Inertial Labs
Attitude is Everything

Miniature Attitude & Heading Reference System
miniAHRS

Datasheet
Revision 2.10

MADE IN USA

The **Miniature Inertial Labs Attitude and Heading Reference System, miniAHRS** is a high-performance strapdown system that determines absolute orientation (heading, pitch and roll) for any device on which it is mounted. Orientation is determined with high accuracy for both motionless and dynamic applications.

The Inertial Labs MiniAHRS utilizes 3-axes each of precision accelerometers, magnetometers and 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 Pitch, Roll and magnetic Azimuth at AHRS initial alignment as well as providing ongoing corrections to gyroscopes during operation.

Parameter	MiniAHRS
Heading static accuracy, RMS	0.3 deg
Heading dynamic accuracy in temperature range, RMS	0.6 deg
Pitch & Roll static accuracy, RMS	0.08 deg
Pitch & Roll dynamic accuracy in temperature range, RMS	0.1 deg
Dimensions	53 × 19 × 13 mm
Weight	20 grams
Interface	RS-422

KEY FEATURES AND FUNCTIONALITY

- One model with multiple configurations at an exceptional price performance ratio
- State-of-the-art algorithms for different dynamic motions of Robots, UAV, UUV, UGV, AGV, ROV, Gimbals and Antennas
- Highly accuracy Magneto-Inductive and Fluxgate magnetometers
- Gyro-Stabilized Slaved Magnetic Heading
- Suitable for 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
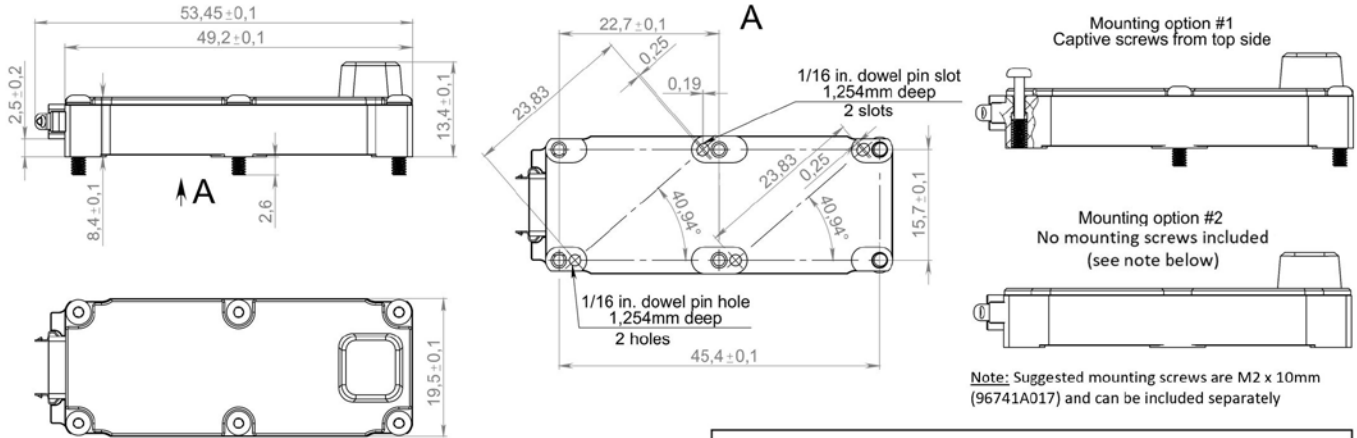- Environmentally sealed (IP67) and Compact design

One of the key elements to the success of Inertial Labs AHRS 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.
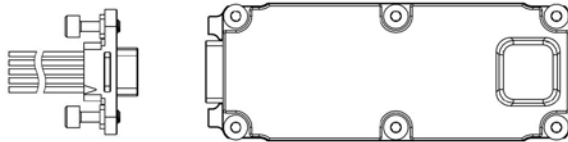
miniAHRS Specifications

Parameter	Units	MiniAHRS
Output signals		Heading, Pitch, Roll; Quaternion; PPS Time; Accelerations; Angular rates; Magnetic field; Delta Theta & Delta Velocity
Update rate	Hz	1 ... 2000 (user settable)
Start-up time	sec	< 1
Heading	**Units**	**MiniAHRS**
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**	**MiniAHRS**
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**	**MiniAHRS**
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**	**MiniAHRS**
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	0.02, 0.045, 0.06
Non-linearity	ppm, 1σ	340, 800, 1000
Axis misalignment	mrad, 1σ	0.15, 0.15, 0.2
Magnetometers	**Units**	**MiniAHRS**
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**	**MiniAHRS**
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	**Units**	**MiniAHRS**
Supply voltage	V DC	5 to 15
Power consumption	Watts	0.5
Output Interface	-	RS-422
Output data format	-	Binary, ASCII (in GUI)
Physical	**Units**	**miniAHRS**
Size	mm	53 × 19 × 13
Weight	gram	20

1σ specifications are manufactured to a controlled 3σ standard.

MiniAHRS mechanical interface drawing

Mounting option #1
Captive screws from top side

Mounting option #2
No mounting screws included
(see note below)

Note: Suggested mounting screws are M2 x 10mm
(96741A017) and can be included separately

Mating option #2 - screw-lock connector - G125-2241096F1

ADDITIONAL PARTS			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	SSBA-M2-10-A2	M2 x 10mm Captive Screws	6
2	96741A017	M2 x 10mm	6
3	97325A101	Brass Dowel Pin, 1/16" Diameter, 1/4" Long	2
4	G125-FC11005F1-0150L	Screw-lock connector with cable	1

MiniAHRS electrical interface description
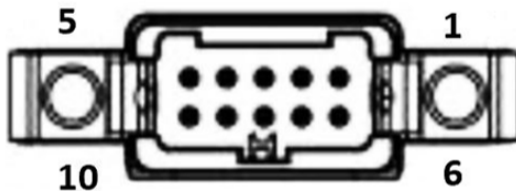
1	POWER	Power Supply Input (3.5V-15V)
2	RESERV	Reserved for future
3	RESERV	Reserved for future
4	RS422-A	RS-422 Non-Inverting Input
5	RS422-B	RS-422 Inverting Input
6	GROUND	Power Supply Return
7	TOV	Time of validity output (by request)
8	EXTRIG	External trigger input (by request)
9	RS422-Y	RS-422 Non-Inverting Output
10	RS422-Z	RS-422 Inverting Output

Product Code description

Model	Gyro Range	Accel. Range	Calibrated	Case	Color	Version	Interface
miniAHRS	G2000	A8	TMGA	C12	B	V1.X	X.2
		A15		C22			
		A40					

Example: miniAHRS-G2000-A8-TMGA-C22-B-V1.2

- miniAHRS: Miniature Version of the Attitude and Heading Reference System
- 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
- C12: Aluminum case, mounting option #1 mating option #2 (Captive screws; reference mechanical drawing)
- C22: Aluminum case, mounting option #2 mating option #2 (No screws included; reference mechanical drawing)
- V1X: Version 1
- X.2: RS-422 Interface