





The ACEINNA OpenIMU300RI is an easy-to-use high-performance 9-DOF open inertial platform packaged in a rugged sealed overmolded plastic housing. The OpenIMU300RI features a precision MEMS 3-Axis Accelerometer, low-drift MEMS 3-Axis Rate Gyro, and 3-Axis AMR Magnetometer. The processing power is provided by a 168MHz ARM M4 CPU with a Floating Point Unit. The OpenIMU300RI runs the OpenIMU open-source stack that includes an optimized 16-state Kalman Filter for Attitude and GPS-Aided Position-Velocity-Time (PVT) measurement. A free tool-chain based on VS Code supports PC, MAC, and Ubuntu.



## **OpenIMU300RI** Rugged Open-Source IMU with CAN Output

The ACEINNA OpenIMU300RI is designed for use in 12 V and 24 V vehicle platforms. The plastic over-molded sealed packaging meets the challenging performance, reliability and cost requirements of the automotive, construction and agriculture vehicle markets.

### Applications

- Autonomous Vehicles
- Self-Driving Taxis / Delivery Vehicles
- Construction Vehicles
  - Boom, Bucket and Cab Attitude
- Agriculture Vehicles and Implements
- Forklifts
- Robotics Control / Feedback
- Antenna / Camera Gimballing and Stabilization









#### Features

- Precision 3-axis MEMS Accelerometer
- Low-Drift 3-axis MEMS angular rate sensor
- High Performance 3-axis AMR Magnetometer
- CAN 2.0 and RS232 Interfaces
- 168 MHz ARM M4 processor
- Open Source Tool Chain
- Open Source Algorithms (VG / AHRS / INS)
- Built in Open Source Extended State Kalman Filter
- Open Community & Support
- Wide Temp Range, -40C to +85C
- Wide Supply Voltage Range, 5 V 32 V
- IP67 Ampseal Connector
- CE Certified
- RoHS REACH Compliant
- High Reliability, MTBF > 50k hours

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.

info@aceinna.com

www.a<u>ceinna.com</u>

#### Document: 6020-3309-01\_C



# OpenIMU300RI Rugged Open-Source IMU with CAN Output

#### Performance Specification

$Ta = 25^{\circ}C$ , $VDC = 12$ V, unless otherw	wise stated		
Angular Rate	MIN	TYP <sup>2</sup>	MAX
Range (°/s)	-400	-	+400
Bias Instability (°/hr) <sup>1</sup>		6	
Bias Stability over Temp (°/s)		0.3	
Scale Factor Accuracy (%)		0.03	
Cross-Axis Error (%FSR)		0.02	
Angle Random Walk (°/√hr) <sup>1</sup>		0.3	
Configurable Bandwidth (Hz)	5		50
Acceleration	MIN	TYP <sup>2</sup>	MAX
Range (g)	-8		+8
Bias Instability (µg) <sup>1</sup>		10	
Bias Stability over Temp (mg)		3	
Scale Factor Accuracy (%FSR)		0.03	
Non-Linearity (%FSR)		0.03	
VRW (m/s/\/hr)1		0.06	
Configurable Bandwidth (Hz)	2		50
Magnetic Field	MIN	TYP <sup>2</sup>	MAX
Range (mGauss)	-8000		+8000
Resolution (mGauss)		0.3	
Noise (mGauss/\/Hz)		0.25	
Bandwidth (Hz)		5	

Note 1: Allan variance curve, constant temperature

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

#### Qualification Summary (Not inclusive of all tests)

Electrical Specifications			
Characteristic	Specification		
Input voltage	4.9 – 32 V		
Over voltage	36 V		
Reverse voltage	-36 V		
Current	< 100 mA		
Power	< 400 mW		
Reset response	Automatic after voltage dropout		
Start-up time	<2 seconds		
Max Output Data Rate	100 Hz		
CAN Baud rate	250k - 1M		
RS232 Baud Rate	38400 - 230400		

#### **Physical Specifications**

Electrical Creatificati

Characteristic	Specification	
Dimensions	65 x 66 x 27 mm	
Weight	< 75 g	
Interface Connector	Ampseal 16 – 6 Position IP67	
Mating Connector	TE Connectivity 776531-1	

#### **Environmental Specifications**

Characteristic	Specification		
Operating Temperature	-40 – 85 °C		
Storage Temperature	-55 − 105 °C		
Ingress Protection	IP67, IP69K		

Electrical Loads	DUTs	Op Mode <sup>3</sup>	Function Class <sup>3</sup>	Summary
Over Voltage (V)	3	3.2	А	SAE J1455 4.13.1: 36 V, 1 hour
Reverse Voltage (V)	3	1.1	С	SAE J1455 4.13.1: -36 V, 5 minutes
Short Circuit	3	3.2	С	SAE J1455, 4.13.1: 32V
Starting Profile	3	3.2	А	10 cycles, 12 V System, Class IV
Load dump	3	3.2	А	5 pulses, 64V, 60 s pulse rate; 95 pulses 56V 120 s pulse rate
Reset Behavior at Voltage Drop	1	3.2	В	ISO 16750-2: 4.6.2
Mechanical Loads				
Vibration Swept Sine	3	3.2	А	$5 - 500$ Hz; $<10$ Hz Displacement = $\pm 12$ mm; $>10$ Hz = 5 g Pk
Vibration Random	3	3.2	C	10 – 2000 Hz; 13.9 g RMS
Mechanical Bump	4	3.2	С	100 bumps x 3 axis/DUT (600 Total/DUT) 400m/s <sup>2</sup> , ½ sine, 6 ms pulse
Mechanical Shock	4	3.2	С	3 Shocks x 3 axis x 2 directions (18 total) 500m/s <sup>2</sup> , ½ sine, 11 ms pulse
Mechanical Drop	2	1.1	С	1 m to steel plate, 1 drop x 3 axis x 2 directions (6 total)
Climatic Loads				
Hot Soak	10	3.2	А	96 Hours 85 °C
Cold Soak	10	3.2	А	96 Hours -40 °C
Temperature Cycle	10	3.2	А	2 cycles, -40 – 85 °C
Temperature Shock	10	1.1	С	10 Cycles; -40 - 85 °C, <30s Transition, 3 hour dwell
Chemical Loads				
Salt Spray	2	1.1	С	EN 60068-2-52 Kb. Salt mist Cyclic (NaCl Solution) 35 °C
General	2	3.2	A	Engine oil, Diesel, Hydraulic Oil, Ethylene Glycol, Urea Nitrogen, Liquid Lime, NPK Fertilizer, Ammonia, Calcium Chloride

info@aceinna.com

www.aceinna.com

Document: 6020-3309-01\_C



# **OpenIMU300RI**

Rugged Open-Source IMU with CAN Output

#### **EMC** Specifications

ENIC Specifications				
Characteristic	Standard	Test Level / Frequency		
ESD direct contact discharge	ISO 13766	8 kV - Function Class A, Reference Limits IV		
ESD air discharge	ISO 13766	15 kV - Function Class A, Reference Limits IV		
Radiated Immunity	ISO 11452-2	100 V/m, 200 – 2000 MHz		
Bulk current injection	ISO 11452-2	100 mA, 20 – 400 MHz		
EMC Transient Emissions	ISO 13766	30 – 75 MHz 51 Bb uV/m		
		75-400 MHz	51+15.13 log (freq in MHz/75)	
		400 – 1000 MHz	62 dB uV/m	
EMC Conducted Transmission	ISO 13766; 7637	24V Parameters, Pulse 1, 2a, 2b, 3a, 3b,, 4, 5b		

#### Development Kit

- OpenIMU300RI EVK
- Special Housing with JTAG connection for development / debugging
- ST-Link debugger for in-system development of application code
- Fixture and Interface JTAG board
- Development Cable with Ampseal 16-6 Position to Dual DB9
  - CAN 2.0 Connection DB9
  - RS232 Connection DB9
  - Flying Lead for power connection

#### **Open Navigation Platform**

Embedded navigation applications quickly developed on PC, MAC, and Ubuntu and deployed to run on OpenIMU hardware.

Code / Compile / Debug / Simulate / Analyze

Aceinna Navigation Studio developer tools and GUI are found on Aceinna developer site: <u>developers.aceinna.com</u>

Full manual, API and Algorithm documentation are found at: <u>openimu.readthedocs.io</u>

#### Ready to Use Open Source Algorithms

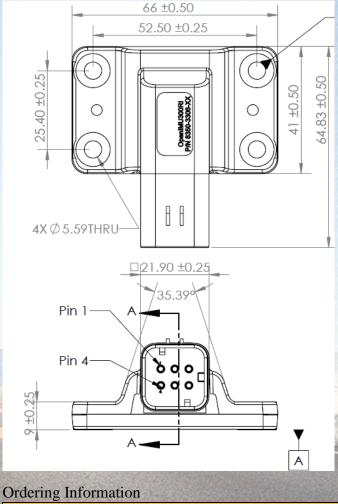
- Calibrated IMU, 3D Acceleration, 3D Rate, 3D Mag
- VG / AHRS, and Dynamic Roll, Pitch and Heading
- INS, Position, Velocity, Attitude and Heading

VG / AHRS Performance <sup>3</sup>	Typical
Pitch and Roll Dynamic Accuracy (Degree) <sup>4</sup>	0.5
Heading Accuracy (Degree) <sup>5</sup>	2
INS Performance <sup>3</sup>	
Position Accuracy (m) <sup>6</sup>	2
Pitch and Roll (Degree) <sup>6</sup>	0.2
Velocity Accuracy (m/s) <sup>6</sup>	0.05
Heading Accuracy (Degree) <sup>6</sup>	0.5

Note 5: Tested in low distortion magnetic environment.

Note 6: RMS Error as referenced to Novatel SPAN during 30 minute drive test using GNSS input from UBLOX M8

#### **Dimensioned Drawing**



Part Ordering Infor	mation
Rugged High-Perfor	rmance OpenIMU Platform
OpenIMU300RI	Industrial Grade: 9 DOF IMU, FSR = 400dps / ±8g
OpenIMU300RI EVK	Developer Kit with OpenIMU300RI with JTAG, STLink/v2 and developer cable

info@aceinna.com

#### www.aceinna.com

Document: 6020-3309-01\_C