Inertial+

Inertial and GNSS Measurement System

Inertial+

Novatel OEM6 integration manual

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Revision

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Introduction

This manual explains how the Novatel OEM6 product family can be used with the Inertial+. The Novatel OEM6 products range in accuracy from single point L1 positioning (1.5 m) to 1 cm + 1 ppm RTK positioning. Tight integration has been performed with the Novatel OEM6 receivers and the Inertial+ is optimised to give maximum performance using this product range.

The OEM638 receiver was used in our integration tests but the set-up and configuration described in this manual should cover the full OEM6 range.

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 three types of GNSS card supplied by Novatel in the OEM6 range. All cards have the same software, interfaces and protocols. All types of card are compatible with the Inertial+. Table 1 lists the different card types.

Table 1. Novatel card types

Card type	Description	Accuracies
OEM615	Dual frequency GPS and GLONASS receiver with OEMV-1 form factor.	L1 1.5 m SBAS 0.6 m DGPS 0.4 m RT-2 1 cm + 1 ppm
OEM628	Triple-frequency + L-Band GNSS receiver with OEMV-2 form factor.	L1 1.5 m SBAS 0.6 m DGPS 0.4 m TerraStar 0.1 m RT-2 1 cm + 1 ppm
OEM638	Triple-frequency + L-Band GNSS receiver with OEMV-3 form factor	L1 1.5 m SBAS 0.6 m DGPS 0.4 m TerraStar 0.1 m RT-2 1 cm + 1 ppm

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

Enclosure

The Novatel cards are available as OEM board sets or alternatively can be mounted in an enclosure. Novatel's selection of 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
ProPak6	OEM638	IP67 housing, 3x RS-232 (one required for the Inertial+), 3x RS-422, Ethernet, USB, Bluetooth
FlexPak6	OEM628	Compact housing, 2x RS-232 (one required for the Inertial+), Ethernet, 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.

License

Novatel supply a variety of licenses for their GNSS cards. This enables or disables various hardware functions. For example, despite having the OEM638 you may not have a license to use the RT-2 capability of this card. This has the advantage of using a common platform but paying a reduced price if the functionality is not needed.

Below is a selection of licenses available for the OEM6 cards. A full list of licenses can be found on the Novatel website at:

http://www.novatel.com/assets/Documents/Papers/NovAtelModels.pdf

Table 3. Novatel licenses for OEM6

License type	Description
OEM638-FAJ-R0R-TTR	GPS+GLONASS+GALILEO+BEIDOU, L1/L2/L5/E1/E5a/E5b/AltBOC/B1/B2, SBAS/L-Band/QZSS, RT-2 positions and corrections, 20 Hz measurements, 20 Hz positions
OEM638-G1J-B0R-TTR	GPS, L1, SBAS/L-Band/QZSS, RT-2 corrections
OEM638-D2J-B0R-TTR	GPS+GLONASS, L1/L2, SBAS/L-Band/QZSS, RT-2 corrections, 20 Hz measurements, 20 Hz positions, L-Band/NTRIP
OEM628-G1S-B0G-TTN	GPS RT-20 corrections and raw data, code positions and DGPS, SBAS, 20 Hz
OEM628-D2L-B0G-TTR	GPS+GLONASS, RT-2 corrections and raw data, code positions and DGPS, L-Band/NTRIP, SBAS, 20 Hz
OEM615-G2S-B0G-TT0	GPS, RT-2 corrections and raw data, code positions and DGPS, SBAS, 20 Hz

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

The tracking performance of all the cards is the same.

Connection details

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

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

Power to the GNSS 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 GNSS cards.

To return the card to factory defaults enter the command:

```
freset
```

This will reboot the GNSS 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 COM1 RANGECMPB ONTIME 0.5
LOG COM1 TIMEB ONTIME 1.0
LOG COM1 PSRDOPB ONTIME 1.0
LOG COM1 TERRASTARSTATUSB ONTIME 1.0
LOG COM1 TERRASTARINFOB 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 GNSS card only supports 5 Hz 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 COM1 RANGECMPB ONTIME 0.5
LOG COM1 TIMEB ONTIME 1.0
LOG COM1 PSRDOPB ONTIME 1.0
LOG COM1 TERRASTARSTATB ONTIME 1.0
LOG COM1 TERRASTARINFOB ONTIME 10.0
SAVECONFIG
```

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

Note that the TERRASTARSTATB log and the TERRASTARINFOB log will not be accepted unless your receiver is capable of receiving Terrastar.

It may be necessary to configure other parts of the GNSS card, for example SBAS, differential corrections, Terrastar, 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 OEM6 card outputs. Table 4 lists the information decoded in each message.

Table 4. OEM6 message information

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

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

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

Table 5. Troubleshooting

Problem	Description
The system appears to work even though the External GNSS is not connected.	The Inertial+ is configured to use the internal GNSS receiver.
The GNSS LED is off.	There is no data being received from the OEM6. (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 GNSS.	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 OEM6.
The Velocity Mode is “None”.	The BESTVELB log is not being sent by the OEM6.
The Number of Satellites is not being displayed.	The BESTPOSB or PSRDOPB log is not being sent by the OEM6.
Terrastar information is not being reported.	Neither TERRASTARSTATB log nor the TERRASTARINFOB log are being output by the OEM6.
The Inertial+ does not initialise when driving forwards.	If all the data is being received from the OEM6 then the Internal GNSS 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 OEM6 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 OEM638 card

Parameter	RT-2	PPP	DGPS	SPS
Positioning	L1, L2	Terrastar-D	Differential GPS	SPS
Position accuracy	1 cm 1σ	0.1 m CEP	0.4 m CEP	1.5 m CEP L1 1.2 m 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
Roll/pitch	0.03° 1σ	0.04° 1σ	0.05° 1σ	0.05° 1σ
Heading	0.1° 1σ	0.1° 1σ	0.1° 1σ	0.1° 1σ
Track (at 50km/h)	0.07° RMS	0.1° RMS	0.15° RMS	0.15° RMS
Update rate	100 Hz / 250 Hz (dependent on Inertial+ model)			
Calculation latency	3.5 ms			

Revision history

Table 7. Revision history

Revision	Comments
140501	Initial version.