Integrated GNSS MEMS Stackable Solutions

QUICK START GUIDE

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This guide provides instructions on how to use the NovAtel® Stackable Solutions. This guide provides general instructions for using the Bracket Kit to attach (stack) a NovAtel FlexPak6™ to the top of either an IMU-IGM™ or SPAN-IGM™. It also provides instructions for setting up the IMU-IGM application and configuring the SPAN-IGM with an ALIGN® solution.

When the SPAN-IGM and FlexPak6 are combined, both the SPAN-IGM and FlexPak6 act as GNSS receivers to deliver a NovAtel ALIGN solution. When the IMU-IGM and FlexPak6 are combined, the FlexPak6 acts as the GNSS receiver while the IMU-IGM acts as a sensor, transmitting data to the FlexPak6 to deliver a SPAN® solution.

For detailed information on the installation and operation of the receivers and enclosures, refer to the user manuals located on our web site:

- SPAN-IGM - SPAN-IGM User Manual OM-20000141
- IMU-IGM - SPAN on OEM6 User Manual OM-20000139
- FlexPak6 - OEM6 Family User Manual OM-20000128

BRACKET KIT CONTENTS

In addition to this Quick Start Guide, the following is provided with the bracket kit:

- 1 cable (for power and data)
  SPAN-IGM ALIGN Cable (01019089) for an ALIGN application or
  IMU-IGM Stack Up Cable (01019013) for a SPAN application
- 4 foam spacers
- 2 standoffs
- 2 bolts
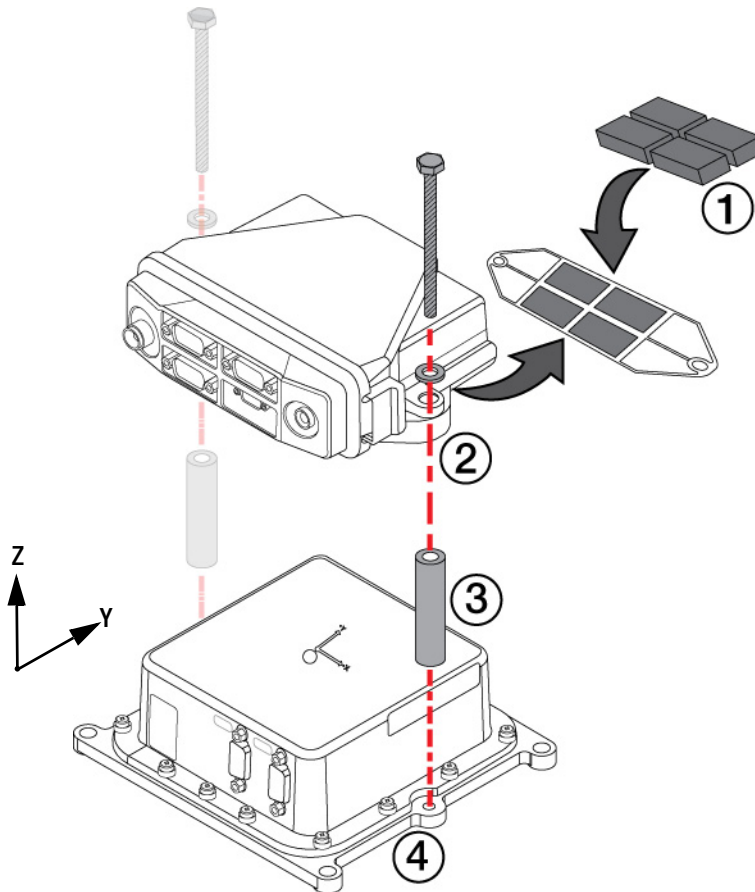- 2 washers

ADDITIONAL EQUIPMENT REQUIRED

- A NovAtel FlexPak6 receiver
- A NovAtel IMU-IGM (for a SPAN solution) or a SPAN-IGM (for an ALIGN solution)
- 10 mm wrench or socket

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STACK UP INSTALLATION

> ▼ Ensure the IMU-IGM or SPAN-IGM is securely mounted prior to starting this procedure.
> For the simplest operation, align the Y-axis of the IMU-IGM or SPAN-IGM with the forward axis (direction of travel) of the vehicle. Ensure the Z-axis is pointing up.

**Figure 1: Stack Up Installation**

1. Flip the FlexPak6 over. Remove the paper liner from the one side of the foam spacers (4). Secure the spacers into the four recesses on the bottom of the FlexPak6. Return to upright position.
2. Place a washer (2) over a bolt (2) and insert into and through the holes (2) of the FlexPak6.
3. Slip a standoff (2) over each bolt.
4. Line up and insert the bolts into the center of the metal base holes (2) of the IMU-IGM and tighten.

> ⬟ These steps can also be used to stack a FlexPak6 on top of a SPAN-IGM enclosure.

IMU-IGM WITH SPAN SOLUTION HARDWARE SETUP
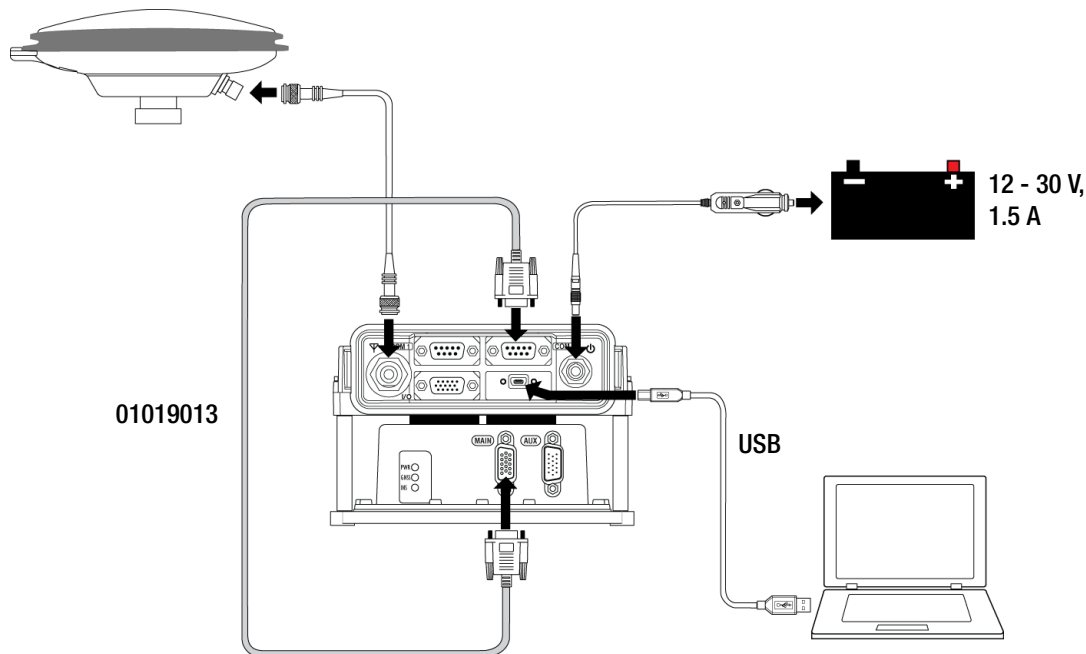
> (i) NovAtel interface cables have more connections than are shown in the diagram.
> Additional connections were removed for clarity.

1. Mount the GNSS antenna securely to the vehicle. Ensure the antenna and IMU-IGM cannot move relative to each other. The distance and relative direction between them must be fixed.

2. Connect the Stack Up Cable (01019013) to *COM2* of the FlexPak6 and *MAIN* on the IMU-IGM.

3. Connect a USB cable from the computer to the USB port on the receiver.

> (i) Make sure you have installed the USB drivers. The USB drivers are available from the NovAtel web site.

> (i) Alternately, you can connect the FlexPak6 to a computer using a serial cable or an Ethernet connection. For information about using these other connection methods, refer to the *SPAN on OEM6 User Manual* (OM-20000139) found on the NovAtel web site at *www.novatel.com/support/firmware-software-and-manuals/*.

4. Connect the GNSS antenna to the antenna port on the FlexPak6 using an appropriate antenna cable.

5. Connect the power cable to the power port on the FlexPak6. Line up the red mark on the power cable connector with the red mark on the receiver's power port and insert the power cable.

6. Connect the FlexPak6 power cable to the power supply.
   The power LED lights red when the FlexPak6 is properly powered.

> (i) In a stack up configuration, power is provided to the IMU-IGM through the Stack Up Cable. Refer to the *OEM6 Family User Manual* for details on powering the FlexPak6.

SPAN-IGM WITH ALIGN SOLUTION HARDWARE SETUP
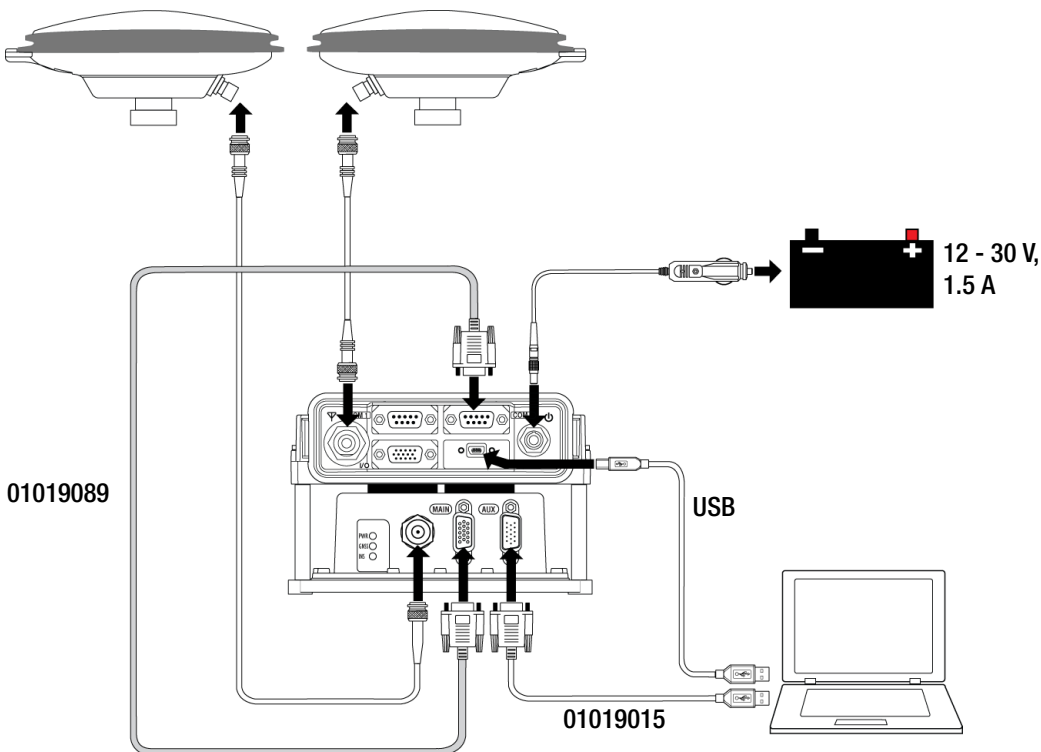
> ⓘ NovAtel interface cables have more connections than are shown in the diagram. Additional connections were removed for clarity.

1. Mount the two GNSS antennas securely to the vehicle.
   Ensure the antennas and SPAN-IGM cannot move relative to each other. The distance and relative direction between them must be fixed. Also, ensure the satellites will not be obstructed by any part of the vehicle. As heading accuracy is dependent on baseline length, mount the antennas as far apart as possible. A minimum separation distance of 1 metre is recommended.

2. Connect the SPAN-IGM ALIGN Cable (01019089) to *COM2* of the FlexPak6 and *MAIN* on the SPAN-IGM.

3. Connect the interface cable (01019015) to the AUX connector on the SPAN-IGM.
   Connect the USB connector on the interface cable to the USB port on the computer.
   Connect a second USB cable from the computer to the USB port on the FlexPak6.

> ⓘ Make sure you have installed the USB drivers. The USB drivers are available from the NovAtel web site.

> ⓘ Alternately, you can connect the SPAN-IGM and FlexPak6 to a computer using a serial cable or an Ethernet connection. For information about using these other connection methods, refer to the *SPAN-IGM User Manual* (OM-20000141) found on the NovAtel web site at www.novatel.com/support/firmware-software-and-manuals/.

4. Connect the primary GNSS antenna to the antenna port on the SPAN-IGM using an appropriate antenna cable.

5. Connect the secondary GNSS antenna to the antenna port on the FlexPak6 using an appropriate antenna cable.

6. Connect the power cable to the power port on the FlexPak6. Line up the red mark on the power cable connector with the red mark on the receiver's power port and insert the power cable.

7. Connect the FlexPak6 power cable to the power supply.
   The power LED lights red when the FlexPak6 is properly powered.

> ⓘ In a stack up configuration, power is provided to the SPAN-IGM through the SPAN-IGM ALIGN Cable.
>
> Refer to the *OEM6 Family User Manual* for details on powering the FlexPak6.

INSTALL THE PC UTILITIES

1. Install the NovAtel Connect™ PC Utilities and USB drivers.

> ⓘ To access and download the most current version of the NovAtel Connect PC Utilities and USB drivers, go to the *Support* page of the NovAtel web site at www.novatel.com/support/firmware-software-and-manuals/.

Establishing a New Receiver Connection

The first time you establish a connection with the receiver, complete the following:

1. Launch NovAtel Connect from the **Start** menu folder specified during the installation process. The default location is Start | All Programs | NovAtel Connect | NovAtel Connect.

2. Select **New Connection** from the Welcome window.
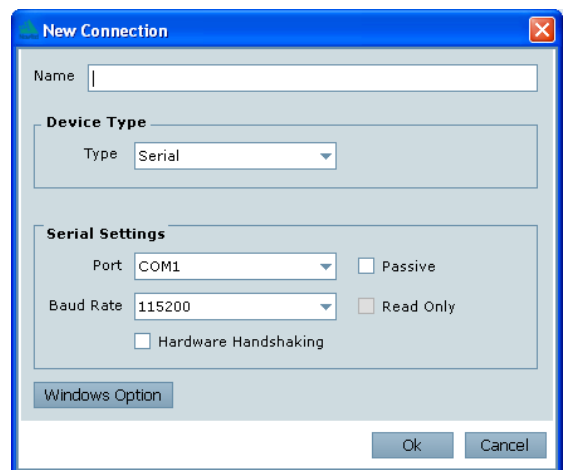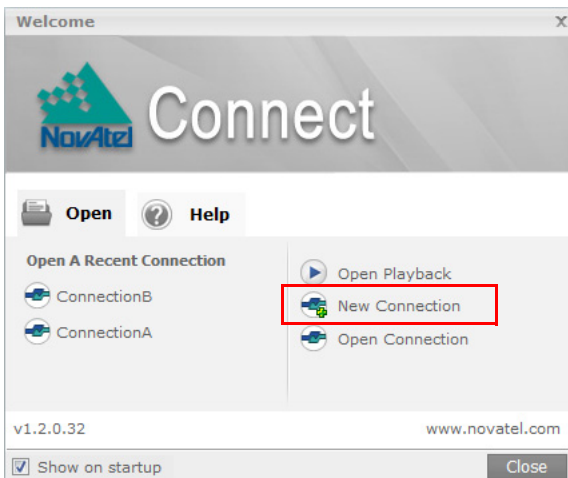
3. Enter a name for the Connection.
4. Select **Serial** or **USB** from the **Type** list.

5. Select the computer port that the SPAN system is connected to from the Port drop down list.

6. If this is a serial connection, select **115200** from the **Baud Rate** drop down list.

7. If this is a serial connection, clear the **Use hardware handshaking** check box.

8. Click the **OK** button to save the new connection.

9. Select the SPAN receiver from the Available Device Connections area of the Open Connection window.

10. Click the **Open** button to open SPAN receiver communications.
    As NovAtel Connect establishes the communication session with the receiver, a progress box is displayed.

> ▼ Detailed instructions for using NovAtel Connect are available from within the utility Help, the .chm file bundled with the software or from our web site www.novatel.com/support/firmware-software-and-manuals.

CONFIGURE THE SPAN SYSTEM

There are two methods to configure the SPAN system:

- Configure SPAN Manually
- Configure SPAN Using NovAtel Connect

Configure SPAN Manually

Follow these steps to enable INS as part of the SPAN system using software commands:

1. Establish a connection to the receiver.
   For SPAN solutions, connect to the FlexPak6. For ALIGN solutions, connect to the SPAN-IGM.

> ⓘ A GNSS antenna must be connected and tracking satellites for operation.

2. Issue the CONNECTIMU command to specify the type of IMU and the receiver port connected to the IMU (see *Table 1*).

Table 1: CONNECTIMU Commands

IMU Type	CONNECTIMU command
IMU-IGM	CONNECTIMU COM2 IMU_ADIS16488
SPAN-IGM	No command required

Basic configuration of the SPAN system is now complete. The inertial filter starts once the GNSS solution is solved and the IMU is connected.

3. Enter the distance from the IMU-IGM or SPAN-IGM to the GNSS antenna using the SETIMUTOANTOFFSET command. The offset between the antenna phase center and the IMU-IGM or SPAN-IGM axes must remain constant and be known accurately. The X (pitch), Y (roll) and Z (azimuth) directions are clearly marked on the enclosure. The SETIMUTOANTOFFSET parameters are (where the standard deviation fields are optional):

```
x_offset y_offset z_offset [x_stdev] [y_stdev] [z_stdev]
```
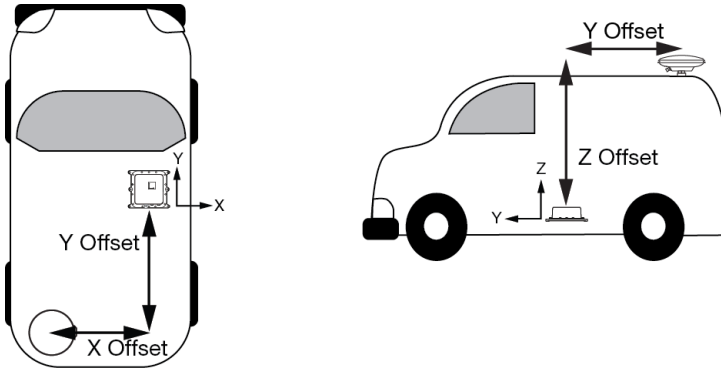
> ℹ️ This example assumes a default mounting configuration resulting in a -X offset, -Y offset and +Z offset.

A typical RTK GNSS solution is accurate to a few centimetres. For the integrated INS/GNSS system to have this level of accuracy, the offset must be measured to within a centimetre.

4. Perform a kinematic alignment.
   See the *SPAN-IGM User Manual* (OM-20000141) for more information.

Configure SPAN Using NovAtel Connect

Follow these steps to enable INS as part of the SPAN system using the NovAtel Connect software utility:

1. Start a NovAtel Connect session and establish a connection to the receiver.
   For SPAN solutions, connect to the FlexPak6. For ALIGN solutions, connect to the SPAN-IGM.

2. Select Wizards | SPAN Alignment from the NovAtel Connect toolbar. This wizard takes you through the steps to complete an alignment and configure the receiver port to accept IMU data.
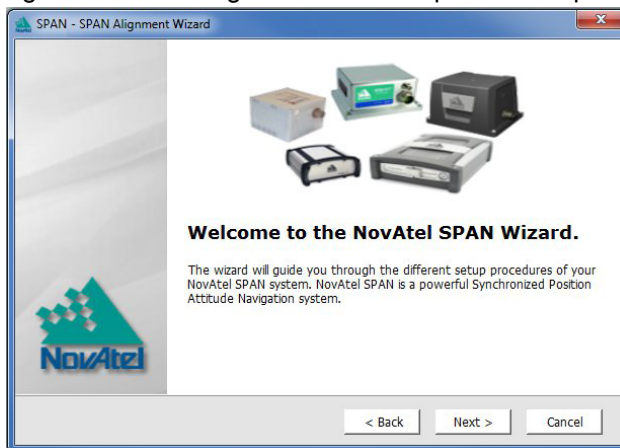
3. Perform a kinematic alignment.
   See the *SPAN-IGM User Manual* (OM-20000141) for more information.

> ℹ️ The IMU-IGM / FlexPak6 product is now ready for use.
> See *Log SPAN Data* on page 9 for information about logging data.

CONFIGURE THE ALIGN SOLUTION (SPAN-IGM WITH ALIGN SOLUTION ONLY)

Before configuring the ALIGN solution, the SPAN-IGM and the FlexPak6 MUST both be powered on and connected directly between COM 2 of the SPAN-IGM and COM 2 of the FlexPak6 through the SPAN-IGM ALIGN Cable (01019089).

> (i) The rover receiver (FlexPak6) must be an ALIGN-capable model, such as D2S-Z00-000, running the latest OEM6 firmware version.

To enable the dual-antenna ALIGN solution to aid the INS alignment and provide heading updates, the offset between the antennas and the SPAN-IGM must be known. This is achieved by entering lever arms to both antennas, using the SETIMUTOANTOFFSET and SETIMUTOANTOFFSET2 commands.

To configure SPAN with ALIGN Aiding:

1. Enter the lever arm from the SPAN-IGM to the primary antenna using the SETIMUTOANTOFFSET command (the primary antenna is connected to the SPAN-IGM).
   Abbreviated ASCII example:

   ```
   SETIMUTOANTOFFSET 0.54 0.32 1.20 0.03 0.03 0.05
   ```

2. Enter the lever arm from the SPAN-IGM to the secondary antenna using the SETIMUTOANTOFFSET2 command (the secondary antenna is connected to the FlexPak6).
   Abbreviated ASCII example:

   ```
   SETIMUTOANTOFFSET2 0.54 2.32 1.20 0.03 0.03 0.05
   ```

   Refer to the *SPAN on OEM6 Firmware Reference Manual* (OM-20000144) for the syntax of the above commands.

3. As with all ALIGN-capable products, the GNSS baseline solution is available from the GPHDT and HEADING logs. For INS heading, use the INSATT or INSPVA logs.
   Abbreviated ASCII example:

   ```
   LOG INSPVASA ONTIME 1
   ```

> (i) **Automatic Alignment**
> Automatic Alignment Mode Selection is the default setting for a SPAN-IGM. This mode is designed to allow alignment of the system as quickly as possible, using either an aided transfer alignment, a kinematic alignment or a manual alignment.
>
> The first available technique is used, regardless of its relative quality. If you wish to guarantee a specific technique is used, see the *SPAN-IGM User Manual* (OM-20000-141)

LOG SPAN DATA

Raw GNSS, IMU and navigation data (position, velocity, attitude) are available from the system as ASCII or binary logs.

Data can be collected through NovAtel Connect using the *Logging Control Window*, or sent out the receiver COM port to user supplied data collection software.
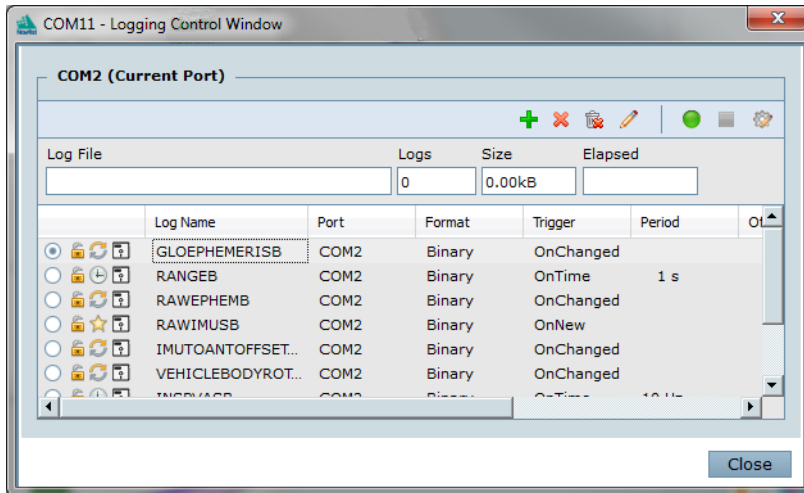
OPERATE THE SPAN SYSTEM

The system is ready to go once it is powered and the INS and GNSS are configured using the previously shown commands.

Observe the status of the system in the NovAtel Connect *INS Window* or in the status field of any of the INS solution logs (for example INSPOS, INSVEL, INSATT and INSPVA).

> (i) INS data is available after the receiver's time status has reached FINESTEERING. Therefore, an antenna must be connected for the system to function.

Move the vehicle forward at a speed faster than 1.15 m/s. The following status stages may be observed:

Table 2: Inertial Solution Status

Binary	ASCII	Description
0	INS_INACTIVE	IMU logs are present, but the alignment routine has not started; INS is inactive.
1	INS_ALIGNING	INS is in alignment mode.
2	INS_HIGH_VARIANCE	The INS solution is in navigation mode but the azimuth solution uncertainty has exceeded the threshold. The default threshold on the SPAN-IGM is 5 degrees. The solution is still valid but you should monitor the solution uncertainty in the INSCOV log. You may encounter this state during times when the GNSS, used to aid the INS, is absent.
3	INS_SOLUTION_GOOD	The INS filter is in navigation mode and the INS solution is good.
6	INS_SOLUTION_FREE	The INS filter is in navigation mode and the GNSS solution is suspected to be in error. This may be due to multipath or limited satellite visibility. The inertial filter has rejected the GNSS position and is waiting for the solution quality to improve.
7	INS_ALIGNMENT_COMPLETE	The INS filter is in navigation mode, but not enough vehicle dynamics have been experienced for the system to be within specifications.
8	DETERMINING_ORIENTATION	INS is determining the IMU axis aligned with gravity.
9	WAITING_INITIALPOS	The INS filter has determined the IMU orientation and is awaiting an initial position estimate to begin the alignment process.

POST-PROCESS DATA

Post-processing requires collection of simultaneous data from the base and rover stations. This includes accurate coordinates of the base station and accurate measurement of the IMU to antenna separation.

Collect the following data for post-processing:

- From the base station
    - RANGECMPB ontime 1
    - RAWEPHEMB onchanged
    - GLOEPHEMERISB onchanged (if using GLONASS)

- From the rover station(s)
    - RANGECMPB ontime 1
    - RAWEPHEMB onchanged
    - GLOEPHEMERISB onchanged (if using GLONASS)
    - RAWIMUSXB onnew
    - IMUTOANTOFFSETSB onchanged
    - VEHICLEBODYROTATIONB onchanged

SPAN system output is compatible with Inertial Explorer® post-processing software from the Waypoint® Products Group, NovAtel Inc. Visit our website at www.novatel.com/products/software/waypoint-products/ for details.

QUESTIONS OR COMMENTS

If you have any questions or comments regarding your SPAN system, please contact NovAtel Customer Service by:

Email:	support@novatel.com
Web:	www.novatel.com
Phone:	1-800-NOVATEL (U.S. & Canada)
	1-800-668-2835
	1-403-295-4500
Fax:	1-403-295-4501
China:	0086-21-54452990-8011
Europe:	44-1993-848-736
SE Asia & Australia	61-400-883-601