Watson Industries Application Notes

High-Speed Train Tilt Control

The sole purpose of train tilt control is passenger comfort.

In the United States, high-speed trains must share the same tracks as all other rail services. Since the tracks were not initially designed for high speeds, especially in turns, the passenger cars of these trains are tilted while turning to alleviate the effects of centrifugal forces. A sensor is required that can provide highly accurate data on the vehicle dynamics to a computer that determines the degree of corrective tilt required to assure a smooth ride.

Watson Industries responded to this need by developing and producing the Train Measurement System (TMS). The TMS provides superelevation (roll angle), roll rate, yaw rate and lateral acceleration output data.

Technical Challenges:

One of the most difficult problems with this application is the required mounting location of the sensor. To provide accurate track data, the sensor must be mounted directly to the suspension bogie. Many solid-state gyros manufactured today are too shock and vibration sensitive for the bogie's 4 G vibration environment. However, the sensors that are used by Watson are rugged and will output accurate data in this environment for extended periods of time.

Furthermore, a sensor mounted on the outside of a train cab must be enclose in a rugged case to protect it from weather, debris, pressure washing and EMI/RFI. The Watson TMS is enclosed in a sealed, durable steel housing with internal vibration mounts and electrical isolation.

Watson Experience:

Watson Industries initially brought the TMS to market in 1993. In 1997 Watson began large-scale production to supply Amtrak's Acela high speed train.

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Requirements:

- High shock – 200 G
- Vibration – 4 Gs rms operational from 9 to 100 Hz
- Electrical isolation – 4 KVolts
- Submersible – NEMA Type 6 standards for submersion, corrosion and water spray due to pressure washing requirements.
- EMI/RFI protection – An electric locomotive has thousands of Amperes of current switching locally. Protection to 20 Volts per meter is required.
- Velocity Input – Our sensors in this application require a velocity input from an outside source. There are three options for this input: An analog voltage, digital RS-232 signal, or pulses from an encoder wheel.

Applicable Products:

- TMS-E232
- DMS-E604
- DMS-EGP01 (DMS with GPS option)

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:

- Non-standard mounting orientation

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