



SPAN[®]

Tightly Coupled GNSS+INS Technology for
Continuous 3D Position, Velocity & Attitude

SPAN Technology

NOVATEL'S SPAN TECHNOLOGY PROVIDES CONTINUAL 3D POSITIONING, VELOCITY AND ATTITUDE DETERMINATION EVEN WHEN SATELLITE RECEPTION MAY BE COMPROMISED FOR SHORT PERIODS OF TIME.

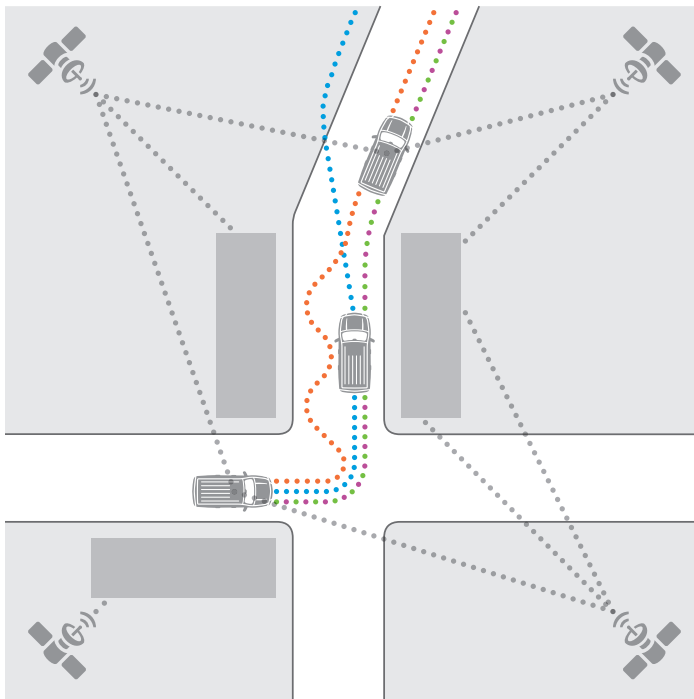
SPAN integrates our industry leading Global Navigation Satellite System (GNSS) technology with Inertial Measurement Units (IMUs) to create a tightly coupled GNSS+INS solution at data rates up to 200 Hz. A range of receiver, IMU and antenna options are available to meet accuracy and size requirements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

For comprehensive SPAN information, visit www.novatel.com/span

The accuracy of SPAN products can be optimized with best-in-class post-processing software from our Waypoint® Products Group.

For more information, go to www.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**

••• **SPAN 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.

SPAN Enclosures



ProPak6™

- » Standalone metre-level to RTK centimetre-level positioning.
- » 4 GB onboard memory for data logging and easy storage and retrieval.

Dimensions: 190 x 185 x 75 mm

Weight: 1.79 kg

GPS L1/L2/L2C + GLONASS L1/L2/L2C + BeiDou¹ + SBAS + L-Band

Power Consumption Operating Temperature

3.5 W²

-40°C to +75°C



FlexPak6™

- » Houses NovAtel's OEM628 GNSS receiver board.
- » Provides multiple communication options including Ethernet, USB and CAN bus.

Dimensions: 113 x 147 x 45 mm

Weight: 337 g

GPS L1/L2/L2C + GLONASS L1/L2/L2C + BeiDou¹ + SBAS + L-Band

1.8 W³

-40°C to +75°C

OEM Receiver Boards



OEM615™

- » Smaller than the size of a business card, the OEM615 features high performance GNSS positioning with low power consumption.

Dimensions: 46 x 71 x 11 mm

Weight: 24 g

GPS L1/L2/L2C + GLONASS L1/L2/L2C + SBAS

<1.0 W⁴

-40°C to +85°C



OEM628™

- » High performance GNSS positioning with low power consumption.
- » Drop in replacement for NovAtel's OEMV-2 GNSS receiver.

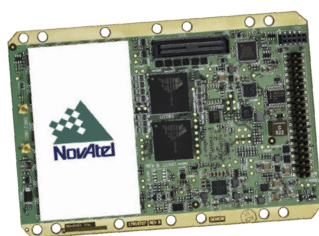
Dimensions: 60 x 100 x 9 mm

Weight: 37 g

GPS L1/L2/L2C + GLONASS L1/L2/L2C + BeiDou¹ + SBAS + L-Band

1.3 W⁵

-40°C to +85°C



OEM638™

- » The most advanced GNSS receiver within the OEM6 series of products.
- » 4 GB onboard memory for data logging and easy storage and retrieval.

Dimensions: 85 x 125 x 14.3 mm

Weight: 84 g

GPS L1/L2/L2C + GLONASS L1/L2/L2C + BeiDou¹ + SBAS + L-Band

2.8 W⁵

-40°C to +85°C

1. Requires OEM6.400 firmware or higher
2. Model and/or configuration dependant.
3. Typical, GPS L1/L2 at 6 VDC with Ethernet disabled.

4. Typical, GPS L1/L2.
5. Typical, GPS L1/L2 with Ethernet disabled.

SPAN Combined GNSS+INS Systems



SPAN-CPT™

- » Features NovAtel's OEM628 GNSS receiver, fiber optic gyros and Micro Electromechanical Systems (MEMS) accelerometers in one enclosure.
- » This product is not ITAR controlled, reducing cross border difficulties when operating in multiple countries.

Dimensions: 152 x 168 x 89 mm

Weight: 2.28 kg

Operating Temperature: -40 °C to +65 °C

GPS L1/L2/L2C + GLONASS L1/L2/L2C + BeiDou¹ + SBAS + L-Band



SPAN-IGM-S1

- » Features the OEM615 receiver and STIM300 IMU.
- » The STIM300 is a tactical grade IMU with MEMS gyros and accelerometers.
- » This product is not ITAR controlled, reducing cross border difficulties when operating in multiple countries.
- » Stacks with a FlexPak6 receiver to create a compact ALIGN® heading system.

Dimensions: 152 x 142 x 51 mm

Weight: 540 g

Operating Temperature: -40 °C to +65 °C

GPS L1/L2/L2C + GLONASS L1/L2/L2C + SBAS

SPAN-IGM-A1

- » Features the OEM615 receiver and ADIS-16488 IMU.
- » The ADIS-16488 is a cost effective IMU with MEMS gyros and accelerometers.
- » This product is not ITAR controlled, reducing cross border difficulties when operating in multiple countries.
- » Stacks with a FlexPak6 receiver to create a compact ALIGN® heading system.

Dimensions: 152 x 142 x 51 mm

Weight: 515 g

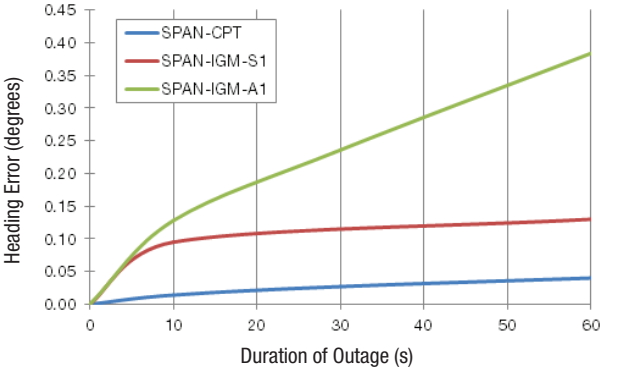
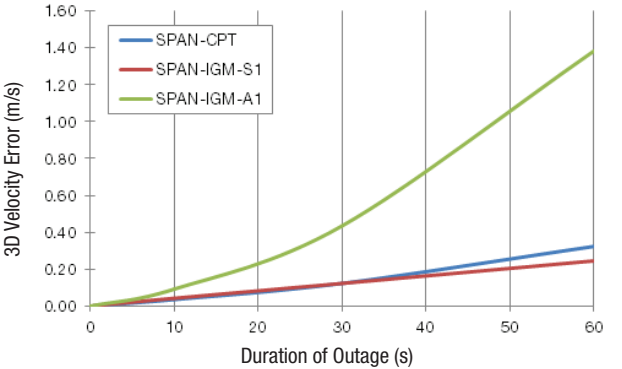
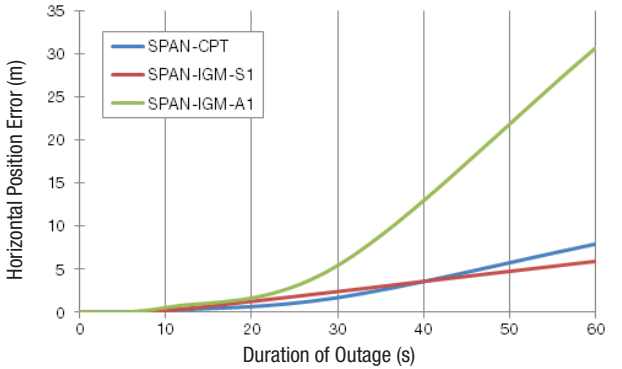
Operating Temperature: -40 °C to +65 °C

GPS L1/L2/L2C + GLONASS L1/L2/L2C + SBAS

1. Requires OEM6.400 firmware or higher
2. Typical, GPS + GLONASS only, 12 V, 25 °C,

IMU SPECS					SPAN SYSTEM ATTITUDE ACCURACY (DEGREES) ¹ RMS					
Power Consumption	Export Control	Data Rate	Gyro Bias	Gyro Technology	RTK ²			PP ³		
16 W (max)	Commercial	100 Hz	20.0 deg/hr	FOG	Roll	Pitch	Heading	Roll	Pitch	Heading
					0.020	0.020	0.060	0.015	0.015	0.030
6 W ²	Commercial	125 Hz	0.5 deg/hr ¹	MEMS	0.015	0.015	0.080	0.015	0.015	0.080
4 W ²	Commercial	200 Hz	6.0 deg/hr ¹	MEMS	0.035	0.035	0.150	0.035	0.035	0.150

SPAN PERFORMANCE



1. Values are in-run bias stability figures.

SPAN Inertial Measurement Units (IMUs)

High Performance IMUs



LN200

The low noise, tactical grade LN200 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 is available in the Universal IMU Enclosure (shown) or the SPAN IMU Enclosure.

Universal IMU Enclosure

Dimensions: 168 x 195 x 146 mm

Weight: 4.5 kg

SPAN IMU Enclosure

Dimensions: 135 x 153 x 130 mm

Weight: 3.0 kg



LCI

A tactical grade IMU from Northrop-Grumman Litef GmbH. The low noise and stable biases of the accelerometer and gyro sensors mean the LCI is well suited for ground or airborne survey applications. Manufactured in Germany, the LCI offers LN200 performance.

Dimensions: 168 x 195 x 146 mm

Weight: 4.25 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 available in the Universal IMU Enclosure (shown) or the SPAN HG Enclosure.

Universal IMU Enclosure

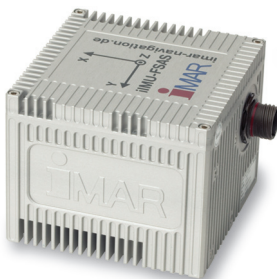
Dimensions: 168 x 195 x 146 mm

Weight: 4.5 kg

SPAN HG Enclosure

Dimensions: 167 x 193 x 100 mm

Weight: 3.4 kg



IMU-FSAS

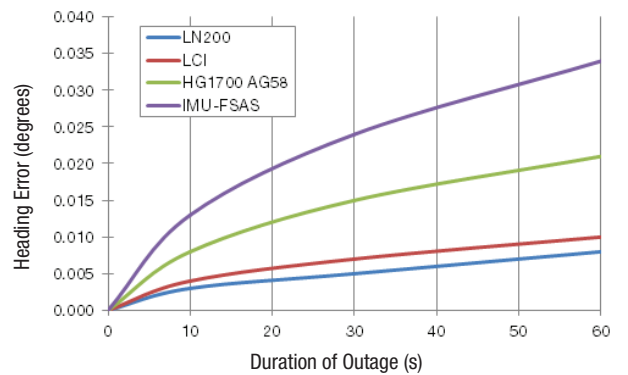
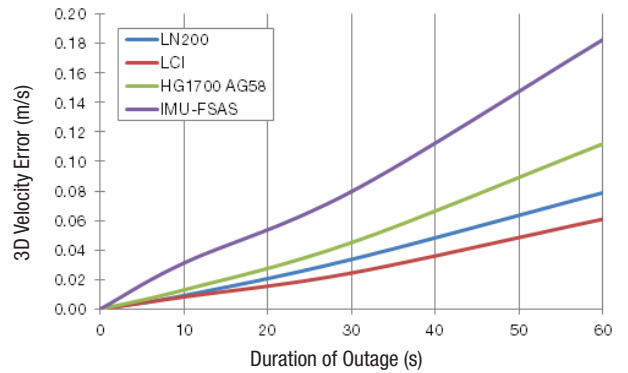
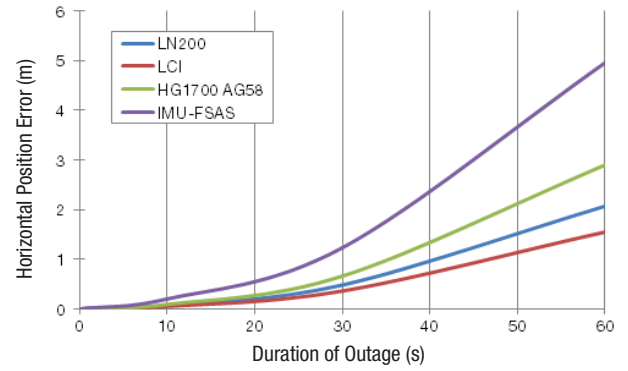
Small, tactical grade IMU consisting of three closed-loop fiber optic gyros and three servo accelerometers. Manufactured in Germany, the IMU-FSAS is a good option for customers looking for a product without International Traffic in Arms Regulations (ITAR) restrictions.

Dimensions: 128 x 128 x 104 mm

Weight: 2.1 kg

IMU SPECS						SPAN SYSTEM ATTITUDE ACCURACY (DEGREES) ¹ RMS					
Power Consumption	Export Control	Data Rate	Gyro Bias	Gyro Technology	Available as OEM	RTK ²			PP ³		
						Roll	Pitch	Heading	Roll	Pitch	Heading
16 W	ITAR	200 Hz	1.0 deg/hr	FOG	+	0.010	0.010	0.020	0.005	0.005	0.008
16 W	Varies	200 Hz	<1.0 deg/hr	FOG		0.007	0.007	0.018	0.005	0.005	0.008
8 W	ITAR	100 Hz	1.0 deg/hr	RLG	+	0.010	0.010	0.021	0.007	0.007	0.010
16 W	Varies	200 Hz	<0.75 deg/hr	FOG		0.008	0.008	0.023	0.008	0.008	0.012

SPAN PERFORMANCE



1. When SPAN is in RTK mode.
2. 0 seconds outage on land vehicle application.
3. RMS, incremental error growth from steady state accuracy. Computed with respect to full GPS, RTK trajectory.

SPAN Inertial Measurement Units (IMUs)

Mid Performance IMUs



OEM-HG1900

The HG1900 is a gyro based MEMS 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 requires a NovAtel MEMS Interface Card (MIC) to integrate with NovAtel GNSS receivers.

Dimensions: 92.7 mm dia max x 79.1 mm h

Weight: <460 g



KVH-1750

The IMU-KVH1750 offers tactical grade performance in a compact and rugged package with minimal power consumption. It contains Fiber Optic gyros (FOG) and MEMS accelerometers.

Dimensions: 88.9 mm dia max x 73.7 mm h

Weight: <700 g



HG1700 AG62

The HG1700 AG62 is a tactical grade IMU from Honeywell containing ring-laser gyros and servo accelerometers. With a Gyro Bias of 5 degrees per hour, the economical HG1700 AG62 offers good performance.

The HG1700 AG62 is available in the Universal IMU Enclosure (shown) or the SPAN HG Enclosure.

Universal IMU Enclosure

Dimensions: 168 x 195 x 146 mm

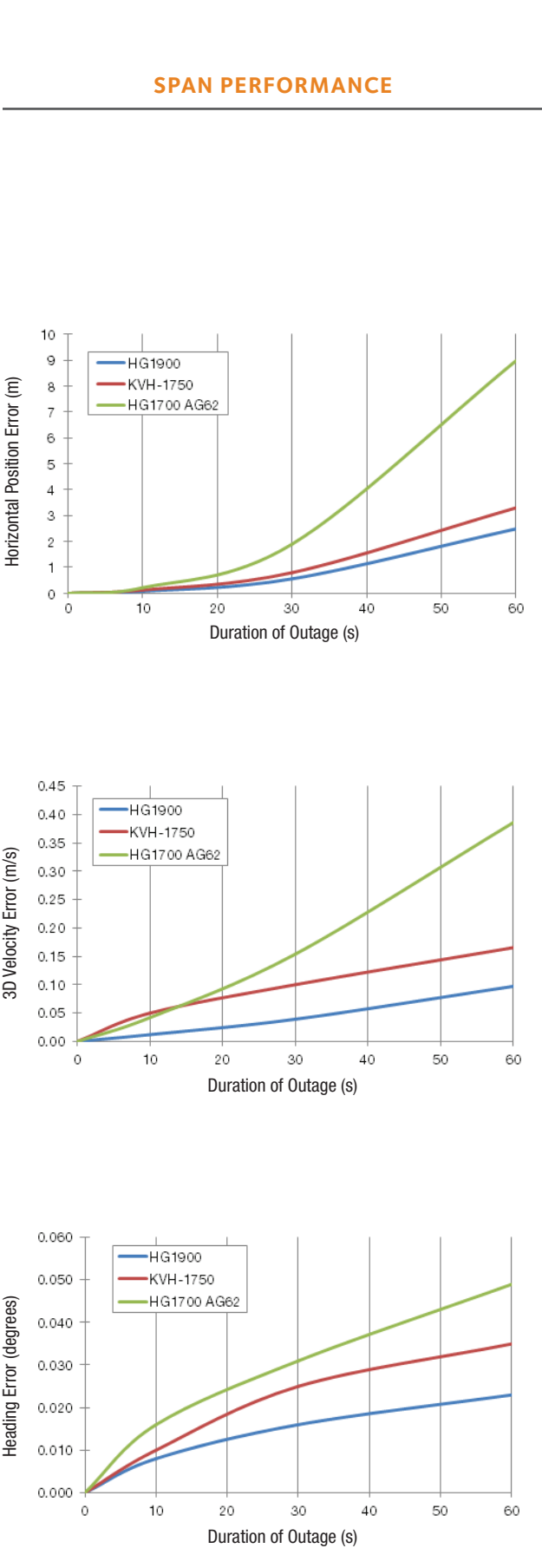
Weight: 4.5 kg

SPAN IMU Enclosure

Dimensions: 167 x 193 x 100 mm

Weight: 3.4 kg

IMU SPECS						SPAN SYSTEM ATTITUDE ACCURACY (DEGREES) ¹ RMS					
Power Consumption	Export Control	Data Rate	Gyro Bias	Gyro Technology	Available as OEM	RTK ²			PP ³		
						Roll	Pitch	Heading	Roll	Pitch	Heading
<3 W	ITAR	100 Hz	5.0 deg/hr	MEMS	+	0.010	0.010	0.030	0.008	0.008	0.020
8 W	Commercial	200 Hz	2.0 deg/hr	FOG		0.015	0.015	0.035	0.015	0.015	0.035
8 W	ITAR	100 Hz	5.0 deg/hr	RLG	+	0.012	0.012	0.035	0.012	0.012	0.030



SPAN Inertial Measurement Units (IMUs)

Entry Level Performance IMUs



IMU-CPT

Stand alone IMU with the same form factor as our SPAN-CPT containing fiber optic gyros and MEMS accelerometers.

Made entirely of commercially available components, the IMU-CPT reduces cross border difficulties when operating in multiple countries.

Dimensions: 152 x 168 x 89 mm **Weight:** 2.29 kg



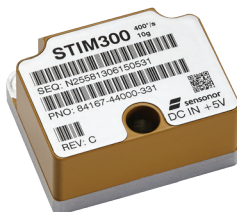
IMU-IGM

Incorporating a MEMS inertial sensor, the IMU-IGM delivers the smallest and lightest IMU enclosure in our SPAN product portfolio. There are two IMU-IGM models available:

IMU-IGM-A1 contains an ADIS-16488 IMU to provide our most cost effective IMU enclosure.

IMU-IGM-S1 contains a STIM300 IMU to deliver our smallest tactical grade IMU enclosure.

Dimensions: 152 x 137 x 51 mm **Weight:** 475 g (A1), 500 g (S1)



OEM-STIM300

MEMS IMU from Sensoror. Features low noise gyros and accelerometers in a small, light weight, environmentally sealed enclosure. It enables precision measurements for applications that require low cost, high performance and rugged durability in a small form factor. When integrated with NovAtel's SPAN technology, this IMU is ideal for airborne and ground applications that require accurate 3D position, velocity and attitude (roll, pitch and azimuth) data.

The OEM-STIM300 requires a NovAtel MEMS Interface Card (MIC) to integrate with NovAtel GNSS receivers.

Dimensions: 39 x 45 x 22 mm **Weight:** 55 g



OEM-HG1930

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

The OEM-HG1930 requires a NovAtel MEMS Interface Card (MIC) to integrate with NovAtel GNSS receivers.

Dimensions: 64.8 mm dia max x 35.7 mm h max **Weight:** 200 g



OEM-ADIS-16488

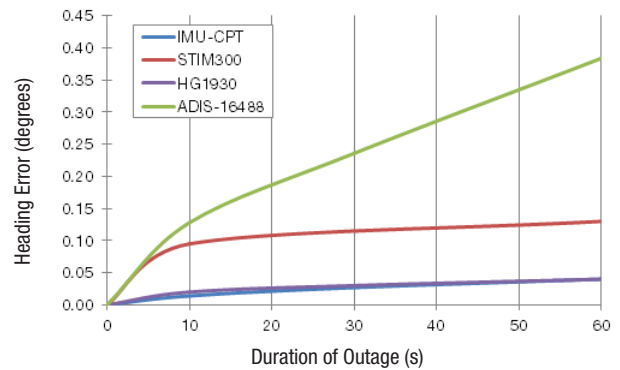
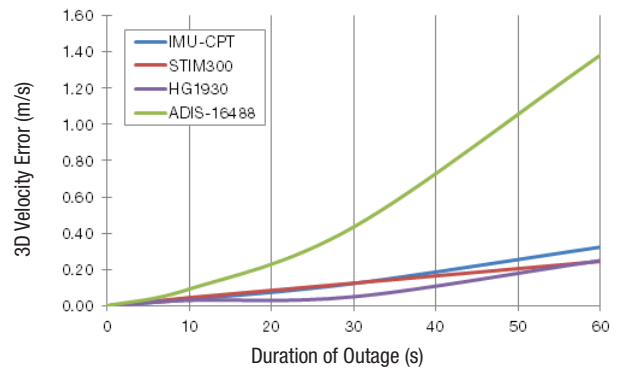
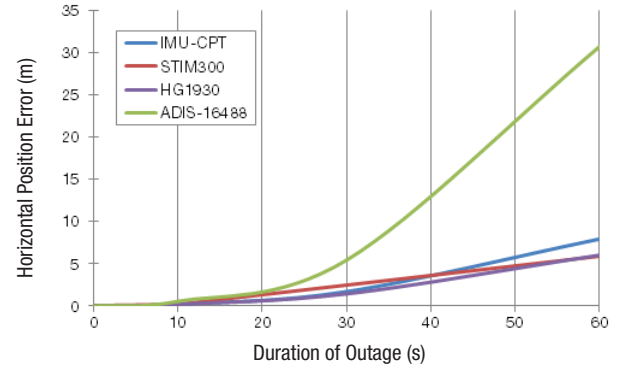
MEMS IMU from Analog Devices. Features low noise gyros and accelerometers in a small, light weight and rugged, environmentally sealed enclosure. Enables precision measurements for applications that require low cost, high performance and rugged durability in a very small form factor.

The OEM-ADIS-16488 requires a NovAtel MEMS Interface Card (MIC) to integrate with NovAtel GNSS receivers.

Dimensions: 47 x 44 x 14 mm **Weight:** 48 g

		IMU SPECS						SPAN SYSTEM ATTITUDE ACCURACY (DEGREES) ¹ RMS					
		Power Consumption	Export Control	Data Rate	Gyro Bias	Gyro Technology	Available as OEM	RTK ²			PP ³		
								Roll	Pitch	Heading	Roll	Pitch	Heading
A1	S1	13 W (max)	Commercial	100 Hz	20.0 deg/hr	FOG		0.020	0.020	0.060	0.015	0.015	0.030
		2.5 W	Commercial	200 Hz	6.0 deg/hr ⁴	MEMS		0.035	0.035	0.150	0.035	0.035	0.150
		<4.6 W	Commercial	125 Hz	0.5 deg/hr ⁴	MEMS		0.015	0.015	0.080	0.015	0.015	0.080
			Commercial	125 Hz	0.5 deg/hr ⁴	MEMS	+	0.015	0.015	0.080	0.015	0.015	0.080
		<3 W	ITAR	100 Hz	20.0 deg/hr	MEMS	+	0.060	0.060	0.100	0.045	0.045	0.090
			Commercial	200 Hz	6.0 deg/hr ⁴	MEMS	+	0.035	0.035	0.150	0.035	0.035	0.150

SPAN PERFORMANCE



- When SPAN is in RTK mode. Based on 0 seconds outage duration.
- 0 seconds outage on land vehicle application.
- RMS, incremental error growth from steady state accuracy. Computed with GPS, RTK trajectory.
- Values are in-run bias stability figures.

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Refer to www.novatel.com for the latest specifications.

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TACTICAL GRADE, LOW NOISE IMU DELIVERS 3D POSITION, VELOCITY AND ATTITUDE SOLUTION AS PART OF SPAN TECHNOLOGY



SPAN: WORLD-LEADING GNSS+INS TECHNOLOGY

Synchronous Position, Attitude and Navigation (SPAN) technology brings together two different but complementary technologies: Global Navigation Satellite System (GNSS) positioning and inertial navigation. The absolute accuracy of GNSS positioning and the stability of Inertial Measurement Unit (IMU) gyro and accelerometer measurements are tightly coupled to provide an exceptional 3D navigation solution that is stable and continuously available, even through periods when satellite signals are blocked.

UIMU-LCI OVERVIEW

The UIMU-LCI is a tactical grade IMU from Northrop-Grumman Litef GMBH. The custom NovAtel mechanical enclosure and software interface of the IMU integrates easily into a NovAtel SPAN enabled GNSS+INS receiver such as the FlexPak6™ or ProPak6™. IMU measurements are sent from the UIMU-LCI to the GNSS+INS receiver where a blended GNSS+INS position, velocity and attitude solution is generated at up to 200 Hz.

ADVANTAGES OF UIMU-LCI

The low noise and stable biases of the accelerometer and gyro sensors mean that the IMU is well suited for ground or airborne survey applications or general positioning and navigation in locations where standard GNSS receivers are not sufficient. The IMU is manufactured in Germany.

IMPROVE SPAN LCI ACCURACY

Take advantage of our Advance® RTK as well as support for other satellite based augmentation systems such as L-Band or SBAS to improve real-time performance and accuracy. For more demanding applications, Inertial Explorer® post-processing software from our Waypoint® Product Group can be used to post-process SPAN LCI data and offers the highest level of accuracy with the system.

BENEFITS

- + Tactical grade IMU performance
- + Easy integration with NovAtel's SPAN capable GNSS+INS receivers

FEATURES

- + Closed-loop fiber optic gyros
- + Micromechanical accelerometers
- + 200 Hz data rate
- + SPAN INS functionality

If you require more information about our SPAN products, visit www.novatel.com/span

UIMU-LCI

SPAN SYSTEM PERFORMANCE¹

Horizontal Position Accuracy (RMS)

Single point L1/L2	1.2 m
SBAS ²	0.6 m
DGPS	0.4 m

NovAtel CORRECT™

» PACE™	0.15m
» TerraStar™ ³	0.1 m
» RT-2®	1 cm + 1 ppm

Data Rate

IMU measurements	200 Hz
INS position	200 Hz
INS velocity	200 Hz
INS attitude	200 Hz

Time accuracy⁴ 20 ns RMS

Max Velocity⁵ 515 m/s

IMU PERFORMANCE

UIMU-LCI

Gyro input range	±800 deg/sec
Gyro rate bias	<1.0 deg/hr
Gyro rate scale factor	100 ppm (typical)
Angular random walk	<0.05 deg/√hr
Accelerometer range ⁶	±40 g
Accelerometer scale factor	250 ppm (typical)
Accelerometer bias	<1.0 mg

PHYSICAL AND ELECTRICAL

Dimensions

168 x 195 x 146 mm

Weight

4.25 kg

Power

Power consumption
16 W (typical)

Input voltage +12 to +28 V

Connectors

MIL-C-38999-III, 22 pin

ENVIRONMENTAL

Temperature

Operating	-40°C to +60°C
Storage	-40°C to +71°C

Humidity 95% non-condensing

Random Vibe

MIL-STD 810F 10 g RMS

Shock MIL-STD 810F 30 g RMS

MTBF >45,000 hrs

Waterproof IEC 60259 IPX7

Dust IEC 60259 IP6X

OPTIONAL ACCESSORIES

- Inertial Explorer post-processing software

For the most recent details of this product:

www.novatel.com/products/span-gnss-inertial-systems/span-imus/uimu-lci/

novatel.com

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PERFORMANCE DURING GNSS OUTAGES^{1,7}

Outage Duration	Positioning Mode	POSITION ERROR (M)		VELOCITY ERROR (M/S)		ATTITUDE ERROR (DEGREES)		
		Horizontal	Vertical	Horizontal	Vertical	Roll	Pitch	Heading
0 s	RTK ⁸	0.020	0.050	0.020	0.010	0.007	0.007	0.018
	SP	1.200	0.600	0.020	0.010	0.007	0.007	0.020
	PP ⁹	0.010	0.015	0.010	0.010	0.005	0.005	0.008
10 s	RTK ⁸	0.070	0.060	0.022	0.010	0.007	0.007	0.018
	SP	1.660	1.170	0.024	0.012	0.008	0.008	0.025
	PP ⁹	0.010	0.020	0.010	0.010	0.005	0.005	0.008
60 s	RTK ⁸	1.670	0.480	0.061	0.015	0.009	0.009	0.021
	SP	2.460	1.330	0.066	0.015	0.009	0.009	0.026
	PP ⁹	0.110	0.030	0.020	0.015	0.006	0.006	0.010

1. Typical values. Performance specifications subject to GPS system characteristics, US DOD operational degradation, ionospheric and tropospheric conditions, satellite geometry, baseline length, multipath effects and the presence of intentional or unintentional interference sources.

2. GPS only.

3. An OEM628, OEM638, FlexPak6 or ProPak6 receiver is required for TERRASTAR.

4. Time accuracy does not include biases due to RF or antenna delay.

5. Export licensing restricts operation to a maximum of 515 metres/second.

6. GNSS receiver sustains tracking up to 4 g.

7. Ground Mobile Operating Environment

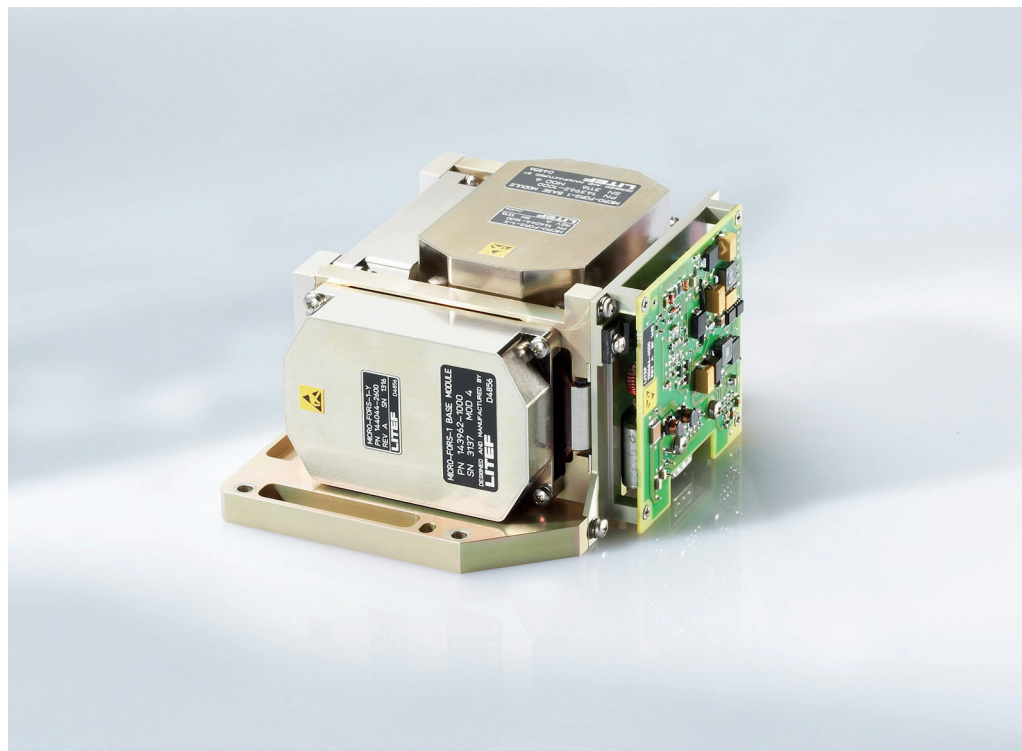
8. 1 ppm should be added to all values to account for additional error due to baseline length.

9. Post-processing results using Inertial Explorer software.



LCI-1

Fiber Optic Inertial Measurement Unit (IMU)



Northrop Grumman LITEF (NG LITEF) is a world leading company with over 45 years of experience in Inertial Systems Technology.

With the LCI-1 NG LITEF provides a flexible 3 gyro/3 accelerometer axis Inertial Measurement Unit for a wide range of applications.

The LCI-1 consists of three μ FORS-1 fiber optic rate sensors, one MEMS B-290 accelerometer triad, one processor module and a power supply.

Its modular design allows an easy customisation to fulfil specific requirements for a wide range of applications.

Features:

- Easy set up for operation
- Output of fully compensated data (e. g. temperature and misalignment)
- Standard digital interface

- Extensive Built-In-Test features
- Ruggedised design
- Low power consumption
- Low life cycle costs
- Designed for long operational life time

Typical Applications:

- Borehole/Pipeline measurement systems
- Platform/Antenna stabilization
- Navigation systems
- Flight Control/Guidance systems

LCI-1**Fiber Optic Inertial Measurement Unit (IMU)****TECHNICAL DATA**

Rate Sensor Parameters		
• Measurement Range	± 800 deg/s	
• Bias (1σ) (Residuals over temperature)	≤ 1°/h	(0.3°/h)*
• Random walk (RMS)	≤ 0.15°/√h	(0.05°/h)*
• Scale Factor Error (1σ)	≤ 500 ppm	(100 ppm)*
• Axis Misalignment (1σ)	≤ 1.0 mrad	
Linear Acceleration Parameters		
• Measurement Range	± 40 g	
• Bias (1σ) (Residuals over temperature)	≤ 1 mg	(0.5 mg)*
• Velocity random walk (Allan Variance)	50 μg/√Hz	(40 μg/√Hz)*
• Scale Factor Error (1σ)	1 000 ppm	(500 ppm)*
• Axis Misalignment (1σ)	1.0 mrad	
System Parameters		
• Mass	1.1 kg 2.4 lb	
• Dimensions	157 x 123 x 75 mm 6.18 x 4.8 x 2.9 inch	
• Volume	1 448 cm³ 86 inch³	
• Supply Voltage	+28 VDC	
• Power Consumption	≤ 15 W, ≤ 10 W nominal	
• Interface	RS 422 HDLC	
• Data Rate	200 Hz	
• Built in Test	Power up BIT Continuous BIT	
• Temperature operating	-40° to +71°C -40° to +160°F	

* typical value, measured at final production acceptance tests

For more information,
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