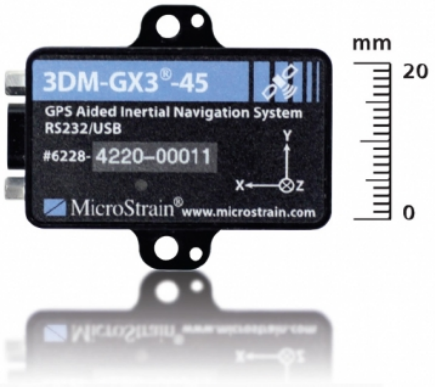
# 3DM-GX3® -45

Data Sheet

## Miniature GPS-Aided Inertial Navigation System (GPS/INS)




## Introduction

The **3DM-GX3®** -45 high-performance, miniature GPS-Aided Inertial Navigation System (GPS/INS) combines MEMS inertial sensors, a highly-sensitive embedded GPS receiver, and a complex Extended Kalman Filter to generate optimal position, velocity, and attitude (PVA) estimates. This combination of technologies creates better short-term GPS-out performance, sustained-G attitude performance, and provides higher rate PVA data than typical GPS and AHRS sensors. Raw GPS data, IMU data, and filtered INS data are time-aligned and available as user-defined packets (either by polling or continuous stream).

## Features & Benefits

**Best in Class**

- precise position, velocity and attitude estimations
- high-speed sample rate & flexible data outputs
- high performance under vibration and high-g

**Easiest to Use**

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

**Cost Effective**

- reduced cost and rapid time to market for customer's applications
- aggressive volume discount schedule

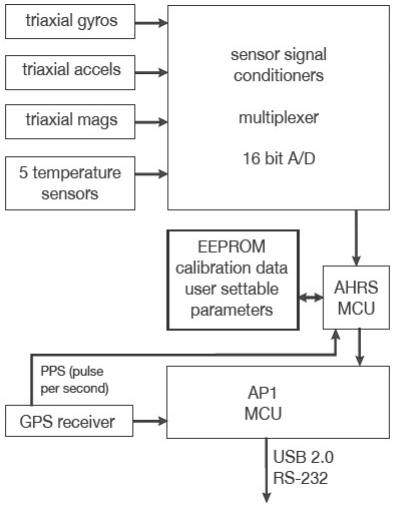
## System Overview

The **3DM-GX3®** -45 offers a range of navigation-related output quantities, including estimated position, velocity, and attitude (PVA), position, velocity, and attitude uncertainties, bias-compensated angular rate, and linear acceleration. Fully-calibrated inertial measurements include acceleration, angular rate, magnetic field, deltaTheta and deltaVelocity vectors, Euler angles (pitch, roll, and heading), rotation matrix and quaternion. Unprocessed GPS data quantities include LLH position, NED velocity, ECEF position and velocity, DOP data, UTC time, GPS time, clock info, GPS fix, and SVI. All quantities are fully temperature compensated and are mathematically aligned to an orthogonal coordinate system. The angular rate quantities are further corrected for g-sensitivity and scale factor non-linearity to third order. The **3DM-GX3®** -45 architecture has been carefully designed to substantially eliminate common sources of error such as hysteresis induced by temperature changes and sensitivity to supply voltage variations. Gyro drift is eliminated in AHRS mode by referencing magnetic North and Earth's gravity and compensating for gyro bias. On-board coning and sculling compensation allows for use of lower data output rates while maintaining performance of a fast internal sampling rate. The **3DM-GX3®** -45 is initially sold as a starter kit consisting of an INS module, RS-232 or USB communication and power cable, software CD, user manual, and quick start guide.

## Applications

Accurate navigation and orientation under dynamic conditions such as:

- Primary and/or Secondary GPS-aided Navigation System
- Unmanned Vehicle Navigation
- Platform Stabilization, Artificial Horizon
- Antenna and Camera Pointing
- Health and Usage Monitoring of Vehicles
- Reconnaissance, Surveillance, and Target Acquisition
- Robotic Control
- Personnel Tracking



## Navigation Specifications

| Kalman Filter Performance | |
|---|---|
| Typical position accuracy † | ±2.5 m RMS horizontal, ±5 m RMS vertical |
| Typical velocity accuracy † | ±0.1 m/s to ±0.75 m/s RMS (application and settings dependent) |
| Typical attitude accuracy † | ±0.35 deg RMS roll & pitch<br>±1.0 deg RMS heading |
| Update rate | 100 Hz |
| Features | • vehicle dynamics mode selection (portable/<br>• automotive/airborne)<br>• user-defined sensor to vehicle frame transformation<br>• antenna offset specification, bias enable/disable,<br>• internal magnetometer enable/disable and external GPS and heading sensor support<br>• full world magnetic model |
| Data output rate | 1 Hz to 100 Hz |

## AHRS Specifications

| Attitude and Heading | |
|---|---|
| Attitude heading range | 360° about all 3 axes |
| Accelerometer range | ±5g standard |
| Gyroscope range | ±300°/sec standard |
| Static accuracy | ±0.5° pitch, roll, heading typical for static test conditions |
| Dynamic accuracy | ±2.0° pitch, roll, heading for dynamic (cyclic) test conditions and for arbitrary angles |
| Long term drift | eliminated by complimentary filter architecture |
| Repeatability | 0.2° |
| Resolution | <0.1° |
| Data output rate | 1 Hz to 100 Hz |
| Filtering | sensors sampled at 30 kHz, digitally filtered (user adjustable ) and scaled into physical units; coning and sculling integrals computed at 1 kHz |
| Output modes | acceleration, angular rate, magnetic field, deltaTheta, deltaVelocity, Euler angles, orientation matrix, quaternion, LLH position, NED velocity, GPS time, filter status, PVA estimate, PVA uncertainties, attitude as: quaternion, matrix, or Euler angles, gravity-free linear acceleration, bias-compensated angular rate |
| **General** | |
| A/D resolution | 16 bits SAR oversampled to 17 bits |
| Interface options | USB 2.0 or RS232 |
| Baud rate | 9,600 bps to 921,600 bps (115,200 bps default) |
| Power supply voltage | +3.2 to +16 volts DC |
| Power consumption | at full performance with GPS lock:<br>200 mA typ (250 mA max) when powered by Vpri (3.2V-5.5V);<br>850 mW typ (1.0W max) when powered by Vaux (5.2V-16V) |
| Connector | micro-DB9 |
| Operating temperature | -40 °C to +65 °C |
| Dimensions | 44 mm x 24 mm x 14 mm - excluding mounting tabs, width across tabs 37 mm |
| Weight | 23 grams |
| ROHS | compliant |
| Shock limit | 500 g |
| Software utility | CD in starter kit (XP/Vista/Win7 compatible) |
| Software development kit (SDK) | complete data communications protocol and sample code |


1.03d 8400-0035 rev. 002

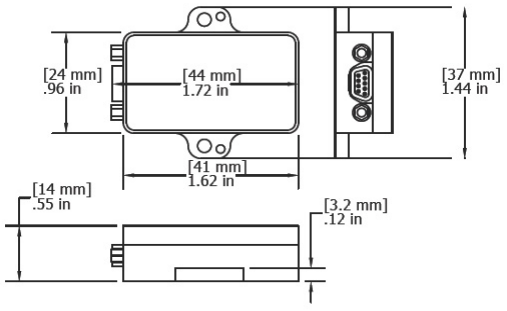
## Sensor Specifications

| | Accels | Gyros | Mags |
|---|---|---|---|
| Measurement range | ±5 g | ±300°/sec | ±2.5 Gauss |
| Non-linearity | ±0.1 % fs | ±0.03 % fs | ±0.4 % fs |
| In-run bias stability | ±0.04 mg | 18°/hr | — |
| Initial bias error | ±0.002 g | ±0.25°/sec | ±0.003 Gauss |
| Scale factor stability | ±0.05 % | ±0.05 % | ±0.1 % |
| Noise density | 80 µg/√Hz | 0.03°/sec/√Hz | 100 µGauss/√Hz |
| Alignment error | ±0.05° | ±0.05° | ±0.05° |
| User adjustable bandwidth | 225 Hz max | 440 Hz max | 230 Hz max |
| Sampling rate | 30 kHz | 30 kHz | 7.5 kHz max |

## GPS Specifications

| GPS Receiver | |
|---|---|
| GPS receiver type | 50 Channels, L1 frequency, GPS C/A Code<br>SBAS: WAAS, EGNOS, MSAS, GAGAN |
| GPS solution update rate | Up to 4Hz |
| Time-to-First-Fix | Cold Start (Autonomous): 36 sec<br>Warm Start (Autonomous): 36 sec<br>Hot Start: < 1 sec |
| GPS tacking and navigation sensitivity | -159 dBm |
| GPS reacquisition sensitivity | -159 dBm |
| GPS cold start (autonomous) sensitivity | -141 dBm |
| GPS velocity accuracy | 0.1 m/sec |
| GPS heading accuracy | 0.5° |
| GPS horizontal position accuracy | < 2.5 m Autonomous<br>< 2.0 m SBAS (CEP, stationary 24 hours, SEP 3.5 m) |
| GPS timepulse signal accuracy | 30 nsec RMS<br>< 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 |
| Data output rate | 1 Hz to 4 Hz |
| **Options** | |
| Accelerometer range | ±1.7 g, ±16 g, ±50 g |
| Gyroscope range | ±50°/sec, ±600°/sec, ±1200°/sec |

† RMS values generated from actual vehicle testing (airborne & land) when compared to a reference navigation unit

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Patent Pending