PRODUCT DATA SHEET

3DM-GX5-GNSS/INS: GNSS-Aided Inertial Navigation System

The MicroStrain 3DM-GX5 family of high-performance, industrial-grade inertial sensors provides a wide range of triaxial inertial measurements, computed attitude, and navigation solutions.

The 3DM-GX5-GNSS/INS all-in-one navigation solution features a high-performance, integrated multi-constellation GNSS receiver utilizing the GPS, GLONASS, BeiDou, and Galileo satellite constellations. Sensor measurements are fully calibrated, temperature-compensated, and mathematically aligned to an orthogonal coordinate system for highly accurate outputs. The auto-adaptive estimation filter algorithm produces highly accurate computed outputs under dynamic conditions.

Automatic Compensation options include magnetic anomalies, gyro and accelerometer noise, and noise effects. The computed outputs include pitch, roll, yaw, heading, position, velocity, and GNSS, making it a complete GNSS/INS (GNSS Aided Inertial Navigation System) solution. MicroEletro-Mechanical System (MEMS) technology provides a highly accurate, small, light-weight device.

SensorConnect software is a user friendly program for device configuration. MIP Monitor (MicroStrain Internet Protocol) can also be used. Both packages provide for device configuration, live data monitoring, and recording. Alternatively, the MIP Data Communications Protocol is available for development of custom interfaces and easy OEM integration.

The sensor operates independent of computer platform, operating system, or coding language.

phone +1 802 862 6629
microstrainsales@hbkworld.com
www.microstrain.com

PRODUCT HIGHLIGHTS

- High-performance integrated multi-constellation GNSS receiver and advanced MEMS sensor technology provide direct inertial measurements, and computed position, velocity, and attitude outputs in a small package
- Triaxal accelerometer, gyroscope, magnetometer, temperature sensors and a pressure altimeter achieve the optimal combination of measurement qualities
- Dual on-board processors run a new Auto-Adaptive Extended Kalman Filter (EKF) for outstanding dynamic position, velocity, and attitude estimates

BEST IN CLASS PERFORMANCE

- Fully calibrated, temperature-compensated, and mathematically-aligned to an orthogonal coordinate system for highly accurate outputs
- High-performance, low-drift gyros with low noise density and Vibrational Rectification Error
- Accelerometer noise as low as 20 ug/√Hz

EASE OF USE

- SensorConnect enables simple device configuration, live data monitoring, and recording
- The MSCL API allows easy integration with C++, Python, .NET, C#, Visual Basic, LabVIEW and MATLAB environments. Robust, forward compatible MIP packet protocol
- MIP open byte level communication protocol
- Automatic magnetometer calibration and anomaly rejection eliminates the need for field calibration
- Automatically compensates for vehicle noise and vibration

COST EFFECTIVE

- Out-of-the-box solution reduces development time
- Volume pricing available

APPLICATIONS

- Unmanned vehicle navigation
- Robotics
- GNSS-aided navigation system
- Platform stabilization, artificial horizon
- Satellite dish, radar, and antenna pointing

MICROSTRAIN 3DM-GX5-GNSS/INS SPECIFICATIONS

General	
Integrated Sensors	Triaxial accelerometer, triaxial gyroscope, triaxial magnetometer, pressure altimeter, temperature sensors and GNSS receiver
Data Outputs	**Inertial Measurement Unit (IMU) outputs:** acceleration, angular rate, magnetic field, ambient pressure, Delta-theta, Delta-velocity **COMPUTED OUTPUTS** **Extended Kalman Filter (EKF):** filter status, GNSS timestamp, LLH position, NED velocity, attitude estimates (in Euler angles, quaternion, orientation matrix), linear and compensated acceleration, bias compensated angular rate, pressure altitude, gyroscope and accelerometer bias, scale factors and uncertainties, gravity and magnetic models, and more. **Complementary Filter (CF):** attitude estimates (in Euler angles, quaternion, orientation matrix) stabilized, north and up vectors, GNSS correlation timestamp **Global Navigation Satellite System outputs (GNSS):** LLH position, ECEF position and velocity, NED velocity, UTC time, GNSS time, SV. GNSS protocol access mode available.

Computed Outputs	
Position accuracy	±2 m RMS horizontal, ± 5 m RMS vertical (typ)
Velocity accuracy	±0.1 m/s RMS (typ)
Attitude accuracy	EKF outputs: ±0.25° RMS roll and pitch, ±0.8° RMS heading (typ) CF outputs: ±0.5° roll, pitch, and heading (static, typ), ±2.0° roll, pitch, and heading (dynamic, typ)
Attitude heading range	360° about all axes
Attitude resolution	< 0.01°
Attitude repeatability	0.02° (typ)
Calculation update rate	500 Hz
Computed data output rate	EKF outputs: up to 500 Hz, CF outputs: up to 500 Hz

Inertial Measurement (IMU) Sensor Outputs			
	Accelerometer	**Gyroscope**	**Magnetometer**
Measurement Range	±8 g (standard) ±2 g, ±4 g, ±20 g, ±40 g (optional)	300°/sec (standard) ±75, ±150, ±900 (optional)	±8 Gauss
Non-linearity	±0.02% fs	±0.02% fs	±0.3% fs
Resolution	0.02 mg (+/- 8g)	<0.003°/sec (300 dps)	--
Bias instability	±0.04 mg	8°/hr	--
Initial bias error	±0.002 g	±0.04°/sec	±0.003 Gauss
Scale factor stability	0.03%	±0.05%	±0.1%
Noise density	20 µg/√Hz (2 g)	0.005°/sec/√Hz (300°/sec)	400 µGauss/√Hz
Alignment error	±0.05°	±0.08°	±0.05°
Bandwidth	225 Hz	250 Hz	--
Offset error over temperature	0.06% (typ)	0.04% (typ)	--
Gain error over temperature	0.03% (typ)	0.03% (typ)	--
Vibration induced noise	--	0.072°/s RMS/g RMS	--
Vibration rectification error (VE)	--	0.001°/s/g^2 RMS	--
Sampling rate	1 kHz	4 kHz	100 Hz
IMU Filtering	Digital sigma-delta ADC sampled at 1kHz and 4kHz. 4kHz data averaged to 1kHz nominal sampling rate. Scaled into physical units at 1kHz. User adjustable IIR filter available for 1kHz data. Coning and sculling integrals computed at 1kHz.		
IMU data output rate	1 Hz to 500 Hz (standard mode) 1 Hz to 1000 Hz (sensor direct mode)		

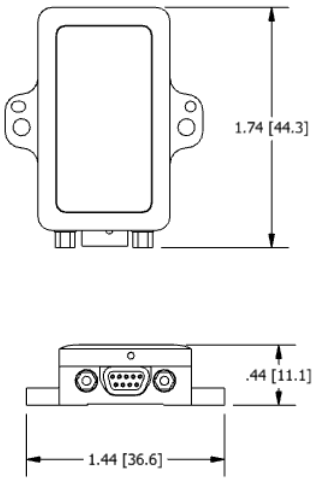
Pressure Altimeter	
Altitude Range	1260-260 mB (hPa) (-500 to 10,000m)
Resolution	0.01 hPa RMS
Relative Accuracy	±0.1 mB, over the range 800-1000mB @ T=25°C
Sampling rate	25 Hz

MICROSTRAIN 3DM-GX5-GNSS/INS SPECIFICATIONS

Operating Parameters	
Communication	USB 2.0 (full speed) RS232 (9,600 bps to 921,600 bps, default 115,200)
Power source	+4 to +36 V dc
Power consumption	700 mW (typ), 800 mW (max)
Operating temperature	-40°C to +85°C
Mechanical shock limit	500g/1ms absolute maximum survivability.*
MTBF	396,193 hours (Telcordia method, GM/35C)
Physical Specifications	
Dimensions	44.2 mm x 36.6 mm x 11.1 mm
Weight	20 grams
Enclosure material	Aluminum
Regulatory compliance	CE, REACH, RoHS
Intregration	
Connectors	Data/power: Micro-D9. GNSS antenna: MMCX type
Software	SensorConnect and MIP Monitor software included; Windows XP/Vista/7/8/10 compatible
Data Communications Protocol (DCP)	Protocol compatibility across GX3, GX4, RQ1, GQ4, GX5, CX5 and CV5 product families
Software development kit (SDK)	MicroStrain Communication Library (MSCL) open source license includes full documentation and sample code.

*Prolonged exposure to >2x full scale range can result in permanent damage. See manual for details

Global Navigation Satellite System (GNSS) Outputs	
Receiver Type	72-channel GPS/QZSS L1 C/A, GLONASS L10F, BeiDou B1, SBAS L1 C/A:WAAS, EGNOS, MSAS Galileo E1B/C
GNSS data output rate	1 Hz to 4 Hz
Time-to-first-fix	Cold start: 27 second, reacquisition: 1 second Hot start: <1 second
Sensitivity	Tracking: -164 dBm, cold start: -147 dBm Hot start: - 156 dBm
Velocity accuracy	0.1 m/sec
Heading accuracy	0.5°
Horizontal position accuracy	GNSS: 2.5 m CEP SBAS: 2.0 m CEP
Time pulse signal accuracy	30 nsec RMS < 60 nsec 99%
Acceleration limit	≤ 4 g
Attitude limit	50,000 meters
Velocity limit	500 m /sec (972 knots)



MicroStrain by HBK
459 Hurricane Lane
Williston, VT 05495 - USA

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