

6-Component Wheel Force Transducers (WFT)



In motor vehicle development, 6 component wheel force transducers (WFTs) are used to determine and record forces and torques at the wheels during test drives – in all three dimensions, resulting in 3 forces (F_x , F_y , F_z) and 3 torques (M_x , M_y , M_z). The measurement results generate the data used for computer simulations or as input parameters for test rig systems. The WFTs are wheel force transducers which are not only waterproof, but furthermore provide a higher thermal and mechanic load to perform even in off road tests of cars in any weather conditions.

The entire signal processing system relies on extremely short signal lead lengths. Each strain gauge signal is digitized individually, all channels are recorded simultaneously. The WFTs can be used on small to large cars (minimum wheel size: 14 inches), but also on SUVs and light trucks (maximum hub diameter: 5.5 inches).

Highlights

- Waterproof (IP66, IP67)
- Ideal for brake testing due to excellent heat dissipation
- Removable stator for comfortable wheel mounting and convenient balancing of wheels
- Online zeroing - system is ready to measure after six turns of the wheel
- Automatic balance of the wheel angular
- Incremental angular resolution of 0.072° (with up to 5.000 points per turn)




An optimized sensor design, along with the high thermal conductivity of the sensor material, avoids excessive heating of the measurement body even on heavy break tests. The entire signal processing is designed for a temperature range of -40°C to $+105^\circ\text{C}$. All this results in a much wider range of applications than before, which now also includes braking tests, ride comfort tests and tire tests with the very same WFT configuration. Along with its waterproof design, its remarkable shock resistance of up to 100 g now enables WFT measurements with speed bumps!

Due to mechanically induced nonlinearities, accurate calibration for each wheel on a specially designed test rig is essential. The inhouse calibration test rig at CAEMAX has been enhanced to be able to offer optimal calibration. There, each wheel force transducer's profile containing all calibration and correction values necessary for exact online/real time calculation can be exactly determined.

Overview of available variants

Order Code		article no.
• H-SEN-CMX-WFT-Cx-AL	WFT-C ^x Wheel Force Transducer Aluminium without connection unit	13700001
• H-SEN-CMX-WFT-Cx-TI	WFT-C ^x Wheel Force Transducer Titanium without connection unit	13700002
• H-SEN-CMX-WFT-Cx-ST	WFT-C ^x Wheel Force Transducer Steel without connection unit	13700031
• H-SEN-CMX-WFT-Cxs-AL	WFT-C ^{xs} Wheel Force Transducer Aluminium without connection unit	13700033

Accessories

Order Code		article no.
• H-SEN-CMX-WFT-Cx-STAT	Telemetry unit for WFT-C ^x rotated application	13700003
	Connection unit telemetry type for WFT-C ^x in rotating applications.	
		
• H-SEN-CMX-WFT-Cx-SI	Fixed unit for WFT-C ^x stationary application	13700004
	Connection unit fixed-type for WFT in test rack applications.	
		
• H-SEN-CMX-WFT-Cx-HUB	Hub Adapter for WFT	13700005
	The exact specification / type of the wheel hub is needed.	
• H-SEN-CMX-WFT-Cx-RIM	Rim Adapter for WFT	13700006
	Rim Adapter for WFT (specification of the wheel rim is needed)	
• H-SEN-CMX-WFT-Cx-SCR	Bolts for WFT hub & rim adapter	13700007
	Mounting bolts (set of 32) for mounting WFT to hub adapter and rim adapter	
• H-SEN-CMX-WFT-Cx-CASE	Transportation case for WFT-C ^x	13700008
• H-SEN-CMX-WFT-Cx-MK	Torque arm (carbon) with 3 suction cups	13700010
	Torque arm (carbon) with 3 adjustable suction caps	
		
• H-CAB-LEM-WFT-6m	Connection cable between Wheel Force Transducer and Control Unit, 6 m	13700012
• H-CAB-LEM-WFT-12m	Connection cable between Wheel Force Transducer and Control Unit, 12 m	13700013
• M-SEN-CMX-WFT-TTI-BAS	Control Unit incl. WFT telemetry interface	13700014
	Telemetry Control Unit incl. WFT telemetry interface (TTI) for connecting of two Wheel Force Transducers. 4 slots available for further modules. Larger housings upon request.	
• M-VST-CMX-TTI-STD	WFT telemetry interface	13700015
	Additional WFT telemetry interface (TTI) for connecting two 6-component WFTs occupies 2 slots.	

Optional extension

- M-KOM-CMX-WFT-CAN CAN output module 13700016
CAN output module for WFT telemetry control unit, for two WFTs;
occupies 1 slot
- M-DAC-CMX-DAC-K16 16-channel analog output module 13700017
16-channel analog output module; simultaneous or asynchronous output;
 $\pm 5\text{ V}$ or $\pm 10\text{ V}$; occupies 1 slot.

Optional service

- D-SEN-CMX-WFT-Cx-KAL Wheel Force Transducer calibration 13700028
Calibration of one Wheel Force Transducer WFT incl. crosstalk compensation.
Recommended every year.

Technical Specs

Parameter	Value				Remarks
	WFT-C ^x			WFT-C ^{xs}	
Material	Aluminium	Titan	Steel	Aluminium	
Measurement principle	temperature compensated strain gauge application				
Measurement ranges					
Forces	$F_x, F_z = \pm 45 \text{ kN}$ $F_y = \pm 25 \text{ kN}$	$F_x, F_z = \pm 60 \text{ kN}$ $F_y = \pm 30 \text{ kN}$		$F_x, F_z = \pm 25 \text{ kN}$ $F_y = \pm 20 \text{ kN}$	
Torsional moment	$M_x, M_z = \pm 8.75 \text{ kNm}$ $M_y = \pm 8.75 \text{ kNm}$	$M_x, M_z = \pm 10 \text{ kNm}$ $M_y = \pm 10 \text{ kNm}$		$M_x, M_z = \pm 6 \text{ kNm}$ $M_y = \pm 6 \text{ kNm}$	
Sampling rate	up to 10 kHz				per channel with CRFX/WFT-2 module
Angle resolution	0.072 °				5000 increments
Accuracy	<0.2 %				of the measured value
Hysteresis	<0.2 %				of the range
Crosstalk	<0.2 %				of the measured value
Temperature drift	0.005 %/°C				
Low pass filter	6-pol Butterworthfilter				cut-off frequency: 1200 Hz
Revolution speed	max. 2300 rpm (approx. 278 km/h)				
Weight	approx. 7.5 kg	approx. 10.5 kg	approx. 17.5 kg	approx. 5.9 kg	w/o adapters
Dimension (w/o adapter)	317.5 mm 203.0 mm 76.0 mm			61.5 mm	outer diameter (OD) inner diameter (ID) height
Rim diameter	min. 14" (356 mm)				
Hub diameter	max. 5.5"				with hub adapter
Protection class	IP66, IP67				
Operating temperature					
Sensor	-40 °C to 150 °C				
Electronics	-40 °C to 105 °C				
Mechanical load	stress analysis according to BMW QV 36026				
Acceleration	max. 100 g				
Security	mechanical breakage protection				
Mounting bolts	32				
Adaption	custom specific adaption for every vehicle possible				