



## Watson Industries Application Notes

### Remote Piloted Submarines

Normally, small submersibles are stabilized by the pilot's actions in response to the orientation of the sub. In the case of remotely piloted subs, the pilot is not on board so there is no human "feel" for the orientation of the vehicle. This situation can lead to damage or loss of the submersible. Since the cost of the vehicles as well as the expense of at-sea operations is quite high, a sensor package is necessary that can reliably transmit accurate data on the attitude of the sub.



Remotely piloting a submersible requires a full attitude sensor. Heading data is necessary to navigate the vehicle to its destination. Pitch and roll data is also required to provide an accurate picture of the vehicle's orientation. Other important features of the sensor package are wide bandwidth, low power consumption, and high reliability.

Watson Industries offers the Attitude and Heading Reference System (AHRS) for this application. The AHRS provides bank, elevation and heading data. Additionally, the AHRS can output roll, pitch and yaw rates, X, Y and Z accelerations and X, Y and Z magnetometer data if requested.

#### **Technical Challenges:**

The primary problem with providing a sensor for this application is the difficult magnetic environment of the submersible. Undersea vehicles cannot use GPS for their heading reference, so a magnetometer is required. The problem with using magnetometers in submersibles is that they have large steady state magnetic fields and also create large variable magnetic fields.

Magnetometers provide a heading reference by sensing the Earth's magnetic field. This means that any extraneous magnetic fields in the vicinity will induce heading errors. Submersibles can create steady state magnetic fields of over 400 milliGauss. Considering that the Earth's field is only about 650 milliGauss, considerable heading errors can result. These vehicles also have motors, relays, batteries and high current carrying conductors that can create a highly variable magnetic field that again can induce heading errors. The two keys to solving these problems are mounting location and a highly sensitive magnetometer.



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The Watson AHRS has one of the best magnetometers on the market. The primary concern is finding the best mounting location on the vehicle. See our magnetometer mounting location paper online at [www.watson-gyro.com](http://www.watson-gyro.com) for more information on finding the best location. We also provide free software for calibrating the magnetometer after it has been installed to help to remove any remaining heading errors that may result from its mounting environment.

### **Watson Experience:**

Watson Industries has been manufacturing AHRS for this application since 1993.

### **Requirements:**

- Bank:  $\pm 45^\circ$ ,  $2^\circ$  accuracy
- Elevation:  $\pm 45^\circ$ ,  $2^\circ$  accuracy
- Heading:  $4^\circ$  accuracy
- Installation magnetic calibration

### **Applicable Products:**

- AHRS-E304
- AHRS-S305
- SHR-E360
- SHR-S360

### **Typical Options:**

We are able to accommodate your custom needs. Shown below is a listing of our most common custom modifications.

- Digital velocity input – Watson can support digital velocity inputs in many formats.
- Custom specifications – For certain applications, customers require specifications that are different from our standard units. Watson Industries engineering is willing and able to accommodate these needs.
- Input Voltage – Many different input voltages can be accommodated.
- Output Format – Communications Protocols RS-232, RS-485, RS-422, USB, Syncro.
- Data Format – We have made many products with custom formatted data outputs.
- Sensor Ranges – The ranges for most of our sensors can be expanded or reduced to meet your requirements.

Options specific to this application:

- Velocity Input – Analog Voltage
- Package Configuration – This unit can be repackaged to fit different profiles including installation inside a pressure vessel.



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