# ATTITUDE AND HEADING REFERENCE SYSTEMS, AHRS-II

The DILABS Attitude and Heading Reference Systems, AHRS-II is the next generation of enhanced, high-performance strapdown systems 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.
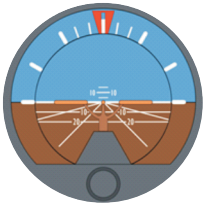
The DILABS AHRS-II-P utilizes Tactical-grade IMU: 3-axes each of precision accelerometers & gyroscopes and Ultra High precision, gyro-compensated, embedded Fluxgate Compass to provide accurate Heading/Yaw, Pitch and Roll of the device under measure.

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

- State-of-the-art Kalman Filter based algorithms for different dynamic motions of UAV, Aircrafts, Helicopters, Vessels, Ships, ROV, UUV, Robots, UGV, AGV, Gimbals & Antennas
- Highly accurate, sensitive, and temperature stable Fluxgate magnetometers (in-house technology)
- Input from External GNSS Receiver;
- 0.6 deg Gyro-Stabilized Heading and 0.08 deg Pitch & Roll Dynamic Accuracy over operational temperature range
- 1 deg/hr gyroscopes Bias in-run stability
- 5µg accelerometers Biasin-run stability
- Suitable for Primary Attitude Reference & as Motion Control System for marine applications
- Embedded 2D and 3D magnetic calibration on hard and soft iron
- RS-232, RS-422, and CAN 2.0 interfaces
- Full temperature calibration of all sensing elements
- Up to 200Hz data update rate (AHRS) and 2000 Hz data rate (IMU)
- Compact design. Environmentally sealed (Ip67)

One of the key elements to the success of DILABS AHRS-II is its use of 8mm Fluxgate Magnetometers, which have 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.

AHRS-II-P KEY SPECIFICATIONS SUMMARY

PARAMETER	UNITS	
Heading Static Accuracy	deg	0.3
Heading Dynamic Accuracy	deg	0.6 (gyro magnetic)
Heading Dynamic Accuracy	deg	0.1 (with GNSS input)
Pitch & Roll Static Accuracy	deg	0.05
Pitch & Roll Dynamic Accuracy	deg	0.08
Gyroscopes Bias in-run Stability	deg/hr	1
Accelerometers Bias in-run Stability	mg	0.005

AHRS-II-P KEY PERFORMANCE

PARAMETER	UNITS	AHRS-II-P	
STATUS		IN PRODUCTION	
Output signals	Without GNSS Input	Euler angles; Quaternion; Relative Altitude; IMU data (angular rates, accelerations); Magnetic field; Pressure; Delta Theta, Delta Velocity	
	With GNSS Input	Horizontal & Vertical Positions (LAT, LONG); Heading, Pitch, Roll, Velocity, PPS time, IMU data (angular rates, accelerations)	
Input Signals		External GNSS receiver, External magnetic compass	
Update Rate (AHRS data)	Hz	1 … 200 (user settable)	
Update Rate (IMU data)	Hz	2000	
Start-up Time	Sec	<1	
Full Accuracy Data (Warm-up Time)	Sec	10	
HEADING	**UNITS**	**AHRS-II-P**	
Range	deg	0 to 360	
Angular Resolution	deg	0.01	
Static Accuracy Over Operational Temperature Range	deg RMS	0.3	
Dynamic Accuracy Over Operational Temperature Range	deg RMS	0.6	
Dynamic Accuracy with GNSS input	deg RMS	0.1	
PITCH & ROLL	**UNITS**	**AHRS-II-P**	
Range: Pitch, Roll	deg	±90, ±180	
Angular Resolution	deg	0.01	
Static Accuracy in whole Temperature Range	deg	0.05	
Dynamic Accuracy Over Operational Temperature Range	deg RMS	0.08	
Dynamic Accuracy with GNSS input	deg RMS	0.05	
RELATIVE ALTITUDE	**UNITS**	**AHRS-II-P**	
Measurement range	Meters	-600 to 9000	
Resolution	Meters	0.01	
Relative accuracy	Meters	<1	
GYROSCOPES	**UNITS**	**AHRS-II-P**	
Type		Tactical-grade	
Measurement range	deg/sec	±450 / ±950 / ±2000	
Bandwidth	Hz	262	
Bias in-run stability (RMS, Allan Variance)	deg/hr	1	
Bias residual error over operational temperature range	deg/hr, RMS	<35	
SF accuracy	ppm	1000	
Noise (Angular Random Walk)	deg/√hr	<0.2	
Non-linearity	ppm	100	
Axis misalignment	mrad	0.15	
ACCELEROMETERS	**UNITS**	**AHRS-II-P**	
Type		Tactical-grade	
Measurement range	g	±8 g / ±15 g / ±40 g	
Bandwidth	Hz	262	
Bias in-run stability (RMS, Allan Variance)	mg	0.005 (±8 g) / 0.02 (±15 g) / 0.03 (±40 g)	
Bias error over temperature range (RMS)	mg	0.5 (±8 g) / 0.7 (±15 g) / 1.2 (±40 g)	
Bias one-year repeatability	mg	1.0 (±8 g) / 1.3 (±15 g) / 1.5 (±40 g)	
Velocity Random Walk	m/s/√hr	0.015 (±8 g) / 0.035 (±15 g) / 0.045 (±40 g)	
SF accuracy	ppm	150 (±8 g) / 300 (±15 g) / 500 (±40 g)	
Non-linearity	ppm	100	
Axis misalignment	mrad	0.15	
MAGNETOMETERS (EMBEDDED FLUXGATE COMPASS)	**UNITS**	**AHRS-II-P**	
Measurement range	Gauss	±1.6	
Bias in-run stability, RMS	nT	0.2	
Noise density, PSD	nT√hz	0.3	
SF accuracy	%	0.02	
Bandwidth	Hz	50	
PRESSURE	**UNITS**	**AHRS-II-P**	
Measurement range	hPa	300 – 1100	
Bandwidth	Hz	50	
Resolution	Pa	2	
Bias in-run stability (RMS, Allan Variance)	Pa	0.8	
Noise density	Pa/√hz	1	
ENVIRONMENT	**UNITS**	**AHRS-II-P**	
Operating temperature	deg C	-40 to +70	
Storage temperature	deg C	-50 to +85	
MTBF (GM @ +65degC)	hours	100,000	
Vibration & Shock		MIL-STD-810G	
EMC/EMI		MIL-STD-461	
ELECTRICAL	**UNITS**	**AHRS-II-P**	
Supply voltage	V DC	9 to 36	
Power consumption	Watts	1.4 (2.4 with data logger)	
Output Interface		RS-232, RS-422, CAN 2.0	
Output data format		Binary, NMEA 0183 ASCII characters	
PHYSICAL	**UNITS**	**AHRS-II-P**	
Size	mm	120 x 50 x 53	
Weight	Gram	280	