OEM6 to OEM7
Integration Guide

OEM6 to OEM7 Integration Guide

Publication Number: D100401

Revision Level: v1B

Revision Date: November 2024

Firmware Version: 7.09.02 / OM7MR0902RN0000

Proprietary Notice

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Customer Support

NovAtel Knowledge Base

If you have a technical issue, visit the NovAtel Support page at novatel.com/support. Through the *Support* page you can contact Customer Support, find papers and tutorials or download the latest firmware. To access the latest user documentation, visit docs.novatel.com/OEM7.

Before Contacting Customer Support

Before contacting NovAtel Customer Support about a software problem, perform the following steps:

If logging data over an RS-232 serial cable, ensure that the configured baud rate can support the data bandwidth (see **SERIALCONFIG** command). NovAtel recommends a minimum suggested baud rate of 230400 bps.

1. Use the information in the **Troubleshooting** section to diagnose and troubleshoot your receiver's symptoms. Refer to the OEM7 Documentation Portal (docs.novatel.com/OEM7/Content/Troubleshooting/Troubleshooting.htm).
2. Log the data suggested in the appropriate *Troubleshooting Logs* section to a file on your computer for 15 minutes.
   - *General Troubleshooting Logs* on the next page
   - *Tracking and Interference Troubleshooting Logs* on the next page
   - *SPAN Troubleshooting Logs* on page 13
   - *RTK Troubleshooting Logs* on page 13
   - *PPP Troubleshooting Logs* on page 14
   - *ALIGN Troubleshooting Logs* on page 15

   If using NovAtel Application Suite, log the Troubleshooting message set for 15 minutes.
3. Send the data file to NovAtel Customer Support: support.novatel@hexagon.com
4. You can also issue a **FRESET** command to the receiver to clear any unknown settings.

The **FRESET** command will erase all user settings. You should know your configuration (by requesting the RXCONFIGA log) and be able to reconfigure the receiver before you send the **FRESET** command.

If you are having a hardware problem, send a list of the troubleshooting steps taken and the results.

Contact Information

Log a support request with NovAtel Customer Support using one of the following methods:

Log a Case and Search Knowledge:

Website: novatel.com/support

Log a Case, Search Knowledge and View Your Case History: (login access required)

Web Portal: shop.novatel.com/novatelstore/s/login/

E-mail:

support.novatel@hexagon.com

Telephone:

U.S. and Canada: 1-800-NOVATEL (1-800-668-2835)

International: +1-403-295-4900

General Troubleshooting Logs

```
LOG RXSTATUSB ONCHANGED
LOG RAWEPHEMB ONNEW
LOG GLORAWEPHEMB ONNEW
LOG BESTPOSB ONTIME 1
LOG RANGEB ONTIME 0.5
LOG RXCONFIGA ONCE
LOG VERSIONA ONCE
LOG LOGLISTA ONCE
LOG PORTSTATSA ONTIME 10
LOG PROFILEINFOA ONCE
LOG HWMONITORA ONTIME 10
```

Tracking and Interference Troubleshooting Logs

```
LOG VERSIONA ONCE
LOG RXCONFIGA ONCE
LOG CHANCONFIGLISTB ONCE
LOG PASSTHROUGHA ONNEW
LOG RXSTATUSB ONCHANGED
LOG CLOCKSTEERINGB ONCHANGED
LOG RAWEPHEMB ONNEW
LOG GLORAWEPHEMB ONNEW
LOG GALINAVRAWEPHEMERISB ONNEW
LOG BDSEPHEMERISB ONNEW
LOG QZSSEPHEMERISB ONNEW
LOG NAVICEPHEMERISB ONNEW
LOG RAWALMB ONNEW
LOG GLORAWALMB ONNEW
LOG GALALMANACB ONNEW
LOG BDSALMANACB ONNEW
LOG QZSSALMANACB ONNEW
LOG NAVICALMANACB ONNEW
LOG IONUTCB ONNEW
LOG GLOCLOCKB ONNEW
LOG GALCLOCKB ONNEW
LOG BDSCLOCKB ONNEW
LOG TRACKSTATB ONTIME 1
LOG RANGEB ONTIME 0.5
LOG BESTPOSB ONTIME 1
LOG SATVIS2B ONTIME 30
LOG ITDETECTSTATUSB ONCHANGED
```

For dual antenna receivers, add these logs:

```
LOG TRACKSTATB_1 ONTIME 1
LOG RANGEB_1 ONTIME 0.5
```

For interference issues add this log:

```
LOG ITPSDDETECTB ONNEW
```

For interference issues, when you have enough datalink bandwidth to handle large logs, add this log:

```
LOG ITPSDFINALB ONNEW
```

SPAN Troubleshooting Logs

```
LOG RXSTATUSB ONCHANGED
LOG RAWEPHEMB ONNEW
LOG GLORAWEPHEMB ONNEW
LOG GALINAVRAWEPHEMERISB ONNEW
LOG BDSEPHEMERISB ONNEW
LOG BESTPOSB ONTIME 1
LOG RANGEB ONTIME 0.5
LOG RXCONFIGA ONCE
LOG VERSIONA ONCE
LOG RAWIMUSXB ONNEW
LOG INSUPDATESTATUSB ONCHANGED
LOG INSPVAXB ONTIME 1
LOG INSCONFIGA ONCHANGED
LOG BESTGNSSPOSB ONTIME 1
```

RTK Troubleshooting Logs

```
LOG RXSTATUSB ONCHANGED
LOG RAWEPHEMB ONNEW
LOG GLORAWEPHEMB ONNEW
LOG QZSSRAWEPHEMB ONNEW
LOG BDSRAWNAVSUBFRAMEB ONNEW
LOG GALFNAVRAWEPHEMERISB ONNEW
LOG GALINAVRAWEPHEMERISB ONNEW
LOG RANGEB ONTIME 0.5
LOG BESTPOSB ONTIME 1.0
LOG RXCONFIGB ONCE
LOG VERSIONB ONCE
LOG TRACKSTATB ONTIME 1.0
LOG RTKPOSB ONTIME 1.0
LOG MATCHEDPOSB ONNEW
LOG MATCHEDSATSB ONNEW
LOG RTKSATSB ONTIME 1.0
LOG PSRPOSB ONTIME 1.0
LOG RAWALMB ONNEW
LOG IONUTCB ONNEW
LOG GLORAWALMB ONNEW
LOG GLOCLOCKB ONNEW
LOG PASSTHROUGHB ONNEW
LOG CLOCKMODELB ONTIME 1.0
LOG REFSTATIONB ONNEW
LOG RTKVELB ONTIME 1.0
```

PPP Troubleshooting Logs

```
LOG RXSTATUSB ONCHANGED
LOG GPSEPHEMB ONNEW
LOG GLOEPHEMERISB ONNEW
LOG QZSSEPHEMERISB ONNEW
LOG BDSEPHEMERISB ONNEW
LOG BDSBCNAV1EPHEMERISB ONNEW (firmware versions 7.08.03 and 7.08.10 and later)
LOG BDSBCNAV2EPHEMERISB ONNEW (firmware versions 7.08.03 and 7.08.10 and later)
LOG BDSBCNAV3EPHEMERISB ONNEW (firmware versions 7.08.03 and 7.08.10 and later)
LOG GALFNAVEPHEMERISB ONNEW
LOG GALINAVEPHEMERISB ONNEW
LOG RANGEB ONTIME 0.5
LOG BESTPOSB ONTIME 1.0
LOG RXCONFIGB ONCE
LOG VERSIONB ONCE
LOG TRACKSTATB ONTIME 10.0
LOG LBANDTRACKSTATB ONTIME 1.0
LOG PPPPOSB ONTIME 1.0
LOG PPPSATSB ONTIME 1.0
LOG TERRASTARINFOB ONCHANGED
LOG TERRASTARSTATUSB ONCHANGED
LOG PSRPOSB ONTIME 1.0
LOG ALMANACB ONNEW
LOG GLOALMANACB ONNEW
LOG GALALMANACB ONNEW
LOG BDSALMANACB ONNEW
LOG QZSSALMANACB ONNEW
LOG IONUTCB ONNEW
LOG GLOCLOCKB ONNEW
LOG LBANDBEAMTABLEB ONCHANGED
```

ALIGN Troubleshooting Logs

```
LOG RXSTATUSB ONCHANGED
LOG RAWEPHEMB ONNEW
LOG GLORAWEPHEMB ONNEW
LOG GALINAVRAWEPHEMERISB ONNEW
LOG BDSEPHEMERISB ONNEW
LOG BESTPOSB ONTIME 1
LOG RANGEB ONTIME 0.5
LOG RXCONFIGA ONCE
LOG VERSIONA ONCE
LOG LOGLISTA ONCE
LOG PORTSTATSA ONTIME 10
LOG ALIGNBSLNENUB ONNEW
LOG ALIGNBSLNXYZB ONNEW
LOG ALIGNDOPB ONNEW
LOG HEADING2B ONNEW
LOG MASTERPOSB ONNEW
```

`LOG ROVERPOSB ONNEW` (This log can only be output on a receiver where ALIGN is enabled.)

`LOG HEADINGSATSA ONNEW` (This log can only be output on a receiver where ALIGN is enabled and configured as the ALIGN rover.)

`LOG DUALANTENNAHEADINGB ONTIME 1.0`

`LOG TRACKSTATB_1 ONTIME 1` (dual antenna receivers only)

`LOG RANGEB_1 ONTIME 0.5` (dual antenna receivers only)

Chapter 1 OEM6 to OEM7 Integration

When upgrading from an OEM6 receiver to an OEM7 receiver, there are several hardware and software differences that must be accounted for in the system design.

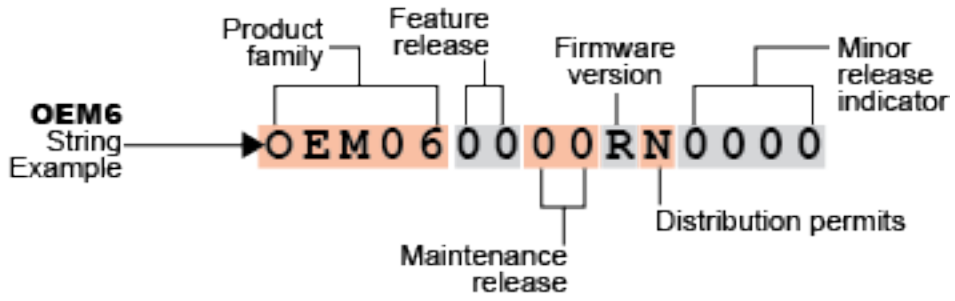
These differences are described in the following chapters:

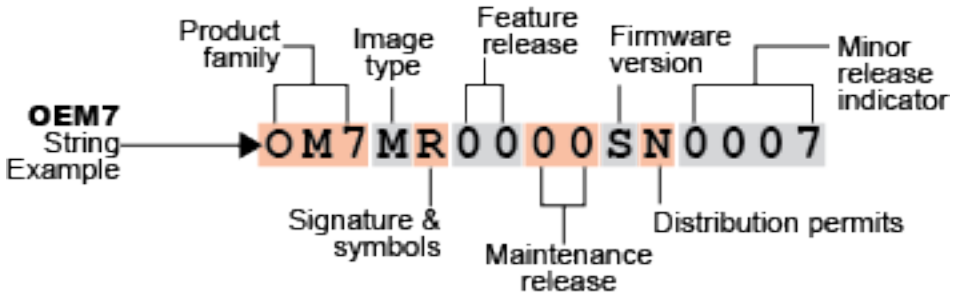
- *New for OEM7 – Firmware* on page 17
- *OEM6 to OEM7 – Hardware* on page 165
- *Receiver Technical Specifications* on page 187

Chapter 2 New for OEM7 – Firmware

This chapter describes the new commands, logs, features and functionality available on OEM7 receivers.

2.1 Firmware Version Naming





For information about the fields in the firmware version, refer to the **VERSION** log.

2.2 OEM6 to OEM7 – Commands

The following sections describe the command changes between OEM6 and OEM7.

2.2.1 Deleted Commands

The following table lists the OEM6 commands that have been deleted or replaced in OEM7.

Table 1: Deleted and Replaced Commands in OEM7

OEM6	OEM7
APPLYVEHICLEBODYROTATION	Deleted.
ASSIGNLBAND	Replaced. Use the existing **ASSIGNLBANDBEAM** command
ASSIGNLBAND2	Replaced. Use the existing **ASSIGNLBANDBEAM** command
BASEANTENNAMODEL	Replaced. Use the existing **BASEANTENNAPCO** command and **BASEANTENNAPCV** command
COM	Replaced. Use the existing **SERIALCONFIG** command

OEM6	OEM7
COMCONFIG	Replaced. Use the existing **SERIALCONFIG** command, **INTERFACEMODE** command and **ECHO** command
DGPSEPHEMDELAY	Deleted.
EXTHDGOFFSET	Replaced. Use the new **SETINSROTATION** command (see page 74)
GIMBALSPANROTATION	Replaced. Use the new **SETINSROTATION** command (see page 74)
INSWHEELUPDATE	Replaced. Use the existing **SETINSUPDATE** command
INSZUPTCONTROL	Replaced. Use the existing **SETINSUPDATE** command
LEVERARMCALIBRATE	Replaced. Use the new **INSCALIBRATE** command (see page 39)
OMNIUSEGLONASS	Deleted.
PDPVELOCITYOUT	Replaced. Use the existing **BESTVELTYPE** command
RTKCOMMAND	Deleted.
RTKELEVMASK	Deleted.
RVBCALIBRATE	Replaced. Use the new **INSCALIBRATE** command (see page 39)
SETCANNAME	Deleted.
SETGIMBALORIENTATION	Replaced. Use the new **SETINSROTATION** command (see page 74)
SETIMUORIENTATION	Replaced. Use the new **SETINSROTATION** command (see page 74)
SETIMUTOANTOFFSET	Replaced. Use the new **SETINSTRANSLATION** command (see page 77)
SETIMUTOANTOFFSET2	Replaced. Use the new **SETINSTRANSLATION** command (see page 77)
SETIMUTOEXTOFFSET	Replaced. Use the new **SETINSTRANSLATION** command (see page 77)
SETIMUTOGIMBALOFFSET	Replaced. Use the new **SETINSTRANSLATION** command (see page 77)
SETINSOFFSET	Replaced. Use the new **SETINSTRANSLATION** command (see page 77)
SETINITATTITUDE	Replaced. Use the existing **SETINITAZIMUTH** command
SETINSOFFSETS	Replaced. Use the new **SETINSROTATION** command on page 74 and **SETINSTRANSLATION** command on page 77
SETINSROTATION	Replaced. The existing SETINSROTATION command (Message ID 1796) has removed. A new **SETINSROTATION** command (see page 74) (Message ID 1921) has been added. This new command has enhanced capability and is the recommend command to use.
SETMARK1OFFSET SETMARK2OFFSET SETMARK3OFFSET SETMARK4OFFSET	Replaced. Use the new **SETINSROTATION** command on page 74 and **SETINSTRANSLATION** command on page 77

OEM6	OEM7
SETRTCM16	Deleted.
SETRTCM36	Deleted.
SETRTCMRXVERSION	Deleted.
SETRTCMTXVERSION	Deleted.
SETWHEELSOURCE	Deleted.
VEHICLEBODYROTATION	Replaced. Use the new **SETINSROTATION** command (see page 74)

2.2.2 Revised Commands

Revised commands are listed in the following table.

Table 2: Revised Commands in OEM7

OEM6	OEM7
ANTENNAPOWER	3V3 option removed If a short circuit or other problem causes an overload of the current supplied to the antenna, the receiver hardware shuts down the power supplied to the antenna. To restore power, power cycle the receiver. The Receiver Status word, available in the **RXSTATUS** log (see page 139), provides more information about the cause of the problem.
ASSIGN, ASSIGNALL, LOCKOUT, SBASCONTROL, TRACKSV, UNLOCKOUT	The OEM7 tracks SBAS PRNs 120-158 and 183-187. The OEM6 tracked 120-138 and 183-187
ASSIGNLBANDBEAM	This command now supports multiple L-Band channels. The Frequency field is entered only in Hz.

<table>
<tr><th>OEM6</th><th>OEM7</th></tr>
<tr><td>AUTH</td><td>New options were added for the State parameter

<table><tr><th>ASCII</th><th>Binary</th><th>Description</th></tr><tr><td>ERASE_ TABLE</td><td>7</td><td>Erase all auth codes from the system. Requires a special auth code to prevent against accidental erasing</td></tr><tr><td>CLEAN_ TABLE</td><td>8</td><td>Remove all invalid auth codes from the system</td></tr></table>
Special auth code for the ERASE_TABLE case:
PW5W2B,WW5TM9,WW2PCZ,WW3M4H,WW4HPG,ERASE_AUTH

Special auth code for the CLEAN_TABLE case:
4DR69H,G369W8,34MNJJ,5NHXCJ,GW7C75,CLEAN_AUTH</td></tr>
<tr><td>COMCONTROL</td><td>The COM ports available have changed to reflect the OEM7 receivers.

See the COMCONTROL command on page 27</td></tr>
<tr><td>CONNECTIMU</td><td>Added the EPSON G320N IMU.

Removed the Litef LCI-1 IMU.

For the IMU Type parameter, the ASCII values for IMU no longer use the "IMU_" prefix. However, the legacy ASCII values that contain the "IMU_" prefix are still supported. The binary IMU type values have not changed.

See the CONNECTIMU command on page 30</td></tr>
<tr><td>ETHCONFIG</td><td>Ethernet interface hardware now automatically connects properly to the other physical device</td></tr>
<tr><td>EXTERNALPVAS</td><td>The format of several of the options in this command have been changed from Double to Float.
See the EXTERNALPVAS command on page 33</td></tr>
<tr><td>FRESET</td><td>Added new FRESET targets.

<table><tr><th>Binary</th><th>ASCII</th><th>Description</th></tr><tr><td>10</td><td>USERDATA</td><td>Resets the user data saved using the NVMUSERDATA command (see page 62)</td></tr></table></td></tr>
<tr><td>INTERFACEMODE</td><td>Added new Interface Mode options:

<table><tr><th>Binary</th><th>ASCII</th><th>Description</th></tr><tr><td>49</td><td>NOVATELMINBINARY</td><td>NovAtel binary message with a minimal header.
Only available for CCOM ports.</td></tr></table></td></tr>
</table>

OEM6	OEM7
LOG	The optional parameters Period, Offset and Hold are only used when the Trigger is ONTIME. Previous versions of the firmware accepted (but ignored) non-zero values for Period and Offset even if the Trigger was not ONTIME. The firmware on OEM7 receivers will reject such commands and return an error. It is especially important that these values are zero when entering a LOG command in Binary or ASCII format.
POSAVE	“state” field no longer optional; default ON. A value must now be entered
SETINITAZIMUTH	The range for the standard deviation parameter has changed to 1 to 25 degrees.

2.2.3 New Commands

The following table lists the commands added in OEM7.

Table 3: New Commands in OEM7

OEM7	Description
CANCONFIG	Configures the CAN port parameters See the **CANCONFIG** command on page 23
CCOMCONFIG	Binds a CAN port to a J1939 node configures the CAN protocol used by the port. See the **CCOMCONFIG** command on page 25
FORCEGALE6CODE	Forces Galileo E6 channels to track E6B or E6C See the **FORCEGALE6CODE** command on page 38
INSCALIBRATE	Initiates the calibration of INS offsets See the **INSCALIBRATE** command on page 39
INSSEED	Enables or disables saving and restoring the last known SPAN solution See the **INSSEED** command on page 42
ITBANDPASSCONFIG	Configures a bandpass filter on the receiver See the **ITBANDPASSCONFIG** command on page 44
ITDETECTCONFIG	Enables interference detection See the **ITDETECTCONFIG** command on page 46
ITFRONTENDMODE	Configures the front end mode for each RF path See the **ITFRONTENDMODE** command on page 48
ITPROGFILTCONFIG	Configures filtering on the receiver See the **ITPROGFILTCONFIG** command on page 51
ITSPECTRALANALYSIS	Enables and configures spectral analysis on the receiver See the **ITSPECTRALANALYSIS** command on page 53

OEM7	Description
J1939CONFIG	Configures the CAN J1939 network-level parameters See the **J1939CONFIG** command on page 57
NMEAFORMAT	Customizes the NMEA output See the **NMEAFORMAT** command on page 59
NVMUSERDATA	Writes the data provided to NVM See the **NVMUSERDATA** command on page 62
PPPBASICCONVERGEDCRITERIA	Sets the convergence threshold for lower accuracy PPP solutions. See the **PPPBASICCONVERGEDCRITERIA** command on page 63
PPPDYNAMICSEED	Seed the PPP filter in any platform motion state See the **PPPDYNAMICSEED** command on page 64
PPPRESET	Resets the PPP filter. See the **PPPRESET** command on page 66
REFERENCESTATIONTIMEOUT	Sets a timeout for removing previously stored base stations See the **REFERENCESTATIONTIMEOUT** command on page 67
RFINPUTGAIN	Selects the mode of setting the CAG for the purpose of interference detection. See the **RFINPUTGAIN** command on page 68
RTKPORTMODE	Assigns a port on the rover receiver for the RTK and ALIGN information being received See the **RTKPORTMODE** command on page 70
RTKRESET	Resets the RTK filter. See the **RTKRESET** command on page 72
SETINSPROFILE	Set the filter behavior to optimize the output for a specific environment See the **SETINSPROFILE** command on page 73
SETINSROTATION	Specifies the rotational offsets between the IMU frame and other reference frames, such as the vehicle frame or an ALIGN baseline see the **SETINSROTATION** command on page 74
SETINSTRANSLATION	Specifies the translational offsets between the IMU frame and other reference frames, including GNSS antennas or the desired output frame See the **SETINSTRANSLATION** command on page 77

2.2.4 CANCONFIG

Configure CAN ports

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

Use the CANCONFIG command to configure the hardware parameters of the CAN ports.

Message ID: 884

Abbreviated ASCII Syntax:

```
CANCONFIG port switch [speed]
```

Factory Default:

```
CANCONFIG CAN1 OFF 250K
CANCONFIG CAN2 OFF 250K
```

ASCII Example:

```
CANCONFIG CAN1 OFF 500K
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	CANCONFIG header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	port	CAN1	1	Physical CAN port ID **Note**: The SMART2 supports the CAN1 port only. **Note**: The OEM7500 supports the CAN1 port only (firmware version 7.07.03 and later). With firmware versions earlier than 7.07.03, the OEM7500 supports the CAN2 port only.	Enum	4	H
		CAN2	2				
3	switch	ON	1	Sets the port to be On or Off the CAN bus	Enum	4	H+4
		OFF	0				
4	speed	See *Table 4: CAN Port Speed* on the next page		Physical CAN port speed (bits per second) (default = 250K	Enum	4	H+8

The CAN port must be set to OFF (using `CANCONFIG <port> OFF`) before the port speed can be changed.

Table 4: CAN Port Speed

ASCII Value	Binary Value
10K	0
20K	1
50K	2
100K	3
125K	4
250K	5
500K	6
1M	7

2.2.5 CCOMCONFIG

Configure the CAN COM port

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

Bind a CAN communication port to a J1939 node (see **J1939CONFIG** command on page 57) and specify the CAN protocol, PGN, priority and address for messages transmitted and received over the CCOM port.

The SMART2 requires a "-C" model to use this command.

Message ID: 1902

Abbreviated ASCII Syntax:

```
CCOMCONFIG port node protocol [pgn [priority [address]]]
```

Factory Default:

```
CCOMCONFIG ccom1 node1 J1939 61184 7 fe
CCOMCONFIG ccom2 node2 J1939 61184 7 fe
CCOMCONFIG ccom3 node1 J1939 126720 7 fe
CCOMCONFIG ccom4 none none 0 0 0
CCOMCONFIG ccom5 none none 0 0 0
CCOMCONFIG ccom6 none none 0 0 0
```

ASCII Example :

```
ccomconfig ccom1 node1 j1939 1792 6 1b
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	CCOMCONFIG header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	port	CCOM1	38	Name of CCOM port.	Enum	4	H
		CCOM2	39				
		CCOM3	40				
		CCOM4	41				
		CCOM5	42				
		CCOM6	43				

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
3	node	NODE1	1	The J1939 node to use. This binds a CCOM port to the CAN NAME/address associated with the node.	Enum	4	H+4
		NODE2	2				
4	protocol	See *Table 5: CAN Protocol* below		CAN transport protocol to use.	Enum	4	H+8
5	pgn	0 - 131071		Any valid PGN as defined by the J1939 protocol. All messages transmitted over this CCOM port will contain this PGN value. Only messages with this PGN will be received on this CCOM port. **Note**: This value is ignored if the protocol is NMEA2000.	Ulong	4	H+12
6	priority	0-7		Default CAN message priority for transmitted messages. (Priority 0 is the highest priority) **Note**: This value is ignored if the protocol is NMEA2000.	Uchar	1	H+16
7	address	00 – FF		**00 – FD**: Transmit and receive messages to/from this address only. **FE**: Transmit and receive message to/from the address of the first message received. **FF**: Broadcast messages and receive messages from all addresses. **Note**: This value is ignored if the protocol is NMEA2000.	Hex	1	H+17

Table 5: CAN Protocol

Binary	ASCII	Description
2	J1939	J1939 single packet
3	NMEA2000	NMEA2000 (single packet, multi-packet, fast packet)
5	ISO11783	ISO 11783 transport protocol

2.2.6 COMCONTROL

Controls the serial port hardware control lines

Platform: OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720

This command is typically used to control the hardware RTS control line of the serial communication (COM) ports; or, for SPAN applications, to output a 1PPS timing signal on a COM TX port. The TOGGLEPPS mode of this command is typically used to supply a timing signal to a host PC computer by using the RTS line. The PULSEPPSHIGH mode of this command is typically used to supply the timing pulse for SPAN applications by using the TX line. The accuracy of controlling the COM control signals is better than 900 µs. The other modes are typically used to control custom peripheral devices.

1. If handshaking is disabled, any of these modes can be used without affecting regular serial communications through the selected COM port. However, if handshaking is enabled, it may conflict with handshaking of the selected COM port, causing unexpected results.
2. To use the COM2 flow control signals, COM5 must be disabled. See OEM7600, OEM7700 and OEM7720 Multiplexed Port in the OEM7 Installation and Operation User Manual for more information.

Message ID: 431

Abbreviated ASCII Syntax:

```
COMCONTROL [port] [signal] [control]
```

Factory Default:

```
COMCONTROL COM1 TX DEFAULT
COMCONTROL COM2 TX DEFAULT
COMCONTROL COM3 TX DEFAULT
COMCONTROL COM4 TX DEFAULT
COMCONTROL COM5 TX DEFAULT
```

ASCII Example 1:

```
INTERFACEMODE COM5 NONE NONE OFF (OEM7600, OEM7700 and OEM7720 only)
SERIALCONFIG COM2 9600 N 8 1 CTS (to enable handshaking)
COMCONTROL COM2 RTS FORCELOW
```

ASCII Example 2:

To set a break condition on COM1:

```
COMCONTROL COM1 TX FORCEHIGH
```

A break condition remains in effect until it is cleared. To clear a break condition on COM1:

```
COMCONTROL COM1 TX DEFAULT
```

or

```
COMCONTROL COM1 TX FORCELOW
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	COMCONTROL header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	port	COM1	1	Serial port to control.	Enum	4	H
		COM2	2				
		COM3	3				
		COM4	19				
		COM5	31				
3	signal	RTS	0	COM signal to control. The controllable COM signals are RTS and TX.	Enum	4	H+4
		TX	2				
4	control	See *Table 6: Control Options* below		Control applied to the signal	Enum	4	H+8

Table 6: Control Options

Binary	ASCII	Description
0	DEFAULT	Disables this command and returns the COM signal to its default state
1	FORCEHIGH	Immediately forces the signal high[1]
2	FORCELOW	Immediately forces the signal low[2]
3	TOGGLE	Immediately toggles the current state of the signal
4	TOGGLEPPS	Toggles the state of the selected signal within 900 µs after each 1PPS event. The state change of the signal lags the 1PPS by an average value of 450 µs. The delay of each pulse varies by a uniformly random amount less than 900 µs
5	PULSEPPSLOW	Pulses the line low at a 1PPS event and to high 1 ms after it.
6	PULSEPPSHIGH	Pulses the line high for 1 ms at the time of a 1PPS event

[1]High on RS232; Low on UART

[2]Low on RS232; High on UART

Table 7: Port, Signal and Control Availability on OEM7 Receivers

	OEM719	OEM729	OEM7600	OEM7700	OEM7720
COM1 TX	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH
COM2 TX	N/A	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH
COM2 RTS	N/A	DEFAULT FORCEHIGH FORCELOW TOGGLE TOGGLEPPS PULSEPPSLOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW TOGGLE TOGGLEPPS PULSEPPSLOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW TOGGLE TOGGLEPPS PULSEPPSLOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW TOGGLE TOGGLEPPS PULSEPPSLOW PULSEPPSHIGH
COM3 TX	N/A	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH
COM4 TX	N/A	N/A	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH
COM5 TX	N/A	N/A	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH	DEFAULT FORCEHIGH FORCELOW PULSEPPSHIGH

2.2.7 CONNECTIMU

Connects an IMU to a Port

Platform: OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7

Use this command to specify the type of IMU connected to the receiver and the receiver port used by the IMU.

Message ID: 1428

Abbreviated ASCII Syntax:

```
CONNECTIMU IMUPort IMUType
```

Abbreviated ASCII Example:

```
CONNECTIMU COM2 LN200
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	Command header	-	-	CONNECTIMU header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	IMUPort	COM1	1	IMU Port is COM port 1	Enum	4	H
		COM2	2	IMU Port is COM port 2			
		COM3	3	IMU Port is COM port 3			
		SPI	7	IMU Port is the SPI port			
		COM4	19	IMU Port is COM port 4			
		COM5	31	IMU Port is COM port 5			
3	IMUType	See *Table 8: IMU Type* on the next page		IMU Type	Enum	4	H+4

SPI is available only on the OEM7500, OEM7600, OEM7700, and OEM7720.

COM4 and COM5 are available only on the OEM7600, OEM7700 and OEM7720.

For the **CONNECTIMU** command, COM2 is available only on the OEM719 with hardware revisions 1.04 and earlier. For the OEM719, it is recommended to use COM1 to connect to an IMU.

The IMU-ISA-100C, IMU-FSAS, IMU-HG1900, IMU-LN200, IMU-LN200C, IMU-µIMU-IC, IMU-CPT, IMU-P1750, IMU-KVH1750 and OEM-IMU-µIMU-IC-UART use RS-422 protocol and must be connected to a receiver port that is configured to use RS-422. Refer to the OEM7 Installation and Operation User Manual or PwrPak7 Installation and Operation User Manual for information about which receiver ports support RS-422 and instructions for enabling RS-422.

Table 8: IMU Type

Binary	ASCII	IMU Name	Description
0	UNKNOWN		Unknown IMU type (default)
1	HG1700_AG11		Honeywell HG1700 AG11
4	HG1700_AG17		Honeywell HG1700 AG17
5	HG1900_CA29		Honeywell HG1900 CA29
8	LN200	IMU-LN200 IMU-LN200C UIMU-LN200	Northrop Grumman LN200/LN200C
11	HG1700_AG58	UIMU-HG1700-AG58	Honeywell HG1700 AG58
12	HG1700_AG62	UIMU-HG1700-AG62	Honeywell HG1700 AG62
13	IMAR_FSAS	IMU-FSAS	iMAR iIMU-FSAS
16	KVH_COTS	IMU-CPT	KVH CPT IMU
20	HG1930_AA99	OEM-HG1930	Honeywell HG1930 AA99
26	ISA100C	IMU-ISA-100C OEM-IMU-ISA-100C	Northrop Grumman Litef ISA-100C
27	HG1900_CA50	IMU-HG1900 OEM-HG1900	Honeywell HG1900 CA50
28	HG1930_CA50	OEM-HG1930	Honeywell HG1930 CA50
31	ADIS16488	IMU-IGM-A1 OEM-IMU-ADIS-16488	Analog Devices ADIS16488
32	STIM300	IMU-IGM-S1 OEM-IMU-STIM300	Sensonor STIM300
33	KVH_1750	IMU-KVH1750 IMU-P1750	KVH 1750 IMU KVH P-1750 IMU
41	EPSON_G320	OEM-IMU-EG320N	Epson G320N
52	LITEF_MICROIMU	IMU-µIMU-IC OEM-IMU-µIMU-IC	Northrop Grumman Litef µIMU-IC
56	STIM300D	OEM-IMU-STIM300D	Sensonor STIM300, Direct Connection
58	HG4930_AN01	OEM-IMU-HG4930	Honeywell HG4930 AN01

Binary	ASCII	IMU Name	Description
61	EPSON_G370	OEM-IMU-EG370N	Epson G370N
62	EPSON_G320_200HZ	OEM-IMU-EG320N (200 Hz)	Epson G320N – 200 Hz
68	HG4930_AN04	OEM-IMU-HG4930	Honeywell HG4930 AN04 – 100 Hz
69	HG4930_AN04_400HZ	OEM-IMU-HG4930 (400 Hz)	Honeywell HG4930 AN04 – 400 Hz
71	LITEF_MICROIMUD_ 400HZ	OEM-IMU-µIMU-IC-UART	Northrop Grumman Litef µIMU-IC-UART – 400 Hz

2.2.8 EXTERNALPVAS

Enter PVA Update

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7-S**

This command should only be used by advanced users of GNSS+INS.

The standard deviations entered using this command must be representative of actual input error.

Relative updates should only be used when they are input at consistent rates.

The **EXTERNALPVAS** command uses a short header if the command is entered in ASCII or Binary.

This command allows the user to provide their own update for INS in full position, velocity, attitude and other updates, and in any combination. The user can also provide height or attitude only updates, along with Zero Velocity Updates (ZUPTs). The position and velocity updates can be entered in local level or ECEF.

The **EXTERNALPVAS** command is designed to provide a method for additional sensor information to be input into the SPAN filter, specifically during GNSS denied environments. This will provide a method to constrain the error growth that is typical in an Inertial Kalman Filter when GNSS observations are unavailable (environments such as: urban canyon, tunnels, jamming etc.). It is important to ensure that the external update and its corresponding standard deviations are accurate and input with minimal latency to provide optimal effectiveness. Entering an external update or its standard deviation inappropriately may have an adverse effect on the SPAN solution.

The default input frame is ECEF. Updates are entered in ECEF unless Local Level is specified using the OptionsMask parameter.

Message ID: 1463

Abbreviated ASCII Syntax:

```
EXTERNALPVAS Position1 Position2 Position3 Velocity1 Velocity2 Velocity3
Attitude1 Attitude2 Attitude3 PosStdDev1 PosStdDev2 PosStdDev3 VelStdDev1
VelStdDev2 VelStdDev3 AttStdDev1 AttStdDev2 AttStdDev3 UpdateMask OptionsMask
```

Abbreviated ASCII Example: (Local Level Velocity Update)

```
EXTERNALPVAS 0.0 0.0 0.0 0.4502 10.54 -0.09598 0.0 0.0 0.0 0.0 0.0 0.0 0.01
0.01 0.01 0.0 0.0 0.0 4000 10
```

Full ASCII Example: (Local Level Velocity Update)

```
%EXTERNALPVASA,2051,493713.000;0.00000000000,0.00000000000,0.00000000000,
0.1333,17.1424,-0.3311,0.000000000,0.000000000,0.000000000,0.0000,0.0000,
0.0000,0.0119,0.0096,0.0132,0.0000,0.0000,0.0000,00004000,00000010*edced535
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	Command header	-	-	EXTERNALPVAS header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	Position1			Latitude (degrees), ECEF X-coordinate (m) or X relative coordinate (m)	Double Array [3]	24	H
	Position2			Longitude (degrees), ECEF Y-coordinate (m) or Y relative coordinate (m)			
	Position3			Height (ellipsoidal m), ECEF Z-coordinate (m) or Z relative coordinate (m)			
3	Velocity1			North velocity or velocity along the X-axis (m/s)	Float Array [3]	12	H+24
	Velocity2			East velocity or velocity along the Y-axis (m/s)			
	Velocity3			Up velocity or velocity along the Z-axis (m/s)			
4	Attitude1			Pitch – Local Level to SPAN User Output Frame or relative delta from SPAN User Output Frame (degrees)	Float Array [3]	12	H+36
	Attitude2			Roll – Local Level to SPAN User Output Frame or relative delta from SPAN User Output Frame (degrees)			
	Attitude3			Azimuth – Local Level to SPAN User Output Frame or relative delta from SPAN User Output Frame (degrees)			
5	PosStdDev1			Position1 standard deviation (m)	Float Array [3]	12	H+48
	PosStdDev2			Position2 standard deviation (m)			
	PosStdDev3			Position3 standard deviation (m)			

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
6	VelStdDev1			Velocity1 standard deviation (m/s)	Float Array [3]	12	H+60
	VelStdDev2			Velocity2 standard deviation (m/s)			
	VelStdDev3			Velocity3 standard deviation (m/s)			
7	AttStdDev1			Attitude1 standard deviation (degrees)	Float Array [3]	12	H+72
	AttStdDev2			Attitude2 standard deviation (degrees)			
	AttStdDev3			Attitude3 standard deviation (degrees)			
8	UpdateMask			This mask selects which updates are applied. Setting a bit applies the update. More than one update can be applied at one time. See *Table 9: EXTERNALPVAS Updates Mask* below for the external update bits that can be used.	HEX Ulong	4	H+84
9	OptionsMask			This mask selects the update options for various updates, such as using an ECEF or Local Level system for the position updates. See *Table 10: EXTERNALPVAS Options Mask* on the next page for details.	HEX Ulong	4	H+88

Table 9: EXTERNALPVAS Updates Mask

Bit	Mask	Description
0	0x00001	Reserved
1	0x00002	Reserved
2	0x00004	ZUPT Update. No fields are required in the **EXTERNALPVAS** command for this update.
3	0x00008	Reserved
4	0x00010	Reserved
5	0x00020	External Position Update. This update is entered using Position1 to Position3 in the **EXTERNALPVAS** command.

Bit	Mask	Description
6	0x00040	Reserved
7	0x00080	Reserved
8	0x00100	Reserved
9	0x00200	Reserved
10	0x00400	Reserved
11	0x00800	Reserved
12	0x01000	Reserved
13	0x02000	Reserved
14	0x04000	External Velocity Update. This update is entered using Velocity1 to Velocity3 in the **EXTERNALPVAS** command.
15	0x08000	External Attitude Update. This update is entered using Attitude1 to Attitude3 in the **EXTERNALPVAS** command.
16	0x10000	External Heading Update. This update is entered using Attitude3 in the **EXTERNALPVAS** command.
17	0x20000	External Height Update. This update is entered using Position3 in the **EXTERNALPVAS** command.

If both the External Position Update and External Height Update bits are set, only the External Position Update will be applied.

If both the External Attitude Update and External Heading Update bits are set, only the External Attitude Update will be applied.

Table 10: EXTERNALPVAS Options Mask

Bit	Mask	Description	Range Value
0	0x00000001	Reserved	
1	0x00000002	Reserved	
2–3	0x0000000C	Position Input Frame	00 – ECEF
			01 – LLH
			10 - Vehicle Frame (Relative update only)
4–5	0x00000030	Velocity Input Frame	00 – ECEF
			01 – LLH
			10 - Vehicle Frame (Absolute update only)

Bit	Mask	Description	Range Value
6	0x00000040	Position Update Type	0 – Absolute
			1 – Relative
7	0x00000080	Attitude Update Type	0 – Absolute
			1 – Relative

2.2.9 FORCEGALE6CODE

Force receiver to track Galileo E6C or E6B signal

Platform: OEM719, OEM729, OEM7700, PwrPak7, CPT7700

Use this command to force Galileo E6 channels to track E6B or E6C.

Message ID: 2222

Abbreviated ASCII Syntax:

```
FORCEGALE6CODE E6codetype
```

Factory Default:

```
FORCEGALE6CODE E6B
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	FORCEGALE6CODE header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	E6codetype	E6B	0	Galileo E6 code type (default = E6B)	Enum	4	H
		E6C	1				

2.2.10 INSCALIBRATE

Initiate calibration of the INS offsets

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7-S**

Use this command to initiate the calibration of INS offsets.

The RBV calibration requires a valid RBV estimate to be entered prior to initializing the calibration. See the **SETINSROTATION** command on page 74 for details on entering a RBV estimate.

For optimal performance of Dual Antenna with SPAN, an accurate ALIGN angular offset is required for each unique installation. This value can be calibrated should the entered value or the value derived from the input lever arms be less accurate than 5 degrees.

Message ID: 1882

Abbreviated ASCII Syntax:

```
INSCALIBRATE Offset [Trigger] [SDThreshold]
```

Abbreviated ASCII Example:

```
INSCALIBRATE RBV NEW 1.0
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	Command header	-	-	INSCALIBRATE header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
2	Offset	ANT1	1	Use this option to set the INS calibration offset from the IMU to the primary GNSS antenna The ANT1 option is available only on IMU Grade 2 or higher IMUs. See Models and Features in the OEM7 SPAN Installation and Operation User Manual.	Enum	4	H
		ALIGN	8	Use this option to set the INS calibration offset from the IMU Body frame to ALIGN frame rotation.			
		RBV	11	Use this option to set the INS calibration offset from the IMU Body frame to Vehicle frame rotation.			
3	Trigger	STOP	0	Ends the INS calibration and applies the resulting estimate to the system.	Enum	4	H+4
		NEW	1	Begins a new calibration, overwriting any previous input.			
		ADD	2	Begins a new calibration, the results of which will be cumulatively averaged with previously calibrated offsets. If no previous calibration is present, this trigger behaves as the NEW trigger.			
		RESET	3	Resets the current calibration process and removes it from the cumulative average computation. The previous inputs of calibrated values remain.			

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
4	SDThreshold			Standard Deviation Threshold (default for lever arm calibration = 0.10 m) (default for RBV and ALIGN calibration = 0.5 degrees)	Float	4	H+8

2.2.11 INSSEED

INS Seed Configuration

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7-S**

This command enables or disables the saving and restoration of the last known SPAN solution from NVM.

Message ID: 1906

Abbreviated ASCII Syntax:

```
INSSEED Command [Validation]
```

Abbreviated ASCII Example:

```
INSSEED ENABLE
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	Command header	-	-	INSSEED header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	Command	DISABLE	0	Disable the INS seed functionality	Enum	4	H
		ENABLE	1	Enable the INS seed functionality			
		CLEAR	2	Clear the currently saved seed value so it will not be used until re-saved			
3	Validation	VALIDATE	0	Validate INS Seed data using GNSS solution (default)	Enum	4	H+4
		INJECT	1	Force an NVM seed value (if available) to be used, without any validation. Using this option to force the seed to be used can result in an unstable INS solution if the vehicle has moved. For advanced users only.			

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
4	Reserved (Default = 0) If entering, use the default value.				Ulong	4	H+8
5	Reserved (Default = 0) If entering, use the default value.				Ulong	4	H+12

2.2.12 ITBANDPASSCONFIG

Enable and configure bandpass filter on receiver

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7**

Use this command to apply a bandpass filter at a certain frequency to mitigate interference in the pass band of GNSS signals. The **ITBANDPASSBANK** log (see page 103) provides information on the allowable configuration settings for each frequency band. The bandpass filter is symmetrical in nature, which means that specifying one cutoff frequency will apply a cutoff on both the low side and high side of the signal's center frequency. Only one filter can be applied for each signal.

To enable a filter on the signal received from the secondary antenna of dual antenna receivers (OEM7720, PwrPak7D, PwrPak7D-E1, PwrPak7D-E2 and CPT7), use the **ITBANDPASSCONFIG_1** command.

On OEM7720, PwrPak7D, PwrPak7D-E1, PwrPak7D-E2 and CPT7 receivers, any filter enabled for GPS L2 or GLONASS L2 on the secondary antenna will be applied to both GPS L2 and GLONASS L2. For this reason, care must be taken to avoid attenuating the signals with a bandpass filter that is too narrow in bandwidth. The recommended maximum lower cutoff frequency is 1221 MHz. The recommended minimum upper cutoff frequency is 1254 MHz.

When applying a filter to a signal using the MEC correlator, a brief interruption in tracking may occur on affected channels.

This command is not available for LBand.

This command is available only on some software models. Contact your NovAtel Sales representative (novatel.com/contactus/sales-offices) to obtain interference mitigation functionality.

Message ID: 1999

Abbreviated ASCII Syntax:

```
ITBANDPASSCONFIG frequency switch [cutofffrequency]
```

ASCII Example:

```
ITBANDPASSCONFIG gpsl5 enable 1165.975
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	ITBANDPASSCONFIG header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	frequency	See *Table 19: Frequency Types* on page 55		Set the frequency band on which to apply the filter	Enum	4	H
3	switch	DISABLE	0	Disable filter	Enum	4	H+4
		ENABLE	1	Enable filter			
4	cutofffrequency			Cut off frequency for band pass filter (MHz). (default = 0) Refer to **ITBANDPASSBANK** log (see page 103) for the allowable values.	Float	4	H+8

2.2.13 ITDETECTCONFIG

Enable interference detection on receiver

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7**

This command is used to enable or disable interference detection on the receiver. It is applicable to both Spectral Analysis Detection and Statistical Analysis Detection at the same time. Detection can be enabled on all RF paths, only one RF path (L1, L2, or L5), or no RF paths. By default, only the RF paths connecting to the first antenna are enabled.

To start interference detection on the secondary antenna of dual antenna receivers (OEM7720, PwrPak7D, PwrPak7D-E1, PwrPak7D-E2 and CPT7), use the **ITDETECTCONFIG_1** command. The interference detection results for the secondary antenna are shown in the **ITDETECTSTATUS_1** log.

Enabling interference detection on both antennas slows down interference detection. In most installations, the primary and secondary antennas will be impacted by the same interference signal. Therefore, enabling interference detection on both antennas will slow down detection and may provide only limited benefits.

Message ID: 2143

Abbreviated ASCII Syntax:

```
ITDETECTCONFIG RFPath [reserved1] [reserved2] [reserved3]
```

Factory Default:

```
ITDETECTCONFIG all
```

ASCII Example:

```
ITDETECTCONFIG L1
ITDETECTCONFIG none
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	ITDETECTCONFIG header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	RFPath	See *Table 11: RF Path Selection* on the next page		RF path selected for detection. By default, all paths are turned on. The receiver will cycle through all active paths.	Enum	4	H
3	reserved1	0		Reserved parameter	Ulong	4	H+4
4	reserved2	0		Reserved parameter	Ulong	4	H+8
5	reserved3	0		Reserved parameter	Ulong	4	H+12

Table 11: RF Path Selection

ASCII Value	Binary Value	Description
NONE	0	Turn off detection on all paths
ALL	1	Turn on detection on all paths (cycle through all active paths)
L1	2	Turn on detection only on L1 path
L2	3	Turn on detection only on L2 path
L5	4	Turn on detection only on L5 path

Table 12: RF Paths for OEM7 Receivers

RF Path	OEM719, OEM729, OEM7700, PwrPak7, CPT7700, SMART7	OEM7720, PwrPak7D, CPT7	OEM7500, SMART2	OEM7600
L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1 LBand	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1
L2	GPS L2 GLONASS L2 Galileo E6 BDS B3 QZSS L2/L6	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5
L5	GPS L5 GLONASS L3 Galileo E5 BDS B2 QZSS L5 NavIC L5 SBAS L5			
LBAND	LBand	LBand		LBand

2.2.14 ITFRONTENDMODE

Configure the front end mode settings

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7**

Use this command to configure the front end mode for the L1, L2 and L5 RF paths to use the default third-order CIC mode or HDR (High Dynamic Range) mode. The HDR mode is used in an interference environment to obtain best interference rejection in general. However, the power consumption will increase in this mode.

To configure the front end mode settings for the secondary antenna of dual antenna receivers (OEM7720, PwrPak7D, PwrPak7D-E1, PwrPak7D-E2 and CPT7), use the **ITFRONTENDMODE_1** command.

This command is available only on some software models. Contact your NovAtel Sales representative (novatel.com/contactus/sales-offices) to obtain interference mitigation functionality.

Message ID: 2039

Abbreviated ASCII Syntax:

```
ITFRONTENDMODE frequency mode
```

Factory Default

```
ITFRONTENDMODE L1 cic3
ITFRONTENDMODE L2 cic3
ITFRONTENDMODE LBAND cic3
ITFRONTENDMODE L5 cic3
```

ASCII Example:

```
ITFRONTENDMODE L1 hdr
```

On the OEM7500, the default mode for all frequency bands is HDR.

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	ITFRONTENDMODE header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	frequency	See *Table 13: Frequency Bands* on the next page		Set the frequency band for adjustment	Enum	4	H

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
3	mode	See *Table 14: Mode* below		Select the desired mode	Enum	4	H+4

Table 13: Frequency Bands

Binary Value	ASCII Value	Description
2	L1	Selects the L1 frequency
3	L2	Selects the L2 frequency
4	LBAND	Selects the L-Band frequency
5	L5	Selects the L5 frequency

Table 14: Mode

Binary Value	ASCII Value	Description
0	CIC3	3rd order CIC (CIC3) mode (default)
1	HDR	High Dynamic Range (HDR) mode

Table 15: RF Paths for OEM7 Receivers

RF Path	OEM719, OEM729, OEM7700, PwrPak7, CPT7700, SMART7	OEM7720, PwrPak7D, CPT7	OEM7500, SMART2	OEM7600
L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1 LBand	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1
L2	GPS L2 GLONASS L2 Galileo E6 BDS B3 QZSS L2/L6	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5

RF Path	OEM719, OEM729, OEM7700, PwrPak7, CPT7700, SMART7	OEM7720, PwrPak7D, CPT7	OEM7500, SMART2	OEM7600
L5	GPS L5 GLONASS L3 Galileo E5 BDS B2 QZSS L5 NavIC L5 SBAS L5			
LBAND	LBand	LBand		LBand

2.2.15 ITPROGFILTCONFIG

Enable and configure filtering on the receiver

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7**

Use this command to set the programmable filter to be either a notch filter or a bandpass filter to mitigate interference in the pass band of GNSS signals. The notch filter is used to attenuate a very narrow band of frequencies (specified by the notch width) around the configured center frequency.

The bandpass filter is symmetrical in nature, which means that specifying one cutoff frequency will apply a cutoff on both the low side and high side of the spectrum center frequency.

The **ITPROGFILTBANK** log (see page 112) provides information on the allowable configuration settings for the programmable filter (i.e. the allowable settings for the notch filter and bandpass filter) for each frequency band. Only one filter can be applied for each frequency.

To enable a filter on the signal received from the secondary antenna of dual antenna receivers (OEM7720, PwrPak7D, PwrPak7D-E1, PwrPak7D-E2 and CPT7), use the **ITPROGFILTCONFIG_1** command.

When applying a filter to a signal using the MEC correlator, a brief interruption in tracking may occur on affected channels.

This command is not available for LBand.

This command is available only on some software models. Contact your NovAtel Sales representative (novatel.com/contactus/sales-offices) to obtain interference mitigation functionality.

Message ID: 2000

Abbreviated ASCII Syntax:

```
ITPROGFILTCONFIG frequency filterid switch [filtermode] [cutofffreq]
[notchwidth]
```

ASCII Example:

```
ITPROGFILTCONFIG gpsl1 pf0 enable notchfilter 1580 1
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	ITPROGFILTCONFIG header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
2	frequency	See *Table 19: Frequency Types* on page 55		Set the frequency band on which to apply the filter	Enum	4	H
3	filterid	See *Table 16: Programmable Filter ID* below		Select the filter ID to use	Enum	4	H+4
4	switch	DISABLE	0	Disable the filter	Enum	4	H+8
		ENABLE	1	Enable the filter			
5	filtermode	See *Table 17: Programmable Filter Mode* below		Configure the type of filter to use (default = NONE)	Enum	4	H+12
6	cutofffreq			Center frequency for notch filter or cut off frequency for bandpass filter (MHz). Refer to **ITPROGFILTBANK** log (see page 112) for the allowable values. (default = 0)	Float	4	H+16
7	notchwidth			Notch width (MHz). Refer to **ITPROGFILTBANK** log (see page 112) for the allowable values. (default = 0)	Float	4	H+20

Table 16: Programmable Filter ID

Binary Value	ASCII Value	Description
0	PF0	Programmable Filter 0
1	PF1	Programmable Filter 1

Table 17: Programmable Filter Mode

Binary Value	ASCII Value	Description
0	NOTCHFILTER	Configure the filter as a notch filter
1	BANDPASSFILTER	Configure the filter as a bandpass filter
2	NONE	Turn off filter If the switch parameter is set to ENABLED while the filtermode parameter is set to NONE, the system will return a parameter out of range message.

2.2.16 ITSPECTRALANALYSIS

Enable and configure spectral analysis on receiver

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7**

Use this command to view the spectrum in a range of frequencies. The **ITSPECTRALANALYSIS** command enables and configures the spectral analysis. The spectrum is viewed by plotting the PSD samples in the **ITPSDFINAL** log (see page 114).

Decreasing the update period or increasing the FFT size will impact receiver idle time. The idle time should be monitored to prevent adverse effects on receiver performance.

Due to the high volume of data, a higher bandwidth medium, such as USB or Ethernet, is recommended when monitoring signals using the Interference Toolkit.

To enable and configure spectral analysis on the secondary antenna of dual antenna receivers (OEM7720, PwrPak7D, PwrPak7D-E1, PwrPak7D-E2 and CPT7), use the **ITSPECTRALANALYSIS_1** command.

Message ID: 1967

Abbreviated ASCII Syntax:

```
ITSPECTRALANALYSIS mode [frequency] [updateperiod] [FFTsize] [timeavg]
[integration_window]
```

Factory Default:

```
ITSPECTRALANALYSIS off
```

ASCII Example:

```
ITSPECTRALANALYSIS predecimation gps1 500 1K 20 1
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	ITSPECTRALANALYSIS header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	mode	See *Table 18: Data Sources for PSD Samples* on the next page		Set the view mode.	Enum	4	H

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
3	frequency	See *Table 19: Frequency Types* on the next page		Set the frequency band to view.	Enum	4	H+4
4	updateperiod	50 to 100000		The spectrum update rate in milliseconds. The update period is limited by the FFT size chosen. For 32k the minimum update period is 100 ms and for 64k the minimum update period is 200 ms. (default = 1000)	Ulong	4	H+8
5	FFTsize	See *Table 20: FFT Sizes* on page 56		The frequency resolution of the spectrum. (default = 1k)	Enum	4	H+12
6	timeavg	0 to 50		Time averaging window in seconds. 0 means no time averaging. (default = 10)	Ulong	4	H+16
7	integration window	1 to 1024		The integration window size of FFT samples. 1 means no integration. (default = 5)	Ulong	4	H+20

Table 18: Data Sources for PSD Samples

Binary Value	ASCII Value	Description
0	OFF	Disable spectral analysis
1	PREDECIMATION	Perform spectrum analysis on the pre-decimated spectrum. This can be used to see a wide view of the spectrum for an RF path (L1, L2 or L5).
2	POSTDECIMATION	Perform spectrum analysis on the post-decimated spectrum. This is narrower than pre-decimation and is used to see the spectrum for a given signal.
3	POSTFILTER	Perform spectrum analysis on the post-filtered spectrum. This can be used when either bandpass or notch filters have been enabled to see the spectrum after the filters are applied.

The post-filter spectrum is not available for the Galileo AltBOC frequency. Only the pre-decimation and post-decimation spectrums are available for Galileo AltBOC.

Table 19: Frequency Types

Binary Value	ASCII Value	Description
0	GPSL1	GPS L1 frequency
1	GPSL2	GPS L2 frequency
2	GLONASSL1	GLONASS L1 frequency
3	GLONASSL2	GLONASS L2 frequency
4	Reserved	
5	GPSL5	GPS L5 frequency
6[1]	LBAND	Inmarsat L-Band frequency
7	GALILEOE1	Galileo E1 frequency
8	GALILEOE5A	Galileo E5A frequency
9	GALILEOE5B	Galileo E5B frequency
10	GALILEOALTBOC	Galileo AltBOC frequency
11	BEIDOUB1	BeiDou B1 frequency
12	BEIDOUB2	BeiDou B2I frequency
13	QZSSL1	QZSS L1 frequency
14	QZSSL2	QZSS L2 frequency
15	QZSSL5	QZSS L5 frequency
16	QZSSL6	QZSS L6 frequency
17	GALILEOE6	Galileo E6 frequency
18	BEIDOUB3	BeiDou B3 frequency
19	GLONASSL3	GLONASS L3 frequency
20	NAVICL5	NavIC L5 frequency
21	BEIDOUB1C	BeiDou B1C frequency
22	BEIDOUB2A	BeiDou B2a frequency
23	BEIDOUB2B	BeiDou B2b frequency

[1]Must first enable L-Band using the ASSIGNLBANDBEAM command.

Table 20: FFT Sizes

Binary Value	ASCII Value	Description
0	1K	1K FFT, 1024 samples
1	2K	2K FFT, 2048 samples
2	4K	4K FFT, 4096 samples
3	8K	8K FFT, 8192 samples
4	16K	16K FFT, 16384 samples
5	32K	32K FFT, 32768 samples
6	64K	64K FFT, 65536 samples

The 64k FFT is not available in post-decimation or post-filter modes.

2.2.17 J1939CONFIG

Configure CAN network-level parameters

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

Use this command to configure the CAN J1939 network-level parameters (NAME, etc).

Issuing this command may initiate a CAN 'Address Claim' procedure. The status of the node and address claim are reported in the **J1939STATUS** log (see page 118).

Once a "node" is configured using **J1939CONFIG**, and the "port" is configured to ON using CANCONFIG "port" ON, J1939CONFIG "node" cannot be entered again until the "port" is configured to "OFF" using CANCONFIG "port" OFF. (See the **CANCONFIG** command on page 23

Message ID: 1903

Abbreviated ASCII Syntax:

```
J1939CONFIG node port [pref_addr [alt_addr_range_start] [alt_addr_range_end]
[mfgcode] [industry] [devclass] [devinstance] [func] [funcinstance]
[ECUinstance]]
```

Factory Default:

```
J1939CONFIG NODE1 CAN1 1C 0 FD 305 2 0 0 23 0 0
J1939CONFIG NODE2 CAN2 1C 0 FD 305 2 0 0 23 0 0
```

ASCII Example :

```
J1939CONFIG NODE1 CAN1 AA 0 FD 305 2 0 0 23 0 0
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	J1939CONFIG header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	node	NODE1	1	Identifies the J1939 Node (i.e., CAN NAME) SMART2 does not support NODE2.	Enum	4	H
		NODE2	2				
3	port	CAN1	1	Physical CAN port to use SMART2 does not support the CAN2 port.	Enum	4	H+4
		CAN2	2				

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
4	pref_addr	0x0 - 0xFD		Preferred CAN address. The receiver attempts to claim this address (default = 0x0)	Ulong	4	H+8
5	alt_addr_ range_start	0x0 - 0xFD		When the pref_addr cannot be claimed, the receiver attempts to claim an address from this range. (default: 0x0)	Ulong	4	H+12
6	alt_addr_ range_end	0x0 - 0xFD		End of alternative address range. (default: 0xFD)	Ulong	4	H+16
7	mfgcode	0-2047		NAME: Manufacturer Code. Refer to ISO 11783-5. (default: 0)	Ulong	4	H+20
8	industry	0 - 7		NAME: Industry Group (default: 2)	Ulong	4	H+24
9	devclass	0 - 127		NAME: Device Class (default: 0)	Ulong	4	H+28
10	devinstance	0 - 15		NAME: Device Class Instance (default: 0)	Ulong	4	H+32
11	func	0 - 255		NAME: Function (default: 23)	Ulong	4	H+36
12	funcinstance	0 - 31		NAME: Function instance (default: 0)	Ulong	4	H+40
13	ECUinstance	0 - 7		NAME: ECU Instance (default: 0)	Ulong	4	H+44

Due to current limitations in the CAN stack, NODE1 can only be associated with CAN1 and NODE2 can only be associated with CAN2. A mismatch combination results in an 'invalid parameter' error.

Node statistics are reported in the **J1939STATUS** log (see page 118).

2.2.18 NMEAFORMAT

Customize NMEA output

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

Use the NMEAFORMAT command to customize the NMEA GPGGA and GPGGALONG output.

Modifying the NMEA output will make it not compliant with the NMEA standard.

Message ID: 1861

Abbreviated ASCII Syntax:

```
NMEAFORMAT field format
```

Factory Default:

```
NMEAFORMAT GGA_LATITUDE 9.4
NMEAFORMAT GGA_LONGITUDE 10.4
NMEAFORMAT GGA_ALTITUDE .2
NMEAFORMAT GGALONG_LATITUDE 12.7
NMEAFORMAT GGALONG_LONGITUDE 13.7
NMEAFORMAT GGALONG_ALTITUDE .3
```

Example:

The following settings increase the precision of the GPGGA latitude and longitude fields:

```
NMEAFORMAT GGA_LATITUDE 11.6
NMEAFORMAT GGA_LONGITUDE 12.6
```

The following settings decrease the precision of the GPGGALONG latitude and longitude fields:

```
NMEAFORMAT GGALONG_LATITUDE 11.6
NMEAFORMAT GGALONG_LONGITUDE 12.6
```

The following setting stops the undulation fields of the GPGGALONG log being filled, making a log like the GPGGARTK log that was in NovAtel's OEM6 firmware:

```
NMEAFORMAT GGALONG_UNDULATION !0
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	NMEAFORMAT header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
2	Field	GGA_ LATITUDE	0	GPGGA latitude field	Enum	4	H
		GGA_ LONGITUDE	1	GPGGA longitude field			
		GGA_ ALTITUDE	2	GPGGA altitude (height) field			
		GGA_ UNDULATION	3	GPGGA undulation field			
		GGALONG_ LATITUDE	10	GPGGALONG latitude field			
		GGALONG_ LONGITUDE	11	GPGGALONG longitude field			
		GGALONG_ ALTITUDE	12	GPGGALONG altitude (height) field			
		GGALONG_ UNDULATION	13	GPGGALONG undulation field			

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
3	Format	Char[8]		The Format field has a syntax similar to the printf function commonly found in programming languages. The format is: !x.y Where: **y** is the number of digits to display after the decimal point **x** sets the minimum field width including the decimal point. X is optional if ! is not used. If the value requires fewer digits than x, leading zeros are added to the output. **!** forces the field width to x. ! is optional. If a value exceeds the permitted width, the value will be saturated. If ! is used, y must be less than x. Examples (GGA_ LATITUDE): .5 = 5106.98120 2.3 = 5106.981 7.1 = 05107.0 !7.2 = 5106.98 !7.3 = 999.999	Char[8]	8	H+4

2.2.19 NVMUSERDATA

Write User Data to NVM

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

This command writes the data provided in the data array to NVM. This data can be retrieved by issuing the command **LOG NVMUSERDATA**.

The user data is maintained through power cycles and a standard **FRESET** command. To clear the user data, use the **FRESET USERDATA** command.

The user data may be deleted if the **NVMRESTORE** command is sent. NVMRESTORE should be used with caution and is meant for use only in the event of a NVM receiver error.

Message ID: 1970

Abbreviated ASCII Syntax:

```
NVMUSERDATA #bytes data
```

Field	Field Type	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	Command header	-	NVMUSERDATA header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	#bytes	-	Number of bytes of data to follow	Ulong	4	H
3	data	-	User input data up to a maximum of 2000 bytes. Data is entered in hexadecimal values with no separators between the values. For example, 1a2b3c4e	Uchar	2000	H+4

2.2.20 PPPBASICCONVERGEDCRITERIA

Configures decision for PPP Basic convergence

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

The **PPPBASICCONVERGEDCRITERIA** command sets the threshold that determines if the solution has converged for lower accuracy PPP solutions. These are the PPP solutions reported with the PPP_BASIC and PPP_BASIC_CONVERGING position types.

The convergence threshold for high-accuracy PPP solutions (reported with PPP and PPP_CONVERGING position types) is set using the **PPPCONVERGEDCRITERIA** command.

Relaxing the convergence threshold shortens the time before a PPP solution is reported as converged. However, it does not alter solution behavior. During the initial PPP solution period, the positions can have decimetre error variation. Only relax the convergence threshold if the application can tolerate higher solution variability.

Message ID: 1949

Abbreviated ASCII Syntax:

```
PPPBASICCONVERGEDCRITERIA criteria tolerance
```

Factory Default:

```
PPPBASICCONVERGEDCRITERIA horizontal_stddev 0.60
```

ASCII Example:

```
PPPBASICCONVERGEDCRITERIA total_stddev 0.45
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	PPPBASIC CONVERGED CRITERIA header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	Criteria	TOTAL_ STDDEV	1	Use the total, 3D, standard deviation	Enum	4	H
		HORIZONTAL_ STDDEV	2	Use the horizontal, 2D, standard deviation			
3	Tolerance			Tolerance (m)	Float	4	H+4

2.2.21 PPPDYNAMICSEED

Seed the PPP filter in any platform motion state

Platform: OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2

This command enables seeding of the PPP engine regardless of the receiver motion state. Accurate seeds can be used to improve initial PPP convergence and re-convergence following signal outages.

The seed position given by the **PPPDYNAMICSEED** command must be in a datum consistent with the PPP corrections that are in use. For TerraStar corrections, the datum is ITRF2014. The dynamic seed's time must refer to receiver time and cannot be more than 15 seconds in the past. A valid PPP solution (the **PPPPOS** log solution status is SOL_COMPUTED) must have been computed for the same epoch as the seed in order for the seed to be used.

See the **PPPSEED** command for stationary-only seeding and for other control over seeding.

Message ID: 2071

Abbreviated ASCII Syntax:

```
PPPDYNAMICSEED week seconds latitude longitude height northing_std_dev
easting_std_dev height_std_dev [northing_easting_covariance] [northing_
height_covariance] [easting_height_covariance]
```

Example :

```
PPPDYNAMICSEED 1817 247603 51.2086442297 -113.9810263055 1071.859 0.02 0.02
0.04
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	PPPDYNAMICSEED header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.		H	0
2	week	0-9999		GPS Week number	Ulong	4	H
3	seconds	0-604800		Number of seconds into GPS week	Ulong	4	H+4
4	latitude	±90		Latitude (degrees)	Double	8	H+8
5	longitude	±180		Longitude (degrees)	Double	8	H+16
6	height	> -2000.0		Ellipsoidal height (metres)	Double	8	H+24
7	northing_ std_dev			Northing standard deviation (metres)	Float	4	H+32
8	easting_std_ dev			Easting standard deviation (metres)	Float	4	H+36
9	height_std_ dev			Ellipsoidal height standard deviation (metres)	Float	4	H+40

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
10	northing_ easting_ covariance			Covariance between northing and easting components (metres)	Float	4	H+44
11	northing_ height_ covariance			Covariance between northing and height components (metres)	Float	4	H+48
12	easting_ height_ covariance			Covariance between easting and height components (metres)	Float	4	H+52

2.2.22 PPPRESET

Reset the PPP filter

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

This command resets the PPP filter. After a reset, the PPP filter is restored to its initial state and PPP convergence will start over.

If deletion of the NVM-saved PPP seed information is also required, then a **PPPSEED CLEAR** command must be applied before the PPPRESET command. See the **PPPSEED** command.

Message ID: 1542

Abbreviated ASCII Syntax:

```
PPPRESET [Option]
```

ASCII Example :

```
PPPRESET
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Bytes	Binary Format	Binary Offset
1	Command header	-	-	PPPRESET header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	Option	FILTER	1	Reset the PPP filter. (default = FILTER)	4	Enum	H
		ALL	10	Reset the PPP filter and Corrections			

2.2.23 REFERENCESTATIONTIMEOUT

Sets timeout for removing previously stored base stations

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7**

This command sets how long the receiver will retain RTK base station co-ordinates. Shorter durations might be required if the receiver is operating in a VRS RTK network that recycles base station IDs quickly.

Message ID: 2033

Abbreviated ASCII Syntax:

```
REFERENCESTATIONTIMEOUT option [timeout]
```

Factory Default:

```
REFERENCESTATIONTIMEOUT AUTO
```

ASCII Example:

```
REFERENCESTATIONTIMEOUT SET 90
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	REFERENCESTATION TIMEOUT header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	option	AUTO	1	Sets the Timeout to 90 seconds[1] The Timeout field is optional for AUTO and has no effect	Enum	4	H
		SET	2	Must set the timeout value using the Timeout field 0 is not accepted when using the SET option			
3	timeout	1 to 3600 s		Specify the time	Ulong	4	H+4

[1] This behavior is subject to change.

2.2.24 RFINPUTGAIN

Configure the Calibrated Antenna Gain (CAG)

Platform: OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700

Use this command to select the mode (AUTO or MANUAL) of setting the CAG for the purpose of interference detection.

If auto mode is used, the receiver will automatically compute the CAG at start up. In this case it is assumed that the receiver is powered up with its antenna connected and no interference is present.

If the antenna is changed, either reset the receiver or reissue this command to allow receiver to re-compute the CAG.

If manual mode is used, the CAG input by the user is used by the receiver to detect interference.

The CAG is defined to be the cascaded RF gain before receiver input plus LNA noise figure (NF), counting active antenna LNA gain, in-line amplifier, RF cable or distribution loss prior to receiver input connector.

A typical GNSS active antenna (of reasonable quality) has a noise figure of ~2dB (dominated by the LNA in an active antenna).

RFINPUTGAIN = Cascaded Gain before receiver + LNA NF

For advanced users.
If using this command in manual mode, the antenna gain must be accurately measured when the system is not experiencing any interference. If an erroneous CAG is injected, the interference detection performance can be degraded.

Message ID: 1658

Abbreviated ASCII Syntax:

```
RFINPUTGAIN RFPath [mode] [CAG]
```

Factory Default:

```
RFINPUTGAIN L1 AUTO
RFINPUTGAIN L2 AUTO
RFINPUTGAIN L5 AUTO
```

ASCII Example:

```
RFINPUTGAIN L1 MANUAL 30
RFINPUTGAIN L2 30
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	RFINPUTGAIN header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	RFPath	L1	2	RF path selection	Enum	4	H
		L2	3				
		L5	5				
3	mode	AUTO	0	Calibrated Antenna Gain (CAG) mode. Default = MANUAL	Enum	4	H+4
		MANUAL	1				
4	CAG	0.0-100.0		Calibrated Antenna Gain value If the mode is MANUAL, a value for CAG must be entered.	Float	4	H+8

Table 21: RF Paths for OEM7 Receivers

RF Path	OEM719, OEM729, OEM7700, PwrPak7, CPT7700, SMART7	OEM7720, PwrPak7D, CPT7	OEM7500, SMART2	OEM7600
L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1 LBand	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1
L2	GPS L2 GLONASS L2 Galileo E6 BDS B3 QZSS L2/L6	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5
L5	GPS L5 GLONASS L3 Galileo E5 BDS B2 QZSS L5 NavIC L5 SBAS L5			
LBAND	LBand	LBand		LBand

2.2.25 RTKPORTMODE

Assigns the port for RTK and ALIGN messages

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7**

This command only applies to receivers with both RTK and ALIGN enabled.

A rover receiver with RTK and ALIGN enabled can receive RTK and ALIGN corrections at the same time. However, the two different sources (RTK and ALIGN) must be sent to different ports.

Use the RTKPORTMODE command to route correction feeds to different ports. RTK and ALIGN can be routed to any user specified ports.

Failing to specify the mode for the incoming source could cause unexpected behavior of RTK or ALIGN.

Ports configured using the **RTKPORTMODE** command must also be configured using the **INTERFACEMODE** command.

Message ID: 1936

Abbreviated ASCII Syntax:

```
RTKPORTMODE [port] mode
```

Factory Default:

```
RTKPORTMODE COM1 RTK
RTKPORTMODE COM2 RTK
RTKPORTMODE COM3 RTK
RTKPORTMODE COM4 RTK
RTKPORTMODE COM5 RTK
RTKPORTMODE COM6 RTK
RTKPORTMODE ICOM1 RTK
RTKPORTMODE ICOM2 RTK
RTKPORTMODE ICOM3 RTK
RTKPORTMODE ICOM4 RTK
RTKPORTMODE ICOM5 RTK
RTKPORTMODE ICOM6 RTK
RTKPORTMODE ICOM7 RTK
RTKPORTMODE NCOM1 RTK
RTKPORTMODE NCOM2 RTK
RTKPORTMODE NCOM3 RTK
RTKPORTMODE USB1 RTK
RTKPORTMODE USB2 RTK
```

```
RTKPORTMODE USB3 RTK
RTKPORTMODE WCOM1 RTK
RTKPORTMODE BT1 RTK
RTKPORTMODE AUX RTK
RTKPORTMODE CCOM1 RTK
RTKPORTMODE CCOM2 RTK
RTKPORTMODE CCOM3 RTK
RTKPORTMODE CCOM4 RTK
RTKPORTMODE CCOM5 ALIGN
RTKPORTMODE CCOM6 RTK
```

ASCII Example:

```
RTKPORTMODE COM2 RTK
RTKPORTMODE COM3 ALIGN
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	Command header	-	-	RTKPORTMODE header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	Port	See Table: Communications Port Identifiers		Port identifier (default = THISPORT)	Enum	4	H
3	Mode	RTK	0	Mode for this port	Enum	4	H+4
		ALIGN	1				

2.2.26 RTKRESET

Reset the RTK filter

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7**

This command resets the RTK filter and causes the AdVanceRTK filter to undergo a complete reset, forcing the system to restart the ambiguity resolution calculations.

Message ID: 2082

Abbreviated ASCII Syntax:

```
RTKRESET [Switch]
```

Example :

```
RTKRESET
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Byte	Binary Offset
1	Command header	-	-	RTKRESET header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	Switch	FILTER	1	Reset the RTK filter. This is an optional parameter	Enum	4	H

2.2.27 SETINSPROFILE

Sets filter behavior depending on system environment

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7-S**

This command sets specific filter behavior depending on the environment the system is installed in. The DEFAULT profile is the legacy setting from earlier SPAN products. The other profiles make changes specific to that environment.

See INS Profiles in the OEM7 SPAN Installation and Operation User Manual or CPT7 Installation and Operation User Manual for a detailed description of each profile's effect.

Message ID: 1944

Abbreviated ASCII Syntax:

```
SETINSPROFILE profile
```

Abbreviated ASCII Example:

```
SETINSPROFILE LAND
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	Command header	-	-	SETINSPROFILE header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	Profile	Default	0	Default INS profile with standard SPAN behavior.	Enum	4	H
		LAND	1	INS profile for land vehicles			
		MARINE	2	INS profile for marine vehicles			
		FIXEDWING	3	INS profile for fixed wing aircraft			
		FOOT	4	INS profiles for walking/backpack applications			
		VTOL	5	INS profile for vertical takeoff and landing vehicles (UAVs, helicopters, etc.)			
		RAIL	6	INS profile for trains			
		AGRICULTURE	7	INS profile for agriculture applications			

2.2.28 SETINSROTATION

Specifies rotational offsets between the IMU frame and other reference frames

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7-S**

Use the **SETINSROTATION** command to specify rotational offsets between the IMU frame and other reference frames, such as the vehicle frame or an ALIGN baseline. Offsets must be entered as the rotation from the IMU body frame, to the frame of interest. The order of rotations is Z, X, Y. All rotations are right handed.

It is very important to follow the order of rotations (Z, X, Y) when determining the rotations from IMU body frame to frame of interest.

It is strongly recommended to enter meaningful standard deviations when entering an ALIGN or RBV rotation.

To specify translational offsets between frames, see the **SETINSTRANSLATION** command on page 77.

Message ID: 1921

Abbreviated ASCII Syntax:

```
SETINSROTATION INSRotation XRotation YRotation ZRotation [XRotationSD]
[YRotationSD] [ZRotationSD]
```

Abbreviated ASCII Example:

```
SETINSROTATION RBV 0 0 90 3.0 3.0 3.0
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	Command header	-	-	SETINSROTATION header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	INSRotation	*Table 22: Rotational Offset Types* on the next page		Rotational offset to be set.	Enum	4	H

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
3	XRotation	±180		X rotation offset from IMU origin (degrees)	Float Array [3]	12	H+4
	YRotation	±180		Y rotation offset from IMU origin (degrees)			
	ZRotation	±180		Z rotation offset from IMU origin (degrees)			
4	XRotationSD	0.25 to 45		Optional X rotation offset standard deviation (degrees). Applicable for RBV and ALIGN rotations. (Default = 3.0)	Float Array [3]	12	H+16
	YRotationSD	0.25 to 45		Optional Y rotation offset standard deviation (degrees). Applicable for RBV and ALIGN rotations. (Default = 3.0)			
	ZRotationSD	0.25 to 45		Optional Z rotation offset standard deviation (degrees). Applicable for RBV and ALIGN rotations. (Default = 3.0)			
5	Reserved (Default = 0) If entering, use the default value.				Long	4	H+28

Table 22: Rotational Offset Types

ASCII Value	Binary Value	Description
USER	4	Rotation from the IMU body frame to the user output frame. This offset shifts the attitude information in the INSPVA, INSATT, INSATTQS, INSPVACMP, IMURATEPVA, GIMBALLEDPVA, PASHR and TSS1 logs, along with their short header and extended versions. As well it changes the output frame for the CORRIMUS, IMURATECORRIMUS, INSVELUSER, RELINSPVA and SYNCRELINSPVA logs.
MARK1	5	Rotation from the IMU body frame to the desired output for MARK1. This offset rotates the attitude information in the MARK1PVA log.

ASCII Value	Binary Value	Description
MARK2	6	Rotation from the IMU body frame to the desired output for MARK2. This offset rotates the attitude information in the MARK2PVA log.
ALIGN	8	Rotation from the IMU body frame to an ALIGN dual antenna solution. When using a dual antenna ALIGN solution with SPAN, this offset will be calculated automatically if translational offsets to both the primary and secondary GNSS antennas are provided using the **SETINSTRANSLATION** command on the next page.
MARK3	9	Rotation from the IMU body frame to the desired output for MARK3. This offset rotates the attitude information in the MARK3PVA log.
MARK4	10	Rotation from the IMU body frame to the desired output for MARK4. This offset rotates the attitude information in the MARK4PVA log.
RBV	11	Rotation from the IMU body frame to the vehicle frame.
RBM	12	Rotation from the IMU body frame to the gimbal mount body frame.

2.2.29 SETINSTRANSLATION

Specifies translational offsets between the IMU frame and other reference frames

Platform: OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7-S

Use the **SETINSTRANSLATION** command to specify translational offsets between the IMU frame and other reference frames, including GNSS antennas or the desired output frame. Offsets must be entered as the vector from the IMU, to the frame or position of interest. Offsets can be entered either in the IMU body frame, or the vehicle frame; offsets in the vehicle frame will be automatically rotated into the IMU body frame using the best available IMU Body to Vehicle Rotation (RBV).

For details on entering the RBV rotation or other angular offsets, see the **SETINSROTATION** command on page 74.

Message ID: 1920

Abbreviated ASCII Syntax:

```
SETINSTRANSLATION INSTranslation XTranslation YTranslation ZTranslation
[XTranslationSD] [YTranslationSD] [ZTranslationSD] [InputFrame]
```

Abbreviated ASCII Example:

```
SETINSTRANSLATION USER 1.0 2.0 3.0 0.05 0.05 0.05 VEHICLE
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	Command header	-	-	SETINSTRANSLATION header This field contains the command name for abbreviated ASCII or the message header for ASCII or Binary.	-	H	0
2	InsTranslation	See *Table 23: Translation Offset Types* on page 79		Translation offset to be set	Enum	4	H
3	XTranslation	±100		X translation offset from IMU origin (m)	Float Array [3]	12	H+4
	YTranslation	±100		Y translation offset from IMU origin (m)			
	ZTranslation	±100		Z translation offset from IMU origin (m)			

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
4	XTranslationSD	0 to 10		Optional X translation offset standard deviation (m)	Float Array [3]	12	H+16
	YTranslationSD	0 to 10		Optional Y translation offset standard deviation (m)			
	ZTranslationSD	0 to 10		Optional Z translation offset standard deviation (m)			
5	InputFrame	*Table 24: Translation Input Frame* on the next page		Optional input frame for translation offset values	Enum	4	H+28

For the ANT1, ANT2, EXTERNAL and GIMBAL translations, the standard deviation defaults are set to 10% of the translation value (up to a max of 10 metres).

For USER translations, standard deviation values are assumed to be zero unless specified by the user. When a USER offset is configured in the system, the INS solution standard deviations calculated at the IMU center of navigation will be propagated taking into account the INS attitude errors, USER offset values, and the USER offset standard deviations. This will result in larger scale INS position and velocity standard deviations compared to those calculated without a USER offset configured, but will be more representative of the estimated variance at the location of interest.

It is important to keep in mind that as the USER offset is moved further from the IMU center of navigation, the PVA solution will become noisier due to the projection of angular changes over a longer distance.

For MARK1, MARK2, MARK3 and MARK4 translations, standard deviations values are not used in the solution.

Large translation standard deviations can lead to an inaccurate INS position and velocity solution. Therefore, it is highly recommended to measure translation offsets as accurately as possible and to manually enter translation offset standard deviations that reflect that accuracy.

Table 23: Translation Offset Types

ASCII Value	Binary Value	Description
ANT1	1	Offset from the IMU center of navigation to the phase center of the primary GNSS antenna. Do not use the ANT1 option (SETINSTRANSLATION ANT1) on a SMART7-S. The correct lever arm value has been set at the factory.
ANT2	2	Offset from the IMU center of navigation to the phase center of the secondary GNSS antenna.
EXTERNAL	3	Offset from the IMU center of navigation to the external position source location. This offset type is for use with the **EXTERNALPVAS** command (see page 33).
USER	4	Translation from the IMU center of navigation to the user output location. This offset shifts the position and velocity information in the INSPVA, INSPOS, INSVEL, INSVELUSER, INSATT, INSSPD, IMURATEPVA, INSPVACMP and GIMBALLEDPVA logs along with their short header and extended versions. As well it changes the relative offset point of the HEAVE, SYNCHEAVE, DELAYEDHEAVE, RELINSPVA and SYNCRELINSPVA logs.
MARK1	5	Translation from the IMU center of navigation to the MARK1 output location. This offset shifts the position and velocity information in the MARK1PVA log.
MARK2	6	Translation from the IMU center of navigation to the MARK2 output location. This offset shifts the position and velocity information in the MARK2PVA log.
GIMBAL	7	Translation from the IMU center of navigation to the gimbal mount center of rotation.
MARK3	9	Translation from the IMU center of navigation to the MARK3 output location. This offset shifts the position and velocity information in the MARK3PVA log.
MARK4	10	Translation from the IMU center of navigation to the MARK4 output location. This offset shifts the position and velocity information in the MARK4PVA log.

Table 24: Translation Input Frame

ASCII Value	Binary Value	Description
IMUBODY	0	Offset is provided in the IMU enclosure frame. Default: IMUBODY

ASCII Value	Binary Value	Description
VEHICLE	1	Offset is provided in the vehicle frame. Offsets entered in the vehicle frame will be automatically rotated into the IMU frame using the best available RBV (rotation from IMU Body to Vehicle) information when required. Vehicle frame offsets should only be used if the RBV is known accurately, either though user measurement or calibration. The order of entry for vehicle frame offsets and the RBV rotation does not matter.

2.3 OEM6 to OEM7 – Logs

The following sections describe the log changes between OEM6 and OEM7.

2.3.1 Deleted Logs

The following table lists the OEM6 logs that have been deleted or replaced in OEM7.

Table 25: Deleted and Replaced Logs in OEM7

OEM6	OEM7
BESTLEVERARM	Replaced. Use the new **INSCONFIG** log (see page 93)
BESTLEVERARM2	Replaced. Use the new **INSCONFIG** log (see page 93)
CMR Data logs	Deleted the logs *CMRDESC*, *CMRGLOOBS*, *CMROBS*, *CMRPLUS*, *CMRREF*
GALEPHEMERIS	Replaced with the **GALFNAVEPHEMERIS** log for Galileo FNAV ephemeris information and **GALINAVEPHEMERIS** log for Galileo INAV ephemeris information
GPGGARTK	Deleted Refer to the **NMEAFORMAT** command on page 59 for information about accessing the information that was provided by this log.
HEADING	Replaced. Use the existing **HEADING2** log
IMUTOANTOFFSETS	Replaced. Use the new **INSCONFIG** log (see page 93)
INSCOV	Replaced. Use the new **INSSTDEV** log (see page 96)
INSCOVS	Replaced. Use the new **INSSTDEVS** log (see page 98)
INSUPDATE	Replaced. Use the new **INSUPDATESTATUS** log (see page 100)
LBANDINFO	Replaced. Use the existing **TERRASTARINFO** log or **VERIPOSINFO** log to log subscription information Use the existing **TERRASTARSTATUS** log or **VERIPOSSTATUS** log to log decoder and subscription status information
LBANDSTAT	
OMNIHPPOS	
OMNIHPSATS	
OMNIVIS	
PSRTIME	Deleted
RAWLBANDFRAME	Deleted
RAWLBANDPACKET	Deleted
SATVIS	Replaced. Use the existing **SATVIS2** log
RTCA Data Logs	Deleted the logs: *RTCA1*, *RTCAEPHEM*, *RTCAOBS*, *RTCAOBS2*, *RTCAOBS3*, *RTCAREF*, *RTCAREFEXT*

OEM6	OEM7
RTCM Data Logs	Deleted the logs: *RTCM1, RTCM3, RTCM9, RTCM15, RTCM16, RTCM16T, RTCM1819, RTCM2021, RTCM22, RTCM23, RTCM24, RTCM31, RTCM32, RTCM36, RTCM36T, RTCM59, RTCM59GLO, RTCMOMNI1*
WAAS0, WAAS1, WAAS2, etc.	Replaced. Use the existing **SBAS0** log, **SBAS1** log, **SBAS2** log, etc.

2.3.2 Revised Logs

Revised logs are listed in the table below.

Table 26: Revised Logs in OEM7

<table>
<tr><th>OEM6</th><th>OEM7</th></tr>
<tr><td>AUTHCODES</td><td>Added auth code types for Reserved and High Speed Signatures:
4 = RESERVED
5 = HIGH_SPEED</td></tr>
<tr><td>CHANCONFIGLIST</td><td>The following signal types have been added to Table: CHANCONFIGLIST Signal Type
<table>
<tr><th>Value</th><th>Name</th><th>Description</th></tr>
<tr><td>32</td><td>BEIDOUB1B3</td><td>BeiDou B1, B3</td></tr>
<tr><td>33</td><td>BEIDOUB3</td><td>BeiDou B3</td></tr>
<tr><td>34</td><td>BEIDOUB1B2B3</td><td>BeiDou B1, B2 and B3</td></tr>
<tr><td>35</td><td>GALE1E5AE5BALTBOCE6</td><td>Galileo E1, E5A, E5B, AltBOC, E6</td></tr>
<tr><td>36</td><td>GPSL1L2PL2CL5L1C</td><td>GPS L1CA, L2P, L2C, L5, L1C</td></tr>
<tr><td>37</td><td>QZSSL1CAL2CL5L1C</td><td>QZSS L1CA, L2C, L5, L1C</td></tr>
<tr><td>38</td><td>QZSSL1CAL2CL5L1CL6</td><td>QZSS L1CA, L2C, L5, L1C, L6</td></tr>
<tr><td>39</td><td>GLOL1L3</td><td>GLONASS L1CA, L3</td></tr>
<tr><td>40</td><td>GLOL3</td><td>GLONASS L3</td></tr>
<tr><td>41</td><td>GLOL1L2PL2CL3</td><td>GLONASS L1CA, L2P, L2CA, L3</td></tr>
<tr><td>42</td><td>GPSL1L2PL2CL1C</td><td>GPS L1CA, L2P, L2C, L1C</td></tr>
<tr><td>43</td><td>QZSSL1CAL2CL1C</td><td>QZSS L1CA, L2C, L1C</td></tr>
</table></td></tr>
<tr><td>GPHDT</td><td>The GPHDT log can only be logged using the ONCHANGED trigger. Other triggers, such as ONTIME are not accepted.</td></tr>
<tr><td>HWMONITOR</td><td>A new status, Peripheral Core Voltage, was added for OEM7 receivers. Also, the status options supported by OEM7 receivers are indicated.</td></tr>
</table>

<table>
<tr><th>OEM6</th><th>OEM7</th></tr>
<tr><td>INSATTX,
INSPOSX,
INSPVAX,
INSUPDATESTATUS,
INSVELX,
RELINSPVA,
SYNCRELINSPVA</td><td>Additional status information has been added to the Extended Solution Status word. The Extended Solution Status word is available in these logs.
See the INSATTX log on page 87 for a description of the new status values available.</td></tr>
<tr><td>GIMBALLEDPVA,
IMURATEPVA,
IMURATEPVAS,
INSATT, INSATTS,
INSATTX, INSPOS,
INSPOSS, INSPOSX,
INSPVA, INSPVAS,
INSPVAX, INSSPD,
INSSPDS, INSVEL,
INSVELS, INSVELX,
MARKxPVA,
RELINSPVA,
SYNCRELINSPVA</td><td>The following statuses have been added to the Inertial Solution Status table.
<table>
<tr><th>Binary</th><th>ASCII</th><th>Description</th></tr>
<tr><td>10</td><td>WAITING_
AZIMUTH</td><td>The INS filer has orientation, initial biases, initial position and valid roll/pitch estimated. Will not proceed until initial azimuth is entered.</td></tr>
<tr><td>11</td><td>INITIALIZING_
BIASES</td><td>The INS filter is estimating initial biases during the first 10 seconds of stationary data.</td></tr>
<tr><td>12</td><td>MOTION_
DETECT</td><td>The INS filter has not completely aligned, but has detected motion.</td></tr>
</table></td></tr>
<tr><td>LBANDTRACKSTAT</td><td>This log now reports the L-Band tracking and Viterbi status for more than one beam.</td></tr>
<tr><td>RANGECMP</td><td>GLONASS frequency number added to the Range Record Format table. The changes are shown below:
<table>
<tr><th>Data</th><th>Bits first to last</th><th>Length (bits)</th><th>Scale Factor</th><th>Units</th></tr>
<tr><td>C/No</td><td>165-169</td><td>5</td><td>(20+n)</td><td>dB-Hz</td></tr>
<tr><td>GLONASS Frequency Number</td><td>170-175</td><td>n+7</td><td>1</td><td></td></tr>
<tr><td>Reserved</td><td>176-191</td><td>16</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>RANGE, RANGECMP,
RANGECMP2</td><td>OEM7 tracks additional GNSS signals:
GPS L1C, GLONASS L3, QZSS L1C and QZSS L6</td></tr>
<tr><td>RANGE, RANGECMP,
RANGECMP2,
RANGECMP4,
RANGEGPSL1, SATVIS2,
TRACKSTAT</td><td>The OEM7 tracks SBAS PRNs 120-158 and 183-192.
The OEM7 tracks QZSS PRNs 193-202.
The OEM6 tracks SBAS PRNs 120-138 and 183-187.
The OEM6 tracks QZSS PRNs 193-197.</td></tr>
</table>

OEM6	OEM7
RXSTATUS	New OEM7 error and status states have been added to the Receiver Error, Receiver Status, Auxiliary 1 Status and Auxiliary 2 Status words. See the **RXSTATUS** log on page 139 The receiver family from which the RXSTATUS log was generated must be known to properly interpret the information provided by the Error and Status words. To determine the receiver family, use the Version Bits (25 and 26) of the Receiver Status word. If bit 25 is 1 and bit 26 is 0, the RXSTATUS log is from an OEM7 receiver. If bit 25 is 0 and bit 26 is 0, the RXSTATUS log is from an OEM6 or earlier receiver.
TRACKSTAT	The OEM7 has channel state 23 for BOC sidepeak check.
VARIABLELEVERARM	The computed lever arm offset is now reported in the IMU Body frame, rather than the SPAN computation frame.

2.3.3 New Logs

The table below lists the logs added in OEM7.

Table 27: New Logs in OEM7

OEM7	Description
GALCNAVRAWPAGE	Provides Galileo raw C-NAV page data from Galileo E6 signals. See the **GALCNAVRAWPAGE** log on page 86
INSCALSTATUS	Provides the status and estimated values for the currently running offset calibration. See the **INSCALSTATUS** log on page 91
INSCONFIG	Provides the current configuration of the SPAN system. See the **INSCONFIG** log on page 93
INSSTDEV	Provides the INS PVA standard deviations. See the **INSSTDEV** log on page 96
INSSTDEVS	Provides the INS PVA standard deviations and has a short header. See the **INSSTDEVS** log on page 98
INSUPDATESTATUS	Provides the most recent INS update information See the **INSUPDATESTATUS** log on page 100
ITBANDPASSBANK	Provides the allowable bandpass filter configurations See the **ITBANDPASSBANK** log on page 103

OEM7	Description
ITDETECTSTATUS	Provides a list of detected interference See the **ITDETECTSTATUS** log on page 105
ITFILTTABLE	Provides the filter configuration for each frequency See the **ITFILTTABLE** log on page 108
ITPROGFILTBANK	Provides the allowable filter configurations See the **ITPROGFILTBANK** log on page 112
ITPSDFINAL	Provides the processed power spectral density information See the **ITPSDFINAL** log on page 114
J1939STATUS	Provides the status of the J1939 node See the **J1939STATUS** log on page 118
MODELFEATURES	Clearly states the features available for the current loaded model See the **MODELFEATURES** log on page 120
RANGECMP4	Highly compressed version of the RANGE log See the **RANGECMP4** log on page 123
RAWSBASFRAME2	Provides the raw SBAS frame data and the transmitted frequency. See the **RAWSBASFRAME2** log on page 135
RTKASSISTSTATUS	Provides information on the state of RTK ASSIST See the **RTKASSISTSTATUS** log on page 137
SAFEMODESTATUS	Provides the Safe Mode status See the **SAFEMODESTATUS** log on page 153

2.3.4 GALCNAVRAWPAGE

Galileo raw CNAV page

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

This log provides Galileo raw C/NAV page data from Galileo E6 signals.

The **GALCNAVRAWPAGE** log is not output by default. To receive this log, data decoding for E6B/E6C must be enabled using the **DATADECODESIGNAL** command the specific signal.

Message ID: 2239

Log Type: Asynch

Recommended Input:

```
log galcnavrawpagea onnew
```

ASCII Example:

```
#GALCNAVRAWPAGEA,COM1,0,61.0,SATTIME,2227,252250.000,02000120,ec4c,32768;
214,30,7,185,fffc13c6e6243942790079d6c8a83e7c1ee5dbcefe2b05e637d7b161a643559c44
a7e148041d9a4511720d7ead579003d92588c7ec76880035e6*cf1b4560
```

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Log header	GALCNAVRAWPAGE header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	Signal Channel	Signal channel providing the bits	Ulong	4	H
3	PRN	Satellite PRN number	Ulong	4	H+4
4	Message ID	ID of the message	Ushort	2	H+8
5	Page ID	ID of the transmitted page of the encoded message	Ushort	2	H+10
6	Data	Raw C/NAV page data (464 bits). Does not include CRC or Tail bits. The first 14 bits are the Reserved bits of the C/NAV page. The next 448 bits contain the HAS page. The final 2 bits are included due to the HEX byte format and should be ignored.	HEX[58]	58	H+12
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	h+70
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

2.3.5 INSATTX

Inertial Attitude – Extended

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7-S**

This log includes the information from the **INSATT** log, as well as information about the attitude standard deviation. The position type and solution status fields indicate whether or not the corresponding data is valid.

The INSATTX log is a large log and is not recommend for high rate logging.

If you want to use high rate logging, log the **INSATTS** log at a high rate and the **INSSTDEVS** log ontime 1.

Message ID: 1457

Log Type: Synch

Recommended Input:

```
log insattxa ontime 1
```

ASCII Example:

```
#INSATTXA,USB1,0,66.0,FINESTEERING,2209,490101.000,02000020,5d25,16809;
INS_SOLUTION_GOOD,INS_PPP,-0.312617220,0.320251425,158.010043982,0.0297,
0.0297,0.0580,13001041,0*6557406d
```

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Log header	INSATTX header For information about log headers, see ASCII, Abbreviated ASCII or Binary.		H	0
2	INS Status	Solution status See Table: Inertial Solution Status	Enum	4	H
3	Pos Type	Position type See Table: Position or Velocity Type	Enum	4	H+4
4	Roll	Roll in Local Level (degrees)	Double	8	H+8
5	Pitch	Pitch in Local Level (degrees)	Double	8	H+16
6	Azimuth	Azimuth in Local Level (degrees) This is the inertial azimuth calculated from the IMU gyros and the SPAN filters.	Double	8	H+24
7	Roll σ	Roll standard deviation (degrees)	Float	4	H+32
8	Pitch σ	Pitch standard deviation (degrees)	Float	4	H+36
9	Azimuth σ	Azimuth standard deviation (degrees)	Float	4	H+40

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
10	Ext sol stat	Extended solution status See *Table 28: Extended Solution Status* below	Hex	4	H+44
11	Time Since Update	Elapsed time since the last ZUPT or position update (seconds)	Ushort	2	H+48
12	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+50
13	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 28: Extended Solution Status

Nibble	Bit	Mask	Description	Range Value
N0	0	0x00000001	Position update	0 = Unused 1 = Used
	1	0x00000002	Phase update	0 = Unused 1 = Used
	2	0x00000004	Zero velocity update	0 = Unused 1 = Used
	3	0x00000008	Wheel sensor update	0 = Unused 1 = Used
N1	4	0x00000010	ALIGN (heading) update	0 = Unused 1 = Used
	5	0x00000020	External position update	0 = Unused 1 = Used
	6	0x00000040	INS solution convergence flag	0 = Not converged 1 = Converged
	7	0x00000080	Doppler update	0 = Unused 1 = Used
N2	8	0x00000100	Pseudorange update	0 = Unused 1 = Used
	9	0x00000200	Velocity update	0 = Unused 1 = Used
	10	0x00000400	Reserved	
	11	0x00000800	Dead reckoning update	0 = Unused 1 = Used

Nibble	Bit	Mask	Description	Range Value
N3	12	0x00001000	Phase wind up update	0 = Unused 1 = Used
	13	0x00002000	Course over ground update	0 = Unused 1 = Used
	14	0x00004000	External velocity update	0 = Unused 1 = Used
	15	0x00008000	External attitude update	0 = Unused 1 = Used
N4	16	0x00010000	External heading update	0 = Unused 1 = Used
	17	0x00020000	External height update	0 = Unused 1 = Used
	18	0x00040000	Reserved	
	19	0x00080000	Reserved	
N5	20	0x00100000	Reserved	
	21	0x00200000	Reserved	
	22	0x00400000	Secondary INS solution	0 = Unused 1 = Used
	23	0x00800000	Reserved	
N6	24	0x01000000	Turn on biases estimated	0 = Static turn-on biases not estimated (starting from zero) 1 = Static turn-on biases estimated
	25	0x02000000	Alignment direction verified	0 = Not verified / Not applicable 1 = Verified Alignment direction verification only occurs for RAIL, AGRICULTURE and LAND INS Profiles performing either a NVM Seed and Kinematic Alignment Type.
	26	0x04000000	Alignment Indication 1	0 = Not set, 1 = Set Refer to *Table 29: Alignment Indication* on the next page
	27	0x08000000	Alignment Indication 2	0 = Not set, 1 = Set Refer to *Table 29: Alignment Indication* on the next page

Nibble	Bit	Mask	Description	Range Value
N7	28	0x10000000	Alignment Indication 3	0 = Not set, 1 = Set Refer to *Table 29: Alignment Indication* below
	29	0x20000000	NVM Seed Indication 1	0 = Not set, 1 = Set Refer to *Table 30: NVM Seed Indication* below
	30	0x40000000	NVM Seed Indication 2	0 = Not set, 1 = Set Refer to *Table 30: NVM Seed Indication* below
	31	0x80000000	NVM Seed Indication 3	0 = Not set, 1 = Set Refer to *Table 30: NVM Seed Indication* below

Table 29: Alignment Indication

Bits 28-26 Values[1]	Hex Value	Completed Alignment Type
000	0x00	Incomplete Alignment
001	0x01	Static
010	0x02	Kinematic
011	0x03	Dual Antenna
100	0x04	User Command
101	0x05	NVM Seed

Table 30: NVM Seed Indication

Bit 31-29 Values[2]	Hex Value	NVM Seed Type
000	0x00	INS Seed has not been injected into the solution
001	0x01	Valid INS Seed was not found in non-volatile memory
010	0x02	INS Seed has failed validation and has been discarded
011	0x03	INS Seed is awaiting validation
100	0x04	INS Seed alignment data has successfully been injected (including error model data)
101	0x05	INS Seed exists, but has been ignored due to a user commanded filter reset/restart or configuration change
110	0x06	INS Seed error model data has successfully been injected

2.3.6 INSCALSTATUS

Offset calibration status

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7-S**

This log reports the status and estimated values of the currently running offset calibration.

Message ID: 1961

Log Type: Asynch

Abbreviated ASCII Syntax:

```
log inscalstatus onchanged
```

ASCII Example:

```
#INSCALSTATUSA,USB1,0,51.5,FINESTEERING,2209,494041.015,02010020,c0db,16809;
RBV,0.0000,0.0000,-0.0000,45.0000,45.0000,45.0000,INSUFFICIENT_SPEED,0*62a2839c
```

Field	Field Type	Description	Binary Format	Binary Bytes	Binary Offset
1	Log header	INSCALSTATUS header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	Offset Type	Type of offset (see *Table 31: Offset Type* on the next page).	Enum	4	H
3	X axis offset	IMU body frame X-axis offset (metres or degrees)	Float	4	H+4
4	Y axis offset	IMU body frame Y-axis offset (metres or degrees)	Float	4	H+8
5	Z axis offset	IMU body frame Z-axis offset (metres or degrees)	Float	4	H+12
6	X uncertainty	IMU body frame X-axis offset uncertainty (metres or degrees)	Float	4	H+16
7	Y uncertainty	IMU body frame Y-axis offset uncertainty (metres or degrees)	Float	4	H+20
8	Z uncertainty	IMU body frame Z-axis offset uncertainty (metres or degrees)	Float	4	H+24
9	Source Status	Source from which offset values originate (see *Table 32: Source Status* on the next page).	Enum	4	H+28
10	Multi-line Calibration Count	Counter for number of completed calibrations cumulatively averaged.	Ulong	4	H+32
11	xxxx	32-bit CRC (ASCII and Binary only).	Hex	4	H+36
12	[CR][LF]	Sentence terminator (ASCII only).	-	-	-

Units for the axis offset and uncertainty values (fields 3-8) are in metres for translational offset components and degrees for rotational offset components.

Table 31: Offset Type

Binary	ASCII	Description
1	ANT1	Primary IMU to antenna lever arm
8	ALIGN	Align offset
11	RBV	IMU body to vehicle offset

Table 32: Source Status

Binary	ASCII	Description
1	FROM_NVM	Offset values originate from saved parameters in NVM
2	CALIBRATING	Offset values originate from a currently running calibration process
3	CALIBRATED	Offset values originate from a completed calibration process
4	FROM_ COMMAND	Offset values originate from a user command
5	Reserved	
6	FROM_DUAL_ ANT	Offset values originate from a dual antenna Align solution
7	INS_ CONVERGING	Offset values originate from initial input values. Calibration process on hold until INS solution is converged.
8	INSUFFICIENT_ SPEED	Offset values originate from a currently running calibration process. Further estimation on hold due to insufficient speed.
9	HIGH_ROTATION	Offset values originate from a currently running calibration process. Further estimation on hold due to high vehicle rotations.

2.3.7 INSCONFIG

Determine required settings for post-processing or system analysis

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7-S**

This log is the single message required to determine all required settings for post-processing or system analysis. This log is asynchronous and published for any change to the included fields. It is intended to be recorded occasionally though it could be updated frequently at system startup. The **INSCONFIG** log may also be logged synchronously with the ONTIME trigger, but this log should **NOT** be requested at a high rate (limited to 1 Hz).

Message ID: 1945

Log Type: Asynch

Recommended Input:

```
log insconfig onchanged
```

ASCII Example:

```
#INSCONFIGA,USB1,0,66.5,FINESTEERING,2209,338183.000,02000020,bba4,16809;
EPSON_G320,5,50,20,DEFAULT,7fd1bf,AUTOMATIC,ROVER,FALSE,0,0,0,17,0,0,0,0,0,0,0,
1,RBV,IMUBODY,0.0000,0.0000,0.0000,3.0000,3.0000,3.0000,FROM_COMMAND*996d7655
```

Field	Field Type	Description	Binary Format	Binary Bytes	Binary Offset
1	Log header	INSCONFIG header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	IMU Type	IMU type. See *Table 8: IMU Type* on page 31.	Enum	4	H
3	Mapping	Mapping / Orientation	Uchar	1	H+4
4	Initial Alignment Velocity	Minimum Alignment Velocity entered by the user (see the **SETALIGNMENTVEL** command). Velocity (m/s) is scaled by 10 for 10 cm/s precision	Uchar	1	H+5
5	Heave Window	Length of the heave window in seconds (if set using the **SETHEAVEWINDOW** command)	Ushort	2	H+6
6	Profile	Profile setting (see the **SETINSPROFILE** command on page 73)	Enum	4	H+8
7	INS Enabled Updates	Enabled INS updates (see *Table 35: INS Update Values* on page 102)	Hex	4	H+12
8	Alignment Mode	Alignment mode configured on the system (see the **ALIGNMENTMODE** command)	Enum	4	H+16

Field	Field Type	Description	Binary Format	Binary Bytes	Binary Offset
9	Relative INS Output Frame	The user specified output frame of the Relative INS Vector (see **SETRELINSOUTPUTFRAME** command) If not specified, the default value appears.	Enum	4	H+20
10	Relative INS Output Direction	The User specified Output direction of the Relative INS Vector (From or To Base-Rover) (see the **SETRELINSOUTPUTFRAME** command). If not specified, the default value appears. TRUE if From Base, FALSE (Default) if From Rover	Bool	4	H+24
11	INS Receiver Status	Lower byte- INS Reset. Corresponds numerically to the INS Reset as described by the INSResetEnum Second byte- = 0x01 if an IMU Communication Error (Receiver status bit 17). = 0x00 otherwise. Other values are reserved for future use. Upper 2 bytes - reserved.	Hex	4	H+28
12	INS Seed Enabled	INS Seed Enable setting (see the **INSSEED** command on page 42) Enabled = 1, Disabled = 0	Uchar	1	H+32
13	INS Seed Validation	INS Seed Validation setting (see the **INSSEED** command on page 42)	Uchar	1	H+33
14	Reserved 1		N/A	2	H+34
15	Reserved 2		N/A	4	H+36
16	Reserved 3		N/A	4	H+40
17	Reserved 4		N/A	4	H+44
18	Reserved 5		N/A	4	H+48
19	Reserved 6		N/A	4	H+52
20	Reserved 7		N/A	4	H+56
21	Number of Translations	Number of translation entries to follow	Ulong	4	H+60
22	Translation	Translation to follow (see *Table 23: Translation Offset Types* on page 79)	Enum	4	variable
23	Frame	Frame of translation (IMUBODY or VEHICLE)	Enum	4	variable
24	X Offset	X Offset	Float	4	variable
25	Y Offset	Y Offset	Float	4	variable

Field	Field Type	Description	Binary Format	Binary Bytes	Binary Offset
26	Z Offset	Z Offset	Float	4	variable
27	X Uncertainty	X Uncertainty	Float	4	variable
28	Y Uncertainty	Y Uncertainty	Float	4	variable
29	Z Uncertainty	Z Uncertainty	Float	4	variable
30	Translation Source	Source of translation (see *Table 32: Source Status* on page 92)	Enum	4	variable
	Next Translation				
variable	Number of Rotations	Number of rotation entries to follow	Ulong	4	variable
variable	Rotation	Rotation to follow (see *Table 22: Rotational Offset Types* on page 75)	Enum	4	variable
variable	Frame	Frame of rotation (IMUBODY or VEHICLE)	Enum	4	variable
variable	X Rotation	X Rotation	Float	4	variable
variable	Y Rotation	Y Rotation	Float	4	variable
variable	Z Rotation	Z Rotation	Float	4	variable
variable	X Rotation Std Dev	X Rotation offset standard deviation (degrees)	Float	4	variable
variable	Y Rotation STD Dev	Y Rotation offset standard deviation (degrees)	Float	4	variable
variable	Z Rotation STD Dev	Z Rotation offset standard deviation (degrees)	Float	4	variable
variable	Rotation Source	Source of rotation (see *Table 32: Source Status* on page 92)	Enum	4	variable
	Next Rotation				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

2.3.8 INSSTDEV

INS PVA standard deviations

Platform: OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7-S

This log displays the INS PVA standard deviations.

Message ID: 2051

Log Type: Synch

Abbreviated ASCII Syntax:

```
log insstdev ontime 1
```

ASCII Example:

```
#INSSTDEVA,USB1,0,66.0,FINESTEERING,2209,491004.000,02000020,2396,16809;0.1813,
0.1813,0.1806,0.0018,0.0018,0.0017,0.0292,0.0291,0.0577,13000045,0,0,7fd1bf,0
*b490ddee
```

Field	Field Type	Description	Binary Format	Binary Bytes	Binary Offset
1	Log header	INSSTDEV header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	Latitude σ	Latitude standard deviation (m)	Float	4	H
3	Longitude σ	Longitude standard deviation (m)	Float	4	H+4
4	Height σ	Height standard deviation (m)	Float	4	H+8
5	North Velocity σ	North velocity standard deviation (m/s)	Float	4	H+12
6	East Velocity σ	East velocity standard deviation (m/s)	Float	4	H+16
7	Up Velocity σ	Up velocity standard deviation (m/s)	Float	4	H+20
8	Roll σ	Roll standard deviation (degrees)	Float	4	H+24
9	Pitch σ	Pitch standard deviation (degrees)	Float	4	H+28
10	Azimuth σ	Azimuth standard deviation (degrees)	Float	4	H+32
11	Ext sol stat	Extended solution status See *Table 28: Extended Solution Status* on page 88	Ulong	4	H+36
12	Time Since Update	Elapsed time since the last ZUPT or position update (seconds)	Ushort	2	H+40
13	Reserved		Ushort	2	H+42

Field	Field Type	Description	Binary Format	Binary Bytes	Binary Offset
14	Reserved		Ulong	4	H+44
15	Reserved		Ulong	4	H+48
16	xxxx	32-bit CRC (ASCII and Binary only).	Hex	4	H+52
17	[CR][LF]	Sentence terminator (ASCII only).	-	-	-

The INS standard deviation values reported by the SPAN filter are an estimate of the Inertial filter solution quality. In lower accuracy GNSS position modes, such as SINGLE or WAAS (see Table: Position or Velocity Type), the position standard deviation values can appear to become optimistic compared with the absolute GNSS accuracy. This is due to the INS filter's ability to smooth short term noise in the GNSS solution, although the overall position error envelope still reflects the GNSS accuracy. Therefore, if the desired application requires absolute GNSS position accuracy, it is recommended to also monitor GNSS position messages such as BESTGNSSPOS (see **BESTGNSSPOS** log).

2.3.9 INSSTDEVS

Short INS PVA standard deviations

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7-S**

This log is the short header version of the **INSSTDEV** log (see page 96).

Message ID: 2052

Log Type: Synch

Abbreviated ASCII Syntax:

```
log insstdevs ontime 1
```

ASCII Example:

```
%INSSTDEVSA,2209,491032.000;0.1812,0.1812,0.1805,0.0018,0.0018,0.0017,0.0291,
0.0291,0.0575,13000045,0,0,7fd1bf,0*b6d40807
```

Field	Field Type	Description	Binary Format	Binary Bytes	Binary Offset
1	Log header	INSSTDEVS header For information about short log headers, see Description of ASCII and Binary Logs with Short Headers.	-	H	0
2	Latitude σ	Latitude standard deviation (m)	Float	4	H
3	Longitude σ	Longitude standard deviation (m)	Float	4	H+4
4	Height σ	Height standard deviation (m)	Float	4	H+8
5	North Velocity σ	North velocity standard deviation (m/s)	Float	4	H+12
6	East Velocity σ	East velocity standard deviation (m/s)	Float	4	H+16
7	Up Velocity σ	Up velocity standard deviation (m/s)	Float	4	H+20
8	Roll σ	Roll standard deviation (degrees)	Float	4	H+24
9	Pitch σ	Pitch standard deviation (degrees)	Float	4	H+28
10	Azimuth σ	Azimuth standard deviation (degrees)	Float	4	H+32
11	Ext sol stat	Extended solution status See *Table 28: Extended Solution Status* on page 88	Ulong	4	H+36
12	Time Since Update	Elapsed time since the last ZUPT or position update (seconds)	Ushort	2	H+40

Field	Field Type	Description	Binary Format	Binary Bytes	Binary Offset
13	Reserved		Ushort	2	H+42
14	Reserved		Ulong	4	H+44
15	Reserved		Ulong	4	H+48
16	xxxx	32-bit CRC (ASCII and Binary only).	Hex	4	H+52
17	[CR][LF]	Sentence terminator (ASCII only).	-	-	-

The INS standard deviation values reported by the SPAN filter are an estimate of the Inertial filter solution quality. In lower accuracy GNSS position modes, such as SINGLE or WAAS (see Table: Position or Velocity Type), the position standard deviation values can appear to become optimistic compared with the absolute GNSS accuracy. This is due to the INS filter's ability to smooth short term noise in the GNSS solution, although the overall position error envelope still reflects the GNSS accuracy. Therefore, if the desired application requires absolute GNSS position accuracy, it is recommended to also monitor GNSS position messages such as BESTGNSSPOS (see **BESTGNSSPOS** log).

2.3.10 INSUPDATESTATUS

INS Update Status

Platform: OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7-S

This log provides the most recent INS update information used by the system. It provides information about what updates were performed in the INS filter at the specified time.

Multiple **INSUPDATESTATUS** logs may be published each epoch. For example, any DMI or external updates will trigger an independent, asynchronous log. These asynchronous logs may show that other updates are not being used because they are the only valid update applied at the specified time.

In the ASCII example below, the first INSUPDATESTATUS log shows 22 phase and 24 doppler updates were applied at 416218.000 and the second INSUPDATESTATUS log shows the DMI update was USED at 416218.002.

Message ID: 1825

Log Type: Asynch

Recommended Input:

```
log insupdatestatus onchanged
```

ASCII Example:

```
#INSUPDATESTATUSA,COM3,0,49.0,FINESTEERING,2117,416218.000,02004020,78f1,32768;
INS_PSRSP,0,22,24,INACTIVE,USED,0b0020c3,007ff3bf,0,0*c1d6e8bc
```

```
#INSUPDATESTATUSA,COM3,0,49.0,FINESTEERING,2117,416218.002,02004020,78f1,32768;
INS_PSRSP,0,0,0,USED,INACTIVE,0b0020c3,007ff3bf,0,0*0aa584c7
```

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Log header	INSUPDATESTATUS header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	PosType	Type of GNSS solution used for the last INS filter update. See Table: Position or Velocity Type	Enum	4	H
3	NumPSR	Number of raw pseudorange observations used in the last INS filter update.	Integer	4	H+4
4	NumADR	Number of raw phase observations used in the last INS filter update.	Integer	4	H+8
5	NumDOP	Number of raw doppler observations used in the last INS filter update.	Integer	4	H+12
6	DMI Update Status	Distance measurement instrument (wheel sensor) status. See *Table 33: DMI Update Status* on the next page.	Enum	4	H+16

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
7	ALIGN Update Status	Status of the ALIGN update during the last INS filter update. See *Table 34: ALIGN Update Values* below	Enum	4	H+20
8	Ext sol stat	Extended solution status See *Table 28: Extended Solution Status* on page 88	Hex	4	H+24
9	INS Enabled Updates	Enabled INS updates. See *Table 35: INS Update Values* on the next page	Hex	4	H+28
10	Reserved		Ulong	4	H+32
11	Reserved		Ulong	4	H+36
12	xxxx	32-bit CRC (ASCII, Binary and Short Binary only)	Hex	4	H+40
13	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 33: DMI Update Status

Binary	ASCII	Description
0	INACTIVE	The DMI sensor is not connected.
1	ACTIVE	The DMI sensor is connected but not used.
2	USED	The DMI sensor is connected and used in the INS solution.
3	RESERVED	Reserved
4	BAD_MISC	The measurement of the DMI sensor resulted in bad misclosure and was rejected.
5	HIGH_ ROTATION	The measurement of the DMI sensor was not used because the system is undergoing high rotation.

Table 34: ALIGN Update Values

Binary	ASCII	Description
0	INACTIVE	An ALIGN update was not available.
1	ACTIVE	ALIGN updates are running, but the epoch is not used as an update. When all other rejection criteria pass, an ALIGN update will still only be applied once every 5 seconds (20 seconds when stationary).
2	USED	The update for that epoch was taken.
5	BAD_MISC	ALIGN updates are running, but was not performed this epoch due to a large disagreement with filter estimates.

Table 35: INS Update Values

Nibble	Bit	Mask	Description	Range Value
N0	0	0x00000001	Position update	0 = Disabled 1 = Enabled
	1	0x00000002	Phase update	0 = Disabled 1 = Enabled
	2	0x00000004	Zero velocity update	0 = Disabled 1 = Enabled
	3	0x00000008	Wheel sensor update	0 = Disabled 1 = Enabled
N1	4	0x00000010	ALIGN update	0 = Disabled 1 = Enabled
	5	0x00000020	External position update	0 = Disabled 1 = Enabled
	6	0x00000040	Reserved	
	7	0x00000080	Doppler update	0 = Disabled 1 = Enabled
N2	8	0x00000100	Pseudorange update	0 = Disabled 1 = Enabled
	9	0x00000200	Velocity update	0 = Disabled 1 = Enabled
	10	0x00000400	Reserved	
	11	0x00000800	Dead reckoning update	0 = Disabled 1 = Enabled
N3	12	0x00001000	Phase wind up update	0 = Disabled 1 = Enabled
	13	0x00002000	Course over ground update	0 = Disabled 1 = Enabled
	14	0x00004000	External velocity update	0 = Disabled 1 = Enabled
	15	0x00008000	External attitude update	0 = Disabled 1 = Enabled
N4	16	0x00010000	External heading update	0 = Disabled 1 = Enabled
	17	0x00020000	External height update	0 = Disabled 1 = Enabled
	18	0x00040000	Reserved	
	19	0x00080000	Reserved	

2.3.11 ITBANDPASSBANK

Allowable band pass filter configurations

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

The ITBANDPASSBANK log provides information on the allowable configurations for each frequency when applying a bandpass filter. The current filters in use can be seen with the **ITFILTTABLE** log on page 108.

To view the allowable configurations for the secondary antenna of dual antenna receivers (OEM7720, PwrPak7D, PwrPak7D-E1, PwrPak7D-E2 and CPT7), log **ITBANDPASSBANK_1**.

Message ID: 2022

Log Type: Asynch

Recommended Input:

```
log itbandpassbanka once
```

Abbreviated ASCII Example:

```
<ITBANDPASSBANK USB1 0 54.0 UNKNOWN 0 2.392 02000020 fb2e 16809
<     9
<          GPSL5 1164.3750 1173.1250 1178.1250 1186.8750 0.05
<          GALILEOE5A 1164.3750 1173.1250 1178.1250 1186.8750 0.05
<          GALILEOE5B 1195.6250 1204.3750 1209.3750 1218.1250 0.05
<          BEIDOUB1 1549.6875 1558.4375 1563.4375 1572.1875 0.05
<          BEIDOUB2 1195.6250 1204.3750 1209.3750 1218.1250 0.05
<          QZSSL5 1164.3750 1173.1250 1178.1250 1186.8750 0.05
<          NAVICL5 1164.3750 1173.1250 1178.1250 1186.8750 0.05
<          BEIDOUB2A 1164.3750 1173.1250 1178.1250 1186.8750 0.05
<          BEIDOUB2B 1195.6250 1204.3750 1209.3750 1218.1250 0.05
```

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Log header	ITBANDPASSBANK header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	# of entries	Number of entries to follow	Ulong	4	H
3	frequency	See *Table 19: Frequency Types* on page 55	Enum	4	H+4
4	min lower frequency cutoff	The minimum frequency cutoff at the lower end (MHz)	Float	4	H+8
5	max lower frequency cutoff	The maximum frequency cutoff at the lower end (MHz)	Float	4	H+12
6	min upper frequency cutoff	The minimum frequency cutoff at the upper end (MHz)	Float	4	H+16

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
7	max upper frequency cutoff	The maximum frequency cutoff at the upper end (MHz)	Float	4	H+20
8	frequency step	The minimum cut off frequency resolution (MHz)	Float	4	H+24
9	Next entry offset = H + 4 + (#entries * 24)				
10	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+4+ (#entries * 24)
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

2.3.12 ITDETECTSTATUS

Interference detection status

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

This log lists all of the detected interferences from all active paths where interference detection is enabled.

This log should be used with the **onchanged** trigger only.

To view the detected interferences from all active paths on the secondary antenna of dual antenna receivers (OEM7720, PwrPak7D, PwrPak7D-E1, PwrPak7D-E2 and CPT7), log **ITDETECTSTATUS_1**.

Message ID: 2065

Log Type: Asynch

Recommended Input:

```
log itdetectstatusa onchanged
```

ASCII Example

```
#ITDETECTSTATUSA,USB2,0,74.0,FINESTEERING,1982,430605.267,0200c000,7fdb,32768;3,
L1,STATISTICANALYSIS,-0.718,29.167,0.126,12.797,00000000,00000000,00000000,
L2,SPECTRUMANALYSIS,1249.961,71.191,-56.769,-132.907,00000000,00000000,
00000000,
L2,SPECTRUMANALYSIS,1289.512,1.978,-75.967,-138.493,00000000,00000000,
00000000*5e83b175
```

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Log header	ITDETECTSTATUS header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	# of entries	Number of interferences to follow	Ulong	4	H
3	RF Path	RF path for this entry. 2 = L1 3 = L2 5 = L5	Enum	4	H+4
4	Interference detection type	Interference detection type for this entry. 0 = SPECTRUMANALYSIS 1 = STATISTICALANALYSIS	Enum	4	H+8

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
5	Parameter 1	The first parameter of the interference. For SPECTRUMANALYSIS type, this is the center frequency in MHz. For STATISTICALANALYSIS type, this is reserved.	Float	4	H+12
6	Parameter 2	The second parameter of the interference. For SPECTRUMANALYSIS type, this is the bandwidth in MHz. For STATISTICALANALYSIS type, this is reserved.	Float	4	H+16
7	Parameter 3	The third parameter of the interference. For SPECTRUMANALYSIS type, this is the estimated power in dBm of the interference. For STATISTICALANALYSIS type, this is reserved.	Float	4	H+20
8	Parameter 4	The fourth parameter of the interference. For SPECTRUMANALYSIS type, this is the highest estimated power spectrum density in dBmHz of the interference. For STATISTICALANALYSIS type this is reserved.	Float	4	H+24
9	Reserved 1	Reserved	Ulong	4	H+28
10	Reserved 2	Reserved	Ulong	4	H+32
11	Reserved 3	Reserved	Ulong	4	H+36
12	Next interference signal offset = H + 4 + (#entries * 36)				
13	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H=4+ (#entries * 36)
14	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 36: RF Paths for OEM7 Receivers

RF Path	OEM719, OEM729, OEM7700, PwrPak7, CPT7700, SMART7	OEM7720, PwrPak7D, CPT7	OEM7500, SMART2	OEM7600
L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1 LBand	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1

RF Path	OEM719, OEM729, OEM7700, PwrPak7, CPT7700, SMART7	OEM7720, PwrPak7D, CPT7	OEM7500, SMART2	OEM7600
L2	GPS L2 GLONASS L2 Galileo E6 BDS B3 QZSS L2/L6	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5
L5	GPS L5 GLONASS L3 Galileo E5 BDS B2 QZSS L5 NavIC L5 SBAS L5			
LBAND	LBand	LBand		LBand

2.3.13 ITFILTTABLE

Filter configuration for each frequency

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

The ITFILTTABLE log contains the filter configuration summary for each frequency. It lists which bandpass or notch filters are enabled and how each is configured.

To view the filter configuration summary for the secondary antenna of dual antenna receivers (OEM7720, PwrPak7D, PwrPak7D-E1, PwrPak7D-E2 and CPT7), log **ITFILTTABLE_1**.

Message ID: 1991

Log Type: Asynch

Recommended Input:

```
log itfilttablea once
```

ASCII Example:

```
#ITFILTTABLEA,USB1,0,52.5,FINESTEERING,2209,507953.506,12000020,35d0,16809;
23,
GPSL1,8,CIC3,00000000,DISABLE,0.0000,0.0000,1,ENABLE,PF0,NOTCHFILTER,1569.0000,
1581.0000,0.150,
GPSL2,4,CIC3,00000000,DISABLE,0.0000,0.0000,0,
GLONASSL1,9,CIC3,00000000,DISABLE,0.0000,0.0000,0,
GLONASSL2,5,CIC3,00000000,DISABLE,0.0000,0.0000,0,
GPSL5,0,CIC3,00000000,DISABLE,0.0000,0.0000,0,
LBAND,11,CIC3,00000000,DISABLE,0.0000,0.0000,0,
GALILEOE1,8,CIC3,00000000,DISABLE,0.0000,0.0000,1,ENABLE,PF0,NOTCHFILTER,1569.0
000,1581.0000,0.150,
GALILEOE5A,0,CIC3,00000000,DISABLE,0.0000,0.0000,0,
GALILEOE5B,1,CIC3,00000000,DISABLE,0.0000,0.0000,0,
GALILEOALTBOC,10,CIC3,00000000,DISABLE,0.0000,0.0000,0,
BEIDOUB1,2,CIC3,00000000,DISABLE,0.0000,0.0000,0,
BEIDOUB2,1,CIC3,00000000,DISABLE,0.0000,0.0000,0,
QZSSL1,8,CIC3,00000000,DISABLE,0.0000,0.0000,1,ENABLE,PF0,NOTCHFILTER,1569.0000
,1581.0000,0.150,
QZSSL2,4,CIC3,00000000,DISABLE,0.0000,0.0000,0,
QZSSL5,0,CIC3,00000000,DISABLE,0.0000,0.0000,0,
QZSSL6,6,CIC3,00000000,DISABLE,0.0000,0.0000,0,
GALILEOE6,6,CIC3,00000000,DISABLE,0.0000,0.0000,0,
BEIDOUB3,7,CIC3,00000000,DISABLE,0.0000,0.0000,0,
GLONASSL3,10,CIC3,00000000,DISABLE,0.0000,0.0000,0,
NAVICL5,0,CIC3,00000000,DISABLE,0.0000,0.0000,0,
BEIDOUB1C,8,CIC3,00000000,DISABLE,0.0000,0.0000,1,ENABLE,PF0,NOTCHFILTER,1569.0
000,1581.0000,0.150,
BEIDOUB2A,0,CIC3,00000000,DISABLE,0.0000,0.0000,0,
BEIDOUB2B,1,CIC3,00000000,DISABLE,0.0000,0.0000,0*cfb2b0d4
```

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Log header	ITFILTTABLE header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	# entries	Number of records with information to follow	Ulong	4	H
3	frequency	The frequency at which the filter is applied. See *Table 19: Frequency Types* on page 55	Enum	4	H+4
4	Encoder ID	ID of the digital path used by this frequency	Ulong	4	H+8
5	DDC filter type	The DDC filter type (see *Table 37: DDC Filter Type* on the next page)	Enum	4	H+12
6	status word	Filter warning limit status. Raise a warning flag if the filter is placed too close to the center frequency of the GNSS signal (see *Table 38: ITFILTTable Status Word* on the next page)	Ulong	4	H+16
7	switch	Filter is enabled or disabled (see *Table 39: Filter Switches* on page 111)	Enum	4	H+20
8	lower cut off frequency	Cut off frequency at the lower end (MHz)	Float	4	H+24
9	upper cut off frequency	Cut off frequency at the upper end (MHz)	Float	4	H+28
10	# prog filters	Number of programmable filters applied	Ulong	4	H+32
11	switch	Filter is enabled or disabled (see *Table 39: Filter Switches* on page 111)	Enum	4	H+36
12	prog filter ID	The programmable filter ID (see *Table 16: Programmable Filter ID* on page 52)	Enum	4	H+40
13	mode	Programmable filter mode (notch filter or bandpass) (see *Table 17: Programmable Filter Mode* on page 52)	Enum	4	H+44
14	lower cut off frequency	Cut off frequency at the lower end (MHz)	Float	4	H+48
15	upper cut off frequency	Cut off frequency at the upper end (MHz)	Float	4	H+52
16	notch width	Width of notch filter (MHz)	Float	4	H+56
17	Next programmable filter – variable binary offset				

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
18	Next frequency – variable binary offset				
19	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	Variable
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 37: DDC Filter Type

Binary	ASCII
0	PASSTHROUGH
1	CIC1
2	CIC2
3	CIC3
4	HALFBAND

Table 38: ITFILTTable Status Word

Nibble	Bit	Mask	Description	Range Value
N0	0	0x00000001	First enabled filter	0 = Within acceptable limit 1 = Warning
	1	0x00000002		
	2	0x00000004		
	3	0x00000008		
N1	4	0x00000010		
	5	0x00000020		
	6	0x00000040		
	7	0x00000080		
N2	8	0x00000100	Second enabled filter	0 = Within acceptable limit 1 = Warning
	9	0x00000200		
	10	0x00000400		
	11	0x00000800		
N3	12	0x00001000		
	13	0x00002000		
	14	0x00004000		
	15	0x00008000		

Nibble	Bit	Mask	Description	Range Value
N4	16	0x00010000	Third enabled filter	0 = Within acceptable limit 1 = Warning
	17	0x00020000		
	18	0x00040000		
	19	0x00080000		
N5	20	0x00100000		
	21	0x00200000		
	22	0x00400000		
	23	0x00800000		
N6	24	0x01000000	Fourth enabled filter	0 = Within acceptable limit 1 = Warning
	25	0x02000000		
	26	0x04000000		
	27	0x08000000		
N7	28	0x10000000		
	29	0x20000000		
	30	0x40000000		
	31	0x80000000		

Table 39: Filter Switches

Binary Value	ASCII Value	Description
0	DISABLE	Filter disabled
1	ENABLE	Filter enabled

2.3.14 ITPROGFILTBANK

Allowable filter configurations

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

The ITPROGFILTBANK log provides information on the allowable configurations for the programmable filter for each frequency when applying either a notch filter or bandpass filter. The current filters in use can be seen with the **ITFILTTABLE** log on page 108.

To view the allowable configurations for the secondary antenna of dual antenna receivers (OEM7720, PwrPak7D, PwrPak7D-E1, PwrPak7D-E2 and CPT7), log **ITPROGFILTBANK_1**.

Message ID: 2023

Log Type: Asynch

Recommended Input:

```
log itprogfiltbanka once
```

Abbreviated ASCII Example:

```
<ITPROGFILTBANK USB1 0 53.5 UNKNOWN 0 2.392 12000020 3696 16809
<     21
<          GPSL1 5
<          NOTCHFILTER 1563.0000 1574.0000 1576.0000 1587.0000 0.05 0.15
<          NOTCHFILTER 1563.7500 1573.6000 1576.4000 1586.2500 0.05 0.50
<          NOTCHFILTER 1564.0500 1573.3000 1576.7000 1585.9500 0.05 1.00
<          NOTCHFILTER 1565.7500 1571.7000 1578.3000 1584.2500 0.05 2.50
<          BANDPASSFILTER 1563.7500 1572.5000 1577.5000 1586.2500 0.05 0.00
<          GPSL2 5
<          NOTCHFILTER 1215.5000 1226.5000 1228.5000 1239.5000 0.05 0.15
<          NOTCHFILTER 1216.2500 1226.1000 1228.9000 1238.7500 0.05 0.50
<          NOTCHFILTER 1216.5500 1225.8000 1229.2000 1238.4500 0.05 1.00
<          NOTCHFILTER 1218.2500 1224.2000 1230.8000 1236.7500 0.05 2.50
<          BANDPASSFILTER 1216.2500 1225.0000 1230.0000 1238.7500 0.05 0.00
...
<          BEIDOUB2A 5
<          NOTCHFILTER 1163.6250 1174.6250 1176.6250 1187.6250 0.05 0.15
<          NOTCHFILTER 1164.3750 1174.2250 1177.0250 1186.8750 0.05 0.50
<          NOTCHFILTER 1164.6750 1173.9250 1177.3250 1186.5750 0.05 1.00
<          NOTCHFILTER 1166.3750 1172.3250 1178.9250 1184.8750 0.05 2.50
<          BANDPASSFILTER 1164.3750 1173.1250 1178.1250 1186.8750 0.05 0.00
<          BEIDOUB2B 5
<          NOTCHFILTER 1194.8750 1205.8750 1207.8750 1218.8750 0.05 0.15
<          NOTCHFILTER 1195.6250 1205.4750 1208.2750 1218.1250 0.05 0.50
<          NOTCHFILTER 1195.9250 1205.1750 1208.5750 1217.8250 0.05 1.00
<          NOTCHFILTER 1197.6250 1203.5750 1210.1750 1216.1250 0.05 2.50
<          BANDPASSFILTER 1195.6250 1204.3750 1209.3750 1218.1250 0.05 0.00
```

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Log header	ITPROGFILTBANK header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	# entries	Number of entries to follow	Ulong	4	H
3	frequency	See *Table 19: Frequency Types* on page 55	Enum	4	H+4
4	# prog filters	Number of programmable filters applied with information to follow	Ulong	4	H+8
5	mode	Programmable filter mode (notch filter or bandpass) (see *Table 17: Programmable Filter Mode* on page 52)	Enum	4	H+12
6	min lower frequency cutoff	The minimum frequency cutoff at the lower end (MHz)	Float	4	H+16
7	max lower frequency cutoff	The maximum frequency cutoff at the lower end (MHz)	Float	4	H+20
8	min upper frequency cutoff	The minimum frequency cutoff at the upper end (MHz)	Float	4	H+24
9	max upper frequency cutoff	The maximum frequency cutoff at the upper end (MHz)	Float	4	H+28
10	frequency step	The minimum cut off frequency resolution (MHz)	Float	4	H+32
11	notch width	Width of notch filter (MHz)	Float	4	H+36
12	Next programmable filter – variable binary offset				
13	Next frequency – variable binary offset				
14	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	variable
15	[CR][LF]	Sentence terminator (ASCII only)			

2.3.15 ITPSDFINAL

Processed power spectral density

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

The ITPSDFINAL log contains the samples for the spectral analysis. The rate and size is set by the update period and the FFT size respectively when issuing the **ITSPECTRALANALYSIS** command (see page 53).

PSD samples are compressed into 2 byte samples to reduce log sizes. The range of values that can be displayed is -200 dBm to +56 dBm with a 1/256 resolution. The following steps should be performed on the PSD samples in this log to convert them back into dBm units for display purposes:

1. Divide the sample by 256.0
2. Subtract 200

The number of samples are calculated according to the following table. The maximum number of samples in one ITPSDFINAL log is 1024. That means if the number of samples is less than 1024, one log is enough to output them. However, if the number of samples is larger than 1024, more than one ITPSDFINAL log is needed. For example, in postdecimation mode with the FFT size of 8K and subcarrier integration of 5, there is one log with 1024 samples and another log with 614 samples. The output logs can be grouped together through the sequence number of the log header.

Data Source	Number of Samples
PREDECIMATION	FFTsize/(2*subcarrier_integration)
POSTDECIMATION	FFTsize/subcarrier_integration
POSTFILTER	FFTsize/subcarrier_integration

As the data rate for the ITPSDFINAL log is dictated by the updateperiod parameter in the **ITSPECTRALANALYSIS** command (see page 53), do not use ONTIME or ONCE to log this message. Instead use ONNEW to log ITPSDFINAL.

The pre-decimation spectrum shows the absolute power in dBm which is proportional to the resolution bandwidth (RBW). The post-decimation and post-filter spectrum shows the signal magnitude in relative power (dB).

To view the samples for the spectral analysis for the secondary antenna of dual antenna receivers (OEM7720, PwrPak7D, PwrPak7D-E1, PwrPak7D-E2 and CPT7), log **ITPSDFINAL_1**.

Message ID: 1968

Log Type: Asynch

Recommended Input:

```
log itpsdfinala onnew
```

ASCII Example

```
#ITPSDFINALA,USB1,0,52.5,FINESTEERING,2209,507969.564,12000020,b79a,16809;26142
860,1562.561,122070.313,204,29796,29396,29720,29568,30272,29991,30321,29749,294
82,29315,29754,29329,29859,29839,29366,29818,30178,30317,29421,30146,29896,3014
4,30760,30315,29564,30139,30164,30667,30943,29849,30659,30339,30895,30267,30462
,29965,30541,30240,30712,30883,30523,30596,30775,30638,30753,30839,29860,31314,
31508,30487,30353,28644,26580,26452,27765,29511,30887,31557,31096,31549,31135,3
1567,31193,31756,31568,31470,31732,31118,31946,31416,31526,31193,31882,31454,31
379,31558,31555,31972,32125,31970,31384,31204,32437,31611,31551,32050,31730,319
69,31871,31232,31584,32252,31373,32220,32198,32189,33447,32370,33055,33660,3318
2,33203,33523,33306,32746,33764,33909,33424,33019,33953,32423,33388,33055,32483
,33109,32435,32411,32205,32338,32310,32051,32228,31851,32049,31698,31584,31816,
31821,31399,32122,32096,32253,31889,32050,31787,31575,31775,31363,31556,31593,3
1216,30940,31538,31570,31529,31265,31295,31518,31361,29133,27947,25797,26746,29
320,30342,30694,31279,31063,31655,30911,30762,30625,30845,30991,30900,30946,308
47,30441,30702,31092,31097,30364,31093,30439,31202,30641,30051,29842,30629,3067
6,30082,30466,30499,30363,30245,30515,30441,30365,30217,30359,29207,30538,30327
,30162,30518,29656,29978,30273,30084,30297,30136,30172,29755,29455*40f7bd2d
```

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Log header	ITPSDFINAL header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	status word	Status word containing information about the configuration of the spectral analysis (see *Table 40: Spectral Analysis Status Word* on the next page)	Ulong	4	H
3	frequency start	Frequency represented by first data sample (MHz)	Float	4	H+4
4	resolution bandwidth	The resolution bandwidth (Hz)	Float	4	H+8
5	# samples	Number of spectral density samples	Ulong	4	H+12
6	sample	Power spectral density sample	Ushort	2	H+16
7	Next sample = H+16+(2*#samples)				
8	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+16+ (2*#samples)
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 40: Spectral Analysis Status Word

Nibble	Bit	Mask	Description	Range Value
N0	0	0x00000001	Frequency	0 – 20 See *Table 19: Frequency Types* on page 55
	1	0x00000002		
	2	0x00000004		
	3	0x00000008		
N1	4	0x00000010		
	5	0x00000020	Data Source	0 – 3 See *Table 18: Data Sources for PSD Samples* on page 54
	6	0x00000040		
	7	0x00000080		
N2	8	0x00000100	FFT Size	0 – 6 See *Table 20: FFT Sizes* on page 56
	9	0x00000200		
	10	0x00000400		
	11	0x00000800	Integration Window	1 – 1024 samples
N3	12	0x00001000		
	13	0x00002000		
	14	0x00004000		
	15	0x00008000		
N4	16	0x00010000		
	17	0x00020000	Time Average Window	0 – 100 seconds
	18	0x00040000		
	19	0x00080000		
N5	20	0x00100000		
	21	0x00200000		
	22	0x00400000		
	23	0x00800000		
N6	24	0x01000000		
	25	0x02000000	Reserved	
	26	0x04000000		
	27	0x08000000		

Nibble	Bit	Mask	Description	Range Value
N7	28	0x10000000	Reserved	
	29	0x20000000		
	30	0x40000000		
	31	0x80000000		

2.3.16 J1939STATUS

Status of CAN J1939 Node

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

This logs reports the status of J1939 node, specifically J1939 Address Claim function (initiated using the **J1939CONFIG** command (see page 57)).

This log displays the status only for nodes that have been set.

Message ID: 1907

Log Type: Asynch

Recommended Input:

```
LOG J1939STATUSA ONCHANGED
```

ASCII Examples:

```
#J1939STATUSA,USB1,1,53.0,UNKNOWN,0,0.204,12000020,e9ce,16809;NODE1,DISABLED,0,
FE*6980fd0f
```

```
#J1939STATUSA,USB1,0,53.0,UNKNOWN,0,0.204,12000020,e9ce,16809;NODE2,DISABLED,0,
FE*cee67706
```

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Log header	J1939STATUS header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	node	J1939 Node. The node can be either NODE1 or NODE2.	Enum	4	H
3	status	Node status. See *Table 41: Node Status* below	Enum	4	H+4
4	count	Number of attempts that were made to claim address. This will be 1 when the preferred address is used and may be more if the alternate range is used.	Ulong	4	H+8
5	address	Claimed CAN Address. 0xFE (NULL address) if the address could not be negotiated.	Uchar	1	H+12
6	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+13
7	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

Table 41: Node Status

Value	ASCII	Description
1	DISABLED	Address claim activity is not taking place. The node does not have J1939 enabled.

Value	ASCII	Description
2	CLAIMING	Address claim procedure is in progress.
3	CLAIMED	Address claimed successfully. Ready for data transfer.
4	FAILED	Address claim was not successful. No further activity is taking place.

2.3.17 MODELFEATURES

States features available for current loaded model

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

The MODELFEATURES log states the features available for the current loaded model.

To see which satellite systems are available for the current model, use the **CHANCONFIGLIST** log.

Most features have a boolean state: authorized or unauthorized. However, some have more complex licensed states with varying degrees of capability.

This log is best viewed in Abbreviated ASCII.

Message ID: 1329

Log Type: Polled

Recommended Input:

```
log modelfeatures once
```

Abbreviated ASCII Example:

```
<MODELFEATURES USB1 0 53.5 FINESTEERING 2209 508953.938 12000020 141a 16809
<     26
<          100HZ MAX_MSR_RATE
<          100HZ MAX_POS_RATE
<          SINGLE ANTENNA
<          COMMERCIAL_MEMS IMU
<          STANDARD INS
<          AUTHORIZED MEAS_OUTPUT
<          AUTHORIZED DGPS_TX
<          AUTHORIZED RTK_TX
<          AUTHORIZED RTK_FLOAT
<          AUTHORIZED RTK_FIXED
<          AUTHORIZED PPP
<          AUTHORIZED LOW_END_POSITIONING
<          AUTHORIZED RAIM
<          AUTHORIZED INTERFERENCE_MITIGATION
<          AUTHORIZED NTRIP
<          AUTHORIZED INS_PLUS_PROFILES
<          AUTHORIZED HEAVE
<          AUTHORIZED DEBUG
<          UNAUTHORIZED ALIGN_HEADING
<          UNAUTHORIZED ALIGN_RELATIVE_POS
<          UNAUTHORIZED API
<          UNAUTHORIZED SPRINKLER
<          UNAUTHORIZED RTKASSIST
<          UNAUTHORIZED SCINTILLATION
<          UNAUTHORIZED GENERIC_IMU
<          UNAUTHORIZED RELATIVE_INS
```

Field	Field type	Description	Format	Binary Bytes	Binary Offset
1	Log header	MODELFEATURES header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	# Feature	Number of features in list	Ulong	4	H
3	Feature Status	Licensing status of feature See *Table 42: Feature Status* below	Enum	4	H+4
4	Feature Type	Type of feature See *Table 43: Feature Type* on the next page	Enum	4	H+8
5...	Next feature = H+4+(# Feature x 8)				
6	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+4+(# Feature x 8)
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 42: Feature Status

Value	Name	Description
0	AUTHORIZED	The feature is authorized
1	UNAUTHORIZED	The feature is unauthorized
2	0Hz	Disables output of POS logs
6	20Hz	Maximum logging rate for POS or MSR logs is 20 Hz
8	100Hz	Maximum logging rate for POS or MSR logs is 100 Hz
9	RATE_INVALID	Option bits don't correspond to a valid rate
15	STANDARD	SPAN Standard Model
20	COMMERCIAL_MEMS	IMU Grade-Commercial MEMS
21	TACTICAL	IMU Grade-Tactical
22	HIGH_GRADE_TACTICAL	IMU Grade-High Grade Tactical
23	NAVIGATION	IMU Grade-Navigation
25	SINGLE	Single antenna
26	DUAL	Dual antenna
30	LITE	SPAN Lite Model
33	CONSUMER_MEMS	IMU Grade-Consumer MEMS
37	RADIO_TX	External Radio Control
38	GLIDE	GLIDE
39	TILT	Tilt

Table 43: Feature Type

Value	Name	Description
0	MAX_MSR_RATE	Maximum measurement logging rate
1	MAX_POS_RATE	Maximum position logging rate
3	MEAS_OUTPUT	Output of raw measurements (phase and pseudorange)
4	DGPS_TX	Transmission of DGPS (non RTK) corrections
5	RTK_TX	Transmission of RTK corrections
6	RTK_FLOAT	RTK float positioning
7	RTK_FIXED	RTK fixed positioning
8	RAIM	Extended RAIM
9	LOW_END_ POSITIONING	GLIDE and TerraStar-L positioning
10	ALIGN_HEADING	Heading
11	ALIGN_RELATIVE_ POS	Heading and Relative Positioning
12	API	Lua Scripted User Interface (formerly User Application API)
15	NTRIP	NTRIP Server/Client
19	PPP	TerraStar-C PRO or TerraStar-X positioning
20	SCINTILLATION	Scintillation
22	INS	Inertial (SPAN)
23	IMU	IMU Grade
26	INTERFERENCE_ MITIGATION	Interference Mitigation
28	ANTENNA	Number of antenna enabled on the receiver
29	GENERIC_IMU	SPAN Generic IMU Interface
30	INS_PLUS_PROFILES	SPAN Plus Profiles
31	HEAVE	SPAN Heave Option
32	RELATIVE_INS	SPAN Relative INS
33	PRODUCT_FEATURE	Additional product feature has been authorized. See the **Feature Status** field for details.
34	SPRINKLER	Sprinkler
999	MODEL_INVALID	If a bad model is loaded, MODELFEATURES will contain one entry: MODEL_ INVALID STATUS_INVALID

2.3.18 RANGECMP4

Highly compressed version of the RANGE log

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

This log contains the RANGE data in a more heavily compressed format compared to the RANGECMP2 log.

For dual antenna receivers, a RANGECMP4_1 log can be requested to get RANGECMP4 data from the second antenna. As described in Table: Binary Message Header Structure, the message type indicates the log is from the second antenna. To request an ASCII log enter RANGECMP4A_1, and for a binary log enter RANGECMP4B_1.

1. Channels that have been manually assigned to a PRN with **ASSIGN** or **ASSIGNALL** are not reported in the **RANGECMP4** log.
2. L-Band channels are not reported in the **RANGECMP4** log.
3. The **RANGECMP4** log should not be logged with an offset. The RANGECMP4 implementation is dependent on getting measurements at the even second. The allowable triggers are the same as other measurement logs such as **RANGE**, **RANGECMP** and **RANGECMP2**.
4. **RANGECMP4** is a complex log. For more information about decoding the **RANGECMP4** log, refer to Example of Bit Parsing a RANGECMP4 Log.

Message ID: 2050

Log Type: Synch

Recommended Input:

```
log rangecmp4a ontime 10
```

Example:

```
#RANGECMP4A,USB1,0,54.0,FINESTEERING,2209,512549.000,02000020,fb0e,16809;1843,e
70012090a5300000000b280e3bcf3c77be740d2fb1aa652a93f153ffce7b40f22ddbdcc060018dc
fe090078834fb2f11b379bb20b008429d3dfbe17915a80ca1b80ff1ffd9ee45e02a02700fd3ffcb
6b712ef93b55da3b7fffc4a12eedb8f09a0c0ece1df0228716fe6370208717f0b20dfbd08d60abc
a5fe1b0298746f1317599ab27898fe574c724cb71f224d01f066bf0310e3de085605fc5cfd0f00c
4bbaf19ebf6fc563064803636d24bdccf6887808923c0fecf785f337202025080fbbf077ec41613
...
f0c0164bc97e1ded4165bc259007451d5d7dccb74b201d9006033e8745f345cffef00019fbf047e
84342030ef010e82b4f710577970a10a5809201a3ec40d2bea90aaedff6be9967ffb3e626603604
700b440107c9235f88f9c019c00edf00114436060ec9f03e4bf87b8d1805701c00a00d8ef43709f
8488d89005203102780100000000000008d8087b9f65763259740342702309 7a17f38fbab2f165
09ffd030031ee67e67ce09cfe9f09f4b52782e4ff721bc0f90f*4fb4c740
```

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Log header	RANGECMP4 header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	# bytes	Number of bytes in the compressed binary Range Data.	Uchar	4	H
3	Range Data	The compressed binary range data is organized into satellite system blocks which break down into measurement blocks for each active signal within each system. Refer to the following tables for more details about this format: *Table 44: Header* on the next page (sent once) *Table 45: Satellite and Signal Block* on the next page (sent once per satellite system bit set to 1 in the GNSS Field found in *Table 44: Header* on the next page) *Table 46: Measurement Block Header* on page 126 (sent once for each bit set to 1 in the Satellites Field found in *Table 45: Satellite and Signal Block* on the next page) *Table 47: Primary Reference Signal Measurement Block* on page 127 and *Table 48: Secondary Reference Signals Measurement Block* on page 128, or *Table 49: Primary Differential Signal Measurement Block* on page 129 and *Table 50: Secondary Differential Signals Measurement Block* on page 130, Measurement Block (sent for each bit set to 1 in the Included Signals Field for a given satellite found in *Table 45: Satellite and Signal Block* on the next page) The byte data is received MSB first so each group of bytes (as defined by the number of needed bits) must be swapped prior to processing.	Uchar	# bytes	H+4
4	xxxx	32-bit CRC (ASCII only)	Hex	4	H+4+(# bytes)
5	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 44: Header

Data Name	Description	Bits	Scale Factor
GNSS	Indicates which satellite system data is encoded and in what order. When the bit is set the satellite data is included. Data for each system is encoded sequentially: Bit 0 = GPS Bit 1 = GLONASS Bit 2 = SBAS Bit 5 = Galileo Bit 6 = BeiDou Bit 7 = QZSS Bit 9 = NavIC	16	1
	Bit Sum:	16	
	This block is sent once per message		

Table 45: Satellite and Signal Block

Data Name	Range	Description	Bits	Scale Factor
Satellites	0… 1.84467E+19	Indicates which satellites are present for this system and their order in the message. Each PRN is represented by a bit. (Bit 0 = PRN 1, Bit 1 = PRN 2, …) **Notes**: • GLONASS Satellite: This value represents the Slot ID of the satellite (range of 1 to 24 where Bit 0 = Slot ID 1). In the event the Slot ID is between 43 and 63, the actual GLONASS Slot ID has not yet been determined and has been replaced with a temporary Slot ID calculated using the GLONASS Frequency Number. See the GLONASS Frequency Number field in *Table 46: Measurement Block Header* on the next page for more details. • SBAS Satellite PRNs 120 to 158 are offset by 120. (Bit 0 = PRN 120, Bit 1 = 121, …) • SBAS Satellite PRNs 183 to 191 are offset by 130 • QZSS Satellite PRNs are offset by 193	64	1
Signals	0… 65535	Indicates which signals are present for this system and their order in the message. Each signal is represented by a bit as defined in *Table 51: Signal Bit Mask* on page 132.	16	1

Data Name	Range	Description	Bits	Scale Factor
Included Signals	0… mxn	A two dimensional field to tell the decoder which signals are present for each of the satellites. **m** = The number of rows equals the number of bits set to 1 found in the Satellites field. (Maximum number of PRNs in the satellite system) **n** = The number of columns equals the number of bits set to 1 found in the Signals field. (Maximum number of Signals in the satellite system)	mxn	
		Bit Sum:	80 + mxn	

This block is sent once for each bit set to 1 in the GNSS field found in *Table 44: Header* on the previous page.

Table 46: Measurement Block Header

Data Name	Range	Description	Bits	Scale Factor
Data Format Flag	0… 1	Identifies what type of Measurement Block will be used: 0 = Reference (*Table 47: Primary Reference Signal Measurement Block* on the next page and *Table 48: Secondary Reference Signals Measurement Block* on page 128) 1 = Differential (*Table 49: Primary Differential Signal Measurement Block* on page 129 and *Table 50: Secondary Differential Signals Measurement Block* on page 130)	1	1
Ref Data Block ID	0… 7	This ID identifies to which reference data the Differential Data is linked. This value is incremented by 1 each time a new Reference Measurement Block is used.	3	1

Data Name	Range	Description	Bits	Scale Factor
GLONASS Frequency Number	0… 20 (-7 to +13)	These bits are only present for GLONASS satellites in the Reference Data. This represents the GLONASS Frequency Number which identifies the frequency offset of the carrier frequency. The value will appear as a number between 0 and 20 which directly translates into a frequency offset number between -7 to +13. If the GLONASS Slot ID is unknown, a temporary Slot ID for this satellite will be set between 43 and 63 based on the GLONASS Frequency Number: PRN = 63 – GLONASS Frequency Number The GLONASS Frequency Number used in this calculation is the 0 to 20 value, not the adjusted -7 to +13 value.	5	1
		Bit Sum:	4 (Non-GLONASS) 9 (GLONASS)	
This block is sent once for each bit set to 1 in the Satellites field found in *Table 45: Satellite and Signal Block* on page 125.				

Table 47: Primary Reference Signal Measurement Block

Data Name	Range	Description	Bits	Scale Factor
Parity Flag	0… 1	0 = Parity Unknown 1 = Parity Known	1	1
½ Cycle Flag	0… 1	0 = Half Cycle Not Added 1 = Half Cycle Added	1	1
C/No	0… 63.95	C/No	11	0.05 dBHz
Lock Time	0… 15	The Lock Time – See *Table 52: Lock Time* on page 132	4	1
Pseudorange Std Dev	0… 15	The Pseudorange Standard Deviation (m) – See *Table 54: Pseudorange Std Dev* on page 134	4	
ADR Std Dev	0… 15	The ADR Standard Deviation (cycles) – See *Table 53: ADR Std Dev* on page 133	4	

Data Name	Range	Description	Bits	Scale Factor
Primary Pseudorange	0… 68719476.74	The Pseudo Range of the 1st signal (Signals field in *Table 45: Satellite and Signal Block* on page 125). If this value equals (2^{37}-1) = 137438953471, it represents a signal that is not locked.	37	0.0005 m
PhaseRange – Primary Pseudorange	±419.4303	(2's Complement) If this value equals –(2^{23}-1) = -4194304, it represents the signal is not locked.	23	0.0001 m
Primary Doppler	±3355.4431	(2's Complement) If this value equals –(2^{26}-1) = -33554432, it represents an invalid Doppler.	26	0.0001 m/s
		Bit Sum:	111	

This block is sent once for the first bit set to 1 in the Included Signals field found in *Table 45: Satellite and Signal Block* on page 125.
For any bits set to 1 after the first bit set to 1, refer to *Table 48: Secondary Reference Signals Measurement Block* below.

This table is for Reference blocks only, as indicated by the Data Format Flag (see *Table 46: Measurement Block Header* on page 126).

Table 48: Secondary Reference Signals Measurement Block

Data Name	Range	Description	Bits	Scale Factor
Parity Flag	0… 1	0 = Parity Unknown 1 = Parity Known	1	1
½ Cycle Flag	0… 1	0 = Half Cycle Not Added 1 = Half Cycle Added	1	1
C/No Indicator	0… 63.95	C/No	11	0.05 dBHz
Lock Time	0… 15	The Lock Time – See *Table 52: Lock Time* on page 132	4	1
Pseudorange Std Dev	0… 15	The Pseudorange Standard Deviation (m) – See *Table 54: Pseudorange Std Dev* on page 134	4	
ADR Std Dev	0… 15	The ADR Standard Deviation (cycles) – See *Table 53: ADR Std Dev* on page 133	4	

Data Name	Range	Description	Bits	Scale Factor
Pseudorange – Primary Signal Pseudorange	±262.1435	(2's Complement) If this value equals $-(2^{20}-1) = -524288$, it indicates the signal is not locked.	20	0.0005 m
Phaserange – Pseudorange	±419.4303	(2's Complement) If this value equals $-(2^{23}-1) = -4194304$, it indicates the signal is not locked.	23	0.0001 m
Doppler – Primary Doppler	±0.8191	(2's Complement) If this value equals $-(2^{14}-1) = -8192$, it indicates an invalid Doppler.	14	0.0001 m/s
		Bit Sum:	82	

This block is sent once for each bit set to 1 after the first bit set to 1 in the Included Signals field found in *Table 45: Satellite and Signal Block* on page 125.

This table is for Reference blocks only, as indicated by the Data Format Flag (see *Table 46: Measurement Block Header* on page 126).

Table 49: Primary Differential Signal Measurement Block

Data Name	Range	Description	Bits	Scale Factor
Parity Flag	0… 1	0 = Parity Unknown 1 = Parity Known	1	1
½ Cycle Flag	0… 1	0 = Half Cycle Not Added 1 = Half Cycle Added	1	1
C/No	0… 63.95	C/No	11	0.05 dBHz
Lock Time	0… 15	The Lock Time – See *Table 52: Lock Time* on page 132	4	1
Pseudorange Std Dev	0… 15	The Pseudorange Standard Deviation (m) – See *Table 54: Pseudorange Std Dev* on page 134	4	
ADR Std Dev	0… 15	The ADR Standard Deviation (cycles) – See *Table 53: ADR Std Dev* on page 133	4	

Data Name	Range	Description	Bits	Scale Factor
Pseudorange – Predicted Pseudorange	±131.0715	(2's Complement) If this value equals $-(2^{19}-1) = -262144$, it indicates a signal that is not locked. The Predicted Pseudorange = reference pseudorange plus (the reference doppler x time difference between the reference log and the differential log). The Reference log and Differential logs used must contain matching Ref Data Block ID references (*Table 46: Measurement Block Header* on page 126).	19	0.0005 m
Phaserange – Predicted Phaserange	±3.2767	(2's Complement) If this value equals $-(2^{16}-1) = -32768$, it indicates the signal is not locked. The Predicted Phaserange = reference phaserange plus (the reference doppler x time difference between the reference log and the differential log). The Reference log and Differential logs used must contain matching Ref Data Block ID references (*Table 46: Measurement Block Header* on page 126).	16	0.0001 m
Doppler – Reference Doppler	±13.1071	(2's Complement) If this value equals $-(2^{18}-1) = -131072$, it indicates an invalid Doppler. The Reference Doppler is the Doppler for that PRN and for that signal from the Reference log. The Reference log and Differential logs used must contain matching Ref Data Block ID references (*Table 46: Measurement Block Header* on page 126).	18	0.0001 m/s
		Bit Sum:	78	

This block is sent once for each bit set to 1 after the first bit set to 1 in the Included Signals field found in *Table 45: Satellite and Signal Block* on page 125.
For any bits set to 1 after the first bit set to 1, refer to *Table 50: Secondary Differential Signals Measurement Block* below.

This table is for Differential blocks only, as indicated by the Data Format Flag (see *Table 46: Measurement Block Header* on page 126).

Table 50: Secondary Differential Signals Measurement Block

Data Name	Range	Description	Bits	Scale Factor
Parity Flag	0… 1	0 = Parity Unknown 1 = Parity Known	1	1

Data Name	Range	Description	Bits	Scale Factor
½ Cycle Flag	0… 1	0 = Half Cycle Not Added 1 = Half Cycle Added	1	1
C/No	0… 63.95	C/No	11	0.05 dBHz
Lock Time	0… 15	The Lock Time – See *Table 52: Lock Time* on the next page	4	1
Pseudorange Std Dev	0… 15	The Pseudorange Standard Deviation (m) – See *Table 54: Pseudorange Std Dev* on page 134	4	1
ADR Std Dev	0… 15	The ADR Std Dev (cycles)– See *Table 53: ADR Std Dev* on page 133	4	1
Pseudorange – Predicted Pseudorange	±131.0715	(2's Complement) If this value equals $-(2^{19}-1) = -262144$, it indicates the signal is not locked. The Predicted Pseudorange = reference pseudorange plus (the reference doppler x time difference between the reference log and the differential log). The Reference log and Differential logs used must contain matching Ref Data Block ID references (*Table 46: Measurement Block Header* on page 126).	19	0.0005 m
Phaserange – Predicted Phaserange	±3.2767	(2's Complement) If this value equals $-(2^{16}-1) = -32768$, it indicates the signal is not locked. The Predicted Phaserange = reference phaserange plus (the reference doppler x time difference between the reference log and the differential log). The Reference log and Differential logs used must contain matching Ref Data Block ID references (*Table 46: Measurement Block Header* on page 126).	16	0.0001 m
Doppler – Reference Doppler	±13.1071	(2's Complement) If this value equals $-(2^{14}-1) = -8192$, it indicates an invalid Doppler. The Reference Doppler is the Doppler for that PRN and for that signal from the Reference log. The Reference log and Differential logs used must contain matching Ref Data Block ID references (*Table 46: Measurement Block Header* on page 126).	14	0.0001 m/s
		Bit Sum:	74	

Data Name	Range	Description	Bits	Scale Factor
This block is sent once for each bit set to 1 after the first bit set to 1 in the Included Signals field found in *Table 45: Satellite and Signal Block* on page 125.				
This table is for Differential blocks only, as indicated by the Data Format Flag (see *Table 46: Measurement Block Header* on page 126).				

Table 51: Signal Bit Mask

	GPS	GLONASS	SBAS	Galileo	BeiDou	QZSS	NavIC
Bit 1	L1CA	L1CA	L1CA	E1	B1I	L1CA	L5SPS
Bit 2			L5I	E5A	B1GEO		
Bit 3		L2CA		E5B	B2I	L2C	
Bit 4	L2Y	L2P		ALTBOC	B2GEO	L5Q	
Bit 5	L2C			E6C	B3I		
Bit 6	L2P	L3			B3GEO		
Bit 7	L5Q				B1CP		
Bit 8						L1C	
Bit 9					B2AP		
Bit 10							
Bit 11					B2bI	L6P	
Bit 12				E6B			
Bit 13							
Bit 14							
Bit 15	L1C						

Table 52: Lock Time

Indicator (i)	Minimum Lock Time (ms)	Range of Indicated Lock Times (t represents the Lock Time) (ms)
0	0	$0 \le t < 16$
1	16	$16 \le t < 32$
2	32	$32 \le t < 64$

Indicator (i)	Minimum Lock Time (ms)	Range of Indicated Lock Times (t represents the Lock Time) (ms)
3	64	64 ≤ t < 128
4	128	128 ≤ t < 256
5	256	256 ≤ t < 512
6	512	512 ≤ t < 1024
7	1024	1024 ≤ t < 2048
8	2048	2048 ≤ t < 4096
9	4096	4096 ≤ t < 8192
10	8192	8192 ≤ t < 16384
11	16384	16384 ≤ t < 32768
12	32768	32768 ≤ t < 65536
13	65536	65536 ≤ t < 131072
14	131072	131072 ≤ t < 262144
15	262144	262144 ≤ t

Table 53: ADR Std Dev

ADR Std Dev (cycles)	
0	≤ 0.0039
1	≤ 0.0052
2	≤ 0.0070
3	≤ 0.0093
4	≤ 0.0124
5	≤ 0.0165
6	≤ 0.0221
7	≤ 0.0295
8	≤ 0.0393
9	≤ 0.0525
10	≤ 0.0701
11	≤ 0.0935
12	≤ 0.1248
13	≤ 0.1666

ADR Std Dev (cycles)	
14	≤ 0.2223
15	> 0.2223

Table 54: Pseudorange Std Dev

Pseudorange Std Dev (m)	
0	≤ 0.020
1	≤ 0.030
2	≤ 0.045
3	≤ 0.066
4	≤ 0.099
5	≤ 0.148
6	≤ 0.220
7	≤ 0.329
8	≤ 0.491
9	≤ 0.732
10	≤ 1.092
11	≤ 1.629
12	≤ 2.430
13	≤ 3.625
14	≤ 5.409
15	> 5.409

2.3.19 RAWSBASFRAME2

Raw SBAS frame data 2

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

This log contains the raw SBAS frame data of 226 bits (8-bit preamble, 6-bit message type and 212 bits of data but without a 24-bit CRC). It also contains the transmitted frequency. Only frame data with a valid preamble and CRC are reported.

Message ID: 2185

Log Type: Asynch

Recommended Input:

```
log rawsbasframe2a onnew
```

ASCII Example:

```
#RAWSBASFRAME2A,USB1,0,48.5,SATTIME,2209,512947.000,02000020,b39f,16809;135,160
,1,0,0,3,9a0c9ffc00ffe9ffc033ffc005ffdffc121ffc00403ba2b9b97bbb95c0*4e57856f
```

The **RAWSBASFRAME2** log output contains all the raw data required for an application to compute its own SBAS correction parameters.

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Log header	RAWSBASFRAME2 header For information about log headers, see ASCII, Abbreviated ASCII or Binary.		H	0
2	PRN	SBAS satellite PRN number	Ulong	4	H
3	signal channel	Signal channel number that the frame was decoded on	Ulong	4	H+4
4	SBAS Signal Source	Identifies the source of the SBAS signal: 1 – SBASL1CA 2 – SBASL5I	Uchar	1	H+8
5	SBAS Preamble Type	Identifies what preamble was used when tracking the SBAS signal: 0 – 8-bit Preamble (3x8) 1 – 4-bit Preamble (6x4)	Uchar	1	H+9
6	Reserved		Ushort	2	H+10
7	SBAS frame ID	SBAS frame ID	Ulong	4	H+12

Field	Field Type	Description	Format	Binary Bytes	Binary Offset
8	data	Raw SBAS frame data. There are 226 bits of data and 6 bits of padding.	Hex[29]	32[1]	H+16
9	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+48
10	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

[1] In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment.

2.3.20 RTKASSISTSTATUS

RTK ASSIST status

Platform: OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7

This log provides information on the state of RTK ASSIST.

RTK ASSIST operates in two modes: coast and full assist. The RTKASSISTSTATUS log reports which mode is currently available. Coast mode is available as soon as the RTK ASSIST corrections are received from the L-Band satellite, while full assist mode requires a convergence period. In coast mode, position error growth during RTK correction outages is slightly worse than in full assist mode and RTK will not resume following a full signal outage until after RTK corrections are restored. Full assist gives the lowest position error growth during RTK correction outages, and makes it possible for RTK to resume even if there are complete GNSS signal outages during the RTK ASSIST period.

The RTK ASSIST ACTIVE state reported in the RTKASSISTSTATUS log is also reported in the RTKPOS and BESTPOS extended solution status field. See Table: Extended Solution Status.

The RTKASSISTSTATUS log reports the time remaining in the RTK ASSIST ACTIVE state. Once RTK ASSIST becomes active, the remaining time will count down from the time out set by the **RTKASSISTTIMEOUT** command .

The corrections age reported in the RTKASSISTSTATUS log should typically be below 30 seconds. If the age exceeds this value, then L-Band tracking is likely degraded. The most likely cause of degraded L-Band tracking are obstructions between the antenna and the L-Band satellite.

Message ID: 2048

Log Type: Synch

Recommended Input:

```
log rtkassiststatusa ontime 5
```

ASCII Example:

```
#RTKASSISTSTATUSA,USB1,0,55.5,FINESTEERING,2209,513133.000,02000020,80fe,16809;
INACTIVE,UNAVAILABLE,0.0,13.0*4966edec
```

Field	Field type	Description	Format	Binary Bytes	Binary Offset
1	Log header	RTKASSISTSTATUS header For information about log headers, see ASCII, Abbreviated ASCII or Binary.		H	0
2	State	State: INACTIVE (0) ACTIVE (1)	Enum	4	H
3	Mode	Mode: UNAVAILABLE (0) COAST (1) ASSIST (2)	Enum	4	H+4

Field	Field type	Description	Format	Binary Bytes	Binary Offset
4	Remaining time	Time remaining in seconds	Float	4	H+8
5	Corrections age	Age of the RTK ASSIST corrections in seconds. Maximum value of 120 seconds.	Float	4	H+12
6	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+16
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

2.3.21 RXSTATUS

Receiver status

Platform: OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2

This log conveys various status parameters of the GNSS receiver system. These include the Receiver Status and Error words which contain several flags specifying status and error conditions. If an error occurs (shown in the Receiver Error word), the receiver idles all channels, turns off the antenna and disables the RF hardware as these conditions are considered to be fatal errors. The log contains a variable number of status words to allow for maximum flexibility and future expansion. For information about resolving an error, refer to Examining the RXSTATUS Log in the OEM7 Installation and Operation User Manual, PwrPak7 Installation and Operation User Manual, CPT7 Installation and Operation User Manual, SMART7 Installation and Operation User Manual or SMART2 Installation and Operation User Manual.

The receiver gives the user the ability to determine the importance of the status bits. In the case of the Receiver Status, setting a bit in the priority mask causes the condition to trigger an error. This causes the receiver to idle all channels, turn off the antenna and disable the RF hardware, the same as if a bit in the Receiver Error word is set. Setting a bit in an Auxiliary Status priority mask causes that condition to set the bit in the Receiver Status word corresponding to that Auxiliary Status. See also the **STATUSCONFIG** command.

Field #4, the receiver status word as represented in *Table 56: Receiver Status* on page 143, is also in Field #8 of the header. See the ASCII Example below and *Table 56: Receiver Status* on page 143 for clarification.

Refer also to Built-In Status Tests in the OEM7 Installation and Operation User Manual, PwrPak7 Installation and Operation User Manual, CPT7 Installation and Operation User Manual, SMART7 Installation and Operation User Manual or SMART2 Installation and Operation User Manual.

Message ID: 93

Log Type: Asynch

Recommended Input:

```
log rxstatusa onchanged
```

Abbreviated ASCII Example:

```
<RXSTATUS USB1 0 66.5 FINESTEERING 2210 333374.033 02000020 2ae1 16809
<     00000000 5
<          02000020 00000000 00030000 00020000    (Receiver Status)
<          00040000 00001008 00000000 00000000    (Aux1 Status)
<          00000000 00000000 80000000 00000000    (Aux2 Status)
<          82000000 00000000 00000000 00000000    (Aux3 Status)
<          0030c000 00000000 ffffffff 00000000    (Aux4 Status)
```

Receiver errors automatically generate event messages. These event messages are output in RXSTATUSEVENT logs. It is also possible to have status conditions trigger event messages to be generated by the receiver. This is done by setting/clearing the appropriate bits in the event set/clear masks. The set mask tells the receiver to generate an event message when the bit becomes set. Likewise, the clear mask causes messages to be generated when a bit is cleared. See the **STATUSCONFIG** command for details.

If you wish to disable all these messages without changing the bits, simply UNLOG the **RXSTATUSEVENT** logs on the appropriate ports. See the **UNLOG** command.

Field	Field type	Description	Format	Binary Bytes	Binary Offset
1	Log header	RXSTATUS header For information about log headers, see ASCII, Abbreviated ASCII or Binary.		H	0
2	error	Receiver error (see *Table 55: Receiver Error* on the next page). A value of zero indicates no errors	Ulong	4	H
3	# stats	Number of status codes (including Receiver Status). Each status code consists of 4 fields, the status, priority mask, event set mask and event clear mask. Each set is repeated for each status type. Note that for clarity, the Receiver Status, Auxiliary 1 Status, Auxiliary 2 Status, Auxiliary 3 Status and Auxiliary 4 status are listed separately in this message	Ulong	4	H+4
4	rxstat	Receiver status word (see *Table 56: Receiver Status* on page 143)	Ulong	4	H+8
5	rxstat pri	Receiver status priority mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+12
6	rxstat set	Receiver status event set mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+16
7	rxstat clear	Receiver status event clear mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+20
8	aux1stat	Auxiliary 1 status word (see *Table 58: Auxiliary 1 Status* on page 145)	Ulong	4	H+24
9	aux1stat pri	Auxiliary 1 status priority mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+28
10	aux1stat set	Auxiliary 1 status event set mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+32
11	aux1stat clear	Auxiliary 1 status event clear mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+36
12	aux2stat	Auxiliary 2 status word (see *Table 60: Auxiliary 2 Status* on page 148)	Ulong	4	H+40

Field	Field type	Description	Format	Binary Bytes	Binary Offset
13	aux2stat pri	Auxiliary 2 status priority mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+44
14	aux2stat set	Auxiliary 2 status event set mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+48
15	aux2stat clear	Auxiliary 2 status event clear mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+52
16	aux3stat	Auxiliary 3 status word (see *Table 61: Auxiliary 3 Status* on page 149)	Ulong	4	H+56
17	aux3stat pri	Auxiliary 3 status priority mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+60
18	aux3stat set	Auxiliary 3 status event set mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+64
19	aux3stat clear	Auxiliary 3 status event clear mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+68
20	aux4stat	Auxiliary 4 status word (see *Table 64: Auxiliary 4 Status* on page 151)	Ulong	4	H+72
21	aux4stat pri	Auxiliary 4 status priority mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+76
22	aux4stat set	Auxiliary 4 status event set mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+80
23	aux4stat clear	Auxiliary 4 status event clear mask, which can be set using the **STATUSCONFIG** command	Ulong	4	H+84
24	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+88
25	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 55: Receiver Error

Nibble	Bit	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Dynamic Random Access Memory (DRAM) status RAM failure on an OEM7 card may also be indicated by a flashing red LED.	OK	Error
	1	0x00000002	Invalid firmware	OK	Error
	2	0x00000004	ROM status	OK	Error
	3	0x00000008	Reserved		

Nibble	Bit	Mask	Description	Bit = 0	Bit = 1
N1	4	0x00000010	Electronic Serial Number (ESN) access status	OK	Error
	5	0x00000020	Authorization code status	OK	Error
	6	0x00000040	Slow ADC Status	OK	Error
	7	0x00000080	Supply voltage status	OK	Error
N2	8	0x00000100	Reserved		
	9	0x00000200	Temperature status (as compared against acceptable limits)	OK	Error
	10	0x00000400	MINOS status	OK	Error
	11	0x00000800	PLL RF status. Error with an RF PLL. See AUX2 status bits (*Table 60: Auxiliary 2 Status* on page 148) for individual PLL status	OK	Error
N3	12	0x00001000	Reserved		
	13	0x00002000			
	14	0x00004000			
	15	0x00008000	NVM status	OK	Error
N4	16	0x00010000	Software resource limit exceeded	OK	Error
	17	0x00020000	Model invalid for this receiver	OK	Error
	18	0x00040000	Reserved		
	19	0x00080000			
N5	20	0x00100000	Remote loading has begun	No	Yes
	21	0x00200000	Export restriction	OK	Error
	22	0x00400000	Safe Mode	OK	Error
	23	0x00800000	Reserved		
N6	24	0x01000000			
	25	0x02000000			
	26	0x04000000			
	27	0x08000000			
N7	28	0x10000000			
	29	0x20000000			
	30	0x40000000			
	31	0x80000000	Component hardware failure	OK	Error

Table 56: Receiver Status

Nibble	Bit	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Error flag, see *Table 55: Receiver Error* on page 141	No error	Error
	1	0x00000002	Temperature status	Within specifications	Warning
	2	0x00000004	Voltage supply status	OK	Warning
	3	0x00000008	Primary antenna power status See the **ANTENNAPOWER** command	Powered	Not powered
N1	4	0x00000010	LNA Failure	OK	Failure
	5	0x00000020	Primary antenna open circuit flag	OK	Open, antenna disconnected
	6	0x00000040	Primary antenna short circuit flag	OK	Short circuit detected
	7	0x00000080	CPU overload flag	No overload	Overload
N2	8	0x00000100	COM port transmit buffer overrun. See AUX2 status bits (*Table 60: Auxiliary 2 Status* on page 148) for individual COM port status	OK	COM buffer overrun
	9	0x00000200	Spoofing Detection Status	Not Detected	Detected
	10	0x00000400	Reserved		
	11	0x00000800	Link overrun flag This flag indicates if any of the USB, ICOM, CCOM, NCOM or File ports are overrun. See AUX1, AUX2 and AUX3 status bits (*Table 58: Auxiliary 1 Status* on page 145, *Table 60: Auxiliary 2 Status* on page 148 or *Table 61: Auxiliary 3 Status* on page 149) for the specific port for which the buffer is overrun.	No overrun	Overrun

Nibble	Bit	Mask	Description	Bit = 0	Bit = 1
N3	12	0x00001000	Input overrun flag This flag is set if any of the receiver ports (COM, USB, ICOM or NCOM) experience an input overrun.	No overrun	Overrun
	13	0x00002000	Aux transmit overrun flag	No overrun	Overrun
	14	0x00004000	Antenna gain state See the AUX3 status bits (*Table 61: Auxiliary 3 Status* on page 149) for the antenna gain status.	OK	Out of range
	15	0x00008000	Jammer Detected See the AUX1 status bits (*Table 58: Auxiliary 1 Status* on the next page) for individual RF status	OK	Jammer Detected
N4	16	0x00010000	INS reset flag	No INS reset	INS reset
	17	0x00020000	IMU communication failure	No error	No IMU communication
	18	0x00040000	GPS almanac flag/UTC known	Valid	Invalid
	19	0x00080000	Position solution flag	Valid	Invalid
N5	20	0x00100000	Position fixed flag, see the **FIX** command	Not fixed	Fixed
	21	0x00200000	Clock steering status	Enabled	Disabled
	22	0x00400000	Clock model flag	Valid	Invalid
	23	0x00800000	External oscillator locked flag	Unlocked	Locked
N6	24	0x01000000	Software resource	OK	Warning
	25	0x06000000	Version bit 0	See *Table 57: Version Bits* on the next page	
	26		Version bit 1	See *Table 57: Version Bits* on the next page	
	27	0x08000000	Tracking mode	Normal tracking	HDR tracking
N7	28	0x10000000	Digital Filtering Enabled	Disabled	Enabled
	29	0x20000000	Auxiliary 3 status event flag	No event	Event
	30	0x40000000	Auxiliary 2 status event flag	No event	Event
	31	0x80000000	Auxiliary 1 status event flag	No event	Event

Table 57: Version Bits

Bit 26	Bit 25	Description
0	0	Interpret Status/Error Bits as OEM6 or earlier format
0	1	Interpret Status/Error Bits as OEM7 format
1	0	Reserved for a future version
1	1	Reserved for a future version

Table 58: Auxiliary 1 Status

Nibble	Bit	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Jammer detected on RF1	OK	Jammer detected
	1	0x00000002	Jammer detected on RF2	OK	Jammer detected
	2	0x00000004	Jammer detected on RF3	OK	Jammer detected
	3	0x00000008	Position averaging	Off	On
N1	4	0x00000010	Jammer detected on RF4	OK	Jammer detected
	5	0x00000020	Jammer detected on RF5	OK	Jammer detected
	6	0x00000040	Jammer detected on RF6	OK	Jammer detected
	7	0x00000080	USB connection status	Connected	Not connected
N2	8	0x00000100	USB1 buffer overrun flag	No overrun	Overrun
	9	0x00000200	USB2 buffer overrun flag	No overrun	Overrun
	10	0x00000400	USB3 buffer overrun flag	No overrun	Overrun
	11	0x00000800	Reserved		
N3	12	0x00001000	Profile Activation Bit	OK	Error
	13	0x00002000	Throttled Ethernet Reception	OK	Throttled
	14	0x00004000	Dynamic Channel Configuration	Disabled	Enabled
	15	0x00008000	Reserved		

Nibble	Bit	Mask	Description	Bit = 0	Bit = 1
N4	16	0x00010000	Reserved		
	17	0x00020000	Reserved		
	18	0x00040000	Ethernet not connected	Connected	Not connected
	19	0x00080000	ICOM1 buffer overrun flag	No overrun	Overrun
N5	20	0x00100000	ICOM2 buffer overrun flag	No overrun	Overrun
	21	0x00200000	ICOM3 buffer overrun flag	No overrun	Overrun
	22	0x00400000	NCOM1 buffer overrun flag	No overrun	Overrun
	23	0x00800000	NCOM2 buffer overrun flag	No overrun	Overrun
N6	24	0x01000000	NCOM3 buffer overrun flag	No overrun	Overrun
	25	0x02000000	Reserved		
	26	0x04000000	Reserved		
	27	0x08000000	Reserved		
N7	28	0x10000000	Reserved		
	29	0x20000000	Reserved		
	30	0x40000000	Status error reported by the IMU. May be treated as a notice unless the issue persists.	OK	Status Error Reported
	31	0x80000000	IMU measurement outlier detected. Indicates when the SPAN system has detected an outlier in the IMU performance. May be treated as a notice unless the issue persists.	OK	Outlier detected

Table 59: RF Paths for OEM7 Receivers

RF Path	OEM719, OEM729, OEM7700, PwrPak7, CPT7700, SMART7	OEM7720, PwrPak7D, CPT7	OEM7500, OEM7600, SMART2
RF1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1	1st antenna GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1	GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1 SBAS L1

RF Path	OEM719, OEM729, OEM7700, PwrPak7, CPT7700, SMART7	OEM7720, PwrPak7D, CPT7	OEM7500, OEM7600, SMART2
RF2	Reserved	Reserved	GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5
RF3	GPS L2 GLONASS L2 Galileo E6 BDS B3 QZSS L2/L6	1st antenna GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5 SBAS L5	Reserved
RF4	GPS L5 GLONASS L3 Galileo E5 BDS B2 QZSS L5 NavIC L5 SBAS L5	2nd antenna GPS L1 GLONASS L1 Galileo E1 BDS B1 QZSS L1	Reserved
RF5	Reserved	2nd antenna GPS L2/L5 GLONASS L2/L3 Galileo E5 BDS B2 QZSS L2/L5 NavIC L5	Reserved
RF6	Reserved	Reserved	Reserved

Table 60: Auxiliary 2 Status

Nibble	Bit	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	SPI Communication Failure	OK	Error
	1	0x00000002	I^2C Communication Failure	OK	Error
	2	0x00000004	COM4 buffer overrun flag	No overrun	Buffer Overrun
	3	0x00000008	COM5 buffer overrun flag	No overrun	Buffer Overrun
N1	4	0x00000010	Reserved		
	5	0x00000020	Reserved		
	6	0x00000040	Reserved		
	7	0x00000080	Reserved		
N2	8	0x00000100	Reserved		
	9	0x00000200	COM1 buffer overrun flag	OK	Buffer Overrun
	10	0x00000400	COM2 buffer overrun flag	OK	Buffer Overrun
	11	0x00000800	COM3 buffer overrun flag	OK	Buffer Overrun
N3	12	0x00001000	PLL RF1 unlock flag	OK	PLL Unlock
	13	0x00002000	PLL RF2 unlock flag	OK	PLL Unlock
	14	0x00004000	PLL RF3 unlock flag	OK	PLL Unlock
	15	0x00008000	PLL RF4 unlock flag	OK	PLL Unlock
N4	16	0x00010000	PLL RF5 unlock flag	OK	PLL Unlock
	17	0x00020000	PLL RF6 unlock flag	OK	PLL Unlock
	18	0x00040000	CCOM1 buffer overrun	OK	Buffer Overrun
	19	0x00080000	CCOM2 buffer overrun	OK	Buffer Overrun
N5	20	0x00100000	CCOM3 buffer overrun	OK	Buffer Overrun
	21	0x00200000	CCOM4 buffer overrun	OK	Buffer Overrun
	22	0x00400000	CCOM5 buffer overrun	OK	Buffer Overrun
	23	0x00800000	CCOM6 buffer overrun	OK	Buffer Overrun
N6	24	0x01000000	ICOM4 buffer overrun	OK	Buffer Overrun
	25	0x02000000	ICOM5 buffer overrun	OK	Buffer Overrun
	26	0x04000000	ICOM6 buffer overrun	OK	Buffer Overrun
	27	0x08000000	ICOM7 buffer overrun	OK	Buffer Overrun

Nibble	Bit	Mask	Description	Bit = 0	Bit = 1
N7	28	0x10000000	Secondary antenna power status See the **ANTENNAPOWER** command	Powered	Not Powered
	29	0x20000000	Secondary antenna open circuit This flag is only available on certain products	OK	Open, antenna disconnected
	30	0x40000000	Secondary antenna short circuit This flag is only available on certain products	OK	Short circuit detected
	31	0x80000000	Reset loop detected	OK	Reset Detected

Table 61: Auxiliary 3 Status

Nibble	Bit	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	SCOM buffer overrun flag. This flag is set if any of the SCOM ports (SCOM1 – SCOM4) experience overrun.	No overrun	Overrun
	1	0x00000002	WCOM1 buffer overrun flag	No overrun	Overrun
	2	0x00000004	FILE buffer overrun flag	No overrun	Overrun
	3	0x00000008	Reserved		
N1	4	0x00000010	Antenna 1 Gain State	*Table 62: Antenna Gain State* on the next page	
	5	0x00000020			
	6	0x00000040	Antenna 2 Gain State	*Table 62: Antenna Gain State* on the next page	
	7	0x00000080			
N2	8	0x00000100	GPS reference time is incorrect. Reset the receiver to correct it.	OK	Time incorrect
	9	0x00000200	Memory usage state	*Table 63: Memory Usage State* on page 151	
	10	0x00000400			
	11	0x00000800	Reserved		
N3	12	0x00001000	Reserved		
	13	0x00002000			
	14	0x00004000			
	15	0x00008000			

Nibble	Bit	Mask	Description	Bit = 0	Bit = 1
N4	16	0x00010000	DMI hardware failure detection flag	OK	Error
	17	0x00020000	Reserved		
	18	0x00040000			
	19	0x00080000			
N5	20	0x00100000	Reserved		
	21	0x00200000			
	22	0x00400000			
	23	0x00800000			
N6	24	0x01000000	Spoofing Calibration Status	Successful	Failed
	25	0x02000000	Spoofing Calibration Required	Not required	Required
	26	0x04000000	USB Mass Storage Device Error This flag is only available on certain products.	OK	Error
	27	0x08000000	Internal Storage Device Error This flag is only available on certain products.	OK	Error
N7	28	0x10000000	Reserved		
	29	0x20000000	Web content is corrupt or does not exist	Content is OK	Error with content
	30	0x40000000	RF Calibration Data is present and in error	Data is OK	Data has an error
	31	0x80000000	RF Calibration Data is present	No data found	Data exists and has no errors

Table 62: Antenna Gain State

Bits 4-5 or Bits 6-7	Description
00	Antenna Gain in range
01	Antenna Gain Low This state indicates that the input signal is very weak (under -160 dBm/Hz). It can indicate the antenna is not operating correctly, the antenna is not suitable for NovAtel receivers, or there is no antenna connected.
10	Antenna Gain High. This state indicates that the input signal is very strong (above -120 dBm/Hz). This can be caused by a strong in-band interference or by too much signal gain or too many LNAs cascaded in the path.

Bits 4-5 or Bits 6-7	Description
11	Antenna Gain Anomaly. This state indicates that an anomaly has been detected for the input signal. It can be caused by strong in-band or out-of-band interference, or by the antenna being disconnected/changed during operation.

Table 63: Memory Usage State

Bits 9 & 10	Description
00	Negligible memory usage
01	Low memory usage
10	Medium memory usage
11	High memory usage

Table 64: Auxiliary 4 Status

Nibble	Bit	Mask	Description	Bit = 1
N0	0	0x00000001	GNSS Tracked Status	<60% of available satellites are tracked well
	1	0x00000002		<15% of available satellites are tracked well
	2	0x00000004	Reserved	
	3	0x00000008		
N1	4	0x00000010	Reserved	
	5	0x00000020		
	6	0x00000040		
	7	0x00000080		
N2	8	0x00000100	Reserved	
	9	0x00000200		
	10	0x00000400		
	11	0x00000800		

Nibble	Bit	Mask	Description	Bit = 1
N3	12	0x00001000	Clock freewheeling due to bad position integrity	Clock freewheeling
	13	0x00002000	Reserved	
	14	0x00004000	Usable RTK Corrections Percentage of expected measurements which have timely RTK corrections (latency <20 seconds)	<60% of expected corrections available
	15	0x00008000		<15% of expected corrections available
N4	16	0x00010000	Bad RTK Geometry	PDOP >5.0
	17	0x00020000	Reserved	
	18	0x00040000		
	19	0x00080000	Long RTK Baseline	Baseline >50 km
N5	20	0x00100000	Poor RTK COM Link (poor correction quality)	Corrections quality ≤60%
	21	0x00200000	Poor ALIGN COM Link (poor correction quality)	Corrections quality ≤60%
	22	0x00400000	GLIDE Not Active	GLIDE not active
	23	0x00800000	Bad PDP Geometry	PDOP >5.0
N6	24	0x01000000	No TerraStar Subscription	No subscription
	25	0x02000000	Reserved	
	26	0x04000000		
	27	0x08000000		
N7	28	0x10000000	Bad PPP Geometry	PDOP >5.0
	29	0x20000000	Reserved	
	30	0x40000000	No INS Alignment	No alignment
	31	0x80000000	INS not converged	Not converged

Only GPS and GLONASS are considered in the Auxiliary 4 status word states.

For bits relating to RTK, ALIGN or INS, the bits will only be set if the receiver has that type of positioning is enabled via Auth Code.

2.3.22 SAFEMODESTATUS

Safe Mode Status

Platform: **OEM719, OEM729, OEM7500, OEM7600, OEM7700, OEM7720, PwrPak7, CPT7, CPT7700, SMART7, SMART2**

This log provides additional information about the state of the receiver in the event that the *Safe Mode* error bit and/or *Reset Loop Detected* status bit are set in the **RXSTATUS** log (see page 139).

The data within this log is set at receiver start up and will not change over time.

For information about *Safe Mode*, see Safe Mode in the OEM7 Installation and Operation User Manual, PwrPak7 Installation and Operation User Manual, CPT7 Installation and Operation User Manual, SMART7 Installation and Operation User Manual or SMART2 Installation and Operation User Manual.

Message ID: 2060

Log Type: Asynch

Recommended Input:

```
log SAFEMODESTATUSA once
```

Abbreviated ASCII Example:

```
#SAFEMODESTATUSA,USB1,0,54.0,UNKNOWN,0,0.000,02000020,8e55,16809;
SAFE_MODE_OK,0,"Normal Operation."*484241d0
```

Field	Field Type	Description	Binary Format	Binary Bytes	Binary Offset
1	Log header	SAFEMODESTATUS header For information about log headers, see ASCII, Abbreviated ASCII or Binary.	-	H	0
2	Status	Safe Mode State. See *Table 65: Safe Mode States* on the next page	Enum	4	H
3	Reset Count	Number of resets since power up or a successful boot	Ulong	4	H+4
4	Description	String for additional information about the Safe Mode State	String	80	H+8
5	xxxx	32-bit CRC (ASCII and Binary only)	Ulong	4	H+88
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 65: Safe Mode States

Value	State	Safe Mode Error Bit	Reset Loop Detected Bit	Notes	Recovery Steps
0	SAFE_MODE_OK	0	0	Normal Operation. No reset loop detected.	No action required
1	SAFE_MODE_ WARNING	0	1	An unexpected reset was detected. The receiver will operate as normal	No action required
2	SAFE_MODE_ DISABLE_ SATELLITE_DATA	0	1	Satellite Navigation Data previously saved to NVM is ignored in this state. As the receiver continues to track GNSS satellites, new data will be downloaded. There may be some delay in initial satellite acquisition as this will effectively be a Cold Start, but the receiver will otherwise operate as normal.	No action required
3	SAFE_MODE_ DISABLE_ NON_ COMMUNICATION_ NVM	1	1	All data previously saved to NVM that is not related to communication is ignored in this state. Communication ports (COM, USB, ICOM, etc.) will remain in the configuration previously saved by SAVECONFIG allowing the user to take corrective action.	Depending on what NVM data is causing the problem, a **FRESET** may resolve the issue. If a standard **FRESET** does not resolve the issue, see the **FRESET** command for other NVM targets that may be causing the issue and could be removed.
4	SAFE_MODE_ DISABLE_ ALL_NVM	1	1	All data previously saved to NVM is ignored in this state.	See recovery steps for SAFE_MODE_ DISABLE_ NON_ COMMUNICATION_ NVM.

Value	State	Safe Mode Error Bit	Reset Loop Detected Bit	Notes	Recovery Steps
5	SAFE_MODE_ DISABLE_ AUTH	1	1	All data previously saved to NVM and all Auth Codes are ignored in this state.	Use the **AUTH REMOVE** command to remove the offending Auth Code. The **AUTHCODES** log can be used to determine what Auth Codes are currently loaded.
6	SAFE_MODE_ FAILED	1	1	All data previously saved to NVM and all Auth Codes are ignored in this state.	This state is unexpected. The recovery steps for other states may apply.
7	SAFE_MODE_ UNEXPECTED_ MAIN_FIRMWARE	1	0 or 1	An error related to main firmware loading occurred.	Reload the main firmware.
8	SAFE_MODE_ DISABLE_STARTUP_ EMMC_CHKDSK	1	1	All data previously saved to NVM and all Auth Codes are ignored in this state. The startup eMMC check disk operation is ignored (if eMMC is equipped).	Issue a **MEDIAFORMAT INTERNAL_FLASH** command to format the eMMC (if equipped) and then issue a **RESET** command.
9	SAFE_MODE_ INCOMPLETE_ CONFIG	1	0	Incomplete system configuration.	Contact NovAtel Customer Support.
10	SAFE_MODE_ DISABLE_ EMBEDDED_APP	1	1	All data previously saved to NVM and all Auth Codes are ignored in this state, and product specific functionality is disabled.	See recovery steps for SAFE_MODE_ DISABLE_ NON_ COMMUNICATION_ NVM.

2.4 OEM6 to OEM7 – SPAN

The commands used to enter translational offsets and rotational offsets have changed in OEM7. For information about translations and rotations, see SPAN Translations and Rotations.

2.4.1 Translational Offsets

Determining the translational offsets in OEM7 is similar to the process in OEM6. Three dimensional distances from IMU to the other SPAN system device (e.g. GNSS antenna) are entered into the SPAN receiver. The differences are the commands used to enter the offsets have changed and the distances can be entered in the IMU frame or the vehicle frame.

See *Table 66: Commands for Entering SPAN Offsets and Rotations* below for the changes in the commands used for entering translational offsets. See the **SETINSTRANSLATION** command (see page 77) for more information.

The OEM6 offset commands required that all translational offsets be entered in the IMU Body Frame, so to translate to the new commands, the same values can be entered within the new structure.

2.4.2 Rotational Offsets

Determining rotational offsets in OEM7 has changed significantly. With the OEM6 commands, rotations usually referenced the SPAN Computation Frame. Now, all rotations are given as the rotation from the IMU Body Frame, to the frame of interest. For IMUs installed with their Z axis pointed upwards, rotation angles will be similar as those used with the legacy commands. For IMUs installed in other orientations, angles will be very different.

See *Table 66: Commands for Entering SPAN Offsets and Rotations* below for the changes in the commands used for entering rotational offsets. See the **SETINSROTATION** command (see page 74) for more information.

Table 66: Commands for Entering SPAN Offsets and Rotations

OEM6 Command	OEM7 Command	Notes
SETIMUTOANTOFFSET	**SETINSTRANSLATION** ANT1	
SETIMUTOANTOFFSET2	**SETINSTRANSLATION** ANT2	
SETIMUTOEXTOFFSET	**SETINSTRANSLATION** EXTERNAL	
SETIMUTOGIMBALOFFSET	**SETINSTRANSLATION** GIMBAL	
SETINSOFFSET	**SETINSTRANSLATION** USER	
SETMARKxOFFSET	**SETINSTRANSLATION** MARKx **SETINSROTATION** MARKx	Translational and rotational offsets are now entered separately. Markx can be MARK1, MARK2, MARK3 or MARK4.

OEM6 Command	OEM7 Command	Notes
VEHICLEBODYROTATION SETIMUORIENTATION	**SETINSROTATION** RBV	The information provided by the OEM6 commands is now combined in the RBV rotation.
GIMBALSPANROTATION SETGIMBALORIENTATION	**SETINSROTATION** RBM	The information provided by the OEM6 commands is now combined in the RBM rotation. The RBV rotation must also be specified for correct operation.
EXTHDGOFFSET	**SETINSROTATION** ALIGN	This offset continues to be automatically calculated if the translational offsets to the primary and secondary GNSS antennas are provided.
APPLYVEHICLEBODYROTATION	**SETINSROTATION** RBV	Default attitude output is now in the Vehicle Frame, as long as an RBV rotation is provided. This is overridden if a USER rotational offset is provided.

2.4.3 INS Profiles

INS Profiles are a method to improve the performance of the system in different conditions. When a receiver is configured with an INS Profile, the default receiver settings are modified to optimize performance in the selected condition. See *INS Profiles* on page 159 for more information.

2.4.4 INS Seed

The INS Seed functionality is an alignment method whereby INS alignment information from a previous powerup can be injected into the system at startup to achieve an INS alignment very quickly. This is especially useful for systems that previously required a kinematic alignment. See *INS Seed / Fast INS Initialization* on page 162 for more information.

2.4.5 ALIGN Calibration

For optimal SPAN performance when using Dual Antenna with SPAN, an ALIGN offset calibration is required for each unique installation. This calibration refines the IMU to antenna baseline angular offset from the initial estimate derived from the input lever arms. Refer to **INSCALIBRATE** command for details.

2.4.6 Multi-Line Body to Vehicle Calibration

The Body to Vehicle frame offset calibration feature assumes flat ground when estimating the roll offsets between the IMU Body and Vehicle frames. For applications where vehicle roll must be well known, or pass-to-pass accuracy of a highly offset position is especially important, the Multi-Line IMU Body to Vehicle frame offset calibration routine offers higher calibrated accuracy in roll. This is done by running independent calibrations over the same ground path in opposite directions; averaging the results cancels out the effect of any terrain induced roll. See *Multi-Line Body to Vehicle Frame Rotation Calibration Routine* on page 160 for more information.

2.4.7 IMU-KVH1750 and IMU-P1750 Baud Rate Conversion

If purchased directly from KVH, an IMU-KVH1750 or IMU-P1750 IMU must be configured before it can be used with an OEM7 receiver.

The IMU-KVH1750 and IMU-P1750 natively communicate at 921,600 bps, however the maximum baud rate of the COM ports on an OEM7 receiver is 460,800 bps. Thus, IMU-KVH1750 and IMU-P1750 IMUs purchased from KVH must be modified to use 460,800 bps. Also, the MSYNC setting on the IMU-KVH1750 or IMU-P1750 must be set to EXT.

Though slower, 460,800 bps is more than adequate to transmit the data at the required 200 Hz without any impact to performance.

There are two methods to change the IMU-KVH1750 or IMU-P1750 IMU baud rate. If an OEM6 receiver is available, a command is available that will allow the receiver to change the IMU baud rate. If not, a direct RS-422 connection at 921,600 baud is required to change the IMU baud rate.

Connect Directly to the IMU

This method requires a direct connection to the IMU at 921,600 baud over RS-422. Make sure the RS-422 link used is capable of 921,600 baud as not all serial ports are capable of that rate.

1. Open a command terminal at 921,600 baud via an RS-422 serial link.

   By default, the IMU will output 0.5 Hz binary messages which will help confirm you are connected properly.

2. Issue the following commands in sequence to enter configuration mode and change the baud rate.

   =CONFIG,1

   =MSYNC,EXT

   =BAUD,460800

3. Upon completion of these commands, power cycle the IMU to boot up in the new baud rate.
4. Confirm the change by connecting to the IMU at 460,800 baud and verifying the incoming messages.

The new baud rate configuration is saved to the IMU NVM automatically so the process is complete and the IMU is ready for use with an OEM7 receiver.

Use an OEM6 Receiver Command

OEM6 firmware as of version OEM060631RN0000 (Dec 2016) includes the **IMUCONFIGURATION** command that internally configures the IMU-KVH1750 or IMU-P1750 IMU for SPAN communication. Three sets of configuration options are available, two of which allow changing the baud rate of the IMU to either 921,600 or 460,800. This provides customers upgrading to OEM7 an easy method to modify the baud rate. To change the IMU to 460800 baud, use the following procedure:

1. Connect the IMU to an RS-422 capable OEM6 receiver communication port.
2. Issue the following command.

```
CONNECTIMU COM# IMU_KVH_1750
```

3. Issue the following command.

```
IMUCONFIGURATION IMU_KVH_1750 2
```

The **IMUCONFIGURATION** command can be used to configure an IMU-KVH1750 or IMU-P1750 IMU depending on the value of the Option field.

```
IMUCONFIGURATION IMUType [Option]
```

IMU Type	Option	Configuration Details
IMU_KVH_1750	0	Configure KVH options for NovAtel communication.
	1	Change KVH baud rate to 921,600
	2	Change KVH baud rate to 460,800

2.4.8 INS Profiles

INS Profiles provide two major functions; simplified configuration and enhanced performance. Each INS Profile sets specific filter behavior to enhance system performance in particular environments.

The INS profile settings are enabled by the receiver model. A receiver model with an INS Mode of **S**, **P**, **R** or **K** is required to enable INS Profiles. The INS profile adds enhanced behavior such as Dead Reckoning for land and Heave for marine and allows for simple configuration rather than sending many discreet commands.

Table 67: OEM7 INS Profiles

Profile	Description	Enhanced Profile Settings
DEFAULT	The default SPAN profile. This profile has legacy SPAN default settings.	N/A
LAND	INS Profile for fixed axle land vehicles. Enables robust kinematic alignment routines and configures the update profile.	Enables intelligent vehicle dynamics modeling for land vehicles (Dead Reckoning) Enables course over ground attitude updates Enables direction detection on kinematic alignment routine
MARINE	INS profile for marine vessels. Enacts changes to disable static behavior and make the marine solution more robust.	Disable Zero Velocity Updates Disable turn-on bias estimation Enables Heave algorithms
FIXEDWING	INS profile for fixed wing aircraft	None
FOOT	INS profile for walking or backpack applications	None
VTOL	INS profile for Vertical Take Off and Landing aircraft (helicopter, quadcopter, etc.)	None

Profile	Description	Enhanced Profile Settings
RAIL	INS profile for railway applications	Enables intelligent vehicle dynamics modeling for rail vehicles (Dead Reckoning) Enable course over ground attitude updates Enable direction detection on kinematic alignment routine
AGRICULTURE	INS profile for agriculture applications	Enables direction detection on kinematic alignment routine Enables course over ground attitude updates Enables intelligent vehicle dynamics modeling for agricultural vehicles (Dead Reckoning)

Use

To use an INS Profile, send the **SETINSPROFILE** command at startup (or save to NVM) to activate the mode. For example:

```
SETINSPROFILE LAND
```

The type of profile activated, basic or enhanced, is determined by the SPAN model.

The currently selected profile option is available in the **INSCONFIG** log.

RBV Calibration

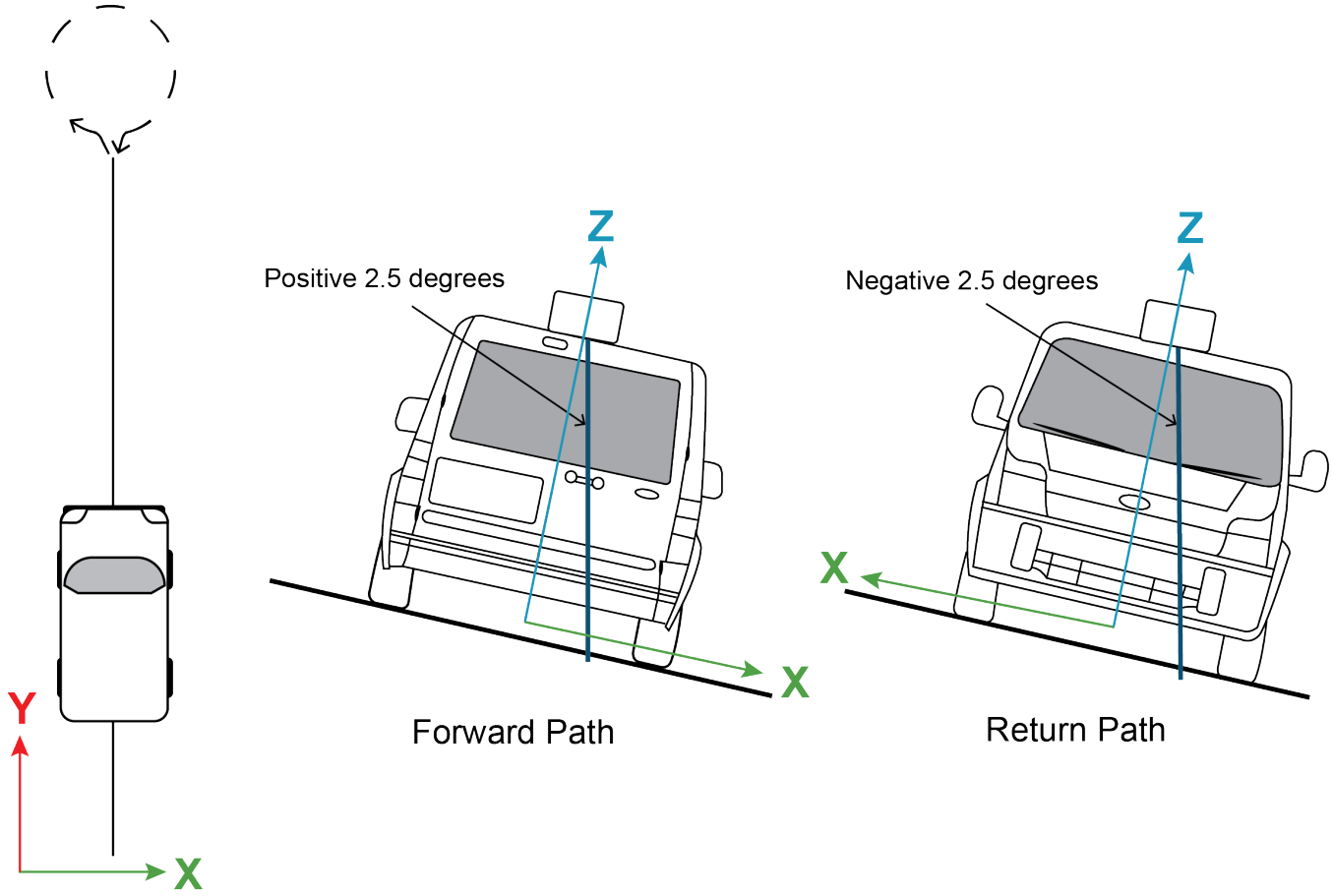
For the profiles to provide the greatest benefit, the rotation offset of the IMU body to the vehicle frame (RBV) should be known as accurately as possible. Since constraints happen at the vehicle level, any error in the offset will translate into worse performance. These parameters are estimated in the background when the system is fully converged, however it is always better to have this measured as precisely as possible before mission critical data is collected.

The INSCALIBRATE RBV functionality can be used to estimate and save these offsets to NVM in a controlled manner.

2.4.9 Multi-Line Body to Vehicle Frame Rotation Calibration Routine

The single pass Body to Vehicle frame offset calibration feature assumes flat ground when estimating the roll offsets between the IMU Body and Vehicle frames, as this component of the rotational offset is difficult to observe through typical ground vehicle motion. In practice this can result in an outstanding roll offset error as high as several degrees. For applications where vehicle roll must be well known, or pass-to-pass accuracy of a highly offset position is especially important, the Multi-Line IMU Body to Vehicle frame offset calibration routine offers higher calibrated accuracy in roll. This is done by running independent calibrations over the same ground path in opposite directions; averaging the results cancels out the effect of any terrain induced roll. A minimum of two iterations are required. Additional iteration pairs can be executed for increased reliability.

Figure 1: Multi-Line IMU Body to Vehicle Calibration



The steps for the calibration routine are:

1. Apply power to the .
2. Configure the SPAN system, see .
3. Perform an initial system alignment using one of the methods described in System Start-Up and Alignment Techniques. Ensure the system reaches Solution Good.
4. Enable a new calibration using the **INSCALIBRATE** command, with the optional standard deviation target omitted:

   ```
   INSCALIBRATE RBV NEW
   ```

5. Start to move the vehicle. Drive a straight course, at a vehicle speed greater than 5 m/s (18 km/hr). A distance of approximately 250 metres is recommended.

   To monitor the calibration, log **INSCALSTATUS** using the ONCHANGED trigger.

6. When the end of the available distance is reached, stop the vehicle. Halt the ongoing calibration by sending the **INSCALIBRATE** command again:

   ```
   INSCALIBRATE RBV STOP
   ```

7. At this point **INSCALSTATUS** will report a source status of CALIBRATED. Turn the vehicle around and come to a stop on the finishing point of the previous line.
8. Initiate the second pass of the calibration by issuing the **INSCALIBRATE** command with the **ADD** parameter:

```
INSCALIBRATE RBV ADD
```

9. Drive the vehicle back along the original course, until you reach the starting point for the first pass. Stop the vehicle, and re-issue the **INSCALIBRATE** command, with the **STOP** parameter. **INSCALSTATUS** will again indicate a source status of CALIBRATED.

   At this point the Multi-Line calibration can be considered complete, but more iterations can be repeated until the desired accuracy level is reached.

   At any point during an active calibration line, the **INSCALIBRATE** command, with the **RESET** parameter can be used to reset the calibration. This will ensure that the results of the active line are not added to the Multi-Line calibration. The **INSCALSTATUS** log will restore the previous source status and calibration values.

10. When the calibration is complete, the calibrated offset value can be viewed in either the **INSCALSTATUS** log or the **INSCONFIG** log.

To save a calibrated rotation for subsequent start ups, issue the **SAVECONFIG** command after calibration is complete. Each time the IMU is re-mounted this calibration should be performed again.

Do not start INS Calibrations (NEW or ADD) until the inertial alignment is completed and system has converged.

For information about the logs and commands used in this procedure, refer to the OEM7 Commands and Logs Reference Manual.

2.4.10 INS Seed / Fast INS Initialization

The INS Seed functionality is an alignment method whereby INS alignment information from a previous powerup can be injected into the system at startup to achieve an INS alignment more quickly. This is especially useful for systems that previously required a kinematic alignment.

When INS Seed is enabled, alignment data is automatically saved when appropriate, with no specific action required from the user. During subsequent power ups, the saved solution is compared to the current position of the system, and if valid, the saved solution is used to immediately initialize the inertial filter, making it ready for use.

Error model information is also saved with the seed data. Even if full alignment cannot be achieved, this information will still be used to aid filter convergence, although another method of alignment will be required.

This feature is enabled via the **INSSEED** command. This command setting must be saved to NVM via the **SAVECONFIG** command to be used upon next system boot-up.

When the INS Seed functionality is enabled, it will most often be the first available alignment method and therefore the used alignment method. If Dual Antenna Alignment is desired, consider disabling INSSEED. See System Start-Up and Alignment Techniques for more details.

Criteria

For the INS seed functionality to be enabled, the **INSSEED ENABLE** command must be sent.

Saving

The following criteria must be met for valid alignment data to be saved into receiver NVM.

- The INS solution status must be converged, as indicated by the INS solution convergence flag in the inertial Extended Solution Status.
- The system velocity is less than 0.2 m/s.

When these conditions are met, the required information is automatically saved to NVM. If these conditions cease to be met, the saved alignment data is automatically discarded. If the alignment data is discarded, error model information is automatically retained as appropriate.

Use at Boot-up

Upon boot, several checks are done to verify that any seed data existing in NVM is appropriate for use. These checks require a GNSS position to be computed, so an NVM seed will never be injected prior to achieving a GNSS position. The following criteria must be met in order to use a seed:

- Seed data from NVM must be valid
- The system must be stationary
- The system must not have moved significantly from the seed position: less than 10 metres in position and 10 degrees in heading

If a valid error model is present in the seed data from NVM, this will always be used, even if the system is not stationary or exceeded the movement thresholds.

INJECT Option (Advanced Users Only)

There is an advanced option available to skip the second and third validation steps described in the boot-up section above. This can be used if GNSS is not available on power-up or if speed to achieve an alignment is imperative.

This option is for advanced users only. Forcing an injection of an NVM seed without the validation checks can cause an unstable INS solution if the vehicle has moved.

Apart from injecting the seed at start-up without validation, this will also remove some requirements typically asserted to allow the filter to converge. This will allow the system to run without GNSS adequately at start-up.

Example Usage

Enabling functionality after FRESET:

1. Send the following command.

```
INSSEED ENABLE VALIDATE
```

2. Send the following command.

```
SAVECONFIG
```

Saving valid INS information:

1. Operate the system as normal, until the filter completes convergence.
2. Bring the system to a complete stop before powering off or resetting.

Using valid INS information on start-up:

1. Remain static while initializing.
2. Wait for the system to receive a valid position from GNSS.
3. If valid, alignment data will be injected.

System Indicators

The **INSSEEDSTATUS** log reports the seed injection status for the current power up and information on current seed validity. Refer the OEM7 Commands and Logs Reference Manual for more information about the **INSSEEDSTATUS** log.

The Extended Solution Status field in the **INSPVAX** log has bits that indicate if the alignment direction is verified, the Alignment type that occurred and NVM seed injection status.

Alignment Direction Verified: Bit 25

This bit indicates whether the alignment is verified or not. When the seed is injected and kinematic validation is finished, bit 25 is set to 1. Note that this bit will not be set until the kinematic validation completes. When the INJECT option is used, validation is skipped and this bit will not be set.

Alignment Type: Bits 26-28

These bits indicate how the INS system reached INS_ALIGNMENT_COMPLETE. When the INS system aligns using saved INS solution data from NVM, bits 26-28 will be set to 101

NVM Seed Status: Bits 29-31

These bits indicate the current status of the seeding process at start-up, as described in the table below:

Table 68: NVM Seed Indication

Bit 31-29 Values[1]	Hex Value	NVM Seed Type
000	0x00	INS Seed has not been injected into the solution
001	0x01	Valid INS Seed was not found in non-volatile memory
010	0x02	INS Seed has failed validation and has been discarded
011	0x03	INS Seed is awaiting validation
100	0x04	INS Seed alignment data has successfully been injected (including error model data)
101	0x05	INS Seed exists, but has been ignored due to a user commanded filter reset/restart or configuration change
110	0x06	INS Seed error model data has successfully been injected

Chapter 3 OEM6 to OEM7 – Hardware

The following OEM7 GNSS receivers are discussed in the following sections.

- OEM719
- OEM729

3.1 Physical changes

Two of the OEM7 receivers are form factor replacements for OEM6 receivers. The OEM719 replaces the OEM615 and the OEM729 replaces the OEM628. Form factor replacement means that the OEM7 receivers:

- have the same physical dimensions as the OEM6 receivers
- have the same keep-out zones as the OEM6 receivers
- use the same locations for the mounting holes as the OEM6 receivers
- use the same connectors as the OEM6 receivers
- use the same locations for the connectors as the OEM6 receivers

The physical differences between the OEM7 and OEM6 receivers are described in the following sections.

3.1.1 Shielding

The OEM719 and OEM729 have an additional shield compared to the OEM615 and OEM628. However, all of the shields on the OEM719 are within the keep-out zone defined for the OEM615 and all of the shields on the OEM729 are within the keep-out zone defined for the OEM628. Designs that respected the keep-out zones for the OEM6 receivers will not be affected by the shields on the OEM719 and OEM729.

For information about the OEM615 and OEM628 keep-out zones, see the OEM6 Family Installation and Operation User Manual (OM-20000128). For information about the OEM719 and OEM729, see *Figure 10: OEM719 Keep-outs* on page 192 and *Figure 17: OEM729 Keep-outs* on page 211.

3.1.2 Mounting

The OEM719 and OEM729 can be mounted using standoffs or bosses that have the same spacing required for OEM6 receivers. See *Figure 9: OEM719 Dimensions* on page 191 and *Figure 16: OEM729 Dimensions* on page 210 for the exact spacing.

OEM7 receivers also have an area on the edge of the cards to allow the use of mounting rails. In *Figure 15: OEM719 Mounting Surface* on page 197 and *Figure 18: OEM729 Mounting Surfaces* on page 212, this is the area outside of the keep-out zone. On the OEM719, this area is 1.75 mm wide. On the OEM729, this area is 2.5 mm wide.

Using rails to mount the OEM7 receiver improves the thermal and vibration performance of the receiver. Securing the OEM7 receiver to mounting rails using clamping bars provides the most secure configuration for aggressive thermal and vibration use cases.

For more details about mounting OEM7 receiver cards, refer to the *OEM7 Receiver Card Mechanical Integration Application Note* (D19021).

3.1.3 Weight

The OEM7 receivers are slightly heavier than the OEM6 receivers they replace.

Receiver	Weight		Receiver	Weight
OEM615	24 g		OEM628	37 g
OEM719	31 g		OEM729	48 g

3.2 Electrical changes

3.2.1 COM Port Data Rate

The maximum data rate for COM ports has changed. On OEM6 receivers, the maximum data rate was 921,600 bps. On OEM7 receivers, the maximum data rate is 460,800 bps.

3.2.2 Power Supply

The power consumption of OEM7 receivers is dependent on receiver configuration and feature use. Enabling more features (e.g. interference detection) will increase the power required.

- The OEM719 power consumption is approximately 10% higher than a similarly configured OEM615.
- The OEM729 power consumption is approximately 10% lower than a similarly configured OEM628.

A monotonic rise of the supply voltage input is required to guarantee a proper power-on reset sequence. The maximum rise time is 100 ms.

Bulk supply bypassing (approx 10 µF) and high-frequency bypassing (0.1 µF and 220 pF) near the supply pin is recommended for optimal performance.

On the OEM7 receiver cards, there is an approximate effective input bulk capacitance of 100 µF at room temperature. This is made up of ceramic capacitors with a voltage rating of 6.3 VDC and tolerance of 20%.

OEM7 receivers monitor the supply voltage. If the supply voltage falls outside of the normal operating range, a warning or error is provided in the RXSTATUS log. See the **RXSTATUS** log on page 139 for more information.

Inrush Current

The inrush current behavior of the OEM7 receivers is different than the OEM6 receivers.

Table 69: OEM6 Receiver Inrush Current

OEM6 Receiver	Inrush Current (Typical)
OEM615	6.0 A for less than 60 µs
OEM617	6.0 A for less than 60 µs
OEM617D	6.0 A for less than 60 µs
OEM628	6.6 A for less than 60 µs
OEM638	12.0 A for less than 60 µs

Table 70: OEM7 Receiver Inrush Current

OEM7 Receiver	Inrush Current (Typical)
OEM719	1.71 A for less than 1.5 ms

OEM7 Receiver	Inrush Current (Typical)
OEM729	2.0 A for less than 1.8 ms
OEM7500	1.7 A for less than 1.5 ms (3.3 VDC) No inrush current for 1.2 VDC
OEM7600	2.0 A for less than 1.8 ms
OEM7700	2.0 A for less than 1.8 ms
OEM7720	2.0 A for less than 1.8 ms

3.2.3 USB Interfaces

The layout guidelines are identical to those provided for OEM6, but the recommended common-mode choke value has changed. See *USB Interface* on page 175.

The OEM719 and OEM729 USB interfaces operate at 12 Mb/s ("Full-Speed") operation for backwards-compatibility reasons.

3.2.4 Input and Output lines

The voltage limits and drive currents on the input and output lines of the OEM7 receivers are different than the levels on the OEM6 receivers. See *Table 109: OEM719 Strobe Electrical Specification* on page 203 and *Table 118: OEM729 Strobe Electrical Specifications* on page 219 for details.

3.2.5 LNA Power

If a short circuit or other problem causes an overload of the current supplied to the antenna, the receiver hardware shuts down the power supplied to the antenna. To restore power, power cycle the receiver. The Receiver Status word, available in the **RXSTATUS** log (see page 139), provides more information about the cause of the problem.

OEM719

On OEM615 receivers, LNA power is provided by an external power supply connected to pin 1 of the main connector.

On OEM719 receivers, LNA power is generated on the receiver and pin 1 of the main connector has no electrical connection on the board. The OEM719 provides up to 200 mA of current at +5 VDC. The LNA is generated from the 3.3 V supply; therefore the OEM719 will draw more power on the 3.3 V rail than a similarly configured OEM615.

The typical current draw for a NovAtel active antenna is <40 mA. For a typical antenna, this may increase the power drawn from the 3.3 V supply by as much as 70 mA (as the LNA supply is approximately 85-90% efficient).

OEM729

On OEM628 receivers, the voltage provided to the LNA could be changed from the default of +5 VDC to +3.3 VDC using the ANTENNAPOWER command.

The voltage for the LNA power is not selectable on OEM729 receivers, but the OEM729 can provide more current to the LNA. The OEM729 provides up to 200 mA of current at +5 VDC.

3.3 Environmental changes

3.3.1 Thermal dissipation

To ensure functionality and reliability, the OEM7 receiver cards must operate within the specified ambient air temperature limits (-40°C to +85°C).

The OEM7 receivers have been designed to efficiently transfer heat from the receiver components into the printed circuit board. Mounting the OEM7 receiver on rails, or attaching heat sinks to the mounting areas, will transfer the heat from the receiver card to adjacent circuit boards, the enclosure or the air.

The mounting area is the area on the sides of the receiver that are outside of the keep-out zone. See *Figure 15: OEM719 Mounting Surface* on page 197 and *Figure 18: OEM729 Mounting Surfaces* on page 212.

The best thermal mitigation comes from sinking heat through the mounting rails. This provides more effective thermal relief than attaching a heat sink to the MINOS.

For more information about thermal dissipation, refer to the *OEM7 Receiver Card Mechanical Integration Application Note* (D19021).

3.3.2 Vibration

On OEM6 receivers, the random vibration specification is dependent on the receiver variant. Standard OEM6 receivers were rated to 7.7g RMS (MIL-STD-810G Method 514.6, Category 24). High vibration OEM6 receivers were rated to 20g RMS (MIL-STD-810G Method 514.6, Category 24).

All OEM7 receivers are rated to 20g RMS (MIL-STD-810G Method 514.6E-1, Category 24). However, for high vibration installations, special considerations are required.

For more information about vibration considerations, refer to the *OEM7 Receiver Card Mechanical Integration Application Note* (D19021).

3.4 Interference

Typical GNSS signal levels are in the order of -130 dBm. Spurious emissions from digital logic (especially a microprocessor) or a nearby radio transmitter can easily meet the appropriate EU or FCC emission limits and still be several orders of magnitude above the level of the GNSS signals.

These emissions may desensitize the GNSS receiver and lead to performance degradation (low carrier to noise ratios, position accuracy, or loss of lock in extreme cases).

There are two bands of interest:

- Low Band (1164 MHz to 1300 MHz): contains GPS L2, GPS L5, GLONASS L2, BeiDou B2, BeiDou B3, Galileo E5a, Galileo E5b, Galileo E5 and Galileo E6.
- High Band (1525 MHz to 1610 MHz): contains GPS L1, GLONASS L1, BeiDou B1, Galileo E1, and L-Band.

OEM7 receivers are designed to mitigate RF interference on the GNSS card itself. However, if an emission (fundamental or harmonic) from equipment co-located with the GNSS receiver or antenna falls into one of these bands, there are a few things that can be done to ensure good system performance:

- Place radio transmitters and their associated antennas as far away from the GNSS antenna and OEM7 card as possible (for example, a cellular radio antenna).
- Provision for RF shielding over all high-speed digital logic circuitry (even if the design meets the required emissions regulations). A CPU operating at 400MHz will produce an emission at 1200MHz (3rd harmonic) and another at 1600MHz (4th harmonic) – the emissions may be strong enough to affect the GNSS system performance. Similar provisions should be made for any RF circuitry near the GNSS receiver or antenna.
- Run the OEM7 antenna coaxial cable away from high-speed digital logic, other radio sections and high-current nets (as in switching power supplies).

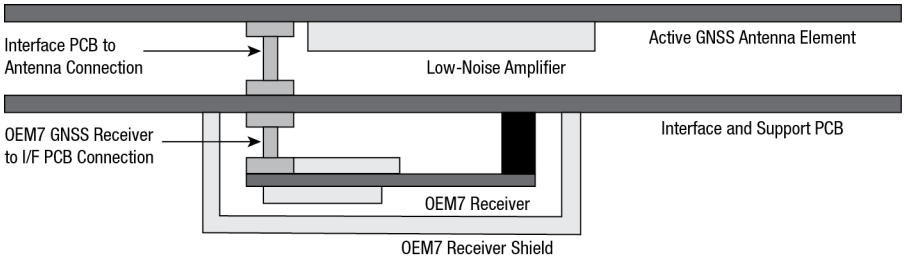
3.4.1 Interference from Co-Located LNA

Often a GNSS receiver is placed in the same enclosure as a GNSS antenna and LNA to create an all in one GNSS receiver product (also referred to as a *smart antenna*).

The close proximity of a high-gain amplifier to the GNSS receiver may cause some low-level near-field energy from the receiver to be amplified and fed back into the receiver, causing C/No degradation to one or more constellations.

It is strongly advised in a smart antenna design that the receiver be enclosed in a shield to prevent this near-field energy from coupling into the antenna. This includes connecting the GNSS receiver input ground to the shield surrounding the receiver, similar to the following image. It is also strongly advised to use mounting rail for receiver cards used in this configuration.

Figure 2: SMART Antenna Interference Example



The previous figure shows one method of shielding the receiver.

The rail mounting provision on the edges of the receiver card can also used to attach entire board shielding.

3.1 Receiver Card Interface Examples

The OEM7 receiver cards provide a number of 3.3V CMOS-level I/O pins for status indication and timing:

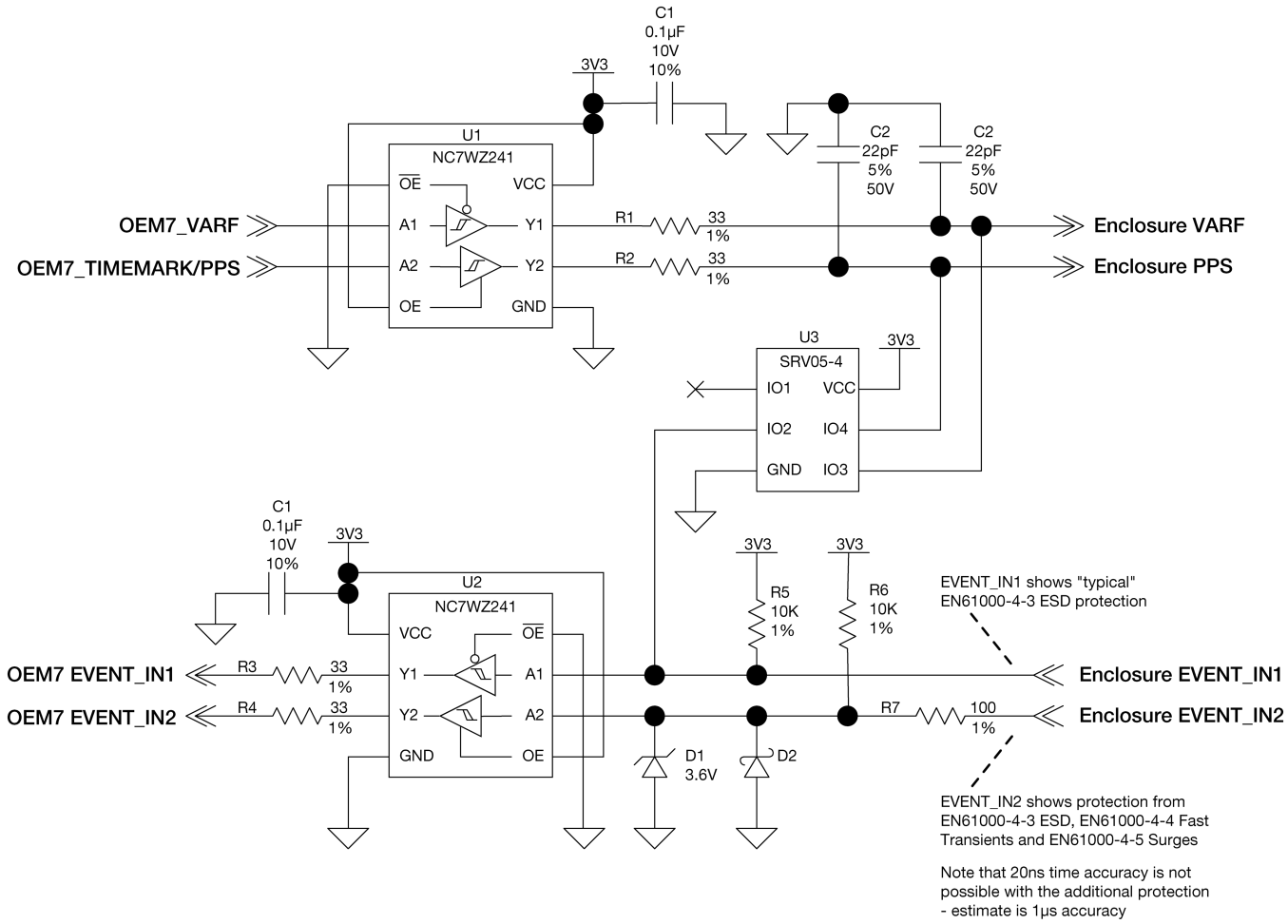
- **COMx**: CMOS-level UART ports
- **Ethernet**: 10/100 Ethernet port
- **CAN1** and **CAN2**: CMOS-level CAN ports (external CAN transceivers required)
- **PPS**: Output pulse providing time reference signal (software configurable output rate, defaults to 1 Pulse Per Second)
- **EVENTx_OUT**: Variable Frequency output (a software-configurable clock output similar to PPS, off by default). (The EVENT1_OUT signal may also be referred to as an VARF.)
- **PV**: Position Valid (This signal drives high when the receiver has calculated a valid position)
- **EVENTx_IN**: Event inputs (with configurable polarity)
- **USERIO**: A user defined general purpose input or output (OEM729 only)

These I/O require additional ESD protection if they are to be routed to enclosure connectors. A protection circuit similar to the following examples must be used on any OEM7 CMOS-level signals that will be routed to an enclosure connector. The ferrite bead and small-value capacitor provide some immunity to electrostatic discharge events, but also serve to reduce radiated and conducted emissions from the enclosure.

3.4.2 EVENT_IN, EVENT_OUT and PPS Signal Protection

The following schematic shows appropriate signal conditioning for EVENT_IN (MKI), EVENT_OUT (VARF) and PPS (TIMEMARK) signals.

Figure 3: Protection and Buffering for EVENT_IN, PPS and EVENT_OUT signals



The buffers (U1, U2) are chosen to provide additional drive strength for long cables. The series terminations (R1, R2, R3, R4) are present to allow for signal integrity adjustments (to reduce overshoot/undershoot, etc.). The passive component values may require tuning, depending on the application.

The TVS (U3) provides protection from ESD/EFT events and some induced power line surges. There are two implementations shown for the EVENT_IN signals. EVENT_IN1 is shown with basic ESD/EFT protection, while EVENT_IN2 is shown with additional surge protection for harsh environments (see D1, R7, D2, D3 and R9). If the additional surge protection is to be used on a design, the buffer must be included as well. This design has been used to protect EVENT_IN signals from EN61000-4-5 induced surges up to 2kV on several NovAtel enclosure products. If nanosecond-level timing is critical to the application, this protection circuit may be unsuitable, as it causes a timing shift of a few microseconds to the EVENT signal (heavily dependent on temperature).

The 10 kΩ pullups (R5, R6) are required if the buffers are used on the EVENT_IN lines. If the buffers are not used, the OEM7 cards have built-in 10 kΩ pullup resistors – external pull resistors are not required.

Table 71: EVENT_IN, EVENT_OUT and PPS Pin Designation

	OEM719	OEM729	OEM7600	OEM7700	OEM7720
Connector	P1701	P1802	P1701	P2001	P1901

	OEM719	OEM729	OEM7600	OEM7700	OEM7720
EVENT_IN1	9[1]	8	30	30	30
EVENT_IN2	7[2]	7[3]	29	29	29
EVENT_IN3	–	–	32	32	32
EVENT_IN4	–	–	31	31	31
PPS	19	4	24	24	24
EVENT_OUT1/VARF	6[4]	3	17	17	17
EVENT_OUT2	–	–	26	26	26
EVENT_OUT3	–	–	23	23	23
EVENT_OUT4	–	–	25	25	25

Table 72: Bill of Materials (critical components)

Designator	Manufacturer	Manufacturer Part Number
D1	On Semiconductor	MMSZ5227BT1G
D2	Comchip Technology	CDBU00340
U1, U2	Fairchild Semiconductor	NC7WZ241L8X
U3	Semtech	SRV05-4A.TCT

3.4.3 Position Valid (PV) LED Driver

The PV signal may be used to indicate that the receiver card has computed a valid position. Many NovAtel enclosure products use it to drive a green LED on the enclosure. It may also be used to monitor the status of the receiver with an external microcontroller.

If the LED requires less than 6 mA to drive, and can be operated from a 3.3 V supply, the PV pin may be used to drive the LED directly (with an appropriate current-limiting resistor). If the LED must be driven from a different supply voltage or requires more than 6 mA, a buffer must be used.

A simple buffer – suitable for driving a high-brightness LED from a 5 V supply – is shown below. The value for R2 was selected to limit the LED current to 10 mA (assuming $V_{CE(Q1,sat)}$=0.25 V, $V_{FWD(D1)}$=3.4 V). This circuit will not compensate for the forward voltage change over temperature (and the resulting brightness changes).

[1]This pin is multiplexed with the COM3 transmit signal and is not available if COM3 is enabled.

[2]This pin is multiplexed with the CAN1 transmit signal and is not available if CAN1 is enabled.

[3]This pin is multiplexed with the COM3 receive signal and is not available when COM3 is enabled. See *P1802 Main Connector 24-Pin Header* on page 220 for more information.

[4]This pin is multiplexed with the CAN1 receive signal and is not available if CAN1 is enabled.

Figure 4: OEM7 Buffer for Driving High-Brightness LEDs from PV

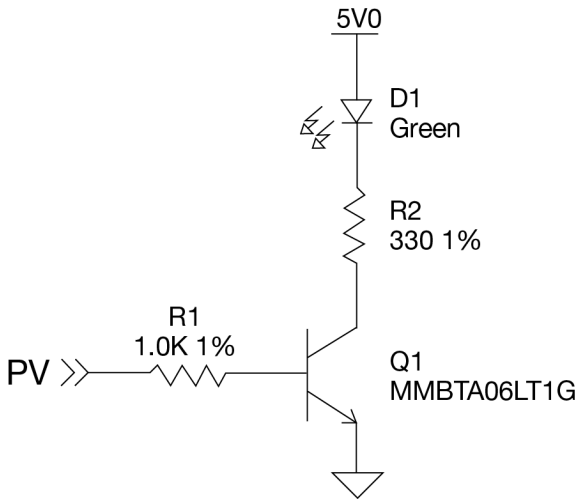


Table 73: PV Pin Designation

	OEM719	OEM729	OEM7600	OEM7700	OEM7720
Connector	P1701	P1802	P1701	P2001	P1901
PV	17	10	22	22	22

Table 74: PV LED Driver Bill of Materials (critical components)

Designator	Manufacturer	Manufacturer Part Number
Q1	ON Semiconductor	MMBTA06LT3G
	Fairchild Semiconductor	MMBTA06LT1G
	Diodes Inc	MMBTA06-7-F
D1	OSRAM	LT L29S-N1R2-25-Z

3.4.4 Communication Ports

The COM ports on OEM7 receivers (except COM1 on the OEM729) are CMOS-level I/O pins only. These ports require the addition of an RS-232 or RS-422 transceiver to provide appropriate signal levels. Most RS-232 or RS-422 transceivers will provide some ESD protection (for harsh environments, additional protection may be required).

COM1 on the OEM729 uses RS-232 protocol by default. This port can be changed to RS-422 protocol using the **SERIALPROTOCOL** command.

A combination of a series ferrite bead and small-value shunt capacitor is recommended on any RS-232/RS422 lines that leave the enclosure (similar to the arrangement used on the I/O ports and CAN interfaces). Many of the available transceivers provide protection for ESD events to ±15kV – if additional protection is required, an external TVS with a working voltage of ±15V to ±25V will be required.

3.4.5 CAN Controller Ports

OEM7 receivers provide 3.3 V CMOS-level CAN controller ports. An external CAN transceiver is required. The following figure shows a typical CAN transceiver implementation.

The combination of ferrite beads and small-value capacitors are not necessarily required but may provide improved EMI performance. A low-capacitance TVS device is shown on the schematic to provide ESD protection.

Figure 5: OEM7 CAN Transceiver Example

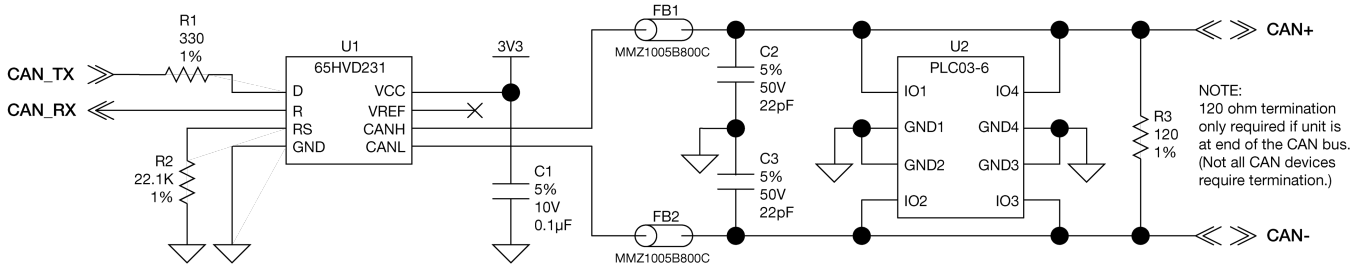


Table 75: CAN Transceiver Pin Designation

	OEM719	OEM729	OEM7600	OEM7700	OEM7720
Connector	P1701[1]	P1803	P1701	P2001	P1901
CAN1TX	7	10	36	36	36
CAN1RX	6	11	38	38	38
CAN2TX	20	12	37	37	37
CAN2RX	8	13	35	35	35

The 120Ω termination resistor should only be used when the CAN device is used at one end of the CAN bus. Multiple terminations along the length of the CAN bus will degrade performance for all CAN devices on that bus.

The slew rate adjustment resistor (R2) value shown sets the slew rate for applications for SAE J1939 agricultural applications. Other applications may require a different slew rate. Refer to the transceiver data sheet for more information.

Table 76: CAN Transceiver Example Bill of Materials (critical components)

Designator	Manufacturer	Manufacturer Part Number
FB1, FB2	TDK	MMZ1005B800C
U1	Texas Instruments	SN65HVD231QD
U2	Bourns	CDNBS08-PLC03-6

[1]Pins 6 and 7 are multiplexed with other signals and may not be available when certain features are enabled. See *OEM719 Interface Connector* on page 204 for more information.

3.4.6 USB Interface

This section describes the interface requirements for an OEM7 receiver card USB port. For general information about the OEM7 receiver card USB ports, see USB Ports.

OEM7 receivers include an USB 2.0 device interface set to either Full-Speed (12 Mb/s) or High-Speed (480 Mb/s) transfer rate. On the OEM719 and OEM729 receivers, the transfer rate for the USB Device port is Full-Speed (12 Mb/s). The USB device interface on the OEM7600, OEM7700 and OEM7720 receivers use the High-Speed (480 Mb/s) transfer rate. The device interface will not auto-negotiate the speed with the Host computer.

It is imperative for signal integrity and EMI reasons that the differential data traces be routed as a 90Ω differential pair. Use of a small-value common-mode choke (as shown in *Figure 6: OEM7 USB Device Interface Example* below) may improve the radiated emissions performance (but should not be necessary).

Any stubs on the traces must be kept as short as possible and it is strongly recommended not to change reference planes. Match the USB differential pair (D+ and D- trace lengths) to within 3 mm or less.

The common-mode choke and ESD protection should be placed as close as possible to the USB connector (J1).

Figure 6: OEM7 USB Device Interface Example

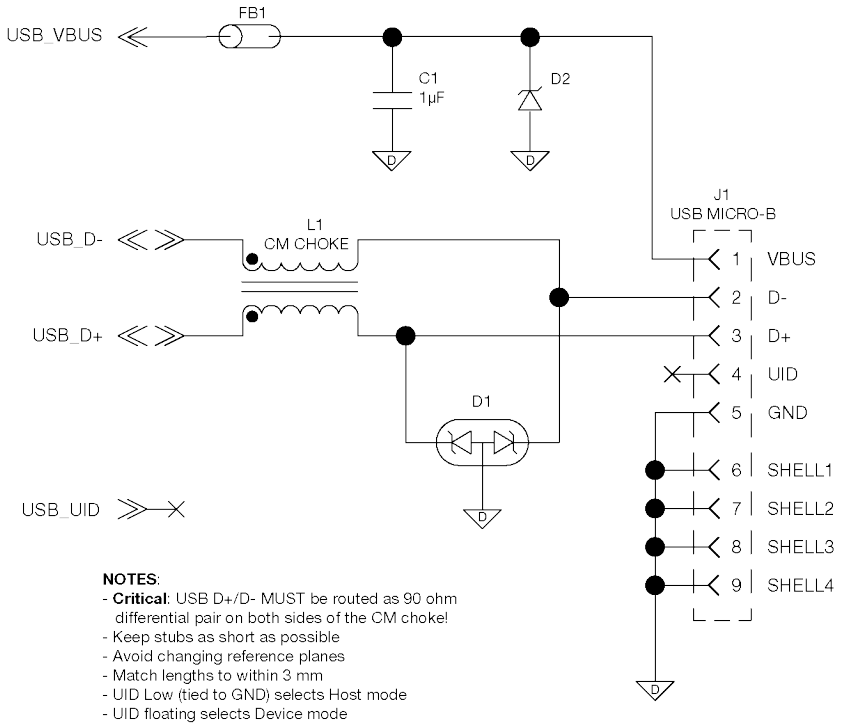


Table 77: USB Device Interface Pin Designation

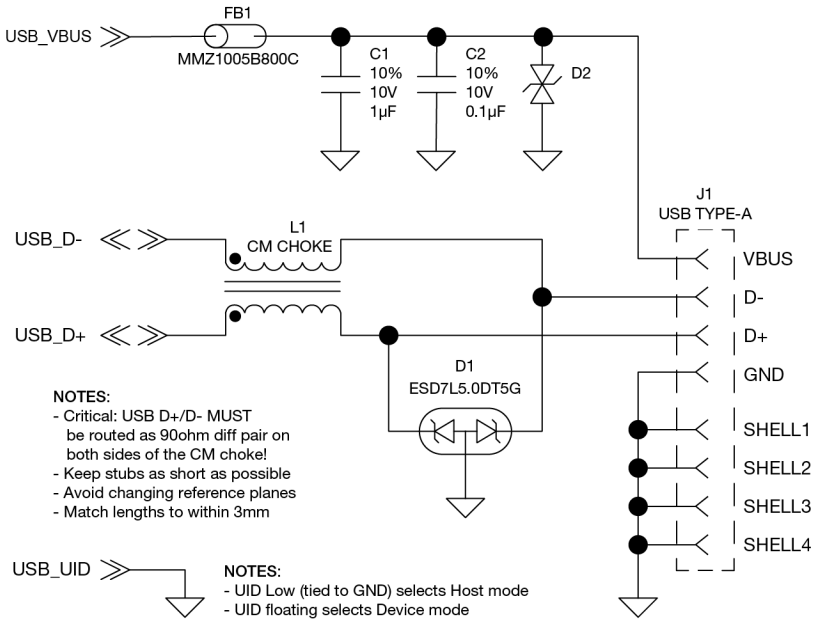
	OEM719	OEM729		OEM7600	OEM7700	OEM7720
Connector	P1701	P1802	P1803	P1701	P2001	P1901
USB0_D-	3	21	-	50	50	50

	OEM719	OEM729		OEM7600	OEM7700	OEM7720
USB0_D+	4[1]	22	-	48	48	48
USB1_D-	-	-	-	47	47	47
USB1_D+	-	-	-	49	49	49
USB_VBUS	-	-	15	52	52	52
UID	-	-	14	51	51	51

Table 78: USB Device Interface Example Bill of Materials

Designator	Manufacturer	Manufacturer Part Number
D1	On Semiconductor	ESD7L5.0DT5G
D2	On Semiconductor	ESD5Z6.0T1G
FB1	TDK	MMZ1005B800C
L1	Wurth Electronics	744230900
J1	FCI	10104110-0001LF

Figure 7: OEM7 USB Host Device Interface Example



[1]This pin is multiplexed with the COM3 receive signal and is not available when COM3 is enabled.

Table 79: USB Host Interface Pin Designation

	OEM719	OEM729		OEM7600	OEM7700	OEM7720
Connector	P1701	P1802	P1803	P1701	P2001	P1901
USB0_D-	3	21	-	50	50	50
USB0_D+	4[1]	22	-	48	48	48
USB1_D-	-	-	-	47	47	47
USB1_D+	-	-	-	49	49	49
USB_VBUS	-	-	15	52	52	52
UID	-	-	14	51	51	51

Table 80: USB Host Interface Example Bill of Materials

Designator	Manufacturer	Manufacturer Part Number
D1	On Semiconductor	ESD7L5.0DT5G
D2	Littelfuse	V5.5MLA0402NR
FB1	TDK	MMZ1005B800C
J1	Molex	0482040001
L1	Wurth Electronics	744230450

3.4.7 Ethernet Port

OEM7 receivers, except the OEM719, provide a 10/100 Ethernet port with auto-negotiation. The Ethernet interface is disabled by default and must be configured. See the Ethernet Configuration for instructions on Ethernet device configuration. The PHY layer is based on the Texas Instruments TLK106 Ethernet PHY.

PHY terminations are provided on the OEM7 receiver card and a 3.3 V output is presented to bias the Ethernet magnetics. The 3.3 V power supplied by the OEM7 receiver card is not to be used for any purposes other than biasing the Ethernet magnetics.

A reference schematic is shown in *Figure 8: Ethernet Reference Schematic* on the next page. The ferrite bead is included as an EMI de-risk contingency and may not be necessary.

[1]This pin is multiplexed with the COM3 receive signal and is not available when COM3 is enabled.

Figure 8: Ethernet Reference Schematic

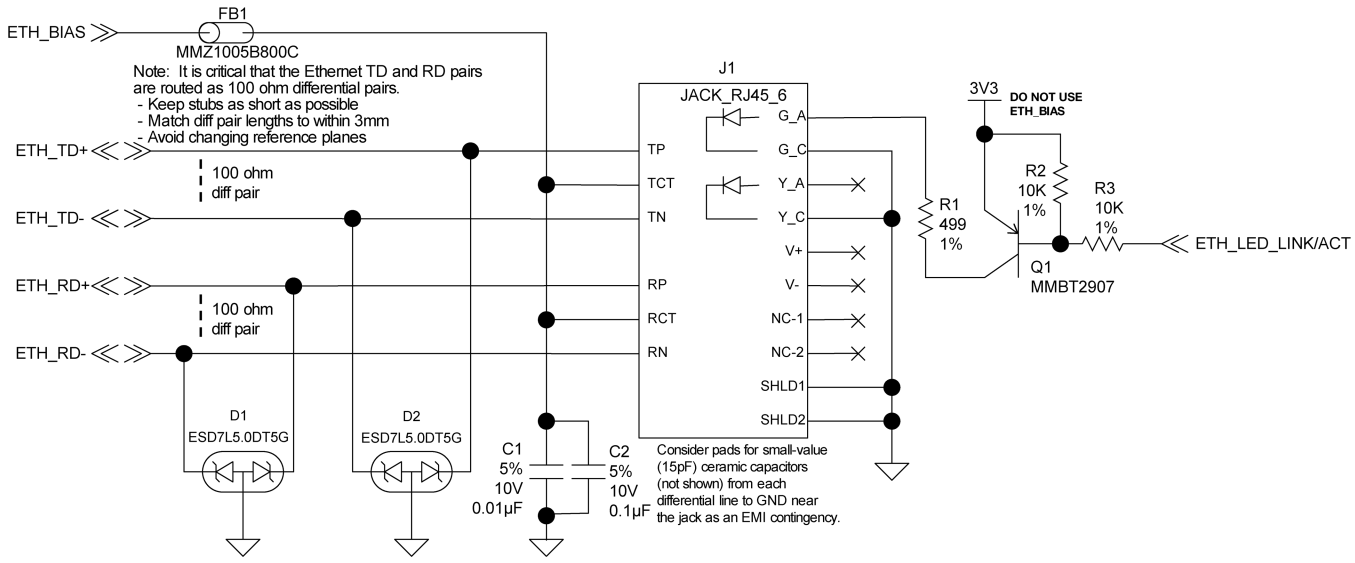


Table 81: Ethernet Pin Designation

	OEM729	OEM7600	OEM7700	OEM7720
Connector	P1803	P1701	P2001	P1901
ETH_BIAS	Receive: 3 Transmit: 6	56	56	56
ETH_TD+	4	58	58	58
ETH_TD-	5	60	60	60
ETH_RD+	2	57	57	57
ETH_RD-	1	59	59	59

Run 100 Ω differential pairs over unbroken reference planes directly to the jack. Ensure the integrated magnetics in the jack meet the specifications in *Table 82: Ethernet Transformer Characteristics* below. Ensure that the jack is no more than 15 cm (6 inches) from the OEM7 connector. Shorter runs are better.

Table 82: Ethernet Transformer Characteristics

Parameter	Value	Test Condition
Turns ratio	1 CT : 1 CT	
Open-CCT inductance (minimum)	350 µH	100 mV, 100 kHz, 8 mA
Leakage inductance (maximum)	0.4 µH	1 MHz (minimum)
Inter-winding capacitance (minimum)	12 pF	
DC resistance (maximum)	0.9 Ω	
Insertion loss (maximum)	1.0 dB	0 MHz - 65 MHz
HIPOT (minimum)	1500 Vrms	

Table 83: Bill of Materials (critical components)

Designator	Manufacturer	Manufacturer Part Number
FB1	TDK	MMZ1005B800C
D1, D2	On Semiconductor	ESD7L5.0DT5G
J1	Wurth Electronics	7499211121A
Q1	On Semiconductor Fairchild Semiconductor	MMBT2907ALT1G MMBT2907A

3.5 Differences Between PwrPak7 and OEM6 Enclosures

The following tables compare the specifications and features of the PwrPak7 with the specifications and features of OEM6 enclosures.

Table 84: Physical Specifications

	PwrPak7-E1 PwrPak7D-E1	PwrPak7 PwrPak7D	FlexPak6	FlexPak6D	ProPak6
Dimensions	147 x 125 x 55 mm	147 x 125 x 55 mm	147 x 113 x 45 mm	147 x 113 x 45 mm	190 x 185 x 75 mm
Weight	510 g	500 g	337 g	315 g	1.79 kg

Table 85: Power Requirements

	PwrPak7 (all models)	FlexPak6	FlexPak6D	ProPak6
Input Voltage	9 to 36 VDC	6 to 36 VDC	6 to 36 VDC	9 to 36 VDC
Power Consumption	1.8 W	1.8 W	1.9 W	3.5 W

Table 86: Signals Tracked

		PwrPak7 PwrPak7-E1	PwrPak7D PwrPak7D-E1	FlexPak6	FlexPak6D	ProPak6
GPS	L1 C/A	Y	Y	Y	Y	Y
	L1C	Y	Y	–	–	–
	L2C	Y	Y	Y	Y	Y
	L2P	Y	Y	Y	Y	Y
	L5	Y	Y	Y	–	Y

		PwrPak7 PwrPak7-E1	PwrPak7D PwrPak7D-E1	FlexPak6	FlexPak6D	ProPak6
GLONASS	L1 C/A	Y	Y	Y	Y	Y
	L2 C/A	Y	Y	Y	Y	Y
	L2P	Y	Y	Y	–	Y
	L3	Y	Y	–	–	–
Galileo	E1	Y	Y	Y	Y	Y
	E5a	Y	Y	Y	–	Y
	E5b	Y	Y	Y	Y	Y
	E5 AltBOC	Y	Y	Y		Y
	E6	Y	–	–	–	–
BeiDou	B1I	Y	Y	Y	Y	Y
	B1C	Y	Y	–	–	–
	B2I	Y	Y	Y	Y	Y
	B2a	Y	Y	–	–	–
	B2b	Y	Y	–	–	–
	B3I	Y	–	–	–	–
QZSS	L1 C/A	Y	Y	Y	Y	Y
	L1C	Y	Y	–	–	–
	L2C	Y	Y	Y	Y	Y
	L5	Y	Y	Y	–	Y
	L6	Y	–	–	–	–
NavIC	L5	Y	Y	–	–	–
SBAS	L1	Y	Y	Y	Y	Y
	L5	Y	Y	–	–	–
L-Band		5 channels	5 channels	1 channel	–	1 channel

Table 87: Horizontal Position Accuracy (RMS)

	PwrPak7 (all models)	FlexPak6	FlexPak6D	ProPak6
Single Point L1	1.5 m	1.5 m	1.5 m	1.5 m
Single Point L1/L2	1.2 m	1.2 m	1.2 m	1.2 m

	PwrPak7 (all models)	FlexPak6	FlexPak6D	ProPak6
SBAS	60 cm	60 cm	60 cm	60 cm
DGPS	40 cm	40 cm	40 cm	40 cm
TerraStar-L	40 cm	40 cm	–	–
TerraStar-C	–	4 cm	–	4 cm
TerraStar-C PRO	2.0 cm	–	–	–
RTK	1 cm + 1 ppm	1 cm + 1 ppm	1 cm + 1 ppm	1 cm + 1 ppm
RTK ASSIST	Y	Y	–	–
RTK ASSIST PRO	Y	–	–	–

Table 88: Communications Ports

		PwrPak7 (all models)	FlexPak6	FlexPak6D	ProPak6
Serial Ports	COM1	RS-232/RS-422	RS-232/RS-422	RS-232/RS-422	RS-232/RS-422
	COM2	RS-232/RS-422	RS-232/RS-422	RS-232/RS-422	RS-232/RS-422
	COM3	RS-232	–	–	RS-232/RS-422
	COM7[1]	–	–	–	RS-232*
	COM8[1]	–	–	–	RS-232*
	COM9[1]	–	–	–	RS-232*
	COM10[1]	–	–	–	RS-232*
USB Ports	Device	1	1	1	1
	Host	1	–	–	1
CAN Bus Ports		1	1	–	2
Ethernet Port (10BASE-T/100BASE-TX)		1	1	–	1
Wi-Fi	Access Point	1	–	–	1
	Client	–	–	–	1
Cellular (CDMA or GSM/GPRS/HSDPA)		–	–	–	1
Bluetooth		–	–	–	1

1. Only available when using the ProPak6 Expansion cable. The ProPak6 Expansion cable multiplexes four serial COM ports onto a single USB port.

Table 89: RF Input

		PwrPak7 PwrPak7-E1	PwrPak7D PwrPak7D-E1	FlexPak6	FlexPak6D	ProPak6 Dual Antenna	ProPak6
GNSS Antenna Connector	Primary	TNC	SMA	TNC	SMA	TNC	TNC
	Secondary	–	SMA	–	SMA	TNC	–
LNA	Primary	+5 VDC ±5%; 200 mA	+5 VDC ±5%; 200 mA	+5 VDC ±5%; 100 mA	+5 VDC ±5%; 100 mA	+5 VDC ±5%; 200 mA	+5 VDC ±5%; 200 mA
	Secondary	–	+5 VDC ±5%; 200 mA	–	+5 VDC ±5%; 100 mA	+5 VDC ±5%; 100 mA	–
External Oscillator Connector		–	–	–	–	–	BNC
Cellular Antenna Connector		–	–	–	–	TNC	TNC

Table 90: I/O Strobes

	PwrPak7 (all models)	FlexPak6	FlexPak6D	ProPak6
Event In	3	2	2	4
Event Out	3	1	1	3
PPS	1	1	1	1
ERROR	–	1	–	*
Position Valid (PV)	–	1	1	*
Wheel Sensor	1	–	–	–
* The ProPak6 I/O strobes can be configured to change an Event line to this signal.				

Table 91: Features

		PwrPak7-E1 PwrPak7D-E1	PwrPak7 PwrPak7D	FlexPak6	FlexPak6D	ProPak6
Data Rates	GNSS Measurements	20 Hz	100 Hz	100 Hz	20 Hz	100 Hz
	GNSS Position	20 Hz	100 Hz	100 Hz	20 Hz	100 Hz
	INS Position/ Attitude	200 Hz	*	*	–	*
	INS Raw Data	125 Hz	*	*	–	*
SPAN Compatible		Y	Y	Y	–	Y
Integrated IMU		Y	–	–	–	–

		PwrPak7-E1 PwrPak7D-E1	PwrPak7 PwrPak7D	FlexPak6	FlexPak6D	ProPak6
Compatible UI	NovAtel Connect	Y	Y	Y	Y	Y
	Web UI	Y	Y	–	–	–
Onboard Memory		16 GB	16 GB	–	–	4 GB
* INS data rates vary depending on the external IMU connected to the receiver.						

3.6 Differences Between SMART7 and SMART6

The following tables compare the specifications and features of the SMART7 with the specifications and features of the SMART6 and SMART6-L.

Table 92: Physical Specifications

	SMART7 (all models)	SMART6	SMART6-L
Dimensions	220 x 192 x 66 mm	155 (diameter) x 81 mm	155 (diameter) x 81 mm
Weight	<1.1 kg	<520 g	<570 g

Table 93: Power Requirements

	SMART7 (all models)	SMART6	SMART6-L
Input Voltage	+7 to +30 VDC	+8 to +36 VDC	+8 to +36 VDC
Power Consumption (typical)	4 W	3.5 W	2.9 W

Table 94: Signals Tracked

		SMART7 (all models)	SMART6	SMART6-L
GPS	L1 C/A	Y	Y	Y
	L1C	Y	–	–
	L2C	Y	Y	Y
	L2P	Y	Y	Y
	L5	Y	–	–
GLONASS	L1 C/A	Y	Y	Y
	L2 C/A	Y	Y	Y
	L2P	Y	–	–
	L3	Y	–	–

		SMART7 (all models)	SMART6	SMART6-L
Galileo	E1	Y	Y	Y
	E5a	Y	–	–
	E5b	Y	–	–
	E5 AltBOC	Y	–	–
BeiDou	B1I	Y	Y	Y
	B1C	Y	–	–
	B2I	Y	–	–
	B2a	Y	–	–
	B2b	Y	–	–
QZSS	L1 C/A	Y	–	–
	L1C	Y	–	–
	L2C	Y	–	–
	L5	Y	–	–
SBAS	L1	Y	Y	Y
	L5	Y	–	–
L-Band		5 channels	–	Y

Table 95: Horizontal Position Accuracy

	SMART7 (all models)	SMART6	SMART6-L
Single Point L1	1.5 m	1.5 m	1.5 m
Single Point L1/L2	1.2 m	1.2 m	1.2 m
SBAS	60 cm	60 cm	60 cm
DGPS	40 cm	40 cm	40 cm
TerraStar-L	40 cm	–	40 cm
TerraStar-C	–	–	4 cm
TerraStar-C PRO	2.0 cm	–	–
RTK	1 cm + 1 ppm	1 cm + 1 ppm	1 cm + 1 ppm
RTK ASSIST	–	–	Y
RTK ASSIST PRO	Y	–	–

Table 96: Communications Ports

		SMART7 SMART7-S	SMART7-I	SMART7-W	SMART6	SMART6-L
Serial Ports	COM1	RS-232	RS-232	RS-232	RS-232	RS-232
	COM2	RS-232	RS-232	RS-232	RS-232	RS-232
	COM3	RS-232	RS-232	RS-232	RS-232	RS-232
CAN Bus Ports		1	1	1	1	1
Ethernet Port 10BASE-T/100BASE-TX		–	1	–	–	–
Wi-Fi	Access Point	–	Y	Y	–	–
	Client	–	Y	Y	–	–
Bluetooth		–	–	–	Y	–

Table 97: I/O Strobes

	SMART7 (all models)	SMART6	SMART6-L
Event In	–	1	1
PPS	1	1	1
Emulated Radar	1	1	1

Table 98: Features

		SMART7	SMART7-I SMART7-W	SMART7-S	SMART6	SMART6-L
Data Rates	GNSS Measurements	20 Hz	20 Hz	20 Hz	20 Hz	50 Hz
	GNSS Position	20 Hz	20 Hz	20 Hz	20 Hz	50 Hz
	INS Position/ Attitude	*	*	200 Hz	–	*
	INS Raw Data	*	*	125 Hz	–	*
SPAN Compatible		Y	Y	Y	–	Y
Integrated IMU		–	–	Y	–	–
Compatible UI	NovAtel Connect	Y	Y	Y	Y	Y
	Web UI	–	Y	–	–	–
* INS data rates vary depending on the external IMU connected to the receiver.						

3.7 Differences between RELAY7 and RELAY

The following tables compare the specifications and features of the RELAY7 with the specifications and features of the RELAY (for the SMART6-L).

Table 99: Physical Specifications

	RELAY7	RELAY
Dimensions	186.5 x 199.5 x 76.4 mm	290 x 275 x 80 mm
Weight	<850 g	2.0 kg

Table 100: Power Requirements

	RELAY7	RELAY
Input Voltage	+7 to +30 VDC	+9 to +36 VDC
Power Consumption (typical)	2 W	10.5 W – UHF 400 MHz radio 8.5 W – UHF 900 MHz radio 5.5 W – HSPA radio

Table 101: Supported Radios

	RELAY7	RELAY
400 MHz	Y	Y
900 MHz	Y	Y
HSPA	–	Y
Wi-Fi	–	Y
The RELAY7 will have either a 400 MHz or 900 MHz radio. The RELAY will have Wi-Fi and either a 400 MHz, 900 MHz or HSPA radio.		

Chapter 4 Receiver Technical Specifications

The following sections detail the technical specifications of the OEM7 family receivers.

4.1 OEM719 Technical Specifications

Table 102: OEM719 Physical Description

Size	46 mm x 71 mm x 11 mm
Weight	31 grams
NovAtel Part Number	Generic assembly OEM719 01019520

See the following sections for more information about the OEM719:

- *OEM719 Performance Specifications* on the next page
- *OEM719 Mechanical Specifications* on page 191
- *OEM719 Electrical and Environmental Specifications* on page 198
- *OEM719 Data Communication Specifications* on page 200
- *OEM719 Strobe Specifications* on page 202
- *OEM719 Interface Connector* on page 204

4.1.1 OEM719 Performance Specifications

All specifications subject to GNSS system characteristics.

Table 103: OEM719 Receiver Performance

Signals Tracked	GPS	L1 C/A, L1C, L2C, L2P, L5
	GLONASS	L1 C/A, L2 C/A, L2P, L3
	BeiDou	B1I, B1C, B2I, B2a, B2b, B3I
	Galileo[1]	E1, E5 AltBOC, E5a, E5b, E6
	NavIC (IRNSS)	L5
	QZSS	L1 C/A, L1C, L1S, L2C, L5, L6
	SBAS	L1, L5
	L-Band[2]	Up to 5 channels
Position Accuracy[3]	Single point L1	1.5 m RMS
	Single point L1/L2	1.2 m RMS
	SBAS[4]	60 cm RMS
	DGPS	40 cm RMS
	TerraStar-L[5]	40 cm RMS
	TerraStar-C PRO[5]	2.0 cm RMS
	TerraStar-X[5]	2.0 cm RMS
	RTK	1 cm + 1 ppm RMS
Time to First Fix	Hot: <20 s (Almanac and recent ephemeris saved and approximate position and time entered) Cold: <34 s (No almanac or ephemeris and no approximate position or time)	
Signal Reacquisition	<0.5 s L1 (typical) <1.0 s L2 and L5 (typical)	
Data Rates	Measurements	up to 100 Hz
	Position	up to 100 Hz

[1] E1bc and E6bc support only.

[2] Currently the receiver can track up to 3 L-Band channels.

[3] Typical values under ideal, open sky conditions.

[4] GPS-only.

[5] Requires a TerraStar subscription which is available direct from NovAtel novatel.com/products/gps-gnss-correction-services/terrastar-correction-services.

Time Accuracy[1]	<5 ns RMS			
Velocity Accuracy	<0.03 m/s RMS			
Measurement Precision[2]			Code	Carrier
	GPS	L1 C/A	4 cm	0.5 mm
		L2 P(Y)	8 cm	1.0 mm
		L2C	8 cm	0.5 mm
		L5	3 cm	0.5 mm
	GLONASS	L1 C/A	8 cm	1.0 mm
		L2 P	8 cm	1.0 mm
		L2 C/A	8 cm	1.0 mm
	Galileo	E1	3 cm	0.5 mm
		E5a	3 cm	0.75 mm
		E5b	3 cm	0.75 mm
		E5 AltBOC	3 cm	0.75 mm
		E6	3 cm	0.75 mm
	BeiDou	B1I	4 cm	0.5 mm
		B1C	3 cm	0.5 mm
		B2I	4 cm	0.5 mm
		B2a	3 cm	0.5 mm
		B2b[3]	3 cm	0.5 mm
		B3I	4 cm	0.5 mm
Velocity Limit[4]	600 m/s			

[1]Time accuracy does not include biases due to RF or antenna delay.

[2]Measurement precision should be compared with measurements using the same correlator spacing.

[3]Under good CN0 conditions, e.g. 44 dBHz.

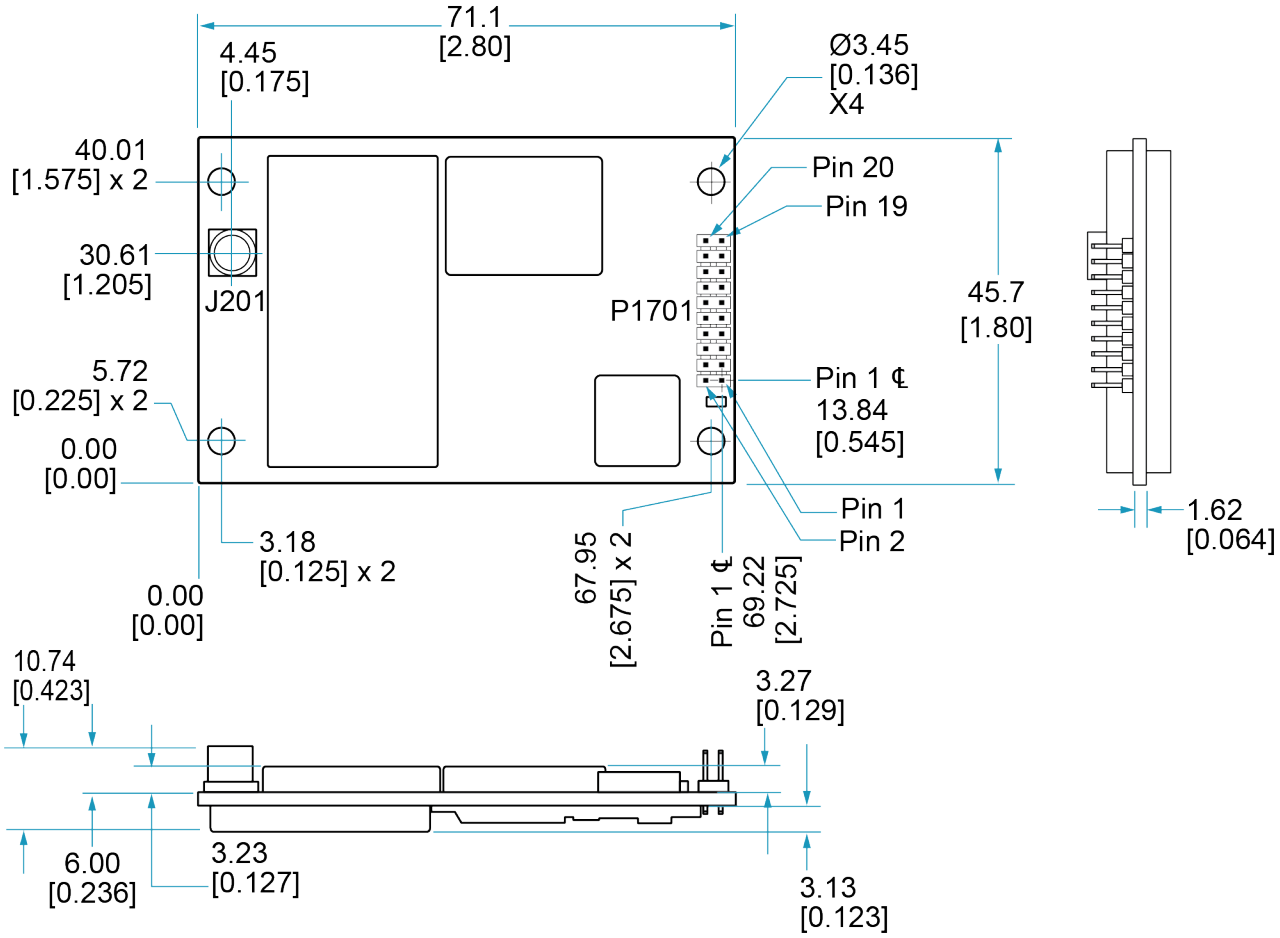
[4]Export licensing restricts operation to a maximum of 600 m/s, message output impacted above 585 m/s.

4.1.2 OEM719 Mechanical Specifications

- *Figure 9: OEM719 Dimensions* below
- *Figure 10: OEM719 Keep-outs* on the next page
- *Figure 11: OEM719A Dimensions* on page 193
- *Figure 12: OEM719A Keep-outs* on page 194
- *Figure 13: OEM719B Dimensions* on page 195
- *Figure 14: OEM719B Keep-outs* on page 196
- *Figure 15: OEM719 Mounting Surface* on page 197

In the following diagrams, the dimensions are in millimetres [inches].

Figure 9: OEM719 Dimensions



Notes: 719
Connectors:
(a) J201 MCX jack receptacle, straight (Johnson P/N 133-3711-202 or Samtec P/N MCX-J-P-HST-SMI or equivalent)
(b) P1701 2x10 header, 2 mm pitch (Samtec P/N TMM-110-03-G-D)

Figure 10: OEM719 Keep-outs

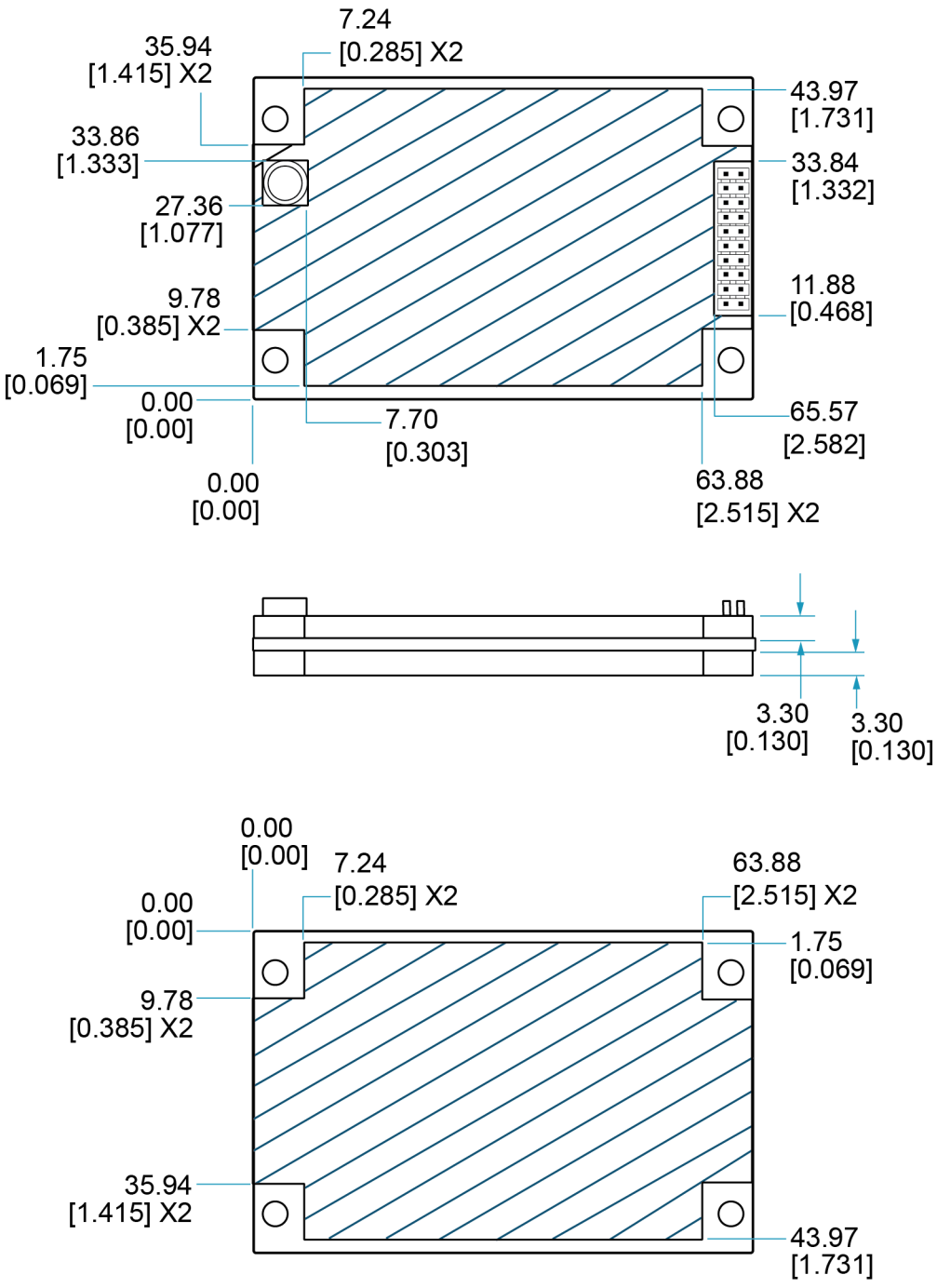
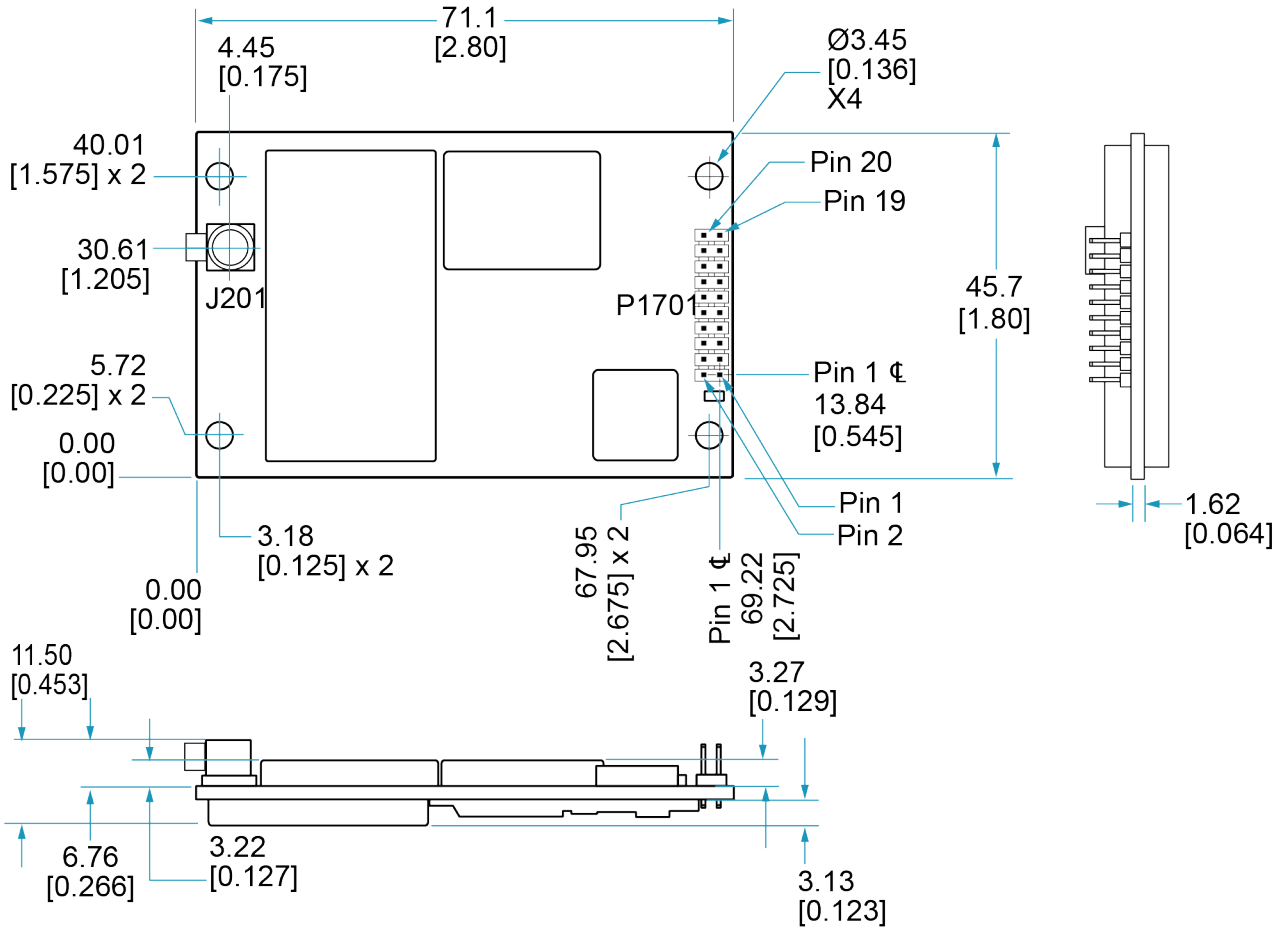


Figure 11: OEM719A Dimensions



Notes: 719A
Connectors:
(a) J201 MCX jack receptacle, right angle (Samtec P/N MCX-J-P-H-RA-SMI or equivalent)
(b) P1701 2x10 header, 2 mm pitch (Samtec P/N TMM-110-03-G-D)

Figure 12: OEM719A Keep-outs

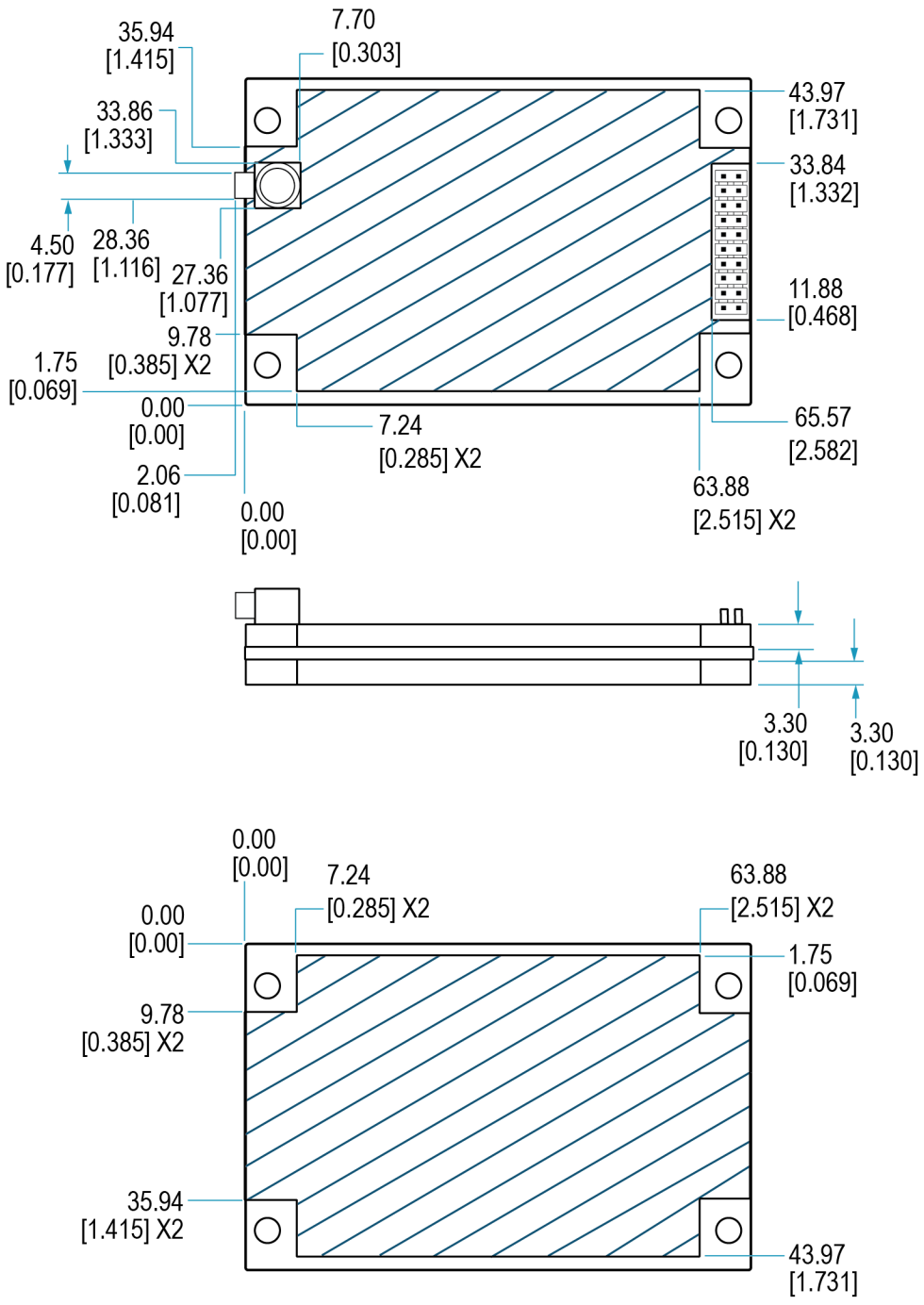
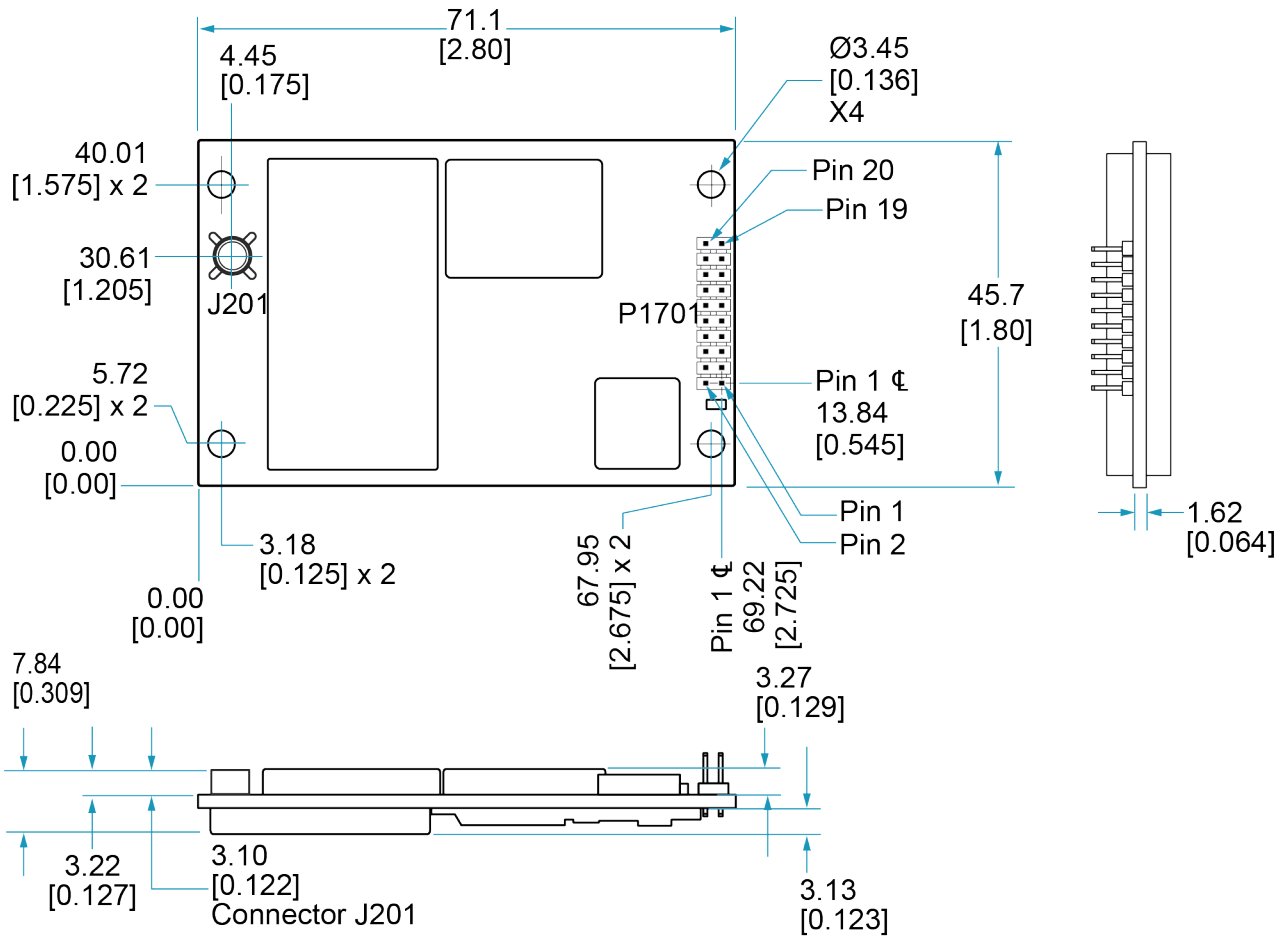


Figure 13: OEM719B Dimensions



Notes: 719B
Connectors:
(a) J201: MMBX jack receptible, straight (Huber+Shuhner 82-MMBX-S50-0-1/111_NM)
(b) P1701: 2x10 header, 2 mm pitch (Samtec P/N TMM-110-03-G-D)

Figure 14: OEM719B Keep-outs

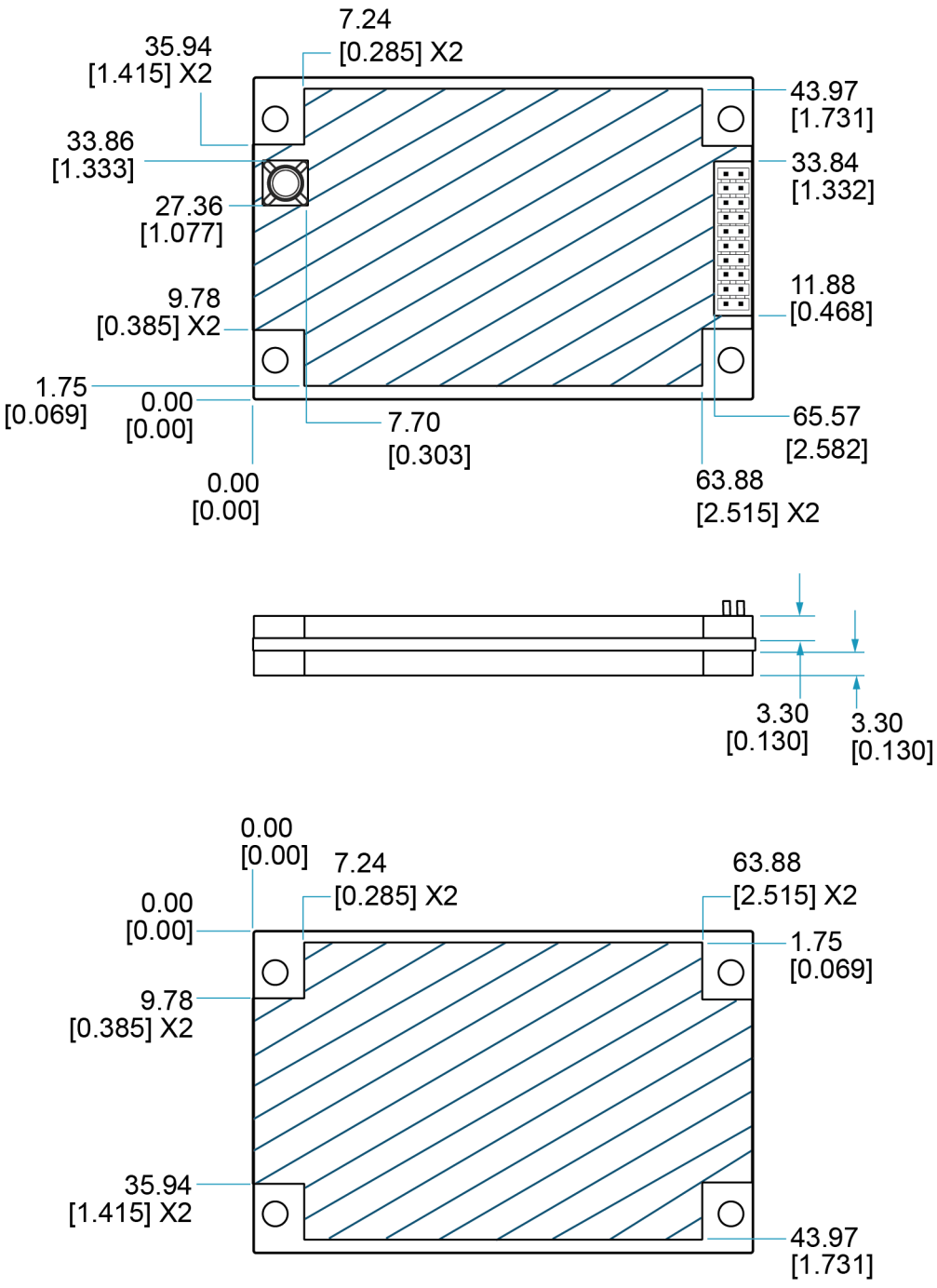
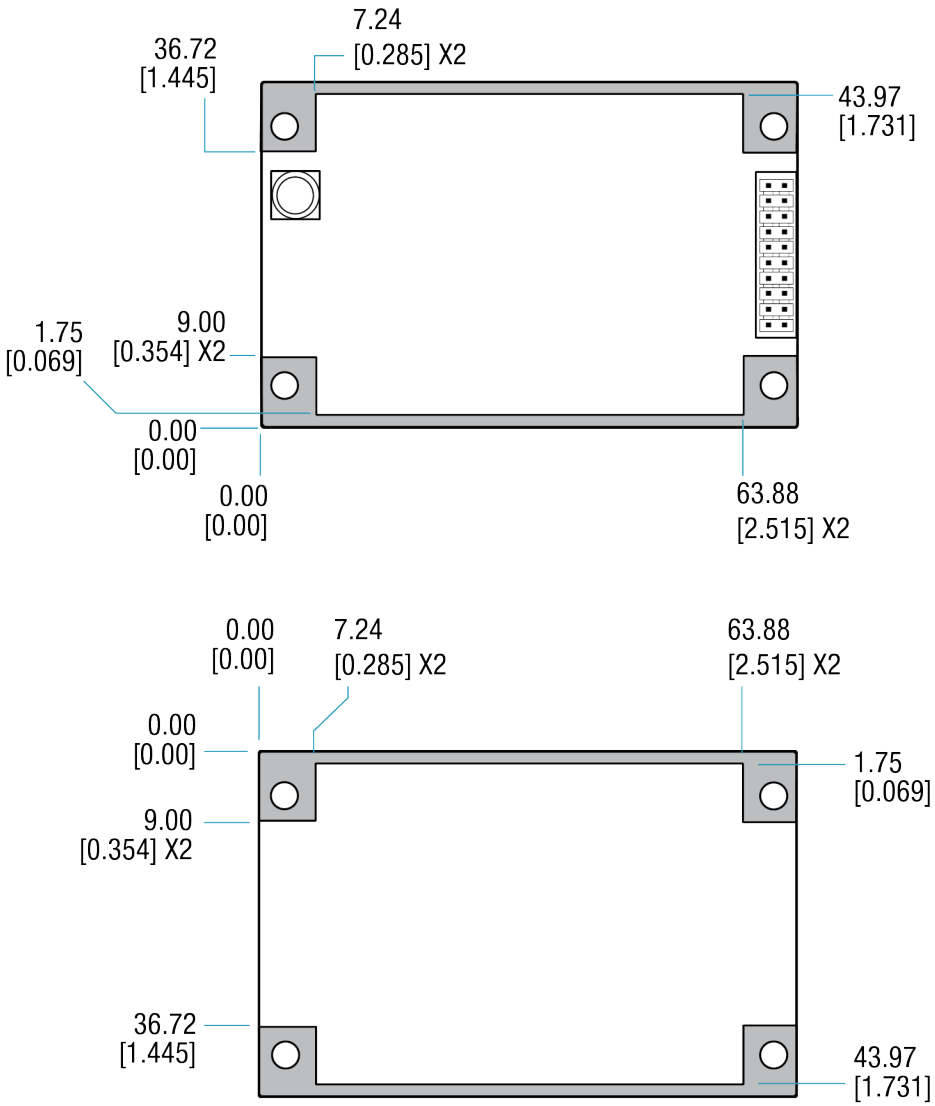


Figure 15: OEM719 Mounting Surface



The mounting surfaces are shown in gray. These mounting surfaces apply to all variants of the OEM719.

These mounting surfaces are designed to work with mounting rails. For information about mounting the OEM719, refer to Mounting the Printed Circuit Board.

Assembly tolerances must be considered when using mounting rail features.

For information about the recommended mating connector, refer to Table: OEM7 Communication and I/O Connectors.

4.1.3 OEM719 Electrical and Environmental Specifications

Table 104: OEM719 Environmental Specifications

Operating Temperature	-40°C to +85°C
Storage Temperature	-55°C to +95°C
Humidity	95% non-condensing
Random Vibration	MIL-STD-810G, Method 514.6, Category 24 (20 g RMS)[1]
Sinusoidal Vibration	IEC 60068-2-6
Bump	ISO 9022-31-06 (25 g)
Shock Operating Non-operating	 MIL-STD-810G, Method 516.6 (40 g) MIL-STD-810G, Method 516.6 (75 g)
Acceleration, Operating	MIL-STD-810G (CH1), Method 513.7 (16 g)

Table 105: OEM719 Power Requirements

Voltage	+3.3 VDC ±5%
Allowable Input Voltage Ripple	100 mV p-p maximum
Power Consumption	0.9 W typical, GPS L1 only 1.3 W typical, GPS L1/L2, GLONASS L1/L2 1.8 W typical, all constellations/all frequencies, plus L-Band These are typical values using serial ports without interference mitigation. Values can change with the number of satellites in view, firmware version, data logging rates and features in use. Use them as a guide for what you might expect but not as absolute values.
Inrush Current	1.71 A for less than 1.5 ms (typical)

Table 106: OEM719 RF Input/LNA Power Output

Antenna Connector	OEM719	MCX female, 50 Ω nominal impedance
	OEM719A	Right angle, MCX female, 50 Ω nominal impedance
	OEM719B	MMBX female, 50 Ω nominal impedance

[1] Requires mechanical mounting rails to meet 20 g; meets 7.7 g without rails.

<table>
<tr><td rowspan="4">Cascaded antenna LNA gain (before receiver)</td><td rowspan="2">Firmware 7.04 and later</td><td>HDR disabled</td><td>+15 dB to +55 dB, 26 dB typical</td></tr>
<tr><td>HDR enabled</td><td>+20 dB to +55 dB, 30 dB typical</td></tr>
<tr><td rowspan="2">Firmware before 7.04</td><td>HDR disabled</td><td>+15 dB to +40 dB, 26 dB typical</td></tr>
<tr><td>HDR enabled</td><td>+20 dB to +40 dB, 30 dB typical</td></tr>
<tr><td rowspan="5">RF Input Frequencies</td><td>GPS L1:
GPS L2:
GPS L5:</td><td colspan="2">1575.42 MHz
1227.60 MHz
1176.45 MHz</td></tr>
<tr><td>GLONASS L1:
GLONASS L2:
GLONASS L3:</td><td colspan="2">1593-1610 MHz
1237-1254 MHz
1202.025 MHz</td></tr>
<tr><td>Galileo E1:
Galileo E5a:
Galileo E5b:
Galileo E5:
Galileo E6:</td><td colspan="2">1575.42 MHz
1176.45 MHz
1207.14 MHz
1191.795 MHz
1278.75 MHz</td></tr>
<tr><td>BeiDou B1I:
BeiDou B1C:
BeiDou B2I:
BeiDou B2a:
BeiDou B2b:
BeiDou B3I:</td><td colspan="2">1561.098 MHz
1575.42 MHz
1207.14 MHz
1176.45 MHz
1207.14 MHz
1268.52 MHz</td></tr>
<tr><td>L-Band:</td><td colspan="2">1545 to 1560 MHz[1]</td></tr>
<tr><td>LNA Power</td><td colspan="3">+5.0 VDC ±5%, 0 mA to 200 mA (supplied by card through center conductor of RF connector).
LNA Power is generated from the 3.3 V supply input for the OEM719.
  Pin 1 of P1701 is not electrically connected on the OEM719. This was the external LNA power input (LNA-PWR) on the OEM615.</td></tr>
</table>

[1]For hardware releases 1.10 and later. For earlier hardware versions, the L-Band RF Input Frequency is 1525 to 1560 MHz.

4.1.4 OEM719 Data Communication Specifications

Table 107: OEM719 Data Communication Interfaces

COM1	
Electrical format	LVCMOS
Data rates[1]	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 or 460800 bit/s.
Signals supported	COM1_Tx, COM1_Rx
Electrostatic discharge protection	No
COM2	
Electrical format	LVCMOS
Data rates[1]	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 or 460800 bit/s.
Signals supported	COM2_Tx, COM2_Rx
Electrostatic discharge protection	No
COM3	
Electrical format	LVCMOS [2]
Data rates[1]	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 or 460800 bit/s.
Signals supported	COM3_Tx, COM3_Rx
Electrostatic discharge protection	No
CAN Bus	
Electrical format	LVCMOS (requires external CAN transceiver)[3]

[1]Data rates higher than 115200 bit/s are not supported by standard PC hardware. Special computer hardware may be required for higher rates, including 230400 bit/s and 460800 bit/s.

[2]COM3 is disabled by default.

[3]CAN1 Rx and Tx signals are internally multiplexed with VARF and Event2, respectively. Both VARF and Event2 are enabled by default. To enable CAN functionality, the following commands must be issued before configuring the CAN1 port:

EVENTOUTCONTROL MARK1 DISABLE
EVENTINCONTROL MARK2 DISABLE

These commands, together with the commands to configure the CAN1 port, can be saved using SAVECONFIG.

Data rates	250, 500 or 1000 kb/s CAN Bus throughput is determined by slowest device on the bus
Signals supported	CAN1Tx, CAN1Rx, CAN2Tx, CAN2Rx
USB	
Electrical format	Conforms to USB 2.0
Data rates	Full-speed (12 Mb/s)
Signals supported	USB D (+), USB D (-)

4.1.5 OEM719 Strobe Specifications

Table 108: OEM719 Strobe Description

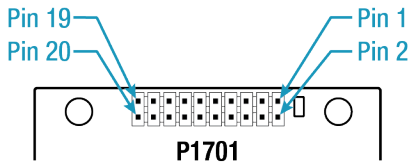
Strobes	Input/Output	Factory Default	Comment
Event1 (Mark 1)	Input Leading edge triggered	Active low	An input mark for which a pulse greater than 150 ns triggers certain logs to be generated. (Refer to the MARKPOS and MARK1TIME logs and ONMARK trigger.) Polarity is configurable using the **EVENTINCONTROL** command. The mark inputs have 10K pull-up resistors to 3.3 V Event1 is the default behavior for pin 9 of connector P1701. The secondary behavior for pin 9 is COM3_Tx. If COM3 is enabled, the Event1 input is disabled.
Event2 (Mark 2)	Input Leading edge triggered	Active low	An input mark for which a pulse greater than 150 ns triggers certain logs to be generated (see the MARK2POS and MARK2TIME logs). Polarity is configurable using the **EVENTINCONTROL** command. The mark inputs have 10K pull-up resistors to 3.3 V Event2 is the default behavior for pin 7 of connector P1701. The secondary behavior for pin 7 is CAN1Tx. If CAN1 is enabled, the Event2 input is disabled.
PPS	Output	Active low	A time synchronization output. This is a pulse where the leading edge is synchronized to receiver-calculated GNSS Time. The polarity, period and pulse width can be configured using the **PPSCONTROL** command
PV (Position Valid)	Output	Active high	Indicates a valid GNSS position solution is available.
nRESET_IN	Input	Active low	Reset signal input from external system; active low. This pin must be held low for >20 µs while stable power is already applied, to reset the OEM719 card. It is recommended to hold the nRESET_IN pin low for a >150 ms when initially applying power to the card, giving the power supply time to stabilize before the card starts to boot.
VARF (Variable Frequency)	Output	Active low	A programmable variable frequency output ranging from 0 - 50 MHz (refer to the **EVENTOUTCONTROL** command) VARF is the default behavior for pin 6 of connector P1701. The secondary behavior for pin 6 is CAN1Rx. If CAN1 is enabled, the VARF output is disabled.

Table 109: OEM719 Strobe Electrical Specification

Strobe	Symbol	Min (V)	Typ (V)	Max (V)	Current (mA)
Event1 (Mark1) Event2 (Mark2)	V_{IL}			0.7	-
	V_{IH}	2.1			
PPS	V_{OL}			0.4	16
	V_{OH}	2.4			
PV	V_{OL}			0.4	4
	V_{OH}	2.9			
nRESET_IN	V_{IL}			0.8	-
	V_{IH}	2.3			
VARF	V_{OL}			0.4	4
	V_{OH}	2.9			

4.1.6 OEM719 Interface Connector

P1701 Main Connector 20-Pin Header



For information about the recommended mating connector, refer to Table: OEM7 Communication and I/O Connectors.

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
1	NC	-	-	-	-	-	-	-	No internal connection on OEM719 receiver. (This pin was the supply feed for the external GNSS antenna on the OEM6 family. The OEM719 generates the antenna power from the 3.3V supply input.)
2	3V3	Power	-	-	-	-	-	-	3.3 V ±5% supply voltage. This is monitored by the receiver itself. (Out-of-tolerance supply inputs may generate warning or error messages.)
3	USB_D-	Analog	Input/ Output	-	-	-	-	-	This is one half of a USB differential pair (pins 3 and 4), match lengths and route as 90 Ω differential pair if USB is used.
4	USB_D+/ RXD3	Analog /3.3V CMOS	USB_D+: Input/ Output	-	-	-	-	-	This pin is internally multiplexed. USB_D+ is the default. USB_D+: This is one half of a USB differential pair (pins 3 and 4), match lengths and route as 90 Ω differential pair if USB is used. RXD3: COM3 Receive Data (UART). Internal weak (40 kΩ to 100 kΩ) pullup.
			RXD3 Input	0.7	2.1	-	-	-	

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
5	nRESET_IN	3.3V CMOS	Input	0.8	2.3	-	-	-	Active Low. Resets the OEM719 receiver card. This pin must be held low for >20 µs while stable power is already applied, to reset the OEM719 card. It is recommended to hold the nRESET_IN pin low for a >150 ms when initially applying power to the card, giving the power supply time to stabilize before the card starts to boot. Internal 10 kΩ pullup.
6	VARF/ CAN1RX	3.3V CMOS	VARF: Output	-	-	0.4	2.9	4	This pin is internally multiplexed. VARF is the default. VARF: Variable Frequency Output. Rising or falling edge active. CAN1RX: a CMOS-level signal, requiring an external CAN transceiver. Internal 10 kΩ pullup.
			CAN1RX: Input	0.7	2.1	-	-	-	
7	EVENT2/ CAN1TX	3.3V CMOS	EVENT2: Input	0.7	2.1	-	-	-	This pin is internally multiplexed. EVENT2 is the default. EVENT2: Rising edge triggered. CAN1TX is a CMOS-level signal, requiring an external CAN transceiver. Internal 10 kΩ pullup.
			CAN1TX: Output	-	-	0.4	2.9	4	
8	CAN2RX	3.3V CMOS	Input	0.7	2.1	-	-	-	CAN2RX is a CMOS-level signal, requiring an external CAN transceiver.
9	EVENT1/ TXD3	3.3V CMOS	EVENT1: Input	0.7	2.1	-	-	-	This pin is internally multiplexed. EVENT1 is the default. EVENT1: Rising edge triggered. TXD3: COM3 Transmit Data (UART) Internal 10 kΩ pullup.
			TXD3: Output	-	-	0.4	2.9	4	
10	GND	Power	-	-	-	-	-	-	Supply Return (Ground)
11	TXD1	3.3V CMOS	Output	-	-	0.8	2.0	16	COM1 Transmit Data (UART)
12	RXD1	3.3V CMOS	Input	0.7	2.1	-	-	-	COM1 Receive Data (UART) Internal weak (40 kΩ to 100 kΩ) pullup.
13	GND	Power	-	-	-	-	-	-	Supply Return (Ground)
14	TXD2	3.3V CMOS	Output	-	-	0.4	2.9	4	COM2 Transmit Data (UART)

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
15	RXD2	3.3V CMOS	Input	0.7	2.1	-	-	-	COM2 Receive Data (UART) Internal weak (40 kΩ to 100 kΩ) pullup.
16	GND	Power	-	-	-	-	-	-	Supply Return (Ground)
17	PV	3.3V CMOS	Output	-	-	0.4	2.9	4	Active High. Position Valid Indicator. Indicates that the receiver has computed a position. Active high output.
18	GND	Power	-	-	-	-	-	-	Supply Return (Ground)
19	PPS	3.3V CMOS	Output	-	-	0.4	2.4	16	Rising or Falling Edge active. (Software-configurable active edge.) This pin can be configured to provide a GNSS-synchronized time output (commonly Pulse Per Second but can operate at other rates as well).
20	CAN2TX	3.3V CMOS	Output	-	-	0.4	2.9	4	CAN2TX is a CMOS-level signal, requiring an external CAN transceiver.

4.2 OEM729 Technical Specifications

Table 110: OEM729 Physical Description

Size	60 mm x 100 mm x 9 mm
Weight	48 grams
NovAtel Part Number	Generic assembly OEM729 01019523

See the following sections for more information about the OEM729:

- *OEM729 Performance Specifications* on the next page
- *OEM729 Mechanical Specifications* on page 210
- *OEM729 Electrical and Environmental Specifications* on page 213
- *OEM729 Data Communication Specifications* on page 216
- *OEM729 Strobe Specifications* on page 218
- *OEM729 Interface Connectors* on page 220

4.2.1 OEM729 Performance Specifications

All specifications subject to GNSS system characteristics.

Table 111: OEM729 Receiver Performance

Signals Tracked	GPS	L1 C/A, L1C, L2C, L2P, L5
	GLONASS	L1 C/A, L2 C/A, L2P, L3
	BeiDou	B1I, B1C, B2I, B2a, B2b, B3I
	Galileo[1]	E1, E5 AltBOC, E5a, E5b, E6
	NavIC (IRNSS)	L5
	QZSS	L1 C/A, L1C, L1S, L2C, L5, L6
	SBAS	L1, L5
	L-Band[2]	Up to 5 channels
Position Accuracy[3]	Single point L1	1.5 m RMS
	Single point L1/L2	1.2 m RMS
	SBAS[4]	60 cm RMS
	DGPS	40 cm RMS
	TerraStar-L[5]	40 cm RMS
	TerraStar-C PRO[5]	2.0 cm RMS
	TerraStar-X[5]	2.0 cm RMS
	RTK	1 cm + 1 ppm RMS
Time to First Fix	Hot: <20 s (Almanac and recent ephemeris saved and approximate position and time entered) Cold: <34 s (No almanac or ephemeris and no approximate position or time)	
Signal Reacquisition	<0.5 s L1 (typical) <1.0 s L2 and L5 (typical)	
Data Rates	Measurements	up to 100 Hz
	Position	up to 100 Hz

[1] E1bc and E6bc support only.

[2] Currently the receiver can track up to 3 L-Band channels.

[3] Typical values under ideal, open sky conditions.

[4] GPS-only.

[5] Requires a TerraStar subscription which is available direct from NovAtel novatel.com/products/gps-gnss-correction-services/terrastar-correction-services.

Time Accuracy[1]	<5 ns RMS			
Velocity Accuracy	<0.03 m/s RMS			
Measurement Precision[2]			Code	Carrier
	GPS	L1 C/A	4 cm	0.5 mm
		L2 P(Y)	8 cm	1.0 mm
		L2C	8 cm	0.5 mm
		L5	3 cm	0.5 mm
	GLONASS	L1 C/A	8 cm	1.0 mm
		L2 P	8 cm	1.0 mm
		L2 C/A	8 cm	1.0 mm
	Galileo	E1	3 cm	0.5 mm
		E5a	3 cm	0.75 mm
		E5b	3 cm	0.75 mm
		E5 AltBOC	3 cm	0.75 mm
		E6	3 cm	0.75 mm
	BeiDou	B1I	4 cm	0.5 mm
		B1C	3 cm	0.5 mm
		B2I	4 cm	0.5 mm
		B2a	3 cm	0.5 mm
		B2b[3]	3 cm	0.5 mm
		B3I	4 cm	0.5 mm
Velocity Limit[4]	600 m/s			

[1]Time accuracy does not include biases due to RF or antenna delay.

[2]Measurement precision should be compared with measurements using the same correlator spacing.

[3]Under good CN0 conditions, e.g. 44 dBHz.

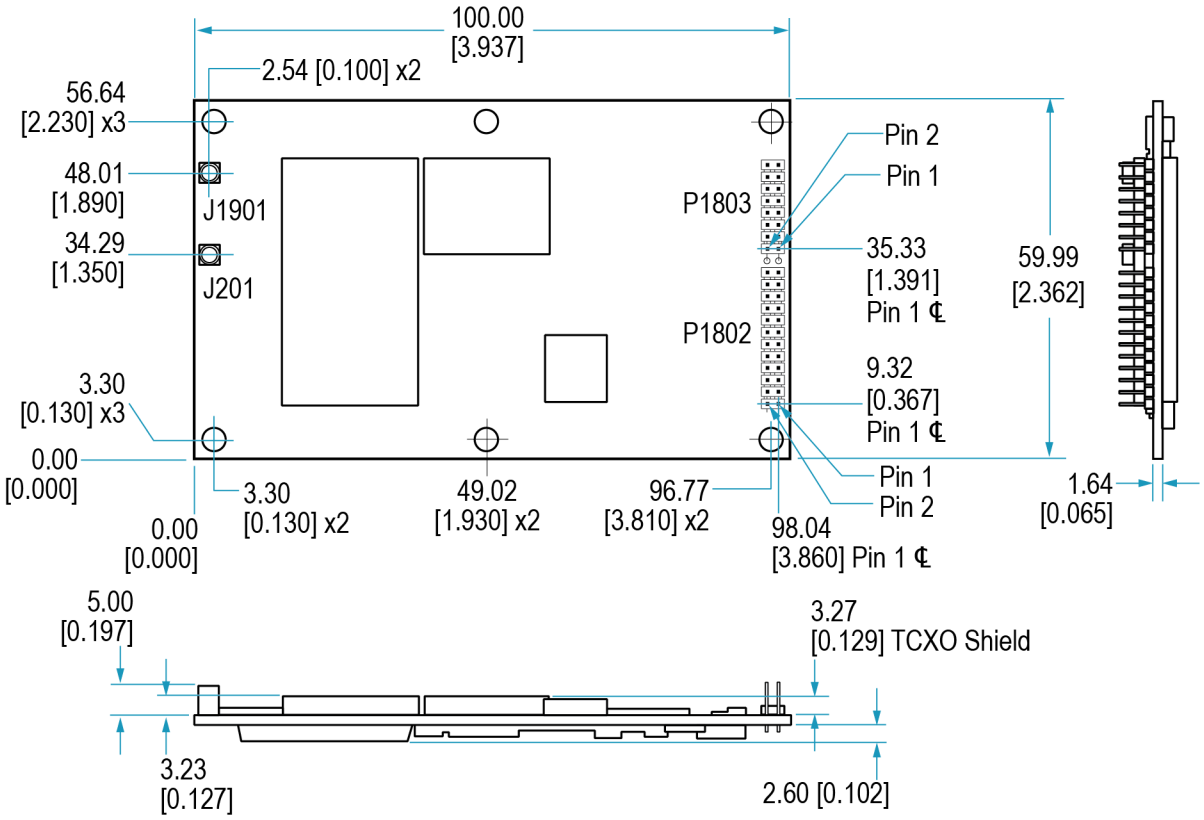
[4]Export licensing restricts operation to a maximum of 600 m/s, message output impacted above 585 m/s.

4.2.2 OEM729 Mechanical Specifications

- *Figure 16: OEM729 Dimensions* below
- *Figure 17: OEM729 Keep-outs* on the next page
- *Figure 18: OEM729 Mounting Surfaces* on page 212

In the following diagrams, the dimensions are in millimetres [inches].

Figure 16: OEM729 Dimensions



Notes:
Connectors:
(a) J201 and 1901 MMCX jack receptacle (Johnson P/N 135-3701-201 or Samtec P/N RSP-149374-01 or equivalent)
(b) P1802 2x12 header, 2 mm pitch (Samtec P/N TMM-112-03-G-D)
P1803 2x8 header, 2 mm pitch (Samtec P/N TMM-108-03-G-D)

Figure 17: OEM729 Keep-outs

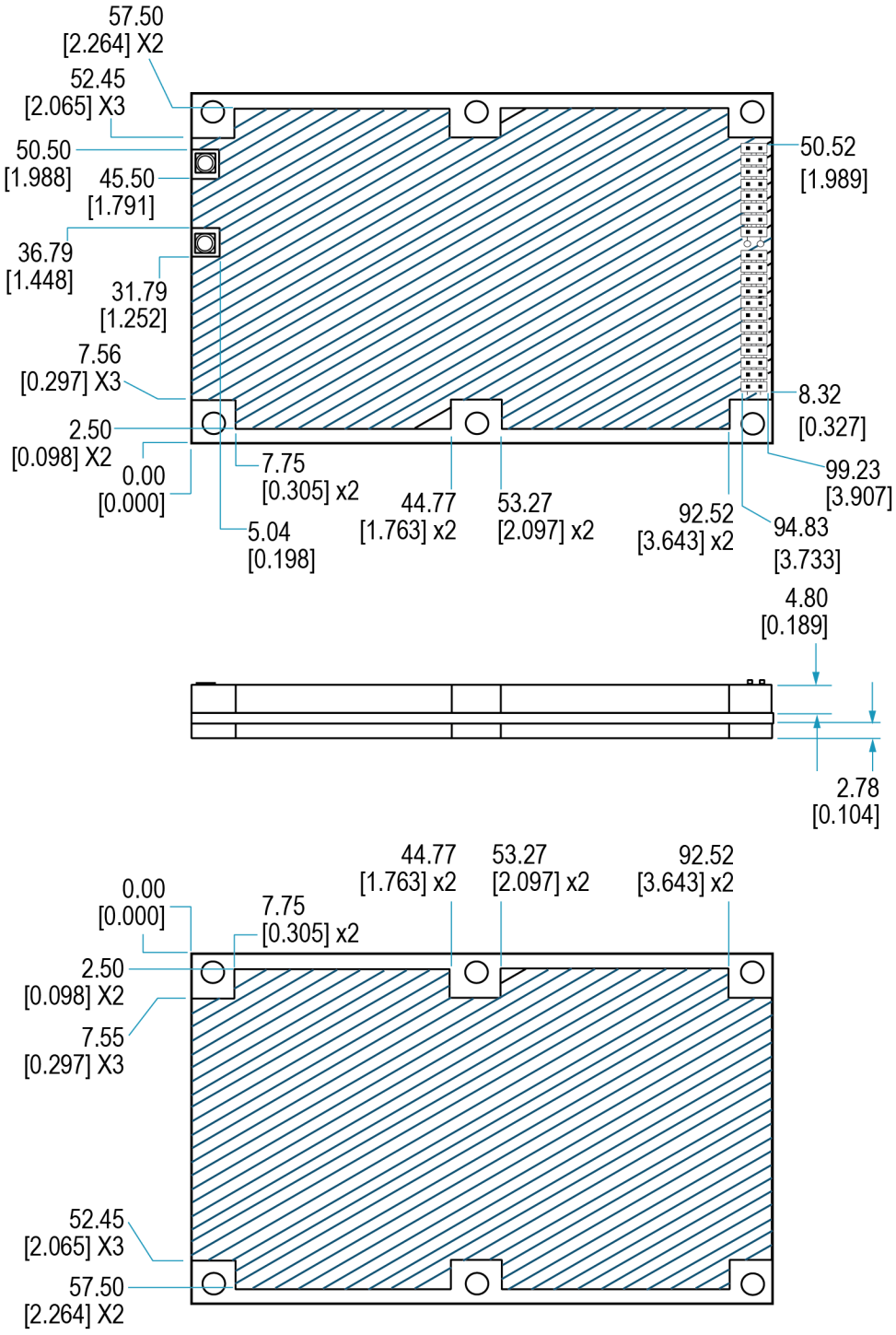
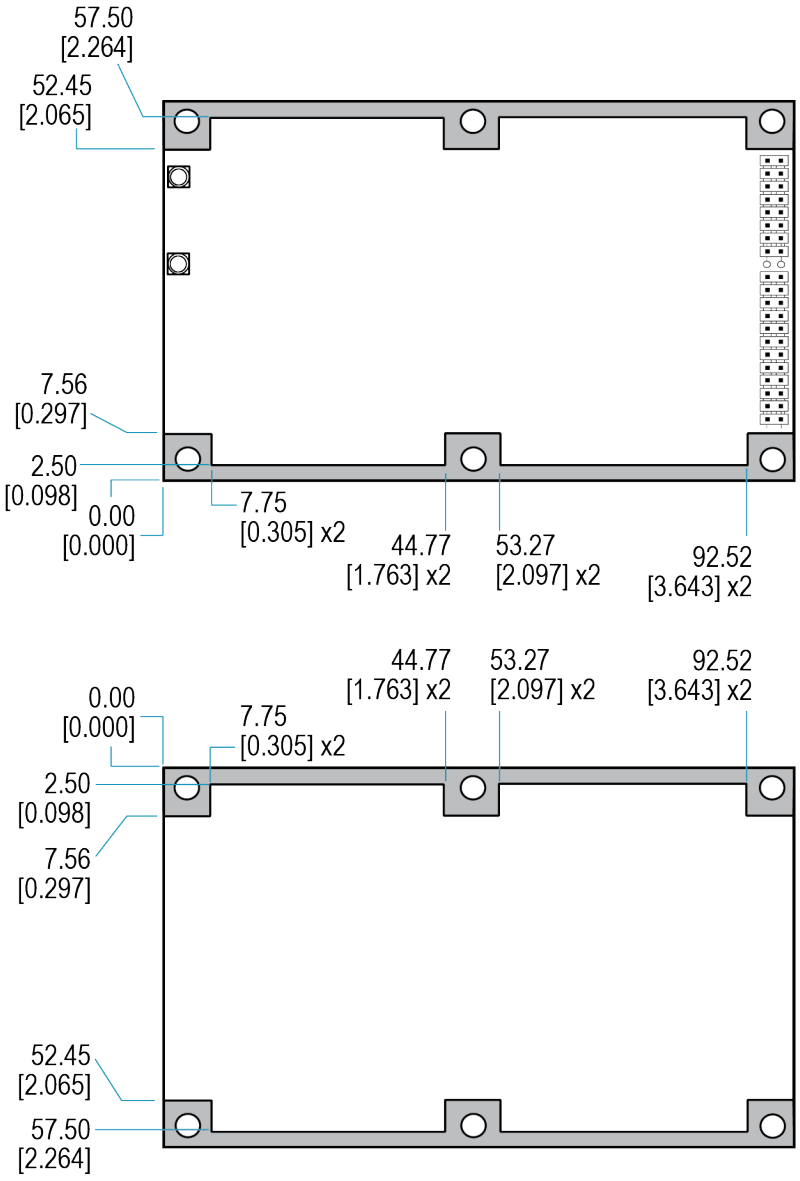


Figure 18: OEM729 Mounting Surfaces



The mounting surfaces are shown in gray. For information about mounting the OEM729, refer to Mounting the Printed Circuit Board.

Assembly tolerances must be considered when using mounting rail features.

For information about the recommended mating connector, refer to Table: OEM7 Communication and I/O Connectors.

4.2.3 OEM729 Electrical and Environmental Specifications

Table 112: OEM729 Environmental Specifications

Operating Temperature	-40°C to +85°C
Storage Temperature	-55°C to +95°C
Humidity	95% non-condensing
Random Vibration	MIL-STD-810G, Method 514.6, Category 24 (20 g RMS)
Sinusoidal Vibration	IEC 60068-2-6
Bump	ISO 9022-31-06 (25 g)
Shock	
Operating	MIL-STD-810G, Method 516.6 (40 g)
Non-operating	MIL-STD-810G, Method 516.6 (75 g)
Acceleration	MIL-STD-810G (CH1), Method 513.7, (16 g)

Table 113: OEM729 Power Requirements

Voltage	+3.3 VDC ±5%
Allowable Input Voltage Ripple	100 mV p-p maximum
Power Consumption	0.9 W typical, GPS L1 only 1.3 W typical, GPS L1/L2, GLONASS L1/L2 1.8 W typical, all constellations, all frequencies, plus L-Band These are typical values using serial ports without interference mitigation. These values can change with the number of satellites in view, firmware version, data logging rates and features in use. Use them as a guide for what you might expect but not as absolute values
Inrush Current	2.0 A for less than 1.8 ms (typical)

Table 114: OEM729 RF Input/LNA Power Output

Antenna Connector	MMCX female, 50 Ω nominal impedance

Cascaded antenna LNA gain (before receiver)	Firmware 7.04 and later	HDR disabled	+15 dB to +55 dB, 26 dB typical
		HDR enabled	+20 dB to +55 dB, 30 dB typical
	Firmware before 7.04	HDR disabled	+15 dB to +40 dB, 26 dB typical
		HDR enabled	+20 dB to +40 dB, 30 dB typical
RF Input Frequencies	GPS L1: GPS L2: GPS L5:	1575.42 MHz 1227.60 MHz 1176.45 MHz	
	GLONASS L1: GLONASS L2: GLONASS L3:	1593-1610 MHz 1237-1254 MHz 1202.025 MHz	
	Galileo E1: Galileo E5a: Galileo E5b: Galileo E5: Galileo E6:	1575.42 MHz 1176.45 MHz 1207.14 MHz 1191.795 MHz 1278.75 MHz	
	BeiDou B1I: BeiDou B1C: BeiDou B2I: BeiDou B2a: BeiDou B2b: BeiDou B3I:	1561.098 MHz 1575.42 MHz 1207.14 MHz 1176.45 MHz 1207.14 MHz 1268.52 MHz	
	L-Band:	1545 to 1560 MHz[1]	
LNA Power	+5.0 VDC ±5%, 0 mA to 200 mA (supplied by card through center conductor of RF connector). LNA Power is generated from the 3.3 V supply input for the OEM729.		

Table 115: OEM729 External Oscillator Input

External Oscillator Connector	MMCX female, 50 Ω nominal impedance
External Clock input	Refer to the **EXTERNALCLOCK** command
Frequency	5 MHz or 10 MHz

[1]For hardware releases 2.10 and later. For earlier hardware versions, the L-Band RF Input Frequency is 1525 to 1560 MHz.

Input Impedance	50 Ohm nominal
Input VSWR	<2:1
Signal Level	0 dBm minimum to +13.0 dBm maximum
Frequency Stability	±0.5 ppm maximum
Wave Shape	Sinusoidal

4.2.4 OEM729 Data Communication Specifications

Table 116: Data Communications Interface

COM1	
Electrical format	RS-232/RS-422
Data rates[1]	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 or 460800 bit/s.
Signals supported	COM1_Tx, COM1_Rx, COM1_RTS, COM1_CTS
Electrostatic discharge protection	Yes
COM2	
Electrical format	LVCMOS
Data rates[1]	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 or 460800 bit/s.
Signals supported	COM2_Tx, COM2_Rx, COM2_RTS, COM2_CTS
Electrostatic discharge protection	No
COM3	
Electrical format	LVCMOS [2, 3]
Data rates[1]	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 or 460800 bit/s.
Signals supported	COM3_Tx, COM3_Rx
Electrostatic discharge protection	No
CAN Bus	
Electrical Format	LVCMOS
Data rates	1 Mbps maximum. CAN Bus throughput is determined by slowest device on the bus
Signals supported	CAN1 and CAN2

[1]Data rates higher than 115200 bit/s are not supported by standard PC hardware. Special PC hardware may be required for higher rates, including 230400 bit/s and 460800 bit/s.

[2]Upon power-up, COM3 is enabled by default. COM3 is multiplexed with Event 2

[3]To enable EVENT2, issue the following commands:

INTERFACEMODE COM3 NONE NONE
EVENTINCONTROL MARK2 ENABLE

USB	
Electrical format	Conforms to USB 2.0
Data rates	Full-speed (12 Mb/s)
Signals supported	USB D (+), USB D (-)
ETHERNET	
Physical layer	10BASE-T/100BASE-TX

4.2.5 OEM729 Strobe Specifications

Table 117: OEM729 Strobes Description

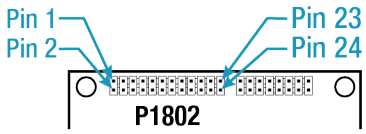
Strobes	Input/Output	Factory Default	Comment
ERROR	Output	Active high	Normally low. A high output on this pin indicates that the receiver is in an error state. For information about the cause of the error, log the **RXSTATUS** log.
Event1	Input Leading edge triggered	Active low	An input mark for which a pulse greater than 150 ns triggers certain logs to be generated. (Refer to the MARKPOS and MARK1TIME logs and ONMARK trigger.) Polarity is configurable using the **EVENTINCONTROL** command.
Event2 (Mark 2)	Input Leading edge triggered	Active low	An input mark for which a pulse greater than 150 ns triggers certain logs to be generated. (Refer to the MARK2POS and MARK2TIME logs.) Polarity is configurable using the **EVENTINCONTROL** command. Event2 is the default behavior for pin 7 of connector P1804. The secondary behavior for pin 7 is COM3_Rx. If COM3 is enabled, the Event2 input is disabled.
PPS	Output	Active low	A time synchronization output. This is a pulse where the leading edge is synchronized to receiver calculated GNSS Time. The polarity, period and pulse width can be configured using the **PPSCONTROL** command
PV (Position Valid)	Output	Active high	Indicates a valid GNSS position solution is available.
nRESET_IN	Input	Active low	Reset signal input from external system; active low. This pin must be held low for >20 µs while stable power is already applied, to reset the OEM729 card. It is recommended to hold the nRESET_IN pin low for a >150 ms when initially applying power to the card, giving the power supply time to stabilize before the card starts to boot.
VARF (Variable Frequency)	Output	Active low	A programmable variable frequency output ranging from 0 Hz to 50 MHz (refer to the **EVENTOUTCONTROL** command)

Table 118: OEM729 Strobe Electrical Specifications

Strobe	Symbol	Min (V)	Max (V)	Current (mA)
ERROR	V_{OL}		0.4	4
	V_{OH}	2.9		
Event1 (Mark) Event2 (Mark2)	V_{IL}		0.7	-
	V_{IH}	2.1		
PPS	V_{OL}		0.4	16
	V_{OH}	2.4		
PV	V_{OL}		0.4	4
	V_{OH}	2.9		
nRESET_IN	V_{IL}		0.8	-
	V_{IH}	2.3		
VARF	V_{OL}		0.4	4
	V_{OH}	2.9		

4.2.6 OEM729 Interface Connectors

P1802 Main Connector 24-Pin Header



For information about the recommended mating connector, refer to Table: OEM7 Communication and I/O Connectors.

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
1	GND	PWR	-	-	-	-	-	-	Ground reference
2	USER1[1]	3.3V CMOS	Input/ Output	0.7	2.1	0.4	2.9	4	User GPIO. Internal 10 kΩ pulldown.
3	VARF	3.3V CMOS	Output	-	-	0.4	2.9	4	Variable Frequency output Edges can be synchronized to the GNSS time reference. Internal 10 kΩ pullup
4	PPS	3.3V CMOS	Output	-	-	0.4	2.4	16	Pulse Per Second output This signal defaults to one pulse per second but may be altered across a wide range of frequencies using software commands. Edges can be synchronized to GNSS time reference.
5	3V3	PWR	-	-	-	-	-	-	3.3 V ±5% supply input
6	3V3	PWR	-	-	-	-	-	-	3.3 V ±5% supply input
7	COM3_RX/ EVENT2[2]	3.3V CMOS	Input	0.7	2.1	-	-	-	This pin is internally multiplexed. COM3_RX: COM3 receive data input. EVENT2 input. Rising or falling edge triggered. This is used to provide position or time data on an external trigger. Internal 10 kΩ pullup.

[1]On power up, if pin 2 is set LOW or not connected, COM1 will be configured as RS-232. If pin 2 is set high then COM1 will be configured as RS-422

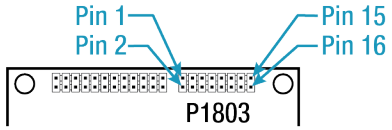
[2]Through firmware, the COM3 UART may be configured on pins 7 and 19.

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
8	EVENT1	3.3V CMOS	Input	0.7	2.1	-	-	-	EVENT1 input Rising or falling edge triggered. This input is used to provide a position or time data log based on an external trigger. Internal 10 kΩ pullup.
9	ERROR	3.3V CMOS	Output	-	-	0.4	2.9	4	ERROR output Normally low. A high output on this pin indicates that the receiver is in an error state. Internal 10 kΩ pulldown.
10	PV	3.3V CMOS	Output	-	-	0.4	2.9	4	Position Valid output A high output on this pin indicates that the receiver has computed a valid GNSS position. Internal 10 kΩ pulldown.
11	COM2_CTS	3.3V CMOS	Input	0.7	2.1	-	-	-	COM2 Clear To Send input This is an optional flow control signal for the COM2 UART. Internal weak (40 kΩ to 100 kΩ) pullup.
12	nRESET_IN	Other	Input	0.8	2.3	-	-	-	Active Low. Resets the OEM729 receiver card. This pin must be held low for >20 µs while stable power is already applied, to reset the OEM729 card. It is recommended to hold the nRESET_IN pin low for a >150 ms when initially applying power to the card, giving the power supply time to stabilize before the card starts to boot. Internal 10 kΩ pullup.
13	COM2_RTS	3.3V CMOS	Output	-	-	0.4	2.9	4	COM2 Request To Send output This is an optional flow control signal for the COM2 UART.
14	COM2_RX	3.3V CMOS	Input	0.7	2.1	-	-	-	COM2 Receive Data input Internal weak (40 kΩ to 100 kΩ) pullup.

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
15	COM1_CTS/ COM1_ RXD-	COM1_ CTS: RS-232	Input	-	-	-	-	-	This pin is internally multiplexed. COM1_CTS is the default. COM1_CTS: COM1 Clear To Send input. This is an optional flow control signal for the COM1 UART (±25V tolerant). COM1_RXD-: This is one half of the COM1 RS-422 receive differential pair (2V differential typical)
		COM1_ RXD-: RS-422	Input	-	-	-	-	-	
16	COM2_TX	3.3V CMOS	Output	-	-	0.4	2.9	4	COM2 Transmit Data output
17	COM1_RTS/ COM1_ TXD-	COM1_ RTS: RS-232	Output	-	-	-	-	-	This pin is internally multiplexed. COM1_RTS is the default. COM1_RTS: COM1 Request To Send output. This is an optional flow control signal for the COM1 UART (±25V tolerant). COM1_TXD-: This is one half of the COM1 RS-422 transmit differential pair. (2V differential typical)
		COM1_ TXD-: RS-422	Output	-	-	-	-	-	
18	COM1_RX/ COM1_ RXD+	COM1_ RX: RS-232	Input	0.7	2.1	-	-	-	This pin is internally multiplexed. COM1_RX is the default. COM1_RX: COM1 Receive Data input (±25V tolerant). COM1_RXD+: This is one half of the COM1 RS-422 receive differential pair (2V differential typical).
		COM1_ RXD+: RS-422	Input	-	-	-	-	-	
19	COM3_ TX/USER0	3.3V CMOS	COM3_TX: Output	-	-	0.4	2.9	4	This pin is internally multiplexed. COM3_TX is the default. COM3_TX: COM3 Transmit Data output. USER0: User GPIO. Internal 10 kΩ pulldown.
			USER0: Input	0.7	2.1	-	-	-	
20	COM1_TX/ COM1_ TXD+	COM1_ TX: RS-232	Output	-	-	-	-	-	This pin is internally multiplexed. COM1_TX is the default. COM1_TX: COM1 Transmit Data output. (±25V tolerant) COM1_TXD+: This is one half of the COM1 RS-422 transmit differential pair (2V differential typical)
		COM1_ TXD+: RS-422	Output	-	-	-	-	-	

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
21	USB_D-	Analog	Input/ Output	-	-	-	-	-	USB device signal. This is one half of the USB differential pair. USB_D+ and USB_D- must be length-matched and routed as a 90 Ω differential pair.
22	USB_D+	Analog	Input/ Output	-	-	-	-	-	USB device signal. This is one half of the USB differential pair. USB_D+ and USB_D- must be length-matched and routed as a 90 Ω differential pair.
23	GND	PWR	-	-	-	-	-	-	Ground reference
24	GND	PWR	-	-	-	-	-	-	Ground reference

P1803 Expansion Connector 16-Pin Header



Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
1	ETH_RD-	Analog	Input	-	-	-	-	-	This is one half of the Ethernet receive differential pair (100 Ω pair).
2	ETH_RD+	Analog	Input	-	-	-	-	-	This is one half of the Ethernet receive differential pair (100 Ω pair).
3	ETH_BIAS	PWR	-	-	-	-	-	-	Center tap power for Ethernet magnetics.
4	ETH_TD+	Analog	Output	-	-	-	-	-	This is one half of the Ethernet transmit differential pair (100 Ω pair).
5	ETH_TD-	Analog	Output	-	-	-	-	-	This is one half of the Ethernet transmit differential pair (100 Ω pair).
6	ETH_BIAS	PWR	-	-	-	-	-	-	Center tap power for Ethernet magnetics.
7	LED_A	3.3V CMOS	Output	-	-	0.4	2.9	8	Activity/Link indicator output. Polarity of the indicator signal is low. When there is an active link, the pin is low. When there is activity on the link, the pin outputs a blink signal.

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
8	LED_B	3.3V CMOS	Output	-	-	0.4	2.9	8	Speed indicator Low = 100 Mbps High = 10 Mbps
9	GND	PWR	-	-	-	-	-	-	Ground reference
10	CAN1TX	3.3V CMOS	Output	-	-	-	-	-	CAN1 Transmit data
11	CAN1RX	3.3V CMOS	Input	-	-	-	-	-	CAN1 Receive data
12	CAN2TX	3.3V CMOS	Output	-	-	-	-	-	CAN2 Transmit data
13	CAN2RX	3.3V CMOS	Input	-	-	-	-	-	CAN2 Receive data
14	UID	3.3V CMOS	Input	-	-	-	-	-	USB Port Mode Leave this pin floating to ensure the USB port is in Device mode. Host mode is not currently supported on the OEM729. Internal 10 kΩ pull up
15	VBUS	PWR	-	-	-	-	-	-	5V output for hosted USB devices
16	GND	PWR	-	-	-	-	-	-	Ground reference

4.3 OEM7700 Technical Specifications

Table 119: OEM7700 Physical Description

Size	46 mm x 71 mm x 8 mm
Weight	31 grams
NovAtel Part Number	Generic assembly OEM7700 01019525

See the following sections for more information about the OEM7700:

4.3.1 OEM7700 Performance Specifications

All specifications subject to GNSS system characteristics.

Table 120: OEM7700 Receiver Performance

Signals Tracked	GPS	L1 C/A, L1C, L2C, L2P, L5
	GLONASS	L1 C/A, L2 C/A, L2P, L3
	BeiDou	B1I, B1C, B2I, B2a, B2b, B3I
	Galileo[1]	E1, E5 AltBOC, E5a, E5b, E6
	NavIC (IRNSS)	L5
	QZSS	L1 C/A, L1C, L1S, L2C, L5, L6
	SBAS	L1, L5
	L-Band[2]	Up to 5 channels
Position Accuracy[3]	Single point L1	1.5 m RMS
	Single point L1/L2	1.2 m RMS
	SBAS[4]	60 cm RMS
	DGPS	40 cm RMS
	TerraStar-L[5]	40 cm RMS
	TerraStar-C PRO[5]	2.0 cm RMS
	TerraStar-X[5]	2.0 cm RMS
	RTK	1 cm + 1 ppm RMS
Time to First Fix	Hot: <20 s (Almanac and recent ephemeris saved and approximate position and time entered) Cold: <34 s (No almanac or ephemeris and no approximate position or time)	
Signal Reacquisition	<0.5 s L1 (typical) <1.0 s L2 and L5 (typical)	
Data Rates	Measurements	up to 100 Hz
	Position	up to 100 Hz

[1] E1bc and E6bc support only.

[2] Currently the receiver can track up to 3 L-Band channels.

[3] Typical values under ideal, open sky conditions.

[4] GPS-only.

[5] Requires a TerraStar subscription which is available direct from NovAtel novatel.com/products/gps-gnss-correction-services/terrastar-correction-services.

Time Accuracy[1]	<5 ns RMS			
Velocity Accuracy	<0.03 m/s RMS			
Measurement Precision[2]			Code	Carrier
	GPS	L1 C/A	4 cm	0.5 mm
		L2 P(Y)	8 cm	1.0 mm
		L2C	8 cm	0.5 mm
		L5	3 cm	0.5 mm
	GLONASS	L1 C/A	8 cm	1.0 mm
		L2 P	8 cm	1.0 mm
		L2 C/A	8 cm	1.0 mm
	Galileo	E1	3 cm	0.5 mm
		E5a	3 cm	0.75 mm
		E5b	3 cm	0.75 mm
		E5 AltBOC	3 cm	0.75 mm
		E6	3 cm	0.75 mm
	BeiDou	B1I	4 cm	0.5 mm
		B1C	3 cm	0.5 mm
		B2I	4 cm	0.5 mm
		B2a	3 cm	0.5 mm
		B2b[3]	3 cm	0.5 mm
		B3I	4 cm	0.5 mm
Velocity Limit[4]	600 m/s			

[1]Time accuracy does not include biases due to RF or antenna delay.

[2]Measurement precision should be compared with measurements using the same correlator spacing.

[3]Under good CN0 conditions, e.g. 44 dBHz.

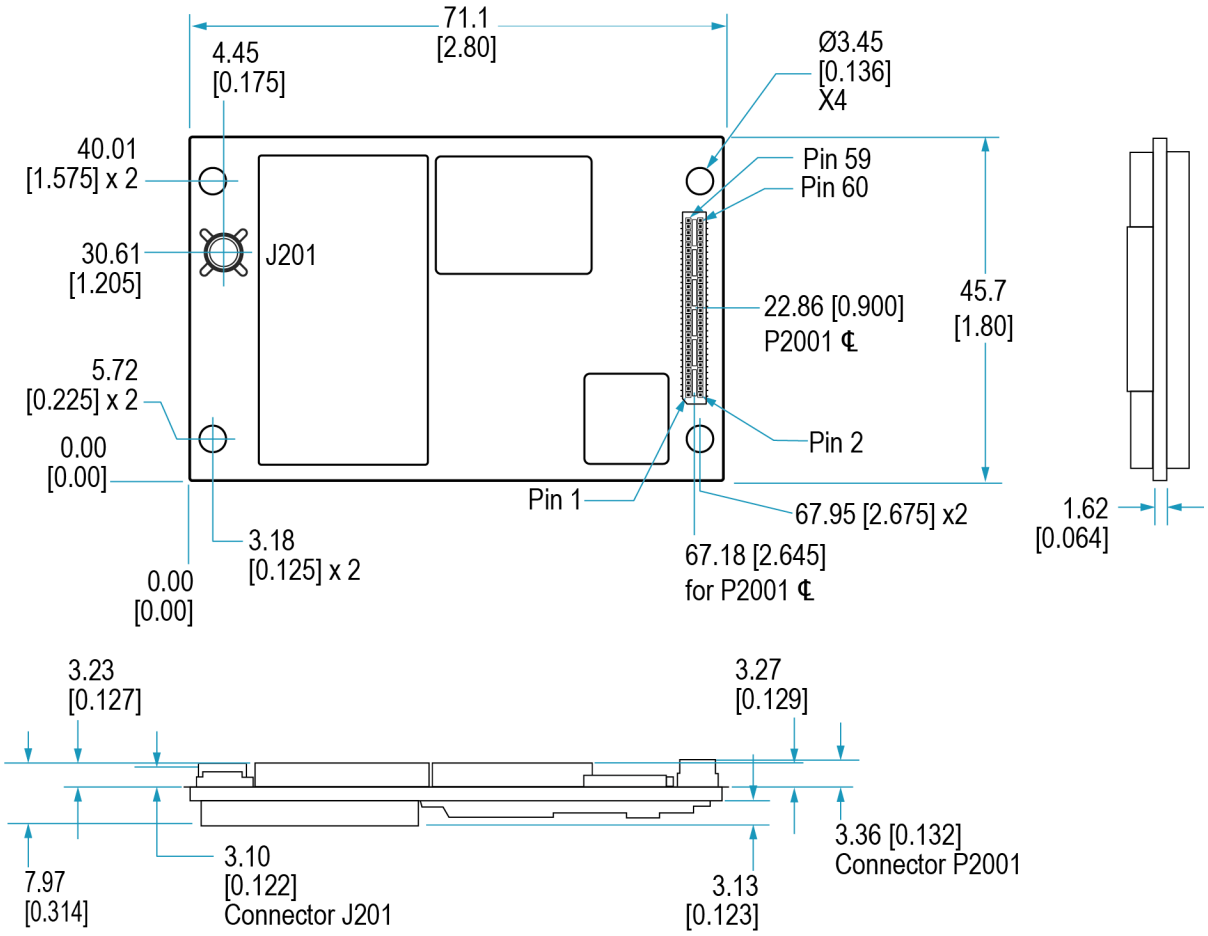
[4]Export licensing restricts operation to a maximum of 600 m/s, message output impacted above 585 m/s.

4.3.2 OEM7700 Mechanical Specifications

- *Figure 19: OEM7700 Dimensions* below
- *Figure 20: OEM7700 Keep-outs* on the next page
- *Figure 21: OEM7700 Mounting Surfaces* on page 230

In the following diagrams, the dimensions are in millimetres [inches].

Figure 19: OEM7700 Dimensions



Notes: OEM7700
Connectors:
(a) J201 Huber + Shuhner 82_MMBX-S50-0-1/111 NE or 82_MMBX-0-1/111 NH or 82_MMBX-S50-0-1/111 NM
(b) P2001 Samtec ASP-189258-01

Figure 20: OEM7700 Keep-outs

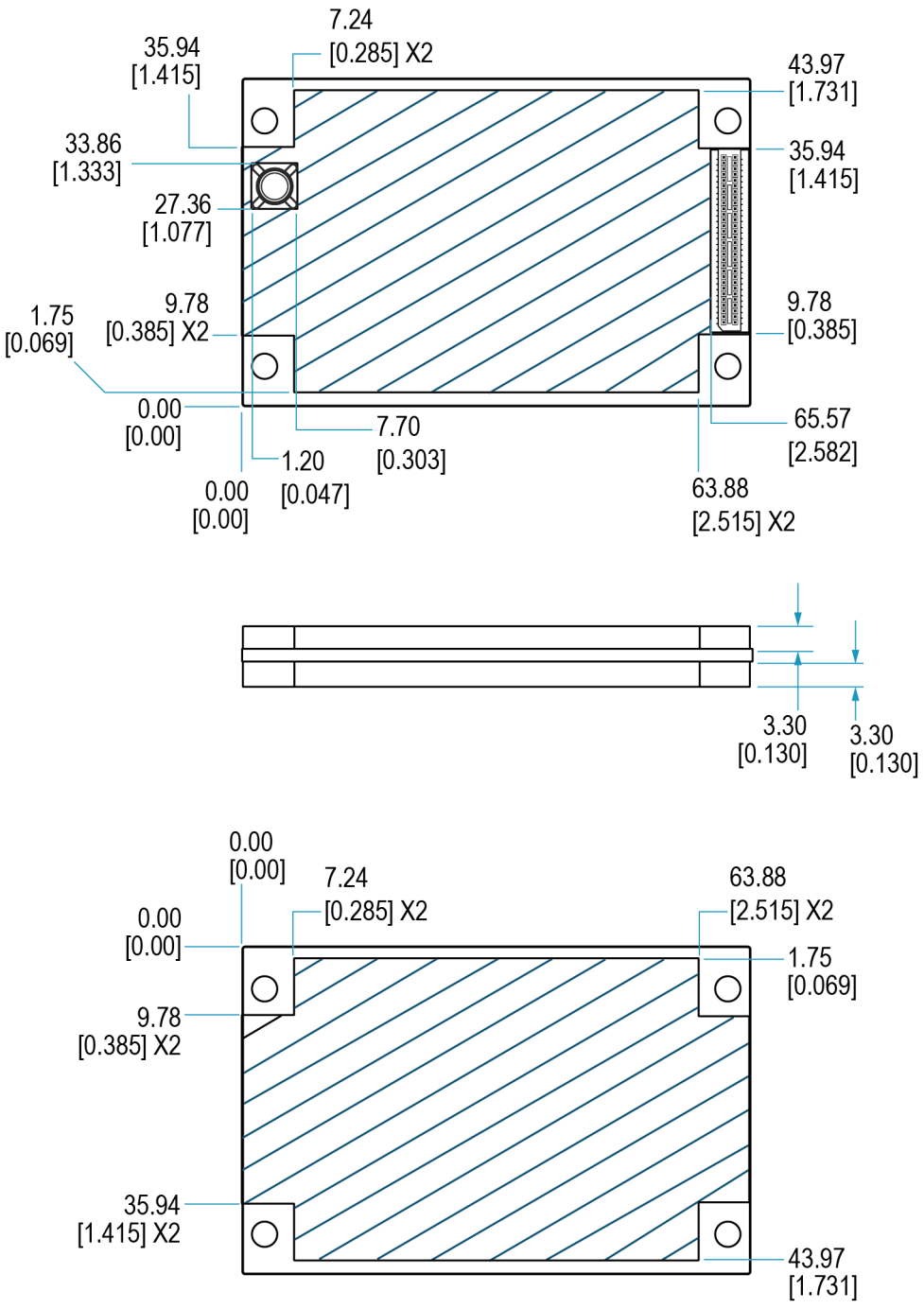
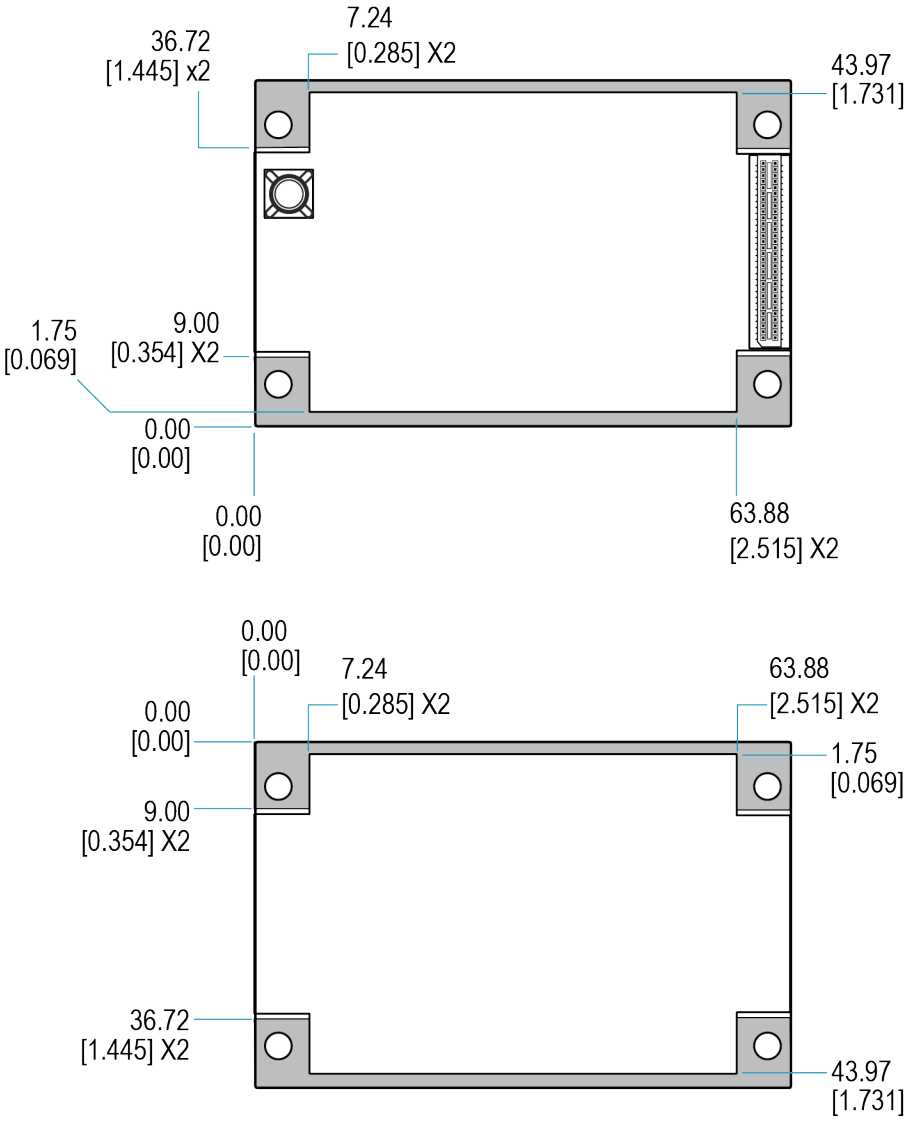


Figure 21: OEM7700 Mounting Surfaces



The mounting surfaces are shown in gray.

These mounting surfaces are designed to work with mounting rails. For information about mounting the OEM7700, refer to Mounting the Printed Circuit Board.

Assembly tolerances must be considered when using mounting rail features.

For information about the recommended mating connector, refer to Table: OEM7 Communication and I/O Connectors.

4.3.3 OEM7700 Electrical and Environmental Specifications

Table 121: OEM7700 Environmental Specifications

Operating Temperature	-40°C to +85°C
Storage Temperature	-55°C to +95°C
Humidity	95% non-condensing
Random Vibration	MIL-STD-810G, Method 514.6, Category 24 (20 g RMS)[1]
Sinusoidal Vibration	IEC 60068-2-6
Bump	ISO 9022-31-06 (25 g)
Shock	
Operating	MIL-STD-810G, Method 516.6 (40 g)
Non-operating	MIL-STD-810G, Method 516.6 (75 g)
Acceleration	MIL-STD-810G, Method 513.7 (16 g)

Table 122: OEM7700 Power Requirements

Voltage	+3.3 VDC ±5%
Allowable Input Voltage Ripple	100 mV p-p maximum
Power Consumption	0.9 W typical, GPS L1 only 1.3 W typical, GPS L1/L2, GLONASS L1/L2 1.8 W typical, all constellations, all frequencies, plus L-Band These are typical values using serial ports without interference mitigation. These values can change with the number of satellites in view, firmware version, data logging rates and features in use. Use them as a guide for what you might expect but not as absolute values
Inrush Current	2.0 A for less than 1.8 ms (typical)

Table 123: OEM7700 RF Input/LNA Power Output

Antenna Connector	MMBX female, 50 Ω nominal impedance

[1] Requires mechanical mounting rails to meet 20 g; meets 7.7 g without rails.

Cascaded antenna LNA gain (before receiver)	Firmware 7.04 and later	HDR disabled	+15 dB to +55 db, 26 dB typical
		HDR enabled	+20 dB to +55 db, 30 dB typical
	Firmware before 7.04	HDR disabled	+15 dB to +40 db, 26 dB typical
		HDR enabled	+20 dB to +40 db, 30 dB typical
RF Input Frequencies	GPS L1: GPS L2: GPS L5:	1575.42 MHz 1227.60 MHz 1176.45 MHz	
	GLONASS L1: GLONASS L2: GLONASS L3:	1593-1610 MHz 1237-1254 MHz 1202.025 MHz	
	Galileo E1: Galileo E5a: Galileo E5b: Galileo E5: Galileo E6:	1575.42 MHz 1176.45 MHz 1207.14 MHz 1191.795 MHz 1278.75 MHz	
	BeiDou B1I: BeiDou B1C: BeiDou B2I: BeiDou B2a: BeiDou B2b BeiDou B3I:	1561.098 MHz 1575.42 MHz 1207.14 MHz 1176.45 MHz 1207.14 MHz 1268.52 MHz	
	L-Band:	1545 to 1560 MHz[1]	
LNA Power	+5.0 VDC ±5%, 0 mA to 200 mA (supplied by card through center conductor of RF connector). LNA Power is generated from the 3.3 V supply input for the OEM7700.		

[1]For hardware releases 1.10 and later. For earlier hardware versions, the L-Band RF Input Frequency is 1525 to 1560 MHz.

4.3.4 OEM7700 Data Communication Specifications

Table 124: Data Communications Interface

COM1	
Electrical format	LVCMOS
Data rates[1]	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 or 460800 bit/s.
Signals supported	COM1_Tx, COM1_Rx, COM1_RTS, COM1_CTS
Electrostatic discharge protection	No
COM2	
Electrical format	LVCMOS
Data rates[1]	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 or 460800 bit/s.
Signals supported	COM2_Tx, COM2_Rx, COM2_RTS, COM2_CTS
Electrostatic discharge protection	No
COM3	
Electrical format	LVCMOS
Data rates[1]	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 or 460800 bit/s.
Signals supported	COM3_Tx, COM3_Rx
Electrostatic discharge protection	No
COM4	
Electrical format	LVCMOS
Data rates[1]	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 or 460800 bit/s.
Signals supported	COM4_Tx, COM4_Rx
Electrostatic discharge protection	No

[1]Data rates higher than 115200 bit/s are not supported by standard PC hardware. Special PC hardware may be required for higher rates, including 230400 bit/s and 460800 bit/s.

COM5	
Electrical format	LVCMOS[1]
Data rates[1]	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400 or 460800 bit/s.
Signals supported	COM5_Tx, COM5_Rx
Electrostatic discharge protection	No
CAN Bus	
Electrical Format	LVCMOS
Data rates	1 Mbps maximum. CAN Bus throughput is determined by slowest device on the bus
Signals supported	CAN1 and CAN2
USB	
Electrical format	Conforms to USB 2.0
Data rates	Hi-speed (480 Mb/s)
Signals supported	USB0 D+, USB0 D- USB1 D+, USB1 D-
ETHERNET	
Physical layer	10BASE-T/100BASE-TX

[1]Upon power-up, COM5 is enabled by default. COM5 is multiplexed with COM2 hardware flow control.

4.3.5 OEM7700 Strobe Specifications

Table 125: OEM7700 Strobes Description

Strobes	Input/Output	Factory Default	Comment
ERROR	Output	Active high	Normally low. A high output on this pin indicates that the receiver is in an error state. For information about the cause of the error, log the **RXSTATUS** log.
EVENT_IN1 EVENT_IN2 EVENT_IN3 EVENT_IN4	Input Leading edge triggered	Active low	Input marks for which a pulse greater than 150 ns triggers certain logs to be generated. (Refer to the MARKxPOS and MARKxTIME logs and ONMARK trigger.) Polarity is configurable using the **EVENTINCONTROL** command.
EVENT_OUT1 EVENT_OUT2 EVENT_OUT3 EVENT_OUT4	Output	Active low	Programmable variable frequency outputs ranging from 0 Hz to 50 MHz (refer to the **EVENTOUTCONTROL** command).
ME_RDY	Output	Active high	Indicates to the host system that the receiver is ready to receive commands. This signal is not asserted while booting or during a reset. If an error is detected during receiver operation (for example, an over temperature condition), the ERROR signal is asserted and the ME_RDY signal will normally remain asserted: commands can still be sent to the receiver under these conditions. At the time ERROR is asserted, POS_VALID signal is changed to not asserted. In the rare case of a fatal, unrecoverable error that leads to a reboot of the receiver, ME_RDY, ERROR and POS_VALID are all not asserted while the receiver restarts.
POS_Valid (Position Valid)	Output	Active high	Indicates a valid GNSS position solution is available.
nRESET_IN	Input	Active low	Reset signal input from external system; active low. This pin must be held low for >20 µs while stable power is already applied, to reset the OEM7700 card. It is recommended to hold the nRESET_IN pin low for a >150 ms when initially applying power to the card, giving the power supply time to stabilize before the card starts to boot.

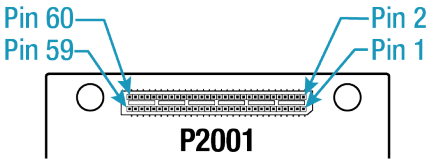
Strobes	Input/Output	Factory Default	Comment
PPS	Output	Active low	A time synchronization output. This is a pulse where the leading edge is synchronized to receiver calculated GNSS Time. The polarity, period and pulse width can be configured using the **PPSCONTROL** command

Table 126: OEM7700 Strobe Electrical Specifications

Strobe	Symbol	Min (V)	Max (V)	Current (mA)
ERROR	V_{OL}		0.2	8
	V_{OH}	3.1		
EVENT_IN1 (Mark) EVENT_IN2 (Mark2) EVENT_IN3 (Mark3) EVENT_IN4 (Mark4)	V_{IL}		0.8	-
	V_{IH}	1.7		
EVENT_OUT1 EVENT_OUT2 EVENT_OUT3 EVENT_OUT4	V_{OL}		0.2	8
	V_{OH}	3.1		
ME_RDY	V_{OL}		0.2	4
	V_{OH}	3.1		
POS_VALID	V_{OL}		0.55	8
	V_{OH}	2.3		
nRESET_IN	V_{IL}		0.8	-
	V_{IH}	2.55		
PPS	V_{OL}		0.55	24
	V_{OH}	2.3		

4.3.6 OEM7700 Interface Connector

P2001 Main Connector 60-Pin Socket



For information about the recommended mating connector, refer to Table: OEM7 Communication and I/O Connectors.

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
1	3V3	Power	Input	-	-	-	-	-	3.3 V ±5% supply input
2	3V3	Power	Input	-	-	-	-	-	3.3 V ±5% supply input
3	COM2_ TXD	3.3V CMOS	Output	-	-	0.2	3.1	4	COM2 Transmit Data (UART)
4	COM1_ TXD	3.3V CMOS	Output	-	-	0.55	2.3	24	COM1 Transmit Data (UART)
5	COM5_ TXD/ COM2_ RTS	3.3V CMOS	Output	-	-	0.2	3.1	4	This pin is internally multiplexed. COM5_TXD is the default. COM5_TXD: COM5 Transmit Data (UART). COM2_RTS: COM2 Request to Send Optional hardware flow control signal for the COM2 serial port.
6	COM1_ RTS	3.3V CMOS	Output	-	-	0.2	3.1	4	COM1 Request to Send Optional hardware flow control signal for the COM1 serial port.
7	GND	Ground	-	-	-	-	-	-	Ground reference
8	GND	Ground	-	-	-	-	-	-	Ground reference
9	COM2_ RXD	3.3V CMOS	Input	0.8	1.7	-	-	-	COM2 Receive Data (UART)
10	COM1_ RXD	3.3V CMOS	Input	0.8	1.7	-	-	-	COM1 Receive Data (UART)

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
11	COM5_ RXD/ COM2_ CTS	3.3V CMOS	Input	0.8	1.7	-	-	-	This pin is internally multiplexed. COM5_RXD is the default. COM5_RXD: COM5 Receive Data (UART). COM2_CTS: COM2 Clear to Send Optional hardware flow control signal for the COM2 serial port.
12	COM1_ CTS	3.3V CMOS	Input	0.8	1.7	-	-	-	COM1 Clear To Send Optional hardware flow control signals for the COM1 serial port.
13	COM4_ RXD	3.3V CMOS	Input	0.8	1.7	-	-	-	COM4 Receive Data (UART)
14	COM3_ RXD	3.3V CMOS	Input	0.8	1.7	-	-	-	COM3 Receive Data (UART)
15	STATUS_ GREEN	3.3V CMOS	Output	-	-	0.2	3.1	4	Used to indicate the state of the receiver or provide error codes. These outputs provide the same information as the Status Indicator LED (see Status LED). STATUS_GREEN high and STATUS_RED low represents a **Green** LED. STATUS_GREEN high and STATUS_RED high represents a **Yellow** LED. STATUS_GREEN low and STATUS_ RED high represents a **Red** LED.
16	STATUS_ RED	3.3V CMOS	Output	-	-	0.2	3.1	4	
17	EVENT_ OUT1	3.3V CMOS	Output	-	-	0.2	3.1	8	EVENT1 (Mark1) Output Rising edge triggered. Outputs a user-specified timing signal. Can be synchronized with PPS. Supports Variable Frequency Output function.
18	ME_RDY	3.3V CMOS	Output	-	-	0.2	3.1	4	Receiver Ready (Active High) Indicates to the host system that the receiver is ready to receive commands. This signal is not asserted while booting or during a reset. Internal 2.2 kΩ pull down.

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
19	COM4_ TXD	3.3V CMOS	Output	-	-	0.2	3.1	4	COM4 Transmit Data (UART)
20	COM3_ TXD	3.3V CMOS	Output	-	-	0.2	3.1	4	COM3 Transmit Data (UART)
21	ERROR	3.3V CMOS	Output	-	-	0.2	3.1	4	Error Indicator (Active High) Normally low. A high output on this pin indicates that the receiver is in an error state. Internal 2.2 kΩ pull down.
22	POS_ VALID	3.3V CMOS	Output	-	-	0.2	3.1	4	Position Valid Output (Active High) A high output on this pin indicates that the receiver has computed a valid GNSS position. Internal 10 kΩ pull down.
23	EVENT_ OUT3	3.3V CMOS	Output	-	-	0.2	3.1	8	EVENT3 (Mark3) Output Rising edge triggered. Outputs a user-specified timing signal. Can be synchronized with PPS. Supports Variable Frequency Output function.
24	PPS	3.3V CMOS	Output	-	-	0.55	2.3	24	Pulse Per Second output This signal defaults to one pulse per second but may be altered across a wide range of frequencies using software commands. Edges can be synchronized to GNSS time reference.
25	EVENT_ OUT4	3.3V CMOS	Output	-	-	0.2	3.1	8	EVENT4 (Mark4) Output Rising edge triggered. Outputs a user-specified timing signal. Can be synchronized with PPS. Supports Variable Frequency Output function.
26	EVENT_ OUT2	3.3V CMOS	Output	-	-	0.2	3.1	8	EVENT2 (Mark2) Output Rising edge triggered. Outputs a user-specified timing signal. Can be synchronized with PPS. Supports Variable Frequency Output function.
27	GND	Ground	-	-	-	-	-	-	Ground reference

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
28	GND	Ground	-	-	-	-	-	-	Ground reference
29	EVENT_IN2	3.3V CMOS	Input	0.8	1.7	-	-	-	EVENT2 (Mark2) input Rising or falling edge triggered. This input is used to provide a position or time data log based on an external trigger. Internal 10 kΩ pull up.
30	EVENT_IN1	3.3V CMOS	Input	0.8	1.7	-	-	-	EVENT1 (Mark1) input Rising or falling edge triggered. This input is used to provide a position or time data log based on an external trigger. Internal 10 kΩ pull up.
31	EVENT_IN4	3.3V CMOS	Input	0.8	1.7	-	-	-	EVENT4 (Mark4) input Rising or falling edge triggered. This input is used to provide a position or time data log based on an external trigger. Internal 10 kΩ pull up.
32	EVENT_IN3	3.3V CMOS	Input	0.8	1.7	-	-	-	EVENT3 (Mark3) input Rising or falling edge triggered. This input is used to provide a position or time data log based on an external trigger. Internal 10 kΩ pull up.
33	GND	Ground	-	-	-	-	-	-	Ground reference
34	GND	Ground	-	-	-	-	-	-	Ground reference
35	CAN2_RXD	3.3V CMOS	Input	0.8	1.7	-	-	-	CAN2 Receive Data This is a CMOS-level signal, requiring an external CAN transceiver.
36	CAN1_TXD	3.3V CMOS	Output	-	-	0.2	3.1	4	CAN1 Transmit Data This is a CMOS-level signal, requiring an external CAN transceiver.
37	CAN2_TXD	3.3V CMOS	Output	-	-	0.2	3.1	4	CAN2 Transmit Data This is a CMOS-level signal, requiring an external CAN transceiver.
38	CAN1_RXD	3.3V CMOS	Input	0.8	1.7	-	-	-	CAN1 Receive Data This is a CMOS-level signal, requiring an external CAN transceiver.

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
39	I2C_SCA	3.3V CMOS Open drain	I/O	0.7	2.0	0.4	2.9	-	I2C data line Open drain signal with internal 2.2 kΩ pull up to 3.3 V
40	I2C_SCL	3.3V CMOS Open drain	Output-	-	-	0.4	3.1	-	I2C clock line Open drain signal with internal 2.2 kΩ pull up to 3.3 V
41	SPI_MOSI	3.3V CMOS	Output	-	-	0.2	3.1	4	Serial Peripheral Interface Master Output/Slave Input
42	SPI_nCS	3.3V CMOS	Output	-	-	0.2	3.1	4	Serial Peripheral Interface Chip Select (Active Low)
43	SPI_MISO	3.3V CMOS	Input	0.8	1.7	-	-	-	Serial Peripheral Interface Master Input/Slave Output
44	SPI_SCLK	3.3V CMOS	Output	-	-	0.2	3.1	4	Serial Peripheral Interface Serial Clock
45	GND	Ground	-	-	-	-	-	-	Ground reference
46	GND	Ground	-	-	-	-	-	-	Ground reference
47	USB1_D-	Analog	I/O	-	-	-	-	-	USB1 signal. This is one half of the USB1 differential pair. USB1_D+ and USB1_D- must be length-matched and routed as a 90 Ω differential pair.
48	USB0_D+	Analog	I/O	-	-	-	-	-	USB0 signal. This is one half of the USB0 differential pair. USB0_D+ and USB0_D- must be length-matched and routed as a 90 Ω differential pair.
49	USB1_D+	Analog	I/O	-	-	-	-	-	USB1 signal. This is one half of the USB1 differential pair. USB1_D+ and USB1_D- must be length-matched and routed as a 90 Ω differential pair.
50	USB0_D-	Analog	I/O	-	-	-	-	-	USB0 signal. This is one half of the USB0 differential pair. USB0_D+ and USB0_D- must be length-matched and routed as a 90 Ω differential pair.

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
51	UID	3.3V CMOS	Input	-	-	-	-	-	USB Port Mode Select. Leave this pin floating to put USB0 into Device mode and USB1 into Host mode. Tie this pin to GND to put USB0 into Host mode and USB1 into Device mode. Internal 10 kΩ pull up
52	USB0_ VBUS	Power	I/O	3.3	5.25	-	-	-	When the USB port mode is set to Host, this pin is an output. When the USB port mode is set to Device, this pin is an input. Host or Device mode is set using the USB_Port_Mode_Select pin (Pin 51). When an input, requires a voltage between 3.3 V and 5.25 V. When an output, provides 5 V for hosted devices USB0_VBUS is capable of providing up to 200 mA to a hosted USB device. Devices that require more than 200 mA must be powered separately.
53	nRESET_ IN	3.3V CMOS	Input	0.8	2.55	-	-	-	Reset Input (Active Low) Resets the OEM7700 receiver card. This pin must be held low for >20 µs while stable power is already applied, to reset the OEM7700 card. It is recommended to hold the nRESET_IN pin low for a >150 ms when initially applying power to the card, giving the power supply time to stabilize before the card starts to boot. Internal 10 kΩ pullup.
54	GND	Ground	-	-	-	-	-	-	Ground reference

Pin	Signal Name	Signal Type	Signal Direction	V_{IL} Max (V)	V_{IH} Min (V)	V_{OL} Max (V)	V_{OH} Min (V)	Drive (mA)	Description
55	ETH_LINK_ACT	3.3V CMOS	Output	-	-	0.2	3.1	8	Ethernet Link and Activity LED indicator. Polarity of the indicator signal is low. When there is an active link, the pin is low. When there is activity on the link, the pin outputs a blink signal. Do not use ETH_BIAS to supply the LED.
56	ETH_BIAS	Power	Output	-	-	-	-	-	DC Bias source for the Ethernet magnetics. Do not use ETH_BIAS to supply any other circuitry.
57	ETH_RX+	Analog	Input	-	-	-	-	-	Ethernet Receive One half of the Ethernet receive differential pair. ETH_RX+ and ETH_RX- must be routed as a 100 Ω differential pair.
58	ETH_TX+	Analog	Output	-	-	-	-	-	Ethernet Transmit One half of the Ethernet transmit differential pair. ETH_TX+ and ETH_TX- must be routed as a 100 Ω differential pair.
59	ETH_RX-	Analog	Input	-	-	-	-	-	Ethernet Receive One half of the Ethernet receive differential pair. ETH_RX+ and ETH_RX- must be routed as a 100 Ω differential pair.
60	ETH_TX-	Analog	Output	-	-	-	-	-	Ethernet Transmit One half of the Ethernet transmit differential pair. ETH_TX+ and ETH_TX- must be routed as a 100 Ω differential pair.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