



Watson Industries Application Notes

Aerobatic Piloting Display

Gyros in aerobatic aircraft experience one of the most mechanically demanding environments. A gyro used for this application must be capable of maintaining accuracy through high G maneuvers and sustained motions.

While the attitude display is occasionally useful in performing aerobatics, the most important aspect is that the reliability of the sensor package is in no way impaired by their use in aerobatics. This is a safety issue since more accidents occur while in transit to and from air shows than at the shows themselves.



Watson Industries has the ideal sensor package for this application. The AHRS-E304 outputs attitude, roll, pitch and yaw rate, and X, Y and Z acceleration data. This provides the piloting display with all the necessary information on aircraft attitude and dynamics.

Technical Challenges:

Sustained dynamic maneuvers, high G's and high rates are common during an aerobatic performance. Any sensors that are part of an aerobatic attitude system must have a range that is wide enough to track all the motions involved.

The heading output for the AHRS-E304 is referenced to the magnetic heading provided by a magnetic compass. This means that any extraneous magnetic fields in the vicinity will induce heading errors. Installation in an aerobatic 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.



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Watson Industries has rate gyros with enough range for aerobatic operation. We strongly encourage you to read our magnetometer mounting location paper for more information on finding the best place to install your AHRS. 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 sensor packages for this application since 1997.

Requirements:

- Roll Rate $\pm 500^\circ/\text{sec}$
- Pitch and Yaw Rate $\pm 100^\circ/\text{sec}$
- X, Y, and Z Acceleration $\pm 10G$
- 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 magnetometer calibration

Applicable Products:

AHRS-E304/203
AHRS-E304/182

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 Airspeed Indicators.
- External GPS reference – We have built custom units that utilize GPS data as a 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.

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