



MTLT335M

Triple-Redundant Dynamic Tilt Sensor with CAN Output and M12 Connectors



The ACEINNA MTLT335M is an easy-to-use high-performance 6-DOF IMU packaged in a rugged metal housing with two M12 5 position connectors (1 male, 1 female). The MTLT335 includes triple-redundant 3-Axis MEMS accelerometers and rotational rate gyros, which are calibrated over the full operating temperature range. The processing power is provided by a 168MHz ARM M4 CPU with a Floating Point Unit. An internal Kalman Filter provides gyro-compensated and corrected pitch and roll outputs with Excavator and General Purpose modes, allowing for optimized performance in different dynamic environments. The MTLT335 has been developed in accordance with the ISO13849 Machine Safety standard, and fulfills the requirements of category 2 as specified in DIN EN ISO 13849-1:2016. It can be used in safety functions up to Performance Level d as specified in DIN EN ISO 13849-1:2016.



MTLT335M

Triple-Redundant 1.3°/h Dynamic Tilt Sensor with CAN Output

The ACEINNA MTLT335M is designed for use in 12 V and 24 V vehicle platforms. The sealed metal packaging meets the challenging performance, reliability and cost requirements of the construction and agriculture vehicle markets. Advanced features allow the axes to be re-assigned by the user to accommodate any mounting orientation. A user accessible rotation matrix is available to adjust for mounting errors. MTLT335M can consume and use Wheel Speed CAN messages available on the CAN bus to further improve accuracy. It supports user lever arm input to correct for errors associated with mounting location not being at the center of gravity or at the center of the wheels speed measurements.



Applications

- Construction Vehicles
 - Boom, Arm, Bucket and Cab Attitude
- Agriculture Vehicles and Implements
- Forklifts
- Autonomous Vehicles
- Robotics Control / Feedback



Features

- 6DOF IMU and Dynamic Inclination
- 0.1° accuracy over temperature and angle
- Triple redundant sensors with fault detection
 - Precision 3-axis MEMS Accelerometers
 - Low-Drift 3-axis MEMS angular rate sensors
- CAN 2.0 SAE J1939 Protocol
- Built in EKF algorithm providing pitch and roll
 - Excavator Mode
 - General Purpose mode
- E2E Protection (J1939-76)
- CAN Aiding Signal Support (Wheel Speed Sensor)
- Wide Temp Range, -40 C to +85 C
- Wide Supply Voltage Range, 9 V – 32 V
- M12 5 Position Male and Female Connectors
- Fulfills ISO 13849-1:2016
 - DC = 80%
 - MTTFd > 500 years
- Field Upgradable

This product has been developed exclusively for commercial applications. It has not been tested for, and makes no representation or warranty as to conformance with, any military specifications or its suitability for any military application or end-use. Additionally, any use of this product for nuclear, chemical or biological weapons, or weapons research, or for any use in missiles, rockets, and/or UAV's of 300km or greater range, or any other activity prohibited by the Export Administration Regulations, is expressly prohibited without the written consent and without obtaining appropriate US export license(s) when required by US law. Diversion contrary to U.S. law is prohibited. Specifications are subject to change without notice.

Performance Specification

Ta = 25°C, VDC = 12 V, unless otherwise stated

| Angular Rate | MIN | TYP ² | MAX |
|--|------|------------------|------|
| Range (°/s) | -400 | | +400 |
| Bias Instability (°/hr) ¹ | | 1.3 | |
| Bias Stability over Temp (°/s) | | 0.1 | |
| Scale Factor Accuracy (%FSR) | | 0.1 | |
| Cross-Axis Error (%FSR) | | 0.1 | |
| Non-linearity Error (%FSR) | | 0.1 | |
| Angle Random Walk (°/√hr) ¹ | | 0.15 | |
| Configurable Bandwidth (Hz) | 5 | | 50 |
| Acceleration | MIN | TYP ² | MAX |
| Range (g) | -8 | | +8 |
| Bias Instability (μg) ¹ | | 20 | |
| Bias Stability over Temp (mg) | | 1.3 | |
| Scale Factor Accuracy (%FSR) | | 0.1 | |
| Cross-Axis Error (%FSR) | | 0.1 | |
| Linearity Error (%FSR) | | 0.1 | |
| VRW (m/s/√hr) ¹ | | 0.02 | |
| Configurable Bandwidth (Hz) | 2 | | 50 |
| Pitch / Roll | MIN | TYP ² | MAX |
| Pitch Angle Range (°) | -70 | | +70 |
| Roll Angle Range (°) | -180 | | +180 |
| Angle Accuracy over Temp (°) ³ | | 0.05 | |
| Angle Accuracy over Angle Range (°) ⁴ | | 0.05 | |

Note 1: Allan variance curve, constant temperature

Note 2: Typical values are 1-sigma values unless otherwise noted

Note 3: RMS deviation from 25C value (Pitch and Roll = 0 degrees)

Note 4: RMS error over entire angle operating range

Electrical Specifications

| Characteristic | Specification |
|----------------------|---------------------------------|
| Input voltage | 9 – 32 V |
| Over voltage | 36 V |
| Reverse voltage | -36 V |
| Current | 40 mA @ 12 V Typ |
| Power | 500 mW Typ |
| Reset response | Automatic after voltage dropout |
| Start-up time | <2 seconds |
| Max Output Data Rate | 100 Hz |
| CAN Baud rate | 250k – 1M |

Physical Specifications

| Characteristic | Specification |
|---------------------|---|
| Dimensions | 80 x 66 x 29.4 mm |
| Weight | < 120 g |
| Interface Connector | Two 5 Position M12 Connectors (1 Male, 1 Female) |

Environmental Specifications

| Characteristic | Specification |
|-----------------------|---------------|
| Operating Temperature | -40 – 85 C |
| Storage Temperature | -40 – 85 C |
| Ingress Protection | IP67, IP69K |

Qualification Plan Summary (Not inclusive of all tests)

| Electrical Loads | DUTs | Op Mode ³ | Function Class ³ | Summary |
|--------------------------------|------|----------------------|-----------------------------|---|
| Over Voltage (V) | 3 | 3.2 | A | SAE J1455 4.13.1: 36 V, 1 hour |
| Reverse Voltage (V) | 3 | 1.1 | C | SAE J1455 4.13.1: -36 V, 5 minutes |
| Short Circuit | 3 | 3.2 | C | ISO167507-2 4.10.2: Signal Circuits |
| Starting Profile | 3 | 3.2 | A | ISO16750-2 4.6.3: 10 pulses, 24 V System, Level 2 |
| Load dump | 3 | 3.2 | A | 5 pulses, 56V, 90 s pulse rate; 95 pulses 56V 120 s pulse rate |
| Reset Behavior at Voltage Drop | 3 | 3.2 | B | ISO 16750-2 4.6.2 |
| Mechanical Loads | | | | |
| Vibration Swept Sine | 4 | 3.2 | A | 5 – 500 Hz; <10 Hz Displacement = ± 12 mm; >10 Hz = 5 g Pk |
| Vibration Random | 4 | 3.2 | C | 5 – 2000 Hz; 15.35 g RMS, 48 hrs/axis |
| Mechanical Bump | 4 | 3.2 | C | 100 bumps x 3 axis/DUT (600 Total/DUT) 400m/s ² , ½ sine, 6 ms pulse |
| Mechanical Shock | 4 | 3.2 | C | 3 Shocks x 3 axis x 2 directions (18 total) 981m/s ² , ½ sine, 11 ms pulse |
| Mechanical Drop | 2 | 1.1 | C | 1 m to steel plate, 1 drop x 3 axis x 2 directions (6 total) |

Note 3: ISO 16750-1 Operation Mode and Function Class definition

EMC Specifications

| Characteristic | Standard | Test Level / Frequency | |
|------------------------------|-----------------------|---|---------|
| ESD direct contact discharge | ISO 10605 | 8 kV - Function Class A, Reference Limits IV | |
| ESD air discharge | ISO 10605 | 15 kV - Function Class A, Reference Limits IV | |
| Radiated Immunity Strip line | ISO 11452-5 | 200 V/m, 0.5 – 250 MHz | |
| Radiated Immunity ALSE | ISO 11452-2 | 200 – 1000 MHz | 125 V/m |
| | | 1000 – 2000 MHz | 40 V/m |
| | | 2000 – 2400 MHz | 15 V/m |
| | | 2400 – 2700 MHz | 10 V/m |
| EMC Conducted Transmission | ISO 16750-2; ISO 7637 | 24V Parameters, Pulse 1, 2a, 2b, 3a, 3b,, 4, 5b | |

Tools and Support

- MTLT335M User Manual and Application Notes can be downloaded from the ACEINNA website at www.aceinna.com

Connector Pin Definition

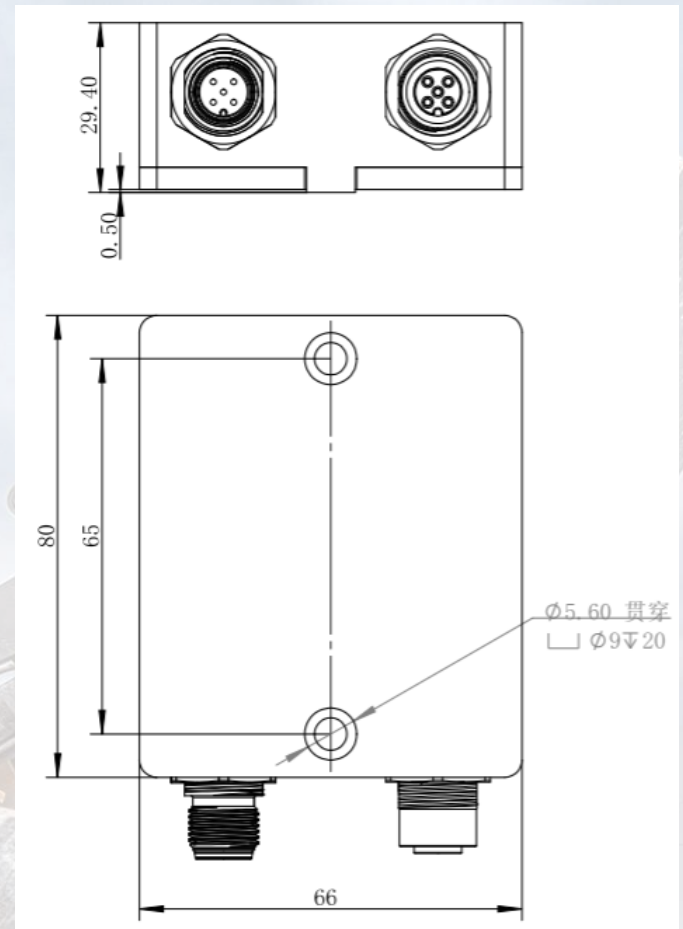
| Pin # | Signal |
|-------|----------------|
| 1 | Shield |
| 2 | V ⁺ |
| 3 | V ⁻ |
| 4 | CAN H |
| 5 | CAN L |

Electrical Interface Description

The two 5 position male and female M12 connectors are electrically connected pin to pin allowing for daisy chain connection of multiple IMUs on the CAN bus.

The shield pin is additionally connected to case ground

Dimensioned Drawing (MTLT335M) mm



Ordering Information

| Part Ordering Information | |
|---|--|
| Rugged High-Performance IMU / Tilt Sensor | |
| MTLT335M | 6DOF IMU/VG in Plastic/Over molded Housing |