



# OpenIMU300RI

Rugged Open-Source IMU with CAN Output



The ACEINNA OpenIMU300RI is an easy-to-use high-performance 9-DOF open inertial platform packaged in a rugged sealed over-molded 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.



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 Gimbaling 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

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## Performance Specification

Ta = 25°C, VDC = 12 V, unless otherwise 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) <sup>1</sup>		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

## 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

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

## Qualification Summary (Not inclusive of all tests)

Electrical Loads	DUTs	Op Mode <sup>3</sup>	Function Class <sup>3</sup>	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	SAE J1455, 4.13.1: 32V
Starting Profile	3	3.2	A	10 cycles, 12 V System, Class IV
Load dump	3	3.2	A	5 pulses, 64V, 60 s pulse rate; 95 pulses 56V 120 s pulse rate
Reset Behavior at Voltage Drop	1	3.2	B	ISO 16750-2: 4.6.2
Mechanical Loads				
Vibration Swept Sine	3	3.2	A	5 – 500 Hz; <10 Hz Displacement = ± 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	C	100 bumps x 3 axis/DUT (600 Total/DUT) 400m/s <sup>2</sup> , ½ sine, 6 ms pulse
Mechanical Shock	4	3.2	C	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	C	1 m to steel plate, 1 drop x 3 axis x 2 directions (6 total)
Climatic Loads				
Hot Soak	10	3.2	A	96 Hours 85 °C
Cold Soak	10	3.2	A	96 Hours -40 °C
Temperature Cycle	10	3.2	A	2 cycles, -40 – 85 °C
Temperature Shock	10	1.1	C	10 Cycles; -40 - 85 °C, <30s Transition, 3 hour dwell
Chemical Loads				
Salt Spray	2	1.1	C	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

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



## EMC 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: [developers.aceinna.com](http://developers.aceinna.com)

Full manual, API and Algorithm documentation are found at:

[openimu.readthedocs.io](http://openimu.readthedocs.io)

## 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

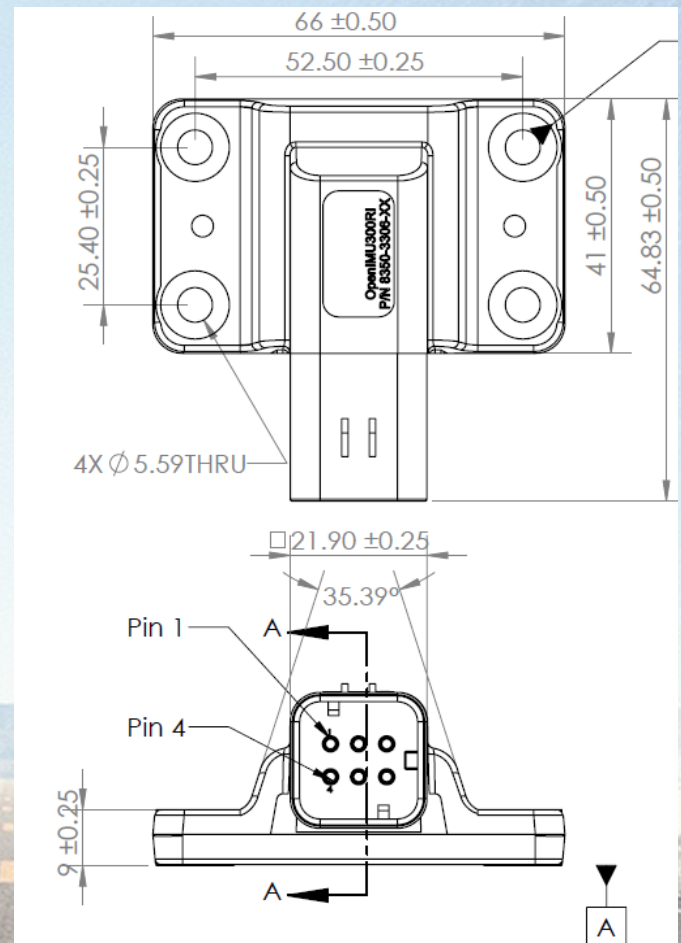
Note 3: Aceinna Open Source Reference Algorithm

Note 4: RMS Error as referenced to Novatel SPAN during 30 minute drive test.

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



## Ordering Information

Part Ordering Information	
<b>Rugged High-Performance OpenIMU Platform</b>	
<b>OpenIMU300RI</b>	<b>Industrial Grade:</b> 9 DOF IMU, FSR = 400dps / ±8g
<b>OpenIMU300RI EVK</b>	<b>Developer Kit with OpenIMU300RI with JTAG, STLink/v2 and developer cable</b>