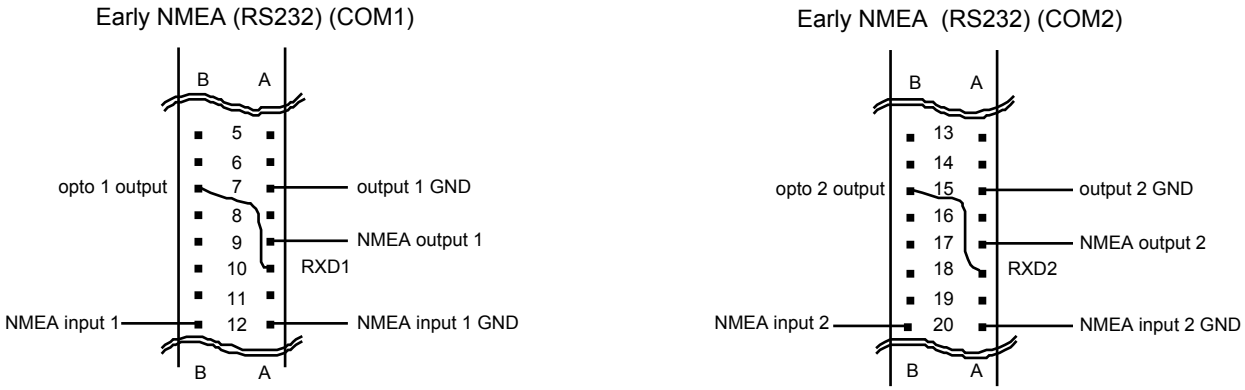
EARLY NMEA (RS232)

Early NMEA (RS232) protocol is established by installing jumper wires from pins 10A to 7B for COM1, and pins 18A to 15B for COM2.

NMEA receiver opto-isolator input for COM1 is Pins 12B and 12A. COM2 opto-isolator inputs are pins 20B and 20A.

To configure the COM ports for Early NMEA RS232 protocol, refer to the figure below for wiring details.

Figure 3-6 Early NMEA (RS232) Wiring Pinout



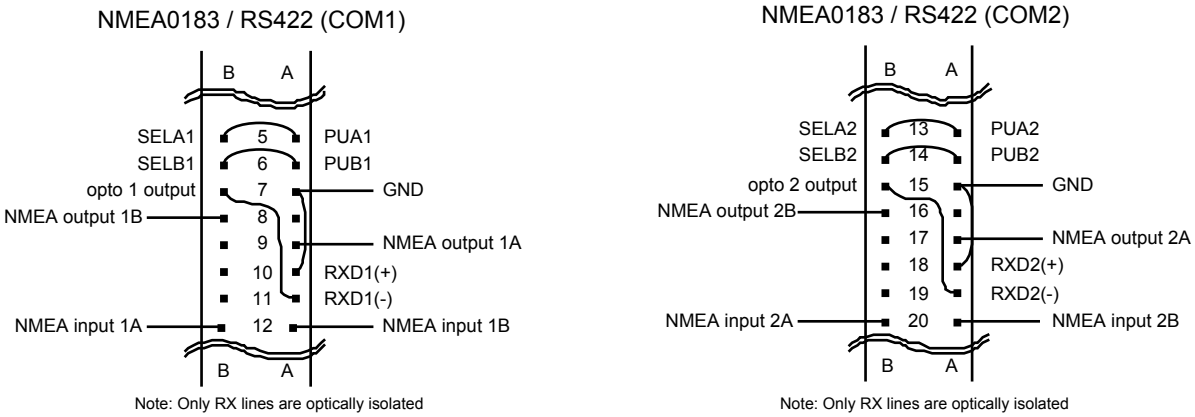
NMEA 0183 (RS422)

NMEA 0183 (RS422) protocol is established by installing jumper wires from pins 5A to 5B, pins 6A to 6B, pins 7A to 10A, and pins 7B to 11A for COM1, and pins 13A to 13B, pins 14A to 14B, pins 15A to 18A, and pins 15B to 19A for COM2.

The NMEA receiver opto-isolator input for COM1 is Pins 12B and 12A. COM2 opto-isolator inputs are Pins 20B and 20A.

To configure the COM ports for NMEA 0183 RS422 protocol, refer to the figure below for wiring details.

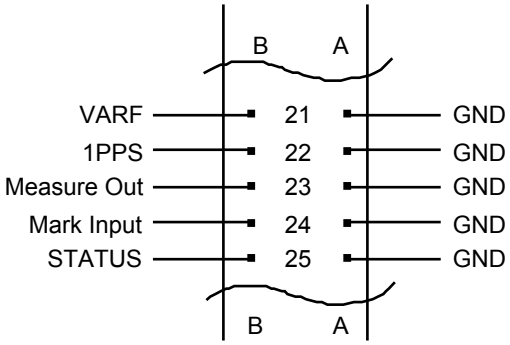
Figure 3-7 NMEA 0183 (RS422) Wiring Pinout



I/O STROBES PINOUT

The GPSCard OEM models have provisions for input and output strobes. The pinout for those strobes is illustrated in the figure below.

Figure 3-8 I/O Strobes



NOTE: See *Appendix B, Technical Specifications*, for further information on I/O strobes.

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 GPSCard has been designed to operate with the NovAtel GPSAntenna models 501, 511, and 521. Though it is possible to operate with other GPS antennae, 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 GPSCard, 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 GPSCard. 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:

- 22 cm coaxial interconnect adapter cable (SMB female/TNC bulkhead - female)
- 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 GPSCard.

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

EXTERNAL LNA POWER (OPTIONAL)

The GPSCard is capable of allowing selection of either an internal or external LNA power source. Your GPSCard is delivered from the factory ready for operation with NovAtel GPSAntenna Models 501, 511, or 521, in which case no special wiring or configuration is required.

If the GPSCard is to be configured with a user supplied antenna/LNA system, then it is required that the external LNA power option be utilized. This is especially useful if the antenna system requires voltage and current capacity beyond that of the GPSCard internal antenna LNA power source (4.5 VDC @ 25 mA). The jumper plug (P3) is normally set for internal operation (pins 1 and 2). If external LNA power is to be applied, then P3 must first be jumpered between pins 2 and 3.

The external LNA power must be applied to pins 4B (0 to +30 VDC) and 4A (GND). It is recommended that the "hot" terminal (4B) be either current limited to 100 mA or appropriately fused.

Figure 3-9 External LNA Power Connection

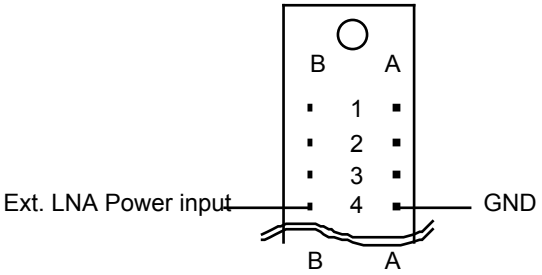
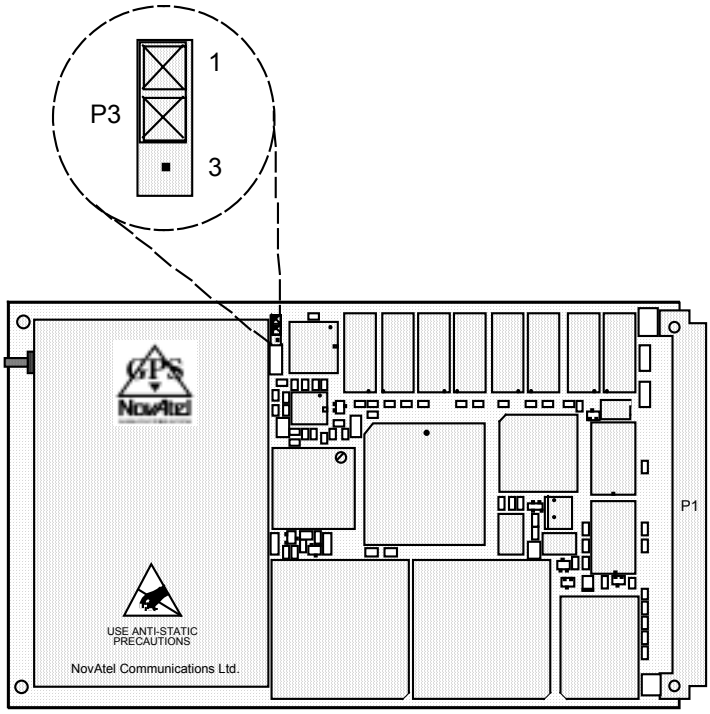


Figure 3-10 LNA Jumper Plug



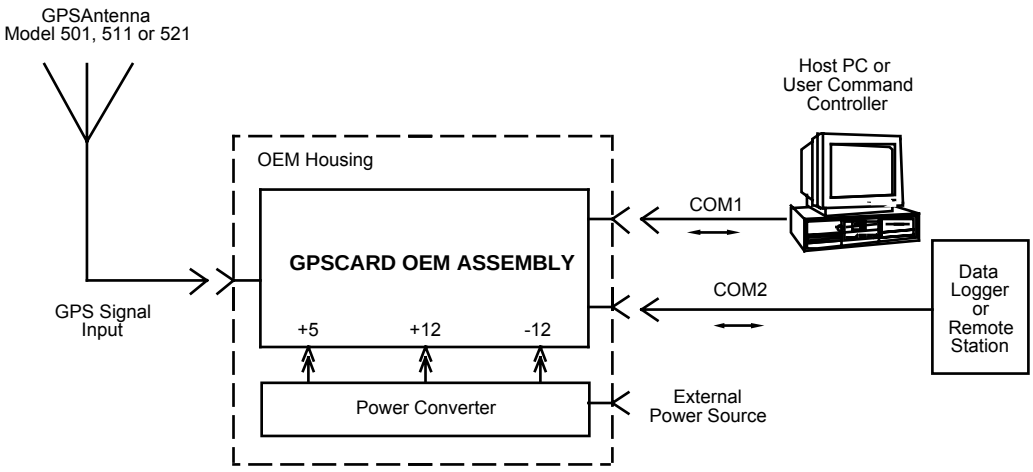
– CAUTION –

- The P3 LNA jumper plug must be jumpered to the external position (pins 2 and 3) before external LNA power is connected to pin 4B of the 64 pin wire harness connector to prevent the power from feeding back into the receiver.
- If external power is being used to power any of the NovAtel GPSAntennas in conjunction with extended length antenna cable runs or using optional in-line LNA amplifiers, use caution not to exceed the voltage ratings of the particular antenna or LNA being used.
- Power applied to pin 4B from an external power supply must not exceed +30 VDC or 100 mA of current.
- The GPSCard is not warranted for operation with non-NovAtel-supplied antennas; such usage is at your own risk.

4 OPERATION

Before operating the GPSCard for the first time, ensure that you have followed the installation instructions in *Section 3*. The figure below illustrates a typical operational configuration for the GPSCard OEM module. It will be assumed that initial operation and testing of the GPSCard will be while using a personal computer to allow greatest ease and versatility of testing.

Figure 4-1 Typical Operational Configuration



GETTING STARTED

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

REMEMBER: If you plan to track satellites upon power-up, the GPSAntenna coaxial cable should be connected to both the GPSCard and GPSAntenna before power is turned on. This is because connecting the antenna to the GPSCard 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 GPSCard input power and then back on again.

COM PORT DEFAULT SETTINGS

Because the GPSCard 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 GPSCard. The GPSCard 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

If you wish to use other protocol formats such as RS422 and NMEA 0183, please refer to *Section 3, Installation* for details of how to wire the 64 pin connector for other configurations. See also the *COMn* command to change baud rate, parity, etc. (*Command Descriptions Manual*).

BOOT-UP

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

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

- Your external DCE (data communications 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 GPSCard is now ready for command input from either or both COM ports.

- A red LED indicator on the GPSCard will flash at a rate of once per second if start-up proceeded normally. If the light is continuously on or off, this indicates an error condition has occurred. If the LED flashes at a rate other than 1PPS, this too indicates that an error condition was detected in start-up self-test. The board should be returned for service if the LED is continuously on, off, or flashing at a rate other than 1PPS.

INITIAL COMMUNICATIONS WITH THE GPSCARD

Communicating with the GPSCard 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 GPSCard, you will probably be using either a remote terminal (DCE) or an IBM-PC compatible that is directly connected to a GPSCard 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 GPSCard'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 GPSCard is to use a remote terminal (DCE). The set-up requirements are listed below:

- The GPSCard wire harness must be prewired to allow proper RS232 interface with your data terminal. To communicate with the terminal the GPSCard only requires the Rx, Tx, and GND lines to be used; handshaking is not generally required.
- Ensure that the terminal's communications set-up matches the GPSCard RS232 protocol.

When the GPSCard 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 GPSCard 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 GPSCard, 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 GPSCard to echo the GPSCard version information. If you type HELP and press [Return], the GPSCard 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 GPSCard COM1 port which sets the GPSCard 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 GPSCard 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 GPSCard activities:

- Use the RCCA log to list the default command settings. After the GPSCard has been operational for a while, the RCCA log will be useful for indicating status of all current command settings. If your GPSCard 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 GPSCard. 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 GPSCard using the PC are:

- Any standard communications software package that emulates a terminal can be used to establish bi-directional communications with the GPSCard.
- 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 GPSCard. 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 GPSCard is a disk containing the setup file to install the NovAtel WINSAT and FILE CONVERTER programs. WINSAT is a Windows graphical user interface which exploits the multitude of features provided by the GPSCard, allowing you to explore the GPSCard's many features without struggling with communications protocol or writing make-do software. The program recognizes the model of GPSCard (10 channel vs 12 channel) that you are using and will display accordingly where applicable.

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

For further information about installation and operation of the WINSAT and FILE CONVERTER programs, refer to the WINSAT Interface Program User Manual.

CREATING COMMAND TEXT FILES

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

Immediately following power-up of the GPSCard, 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 GPSCard.

   Example:

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

4. The GPSCard is now initialized with the contents of the boot1.txt command file and logging is directed from the GPSCard 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 GPSCard. 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 GPSCard.

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 GPSCard COM1 port and a remote terminal is connected to the GPSCard COM2 port.

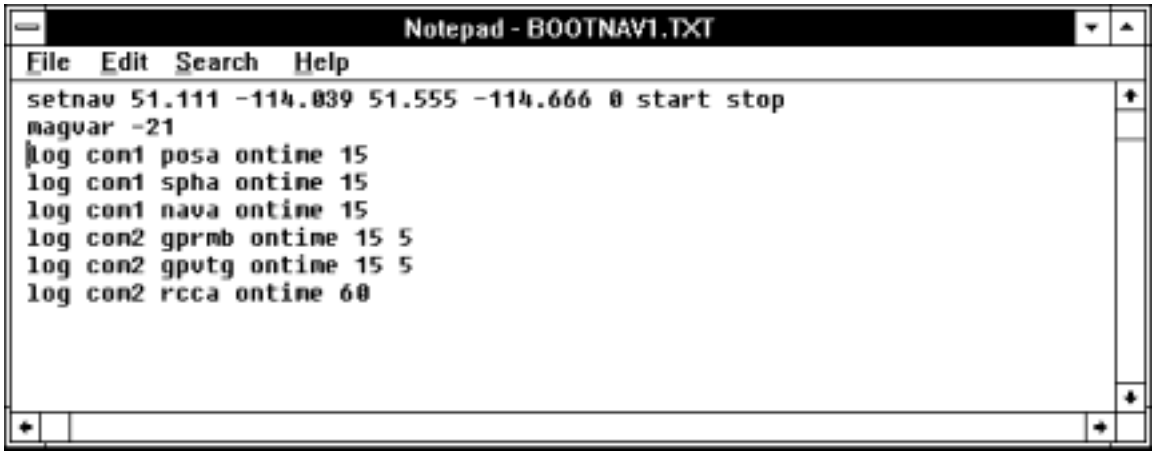
Example Navigation Command File Using Windows "Notepad"

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 4-2 Illustration of Windows "Notepad" Command File



Once this file is saved, it can be called up at any time to initialize the GPSCard 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 GPSCard

1. Ensure that "Terminal" is correctly set up to agree with the GPSCard 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.

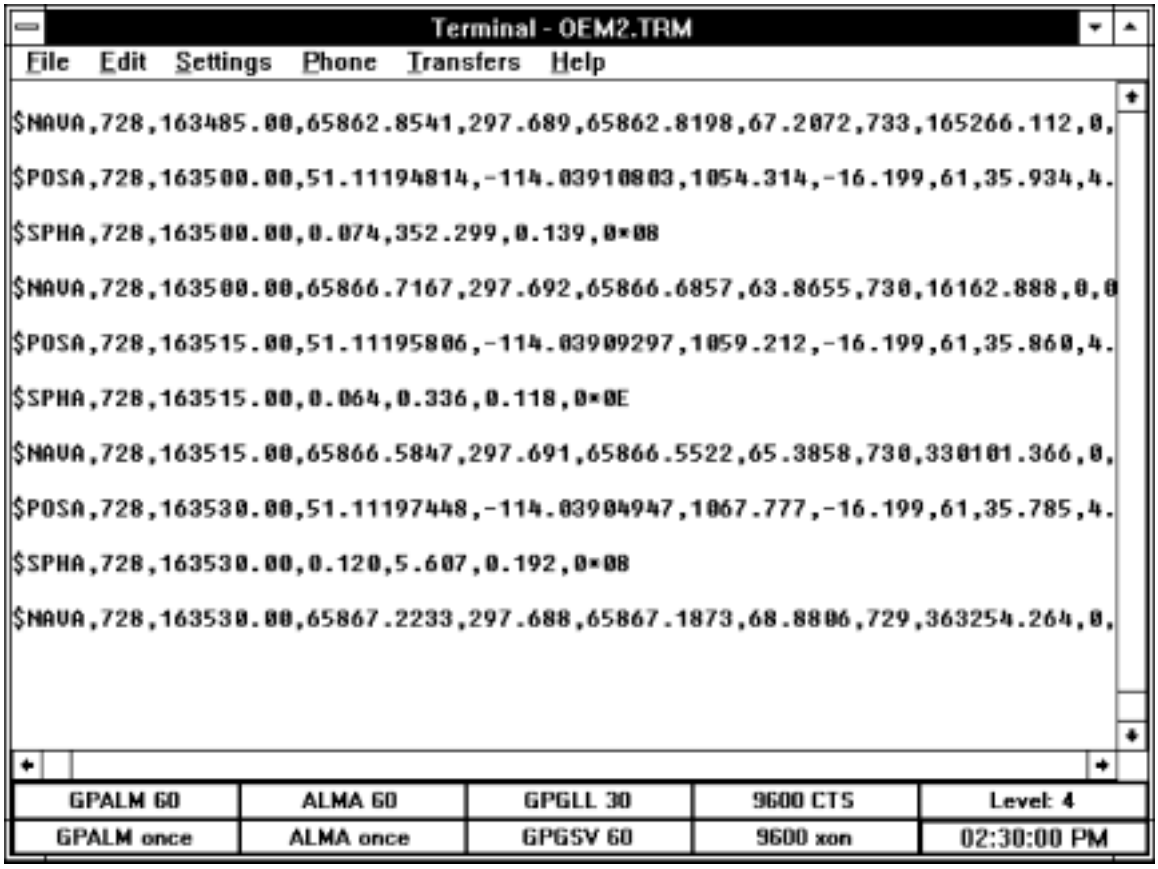
2. Access the **Transfer** menu and use the **Send text file** selection to locate the file you wish to send to the GPSCard (e.g. bootnav1.txt). Once you double-click on the file or select OK, Terminal will send the file to the GPSCard.

Terminal will display the text file contents as it is output to the GPSCard. Figure 4-3 illustrates an example of what you can expect to see on the PC's screen.

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

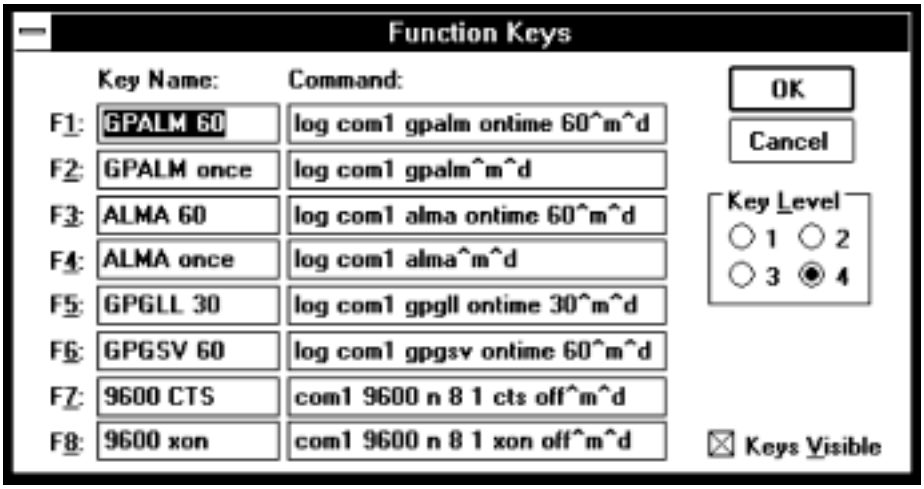
Figure 4-3 Illustration Using Windows "Terminal" Communications



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 GPSCard for your lab testing sessions. Note that ^m^d transmits a carriage return/line feed. (Refer to *Figure 4-4* for an illustration of Terminal's Function Key settings.)

Figure 4-4 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 GPSCard and Windows Terminal be set for **xon/xoff handshaking** as loss of data may occur otherwise.

CONCLUSION

It is hoped that the information contained in this manual is sufficient and clear enough that you will be able to have your GPSCard up and running in minimum time with minimum effort. Should you have any problems, please do not hesitate to contact a NovAtel GPS Customer Support Representative. The address and phone numbers are listed in the front of this manual.

A ANTI-STATIC PRACTICES

OVERVIEW

Static electricity is electrical energy at rest, just waiting for a path of discharge. Static-sensitive units can be permanently damaged by static discharges which are as little as 40 volts. Charges carried by the human body can be thousands of times higher than this. People may have accumulated a charge in many ways, such as friction between their shoes and carpet, tile or other non-conducting floor covering. The charge may be stored on clothing, especially in dry atmospheres, where there is friction between the body and/or various clothing layers. Synthetic materials accumulate higher charges than natural fibers. Electrostatic voltage levels generated by nonconductors may be very high, in the order of thousands of volts.

Various electrical and electronic components are vulnerable to electrostatic discharge (ESD). These include discrete components, hybrid devices, integrated circuits (ICs), and boards assembled with these devices.

RECOMMENDATIONS FOR HANDLING ESD-SENSITIVE DEVICES

ESD-sensitive devices must be handled only in static-free locations. Some recommendations for such handling practices follow:

- Handling areas must be equipped with grounded table and floor mats and grounded wrist or ankle straps.
- A relative humidity level must be maintained between 20% and 80% non-condensing.
- No ESD-sensitive board or component should be removed from its protective package, except in a static-free location.
- A static-free environment and correct static-control procedures are required at both repair stations and maintenance areas.
- ESD-sensitive devices must be handled only after personnel have grounded themselves via wrist or ankle straps and mats.
- Boards or components should never come in contact with clothing, because normal grounding cannot dissipate static charges on fabrics.
- A circuit board must be placed into an anti-static shielding plastic clamshell before being removed from the work location and must remain in the clamshell until it arrives at a static-free repair/test center.
- Circuit boards must not be changed or moved needlessly. Where handles or finger holes are provided on circuit boards they must be used to remove and replace the boards, and care taken to avoid contact with the connectors and components.
- On-site repair of ESD-sensitive equipment should not be undertaken except to restore service in an emergency where spare boards are not available. Under these circumstances repair station techniques must be observed. Under normal circumstances a faulty or suspect circuit board must be sent to a repair center having complete facilities, or to the manufacturer for exchange or repair.
- Where protective measures have not been installed, a suitable alternative would be the use of a Portable Field Service Grounding Kit. This consists of a portable mat and wrist strap.
- A circuit board in a static shielding bag or clamshell may be shipped or stored in a cardboard carton, but the carton must not enter a static-free area such as a bench top or repair zone.

PRIME STATIC GENERATORS

Table A-1 provides some background information on static-generating materials.

Table A-1 Prime Static Generators

Work Surfaces	• formica (waxed or highly resistive) • finished wood • synthetic mats • writing materials, note pads, etc.
Floors	• wax-finished • vinyl
Clothes	• common cleanroom smocks • personal garments (all textiles except virgin wool) • non-conductive shoes
Chairs	• finished wood • vinyl • fiberglass
Packing and handling	• common polyethylene bags, wraps, envelopes, and bubble pack • pack foam • common plastic trays and tote boxes
Assembly, cleaning, test and repair areas	• spray cleaners • common solder sucker • common solder irons • common solvent brushes (synthetic bristles) • cleaning, drying and temperature chambers

STORAGE

ESD damage to unprotected sensitive devices may occur at any time. *Table A-2* shows the susceptibility thresholds of such devices to ESD.

Table A-2 Susceptibility Thresholds of Devices to ESD

Devices	Minimum ESD Voltage (V)
VMOS	30
MOSFET GaAsFet EPROM	100
JFET	140
OP-AMP	190
CMOS	250
Schottky Diode Film Resistors	300
Bipolar Transistors	380
SCR	680
Schottky TTL	1000

CHANGING CIRCUIT BOARDS

Use the following procedure when it becomes necessary to install or remove a circuit board.

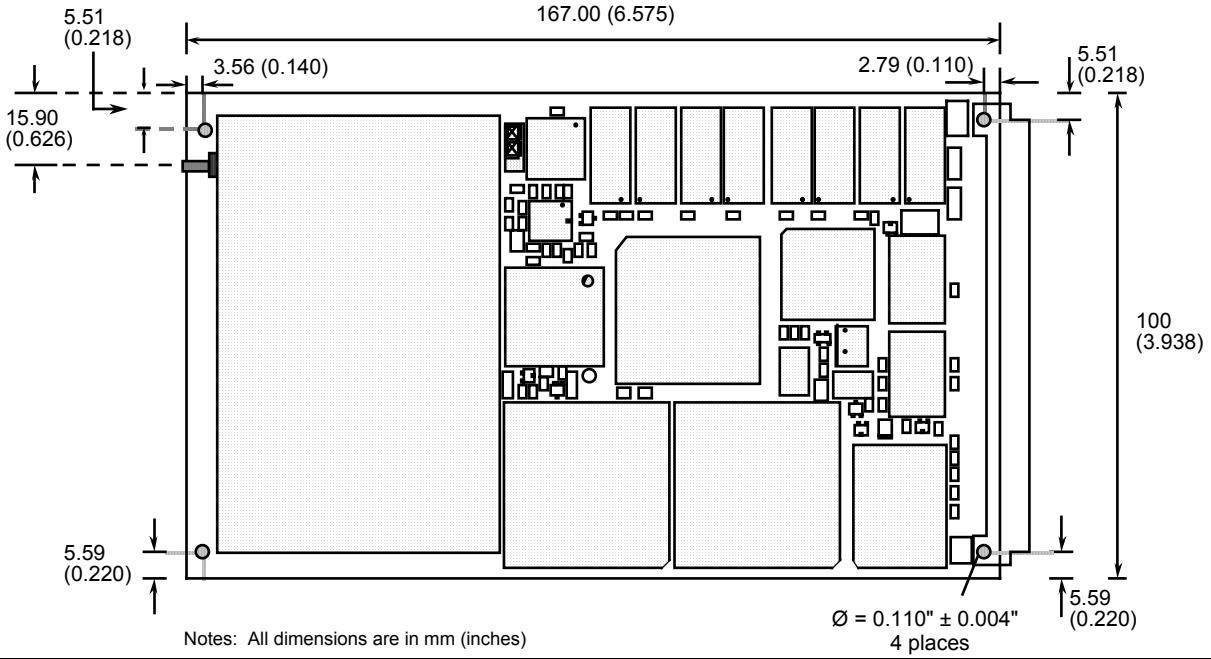
1. After you are connected to the grounded wrist strap, remove the circuit board from the frame and place it on a static-free surface (grounded floor or table mat).
2. Remove the replacement circuit board from the static shielding bag or clamshell and insert it into the correct slot in the frame.
3. Place the original board into the shielding bag or clamshell and seal it with a label.
4. Disconnect the wrist strap.
5. Do not put repair tags inside the shielding bag or clamshell.

B TECHNICAL SPECIFICATIONS

PHYSICAL	
Size:	167 x 100 x 15 mm (Eurocard format)
Weight:	180 grams

ENVIRONMENTAL

Figure B-1 OEM Series Board Dimensions



MECHANICAL DRAWINGS (CONT'D)

Figure B-2 OEM Series Side View

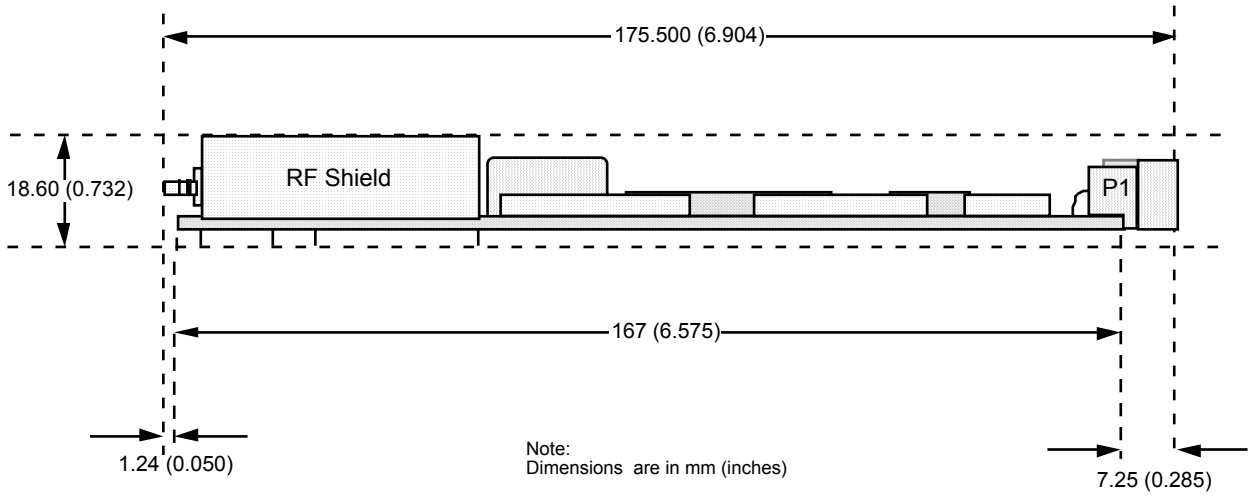
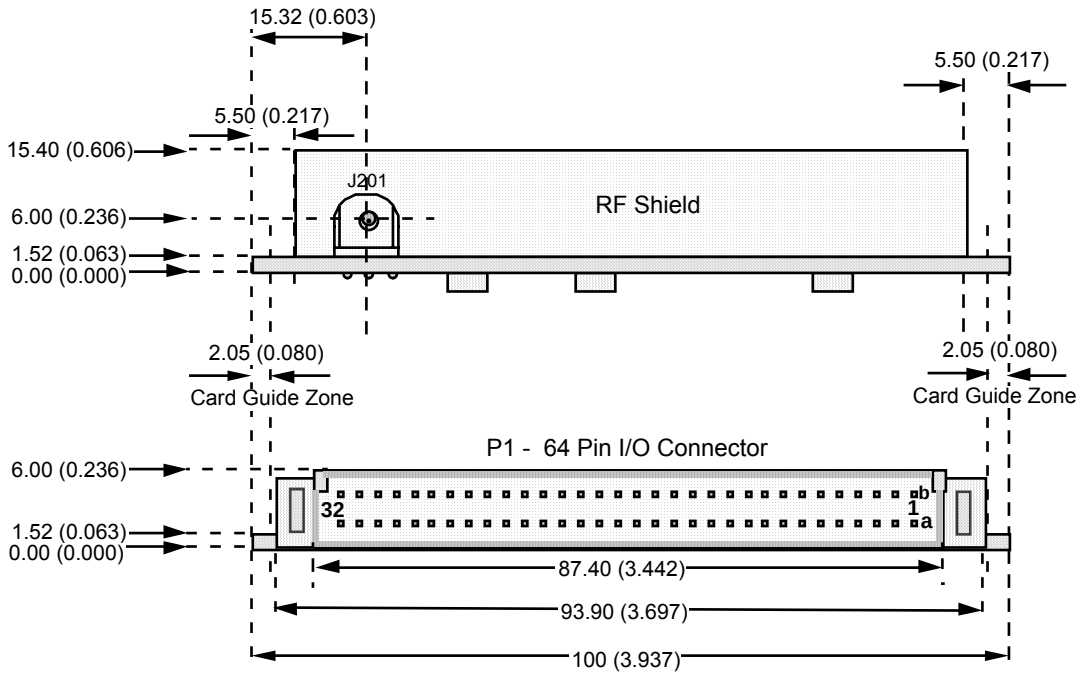


Figure B-3 OEM Series End Views



Note:
Dimensions are in mm (inches)

ENVIRONMENTAL	
Operating Temperature:	0° C to +70° C -40° C to +85° 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.]

VIBRATION		
GPS C/N_0 will not degrade by more than 10 dB when subjected to the following types of vibration:		
Sinusoidal:	The GPSCard will function with sinusoidal peak vibration levels of 0.8G at 60 Hz when mounted in the typical configuration*.	
Random:	The GPSCard will acquire and track satellites in a random vibration profile defined by the following vibration test conditions when installed in the typical mounting configuration*:	
	FREQUENCY	***MAGNITUDE***
	10 Hz	0.003 g^2/Hz
	40 Hz	0.003 g^2/Hz
	100 Hz	0.0005 g^2/Hz

	500 Hz	0.0005 g^2/Hz
	2000 Hz	0.00003 g^2/Hz

* **Typical Mounting Configuration** – Mount the GPSCard securely using screws driven through the card's four corner mounting holes.

Superior Mounting Configuration – Mount the card using full length clamped rail mounts.

Note: The card is sensitive to anything that rattles against it.

ACCELERATION

Acceleration: 4g maximum (sustained tracking)

POWER REQUIREMENTS

Voltage	Noise Tolerance	Current (typical)
+5 VDC +5% / -2.5%	50 mV p-p	900 mA
+12 VDC± 5%	120 mV p-p	80 mA
-12 VDC± 5%	120 mV p-p	40 mA

PERFORMANCE *(Subject To GPS System Characteristics)*	
Frequency:	L1, 1575.42 MHz
Code tracked:	C/A Code (SPS)
Channels:	10 or 12 discrete channels depending on GPSCard model
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:	10 solutions per second (100 msec rate) (model and configuration dependent)
Measured Data Update Rate:	20 data records per second (50 msec rate) (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 ≤ 1.25 metres SEP ≤ 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 Mode** < 0.20 metre CEP nominal (refer to Section 11 of 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/No >44 dBHz Loop BW = 15 Hz
Differential Channel Phase Measurement Accuracy:	0.75 mm RMS, 1 second smoothed, no multipath, C/No > 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 less than 60,000 feet.]
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, RS422, or NMEA Standard selectable

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 VDC
		(Low)	< 0.55 VDC
	Sink Current		64 mA
	Source Current		-15 mA
Mark Input:	Voltage	(High)	> 2.0 VDC and < 5.0 VDC
		(Low)	< 0.8 VDC
	Current		< 5 mA (not to exceed 5 mA)
INPUT/OUTPUT CONNECTORS			
Power/Data:			64 pin 0.1" DIN 41612 Type B Male
ANTENNA / LNA			
Connector:			SMB Male
RF Input:			1575.42 MHz
LNA Power Output:			LNA power output is determined by the LNA jumper plug P3 position (internal/external)
	Internal		4.0 to 5.0 VDC, 10 to 25 mA (current limit 35 mA) Note: If the antenna connected to this port draws current below or above these limits, the GPSCard antenna sensing circuit will cause the self-test status code to be set to 0. Refer to the RCSA log for self-test status codes.
	External		0 to +30 VDC, 100 mA max. (user-supplied) Note: When the LNA jumper plug is in the external position, the antenna sensing circuit will cause the RCSA self-test status code to always report antenna status as 1 (good).

Table B-1 64 Pin I/O Connector Description

Row B	Descriptions	Pin	Row A	Descriptions
GND	Digital Ground	1	GND	Digital Ground
+5V	Input, power supply	2	+5V	Input, power supply
+12	Input, power supply	3	-12V	Input, power supply
LNA_PWR (option)	Used to provide external power to customer's own antenna other than a standard NovAtel GPSAntenna (LNA jumper plug (P3) must be correctly set).	4	GND	Digital Ground
SELA1	This pin selects the communication protocol between RS232 and RS422 for COM 1, it is used in conjunction with PUA1 (A5).	5	PUA1	This pin is internally pulled up to +5V with a 4.7K resistor, it is used in conjunction with SELA1 (B5).
SELB1	This pin selects the communication protocol between RS232 and RS422 for COM 1, it is used in conjunction with PUB1 (A6).	6	PUB1	This pin is internally pulled up to +5V with a 4.7K resistor, it is used in conjunction with SELB1 (B6).
OP1	This is the output of the opto-isolator. This pin is jumpered to an RXD pin to provide ground isolated receiver to comply with NMEA specifications. A1 and B1 are the isolated RXD inputs for COM1.	7	GND	Digital Ground
TXD1(-)/ NULL	Transmitted Data, NULL. See also note 1.	8	RTS1(-)/ DTR1	Ready to Send / Data Terminal Ready for COM 1. See also note 1.
CTS1(+)/ CTS1	Clear to Send for COM 1. See also note 1.	9	TXD1(+)/ TXD1	Transmitted Data for COM 1. See also note 1
RTS1(+)/ RTS1	Request to Send for COM 1. See also note 1.	10	RXD1(+)/ RXD1	Received Data for COM 1. See also note 1.
CTS1(-)/ DSR1	Clear to Send / Data Set Ready for COM 1. See also note 1.	11	RXD1(-)/ DCD1	Received Data / Data Carrier Detected for COM 1. See also note 1.
A1	This is the positive input of the opto-isolator described in OP1 (B7)	12	B1	This is the negative input of the opto-isolator described in OP1 (B7)
SELA2	This pin selects the communication protocol between RS232 and RS422 for COM 2, it is used in conjunction with PUA2 (A13).	13	PUA2	This pin is internally pulled up to +5V with a 4.7K resistor, it is used in conjunction with SELA2 (B13).
SELB2	This pin selects the communication protocol between RS232 and RS422 for COM 2, it is used in conjunction with PUB2 (A14).	14	PUB2	This pin is internally pulled up to +5V with a 4.7K resistor, it is used in conjunction with SELB2 (B14).

Table B-1 64 Pin I/O Connector Description (cont'd)

Row B	Descriptions	Pin	Row A	Descriptions
OP2	This is the output of the opto-isolator. This pin is jumpered to RXD (A18) pin to provide ground isolated receiver to comply with NMEA 0183 specifications. A2 and B2 are the isolated RXD inputs for COM 2.	15	GND	Digital Ground
TXD2(-)/ NULL	Transmitted Data / NULL for COM 2. See also note 1.	16	RTS2(-)/ DTR2	Request to Send / Data Terminal Ready for COM 2. See also note 1.
CTS2(+)/ CTS2	Clear to Send for COM 2. See also note 1.	17	TXD2(+)/ TXD2	Transmitted Data for COM 2. See also note 1.
RTS2(+)/ RTS2	Request to Send for COM 2. See also note 1.	18	RXD2(+)/ RXD2	Received Data for COM 2. See also note 1.
CTS2(-)/ DSR2	Clear to Send / Data Set Request for COM 2. See also note 1.	19	RXD2(-)/ DCD2	Received Data / Data Carrier Detected for COM 2. See also note 1.
A2	This is the positive input of the opto-isolator described in OP2 (B15)	20	B2	This is the negative input of the opto-isolator described in OP2 (B15)
VARF Output	A variable frequency. Normally high. The active low pulse width is 49 nsec. It repeats at the programmed frequency (156Hz to 10.23 MHz.)	21	GND	Digital Ground
1PPS Output	Normally high, active low 200 µs pulse is output once a second. Falling edge is used as the reference.	22	GND	Digital Ground
Measure Out	Normally high, active low pulse is 200 µs wide. The falling edge is the receiver measurement strobe.	23	GND	Digital Ground
Mark Input	Normally high. The input pulse must pull low and exceed 55 nsec in duration. The falling edge is the reference. TTL or contact closure compatible.	24	GND	Digital Ground
STATUS	High level output indicates 'good solution' or Fixed Position. Low level output indicates 'no solution'.	25	GND	Digital Ground
LINKINØ	For factory use only.	26	GND	Digital Ground
LINKOUTØ	For factory use only.	27	GND	Digital Ground
\RESETIN	Reset signal input from external system. Active low. Minimum 1.4µs pulse width is required to reset card.	28	GND	Digital Ground
RESETOUT	Reset signal output to external system. Active high.	29	GND	Digital Ground
LINKIN1	For factory use only.	30	GND	Digital Ground
LINKOUT1	For factory use only.	31	GND	Digital Ground
BootFromROM	For factory use only.	32	GND	Digital Ground

Note 1: RS422/RS232

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