LORD **DATASHEET**

3DM®-CX5-45

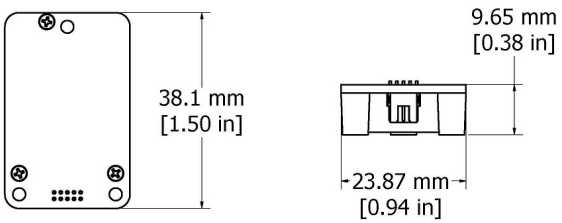
GNSS-Aided Inertial Navigation System (GNSS/INS)

3DM-CX5-45- *miniature, high-performance, industrial-grade all-in-one navigation solution with integrated multi-constellation GNSS, high noise immunity, and exceptional performance*

The **LORD Sensing** family of high- performance, industrial-grade inertial sensors provides a wide range of triaxial inertial measurements and 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. The use of Micro- Electro- Mechanical System (MEMS) technology provides a highly accurate, small, light- weight device.

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.



Best in Class Inertial Measurement

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 noise density of 0.005°/sec/√Hz and VRE of 0.001°/s/g^2RMS
- Accelerometer noise as low as 25 ug/√Hz

Ease of Use

- Automatic magnetometer calibration and anomaly rejection eliminates the need for field calibration
- Automatically compensates for vehicle noise and vibration
- Easy integration via comprehensive and fully backwards-compatible communication protocol

Cost Effective

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

Applications

- 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)	±2.5 Gauss
Non-linearity	±0.02 % fs	±0.02% fs	±0.3% fs
Resolution	<0.1 m*g*	<0.003°/sec	--
Bias instability	±0.04 m*g*	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	25 µg/√Hz (2 *g*)	0.005°/sec/√Hz (300°/sec)	100 µGauss/√Hz
Alignment error	±0.05°	±0.08°	±0.05°
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/g^2 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	50 Hz
IMU data output rate	1 Hz to 500 Hz (standard mode) , 1 Hz to 1000 Hz (sensor direct mode)		
Pressure Altimeter			
Range	-1800 m to 10,000 m		
Resolution	< 0.1 m		
Noise density	0.01 hPa RMS		
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° 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: 1 Hz to 500 Hz CF outputs: 1 Hz 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	700 mW (typ), 800 mW (max) 500 mW (typ)
Operating temperature	-40 °C to +85 °C
Mechanical shock limit	500 *g* (calibration unaffected) 1000 *g* (bias may change), 5000 *g* (survivability)
MTBF	(TBD)
Physical Specifications	
Dimensions	44.2 mm x 36.6 mm x 11 mm
Weight	13 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	MIP Monitor, MIP Hard and Soft Iron Calibration, Windows XP/Vista/7/8/10 compatible
Compatibility	Protocol compatibility across 3DM®-GX3, GX4, RQ1, GQ4, GX5 and CV5 product families
Software development kit (SDK)	MIP data communications protocol with sample code available (OS and platform independent)

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