

## 6-component Wheel Force Transducer WFT-C<sup>x</sup>

precise • robust • quick setup



Weatherproof wheel force transducer for road testing



**At a glance: WFT-C<sup>x</sup>**

- Detection of mechanical forces and torques directly at the wheel
- Data output referred to vehicle coordinate system with online display
- Maximum interference resistance and measurement accuracy through on-site digitization and online processing of raw data
- Precise temperature compensation
- Robust WFT-C<sup>x</sup> sensor housing with long service life
- Safety feature: breakage protection through interlocking mechanical structure
- Extremely quick and comfortable setup
- Easy adaptation to different mounting situations and measurement tasks due to modular design and flexible adapter system
- Versatile range of applications due to optimal heat dissipation and watertight design; e.g., for winter tests, brake tests, etc.
- Comfortable software-controlled angle and zero adjustment - ready for testing after only a few wheel revolutions
- UPS to prevent issues during engine cranking

# Driving in all weather conditions

## Increase productivity with CAEMAX wheel force transducers

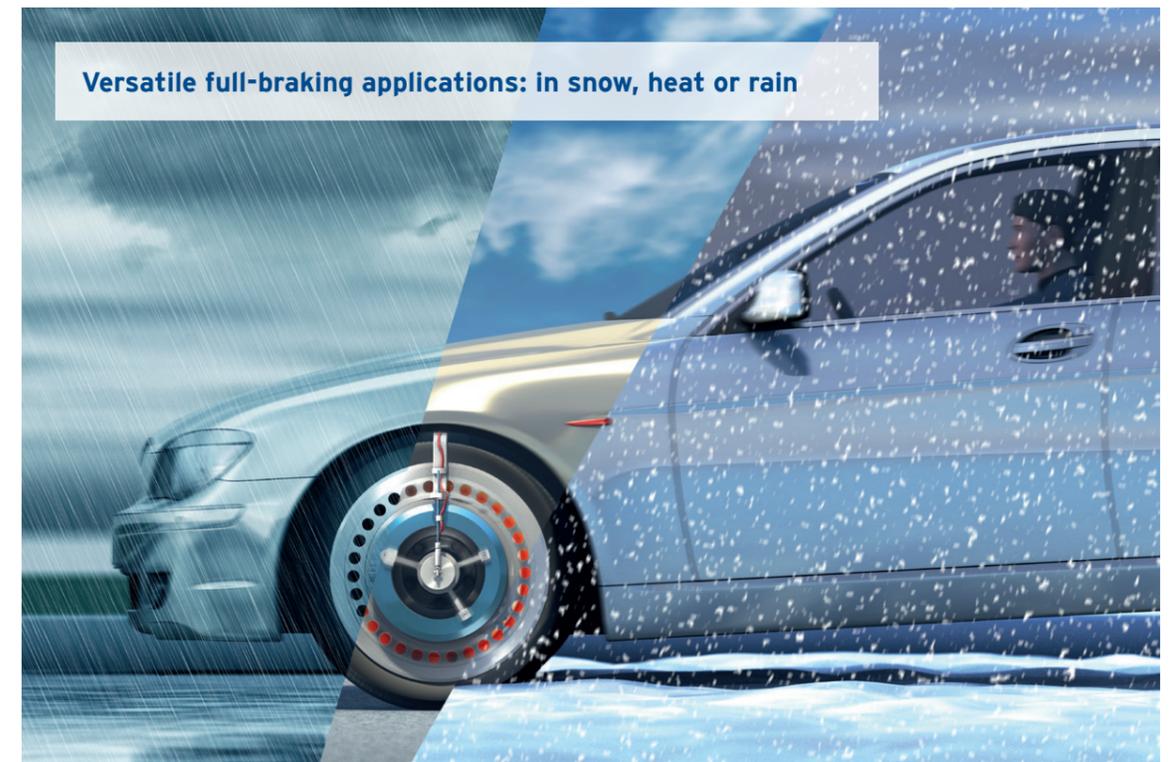
Whether performing handling tests with full braking at high thermal loads or test drives at low temperatures in snow, rain and ice, the WFT-C<sup>x</sup> wheel force transducers are characterized by an absolutely watertight design and a shock resistance of up to 100 g - all the while maintaining the highest measurement accuracy. The intelligent electronics calculate measurement quantities directly in the wheel. All setting and calibration values necessary for operation are stored in each WFT-C<sup>x</sup>.

Thanks to digital signal processing, the 6-component WFT-C<sup>x</sup> needs considerably less strain gauges than comparable systems. Instead of a complex and fault-prone analog interconnection of strain gauge signals, digital online processing is applied with 24-bit DSP resolution. The resulting higher dynamics of measurement signals allow for tests of comfort performance

as well as measurements over rough terrain.

A further advantage is the sensor system's modularity: the WFT-C<sup>x</sup> sensor housing, the telemetry module and the adapter can be reassembled for each application. Exchanging components is simple and fast.

With the CAEMAX adapter system, the WFT-C<sup>x</sup> can be used with minimal effort on different types of vehicles - from compact to full-size cars and also on SUVs and light trucks as well as on the road simulation test rig. An easy system set-up and convenient software functions, such as the zero calibration, enable the system to be test-ready within a very short time. After assembling the WFT-C<sup>x</sup> and switching on the control electronics, all relevant presets and parameters are immediately loaded and displayed.



**Versatile full-braking applications: in snow, heat or rain**

## A complete solution - the 6-component WFT-C<sup>x</sup>



### Highest precision

- High-precision strain gauge sensors, local digital temperature compensation for accurate, reliable results
- High-resolution angle encoder (0.072° resolution)
- Short analog cable routes, digital data transmission
- Differential analog inputs, simultaneous sampling
- Online calculation directly in the wheel, calibration stored in the WFT electronics
- Forces and torques are calculated online from individual strain gauge signals
- Synchronous acquisition of all wheel sensors in the WFT-C<sup>x</sup> controller
- Measurement principle: the sensor unit detects mechanical loads on the rotating wheel
- Calibration with crosstalk compensation



### Robust and weatherproof

- Waterproof sensor housing - IP66, IP67
- Robust telemetric data transmission
- Fail safe emergency operating mode in case of sensor break
- High thermal conductivity: no active cooling required, even with braking tests
- High mechanical durability



### Fast and flexible

- Quick installation - almost as easy as a wheel change
- Modular system, easy exchange of components
- Sensors available for test stand or road test applications
- WFT sensor housings suited to special requirements on test stands: steel and titanium versions, optimal for durability testing
- Sensor can be used mobile and stationary, rotating or non-rotating
- No transformations necessary, system delivers channel data in both the vehicle and the wheel coordinate systems
- Wheel with sensor housing can be balanced
- Convenient software functions for angle and zero adjustment - ready for testing after a few wheel revolutions



### Service-oriented

- Fast reaction times during calibration and service
- Calibration with crosstalk compensation
- Crack testing, mechanical stability
- Individual sensor solutions - CAEMAX, your specialist for durability testing

## In Practice

### Acquiring load collective data from prototypes

In the new development of vehicles, there are often no suitable load collective data for determining the real stress on the components during operation. These must be determined by means of test drives. The WFT-C<sup>x</sup> can be used for wheel sizes from 13" and is proven by its robust, waterproof design, even during multi-day testing. The measured quantities are precisely temperature-compensated by means of thermo-sensors distributed throughout the wheel.



### Fatigue testing of components on the test stand

Component lifetime testing on the test stand requires very robust wheel force transducers. Especially for these applications, CAEMAX offers WFT-C<sup>x</sup> sensor housings made of titanium or steel.

If a rotating measurement is carried out on a chassis dyno or on a road test, the wired signal transmission to the control unit is simply replaced by a stator with telemetric transmission. Since all of the WFT-C<sup>x</sup> sensor housing types have the same shadow mask, existing adapters can be used for all types.



### Function trials during winter testing

Negative temperatures, melting water, ice and snow are a challenge for every measurement system.

The CAEMAX wheel force transducers have a wide temperature range: -40° C ... +105° C. In addition, their waterproof design allows test drives to be conducted in any weather condition - even on ice, snow or meltwater.



## Test-ready in just an hour

Four WFT-C<sup>x</sup> can be installed in just one hour



“With our wheel force transducers, we provide our customers with a high-precision tool for acquiring mechanical loads on the wheel. In order to simultaneously meet the growing personnel and economic pressure in the development departments, we have consistently paid attention to short set-up times and simple, convenient handling. Using our WFT-C<sup>x</sup>, our customers increase the quality of their testing as well as their productivity.”

**Sebastian Asmuss, Senior Engineer at CAEMAX**

## Modular design - universal application

Suitable for many different vehicle types

With the CAEMAX adapter system, wheel force transducers can be mounted with minimum effort on different vehicle types. The WFT-C<sup>x</sup> sensor housing, telemetry module and adapter can be combined as required. A wide range of wheel sizes and vehicles are covered. A quick system set-up and convenient software functions, such as zero calibration, allow the system to be test-ready within a very short time.



- ① **Hub adapter:** The hub adapter connects the WFT-C<sup>x</sup> to the vehicle. It can be used for different types of vehicles, as long as the bolt circle and the wheel offset are the same. With just a few hub adapters, an entire vehicle fleet can be covered.
- ② **Rim adapter:** As with a conventional rim, the rim adapter serves as a mount for the tire. The rim adapter is not directly specific to the vehicle, but depends on the tire. This allows it to be used on different vehicles with the same tire size.
- ③ **WFT-C<sup>x</sup> sensor housing:** The sensor housing connects the hub adapter and the rim adapter to each other. These three components together form the vehicle-specific wheel. Since the calibration factors are permanently stored in the sensor, you can recombine adapters and sensor housings at any time without having to calibrate the wheel again. Thus, based on a modular design, a WFT-C<sup>x</sup> wheel force transducer can be adapted to the vehicle in a time-saving, space-saving and cost-effective manner.

# The complete testing solution: with imc

In the case of holistic vehicle testing, many different physical quantities need to be acquired. In addition to wheel forces, information on acceleration, force, frequencies, suspension displacement, strain or ECUs are also of interest. imc measurement devices ensure synchronous data acquisition of all signals - to which the CAEMAX wheel force transducer WFT-C<sup>x</sup> can be integrated directly. The imc software then offers a wide range of possibilities for measurement data analysis, visualization and further processing.



## Modular, spatially-distributable measurement system

**imc CRONOSflex**

- Flexible modularity through frameless expansion
- Ideal for frequently changing measurement tasks, distributed or centrally located
- Aggregate sampling rate of 2 MHz
- Synchronous acquisition from one up to thousands of channels



## Universal & flexible: on the test stand, in the lab or mobile applications

**imc CRONOScompact**

- Measurement, control and simulation in one system
- Wide selection of measurement amplifiers & modules
- Integration of MATLAB/Simulink models for HiL
- Ideal for mid- to high channel counts



## Measurement systems for extreme environments

**imc CRONOS-SL**

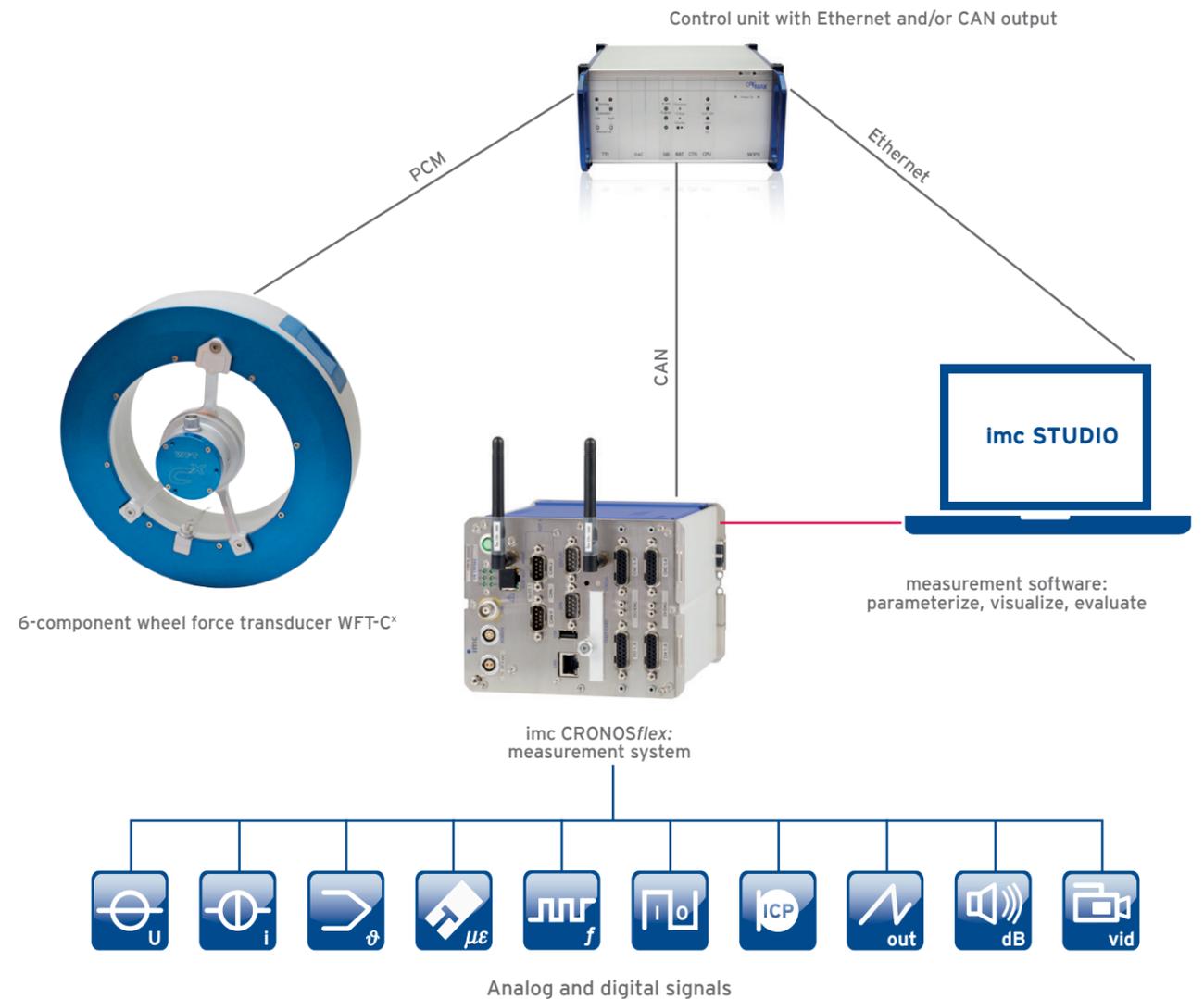
- Extremely robust
- Shock resistant: MIL STD810F
- Protection rating: IP65
- Extended operating temperature: -40° to +85° C
- Condensation allowed



## All-in-one data acquisition & control

**imc C-SERIES**

- Ideal for changing test stand set-ups and mobile applications
- Cost-effective solution for measurement tasks with 8 to 24 channels



# Technical Data

## WFT-C<sup>x</sup> wheel force transducer

Parameter	Value		
	Aluminium	Titanium	Steel PH17-4
Measurement principle	temperature compensated strain gauge application		
Measurement range: forces	F <sub>x</sub> , F <sub>z</sub> = ±45 kN F <sub>y</sub> = ±25 kN	F <sub>x</sub> , F <sub>z</sub> = ±60 kN F <sub>y</sub> = ±30 kN	F <sub>x</sub> , F <sub>z</sub> = ±60 kN F <sub>y</sub> = ±30 kN
Measurement range: torques	M <sub>x</sub> , M <sub>y</sub> , M <sub>z</sub> = ±8,75 kNm	M <sub>x</sub> , M <sub>y</sub> , M <sub>z</sub> = ±10 kNm	M <sub>x</sub> , M <sub>y</sub> , M <sub>z</sub> = ±10 kNm
Protection class	IP66, IP67		
Sampling rate per channel	up to 5 kHz		
Angular resolution with 5000 increments	0.072°		
Linearity	<0.2% FS		
Hysteresis	<0.2% FS		
Crosstalk	<0.2% FS		
Low pass filter (cut-off frequency 1200 Hz)	6-pole Butterworth filter		
Weight without adapter	<7.9 kg	ca. 10.5 kg	ca. 17.5 kg
Rim diameter	min. 14" (356 mm), 13" by request		
Hub diameter with adapter	max. 5.5"		
Operating temperature	-40 °C up to +105 °C		
Mechanical load	stress analysis according to BMW QV 36026		
Shock proof	max. 100 g		
Rotational speed	max. 2300 rpm (ca. 278 km/h)		
Safety	mechanical breakage protection		
Dimension: outer diameter (without adapter)	317.5 mm		
Dimension: inner diameter (without adapter)	203 mm		
Dimension: height	76 mm		
Temperature drift	0.005% / °C		
Mounting bolts	32		
Adaption	customer-specific adaption for any vehicle possible		

## Calibration

CAEMAX calibrates each WFT-C<sup>x</sup> on its own specifically developed test bench. Each force and torque is measured separately. Interactions (crosstalk) between the measured variables can thus be detected and compensated for. This results in an unprecedented precision of the measured values (crosstalk, non-linearity, hysteresis: all below 0.2%).

# Accessories



## Telemetry module: mobile testing

This telemetry unit is used to transmit measured data from a rotating 6-component WFT-C<sup>x</sup> to an external stator unit.



## Telemetry unit: stationary applications

This telemetry unit is used to transmit measured data from a fixed 6-component WFT-C<sup>x</sup> (for example, on a test stand) to an external connection unit.



## Carbon torque arm

The torque arm (stator holding device) is made from carbon and has three adjustable suction cups serving to lock the rotating telemetry unit.



## Control unit with WFT-telemetry interface

The control unit takes over the online processing of the WFT data. A WFT telemetry interface (TTI) is standard for the connection of two WFTs. Expansion slots allow the installation of additional modules.

- Dimensions: (W x D x H): 300 x 350 x 150 mm
- Weight: ca. 7 kg
- Operating temperature range: 0° ... 65°C
- Ethernet interface

### Options:

- CAN output module for data output via CAN from a maximum of two 6-component WFTs
- Analog output module with 16 analog outputs (± 5 or ± 10 V)



**CAEMAX Technologie GmbH**

Bunzlauer Platz 1  
80992 München  
Germany

Tel.: +49 (0)89 613049-0  
Fax: +49 (0)89 613049-57  
info@caemax.de  
www.caemax.de

**imc Meßsysteme GmbH**

Voltastraße 5  
13355 Berlin  
Germany

Tel.: +49 (0)30 - 46 70 90 26  
Fax: +49 (0)30 - 463 15 76  
hotline@imc-berlin.de  
www.imc-berlin.com