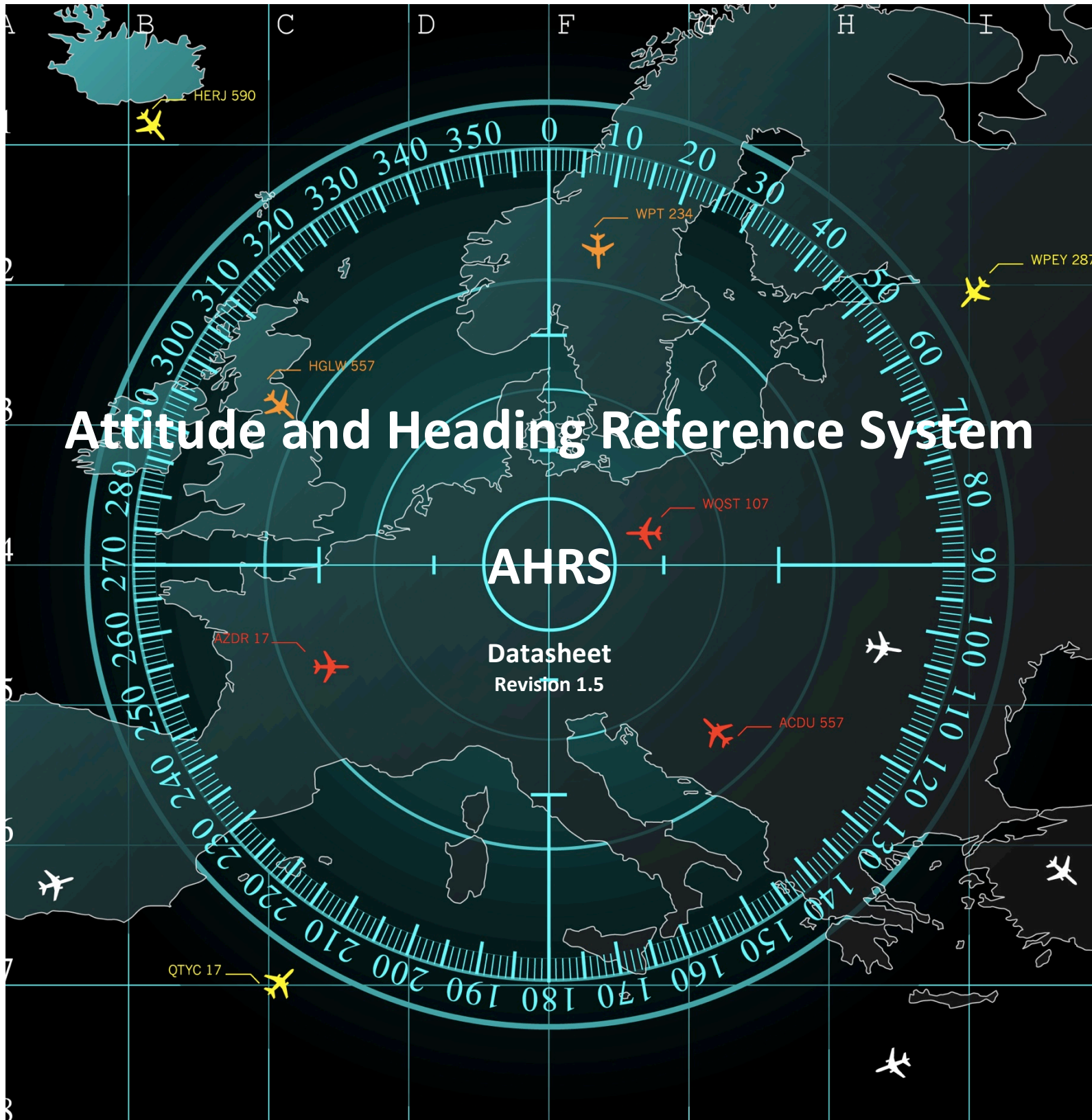# Inertial Labs

Attitude and Heading Reference System

AHRS

Datasheet
Revision 1.5

The **Inertial Labs**[TM] **Attitude and Heading Reference System − AHRS** 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[TM] AHRS 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.

KEY FEATURES AND FUNCTIONALITY

- No export restrictions. Export Classification: Commerce ECCN7A994
- State-of-the-art algorithms for different dynamic motions of Robots, UAV, UUV, UGV, AGV, ROV, Gimbals and Antennas
- Highly accurate, sensitive, and temperature stable Fluxgate magnetometers (in-house technology)
- Gyro-Stabilized Slaved Magnetic Heading
- Suitable for Primary Attitude Reference
- Advanced, extendable, embedded 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
- Up to 100Hz data update rate
- Tested to MIL-STD-810F, MIL-STD-461D and DO-160D standards
- Environmentally sealed (IP67)
- Compact design

One of the key elements to the success of Inertial Labs[TM] AHRS is its use of **Inertial Labs**[TM] **8mm Fluxgate Magnetometers**.

Inertial Labs[TM] **Fluxgate Magnetometer** 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.
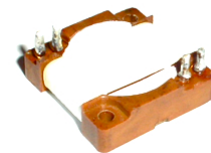
In addition to the performance advantages, unlike the chip-level magnetometer technology, fluxgate magnetometer technology has been depended on for over 70 years to provide an accurate reference to North. It remains the most reliable magnetic sensor technology for determining an object's heading.

InertialLabs

AHRS Specifications

Parameter	Units	AHRS part numbers		
		AHRS-G300-A2-TMGA-C1-V1.1	AHRS-G300-A2-TGA-C1-V1.1	AHRS-G300-A6-TGA-C1-V1.1
Output signals		Euler angles; Quaternion; Accelerations; Angular rates; Magnetic field, Delta Theta and Delta Velocity		
Update rate	Hz	1 … 100 (user settable)		
Start-up time	sec	< 1		
Full Accuracy Data (Warm-up Time) [1]	sec	30		
Heading		AHRS-G300-A2-TMGA-C1-V1.1	AHRS-G300-A2-TGA-C1-V1.1	AHRS-G300-A6-TGA-C1-V1.1
Range	deg	0 to 360		
Angular Resolution	deg	0.01		
Static Accuracy in whole Temperature Range [2]	deg	0.4	0.7	1.0
Dynamic Accuracy [3]	deg RMS	0.7	1.0	1.5
Noise (at 100 Hz output)	deg RMS	0.03	0.03	0.03
Attitude		AHRS-G300-A2-TMGA-C1-V1.1	AHRS-G300-A2-TGA-C1-V1.1	AHRS-G300-A6-TGA-C1-V1.1
Range: Pitch, Roll	deg	±90, ±180		
Angular Resolution	deg	0.01		
Static Accuracy in whole Temperature Range	deg	0.1	0.1	0.2
Dynamic Accuracy [3]	deg RMS	0.3	0.3	0.5
Noise (@100 Hz)	deg RMS	0.02	0.02	0.02
Angular Rate		AHRS-G300-A2-TMGA-C1-V1.1	AHRS-G300-A2-TGA-C1-V1.1	AHRS-G300-A6-TGA-C1-V1.1
Gyroscopes measurement range [4]	deg/s	±300	±300	±300
In-run Bias Stability at Constant Temperature	deg/s RMS	0.02	0.02	0.02
Bias stability in whole Temperature Range	deg/s RMS	0.2	0.2	0.2
Scale Factor Accuracy	%	0.1	0.1	0.1
Gyroscopes noise	deg/sec√Hz	0.035	0.035	0.035
Axis misalignment	mrad	0.15	0.15	0.15
Resolution	deg/sec	0.01	0.01	0.01
Bandwidth	Hz	50	50	50
Linear Acceleration		AHRS-G300-A2-TMGA-C1-V1.1	AHRS-G300-A2-TGA-C1-V1.1	AHRS-G300-A6-TGA-C1-V1.1
Accelerometers measurement range	g	±2	±2	±6
In-run Bias Stability at Constant Temperature	mg RMS	0.05	0.05	0.1
Bias Stability in whole Temperature Range	mg RMS	1	1	2
Bias turn-on, turn-on repeatability	mg RMS	0.1	0.1	0.1
Scale Factor Accuracy	%	0.1	0.1	0.2
Accelerometers noise	mg√Hz	0.04	0.04	0.09
Axis misalignment	mrad	0.15	0.15	0.15
Resolution	mg	0.1	0.1	0.2
Bandwidth	Hz	50	50	50
Environment		AHRS-G300-A2-TMGA-C1-V1.1	AHRS-G300-A2-TGA-C1-V1.1	AHRS-G300-A6-TGA-C1-V1.1
Operating temperature	deg C	-40 to +70		
Storage temperature	deg C	-50 to +85		
Non-operating vibration [5]	g, Hz	10-50Hz, 0.15mm/55-500Hz 2.0g		
Non-operating shock [6]	g, ms	50g, 11ms, half sine wave		
MTBF	hours	55500		
Electrical		AHRS-G300-A2-TMGA-C1-V1.1	AHRS-G300-A2-TGA-C1-V1.1	AHRS-G300-A6-TGA-C1-V1.1
Supply voltage	V DC	+5.5 to +6.5		
Current draw in readiness mode	mA	85	85	87
Current draw in sleep mode	mA	15	15	15
Connector	-	6-Pin Binder 718 (Female)		
Output Interface [7]	-	RS-232		
Physical		AHRS-G300-A2-TMGA-C1-V1.1	AHRS-G300-A2-TGA-C1-V1.1	AHRS-G300-A6-TGA-C1-V1.1
Size	mm	90 × 27 × 26		
Weight	gram	73		

[1] including time of initial alignment, it may be decreased on request
[2] in homogeneous magnetic environment, for latitude up to ±65 deg
[3] dynamic accuracy may depend on type of motion
[4] AHRS modification with ±1,000 deg/sec gyro measurement range is also available
[5] MIL-STD 810F. Method 514.5. Procedure I
[6] MIL-STD 810F. Method 516.5. Procedure I
[7] AHRS modification with NMEA protocol is also available

Inertial Labs Attitude and Heading Reference Systems available models and part numbers

| AHRS part number	Gyroscopes measurement range (±deg/sec)	Accelerometers measurement range (±g)	Interface	Heading accuracy (deg)		Attitude accuracy (deg)	
				Static	Dynamic	Static	Dynamic
AHRS-G300-A2-TMGA-C1-V1.1	300	2	RS-232	0.4	0.7	0.1	0.3
AHRS-G300-A2-TGA-C1-V1.1	300	2	RS-232	0.7	1	0.1	0.3
AHRS-G300-A2-TGA-C1-V1.2	300	2	RS-232-NMEA	0.7	1	0.1	0.3
AHRS-G300-A6-TGA-C1-V1.1	300	6	RS-232	1	1.5	0.2	0.5
AHRS-G300-A6-TGA-C1-V1.2	300	6	RS-232-NMEA	1	1.5	0.2	0.5
AHRS-G1000-A2-TMGA-C1-V1.1	1,000	2	RS-232	0.4	0.7	0.1	0.3
AHRS-G1000-A2-TGA-C1-V1.1	1,000	2	RS-232	0.7	1	0.1	0.3
AHRS-G1000-A2-TGA-C1-V1.2	1,000	2	RS-232-NMEA	0.7	1	0.1	0.3
AHRS-G1000-A6-TGA-C1-V1.1	1,000	6	RS-232	1	1.5	0.2	0.5
AHRS-G1000-A6-TGA-C1-V1.2	1,000	6	RS-232-NMEA	1	1.5	0.2	0.5

AHRS mechanical interface drawing
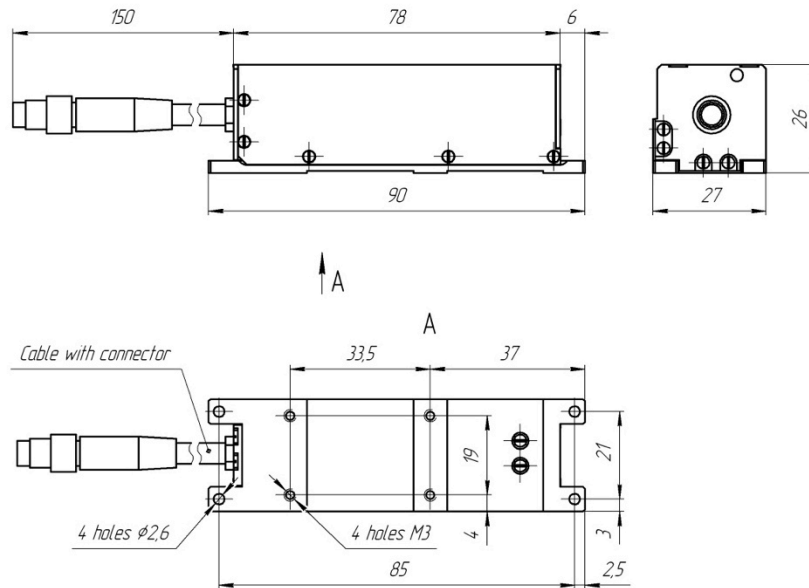
Notes:
1.   All dimensions are in millimeters.
2.   All dimensions within this drawing are subject to change without notice. Customers should obtain final drawings before designing any interface hardware.

AHRS electrical interface description
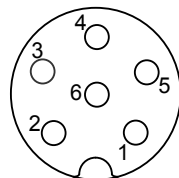
Inertial Labs AHRS
Binder Series 718 Female 6-Pin Connector Pin Out

Pin	Signal
1	Do not connect
2	Tx
3	Rx
4	GND
5	V_{DD}
6	Do not connect

For electrical connection of Inertial Labs AHRS to the host system, a Binder Series 718 male 6 pins cable connector (cordset), part # 79-3465-52-06 or compatible, should be used