SPAN GNSS+INS technology

Deeply coupled GNSS+INS technology
for exceptional continuous 3D position, velocity &
attitude performance

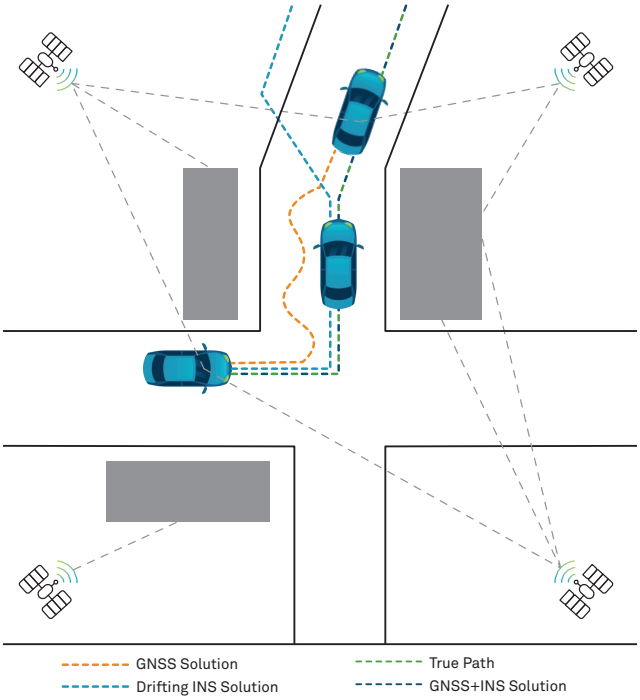
SPAN technology

SPAN technology from Hexagon | NovAtel provides continuous 3D positioning, velocity and attitude determination even when satellite reception may be compromised for short periods of time.

SPAN technology integrates our industry leading Global Navigation Satellite System (GNSS) technology with Inertial Measurement Units (IMUs) to create a deeply coupled GNSS+INS solution at data rates up to 200 Hz. A range of receiver, IMU and antenna options are available to meet accuracy and size requirements for nearly any application. For comprehensive information on SPAN technology, visit novatel.com/span.

The accuracy of our real-time SPAN solution can be optimised with best-in-class Waypoint post-processing software. For more information, go to novatel.com/waypoint.

How SPAN works



- **GNSS solution**
  With GNSS only positioning, navigating becomes unreliable or impossible when satellites are blocked by obstructions such as trees or buildings.
- **Drifting INS solution**
  In the absence of an external reference, the Inertial Navigation System (INS) solution will drift over time due to accumulated errors in the IMU data.
- **True path**
- **GNSS+INS solution**
  Continuously available and following the true path.
- **SATELLITE line-of-sight**

When combined, the two navigation techniques augment and enhance each other to create a powerful positioning system. The absolute position and velocity accuracy of the GNSS is used to compensate for the errors in the IMU measurements. The stable relative position of the INS can be used as a bridge to span times when the GNSS solution is degraded or unavailable. Data is available in real-time or can be post-processed for workflows requiring the most robust solution possible and additional quality control.

Combined GNSS+INS systems

Single enclosure receiver and IMU

CPT7 and CPT7700

- Compact, single enclosure GNSS+INS receiver, powered by NovAtel's world class OEM7 technology.
- Features an OEM7 receiver from NovAtel and a Honeywell HG4930 IMU
- The dual antenna CPT7 also provides an ALIGN heading system from a single enclosure
- 16 GB of internal data logging storage
- Precision Time Protocol (PTP) functionality brings precise timing to synchronise all the devices on your system network

Dimensions: 90 x 60 x 60 mm

Weight: 500 g

Operating Temperature: -40°C to +71°C

GPS L1 C/A, L1C, L2C, L2P, L5 + GLONASS L1 C/A, L2 C/A, L2P, L3, L5 + BeiDou B1I, B1C, B2I, B2a, B2b, B3I + Galileo E1, E5 AltBOC, E5a, E5b, E6 + NavIC L5 + SBAS L1, L5 + QZSS L1 C/A, L1C, L1S, L2C, L5, L6 + L-Band[5]

PwrPak7-E1 and PwrPak7D-E1

- Advanced OEM7 receiver provides an all-constellation, multi-frequency positioning solution
- The dual antenna PwrPak7D-E1 also provides an ALIGN heading solution from a single enclosure
- Integrated Epson G320N MEMS IMU offers cost effective INS performance
- Multiple communication interfaces for easy integration and installation
- Built-in Wi-Fi and 16 GB of internal data logging storage
- Precision Time Protocol (PTP) functionality brings precise timing to synchronise all the devices on your system network

Dimensions: 147 x 125 x 55 mm

Weight: 510 g

Operating Temperature: -40°C to +75°C

GPS L1 C/A, L1C, L2C, L2P, L5 + GLONASS L1 C/A, L2 C/A, L2P, L3, L5 + BeiDou B1I, B1C, B2I, B2a, B2b, B3I + Galileo E1, E5 AltBOC, E5a, E5b, E6 + NavIC L5 + SBAS L1, L5 + QZSS L1 C/A, L1C, L1S, L2C, L5, L6 + L-Band[6]

PwrPak7-E2 and PwrPak7D-E2

- Advanced OEM7 receiver provides an all-constellation, multi-frequency positioning solution
- The dual antenna PwrPak7D-E2 also provides an ALIGN heading solution from a single enclosure
- Integrated Epson G370N MEMS IMU offers improved INS performance and higher data rate
- Multiple communication interfaces for easy integration and installation
- Built-in Wi-Fi and 16 GB of internal data logging storage
- Precision Time Protocol (PTP) functionality brings precise timing to synchronise all the devices on your system network

Dimensions: 147 x 125 x 55 mm

Weight: 560 g

Operating Temperature: -40°C to +75°C

GPS L1 C/A, L1C, L2C, L2P, L5 + GLONASS L1 C/A, L2 C/A, L2P, L3, L5 + BeiDou B1I, B1C, B2I, B2a, B2b, B3I + Galileo E1, E5 AltBOC, E5a, E5b, E6 + NavIC L5 + SBAS L1, L5 + QZSS L1 C/A, L1C, L1S, L2C, L5, L6 + L-Band[7]

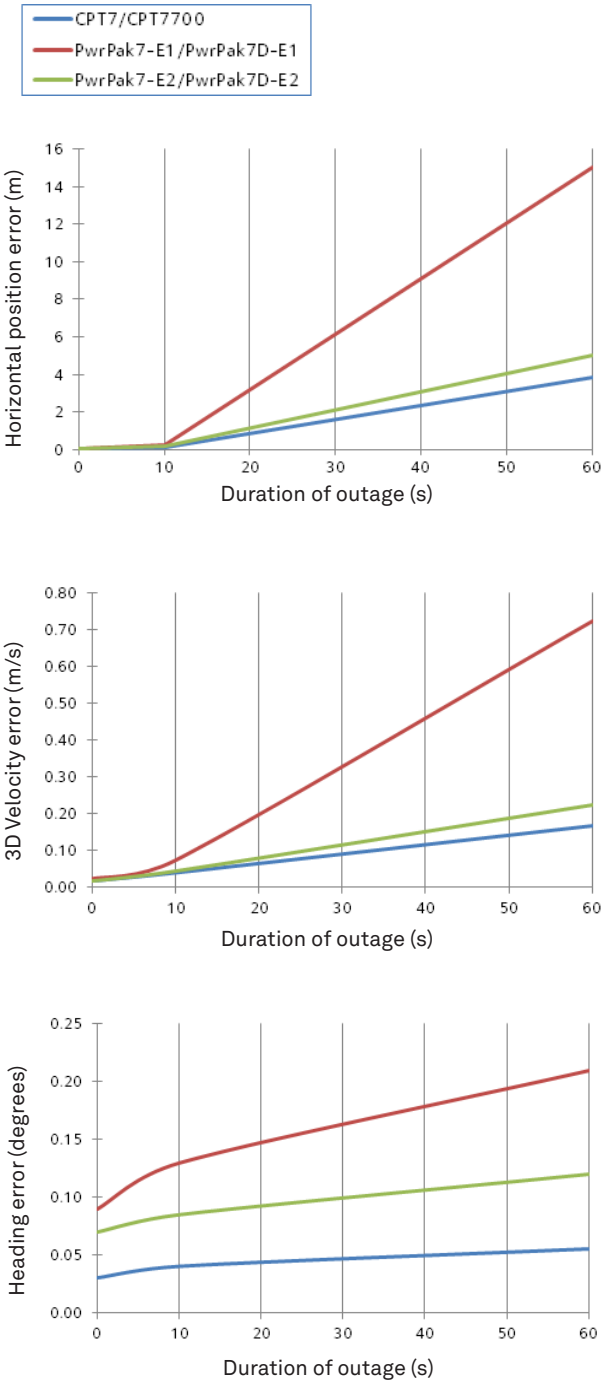
IMU SPECS

Power consumption (typical)[4]	Export control	Data rate	Gyro technology
9 W	Commercial	100 Hz or 400 Hz	MEMS
3.4 W (PwrPak7-E1) 4.15 W (PwrPak7D-E1)	Commercial	125 Hz or 200 Hz	MEMS
3.4 W (PwrPak7-E2) 4.15 W (PwrPak7D-E2)	Commercial	200 Hz	MEMS

SPAN SYSTEM ATTITUDE ACCURACY (DEGREES) RMS

Real-time[2]			Post-processed[3]		
Roll	Pitch	Heading	Roll	Pitch	Heading
0.010	0.010	0.030	0.003	0.003	0.010
0.020	0.020	0.090	0.009	0.009	0.044
0.013	0.013	0.070	0.005	0.005	0.010

SPAN PERFORMANCE[1]



1. Real-time performance with one antenna, no DMI, and default SPAN profile. Performance may be impacted in conditions with unmitigated vibration or significant temperature variations.
2. Typical real-time accuracy based on mixed urban road vehicle dynamics and benign GNSS conditions.
3. Typical post-processed accuracy computed using Waypoint Inertial Explorer. Based on mixed urban road vehicle dynamics and benign GNSS conditions.
4. Typical, GPS + GLONASS only, 12 V, 25°C.
5. BeiDou B3I, Galileo E6 and QZSS L6 are available only on the CPT7700.
6. BeiDou B3I, Galileo E6 and QZSS L6 are available only on the PwrPak7-E1.
7. BeiDou B3I, Galileo E6 and QZSS L6 are available only on the PwrPak7-E2.

Inertial Measurement Units (IMUs)

High performance IMUs

ISA-100C

A near navigation grade IMU from Northrop-Grumman Litef GMBH. The low noise and stable biases of the accelerometer and gyro sensors mean the ISA-100C is well suited for ground or airborne survey applications. The ISA-100C is a commercially exportable IMU that offers the highest level of performance in our IMU portfolio.

Dimensions: 180 x 150 x 137 mm

Weight: 5.0 kg

LN200/LN200C

The low noise, tactical grade LN200 IMU from Northrop Grumman is a proven sensor for airborne survey and mobile mapping applications. The LN200 features closed-loop fiber optic gyros and solid state accelerometers.

The LN200 has the same SPAN performance as the LN200C, but with a higher dynamic range.

The LN200 and LN200C are commercial products that can be licensed under the U.S. Department of Commerce for customers outside the United States.

IMU Enclosure

Dimensions: 150 x 134 x 134 mm

Weight: 3.2 kg

HG1700 AG58

The HG1700 AG58 is a tactical grade IMU from Honeywell containing ring-laser gyros and servo accelerometers. With a Gyro Bias of 1 degree per hour, the economical HG1700 AG58 offers excellent performance.

The HG1700 AG58 is a commercial product that can be licensed under the U.S. Department of Commerce for customers outside the United States.

The HG1700 AG58 is available in the Universal IMU Enclosure (shown) or the SPAN HG Enclosure.

Universal IMU Enclosure

Dimensions: 168 x 195 x 146 mm

Weight: 4.5 kg

SPAN HG Enclosure

Dimensions: 167 x 193 x 100 mm

Weight: 3.4 kg

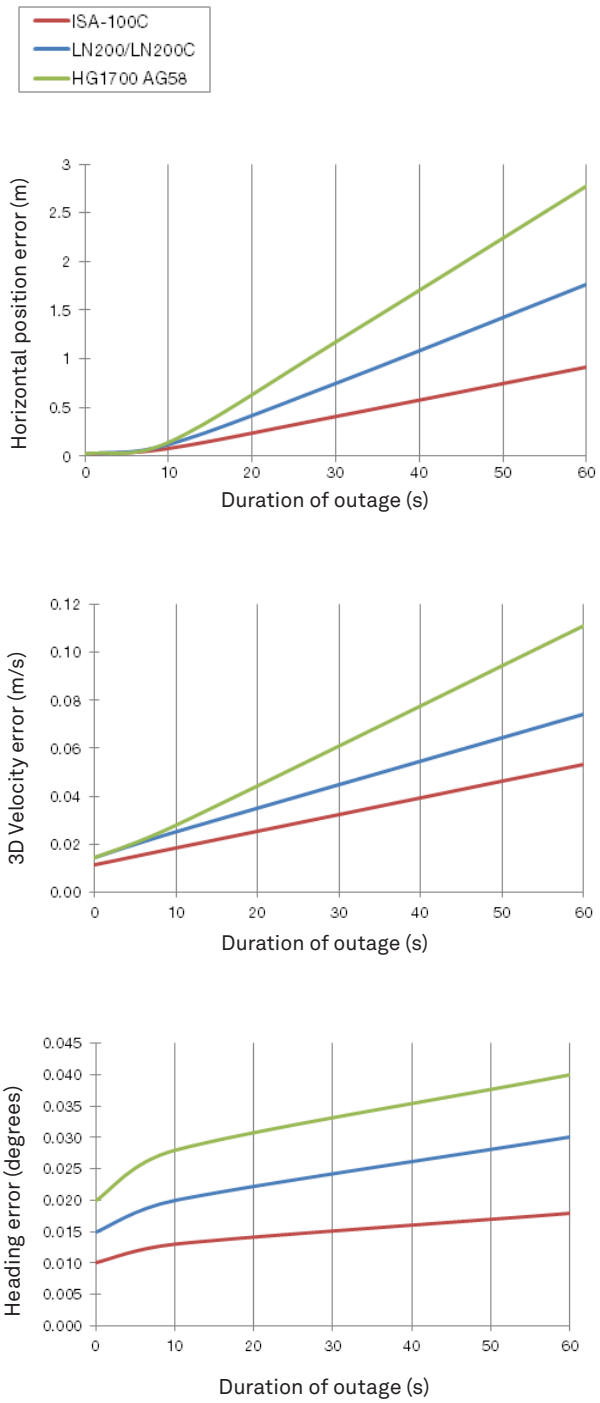
IMU SPECS

Power consumption	Export control	Data rate	Gyro technology	Available as OEM
18 W	Commercial	200 Hz	FOG	+
17 W (typical)	Under the jurisdiction of The U.S. Department of Commerce	200 Hz	FOG	+
8 W	Under the jurisdiction of The U.S. Department of Commerce	100 Hz	RLG	+

SPAN SYSTEM ATTITUDE ACCURACY (DEGREES) RMS

Real-time[2]			Post-processed[3]		
Roll	Pitch	Heading	Roll	Pitch	Heading
0.006	0.006	0.010	0.003	0.003	0.004
0.008	0.008	0.015	0.003	0.003	0.006
0.010	0.010	0.020	0.004	0.004	0.008

SPAN PERFORMANCE[1]



1. Real-time performance with one antenna, no DMI, and default SPAN profile. Performance may be impacted in conditions with unmitigated vibration or significant temperature variations.
2. Typical real-time accuracy based on mixed urban road vehicle dynamics and benign GNSS conditions.
3. Typical post-processed accuracy computed using Waypoint Inertial Explorer. Based on mixed urban road vehicle dynamics and benign GNSS conditions.

Inertial Measurement Units (IMUs)

Mid performance IMUs

HG1900

The IMU-HG1900 incorporates an HG1900, which is a MEMS gyro based IMU manufactured by Honeywell. Economical, robust and small in size, the low power HG1900 provides high end tactical grade performance for commercial and military guidance and navigation applications.

The HG1900 is a commercial product that can be licensed under the U.S. Department of Commerce for customers outside the United States.

Dimensions: 130 x 130 x 125 mm

Weight: 2.5 kg

OEM-HG1900

The HG1900 is a MEMS gyro based IMU manufactured by Honeywell. Economical, robust and small in size, the low power HG1900 provides high end tactical grade performance for commercial and military guidance and navigation applications.

The OEM-HG1900 is a commercial product that can be licensed under the U.S. Department of Commerce for customers outside the United States.

A NovAtel Universal IMU Controller (UIC) is required to integrate an OEM-HG1900 with NovAtel receivers.

Dimensions: 92.7Ø x 79.1 mm

Weight: <460 g

P-1750

The P-1750 IMU from KVH offers tactical grade performance in a compact and rugged package with minimal power consumption. It contains Fiber Optic gyros (FOG) and MEMS accelerometers.

The P-1750 can be connected to OEM7 receivers using an RS-422 serial connection.

Dimensions: 88.9Ø x 73.7 mm

Weight: 700 g

µIMU-IC

The µIMU-IC features Northrop Grumman Litef GMBH's proven inertial measurement technology offering exceptional performance when paired with a SPAN receiver from NovAtel.

The µIMU-IC is also available as an OEM IMU: either as a 200 Hz variant that requires a NovAtel Universal IMU Controller (UIC) to integrate with a NovAtel receiver, or as a 400 Hz variant that can be connected to OEM7 receivers using an RS-422 UART connection.

Dimensions: 130 x 130 x 115 mm

Weight: 2.57 kg

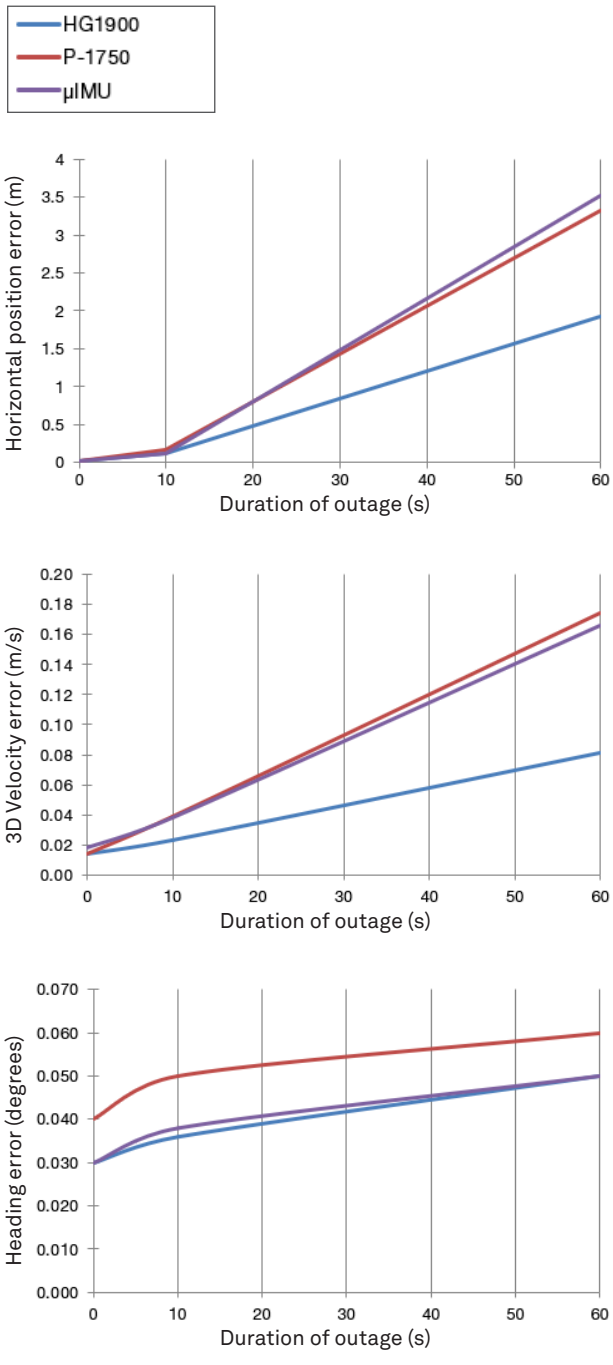
IMU SPECS

Power consumption	Export control	Data rate	Gyro technology	Available as OEM
8 W (typical)	Under the jurisdiction of The U.S. Department of Commerce	100 Hz	MEMS	+
<3 W	Under the jurisdiction of The U.S. Department of Commerce	100 Hz	MEMS	
8 W (max)	Commercial	200 Hz	FOG	
11 W (typical)	Commercial	200 Hz or 400 Hz	MEMS	+

SPAN SYSTEM ATTITUDE ACCURACY (DEGREES) RMS

Real-time[2]			Post-processed[3]		
Roll	Pitch	Heading	Roll	Pitch	Heading
0.010	0.010	0.030	0.004	0.004	0.010
0.010	0.010	0.030	0.004	0.004	0.010
0.015	0.015	0.040	0.005	0.005	0.020
0.010	0.010	0.030	0.004	0.004	0.015

SPAN PERFORMANCE[1]



1. Real-time performance with one antenna, no DMI, and default SPAN profile. Performance may be impacted in conditions with unmitigated vibration or significant temperature variations.
2. Typical real-time accuracy based on mixed urban road vehicle dynamics and benign GNSS conditions.
3. Typical post-processed accuracy computed using Waypoint Inertial Explorer. Based on mixed urban road vehicle dynamics and benign GNSS conditions.

Inertial Measurement Units (IMUs)

Entry-level performance IMUs

HG4930

Small, economical, MEMS IMU manufactured by Honeywell. Provides tactical grade performance for unmanned vehicles and other commercial guidance applications.

The HG4930 can be connected to OEM7 receivers using an RS-422 serial connection. A TTL to RS-422 transceiver is required.

Dimensions: 64.8Ø x 35.7 mm

Weight: 200 g

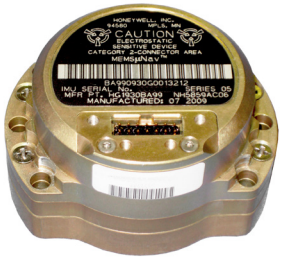
STIM300

MEMS IMU from Sensonor. Features low noise gyros and accelerometers in a small, light weight, environmentally sealed enclosure. When integrated with NovAtel's SPAN technology, this IMU is ideal for airborne and ground applications that require accurate 3D position, velocity and attitude data.

The STIM300 can be connected to OEM7 receivers using an RS-422 serial connection.

Dimensions: 39 x 45 x 22 mm

Weight: 55 g



HG1930

Small, economical MEMS IMU manufactured by Honeywell. Provides tactical grade performance for unmanned vehicles and other commercial and/or military guidance applications. A MEMS Interface Card (MIC) is required to integrate an HG1930 with NovAtel GNSS receivers.

The HG1930 is a commercial product that can be licensed under the U.S. Department of Commerce for customers outside the United States.

Dimensions: 64.8Ø x 35.7 mm

Weight: 200 g

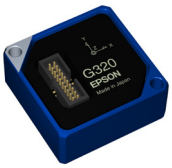
EG370N

MEMS IMU from Epson with higher IMU data rate and improved performance, the EG370N provides applications that require low cost, high performance and rugged durability with a seamless positioning solution in a very small form factor.

The EG370N can communicate directly to OEM7 receivers using a SPI port.

Dimensions: 24 x 24 x 10 mm

Weight: 10 g



EG320N

MEMS IMU from Epson, the EG320N enables precision measurements for applications that require low cost, high performance and rugged durability in a very small form factor.

The EG320N can communicate directly to OEM7 receivers using a SPI port.

Dimensions: 24 x 24 x 10 mm

Weight: 10 g

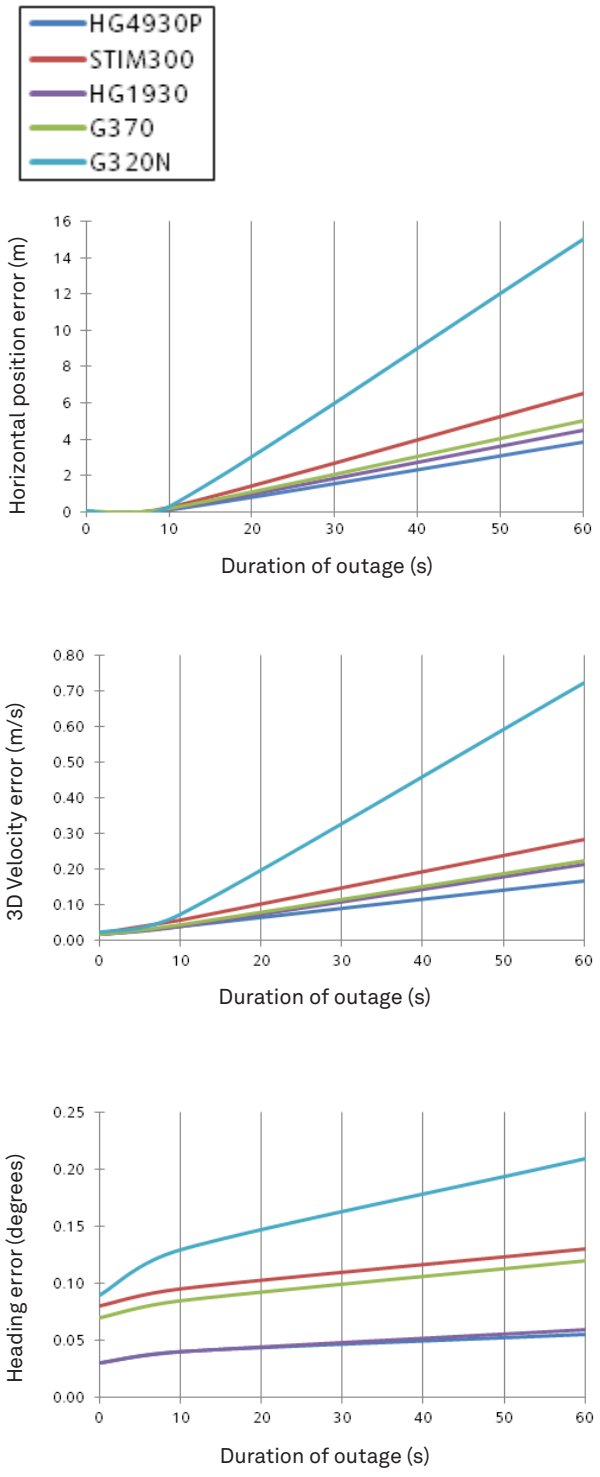
IMU SPECS

Power consumption	Export control	Data rate	Gyro technology	Available as OEM
<3 W	Commercial	100 Hz or 400 Hz	MEMS	+
1.5 W	Commercial	125 Hz	MEMS	+
<3 W	Under the jurisdiction of The U.S. Department of Commerce	100 Hz	MEMS	+
0.1 W	Commercial	200 Hz	MEMS	+
0.1 W	**Commercial**	**125 Hz or 200 Hz**	**MEMS**	+

SPAN SYSTEM ATTITUDE ACCURACY (DEGREES) RMS

Real-time[2]			Post-processed[3]		
Roll	Pitch	Heading	Roll	Pitch	Heading
0.010	0.010	0.030	0.003	0.003	0.010
0.015	0.015	0.080	0.008	0.008	0.022
0.015	0.015	0.030	0.006	0.006	0.015
0.013	0.013	0.070	0.005	0.005	0.010
0.020	0.020	0.090	0.009	0.009	0.044

SPAN PERFORMANCE[1]



1. Real-time performance with one antenna, no DMI, and default SPAN profile. Performance may be impacted in conditions with unmitigated vibration or significant temperature variations.
2. Typical real-time accuracy based on mixed urban road vehicle dynamics and benign GNSS conditions.
3. Typical post-processed accuracy computed using Waypoint Inertial Explorer. Based on mixed urban road vehicle dynamics and benign GNSS conditions.

About Hexagon | NovAtel

Hexagon is a global leader in digital reality solutions, combining sensor, software and autonomous technologies. We are putting data to work to boost efficiency, productivity, quality and safety across industrial, manufacturing, infrastructure, public sector, and mobility applications.

Our technologies are shaping production and people-related ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future.

NovAtel, part of Hexagon, is a global technology leader, pioneering end-to-end solutions for assured positioning for land, sea, and air. NovAtel designs, manufactures and sells high precision positioning technology developed for efficient and rapid integration. Its solutions are empowering intelligent positioning ecosystems in vital industries that depend on the ability to tackle the most complex challenges in the most demanding environments.
Learn more at novatel.com.

Novatel Inc.
Hexagon Calgary Campus | 10921 14th St. NE | Calgary, Alberta, Canada T3K 2L5

Contact Information
US & Canada 1-800-NOVATEL or 403-295-4900
China 0086-21-68882300 | Europe 44-1993-848-736 | SE Asia & Australia 61-400-883-601
Website: novatel.com | Email: sales.nov.ap@hexagon.com

Version 28
D16507 May 2023