The LORD Sensing 3DM-CX5 family of high-performance, industrial-grade, board-level inertial sensors provide 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. Micro-Electro-Mechanical Systems (MEMS) technology provides a highly accurate, small, light-weight device.

SensorConnect software enables easy device configuration, live data monitoring, and recording. Alternatively, the Microstrain Communication Protocol (MSCL) is available for development of custom interfaces and easy OEM integration.

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 25 ug/√Hz

EASE OF USE

- The MSCL API allows easy integration with C++, Python, .NET, C#, Visual Basic, LabVIEW and MATLAB environments.
- MIP open byte level communication protocol.
- Sensor Connect enables simple device configuration, live data monitoring and recording.
- 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

- GNSS-aided navigation system
- Platform stabilization, artificial horizon
- Satellite dish, radar, and antenna pointing
### Specifications

#### General
- Triaxial accelerometer, triaxial gyroscope, triaxial magnetometer, pressure altimeter, temperature sensors, and GNSS receiver

#### Integrated sensors
- **Inertial Measurement Unit (IMU)** outputs: acceleration, angular rate, magnetic field, ambient pressure, Delta-theta, Delta-velocity

#### Data outputs
- **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

<table>
<thead>
<tr>
<th>Measurement Unit (IMU) Sensor Outputs</th>
<th>Accelerometer</th>
<th>Gyroscope</th>
<th>Magnetometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement range</td>
<td>±8 g (standard) ±20 g, ±40 g (optional)</td>
<td>±875°/sec (standard) ±150°, ±300° (optional)</td>
<td>±8 Gauss</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>±0.02% fs</td>
<td>±0.02% fs</td>
<td>±0.3% fs</td>
</tr>
<tr>
<td>Resolution</td>
<td>&lt;0.1 mg</td>
<td>&lt;0.003°/sec</td>
<td>--</td>
</tr>
<tr>
<td>Bias instability</td>
<td>±0.04 mg</td>
<td>8°/hr</td>
<td>--</td>
</tr>
<tr>
<td>Initial bias error</td>
<td>±0.002 g</td>
<td>±0.04°/sec</td>
<td>±0.003 Gauss</td>
</tr>
<tr>
<td>Scale factor stability</td>
<td>±0.03%</td>
<td>±0.05%</td>
<td>±0.1%</td>
</tr>
<tr>
<td>Noise density</td>
<td>25 µg/√Hz (2 g)</td>
<td>0.005°/√Hz (300°/sec)</td>
<td>400 µGauss/√Hz</td>
</tr>
<tr>
<td>Alignment error</td>
<td>±0.05°</td>
<td>±0.08°</td>
<td>±0.05°</td>
</tr>
<tr>
<td>Adjustable bandwidth</td>
<td>225 Hz</td>
<td>250 Hz</td>
<td>--</td>
</tr>
<tr>
<td>Offset error over temperature</td>
<td>0.06% (typ)</td>
<td>0.04% (typ)</td>
<td>--</td>
</tr>
<tr>
<td>Gain error over temperature</td>
<td>0.03% (typ)</td>
<td>0.03% (typ)</td>
<td>--</td>
</tr>
<tr>
<td>Vibration induced noise</td>
<td>--</td>
<td>0.072°/s RMS/g RMS</td>
<td>--</td>
</tr>
<tr>
<td>Vibration rectification error (VRE)</td>
<td>--</td>
<td>0.001°/s RMS/g RMS</td>
<td>--</td>
</tr>
<tr>
<td>IMU filtering</td>
<td>Digital sigma-delta wide band anti-aliasing filter to digital averaging filter (user adjustable) scaled into physical units.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sampling rate</td>
<td>1 kHz</td>
<td>4 kHz</td>
<td>100 Hz</td>
</tr>
</tbody>
</table>

#### Pressure Altimeter
- **Range** | ±1,800 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° 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 |
- **Composed data output rate**
  - EKF outputs: 1 Hz to 500 Hz
  - CF outputs: 1 Hz to 1000 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 |
- **Velocity limit** | < 60 nsec 99% |
- **Velocity limit** | 500 m/s (972 knots) |
- **Acceleration limit** | 50,000 meters |
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#### Operating Parameters
- **Communication**
  - USB 2.0 (full speed) | TTL serial (3.0 V dc, 9,600 bps to 4 kHz) |
- **Power source** | +3.2 V to 5.2 V dc |
- **Power consumption** | 500 mW (typ) |
- **Operating temperature** | -40°C to +85°C |
- **Mechanical shock limit** | 500g/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-D89Samtec FTSH Series (FTSH-105-01-F-D-K) GNSS antenna: MMCX type |
- **Software**
  - SensorConnect; Windows XP/Vista/7/8/10 compatible |
- **Compatability**
  - Protocol compatibility across 3DM-GX3, GX4, RGQ, GQ4, GQ5 and CV5 product families |
- **Software development kit (SDK)**
  - MSCL code examples available. MIP open byte level protocol.)