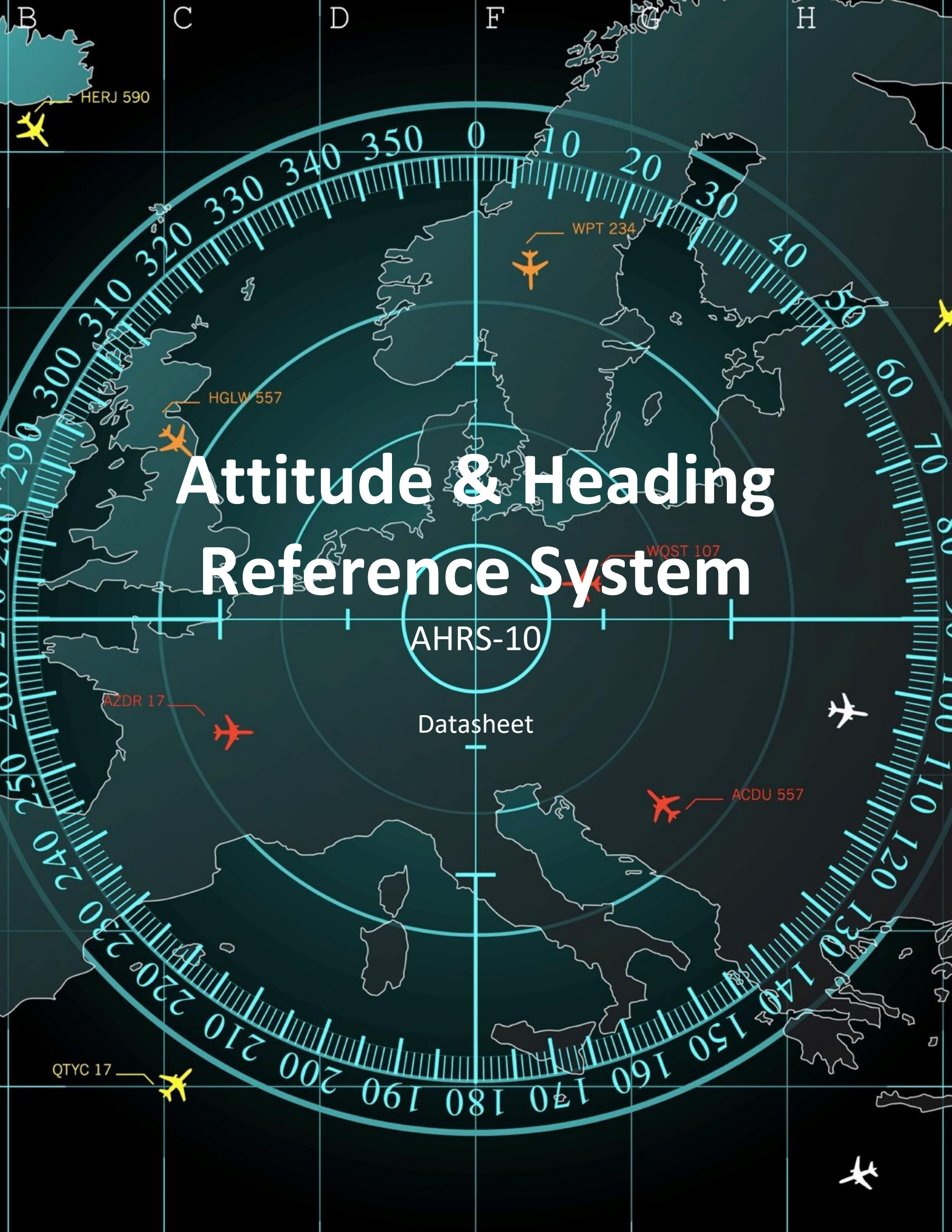


Attitude & Heading Reference System

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 | 0.08 deg |
| Gyroscopes Bias instability in temperature range, RMS | 72 deg/hr | 35 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.

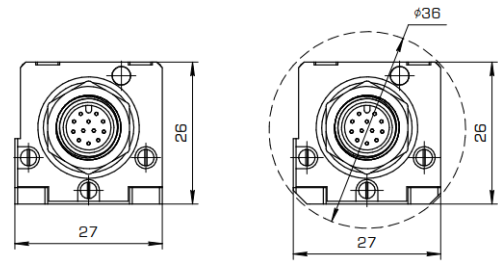
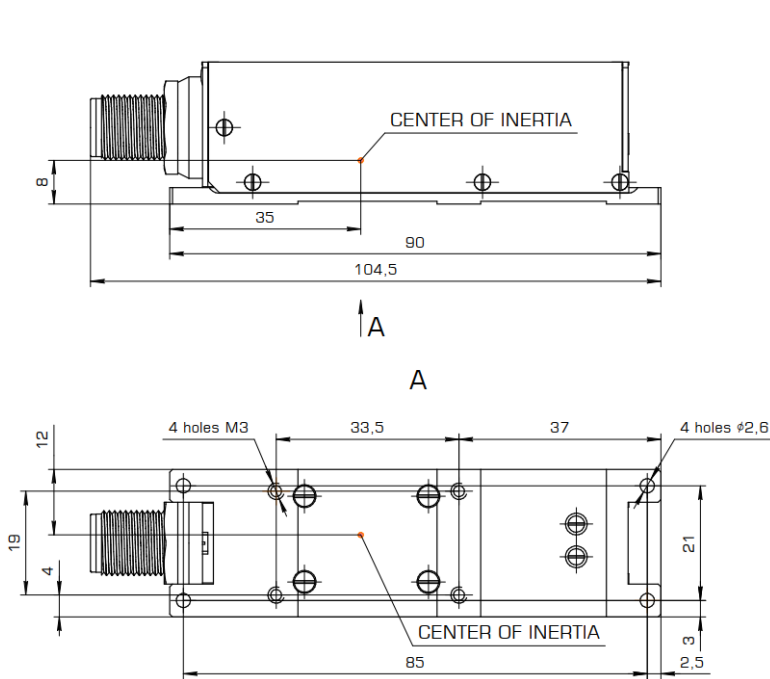
In addition to the performance advantages, unlike the chip-level magnetometer technology, fluxgate magnetometer technology has been depended on for over 70 years to provide an accurate reference to North. It remains the most reliable magnetic sensor technology for determining an object's heading.



| 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) | |
| 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 | 0.05 |
| Dynamic Accuracy | deg RMS | 0.08 | 0.08 |
| 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 | 35 |
| SF accuracy | ppm | 1000 | 1000 |
| Noise. Angular Random Walk (ARW) | deg/hr | 0.38 | 0.2 |
| Non-linearity | ppm | 350 | 100 |
| Axis misalignment | mrاد | 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 | mrاد | 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 ⁽²⁾ | 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)



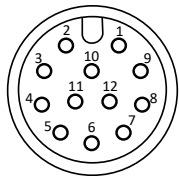
Default (C1)

Optional (C13)

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.

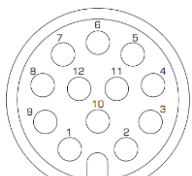
Electrical interface description



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 A15 A40 | TMGA | C1 (default) C4 (obsolete) C13 (modified enclosure) | B (default) D G | V2 | 2 |

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

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

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