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

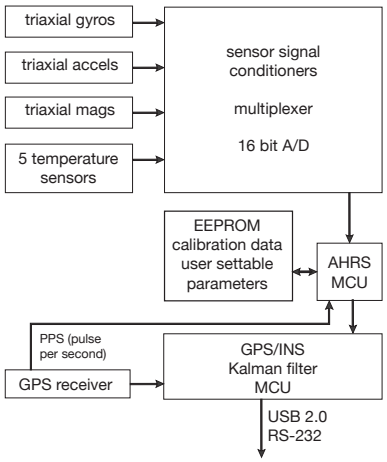
- on-board Extended Kalman Filter for optimal position, velocity, and attitude (PVA) estimation, even under high *g* maneuvers
- smallest, lightest, lowest power GPS/INS available on the market
- fully temperature compensated over operational range
- calibrated for sensor misalignment, gyro G-sensitivity, and gyro scale factor non-linearity to third order; gyro in-run bias is estimated and compensated by the Kalman filter
- improved performance under vibration, as inertial sensors are sampled at 30 kHz and digitally filtered and scaled into physical units; coning and sculling integrals are computed at 1 kHz
- RS-232 and USB 2.0 communication interfaces
- MIP protocol provides fully customizable data output: Kalman filter solution at 100 Hz, inertial data up to 1000 Hz, and GPS data up to 4 Hz with individual data quantity control
- accepts external GPS and heading updates for improved navigational performance
- full world magnetic model
- versions available from 1.7 *g* to 50 *g* and 50°/s to 1200°/s
- rugged aluminum enclosure with precision alignment holes
- ROHS compliant

Applications

- primary and/or secondary GPS-aided navigation system
- location tracking of vehicles or personnel
- unmanned vehicle navigation
- platform stabilization, artificial horizon
- antenna, satellite and camera pointing
- biomechanics, biomedical animation
- robotics, automotive, marine, military
- heavy equipment, container handling
- virtual reality, computer science
- reconnaissance, surveillance and target acquisition system

Product 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.



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 ±1.0 deg RMS heading
Update rate	100 Hz
Features	•vehicle dynamics mode selection (portable/ tautomotive/airborne) •user-defined sensor to vehicle frame transformation •antenna offset specification, bias enable/ disable •internal magnetometer enable/disable and external GPS and heading sensor support •full world magnetic model

AHRS Specifications

Attitude and Heading	
Attitude heading range	360° about all 3 axes
Accelerometer range	±5*g* 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 complementary filter architecture
Repeatability	0.2°
Resolution	<0.1°
Data output rate	IMU: 1 Hz to 1000 Hz, INS: 1 Hz to 100 Hz, GPS: 1 Hz to 4 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	160 mA (typical) @ 5 volts with RS-232 and GPS lock
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

IMU Specifications

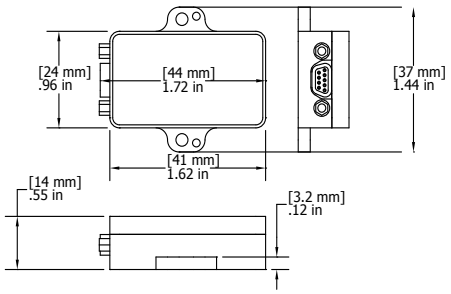
	Accels	Gyros	Mags
Measurement range	±5 *g*	±300°/sec	±2.5 Gauss
Non-linearity	±0.1 % fs	±0.03 % fs	±0.4 % fs
In-run bias stability	±0.04 m*g*	18°/hr	—
Initial bias error	±0.002 *g*	±0.25°/sec	±0.003 Gauss
Scale factor stability	±0.05 %	±0.05 %	±0.1 %
Noise density	80 µg/√Hz	0.03°/sec/√Hz	100 µGauss/√Hz
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 SBAS: WAAS, EGNOS, MSAS, GAGAN
GPS solution update rate	Up to 4Hz
Time-to-First-Fix	Cold Start (Autonomous): 36 sec Warm Start (Autonomous): 36 sec 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 < 2.0 m SBAS (CEP, stationary 24 hours, SEP 3.5 m)
GPS timepulse 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

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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Patents Pending

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