

# MicroStrain Sensing Product Datasheet

## 3DM-GX5-AHRS

### Attitude and Heading Reference System



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

- Triaxial accelerometer, gyroscope, magnetometer, temperature sensors achieve the optimal combination of measurement qualities
- Dual on-board processors run a new Auto-Adaptive Extended Kalman Filter (EKF) for outstanding dynamic attitude estimates

#### FEATURES AND BENEFITS

##### BEST IN CLASS PERFORMANCE

- Bias tracking, error estimation, threshold flags, and adaptive noise modeling allow for fine tuning to conditions in each application
- Accelerometer noise as low as  $20 \mu\text{g}/\sqrt{\text{Hz}}$
- Smallest and lightest industrial AHRS with Adaptive Kalman Filter available

##### EASE OF USE

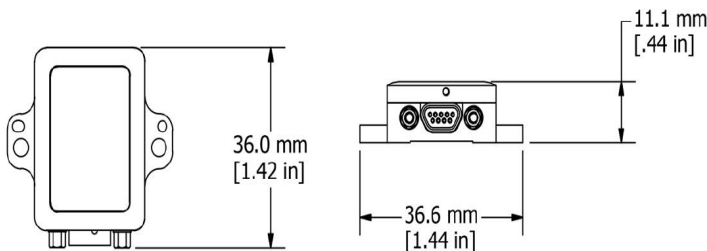
- SensorConnect enables simple device configuration, live data monitoring, and recording
- The MSCL API allows easy integration with C++, Python, .NET, C#, Visual Basic, LabVIEW and MATLAB environments. Robust, forward compatible MIP packet protocol
- MIP open byte level communication protocol
- Automatic magnetometer calibration and anomaly rejection eliminates the need for field calibration
- Automatically compensates for vehicle noise and vibration
- Common protocol between 3DM-GX3, GX4, RQ1, GQ4, and GX5 inertial sensor families for easy migration

##### COST EFFECTIVE

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

##### APPLICATIONS

- Unmanned vehicle navigation
- Robotics
- Platform stabilization, artificial horizon
- Health and usage monitoring of vehicles



# Attitude and Heading Reference System (AHRS)

## Specifications

General				Computed Outputs	
Integrated Sensors	Triaxial accelerometer, triaxial gyroscope, triaxial magnetometer, pressure altimeter, and temperature sensors				
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>Extended Kalman Filter (EKF):</b> filter status, timestamp, attitude estimates (in Euler angles, quaternion,orientation matrix), linear and compensated acceleration, bias compensated angular rate, pressure altitude, gravity-free linear acceleration, gyroscope and accelerometer bias, scale factors and uncertainties, gravity and magnetic models, and more.  <b>Complementary Filter (CF):</b> attitude estimates (in Euler angles, quaternion, orientation matrix) stabilized, north and up vectors, GPS correlation timestamp				
	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 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				

Attitude accuracy	EKF outputs: ±0.25° RMS roll and pitch, ±0.8° RMS heading (typ) CF outputs: ±0.5° RMS roll and pitch, ±1.5° RMS heading (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	EKF outputs: 1 Hz to 500 Hz CF outputs: 1 Hz to 1000 Hz
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	500 mW (typ)
Operating temperature	-40°C to +85°C
Mechanical shock limit	500g/1ms absolute maximum survivability.*
MTBF	557,280 hours (Telcordia method, GM/35C)
Physical Specifications	
Dimensions	36.0 mm x 36.6 mm x 11.1mm
Weight	16.5 grams
Enclosure material	Aluminum
Regulatory compliance	CE, REACH, ROHS
Integration	
Connectors	Data/power: Micro-D9
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