3DM-CX5-45

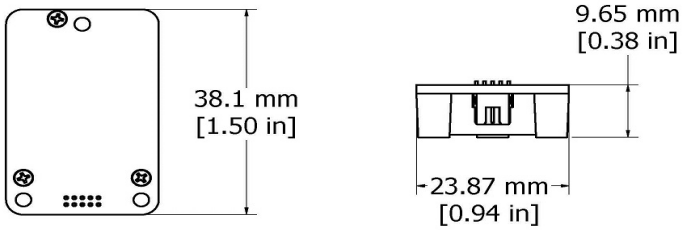
GNSS-Aided Inertial Navigation System (GNSS/INS)

The **LORD Sensing 3DM-CX5** family of high-performance, industrial-grade, board-level inertial sensors provide a wide range of triaxial inertial measurements, computed attitude, and navigation solutions.

The **3DM-CX5-45** all-in-one navigation solution features a high-performance, integrated multi-constellation GNSS receiver utilizing the GPS, GLONASS, BeiDou, and Galileo satellite constellations. Sensor measurements are fully calibrated, temperature-compensated, and mathematically-aligned to an orthogonal coordinate system for highly accurate outputs. The auto-adaptive estimation filter algorithm produces highly accurate computed outputs under dynamic conditions. Compensation options include automatic compensation for magnetic anomalies, gyro and accelerometer noise, and noise effects. The computed outputs include pitch, roll, yaw, heading, position, velocity, and GNSS outputs- making it a complete GNSS/INS (GNSS Aided Inertial Navigation System) solution. Micro-Electro-Mechanical Systems (MEMS) technology provides a highly accurate, small, light-weight device.

SensorConnect software is a user friendly program for device configuration. MIP Monitor (MicroStrain Internet Protocol) can also be used. Both packages provide 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.

The sensor operates independent of computer platform, operating system, or coding language. .



PRODUCT HIGHLIGHTS

- High-performance integrated multi-constellation GNSS receiver and advanced MEMS sensor technology provide direct inertial measurements, 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 new Auto-Adaptive Extended Kalman Filter (EKF) for outstanding dynamic position, velocity, and attitude estimates

FEATURES AND BENEFITS

BEST IN CLASS PERFORMANCE

- Fully calibrated, temperature-compensated, and mathematically-aligned to an orthogonal coordinate system for highly accurate outputs
- High-performance, low-drift gyros with low noise density and vibration rectification error.
- Accelerometer noise as low as 20 ug/√Hz

EASE OF USE

- Sensor Connect enables simple device configuration, live data monitoring and recording.
- Optional hardware development kit available.
- The MSCL API allows easy integration with C++, Python, .NET, C#, Visual Basic, LabVIEW and MATLAB environments.
- MIP open byte level communication protocol.
- Automatic magnetometer calibration and anomaly rejection eliminates the need for field calibration
- Automatically compensates for vehicle noise and vibration

COST EFFECTIVE

- Out-of-the box solution reduces development time
- Volume discounts

APPLICATIONS

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

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Specifications

General	
Integrated sensors	Triaxial accelerometer, triaxial gyroscope, triaxial magnetometer, pressure altimeter, temperature sensors, and GNSS receiver
Data outputs	**Inertial Measurement Unit (IMU) outputs:** acceleration, angular rate, magnetic field, ambient pressure, Delta-theta, Delta-velocity **Computed outputs** **Extended Kalman Filter (EKF):** filter status, GNSS timestamp, LLH position, NED velocity, attitude estimates (in Euler angles, quaternion, orientation matrix), linear and compensated acceleration, bias compensated angular rate, pressure altitude, gyroscope and accelerometer bias, scale factors and uncertainties, gravity and magnetic models, and more. **Complementary Filter (CF):** attitude estimates (in Euler angles, quaternion, orientation matrix) stabilized, north and up vectors, GNSS correlation timestamp **Global Positioning System outputs (GPS)** **Global Navigation Satellite System outputs (GNSS):** LLH position, ECEF position and velocity, NED velocity, UTC time, GNSS time, SV.GNSS protocol access mode available.

Inertial Measurement Unit (IMU) Sensor Outputs			
	Accelerometer	**Gyroscope**	**Magnetometer**
Measurement range	±8 g (standard) ±2 g, ±4 g, ±20 g, ±40 g (optional)	300°/sec (standard) ±75, ±150, ±900 (optional)	±8 Gauss
Non-linearity	±0.02% fs	±0.02% fs	±0.3% fs
Resolution	0.02 mg (+/- 8 g	<0.003°/sec (300 dps	--
Bias instability	±0.04 mg	8°/hr	--
Initial bias error	±0.002 g	±0.04°/sec	±0.003 Gauss
Scale factor stability	±0.03%	±0.05%	±0.1%
Noise density	20 µg/√Hz (2 g)	0.005°/sec/√Hz (300°/sec)	400 µGauss/√Hz
Alignment error	±0.05°	±0.08°	±0.05°
Adjustable bandwidth	225 Hz	250 Hz	--
Offset error over temperature	0.06% (typ)	0.04% (typ)	--
Gain error over temperature	0.03% (typ)	0.03% (typ)	--
Vibration induced noise	--	0.072°/s RMS/g RMS	--
Vibration rectification error (VRE)	--	0.001°/s/g2 RMS	--
IMU filtering	Digital sigma-delta wide band anti-aliasing filter to digital averaging filter (user adjustable) scaled into physical units.		
Sampling rate	1 kHz	4 kHz	100 Hz
IMU data output rate	1 Hz to 500 Hz (standard mode) 1 Hz to 1000 Hz (sensor direct mode)		

Pressure Altimeter	
Range	-1400 m to 10,000 m (1260-260 hPa)
Resolution	0.01 hPa RMS
Relative Accuracy	± 0.1 hPa over the range 800-1000 hPa @ T= 25°C
Sampling rate	25 Hz

Computed Outputs	
Position accuracy	±2 m RMS horizontal, ± 5 m RMS vertical (typ)
Velocity accuracy	±0.1 m/s RMS (typ)
Attitude accuracy	EKF outputs: ±0.25° RMS roll and pitch, ±0.8° RMS heading (typ) CF outputs: ±0.5° RMS roll, pitch, and heading (static, typ), ±2.0° roll, pitch, (dynamic, typ)
Attitude heading range	360° about all axes
Attitude resolution	< 0.01°
Attitude repeatability	0.2° (typ)
Calculation update rate	500 Hz
Computed data output rate	EKF outputs: up to 500 Hz CF oututs: up to 500 Hz
Global Navigation Satellite System (GNSS) Outputs	
Receiver type	72-channel GPS/QZSS L1 C/A, GLONASS L10F, BeiDou B1, SBAS L1 C/A:WAAS, EGNOS, MSAS Galileo E1B/C
GNSS data output rate	1 Hz to 4 Hz
Time-to-first-fix	Cold start: 27 second, reacquisition: 1 second, hot start: <1 second
Sensitivity	Tracking: -164 dBm, cold start: -147 dBm hot start: - 156 dBm
Velocity accuracy	0.1 m/sec
Heading accuracy	0.5°
Horizontal position accuracy	GNSS: 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	50,000 meters
Velocity limit	500 m /sec (972 knots)
Operating Parameters	
Communication	USB 2.0 (full speed) | TTL serial (3.0 V dc, 9,600 bps to 921,600 bps, default 115,200)
Power source	+ 3.2 to 5.2 V dc
Power consumption	500 mW (typ)
Operating temperature	-40°C to +85°C
Mechanical shock limit	500*g*/1ms
MTBF	400,094 hours (Telcordia method, GM/35C)
Physical Specifications	
Dimensions	38 mm x 24 mm x 9.7 mm
Weight	8 grams
Enclosure material	Aluminum
Regulatory compliance	ROHS, CE
Integration	
Connectors	Data/power output: micro-DB9Samtec FTSH Series (FTSH-105-01-F-D-K) GNSS antenna: MMCX type
Software	SensorConnect and MIP Monitor software included; Windows XP/Vista/7/8/10 compatible
Data Communications Protocol (DCP	Protocol compatibility across GX3, GX4, RQ1, GQ4, GX5 CX5 and CV5 product families
Software development kit (SDK)	MicroStrain Communication Library (MSCL) open source license includes full documentation and sample code.

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