

Inertial+

**Inertial
and GPS
Measurement
System**



Inertial+ **Novatel OEM-V** **and OEM-4** **Integration**

Confidently. Accurately.



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Introduction

This manual explains how the Novatel OEM-V product family can be used with the Inertial+. The Novatel OEM-V products range in accuracy from the Standard Positioning Service (typically 1.8m) to 1cm RTK positioning. Tight integration has been performed with the Novatel OEM-V receivers and the Inertial+ is optimised to give maximum performance using this product range.

The Inertial+ is also designed to work with the OEM-4 product range. The OEM-4 product range is a very successful GPS card family and gives superb results when combined with the Inertial+.



Products Covered

When choosing a Novatel product there are three things to consider: the card type, the enclosure and the license.

Card Type

There are four types of GPS card supplied by Novatel in the OEM-V range. All four cards have the same software, interfaces and protocols. All four types of card are compatible with the Inertial+. Table 1 lists the different card types.

Table 1. Novatel Card Types

Card Type	Description	Accuracies
OEM-V1G	Single frequency GPS + GLONASS measurement and positioning engine	L1 1.8m SBAS 0.6m DGPS 0.45m RT-20<20cm
OEM-V1	Single frequency positioning engine	L1 1.8m SBAS 0.6m OmniSTAR VBS 0.7m CDGPS 0.6m DGPS 0.45m RT-20<20cm
OEM-V2	Dual frequency GPS + GLONASS measurement and positioning engine	Single Point L1 1.8m Single Point L1/L2 1.5m SBAS 0.6m DGPS 0.45m RT-20<20cm RT-2 1cm+1ppm
OEM-V3	Triple frequency GPS + GLONASS measurement and positioning engine, L5 capable	Single Point L1 1.8m Single Point L1/L2 1.5m SBAS 0.6m DGPS 0.45m OmniSTAR VBS 0.7m; OmniSTAR XP 0.15m; OmniSTAR HP 0.10m CDGPS 0.6m RT-20<20cm RT-2 1cm+1ppm
OEM-4-G2 OEM-4 OEM-4-G2L	Dual frequency GPS	Single Point L1 1.8m Single Point L1/L2 1.5m SBAS 0.6m DGPS 0.45m RT-20<20cm RT-2 1cm+1ppm

Note: Novatel products may change. Consult Novatel for the latest information.



Enclosure

Typically the Novatel card will be mounted in an Enclosure. Novatel's wide selection of rugged, compact enclosures are designed to protect your receiver from the elements and provide a ready-to-use interface for quick integration.

The enclosures offer a wide variety of features for maximum versatility, including USB support and high-speed serial ports.

Table 2. Novatel Enclosures

Enclosure	Card Type	Description
DL-V3	OEM-V3	3 RS-232 (one required for the Inertial+) Ethernet USB
ProPak-V3	OEM-V3	3 RS-232 (one required for the Inertial+) USB
FlexPak-V2	OEM-V2	2 RS-232 (one required for the Inertial+) USB

Note: Novatel have other enclosures and they are all suitable. The Inertial+ only requires one RS232 port and all Novatel cards/enclosures provide this.

Older enclosures that will work include:

- ProPak-G2+
- ProPak-G2
- DL-4+
- DL-4
- FlexPak-G2L
- ProPak-LB+
- ProPak-LB

Many of these are used with the older OEM-4 cards.

License

Novatel supply a variety of licenses for their GPS cards. This enables or disables various hardware functions. For example, you may have an OEM-V3 card but you may



not have a license to use the OmniStar capability of this card. This has the advantage of using a common platform but paying a reduced price if the functionality is not needed.

Table 3. Novatel Licenses for OEM-V

License Type	Description	Accuracies
L1V	Standard L1 receiver, 20Hz capable, raw data	L1 1.8m SBAS 0.6m DGPS 0.45m
N1BV or L1BV	OmniStar VBS, CDGPS, 20Hz capable with (L1BV) or without (N1BV) raw data	L1 1.8m SBAS 0.6m OmniSTAR VBS 0.7m CDGPS 0.6m DGPS 0.45m
L1BRV	RT-20, OmniStar VBS, CDGPS, 20Hz capable with raw data	L1 1.8m SBAS 0.6m OmniSTAR VBS 0.7m CDGPS 0.6m DGPS 0.45m RT-20<20cm
N12LV	OmniStar HP/XP/VBS, CDGPS, 20Hz capable, no raw data	Single Point L1 1.8m Single Point L1/L2 1.5m SBAS 0.6m DGPS 0.45m OmniSTAR VBS 0.7m; OmniSTAR XP 0.15m; OmniSTAR HP 0.10m CDGPS 0.6m
L12LRV	RT-2, OmniStar HP/XP/VBS, CDGPS, 20Hz capable, raw data	Single Point L1 1.8m Single Point L1/L2 1.5m SBAS 0.6m DGPS 0.45m OmniSTAR VBS 0.7m; OmniSTAR XP 0.15m; OmniSTAR HP 0.10m CDGPS 0.6m RT-20<20cm RT-2 1cm+1ppm

Note: Novatel have other software licenses, this is just a selection.

When the specification is listed at the end of the manual it will refer to the license type. The tracking performance of all the cards is the same.



Connection Details

The Inertial+ should be connected to the Novatel GPS card using RS232 Serial Ports. On the Inertial+ the “External GPS” connector is used. On the Novatel GPS receiver any of the serial ports can be used. Note that the configuration description assumes that COM1 is used.

Most Novatel GPS Enclosures come with a cable that has a 9-way female serial connector. This can be connected directly to the “External GPS” connector on the Inertial+.

Power to the GPS receiver and power to the Inertial+ are wired separately to each product. A common ground should be used to avoid ground problems.



Configuration

For best results you should return the Novatel card to the factory default settings before using it with the Inertial+. Any changes to the tracking loop or carrier phase smoothing may affect the timing and degrade the performance of the Inertial+.

Consult the Novatel documentation to find out how to communicate and configure the GPS cards.

To return the card to factory defaults enter the command:

```
freset
```

This will reboot the GPS card. The serial ports will return to their default states and it may be necessary to reconfigure the terminal (if applicable) before being able to communicate with the card again.

Configure the card with the following commands:

```
COM COM1 115200 N 8 1 N OFF ON
LOG COM1 BESTVELB ONTIME 0.1
LOG COM1 BESTPOSB ONTIME 0.5
LOG COM2 RANGECPB ONTIME 0.5
LOG COM1 TIMEB ONTIME 1.0
LOG COM1 PSRDOPB ONTIME 1.0
LOG COM1 OMNISTATB ONTIME 1.0
LOG COM1 OMNIINFOB ONTIME 10.0
SAVECONFIG
```

If the Inertial+ is connected to a different serial port then change COM1 to the other serial port (COM2 or COM3).

If the GPS card only supports 5Hz data rates then use:

```
COM COM1 115200 N 8 1 N OFF ON
LOG COM1 BESTVELB ONTIME 0.2
LOG COM1 BESTPOSB ONTIME 0.5
LOG COM2 RANGECPB ONTIME 0.5
LOG COM1 TIMEB ONTIME 1.0
LOG COM1 PSRDOPB ONTIME 1.0
LOG COM1 OMNISTATB ONTIME 1.0
LOG COM1 OMNIINFOB ONTIME 10.0
SAVECONFIG
```

It is essential to only use the binary logs from the Novatel GPS card. Sending any ASCII logs will prevent the Inertial+ from working properly.



Note that the OMNISTATB log and the OMNIINFOB log will not be accepted unless your receiver is capable of receiving OmniStar. The RAMNGECMPB logs will not be accepted unless your receiver is capable of outputting raw measurements.

It may be necessary to configure other parts of the GPS card, for example SBAS, Differential Corrections, OmniStar, etc. These can be saved using the SAVECONFIG command.

Do not use faster data rates than the ones proposed above. This does not result in higher accuracy but may overload the processor in the Inertial+.



Fault Diagnosis

The Inertial+ gets different information from the different messages that the OEM-V card outputs. Table 4 lists the information decoded in each message.

Table 4. OEM-V Message Information

Message	Data Rate	Description
BESTPOSB	2Hz	Required for Latitude, Longitude, Altitude, Number of Satellites
BESTVEL	10Hz	Required for North, East and Down Velocity
TIMEB	1Hz	Required for UTC offset
PSRDOPB	1Hz	Required for DOP information and Number of Satellites
OMNISTATB	1Hz	Required for OmniStar tracking information
OMNIINFOB	0.1Hz	Required for OmniStar serial number
RANGECMPB	2Hz	Only required for post-processing, not required for real-time operation in the current versions of firmware.

In addition, the GPS inside the Inertial+ *must* have found time and position so that it can accurately synchronise the IMU to the external GPS. An antenna must be fitted to the Primary GPS port in order to get the Inertial+ to work.

To trouble shoot the interface between the Inertial+ and the external GPS receiver, refer to Table 5.



Table 5. Troubleshooting

Problem	Description
The system appears to work even though the External GPS is not connected	The Inertial+ is configured to use the Internal GPS, which is not as accurate.
The GPS LED is off	There is no data being received from the OEM-V. (If corrupt data was being sent then the LED would be flashing red).
The “External GPS Skipped Chars” field is increasing	Check that the baud rate is correct. Check that the binary, not ASCII logs are being output.
The software shows that there are some skipped chars from the External GPS	This is normal. As long as the number is not increasing then there is nothing to worry about.
The Position Mode is “None”	The BESTPOSB log is not being sent by the OEM-V.
The Velocity Mode is “None”	The BESTVELB log is not being sent by the OEM-V.
The Number of Satellites is not being displayed	The BESTPOSB or PSRDOPB log is not being sent by the OEM-V.
OmniStar information is not being reported	Neither OMNISTATB log nor the OMNIINFOB log are being output by the OEM-V
The Inertial+ does not initialise when driving forwards	If all the data is being received from the OEM-V then the Internal GPS is not working correctly. Check the antenna that is connected to the primary port of the Inertial+.
GPGSA and GPGSV messages have missing fields	The current implementation of the OEM-V binary interface does not support all of the information required for the GPGSA and GPGSV messages so many of the fields will be blank.



Accuracy Specification

Table 6. Performance Specification for Inertial+ using Novatel GPS cards

Parameter	2cm L1/L2 GPS	20cm L1 Float GPS	DGPS	SPS
Positioning	RT-2	RT-20 OmniStar HP	Differential GPS OmniStar VBS	SPS
Position Accuracy	2cm 1 σ	20cm (10cm HP)	0.4m CEP (0.5m CEP VBS)	1.8m CEP L1 1.5m CEP L1/L2
Velocity Accuracy	0.05 km/h RMS	0.08 km/h RMS	0.1 km/h RMS	0.1 km/h RMS
Acceleration				
– Bias	10 mm/s ² 1 σ	10 mm/s ² 1 σ	10 mm/s ² 1 σ	10 mm/s ² 1 σ
– Linearity	0.01%	0.01%	0.01%	0.01%
– Scale Factor	0.1% 1 σ	0.1% 1 σ	0.1% 1 σ	0.1% 1 σ
– Range	100 m/s ²	100 m/s ²	100 m/s ²	100 m/s ²
Roll/Pitch	0.03° 1 σ	0.04° 1 σ	0.05° 1 σ	0.05° 1 σ
Heading	0.1° 1 σ	0.1° 1 σ	0.1° 1 σ	0.1° 1 σ
Angular Rate				
– Bias	0.01°/s 1 σ	0.01°/s 1 σ	0.01°/s 1 σ	0.01°/s 1 σ
– Scale Factor	0.1% 1 σ	0.1% 1 σ	0.1% 1 σ	0.1% 1 σ
– Range	100°/s	100°/s	100°/s	100°/s
Track (at 50km/h)	0.07° RMS	0.1° RMS	0.15° RMS	0.15° RMS
Update Rate	100 Hz			
Calculation Latency	3.9 ms			



Revision History

Table 7. Revision History

Revision	Comments
080123	Initial Version.
080226	Clarification on OMNISTATB message, Fault Finding, OMNIINFOB log added.
091012	Added RANGECMPB log for post-processing support.
100716	Added clarification on the GPGSA and GPGSV messages.