



There is a trend in experimental aircraft instrumentation towards electronic flight information displays due to their versatility and ability to clearly provide more information in a small space. These displays need an electronic signal from a solid-state attitude and heading gyro such as is provided by the Watson Industries' AHRS-E304.



Solid-state gyros are used because mechanical gyros have a very short life, typically a few thousand hours. The mean time between failure (MTBF) for the Watson Industries gyro package is many tens of thousands of hours. This is a safety issue since a more reliable gyro sensor system will result in fewer accidents related to avionics failures.

Watson Industries has the ideal sensor package for this application. The Watson Attitude and Heading Reference System (AHRS-E304) outputs bank elevation, heading, roll rate pitch rate and yaw rate. This provides the attitude indicator with all the necessary information on aircraft attitude and dynamics.

Technical Challenges:

Sustained dynamic maneuvers, and high rates are always possible during flight. All the sensors in the attitude system must have a range that is wide enough to track all the motions involved. When performing a sustained maneuver such as circling a location, bank errors due to centrifugal force could build up in the system. To correct this problem, a velocity input to the AHRS is required. The velocity data is used with the turn rate to calculate the centrifugal force and remove its effects from the system. Velocity is normally transmitted to the Attitude and Heading Reference System via an analog voltage, but we have options available for the sensor to receive velocity digitally as well.

The heading output for the AHRS-E304 is referenced to the magnetic heading provided by an internal magnetic compass. This means that any extraneous magnetic fields in the vicinity will induce heading errors. Installation in an aircraft can be difficult because of the magnetic environment. Aircraft can have 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 create highly variable magnetic fields that can induce heading errors. Finding a mounting location that is magnetically clean is key to solving this issue.

Watson Industries has rate gyros with enough range for any higher-rate maneuvers. We strongly encourage you to read our magnetometer mounting location paper located on our



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website for more information on finding the best place to install your AHRS. We also provide free software for calibrating the AHRS internal compass 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 sensor packages for this application since 1995.

Requirements:

- Roll, Pitch and Yaw Rate $\pm 100^\circ/\text{sec}$
- X, Y, and Z Acceleration $\pm 10\text{G}$
- Airspeed Input – The possibility of sustained dynamic maneuvers requires airspeed be read into the sensor to allow calculation of and correction for those dynamics. The standard input format is an analog voltage. A digital airspeed signal from GPS or another source is available as a custom option.
- Magnetically Clean Installation Location
- Installation digital compass calibration

Applicable Products:

- Pro Gyro® Rate Gyros
- ARS Rate Gyros
- ARS-G152
- ARS-C332-3A
- ARS-E332
- AHRS-E304
- AHRS-S305
- DMS-SGP02
- DMS-EGP02

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 such as GPS and air data sensors.
- External GPS reference – We have built custom units that utilize GPS data as a velocity and / or heading reference.
- 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:

- Digital airspeed input from GPS or other source.

05/19 DAO



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