

# MicroStrain Sensing Product Datasheet

## 3DM-GX5-GNSS/AHRS

### Attitude and Heading Reference System with GNSS



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

In all models, the Inertial Measurement Unit (IMU) includes direct measurement of acceleration and angular rate, and is fully temperature-compensated and calibrated over the operating temperature. The use of Micro-Electro-Mechanical System (MEMS) technology allows for highly accurate, small, lightweight devices.

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.

#### PRODUCT HIGHLIGHTS

- High-performance integrated multi-constellation GNSS receiver and advanced MEMS sensor technology provide direct inertial measurements, and computed attitude and heading outputs in a small package
- Triaxial accelerometer, gyroscope, magnetometer, temperature sensors, and a pressure altimeter achieve the optimal combination of measurement qualities
- Economical combination of AHRS and GNSS outputs for use in customer supplied Kalman Filters

#### FEATURES AND BENEFITS

##### 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 Vibration Rectification Error
- Accelerometer noise as low as 20  $\mu\text{g}/\sqrt{\text{Hz}}$

##### EASE OF USE

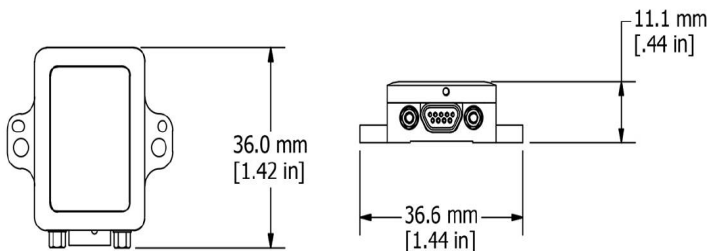
- SensorConnect enables simple device configuration, live data monitoring, and recording
- The MSCL API allows easy integration with C++, Python, .NET, C#, Visual Basic, LabVIEW and MATLAB environments. Robust, forward compatible MIP packet protocol
- MIP open byte level communication protocol

##### COST EFFECTIVE

- Out-of-the box solution reduces development time
- Volume discounts

#### APPLICATIONS

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



ENGINEERING YOUR SUCCESS.

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# Attitude and Heading Reference System (AHRS) with GNSS

## Specifications

General			
Integrated Sensors	Triaxial accelerometer, triaxial gyroscope, triaxial magnetometer, pressure altimeter, temperature sensors, and GNSS receiver		
Data Outputs	<b>Inertial Measurement Unit (IMU) outputs:</b> acceleration, angular rate, magnetic field, ambient pressure, Delta-theta, Delta-velocity		
	<b>COMPUTED OUTPUTS</b>		
	<b>Complementary Filter (CF):</b> attitude estimates (in Euler angles, quaternion, orientation matrix) stabilized, north and up vectors, GNSS correlation timestamp		
<b>Global Navigation Satellite System outputs (GNSS):</b> LLH position, ECEF position and velocity, NED velocity, UTC time, GNSS time, SV. GNSS protocol access mode available.			
Inertial Measurement Unit (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 (+/- 8 g)	<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 (VRE)	--	0.001°/s/g² RMS	--
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.		
Sampling rate	1 kHz	4 kHz	100 Hz
IMU data output rate	1 Hz to 1 kHz		
Pressure Sensor			
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		

Computed Outputs	
Attitude accuracy	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	0.2° (typ)
Calculation update rate	500 Hz
Computed data output rate	CF outputs: 1 Hz to 500 Hz
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
Altitude limit	50,000 meters
Velocity limit	500 m /sec (972 knots)
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
Integration	
Connectors	Data/power: 9 pin Micro-D. 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
(API) Application Programming Interface	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



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