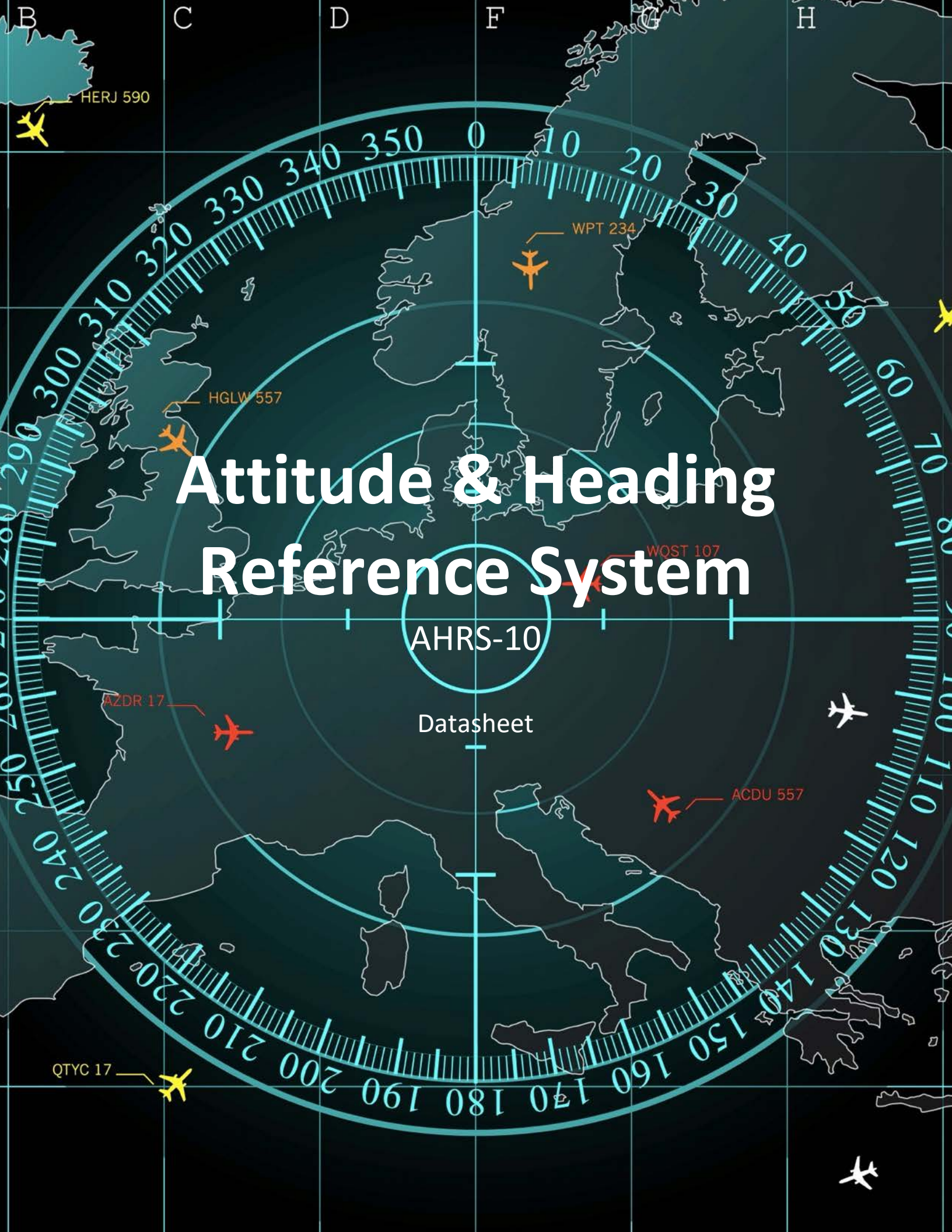


Attitude & Heading Reference System

AHRS-10

Datasheet

Inertial Labs Attitude and Heading Reference System, AHRS-10 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.

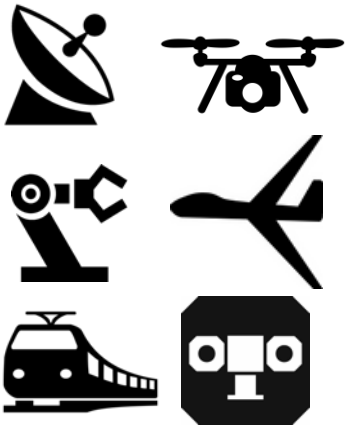
The Inertial Labs AHRS-10 utilizes 3-axes each of precision accelerometers, magnetometers and gyroscopes to provide accurate Heading, Pitch and Roll of the device under measure. Integration of gyroscopes' output provides high frequency, real-time measurement of the device rotation about all three rotational 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.

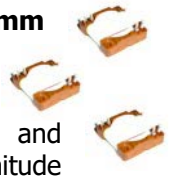
Parameter	AHRS-10B	AHRS-10P
Heading dynamic accuracy in temperature range, RMS	0.6 deg	0.6 deg
Pitch & Roll dynamic accuracy in temperature range, RMS	0.08 deg	0.05 deg
Gyroscopes Bias instability in temperature range, RMS	72 deg/hr	30 deg/hr
Accelerometers Bias instability in temperature range, RMS	0.7 mg	0.5 mg
Dimensions	90 × 27 × 26 mm	90 × 27 × 26 mm
Weight	77	84
Interface	RS-422	RS-232, RS-422, CAN

KEY FEATURES AND FUNCTIONALITY

- Two models (10B and 10P) with differentiated performance and price
- 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 **Inertial Labs 8mm Fluxgate Magnetometers** which has distinct advantages over commonly used magneto-inductive or magneto-resistive magnetometers.



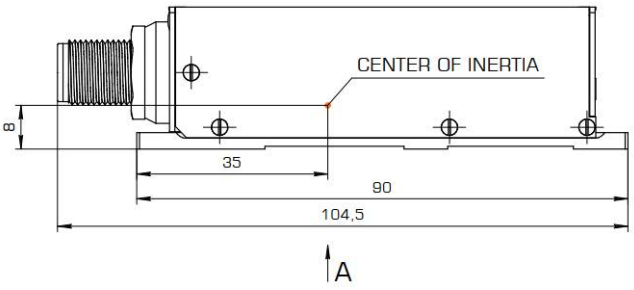
In operation over time and temperature fluxgate magnetometers have superior stability and repeatability. In terms of sensitivity, fluxgate magnetometers provide up to two orders of magnitude increased sensitivity.

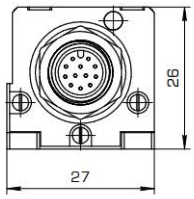
In addition to the performance advantages, unlike the chip-level magnetometer technology, fluxgate magnetometer technology has been depended on for over 70 years to provide an accurate reference to North. It remains the most reliable magnetic sensor technology for determining an object's heading.

Parameter	Units	AHRS-10B	AHRS-10P
Output signals	Heading, Pitch, Roll; Quaternion; Relative Altitude; PPS Time; Accelerations; Angular rates; Magnetic field; Delta Theta & Delta Velocity		
Available colors of enclosure	Black (default), Desert Tan or Green (optional)		
Max Output Data Rate	Hz	1 … 2000 (user settable)	1 … 200 (user settable)
Internal Update Rate	Hz	2000 (IMU data)	2000 (IMU data)
Start-up time	sec	< 1	
Heading	**Units**	**AHRS-10B**	**AHRS-10P**
Range	deg	0 to 360	0 to 360
Angular Resolution	deg	0.01	0.01
Static Accuracy in Temperature Range	deg, RMS	0.3	0.3
Dynamic Accuracy	deg RMS	0.6	0.6
Pitch and Roll	**Units**	**AHRS-10B**	**AHRS-10P**
Range: Pitch, Roll	deg	±90, ±180	±90, ±180
Angular Resolution	deg	0.01	0.01
Static Accuracy in Temperature Range	deg, RMS	0.05	0.03
Dynamic Accuracy	deg RMS	0.08	0.05
Relative altitude	**Units**	**AHRS-10B**	**AHRS-10P**
Measurement range	meters	-600 to 9000	-600 to 9000
Resolution	meters	0.01	0.01
Gyroscopes	**Units**	**AHRS-10B**	**AHRS-10P**
Measurement range	deg/sec	±2000	±450 / ±950 / ±2000
Bandwidth	Hz	260	260
Bias in-run stability (RMS, Allan Variance)	deg/hr	2	1
Bias instability (over temperature range, RMS)	deg/hr	72	30
SF accuracy	ppm	1000	1000
Noise. Angular Random Walk (ARW)	deg/√hr	0.38	0.2
Non-linearity	ppm	350	100
Axis misalignment	mrad	0.15	0.15
Accelerometers	**Units**	**AHRS-10B**	**AHRS-10P**
Type		Tactical-grade	Tactical-grade
Measurement range	g	±8 / ±15 / ±40	±8 / ±15 / ±40
Bandwidth	Hz	260	260
Bias in-run stability (RMS, Allan Variance)	mg	0.01 (±8 g) / 0.03 (±15 g) / 0.05 (±40 g)	0.005 (±8 g) / 0.02 (±15 g) / 0.03 (±40 g)
Bias instability over temp. range (RMS)	mg	0.7 (±8 g) / 1.1 (±15 g) / 1.5 (±40 g)	0.5 (±8 g) / 0.7 (±15 g) / 1.2 (±40 g)
Bias one-year repeatability	mg	1.5 (±8 g) / 2.0 (±15 g) / 2.5 (±40 g)	1.0 (±8 g) / 1.3 (±15 g) / 1.5 (±40 g)
Noise. Velocity Random Walk (VRW)	m/s/√hr	0.02 (±8 g) / 0.045 (±15 g) / 0.06 (±40 g)	0.015 (±8 g) / 0.035 (±15 g) / 0.045 (±40 g)
SF accuracy (over temperature range)	ppm	500 (±8 g) / 700 (±15 g) / 850 (±40 g)	150 (±8 g) / 300 (±15 g) / 500 (±40 g)
Non-linearity	ppm	340 (±8 g) / 800 (±15 g) / 1000 (±40 g)	150
Axis misalignment	mrad	0.15 (±8 g) / 0.15 (±15 g) / 0.2 (±40 g)	0.1 (±8 g) / 0.1 (±15 g) / 0.15 (±40 g)
Magnetometers	**Units**	**AHRS-10B**	**AHRS-10P**
Technology		Magneto Inductive	Fluxgate
Measurement range	Gauss	±8.0	±1.6
Bias in-run stability, RMS	nT	0.8	0.2
Noise density, PSD	nT√Hz	0.15	0.3
SF accuracy	%	0.05	0.02
Environment	**Units**	**AHRS-10B**	**AHRS-10P**
Operating temperature	deg C	-40 to +75	-40 to +75
Storage temperature	deg C	-50 to +85	-50 to +85
Shock & Vibrations		MIL-STD-810G	MIL-STD-810G
MTBF (G_M)	hours	500,000	100,000
Electrical	**Units**	**AHRS-10B**	**AHRS-10P**
Supply voltage	V DC	5 to 15	9 to 28
Power consumption	Watts	0.5	2.0
Output Interface	-	RS-422	RS-232 / RS-422 / CAN
Output data format	-	Binary, ASCII (in GUI)	Binary, NMEA ASCII
Physical	**Units**	**AHRS-10B**	**AHRS-10P**
Size [1]	mm	90 x 27 x 26	90 x 27 x 26
Weight [1]	gram	77	84

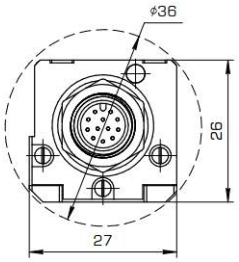
[1] *Weight and size are PN dependent. Customers should obtain the most recent 2D/3D files before designing any interface hardware.*

AHRS-10P mechanical interface drawing (standard configuration)



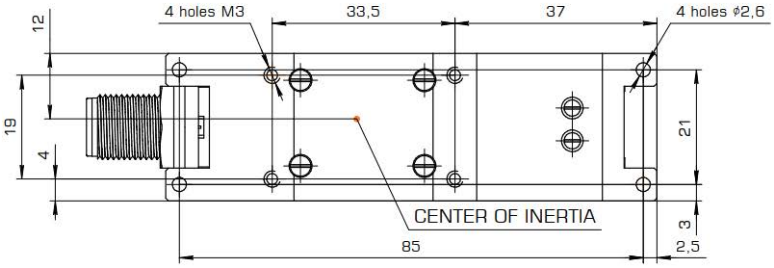


Default (C1)



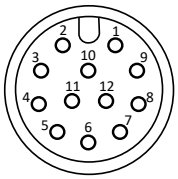
Optional (C13)

A



Notes:
1. All dimensions are in millimeters.
2. All dimensions within this drawing are subject to change without notice.
3. Weight and size are PN dependent. Customers should obtain the most recent 2D/3D files before designing any interface hardware.
4. Please contact Inertial Labs, Inc. if you need the AHRS-10 unit to be delivered in a custom configuration with customized connector and output data.

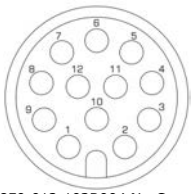
Electrical interface description



859-012-103R004 NorComp
12 Position Circular Connector
Receptacle, Male Pins Solder
Cup Gold

AHRS-10P		
RS-232 and RS-422 interfaces		
PIN	Signal	Description
1	RS422-A	RS-422 Non-Inverting Input
2	RS232-RX	RS232 Receiver Input
3	RS232-TX	RS232 Transmitter Output
4	Power	Power Supply Input 9V-30V DC
5	ExtInp	3.3 V External input
6	1PPS/TOV	Pulse Per Second/Time of validity output
7	RS422-Z	RS-422 Inverting Output
8	RS422-Y	RS-422 Non-Inverting Output
9	RS422-B	RS-422 Inverting Input
10	LD	Load
11	Ground	Power Supply Return
12	GND	Ground signal

AHRS-10P		
RS-232 and CAN interfaces		
PIN	Signal	Description
1	RS232-RX-2	Secondary RS232 Receiver Input
2	RS232-RX	RS232 Receiver Input
3	RS232-TX	RS232 Transmitter Output
4	Power	Power Supply Input 9V-30V DC
5	ExtInp	3.3 V External input
6	1PPS/TOV	Pulse Per Second/ Time of validity output
7	CAN_L	CAN(Low)-Bus differential signal
8	CAN_H	CAN(high)-Bus differential signal
9	RS232-TX-2	Secondary RS232 Transmitter Output
10	LD	Load
11	Ground	Power Supply Return
12	GND	Ground signal



859-012-103R004 NorComp
12 Position Circular Connector
Receptacle, Male Pins Solder
Cup Gold

AHRS-10B		
RS-422 interface		
PIN	Signal	Description
1	RS422-RX+	Non-Inverted Input
2	Reserved	
3	1PPS	1pps 3.3v TTL Input
4	Power IN	Power Supply In (4v to 15v)
5	EXTRIG	EXTRIG 3.3v TTL Input
6	TOV	TOV 3.3v TTL Output
7	RS422-TX-	Inverted Output
8	RS422-TX+	Non-Inverted Output
9	RS422-RX-	Inverted Input
10	Load	Firmware Update Mode
11	Power RTRN	Power Return (tied to GND)
12	Signal GND	GND Reference For Signals

Product Code Structure

AHRS-10B							
Model	**Gyro**	**Accel**	**Calibration**	**Connector**	**Color**	**Version**	**Interface**
AHRS-10B	G2000	A8	TMGA	C1 (default)	B (default)	V2	2
		A15		C4 (obsolete)	D		
		A40		C13 (modified enclosure)	G		

Example: AHRS-10B-G2000-A8-TMGA-C1-B-V2.2

AHRS-10P							
Model	**Gyro**	**Accel**	**Calibration**	**Connector**	**Color**	**Version**	**Interface**
AHRS-10P	G450	A8	TMGA	C1 (default)	B (default)	V1	12
	G950	A15		C4 (obsolete)	D		13
	G2000	A40		C13 (modified enclosure)	G		

Example: AHRS-10P-G450-A8-TMGA-C1-B-V1.12

Description:

- G450: Gyroscopes measurement range = ±450 deg/sec
- G950: Gyroscopes measurement range = ±950 deg/sec
- 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
- C1: 12 pins connector (859-012-103R004 NorComp 12 Position Circular Connector Receptacle, Male Pins Solder Cup Gold)
- C4: 4-inch (10 cm) cord, terminated by Binder 6 PIN connector – not recommended for new design
- C13: 12 pins connector with modified enclosure (36 mm diameter – see above drawing)
- B: Black color (default)
- D: Desert tan color (optional)
- G: Green color (optional)
- V2.2 RS-422 (AHRS-10B)
- V1.12: RS-232 and RS-422 (AHRS-10P)
- V1.13: RS-232 and CAN