MicroStrain Sensing Product Datasheet

3DM-RQ1-GPS/INS

Ruggedized Tactical Grade GPS-Aided Inertial Navigation System

The LORD MicroStrain® family of industrial and tactical grade inertial sensors provides a wide range of triaxial inertial measurements and computed attitude and navigation solutions.

In all models, the Inertial Measurement Unit (IMU) includes direct measurement of acceleration, angular rate, and atmospheric pressure. Sensor measurements are managed by an on-board processor running a sophisticated estimation filter or fusion algorithm. This produces high accuracy computed outputs and offers compensation options for magnetic and linear acceleration anomalies, sensor biases, auto-zero update, and noise offsets.

The computed outputs vary between models and can include pitch, roll, yaw, a complete attitude, heading, and reference solution (AHRS) or a complete position, velocity and attitude solution (PVA), as well as integrated GNSS outputs. All sensors are fully temperature compensated and calibrated over the operating temperature. The use of Micro-Electro-Mechanical System (MEMS) technology allows for highly accurate and small, lightweight devices.

The LORD MicroStrain **MIP™ Monitor** software can be used 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.

PRODUCT HIGHLIGHTS

- High performance integrated GPS receiver and MEMS sensor technology provide direct satellite and inertial measurements, and computed position, velocity, and attitude outputs in a small package
- Triaxial accelerometer, gyroscope, magnetometer, and temperature sensors, and a pressure altimeter achieve the best combination of measurement qualities
- Dual on-board processors run a sophisticated Extended Kalman Filter (EKF) for excellent PVA estimates
- Ruggedized enclosure designed to meet DO-160G for deployment in harsh environments

FEATURES AND BENEFITS

BEST IN CLASS PERFORMANCE

- Fully calibrated, temperature-compensated, and mathematically-aligned to an orthogonal coordinate system for highly accurate outputs
- Bias tracking, error estimation, threshold flags, and adaptive noise, magnetic, and gravitational field modeling allow for fine tuning to conditions in each application
- Compact, low profile, and lightweight

EASE OF USE

- Easy integration via comprehensive and fully backwards-compatible communication protocol
- 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

- GPS-aided navigation system
- Unmanned vehicle navigation
- Satellite dish, radar, and antenna pointing
- Health and usage monitoring of vehicles

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Ruggedized Tactical Grade GPS-Aided Inertial Navigation System (GPS/INS)

Specifications

GENERAL	
Integrated Sensors	Triaxial accelerometer, triaxial gyroscope, triaxial magnetometer*, temperature sensors, and GPS receiver
Data Outputs	**Inertial Measurement Unit (IMU) outputs** Acceleration, angular rate, magnetic field *, ambient pressure, deltaTheta, deltaVelocity **Computed outputs** **Extended Kalman Filter (EKF)** LLH position, NED velocity, attitude estimates (in Euler angles, quaternion, orientation matrix), bias compensated angular rate, pressure altitude, gravity-free linear acceleration, gyroscope and accelerometer bias, scale factors and uncertainties, gravity and magnetic models, and more. **Global Positioning System outputs (GPS)** LLH position, ECEF position and velocity, NED velocity, UTC time, GPS time, SV. GPS protocol access mode available.

Inertial Measurement Unit (IMU) Sensor Outputs			
	Accelerometer	Gyroscope	Magnetometer*
Measurement range	±5 *g*	300°/sec (standard) ±75, ±150, ±900 °/sec (options)	±2.5 Gauss
Non-linearity	±0.03 % fs	±0.03 % fs	±0.4% fs
Resolution	<0.04 m*g*	<0.0025°/sec	--
Bias instability	±0.02 m*g*	5°/hr	--
Initial bias Error	±0.001 *g*	±0.05°/sec	±0.003 Gauss
Scale factor Stability	±0.05 %	±0.05 %	±0.1%
Noise density	50 µg/√Hz	0.002°/sec/√Hz	100 µGauss/√Hz
Alignment Error	±0.05°	±0.05°	±0.05°
Adjustable Bandwidth	250 Hz (max)	160 Hz (max)	--
Vibration induced noise	--	0.06°/s RMS/*g* RMS	--
Vibration rectification error (VRE)	0.025%	0.001°/s/g^2 RMS	--
IMU filtering	4 stage filtering: analog bandwidth filter to digital sigma-delta wide band anti-aliasing filter to (user adjustable), low pass filter; coning and sculling integrals computed at 1 kHz		
Sampling rate	10 kHz	10 kHz	50 Hz
IMU data output rate	1 Hz to 500 Hz		

Computed Outputs	
Position accuracy	±2.5 m RMS horizontal, ± 5 m RMS vertical (typ)
Velocity accuracy	±0.1 m/s RMS (typ)
Attitude accuracy	±0.1° RMS roll & pitch, ±0.5° RMS heading (typical)
Attitude heading range	360° about all axes
Attitude resolution	< 0.01°
Attitude repeatability	0.1° (typ)
Calculation update rate	500 Hz
Computed data output rate	1 Hz to 500 Hz

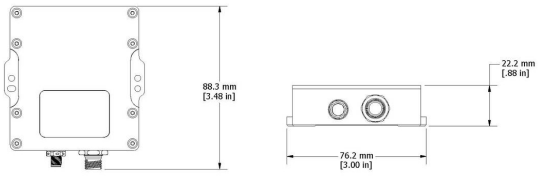
Global Positioning System (GPS) Outputs	
Receiver type	50-channel u-Blox 6 engine GPS, L1 frequency C/A code SBAS: WAAS, EGNOS, MSAS
GPS data output rate	1 Hz to 4 Hz
Time-to-first-fix	Cold start: 36 second, aided start: 36 second, hot start: <1 second
Sensitivity	Tracking: -159 dBm, cold start: -147 dBm hot start: -156 dBm
Velocity accuracy	0.1 m/sec
Heading accuracy	0.5°
Horizontal position accuracy	GPS: 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	No limit
Velocity limit	500 m/sec (972 knots)

Operating Parameters	
Communication	RS422 (9600 bps to 460,800 bps, default 115,200)
Power source	+ 10 to + 28 V dc
Power consumption	Standard model: 2.5 W (typ) Low temperature model: 2.5 W (typ) at 0°C to +80°C, up to 6 W continuous and 25 W occasional at -55°C to 0°C (for internal heater)
Operating temperature	-40°C to +80°C (-55°C to +80°C low temperature model available*)
Vibration limit	6 *g* RMS, 10 Hz to 2 kHz
Mechanical shock limit	750 *g* (half-sine, 2 msec powered, any axis)**
MTBF	180,000 hours (Telcordia method I, AC/30C)

Physical Specifications	
Dimensions	88.3 mm x 76.2 mm x 22.2 mm
Weight	205 grams
Environmental rating	DO-160G
Enclosure material	Aluminum

Integration	
Connectors	Data/power output: 7 pin circular Glenair series 801 GPS antenna: SMA type
Software	MIP™ Monitor, MIP™ Hard and Soft Iron Calibration, Windows XP/Vista/7/8 compatible
Compatibility	Protocol compatibility across 3DM-GX3, GX4, RQ1, GQ1, and GX5 product families
(SDK) Software development kit	MIP™ data communications protocol with sample code available (OS and platform independent)

* Magnetometers are not available with the 3DM-RQ1° low temperature option
** Prolonged exposure to >2x full scale range can result in permanent damage. See manual for details



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