RAILWAY MOTION CONTROL UNIT

RMCU

MADE IN THE USA

Datasheet

The **Railway Motion Control Unit - RMCU** is a high-performance strapdown system that was developed for Railway application in order to determine absolute orientation (Heading, Pitch and Roll) and parameters of motion (Angular Rates and Linear Accelerations) for any Railway Platforms on which it is mounted. Orientation is determined with high accuracy for both motionless and dynamic applications.

The Inertial Labs **RMCU** utilizes 3-axes each of precision MEMS accelerometers, miniature Fluxgate magnetometers and MEMS gyroscopes to provide accurate Heading, Pitch and Roll of the device under measure. Integration of gyroscopes' output provides high frequency, real-time measurement of the device rotation about all three rotational axes.

Accelerometers and Fluxgate magnetometer measure absolute, very accurate in static and dynamic conditions Pitch, Roll and Heading/Azimuth at RMCU initial alignment as well as providing ongoing corrections to gyroscopes during operation.

Parameter	RMCU
Heading static accuracy, RMS	0.3 deg
Heading dynamic accuracy in temperature range, RMS	0.6 deg
Pitch & Roll static accuracy, RMS	0.05 deg
Pitch & Roll dynamic accuracy in temperature range, RMS	0.08 deg
Dimensions	129 × 53 × 49 mm
Weight	120 grams
Interface	RS-485 / Ethernet

KEY FEATURES AND FUNCTIONALITY

- EN 45545, EN 50155 and EN 55011 Railway standards compliant solution
- One model with multiple configurations at an exceptional price performance ratio
- State-of-the-art algorithms for different Railway Platforms
- Highly accuracy miniature Fluxgate magnetometer
- Gyro-Stabilized Slaved Magnetic Heading
- Suitable for Trains Motion Control and Primary Attitude Reference
- Advanced Kalman Filter based sensor fusion algorithms
- Embedded 2D and 3D magnetic calibration on hard and soft iron
- All solid-state components (no moving parts)
- Full temperature calibration of all sensing elements
- Environmentally sealed (IP67)
- Compact design

One of the key elements to the success of Inertial Labs **RMCU** is its use of **mini Fluxgate Magnetometers,** which has distinct advantages over commonly used magneto-inductive or magneto-resistive magnetometers.
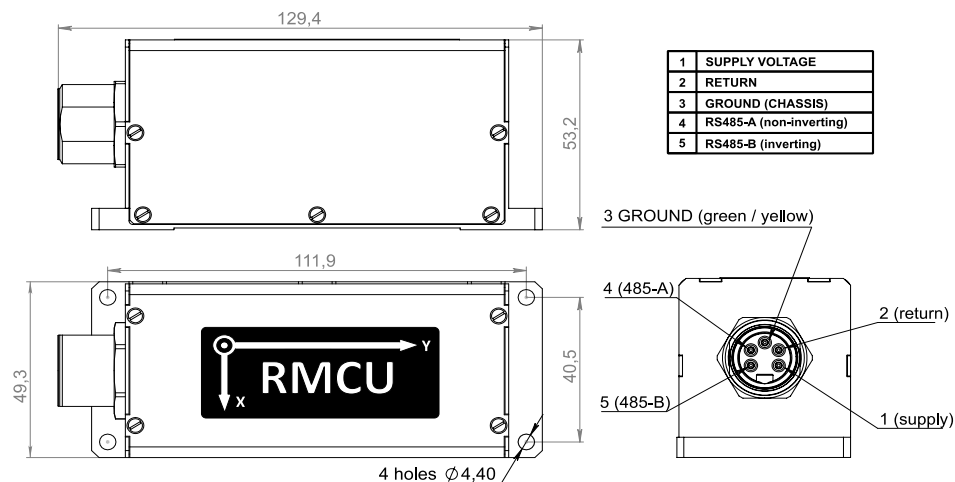
In operation over time and temperature fluxgate magnetometers have superior stability and repeatability. In terms of sensitivity, fluxgate magnetometers provide up to two orders of magnitude increased sensitivity.

In addition to the performance advantages, unlike the chip-level magnetometer technology, fluxgate magnetometer technology has been depended on for over 70 years to provide an accurate reference to North. It remains the most reliable magnetic sensor technology for determining an object's heading.
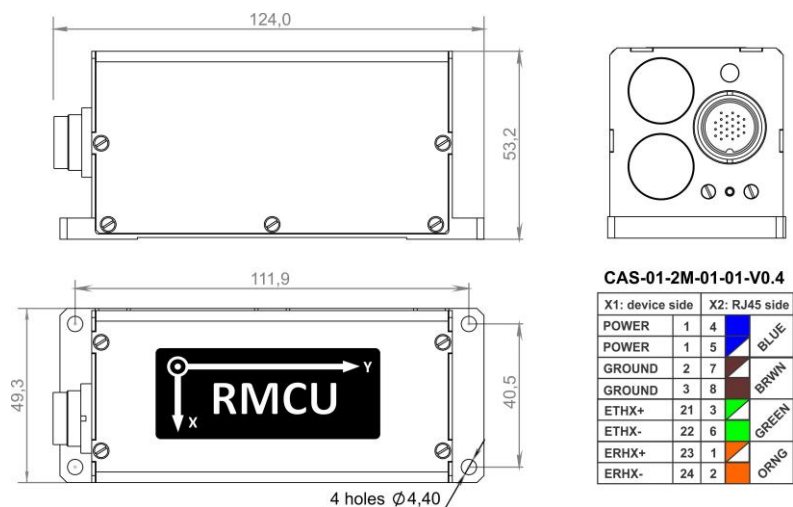
Parameter	Units	RMCU	
Output signals		Heading, Pitch, Roll; Quaternion; Accelerations; Angular rates; Magnetic field; Delta Theta & Delta Velocity	
Update rate	Hz	1 … 2000 (user settable)	
Start-up time	sec	< 1	
Heading	**Units**	**RMCU**	
Range	deg	0 to 360	
Angular Resolution	deg	0.01	
Static Accuracy in Temperature Range	deg, 1σ	0.3	
Dynamic Accuracy	deg RMS, 1σ	0.6	
Pitch and Roll	**Units**	**RMCU**	
Range: Pitch, Roll	deg	±90, ±180	
Angular Resolution	deg	0.01	
Static Accuracy in Temperature Range	deg, 1σ	0.05	
Dynamic Accuracy	deg RMS, 1σ	0.08	
Gyroscopes	**Units**	**RMCU**	
Measurement range	deg/sec	±2000	
Bandwidth (-3dB)	Hz, 1σ	260	
Data update rate	Hz, 1σ	2000	
Bias in-run stability (RMS, Allan Variance)	deg/hr, 1σ	2	
Bias repeatability (turn-on to turn-on, RMS)	deg/hr, 1σ	20	
Bias instability (over temperature range, RMS)	deg/hr, 1σ	72	
SF accuracy (over temperature range)	ppm, 1σ	1000	
Noise. Angular Random Walk (ARW)	deg/√hr, 1σ	0.38	
Non-linearity	ppm, 1σ	350	
Axis misalignment	mrad, 1σ	0.15	
Accelerometers	**Units**	**RMCU**	
Measurement range	g	±8, ±15, ±40	
Bandwidth	Hz, 1σ	260	
Data update rate	Hz, 1σ	2000	
Bias in-run stability (RMS, Allan Variance)	mg, 1σ	0.01, 0.03, 0.05	
Bias instability (in temperature range, RMS)	mg, 1σ	0.7, 1.1, 1.5	
Bias one year repeatability	mg, 1σ	1.5, 2.0, 2.5	
SF accuracy (over temperature range)	ppm, 1σ	500, 700, 850	
SF one-year repeatability	ppm, 1σ	800, 1400, 1700	
Noise. Velocity Random Walk (VRW)	m/sec/√hr, 1σ	0.015, 0.035, 0.05	
Non-linearity	ppm, 1σ	340, 800, 1000	
Axis misalignment	mrad, 1σ	0.15, 0.15, 0.2	
Magnetometers	**Units**	**RMCU**	
Measurement range	Gauss	±8.0	
Bias in-run stability, RMS	μGauss, 1σ	8	
Noise density, PSD	μGauss /√Hz, 1σ	15	
SF accuracy	ppm, 1σ	500	
Environment	**Units**	**RMCU**	
Operating temperature	deg C	-40 to +75	
Storage temperature	deg C	-50 to +85	
Operational Vibration	gRMS, Hz	7g, 20 – 2000 Hz	
Operational Shock	g, sec	40g, 0.01 sec	
MTBF (G$_M$)	hours	600,000	
Electrical & Physical	**Units**	**RMCU**	
Output Interface	-	RS-485	Ethernet
Connector		5 PINs	24 PINs
Supply voltage	V DC	3.3 to 7	9 to 36
Power consumption	Watts	0.5	0.9
Output data format		Binary, NMEA ASCII	Binary, NMEA ASCII
Size	mm	129.4 × 53.2 × 49.3	124 x 53.2 x 49.3
Weight	gram	120	120

RMCU interface drawing (RS-485 interface)

1	SUPPLY VOLTAGE
2	RETURN
3	GROUND (CHASSIS)
4	RS485-A (non-inverting)
5	RS485-B (inverting)

RMCU interface drawing (Ethernet interface)

CAS-01-2M-01-01-V0.4

X1: device side		X2: RJ45 side	
POWER	1	4	BLUE
POWER	1	5	BLUE
GROUND	2	7	BRWN
GROUND	3	8	BRWN
ETHX+	21	3	GREEN
ETHX-	22	6	GREEN
ERHX+	23	1	ORNG
ERHX-	24	2	ORNG

Product Code Description

Model	Gyroscopes Range	Accelerometers Range	Calibration	Case and connector	Color	Version	Interface
RMCU-10	G2000	A8	TMGA	C34	B	V1.X	X.3
		A15		C3			X.5
		A40					

Example: RMCU-10-G2000-A8-TMGA-C34-B-V1.3 (RS-485)
Example: RMCU-10-G2000-A8-TMGA-C3-B-V1.5 (Ethernet)

- RMCU-10: Railway Motion Control Unit
- G2000: Gyroscopes measurement range = ±2000 deg/sec
- A8: Accelerometers measurement range = ±8 g
- A15: Accelerometers measurement range ±15 g
- A40: Accelerometers measurement range ±40 g
- TMGA: Magnetometers, Gyroscopes and Accelerometers
- C3: Aluminum case, IP67, 24 PIN connector (Ethernet interface)
- C34: Aluminum case, IP67, 5 PIN connector (RS-485 interface)
- V1X: Version 1
- X.3: RS-485 Interface (with C34 enclosure)
- X.5: Ethernet Interface (with C3 enclosure)