Temposonics®

Magnetostrictive, Absolute, Non-contact
Linear-Position Sensors

MTS SENSORS

MTS Sensors and Wind Tunnel Testing

Technical Article

Document Part Number
551384 Revision A

Model RF Flex-style position sensor

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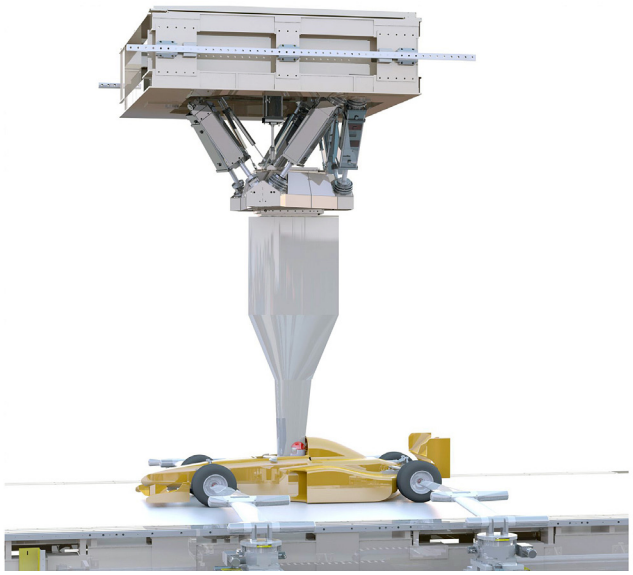
PUSHING PERFORMANCE TO ITS PEAK

When a NASCAR, IndyCar, or F1 racing vehicle takes a turn at speeds averaging greater than 150 miles per hour, the slightest change in the aerodynamic performance can make the difference between winning and finishing second.



The need for performance is no less evident in consumer vehicles. Better performance means better fuel efficiency, increased safety and a more marketable vehicle.

The MTS Rolling Road System simulates these high-stress environments in a controlled setting, allowing manufacturers and race teams to make design adjustments based on real data. The goal is to optimize vehicle designs for drag reduction, noise reduction, and better cross-wind stability. In motorsports, the search for reduced aerodynamic drag and increased down-force requires a moving belt and high measurement fidelity and repeatability. In passenger car development, today's demand for high efficiency and low emissions, along with low noise has led aerodynamicists to seek moving belt simulations to better optimize the vehicle underbody and wheel design.

Placed inside a wind tunnel, the Rolling Road System consists of multiple components. Similar to a treadmill in concept, the Rolling Road System incorporates a stainless steel belt that is just one millimeter thick. This belt glides over high pressure air bearings. Speeds of up to 180 miles per hour are simulated using a moving belt and massive fan in the wind tunnel. Struts similar to those used in airplane flight simulators are mounted to the ceiling and position the model car in the wind tunnel to simulate the car's position and rotational angle on the track.

"The role of the Rolling Road System is to give our customers a way to make small changes that translate into major performance advantages," Tyler Kuhlmann, Systems Product Development Manager, explained. "We do this by providing them with a completely controlled environment in which to test their vehicles – before they hit the pavement."

The system uses advanced software to enable highly accurate and robust vehicle performance evaluations. That includes sophisticated control and data acquisition capabilities that yield unprecedented insight into race car performance. Testing is conducted without the constraints common to fixed-floor wind tunnels that can limit test data integrity for low-ground-clearance motorsport vehicles.

Advanced Temposonics® magnetostrictive sensors, developed by the sensors divisions of MTS, control and monitor the placement of everything in the tunnel. Six R-Series sensors mounted to the ceiling constitute the heart of the MTS Model Motion System and control the position of the race car above the belt.

“The MTS Temposonics sensors provide the linear, accurate, and robust position feedback for the Model Motion System” says Victor Senft, Motorsports System Engineer at MTS. “This is critical for the Model Motion System since it positions the vehicle within only 1.5 mm of the belt moving at 180 mph!”

Additionally, the system measures miniscule changes in vehicle lift, drag and side force. That feedback is especially useful in monitoring vehicle performance during tight cornering and can be used to make adjustments that significantly impact the downforce ratio between the four tires.

“The R-Series linear positioning sensors used in the Model Motion System allow for precise control over the position of the car or model in the tunnel. The Model Motion System can accurately control the model car’s vertical movements by ± 40 microns and repeatedly position the model car within 6 microns,” explains Senft.

A seventh R-Series Model RF flexible sensor resides under the belt and controls the rotational angle of the road, altering the direction from which the wind actually hits the vehicle.

“The flexible Temposonics sensors are easier to install, maintain and use than a more traditional rotary sensor with anti-backlash gearing,” Kuhlmann said. “They provide extremely accurate and reliable feedback that simply isn’t achievable with other technologies we have used in the past.”

Temposonics Sensors work by inducing a sonic strain pulse in a specially designed magnetostrictive waveguide through the momentary interaction of two magnetic fields. One field comes from a movable permanent magnet which passes along the outside of the sensor tube; the other field comes from a current pulse or interrogation pulse applied along the waveguide. This interaction produces a strain pulse, which travels at sonic speed along the waveguide until the pulse is detected at the head of the sensor.

The magnet’s position is determined with high precision by measuring the elapsed time between the application of the interrogation pulse and the arrival of the resulting strain pulse. Consequently, accurate, non-contact position feedback is achieved with absolutely no wear to the sensing components. Magnetostriction also requires no recalibration and can be easily installed in most industrial settings.

The Temposonics Model RF sensor uses a flexible housing that allows users to measure linear position along a curve. Using these sensors, manufacturers can achieve the precision, ease of use and other benefits of a magnetostrictive sensor in applications traditionally reserved for rotary sensors.

“The Rolling Road System is built to last a lifetime.” Kuhlmann said. “Temposonics sensors require very little maintenance, need minimal calibration and provide feedback superior to other technologies and are the most logical fit for these applications.”

ABOUT MTS SENSORS:

MTS Sensors, a division of MTS Systems Corp., is the global leader in the development and production of magnetostrictive linear-position and liquid-level sensors.

MTS Sensors Division is continually developing new ways to apply Temposonics® magnetostrictive sensing technology to solve critical applications in a variety of markets worldwide. With facilities in the U.S., Germany, Japan, and China, MTS Sensors Division is an ISO 9001 certified supplier committed to providing customers with innovative sensing products that deliver reliable position sensing solutions.

Document Part Number: 551384, Revision A 03/13

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