



SENSOR EVOLUTION

THE NEW GENERATION OF WHEEL FORCE TRANSDUCERS

MTS Systems

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Sensor evolution

Two testing and measurement experts have jointly developed a new generation of wheel force transducers for road and lab applications

➤ MTS Systems and its recently acquired subsidiary, PCB Piezotronics, have joined forces to bring to market a new and improved generation of wheel force transducers. The launch of the Swift Evo family effectively reintroduces MTS's renowned Swift product line with engineering enhancements that make it even more accurate and easy to use while carrying forward the same durability characteristics that major auto manufacturers worldwide have come to rely upon.

Like its predecessor, the new Swift Evo family provides high load capacity, durability and accuracy in measurements of longitudinal force (Fx); lateral force (Fy); vertical force (Fz); overturning moment (Mx); driving/braking moment (My); steering moment (Mz); and wheel rotational position. Capable of an extremely low end-to-end latency of 250µs, Swift Evo units can be tightly synchronized with other wheel force transducers, sensors and active systems on a test vehicle. Engineered for easy installation, they can be implemented and ready for operation in just a few hours, saving time and effort in testing setup and changeover.

The Swift Evo family features five standard sizes of wheel force transducers for vehicles ranging from motorcycles and all-terrain vehicles to heavy trucks. Custom wheel force transducers and rim and



TOP: Swift Evo units are subject to a highly refined, automated process that calibrates the entire transducer assembly, cycling through each channel while simultaneously exciting all other channels

ABOVE: A new intuitive graphical user interface streamlines and simplifies Swift Evo set up, orientation and operation

hub adapters can be designed and built for application needs not met by the standard line.

Designed for both spinning and non-spinning applications, Swift Evo transducers are ideal for ensuring data measurement integrity throughout the entire vehicle durability testing process. On the proving ground, they are used for road load data acquisition (RLDA), capturing data on how a vehicle responds to

surfaces and events such as washboard road, pavé, potholes, curb strikes, railroad crossings, broken concrete, etc. In the test lab they are deployed with the vehicle on a spindle-coupled road simulator to provide the data needed to generate drive files via RPC iteration, and then play out the completed drive file during actual durability testing.

Swift Evo transducers are said to achieve unparalleled measurement accuracy and to have a long life, employing a high-stiffness, one-piece design, machined from a forged billet of certified AMS high-strength, high-toughness aluminum or titanium alloy. Unique among wheel force transducers, the design yields high sensitivity, excellent linear behavior and high overload capacity. Furthermore, the transducer's high natural frequency provides phase integrity between measured channels across the operating frequency range.

With no bolted joints, the one-piece design eliminates micro-slippage – the largest contributor to hysteresis – and facilitates efficient heat transfer across the structure, minimizing temperature differentials in gauged areas. It also integrates MTS's flexure isolated shear beam, which decouples the transducer's six components of measurement to reduce cross-coupling between measured axes; this increases transducer sensitivity to minute forces and moments and minimizes

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LEFT: Swift Evo wheel force transducers come in five standard sizes

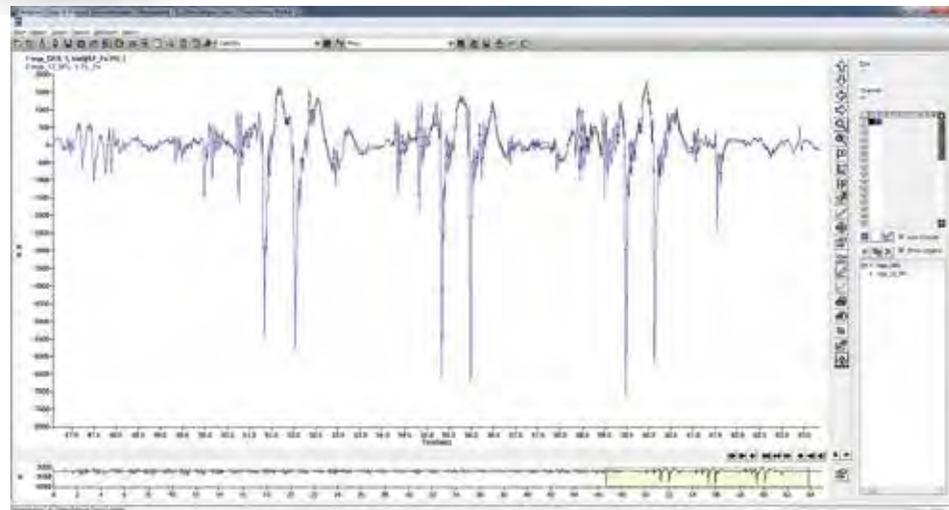
BELOW: An RPC Pro plot shows pothole strikes (black) and data from a converged drive file generated on a spindle-coupled road simulator in a test lab (blue)

thermal response. The design's high-stiffness outer ring and flexure isolated shear beam combine to make the Swift Evo insensitive to variations in stiffness among wheel rims and road simulator fixtures, facilitating easier integration with both.

Moreover, the one-piece design minimizes the number of gauges required, which enhances transducer reliability and robustness. Swift Evo transducers adhere to SAE J267 and J328 requirements and are sealed to IP67 standards, making them almost 100% weather- and contaminant-proof. They are also fatigue rated, so the same unit can be deployed on a vehicle at the proving ground for RLDA and then in the lab for both drive file iteration and actual durability testing, if desired.

The measurement accuracy of Swift Evo transducers is ensured through a unique multi-axial calibration process provided exclusively by the MTS metrology and calibration lab. While most wheel force transducers are calibrated one channel at a time, Swift Evo units are subject to a highly refined, automated process that calibrates the entire transducer assembly, cycling through each channel while simultaneously exciting all other channels.

This approach ensures highly accurate measurements of cross-coupling coefficients under far more realistic loading conditions. The result



of this comprehensive yet meticulous calibration process is a high-fidelity wheel force transducer capable of yielding data that can be transferred from one Swift Evo transducer to another with very high fidelity. This provides test engineers the flexibility to deploy different Swift Evo units for RLDA, drive file generation and durability testing on a road simulator. Many wheel force transducers on the market today cannot afford that flexibility, forcing test engineers to use the exact same device at the track and in the lab.

In addition to leveraging the advantages of the legacy Swift design and MTS multi-axial calibration, PCB and MTS engineers collaborated closely to develop an enhanced, more evolved wheel force transducer family. One of their main

achievements was the reduction in weight of the most heavily used small and passenger car transducers (Swift Evo 20 and 30), to achieve parity mass with wheels on test vehicles – i.e. the total mass of a suspension with a Swift Evo installed equals that of the original (unmodified) suspension. The team also sought enhancements to transducer accuracy, including improved cross-talk, linearity, hysteresis performance and thermal performance. To increase efficiency, it developed the Evo TI (Transducer Interface) and an intuitive graphical user interface to streamline and simplify set up, orientation and operation. New support for TEDS also streamlines operation by minimizing the possibility of incorrect calibration values being entered during setup.

Users are supported by a well established global team of PCB and MTS experts. This includes 24/7 telephone support for assistance with technical issues, on-site technical assistance with Swift Evo setup and installation, timely repair if necessary, and trade-in and rental programs. This includes the previously mentioned multi-axial calibration offered by the MTS metrology and calibration lab, which is A2LA accredited based on adherence to ISO/IEC 17025 and ANSI/NCSL Z540-1 international standards.

New Swift Evo wheel force transducers integrate the best attributes of the market-proven Swift product line while leveraging the formidable engineering and global support capabilities of recently combined MTS and PCB. ◀



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