

3DM-GX4-45™

GPS Aided Inertial Navigation System (GPS/INS)

The **3DM-GX4-45™** is a miniature, industrial-grade GPS Aided Inertial Navigation System (GPS/INS), utilizing the highest performance MEMS sensor technology. It combines a triaxial accelerometer, triaxial gyro, triaxial magnetometer, temperature sensors, pressure altimeter, and dual on-board processors running a sophisticated Extended Kalman Filter (EKF) to provide excellent position, velocity, and attitude estimates. Its form factor, temperature range, shock survivability, bias stability, vibration performance, low power and cost combine to make it the best performing INS/GPS in its class.

Features & Benefits

Best in Class

- high performance gyros
 - noise density: 0.005°/sec/√Hz
 - drift: 10°/hr in-run bias stability
 - g^2 sensitivity: 0.003°/s/ g^2 rms
- dedicated estimation processor for precise position, velocity, & attitude estimations
- high-speed sample rate & flexible data outputs
- -40 °C to +85 °C ambient temperature range operation
- high performance under vibration
- high sensitivity GPS receiver

Easiest to Use

- smallest, lightest industrial GPS/INS available
- simple integration supported by SDK and comprehensive **MIP™** API

Cost Effective

- reduced cost and rapid time to market for customer's applications
- aggressive volume discount schedule
- drop-in protocol compatibility with **3DM-GX3®**, **3DM-RQ1™** families

Applications

Accurate navigation and orientation under dynamic conditions in applications such as:

- GPS-aided navigation system
- camera stabilization
- satellite, radar, and antenna pointing
- platform stabilization, artificial horizon
- unmanned vehicle navigation
- reconnaissance, surveillance, and target acquisition
- robotic control

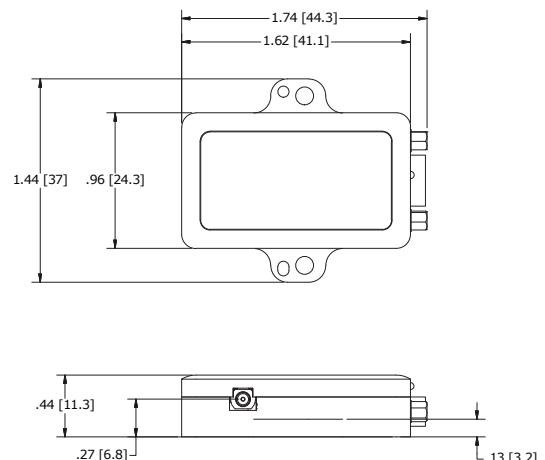


System Overview

The 3DM-GX4-45™ offers a range of fully calibrated AHRS measurements including acceleration, angular rate, magnetic field, deltaTheta and deltaVelocity vectors. GPS measurements include LLH position, ECEF position and velocity, NED velocity, UTC time, GPS time, and SVI. Navigational data quantities from the Estimation Filter include GPS time, LLH position, NED velocity, quaternion, orientation matrix, Euler angles, gyro and accel bias, PVA uncertainties, linear acceleration, WGS84 gravity, pressure altitude and more. Bias tracking and sensor noise model options allow for fine tuning your application. All quantities are fully temperature compensated and are mathematically aligned to an orthogonal coordinate system.

The 3DM-GX4-45™ architecture has been designed to substantially eliminate common sources of error such as gain and offset errors induced by temperature changes and sensitivity to vibration. Gyro drift is extremely low and through a variety of estimation techniques it can approach near-tactical performance in many applications.

Thanks to MIP™ data communications protocol, all **3DM-GX4™** are drop-in compatible with the 3DM-GX3® family of inertial sensors. The starter kit consists of the 3DM-GX4-45™ module, RS-232 or USB communication and power cable, GPS antenna, software, user manual, and quick start guide.



3DM-GX4-45™ GPS Aided Inertial Navigation System (GPS/INS)

Specifications

Navigation

Typical position accuracy	±2.5 m RMS horizontal, ± 5m RMS vertical
Typical velocity accuracy	±0.1 m/s RMS
Typical attitude accuracy	±0.25 deg RMS roll & pitch ±0.8 deg RMS heading
Typical attitude repeatability	0.3°
Attitude resolution	<0.01°
Attitude heading range	360° about all 3 axes
Accelerometer range	±5g standard (±16g option)
Gyroscope range	±300°/sec standard; options: ±75°/sec, ±150°/sec, ±900°/sec
Features	extended Kalman filter with gyro and accel bias tracking magnetometer hard and soft Iron compensation tracking vehicle dynamics mode selection adaptive measurement noise enable/disable user-defined sensor to vehicle frame transformation selectable internal or external heading sources full world magnetic model WGS84 gravity model
Estimation filter update rate	500 Hz
Data output rate	1 Hz to 500 Hz

General

Interface	USB 2.0 and RS232
Baud rate	USB: Full Speed RS232: 9,600 bps to 921,600 bps (115,200 bps default)
Power supply voltage	+3.2 to +36 volts DC
Power consumption	at full performance: 170 mA typ (200 mA max) when powered by Vpri (3.2V-5.5V); 750 mW typ (900 mW max) when powered by Vaux (5.2V-36V)
Connector	micro-DB9
Operating temperature	-40 °C to +85 °C ambient
Mechanical shock	500 g (calibration unaffected) 1000 g (bias may change) 5000 g (unpowered survivability)
MTBF	180,000 hours (Telcordia method I, GL/35C) 67,000 hours (Telcordia method I, GM/35C)
Dimensions	44.0 mm x 24.0 mm x 11.3 mm - excluding mounting tabs, width across tabs 37 mm
Weight	20 grams
Standards	ROHS Compliant, CE, MIL 461
Shock limit	500 g
Software utility	Included in starter kit (XP/Vista/Win7/Win8 compatible)
Software development kit (SDK)	includes complete data communications protocol manual and sample code (OS and platform independent)
API	MIP™ Packet Protocol
Compatibility	Drop-in protocol compatibility with 3DM-GX3®-45, 3DM-RQ1-45†
IMU Filtering	4 stage filtering: Analog bandwidth limiting filter followed by digital sigma-delta wide band anti-aliasing filter followed by digital averaging filter (user adjustable) sampled at 4 kHz, and scaled into physical units; coning and sculling integrals computed at 1 kHz
Data Outputs	AHRS: acceleration, angular rate, magnetic field, pressure, delta Theta, delta Velocity GPS: LLH position, ECEF position and velocity, NED velocity, UTC time, GPS time, SVI Estimation filter: GPS time, LLH position, NED velocity, quaternion, orientation matrix, Euler angles, gyro and accel bias, PVA uncertainties, linear acceleration, WGS84 gravity, pressure altitude and more.

Sensors

	Accels	Gyros	Mags	Pressure
Measurement range (standard)	±5 g	±300°/sec	±2.5 Gauss	-1800 to 10,000m
Non-linearity	±0.03 % fs	±0.03 % fs	±0.4 % fs	
In-run bias stability	±0.04 mg	10°/hr	—	
Initial bias error	±0.002 g	±0.05°/sec	±0.003 Gauss	
Scale factor stability	±0.05 %	±0.05 %	±0.1 %	
Noise density	100 µg/√Hz	0.005°/sec/√Hz	100 µGauss/√Hz	0.15m RMS
Alignment error	±0.05°	±0.05°	±0.05°	n.a.
User adjustable bandwidth	225 Hz max	250 Hz max	n.a.	n.a.
Sampling rate	4 kHz	4 kHz	50 Hz	10Hz
Resolution	<0.1mg	<0.008°/sec		<0.1m
Offset error over temperature (Hysteresis)	0.06% typical	0.05% typical		
Gain error over temperature (Hysteresis)	0.05% typical	0.05% typical		
Scale Factor non-linearity (25°C)	0.02% typical 0.06% max	0.02% typical 0.06% max	±0.0015 Gauss typical	
Vibration Induced Noise	—	0.072°/srms/ g²rms	—	—
Vibration Rectification		0.003°/s/ g²rms	—	—

Options

Accelerometer range	±5 g, ±16 g
Gyroscope range	±75°/sec, ±150°/sec, 300°/sec, ±900°/sec

GPS

GPS receiver type	50-channel u-blox 6 engine GPS L1 C/A code SBAS: WAAS, EGNOS, MSAS
Data output rate	Up to 4 Hz
Time-to-First-Fix	Cold starts: 27 sec Aided starts: 4 sec Hot starts: 1 sec
Sensitivity	Tracking: -159 dBm Cold starts: -147 dBm Hot starts: -159 dBm
GPS velocity accuracy	0.1 m/sec
GPS heading accuracy	0.5°
GPS horizontal position accuracy	GPS: 2.5 m CEP SBAS: 2.0 m CEP
GPS time pulse signal accuracy	30 nsec RMS < 60 nsec 99%
GPS acceleration limit	≤ 4 g
GPS altitude limit	no limit
GPS velocity limit	500 m/sec (972 knots)
GPS antenna connector	MMCX type

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