

## 3DM-GQ4™-45

### Tactical Grade GNSS-Aided Inertial Navigation System (GNSS/INS)



3DM-GQ4™-45-compact, tactical-grade, all-in-one navigation solution with integrated GNSS and magnetometers, high noise immunity, and exceptional performance

The **LORD Sensing** 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 processed through an on-board processor running a sophisticated estimation filter or fusion algorithm to produce high accuracy computed outputs with 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 and heading 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, small, lightweight devices.

The LORD Sensing **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 multi-constellation GNSS receiver and advanced MEMS sensor technology provide direct satellite and inertial measurements, and computed position, velocity, and attitude outputs in a small package
- Triaxial accelerometer, gyroscope, magnetometer, temperature sensors, and a pressure altimeter achieve the optimal combination of measurement qualities
- Dual on-board processors run a sophisticated Extended Kalman Filter (EKF) for excellent PVA estimates
- Improved position outputs with concurrent tracking of up to two GNSS constellations (GPS/QZSS, GLONASS, BeiDou)

### 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
- High-performance, low-drift gyros with noise density of  $0.002^\circ/\text{sec}/\sqrt{\text{Hz}}$  and VRE of  $0.001^\circ/\text{s}/g^2\text{RMS}$

#### **Ease of Use**

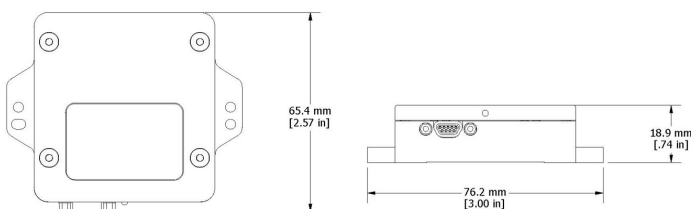
- User-defined sensor-to-vehicle frame transformation
- Easy integration via comprehensive and fully backwards-compatible communication protocol
- Common protocol between 3DM-GX3, GX4, RQ1, GQ4, and GX5 inertial sensor families for easy migration

#### **Cost Effective**

- Out-of-the box solution reduces development time

### Applications

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



**Best in Class Inertial Measurement**

## Specifications

General			
<b>Integrated sensors</b>	Triaxial accelerometer, triaxial gyroscope, triaxial magnetometer, pressure altimeter, temperature sensors and GNSS receiver		
<b>Data outputs</b>	<p><b>Inertial Measurement Unit (IMU) outputs:</b> acceleration, angular rate, ambient pressure, deltaTheta, deltaVelocity</p> <p><b>Computed outputs:</b>  <b>Extended Kalman Filter (EKF):</b> filter status, GNSS timestamp, LLH position, NED velocity, , 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 gravity vectors, GNSS correlation timestamp</p> <p><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.</p>		
Inertial Measurement Unit (IMU) Sensor Outputs			
	Accelerometer	Gyroscope	Magnetometer
<b>Measurement range</b>	±5 g	300°/sec (standard) ±75, ±150, ±900 (optional)	±2.5 Gauss
<b>Non-linearity</b>	±0.03 fs	±0.03% fs	±0.4% fs
<b>Resolution</b>	<0.04 mg	<0.0025°/sec	--
<b>Bias instability</b>	±0.02 mg	5°/hr	--
<b>Initial bias error</b>	±0.001± g	±0.05°/sec	±0.003 Gauss
<b>Scale factor stability</b>	±0.05±%	±0.05%	±0.1%
<b>Noise density</b>	50 µg/√Hz	0.002°/sec/√Hz	100 µGauss/√Hz
<b>Alignment error</b>	±0.05°	±0.05°	±0.05°
<b>Adjustable bandwidth</b>	250 Hz (max)	160 Hz (max)	-
<b>Vibration induced noise</b>	--	0.06°/s RMS/g RMS	--
<b>Vibration rectification error (VRE)</b>	0.03%	0.001°/s/g <sup>2</sup> RMS	--
<b>IMU filtering</b>	4 stage filtering: analog bandwidth filter to digital sigma-delta wide band anti-aliasing filter to (user adjustable) digital averaging filter sampled at 8 kHz and scaled into physical units; coning and sculling integrals computed at 1 kHz		
<b>Sampling rate</b>	10 kHz	10 kHz	50 Hz
<b>IMU data output rate</b>	1 Hz to 500 Hz		
Pressure Altimeter			
<b>Range</b>	-1800 m to 10,000 m		
<b>Resolution</b>	< 0.1 m		
<b>Noise density</b>	0.01 hPa RMS		
<b>Sampling rate</b>	25 Hz		

Computed Outputs	
<b>Position accuracy</b>	±2.5 m RMS horizontal, ±5 m RMS vertical (typ)
<b>Velocity accuracy</b>	±0.1 m/s RMS (typ)
<b>Attitude accuracy</b>	±0.1° RMS roll and pitch, ±0.5° RMS heading (typical)
<b>Attitude heading range</b>	360° about all axes
<b>Attitude resolution</b>	< 0.01°
<b>repeatability</b>	0.1° (typ)
<b>Calculation update rate</b>	500 Hz
<b>Computed data output rate</b>	1 Hz to 500 Hz
Global Navigation Satellite System (GNSS) Outputs	
<b>Receiver type</b>	72-channel GPS/QZSS L1 C/A, GLONASS L10F, BeiDou B1, SBAS L1 C/A:WAAS, EGNOS, MSAS Galileo E1B/C
<b>GNSS data output rate</b>	1 Hz to 4 Hz
<b>Time-to-first-fix</b>	Cold start: 27 second, reacquisition: 1 second, hot start: <1 second
<b>Sensitivity</b>	Tracking: -164 dBm, cold start: -147 dBm, hot start: -156 dBm
<b>Velocity accuracy</b>	0.1 m/sec
<b>Heading accuracy</b>	0.5°
<b>Horizontal position accuracy</b>	GNSS: 2.5 m CEP (autonomous) SBAS: 2.0 m CEP (stationary, 24 hours, SEP 3.5 m)
<b>Time pulse signal accuracy</b>	30 nsec RMS < 60 nsec 99%
<b>Acceleration limit</b>	≤ 4 g
<b>Altitude limit</b>	No limit
<b>Velocity limit</b>	500 m /sec (972 knots)
Operating Parameters	
<b>Communication</b>	USB 2.0 (full speed) RS232 (9,600 bps to 921,600 bps, default 115,200)
<b>Power source</b>	+ 4.2 to + 28 V dc
<b>Power consumption</b>	2.5 W (typ)
<b>Operating temperature</b>	-40 °C to +85 °C
<b>Vibration limit</b>	6 g RMS, 10 Hz to 2 kHz
<b>Mechanical shock limit</b>	750 g (half-sine, 2 msec powered, any axis)
Physical Specifications	
<b>Dimensions</b>	76.2 mm x 65.4 mm x 18.9 mm
<b>Weight</b>	105 grams
<b>Enclosure material</b>	Aluminum
<b>Regulatory compliance</b>	ROHS, CE, FCC Class B
Integration	
<b>Connectors</b>	Data/power output: micro-DB9 GNSS antenna: MMCX type
<b>Software</b>	MIP Monitor, MIP Hard and Soft Iron Calibration, Windows XP/Vista/7/8/10 compatible
<b>Compatibility</b>	Protocol compatibility across 3DM-GX3, GX4, RQ1, GQ4, and GX5 product families
<b>Software development kit (SDK)</b>	MIP data communications protocol with sample code available (OS and platform independent)

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