SPAN® Data Logging for Inertial Explorer®

Overview

This document provides an overview of the OEM6 and OEM7 SPAN® logs used for post-processing in Inertial Explorer®. A list of required logs outlines the minimum logging requirements needed for post-processing. Additional logs are recommended for increased ease of use, specific applications, and troubleshooting purposes. Example lists of commands and logs are provided at the end of the document, which can be used as templates for basic data collections.

1.1 Data Logging

1.1.1 Log Types & Headers

There are multiple logging formats which can be used to record NovAtel receiver data. *Table 1: Logging Different Formatting Types* below provides a summary of these formats and select examples. It is recommended to log data records in binary format, as the NovAtel/OEM decoder in Inertial Explorer supports only binary logs. After data conversion, all decoded logs will be displayed in the conversion summary. Further details on data types and log formats can be found in the OEM User Manuals.

Table 1: Logging Different Formatting Types

	Log Type	Symbol	Example Log
Data Type	ASCII	-	INSPVA
	Binary B	B	INSPVAB
Log Format	Short Header	S	INSPVAS
	Extended	X	INSPVAX
	Compressed	CMP	RANGECMP
Example: RAWIMUSXB Extended version [X] of a Binary Log [B] with a Short header [S]			

1.1.2 Logging Triggers & Frequency

The choice of logging triggers depends on the log itself, and how the data is used in post-processing. Each log trigger outputs the current message immediately after it has been called.

ONCE: Outputs the current message only once.

ONCHANGED: The log is output only when the values in the message change.

ONNEW: The log will be output every time the log is updated. This ensures that internally triggered logs are also output.

ONTIME <#>: The log will continually be requested and output every <#> seconds during data collection.

The choice between ONNEW and ONCHANGED is dependent on the type of data collection and user preferences. The ONNEW trigger can result in larger files with duplicate logs that are ignored by Inertial Explorer's converter. The ONCHANGED trigger is preferable to avoid duplicates and minimize file size. However, if the ONCHANGED log request is made before the logging file is opened the log will not be triggered until a value has

changed. This may cause issues in short surveys, as slow changing logs (such as RAWEPHEMB) may not be logged during the data collection period. For this reason, ONNEW is suggested for short surveys.

If using ONCE, the user must ensure that the logging file has been opened before the log call. If not, the information will not be saved anywhere in the file, as the log will not be called again. While in INS operation, the highest rate that GNSS logs should be requested is 5 Hz (0.2 seconds). GNSS logs include, but are not limited to, RANGECMPB, BESTPOSB, BESTGNSSPOSB, RTKPOSB and PSRPOSB.

The recommended rate for all GNSS logs is 1 Hz for GNSS and INS Integration.

1.2 SPAN Logs

The following list outlines the logs required and recommended for post processing in Inertial Explorer. For differential processing, a subset of these logs must be logged at the base. The *Required for* note describes how Inertial Explorer uses the data provided in the log. Suitable *Alternative* logs are also listed, which can be selected based on user preference. The *Used for* note describes how Inertial Explorer uses the data provided in the log. Not all logs will be used in Inertial Explorer post-processing, but can be *Helpful for* troubleshooting purposes and record keeping. Finally, *Requirement* notes outline prerequisite steps needed for the successful output of the log.

Platform Compatibility:	**OEM6 & OEM7**	**OEM6 ONLY**	**OEM7 ONLY**
Log on Receiver Type:	**R**: ROVER	**M:** MASTER	

1.2.1 Required Logs

These logs are required to collect the raw data necessary for post-processing.

LOG RANGECMPB ONTIME 1 — **R M** Satellite range information. Channel measurements for the currently tracked satellites.

Required for: GPB file creation and GNSS data processing; source of GNSS raw data.

Alternatives: RANGEB, RANGECMP2B, RANGECMP4B

LOG GPSEPHEMB ONNEW — **R M** GPS raw ephemeris information.

Required for: Computing GPS satellite coordinates and elevation.

Alternative: RAWEPHEMB

LOG GLOEPHEMERISB ONNEW — **R M** GLONASS raw ephemeris information.

Required for: Computing GLONASS satellite coordinates and elevation.

Alternative: GLORAWEPHEMERISB

LOG GALINAVEPHEMERISB ONNEW — **R M** Galileo INAV ephemeris information

Alternative: GALEPHEMERISB

LOG GALFNAVEPHEMERISB ONNEW	**R M**	Galileo FNAV ephemeris information **Alternative**: GALEPHEMERISB
LOG BDSEPHEMERISB ONNEW	**R M**	BeiDou ephemeris information
LOG QZSSEPHEMERISB ONNEW	**R M**	QZSS ephemeris parameters
LOG RAWIMUSXB ONNEW	**R**	Raw gyroscope and accelerometer measurements, including an IMU status indicator. **Required for**: IMR file creation and INS data processing; provides sequential changes in velocity and rotation. **Directions**: Must log ONNEW. Use the extended header to include the name of the IMU. This helps to ensure correct conversion in Waypoint products. **Alternatives**: RAWIMUB, RAWIMUSB, RAWIMUXB

1.2.2 Recommended Logs

The following logs are not required for post-processing, but provide information that aids in project setup, data analysis, and troubleshooting. A number of logs specified below are used for extracting real-time trajectories to a Waypoint readable format. Instructions on how to generate these files are provided in *Appendix A: Full Project Example* on page 7.

LOG VERSIONB ONCE	**R M**	Version information for all system components. **Used for**: Keeping record of the system components of the data collection.
LOG RXCONFIGB ONCE	**R M**	Receiver configuration. List of all current command settings. **Helpful for**: Support and troubleshooting. **Note**: Log after the configuration commands are sent.
LOG RXSTATUSB ONCHANGED	**R M**	Receiver Status. List of GNSS receiver system status (health) parameters. **Helpful for**: Support and troubleshooting; Can identify error conditions affecting performance.
LOG THISANTENNATYPEB ONCE	**R M**	The antenna type of the receiver in use. **Used for**: Setting the antenna profile. **Requirement**: User must first set the antenna profile through the THISANTENNATYPE command.

LOG INSPVAXB ONTIME 1	**R**	INS position, velocity and attitude in the SPAN computation frame and their estimated errors. **Used for**: Extracting real-time trajectory to a Waypoint readable format. **Note**: If high rate INSPVA logs are needed, but bandwidth is a concern, use INSPVASB and INSCOVSB as alternatives.
LOG BESTPOSB ONTIME 1	**R**	Best available combined GNSS and INS solution output at the GNSS phase center. **Used for**: Extracting real-time trajectory to a Waypoint readable format, and decoding position estimated by the receiver to the GPB file.
LOG BESTGNSSPOSB ONTIME 1	**R**	Best available GNSS solution computed without INS. **Used for**: Extracting real-time trajectory to a Waypoint readable format.
LOG TIMEB ONTIME 1	**R M**	Time related information such as receiver clock offset, and UTC time and offset. **Used for**: Decoding receiver clock shift to GPB file.
LOG SETIMUORIENTATIONB ONCHANGED	**R**	Orientation of the IMU frame in the SPAN computation frame. Specifies the IMU axis aligned with gravity. **Used for**: IMU alignment settings. **Requirement**: User must first set values through the SETIMUORIENTATION command.
LOG IMUTOANTOFFSETSB ONCHANGED	**R**	Lever arm offset from the IMU to the GNSS antenna. **Used for**: IMU alignment settings. **Requirement**: User must first set values through the IMUTOANTOFFSETS command.
LOG VEHICLEBODYROTATIONB ONCHANGED	**R**	Rotation from the Vehicle frame to the SPAN frame. **Used for**: IMU alignment settings. **Requirement**: User must first set values through the VEHICLEBODYROTATION command.
LOG INSCONFIGB ONCHANGED	**R**	All IMU configuration parameters required for post-processing or system analysis. **Used for**: IMU alignment settings. **Requirement**: User must first set values using variations of the SETINSTRANSLATION and SETINSROTATION commands.

For the commands specific to your system setup, see SPAN documentation.

1.2.3 Supplementary Logs: Common Applications

This section outlines the logs required for integration of application-specific data in Inertial Explorer. Please note that this list contains only the logs required in Inertial Explorer, and does not encompass all logs and commands required for the proper set up and real time tracking of these systems. Further information on application-specific setup can be found in the OEM User Manuals.

1.2.3.1 Dual Antenna (ALIGN Solution)

LOG HEADINGB ONNEW — **R** Angle from true north of the base ALIGN antenna to the rover ALIGN antenna (positive clockwise direction).

Used for: HMR file creation.

Requirement: User must first set the two lever arm values using SETIMUTOANTOFFSET, SETIMUTOANTOFFSET2.

LOG HEADING2B ONNEW — **R** Angle from true north of the base ALIGN antenna to the rover ALIGN antenna (positive clockwise direction).

Used for: HMR file creation.

Requirement: User must first set the two lever arm values using SETINSTRANSLATION ANT1, SETINSTRANSLATION ANT2.

1.2.3.2 Wheel Sensor (Distance Measurement Instrument – DMI)

LOG TIMEDWHEELDATAB ONNEW — **R** Time stamped wheel sensor data.

Used for: Ticks per revolution in the DMR file.

Note: Only available on firmware versions older than 7.07.00.

LOG SETWHEELPARAMETERSB ONCHANGED — **R** Wheel sensor parameters

Used for: Sensor parameters in the DMR file header.

Requirement: User must first set the number of ticks per revolution, wheel circumference, and the resolution of the wheel sensor in the SETWHEELPARAMETERS command.

Note: Only available on firmware versions older than 7.07.00.

Note: These DMI parameters can also be set in the Global Options window of the Convert Raw GNSS data to GPB utility.

LOG RAWDMIB ONNEW — **R** Time stamped raw wheel sensor data.

Used for: Measurements in the DMR file

Note: Available on firmware versions 7.07.00 and newer.

LOG DMICONFIGB ONCHANGED

R Wheel sensor configuration.

Used for: Setting the ID, availability and input type of DMI sensor(s).

Requirement: User must first set these parameters before logging data from wheel sensor(s).

Note: Available on firmware versions 7.07.00 and newer.

Note: A maximum of 3 DMIs can be decoded to the DMR file, but Inertial Explorer will only process data from the first wheel sensor that is logging cumulative ticks.

No RAWDMIB logs will be decoded without the presence of a DMICONFIGB log. As such, users may consider logging this ONTIME at a coarse rate to ensure it is saved to file (e.g. LOG DMICONFIGB ONTIME 300).

1.2.3.3 Miscellaneous

LOG MARKTIMEB ONNEW

R Time of mark input event.

Used for: Measure the time when events are occurring in other devices.

Note: Other mark input event logs include MARK2TIMEB, MARK3TIMEB, and MARK4TIMEB.

1.3 Appendix A: Full Project Example

This section provides an example of how a well-planned list of logs and commands will allow for an efficient work flow in Inertial Explorer. The following SPAN data collection uses GPS and GLONASS constellations, a dual antenna system, and set up with the default IMU orientation (standard Y forward, Z up, X right). The equivalent OEM6 and OEM7 logs and commands used in this data collection are listed below to provide a summary example. The figures on the following pages demonstrate how the information from these logs is used in Inertial Explorer to convert and generate files, and auto-fill set up parameters for the project.

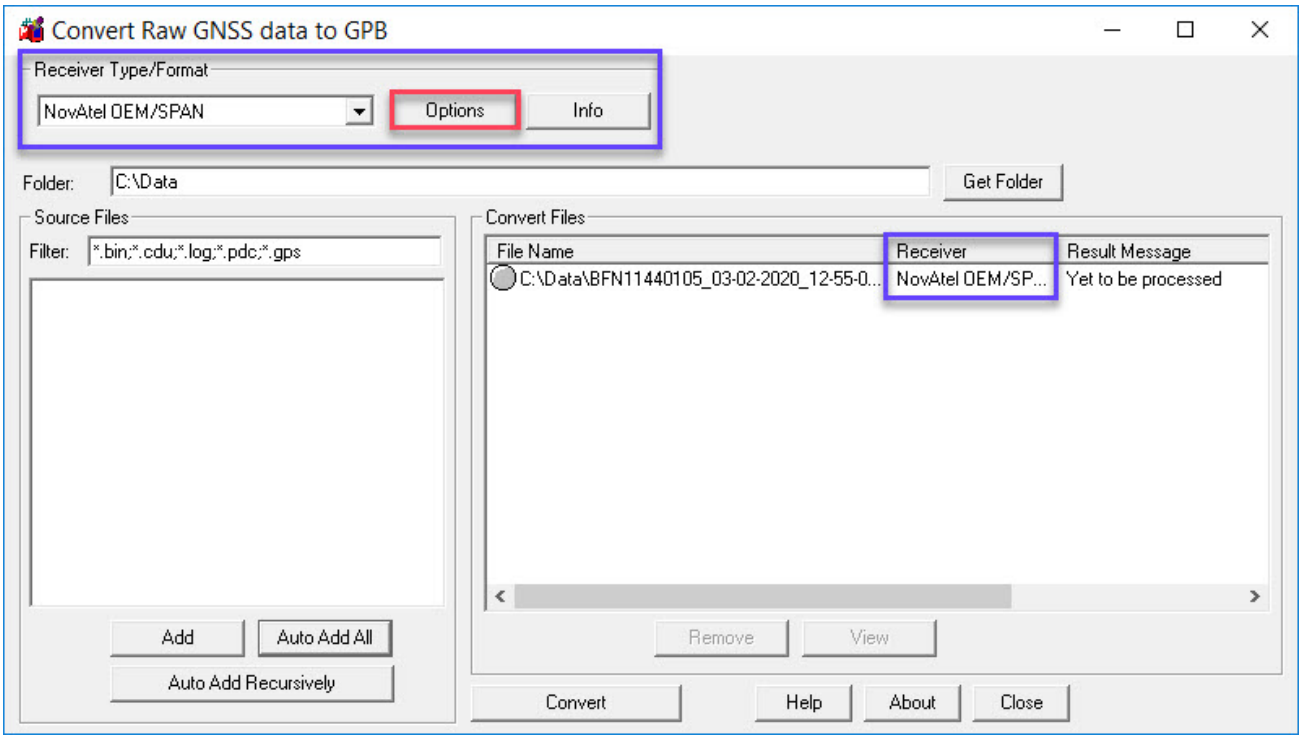
1.3.1 Logs and Commands

OEM6	OEM7
CONNECTIMU COM2 IMU_ADIS16488	CONNECTIMU COM2 IMU_ADIS16488
SETIMUTOANTOFFSET -0.976 -1.661 1.551 0.03 0.03 0.03	SETINSTRANSLATION ANT1 -0.976 -1.661 1.551 0.03 0.03 0.03
SETIMUTOANTOFFSET2 -1.021 0.890 1.567 0.03 0.03 0.03	SETINSTRANSLATION ANT2 -1.021 0.890 1.567 0.03 0.03 0.03
VEHICLEBODYROTATION 0 0 0	SETINSROTATION RBV 0 0 0
SETIMUORIENTATION 5	THISANTENNATYPE NOV702
THISANTENNATYPE NOV702	
LOG VERSIONB ONCE	LOG VERSIONB ONCE
LOG RXCONFIGB ONCE	LOG RXCONFIGB ONCE
LOG RXSTATUSB ONCHANGED	LOG RXSTATUSB ONCHANGED
LOG THISANTENNATYPEB ONCE	LOG THISANTENNATYPEB ONCE
LOG HEADINGB ONNEW	LOG HEADING2B ONNEW
LOG VEHICLEBODYROTATIONB ONCHANGED	LOG INSCONFIGB ONCHANGED
LOG SETIMUORIENTATIONB ONCHANGED	
LOG IMUTOANTOFFSETSB ONCHANGED	
LOG RANGECMPB ONTIME 1	LOG RANGECMPB ONTIME 1
LOG GPSEPHEMB ONNEW	LOG GPSEPHEMB ONNEW
LOG GLOEPHEMERISB ONNEW	LOG GLOEPHEMERISB ONNEW
LOG GALINAVEPHEMERISB ONNEW	LOG GALINAVEPHEMERISB ONNEW
LOG GALFNAVEPHEMERISB ONNEW	LOG GALFNAVEPHEMERISB ONNEW
LOG BDSEPHEMERISB ONNEW	LOG BDSEPHEMERISB ONNEW
LOG QZSSEPHEMERISB ONNEW	LOG QZSSEPHEMERISB ONNEW
LOG RAWIMUSXB ONNEW	LOG RAWIMUSXB ONNEW
LOG TIMEB ONTIME 1	LOG TIMEB ONTIME 1
LOG BESTPOSB ONTIME 1	LOG BESTPOSB ONTIME 1
LOG BESTGNSSPOSB ONTIME 1	LOG BESTGNSSPOSB ONTIME 1
LOG INSPVAXB ONTIME 1	LOG INSPVAXB ONTIME 1
LOG INSUPDATEB ONCHANGED	LOG INSUPDATEB ONCHANGED

1.3.2 Data Conversion

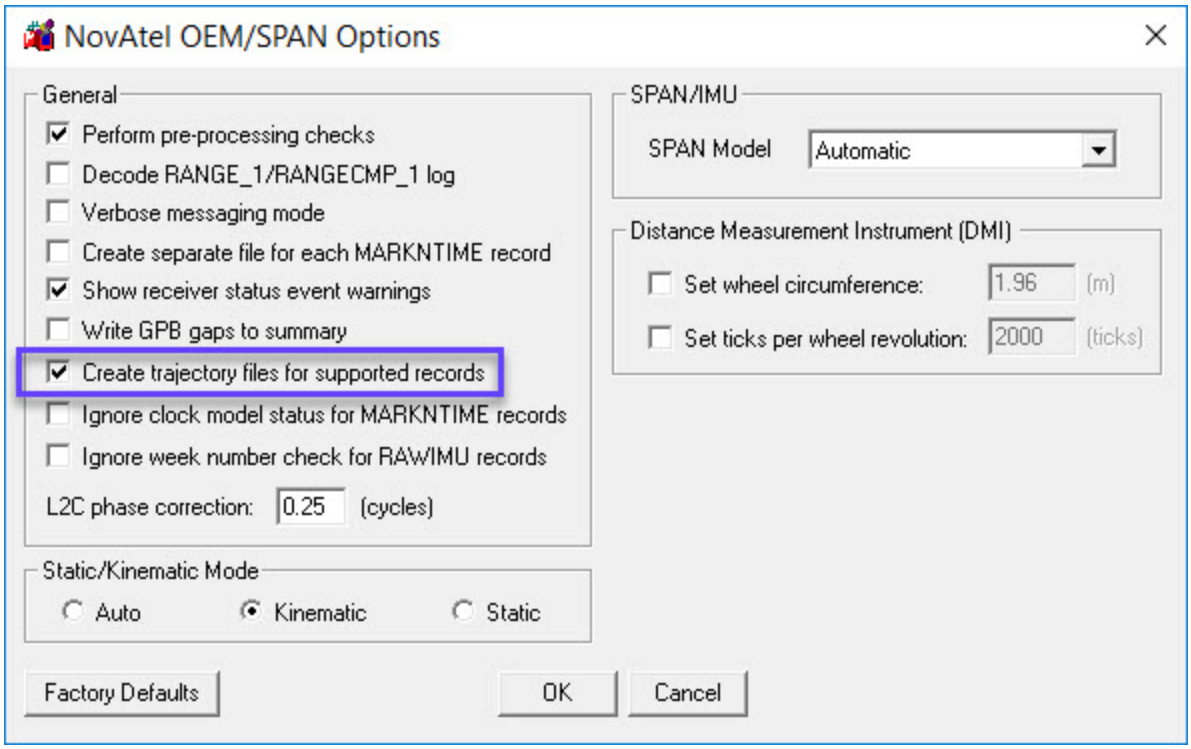
Data conversion can be done with Convert Raw GNSS data to GPB Utility. Use the *Get Folder* button to browse to the folder containing the raw GNSS data, and then use the *Auto Add All* feature to add all raw GNSS data, including NovAtel data, for conversion. *Auto Add All* searches for any supported GNSS manufacturer data within the current folder. *Auto Add Recursively* searches the current folder and all sub-folders.

Figure 1: GNSS Raw Data Converter Utility – Auto-detect the NovAtel OEM7 / SPAN Receiver Type



A number of logs, specified in the Recommended Logs list, are used to generate real time trajectory files during data conversion. After the raw data file is added, click the *Options* button, and select the *Create trajectory files for supported records* option. After the data has been converted, the trajectory files can be loaded and viewed in Inertial Explorer, to compare against the post-processed solutions.

Figure 2: GNSS Raw Data Converter Utility - Generate real time trajectory files during data conversion



1.3.3 Data Files

Depending on the type of data logged, a number of file types will be generated and saved in the same directory as the original raw data file. As shown in *Figure 3: Files generated after raw data conversion of this example data set* below the following figure, the data used in this example generated the *.epp, *.gpb, *.hmr, *.imr, *.sta and real time trajectory files (*.fp and *.ft). *Table 2: All possible file types generated from data conversion* on the next page lists all of the files which can be produced upon data conversion; not all data sets will contain the relevant data to produce all of these files. When the GPB file is loaded into the project as a Rover or Master, the other file types are also added.

Figure 3: Files generated after raw data conversion of this example data set

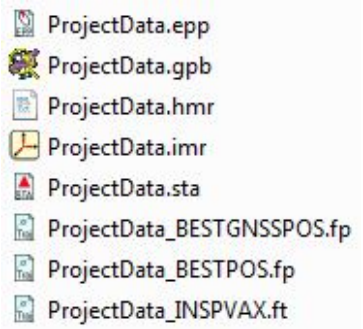


Table 2: All possible file types generated from data conversion

File Type	Type of Data
DMR	DMI data
EPP	GNSS ephemeris records
FP, FT	Real-time trajectory files
GPB	Raw GNSS data
HMR	Heading data
IMR	IMU data
MMR	Mount data
STA	Camera marks, antenna profile, station names

1.3.4 Auto-Fill Set Up Parameters

With this data logged, converted, and added to the project, users can then auto-fill a variety of parameters in the Processing Settings. The following figures show the parameters filled using the logs recorded in the example data collection.

Figure 4: When adding a remote or base station file, the Antenna Profile will be auto-filled using information from the THISANTENNATYPEB log, read in from the STA file

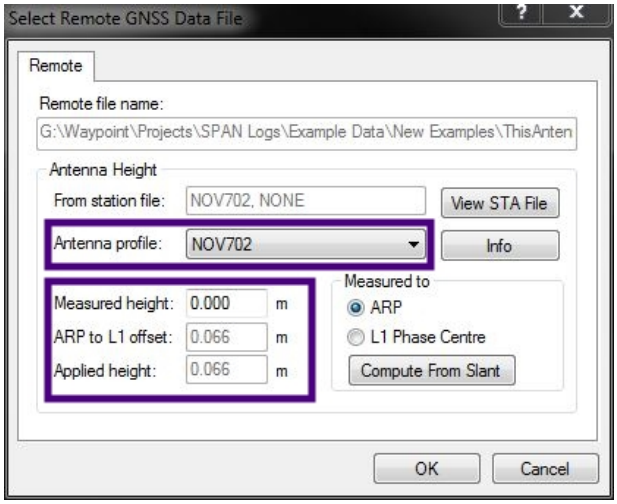


Figure 5: The Lever Arm and IMU rotation will be auto-filled from the IMR file

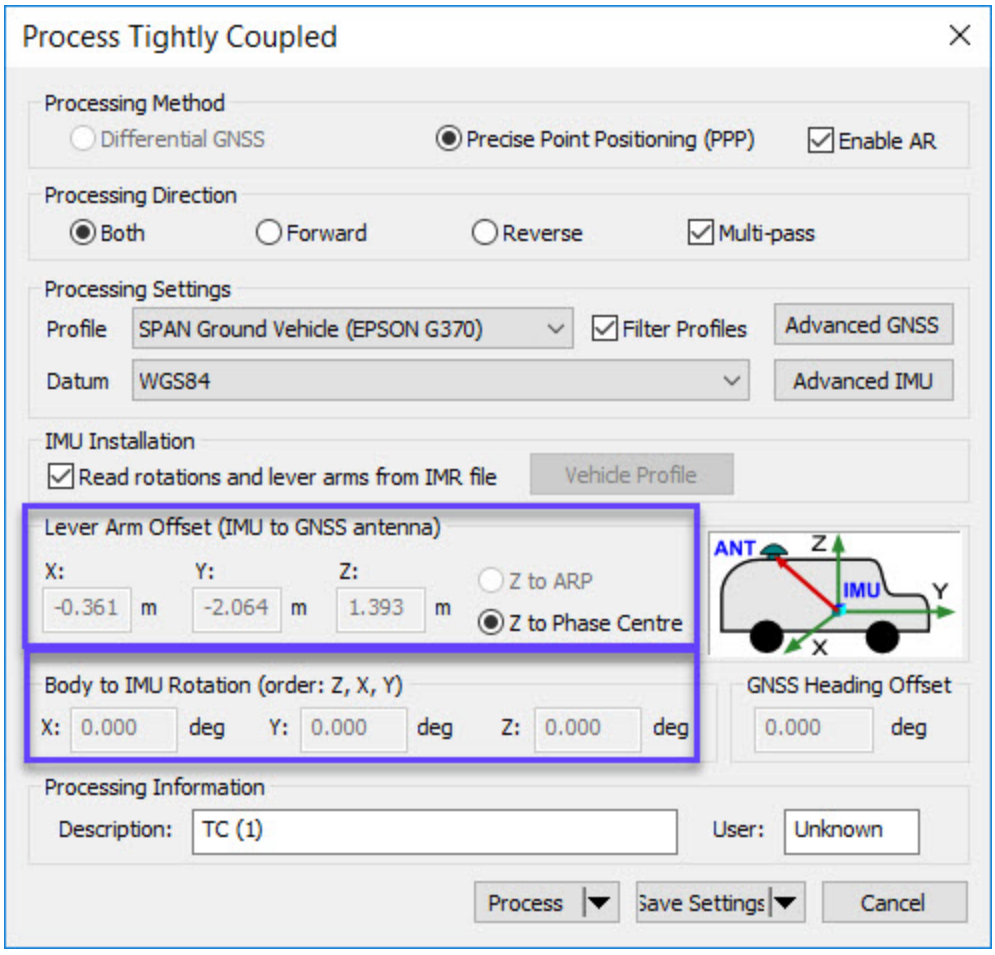
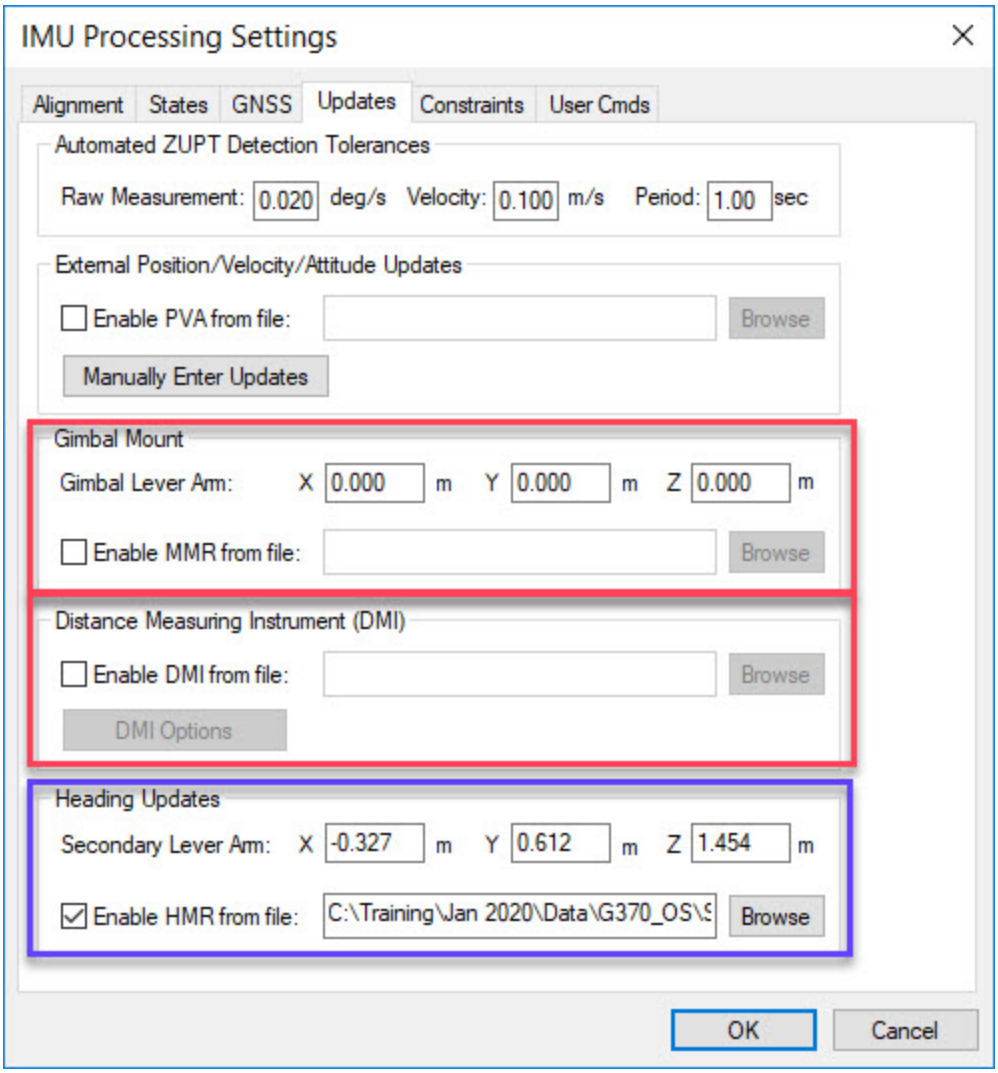


Figure 6: Heading parameters are auto-filled from the HMR file. The Gimbal Mount and Distance Measuring Instrument values are auto-filled when MMR and DMI files, respectively, are added to the project



1.4 Additional Information

1.4.1 OEM User Manuals

Further details on the logs and commands outlined in this document can be found in the NovAtel OEM User Manuals.

1.4.1.1 OEM6:

SPAN on OEM6 Firmware Reference Manual:

https://hexagondownloads.blob.core.windows.net/public/Novatel/assets/Documents/Manuals/OM-20000144UM/OM-20000144UM.pdf

OEM6 Family Firmware Reference Manual:

https://hexagondownloads.blob.core.windows.net/public/Novatel/assets/Documents/Manuals/om-20000129/om-20000129.pdf

1.4.1.2 OEM7:

OEM7 Receiver Documentation Portal:

docs.novatel.com/OEM7

1.4.2 Waypoint Product Manuals:

Detailed instructions on using Inertial Explorer can be found in the Waypoint User Documentation Portal:

docs.novatel.com/Waypoint

1.4.3 Support:

To search for more information or submit a support case, please visit NovAtel's support page: www.novatel.com/support