Company Presentation and information

imc Test & Measurement GmbH (Germany)

February 2019

Facts

imc Test & Measurement GmbH

- Founded in 1988
- Offices in Germany: Berlin, Frankfurt, Stuttgart
- Subsidiaries in China, France, Netherlands, Switzerland and the USA

- Approximately 250 employees (thereof ca. 60% developers and engineers)
- Cooperation with 26 companies in 31 countries

Management: Kai Gilbert, Dr. Dietmar Sprenger, Ralf Winkelmann

Produced in Berlin, used worldwide

imc Test & Measurement GmbH & partner network

productive testing

- **imc** is a leading supplier of test and measurement equipment for the productive acquisition, processing and analysis of data

- **productive testing** means for us that our customers reach their goals faster and more efficiently

- exceptional test & measurement tools, turnkey solutions and application-specific enhancements enable our customers to achieve significant productivity gains

Single source solutions

From signal capture to test reports

Sensor & telemetry solutions

The right equipment for every need

Software for the entire test & measurement process

Test reports – fast and professional

Turnkey solutions

imc ACADEMY: training & seminars

Broad product portfolio

Product portfolio
With more than 11 product lines, in-depth application know-how and training programs, we offer our customers a wide range of comprehensive solutions.

imc – providing innovation-driving ideas and efficient solutions for challenging markets.

Fields of expertise

Transportation

Energy

Machinery

In addition to these areas, our equipment can be found in many other interesting applications as well.

Automotive and vehicle industries

Reaching solutions faster

Mobile applications

- Endurance testing
- Climate testing
- Operational stability/ fatigue testing
- Cold-start behavior
- Model comparison in vehicle trials
- Brake tests
- Crash tests
- Vehicle behavior
- Vehicle dynamics
- Engine and powertrain
- Performance tests

Test stands - Applications

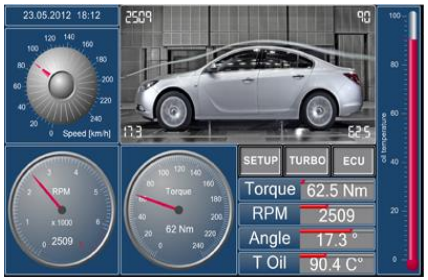
- Component test stands
- Test stands for motors & powertrains
- Hardware-in-the-Loop (HiL) test stands (simulation)
- Noise & sound tests
- Climate and wind-tunnel testing
- Test facilities for exhaust systems
- E-motor test stands (development & End-of-Line)

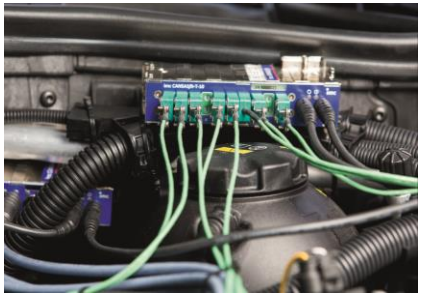
ISO & standard tests

- Acceleration tests
- Fuel consumption measurements
- Noise & vibration testing
- Passenger safety
- Brake tests

Our customers

In the automotive and vehicles area





Milestones in imc history

- 1996: imc developed the first Ethernet-based system with synchronous CAN
- 1998: car manufacturers approved imc µ-MUSYCS for in-car class counting tests
- 2002: more than 5,000 imc CANSAS modules ordered for Mercedes motor test stands
- 2003: developing a measuring system for climatic tests together with Ford Europe
  2003 imc integrates hardware and software for vehicle electronics (LIN, FLEX-Ray, J1939, CCP, KWP 2000, DiagOnCAN, XCPoE)
- 2004: Wind tunnel test: Ferrari F1 team
- 2005: PSA and Japanese auto manufacturers use imc products for component testing
- 2008: Toyota runs imc FAMOS-Software for data analysis
- 2011: Powertrain teststand for electric drives (Fraunhofer Bremen)
- 2014: TAKATA: Drive-by-Wire car component test rigs – world-wide
- 2015: Opel: installation of gear-box component test rig incl. climatic simulation
- 2016: imc CANSAS*fit* a new series of robust, compact and clickable modules

OEM contracts

- BOSCH
- AVL
- Horiba / Schenck
- FEV

Customer services

What we offer:

- Intelligent measurement technology and software tools
- Economical partial or complete solutions from a team of experienced and field-proven measurement technology experts for all your measurement tasks
- Transferring our targeted know-how to you by keeping in close communication
- Training
- Test stand development – customer and application-specific software
- Personnel contracting and equipment rental
- Calibration, adjustment, modification, repair, update

imc FAMOS

Data signal analysis and test reporting software

The following editions of imc FAMOS are available:

imc FAMOS Reader 7.4 (free of charge)

Data import, curve window, report generator, data browser (only viewing function)

imc FAMOS Standard 7.4

Data import, curve window, report generator, data browser

Data analysis, Macro Editor, Data export, Dialogue Editor to open dialogues

imc FAMOS Professional 7.4

Data import, curve window, report generator, data browser

Data analysis, Macro Editor, Data export, Dialogue Editor to open and create dialogues

Spectrum analysis and class counting

imc FAMOS Enterprise 7.4

Data import, curve window, report generator, data browser

Data analysis, Macro Editor, Data export, Dialogue Editor to open and create dialogues

Spectrum analysis and class counting

Class counting, Order tracking

imc FAMOS Enterprise 7.4: 30day trail license available

To test each imc FAMOS edition, start imc FAMOS by using of start options

imc STUDIO

Software for measurement and data analysis

The following editions of imc STUDIO are available:

imc STUDIO Standard 5.2

Device configuration and visualization, customized curve window, printable PDF reports

imc STUDIO Professional 5.2

Device configuration and visualization, customized curve window, printable PDF reports

Project management, full screen view for customized projects, imc STUDIO Sequencer

imc STUDIO Developer 5.2

Device configuration and visualization, customized curve window, printable PDF reports

Project management, full screen view for customized projects, imc STUDIO Sequencer

Scripting, imc Automation (e.g. for test stands), Layout designer

Optional special tools:

imc STUDIO Video 5.2 – synchronized video acquisition

imc STUDIO Monitor 5.2 – multi-client monitoring and visualization

imc Online FAMOS – real time analysis on data streams direct in the imc hardware

imc Inline FAMOS – analysis on data streams during the measuremtent on the PC

Components (“plug-ins”) from imc STUDIO

Homepage	Quick-start, info center, manuals …
Setup	Device configuration, user/project management, …
Panel	Data visualization, data browser, interactive screen …
Sequencer	Workflow automation, post-processing, scripting …
Data Processing	Live data analysis, IFA, OFA …
Automation	Real-time controller for test stand automation (actuators, controllers, etc.) PAC – “PLC in the device” …

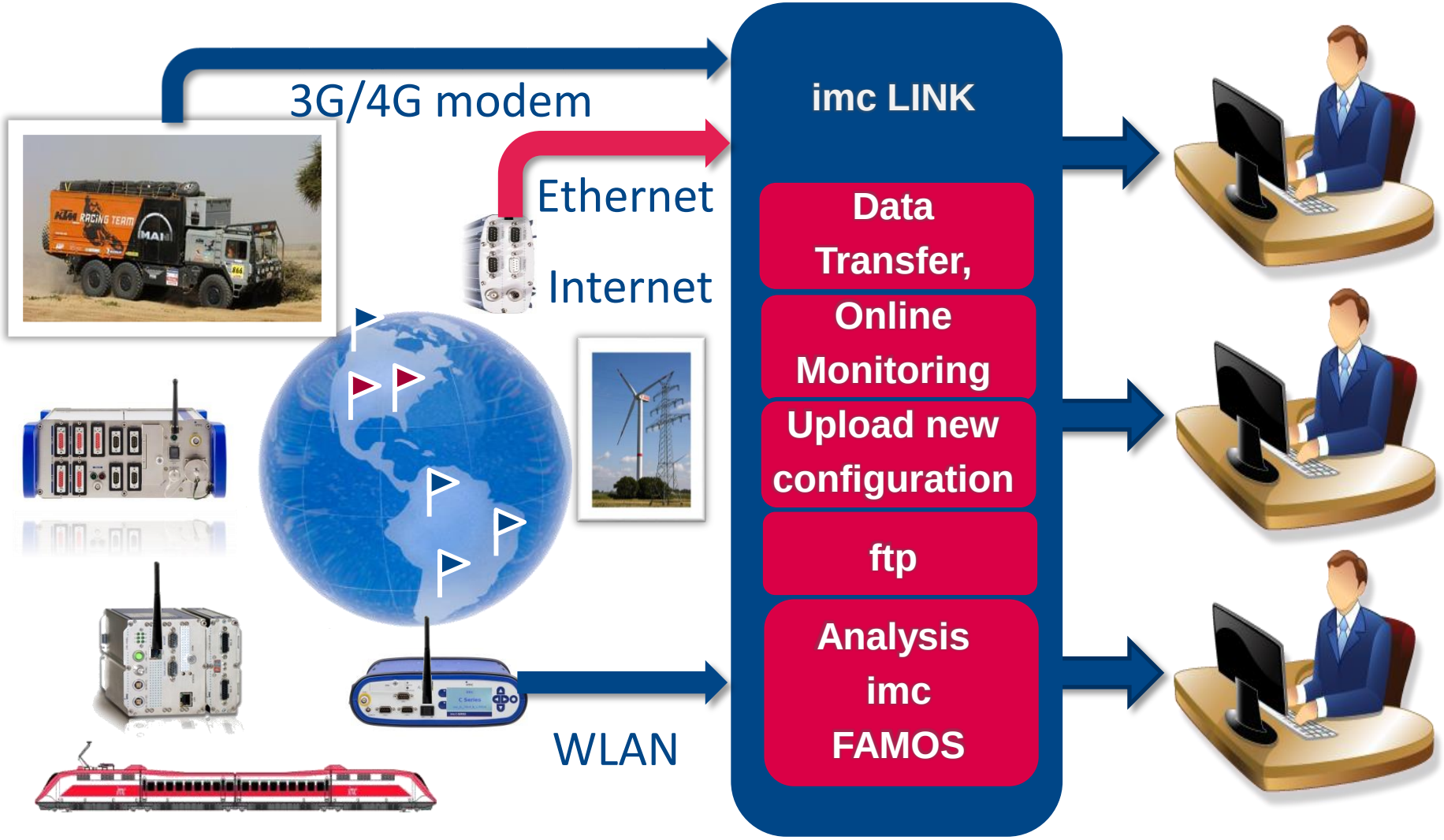
imc STUDIO

Software for measurement and data analysis on the PC

Enables network-wide operation of all systems via a common operating user interface appropriate for all levels of users

imc STUDIO

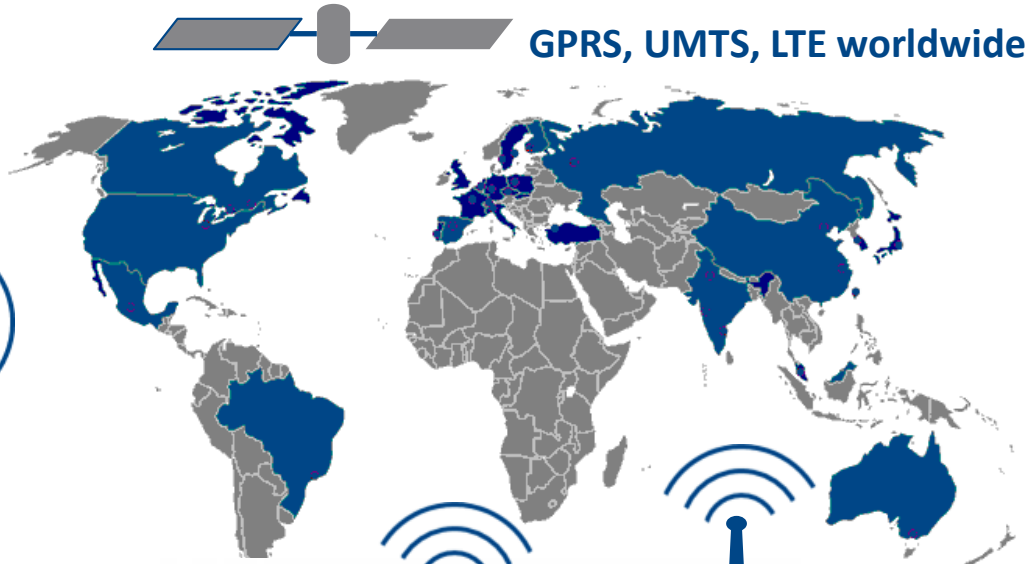
Software for measurement and data analysis on the PC



imc LINK

Automatic remote transfer of measured data

GPRS, UMTS, LTE worldwide



logged data

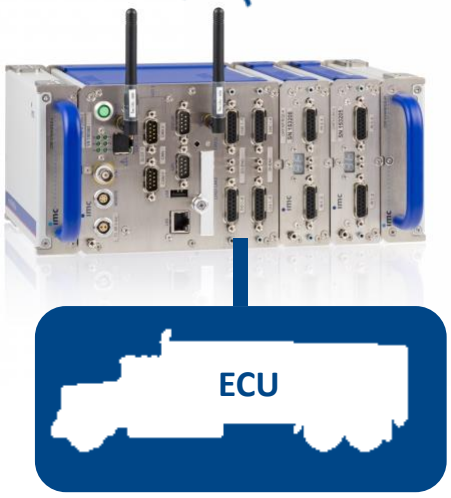
configuration

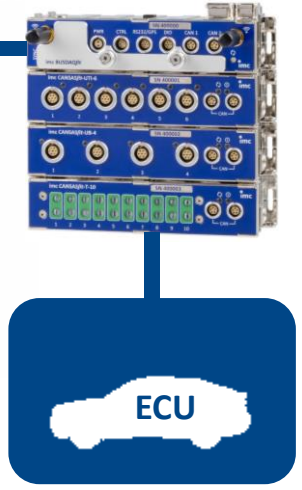
Configuration datas

CANdb

A2L

testing plans



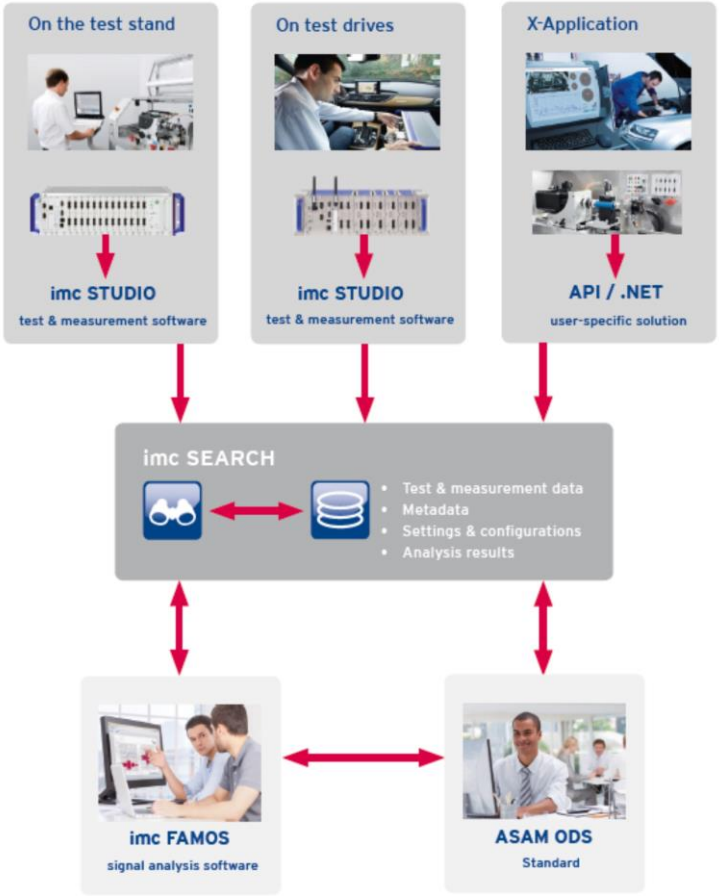


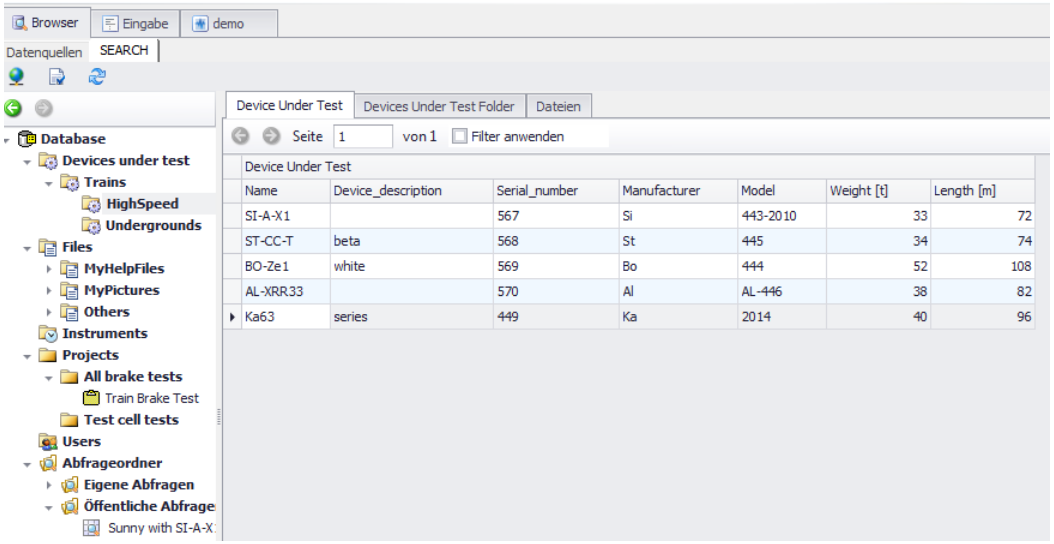
imc SEARCH

database for testing data

Speed up development processes

... with imc SEARCH test data management

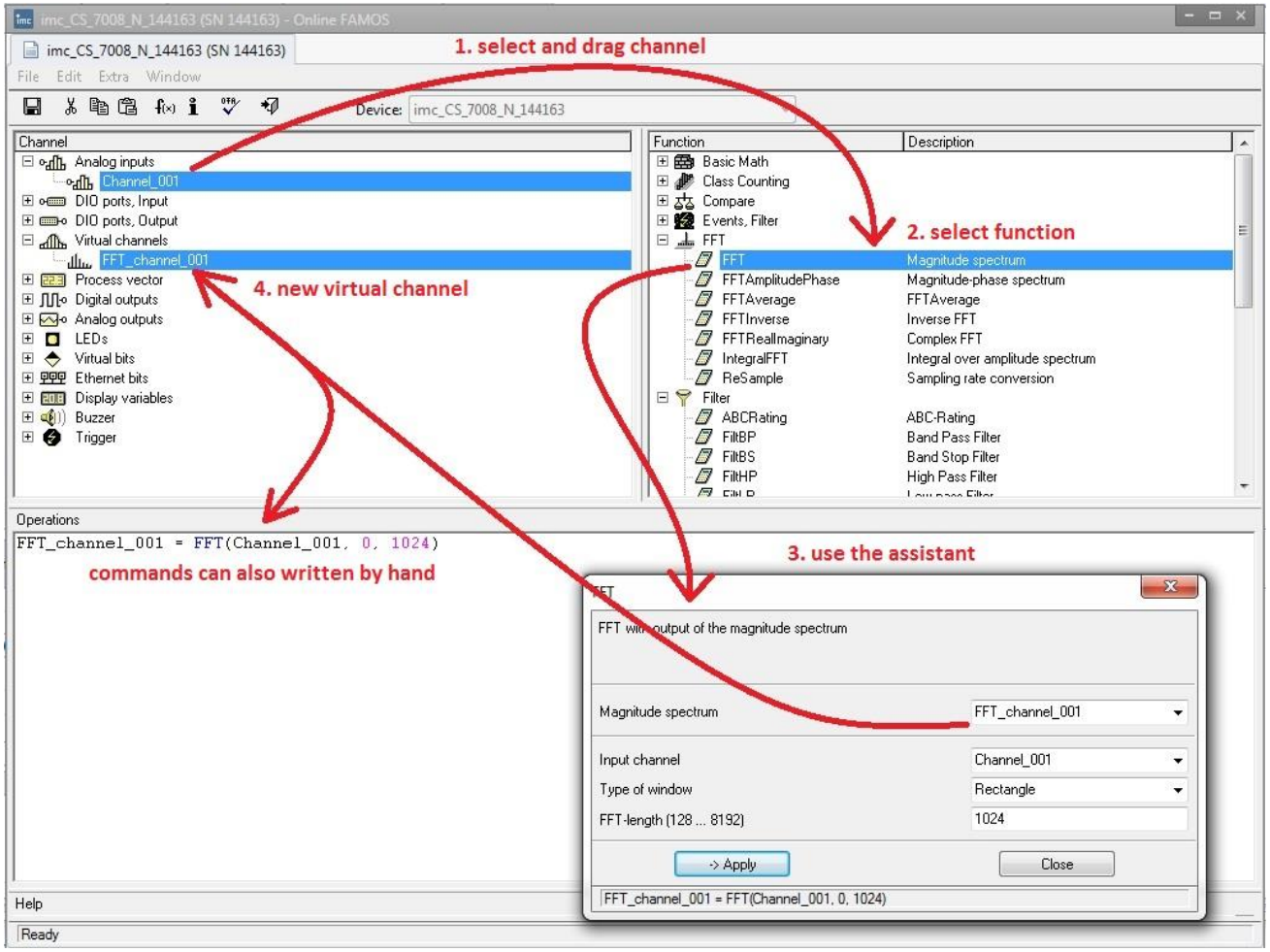




imc Online FAMOS

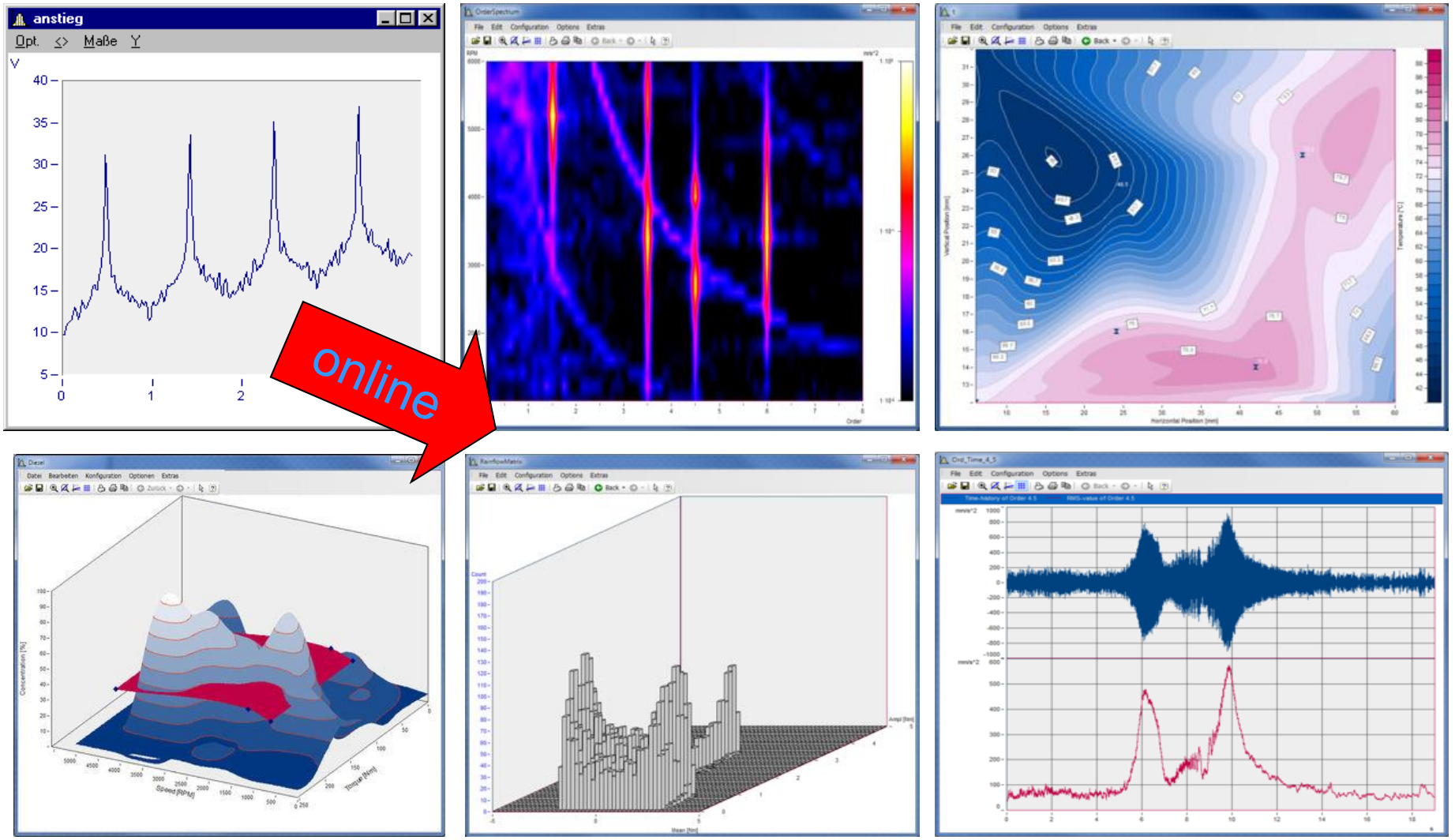
real time analysis on data streams direct in the imc hardware

Onlinecalculations with imc Online FAMOS (OFA)



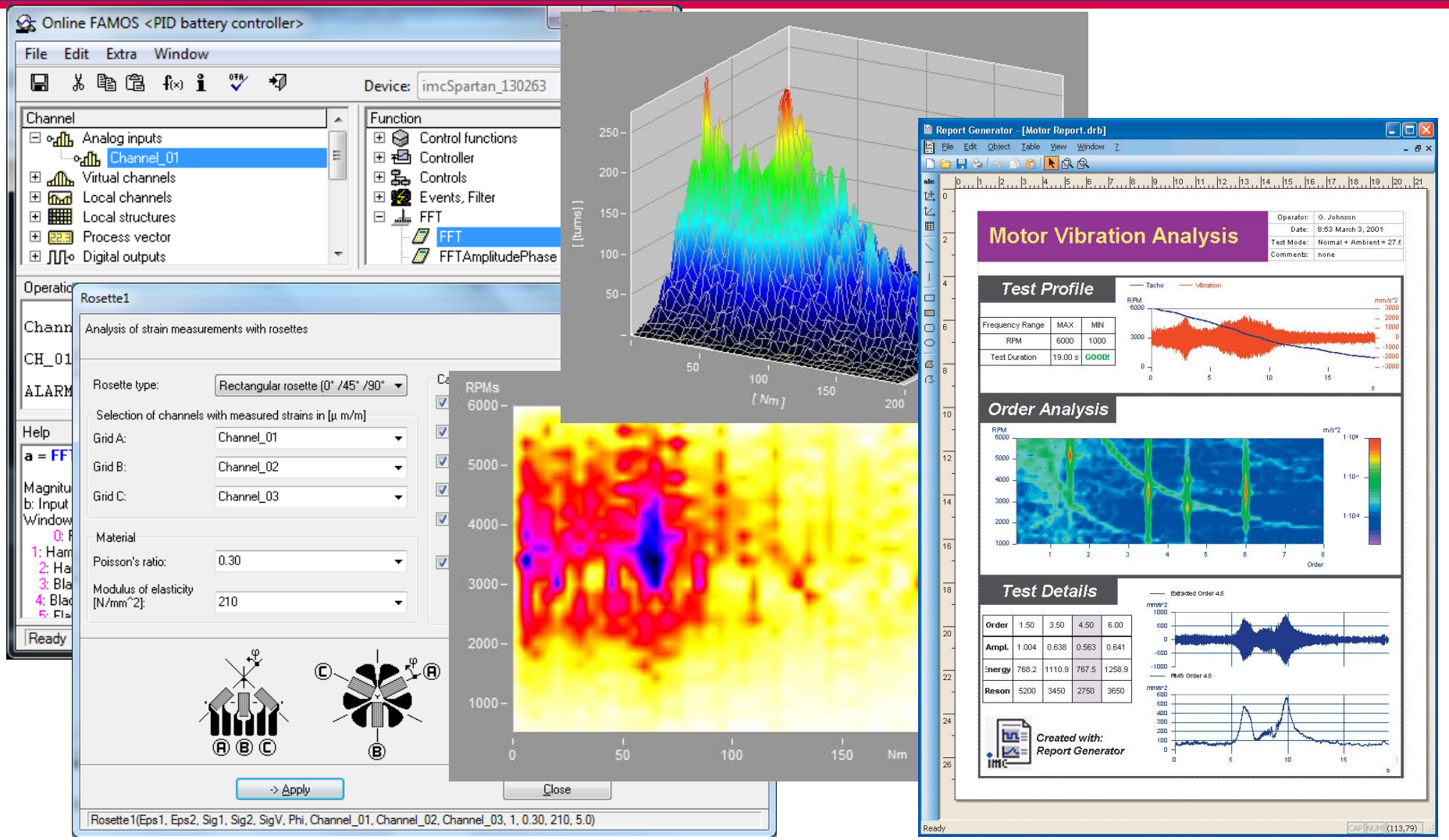
imc Online FAMOS

real time analysis on data streams direct in the imc hardware



imc Online FAMOS

real time analysis on data streams direct in the imc hardware



imc WAVE

Software for sound and vibration analysis

The following analyzer of imc WAVE are available:

imc WAVE Spectrum Analyzer

Sound power-level testing

Octave & 1/3-octave analysis

Frequency and time weighting

Vibration analysis

FFT analysis

imc WAVE Structural Analyzer

Calculation of transfer functions (magnitude and phase)

Coherences

Auto-spectra & DOFs

Export to Excel or modal analysis software ME' Scope™

imc WAVE Order Tracking Analyzer

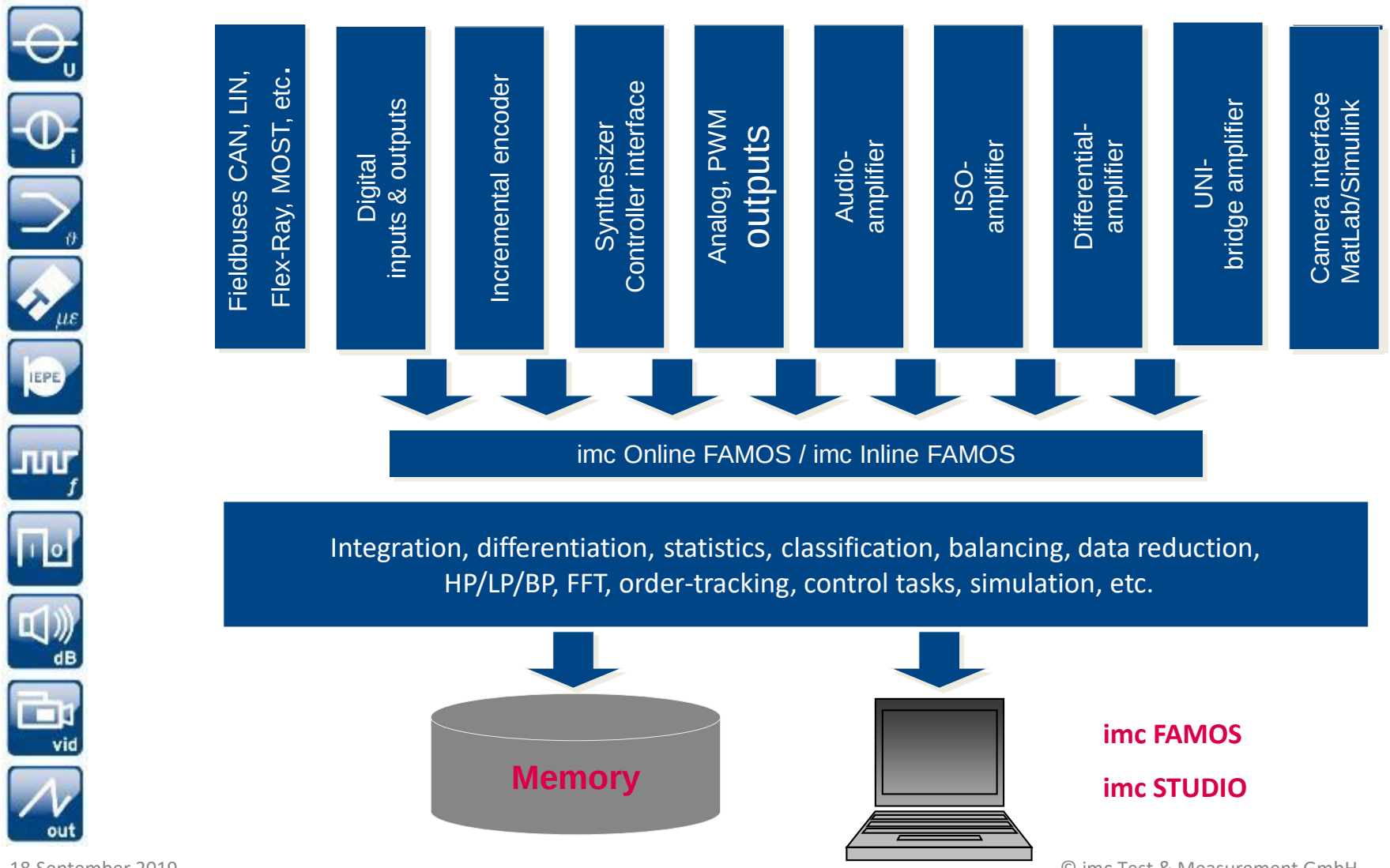
Order tracking spectra based on measured RPM

Noise & vibration levels vs. RPM (various classifications)

Transfer functions vs. time and angle

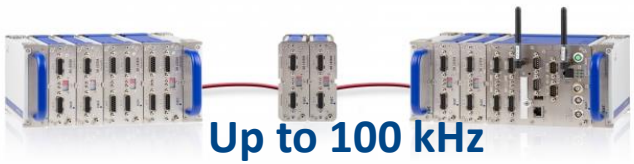
imc hardware

Functionality diagram



imc hardware

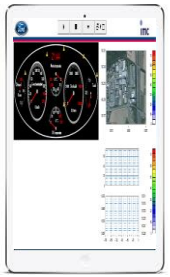
Equipment for different measurement and data analysis



Up to 100 kHz

GPS

imc modules & sensors



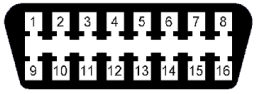
Display

imc data logger

camera

GPRS/3G/4G
WiFi

ECU



OBD2

DIG I/O

external modules

imc hardware

Equipment for different Software for measurement and data analysis

imc CRONOS*compact* (Adaptable measurement and control system for mixed signal testing)

imc CRONOS*flex* (Modular, distributable measuring system, easily connectable to one another)

imc hardware

Equipment for different Software for measurement and data analysis

imc CRONOS-SL (Measurement systems for extreme environments)

imc C-SERIES (compact measurement systems)

imc hardware

Equipment for different Software for measurement and data analysis

imc BUSDAQ*flex* (fieldbus Datalogger)

imc CANSAS*flex* (CAN modules for mobile or test stand, easily connectable to one another)

imc hardware

Equipment for different Software for measurement and data analysis

imc CANSAS-SL (CAN modules for mobile or test stand applications)



imc CANSAS*fit* (robust IP65 CAN modules for mobile, easily connectable to one another)


imc µ-CANSAS (robust IP65 CAN modules for small and mobile conditions)


imc hardware

Equipment for different Software for measurement and data analysis

imc SPARTAN (cost effective measurement and control system)

imc hardware

imc standard amplifier modules

Bridge and universal amplifiers:

- UNI-4 (Channel-wise sensor supply & isolation)
- UNI2-8 (Universal)
- DCB2-8 (DC and strain gauge, multi-channel cost-effective)
- BR2-4 (DC, strain gauge and CF Modus)

Acoustic and NVH measurement amplifiers:

- Audio2-4 (DIN & Standardized filter)
- ICPU2-8 (multi-channel cost-effective)

DI/DO/ENC/DAC module:

- DI- 16
- DO-16
- DAC-8
- Synth-8 (8 channel synthesizer + signal sequence generator)
- HRENC4 (256 MHz sampling e.g., PWM-measuring)

imc hardware

imc special amplifier modules

HV measurement amplifier:

- HV2U2I
- HV4U

Isolated & differential measurement amplifier:

- ISO2-8
- ISOF-8
- LV3-8

High-resolution current measurement module:

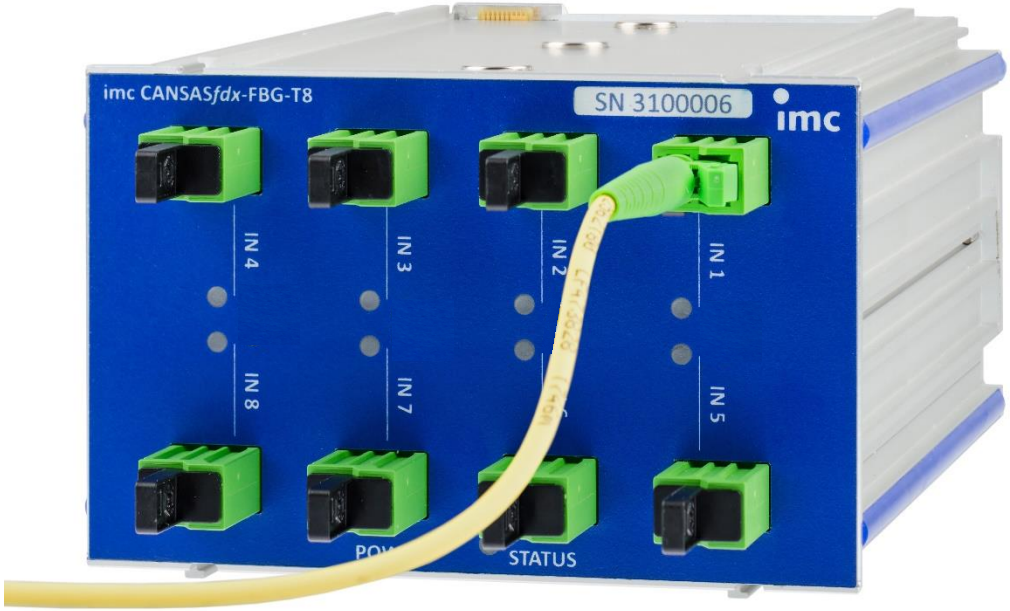
- IHR

imc hardware

Fiber-optic CANSAS measurement module for temperature

Key features

- 8 channels
- Temperature measurement
- 1 kHz/channel sampling rate
  100 Hz Bandwidth
- mechanically compatible with
  imc CANASASflex / imc BUSDAQflex
- Fiber connector: E2000 / APC



➢ *fdx* does not stand for fiber-optic, but for a new ***variant*** of the mechanical / electrical concept of imc CANSAS***flex.***

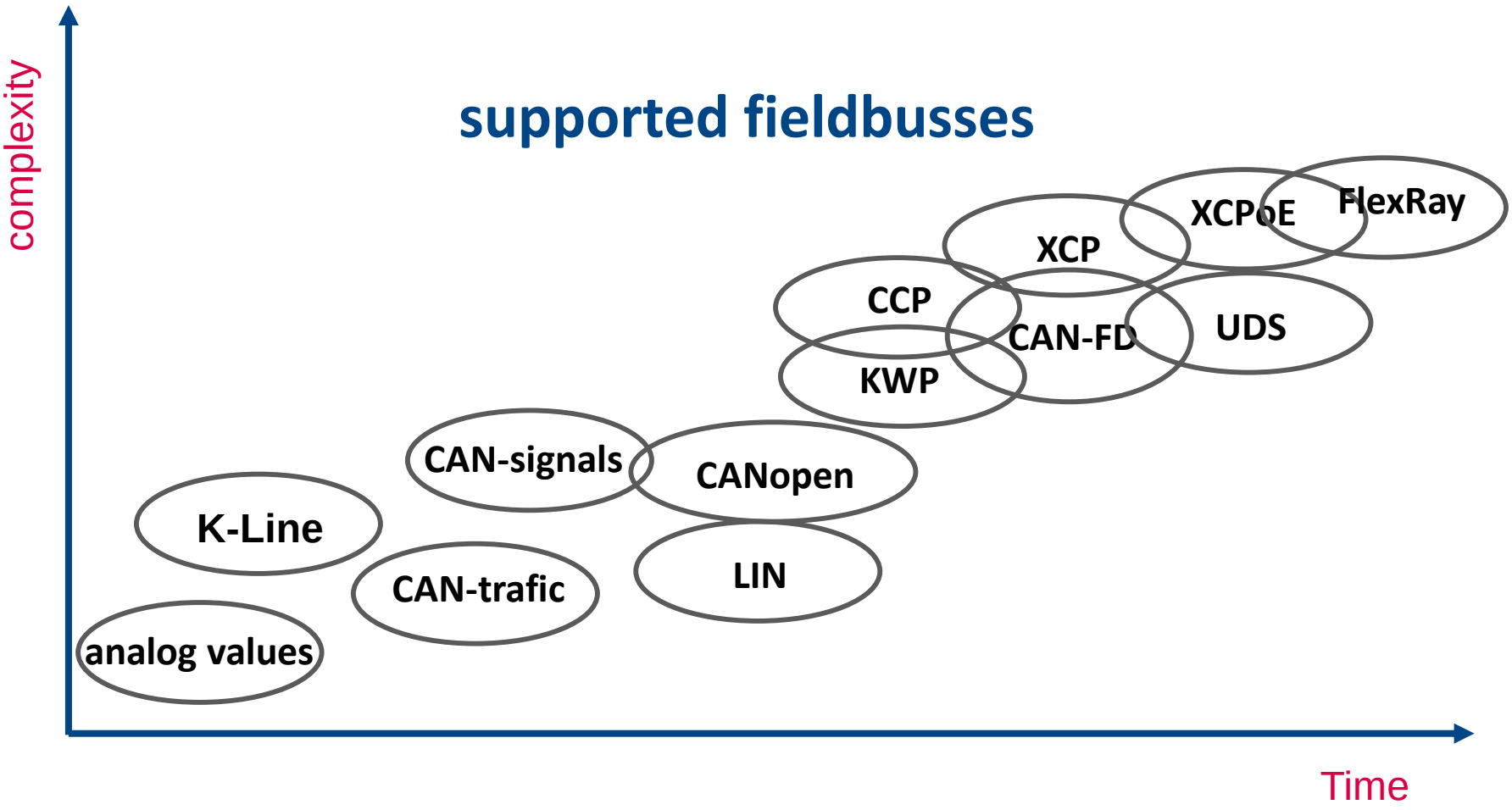
E2000/APC

imc hardware

imc fieldbus modules

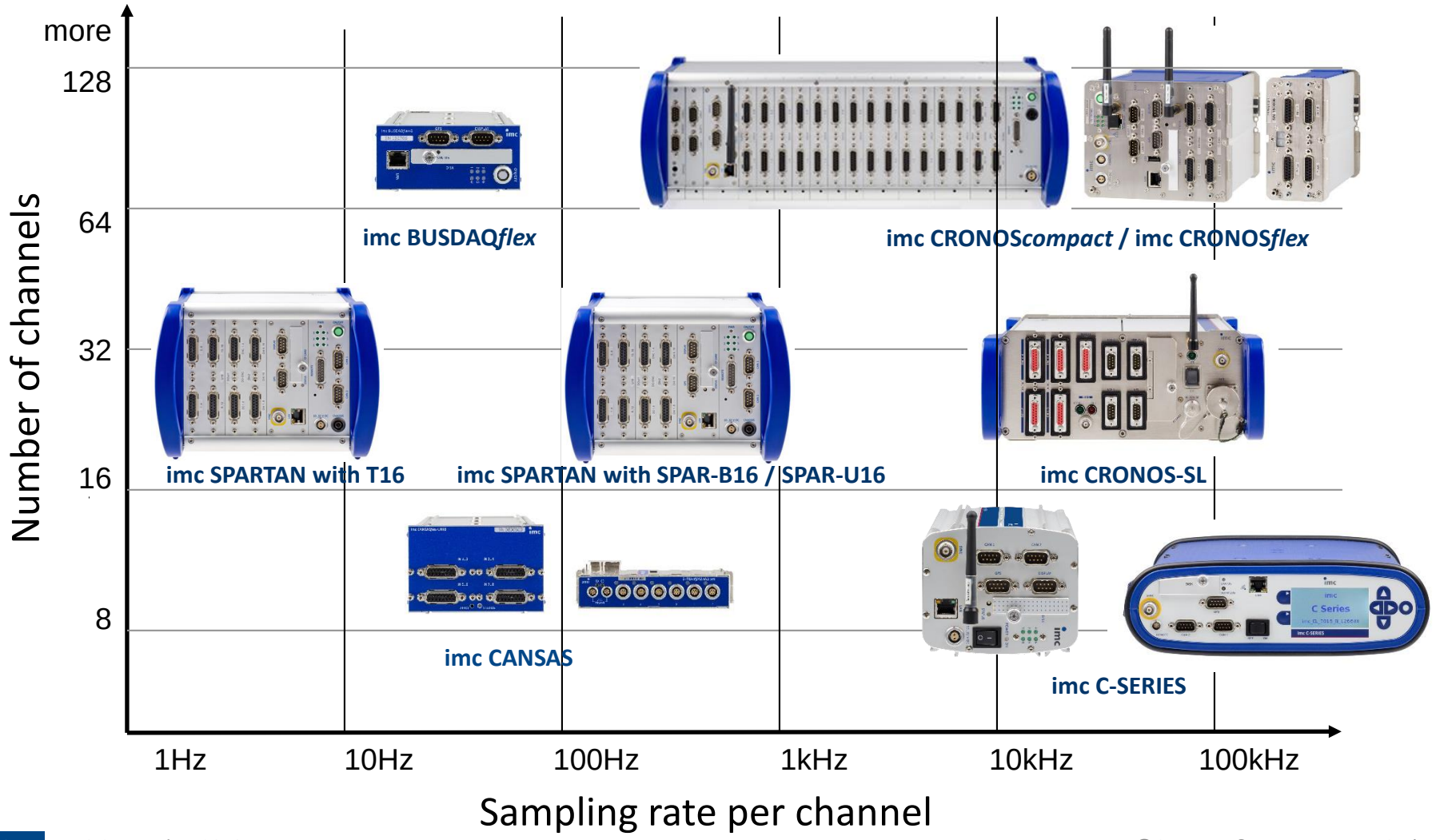
Bus interfaces:

- CAN-Bus
- LIN-Bus
- Flex-Ray
- XCPoE
- RS232/485/…
- ARINC
- MVB
- SENT
- …



imc hardware overview

Different systems for different applications



imc hardware overview

Different systems for different application

Ethernet

imc SPARTAN

imc BUSDAQ*flex*

imc C-SERIES

imc CRONOS-SL

imc CRONOS*flex*

imc CRONOS*compact*

CAN-bus

imc CANSAS*flex* / imc CANSAS*fit*

analog

imc sensors

Optical distance and speed sensor (LUXACT)

Wheel Force transducer (WFT-Cx)

Steering wheel sensor CLS

accelerometers

Digital telemetry

Optical distance and speed measurement

LUXACT 1D Neo

LUXACT 1D Compact

LUXACT 2D Compact
(in development)

1D optical + 2D inertial → 1D optical + 6D inertial → 2D optical + 6D inertial + GPS

Rail brake tests:
Smooth & pitch
compensated speed signal

Since 2017 also with 6D
inertial sensors

Automotive:
Brake testing,
Driving performance,
Consumption measurement

Automotive:
- like 1D Compact+
- Handling & dynamics: European Stationary Cycle test, aquaplaning, track deviation, lane change, ...)
- ADAS & Safety Systems Testing: adaptive cruise control, autonomous emergency braking and collision prevention, lane keeping assistance systems

IMU = Inertial Measurement Unit

Optical distance and speed measurement

LUXACT 1D Compact

Contactless and precise

- Braking test with automated braking distance determination
- Trigger input and direction recognition as standard
- ABS & ESP test
- Coast-down test, consumption measurement
- Compact and light: 950 g !!!

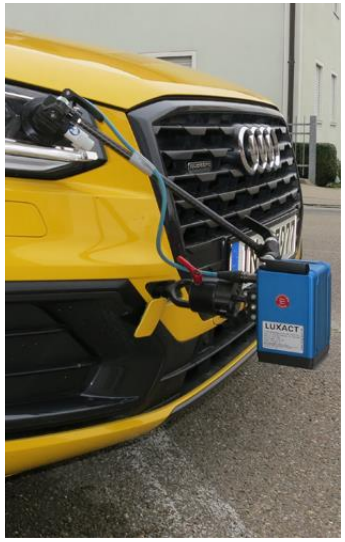
Technical data

- Measuring range: 0.2 - 300 km/h
- Accuracy v: ≤ 0.1 % FS
- Accuracy s: ≤ 3 cm at approx. 40 m braking distance 100 - 0 km/h
- Working range: 400 mm ±30 %
- Output rate: 250 Hz (opt. 1000 Hz)
- Full IMU

  (**I**nertial **M**easurement **U**nit, 6 DOF)

Connection to imc

- CAN bus
- TTL-Pulse Output



Optical distance and speed measurement

Summary:

- Sensor synergy of optics and IMU
- No additional electronics box
- Quick and easy to install
- Surface independent
- measuring range 0.2 ... 300 km/h
- With 6 DOF IMU, angular speeds and accelerations in x, y and z-directions can be measured with high resolution
- Suitable for a variety of dynamic tests
- Can be used in a wide variety of climatic conditions
- Very good price/performance ratio

speed measurement

LUXACT 1D Compact

SMG technologie

Optical distance and speed measurement

LUXACT Neo 1D

Non-contact and precise

- Brake testing
- Slip-free measurement
- Surface independent
- Suitable for harsh environments

Technical data

- Low-Speed Type: 0.1 - 50 km/h
- Standard Type: 0.2 - 270 km/h
- High-Speed Type: 0.3 - 400 km/h oder
  0.5 - 500 km/h
- Accuracy v: ≤ 0.1 % FS
- Accuracy s: ≤ 3 cm at approx. 40 m
  braking distance 100 - 0 km/h
- Working range: up to 1000 mm ±30 %
- Output rate: 50 Hz (up to 1000 Hz)
- Light source: IR-LED
- Full IMU
  (**I**nertial **M**easurement **U**nit, 6 DOF)

imc acceleration sensors

imc AS-series

Static and low-noise

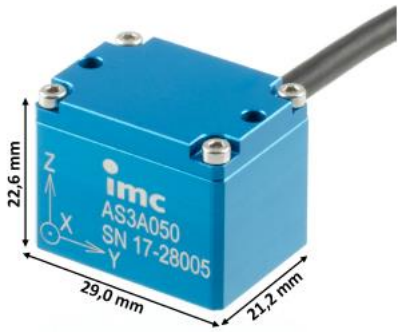
- Static MEMS accelerometers
- Small and light
- Can be used everywhere where accelerations have to be measured reliably
- Any cable length
- Driving dynamics, fatigue strength, comfort measurement, structure monitoring

Technical data

- Very low noise (low-noise sensor elements)
- TEDS (Transducer Electronic Data Sheet) included as standard (IEEE P1451.4)
- Direct connection to all imc bridge or voltage amplifiers with sensor supply
- Measuring range: ±2 g .. ±400 g

Connection to imc

- Analog including TEDS



imc acceleration sensors

imc AD-series

Static and low-noise

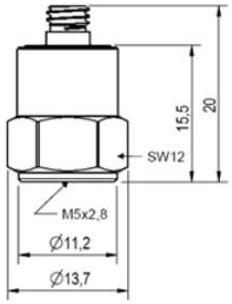
- Piezoelectric IEPE accelerometers
- Isolated housing
- Can be used everywhere where accelerations have to be measured reliably
- Any cable length
- Machine dynamics, vibration, spectral, modal analysis

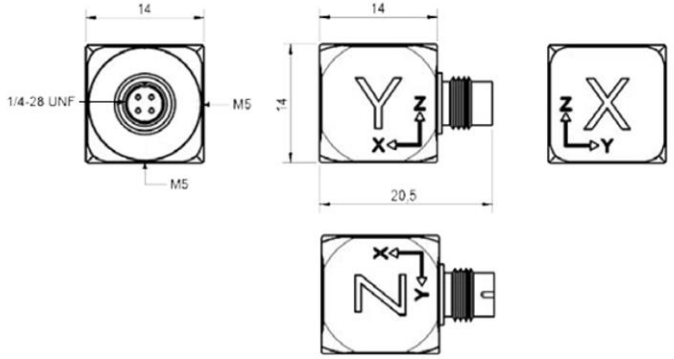
Technical data

- Very low noise
- TEDS (Transducer Electronic Data Sheet) included as standard (IEEE P1451.4)
- Direct connection to all imc measurement amplifiers with IEPE input (constant current)
- High bandwidths up to 23 KHz
- Measuring range: ±60 g; ±500 g; ±600 g
- M5 bottom thread

Connection to imc

- Analog including TEDS





Steering sensor CLS^x / CLS-E

Steering sensor CLS^x / CLS-E

Highest precision with smallest dimensions

- Usability measurement
- Comfort measurement
- Misuse measurement
- **Driver assistance systems**
- **Autonomous driving**

Technical data

- Steering torque: ±100 Nm
- Steering angle CLS^x: ±1440 °
- Steering speed: ±1000 °/sec
- Resolution: 0.02 °
- Acceleration in x-, y-, z- direction up to 5 g
- Rotational Acceleration ±10.000 °/s²
- Breaking strength ≤ 500 Nm

Connection to imc:

- CAN bus
- Analog output

Steering sensor CLS^{x}

Summary:

- Smallest steering sensor on the market
- Universally applicable thanks to individual adapters
- Very fast and problem-free vehicle change possible
- Measurement range and sensitivity suitable for driver assistance systems and autonomous driving
- Original steering wheel, airbag and ESP functionality are retained
- For mobile applications as well as for test bench applications

Digital telemetry

Dx digital multi-channel telemetry

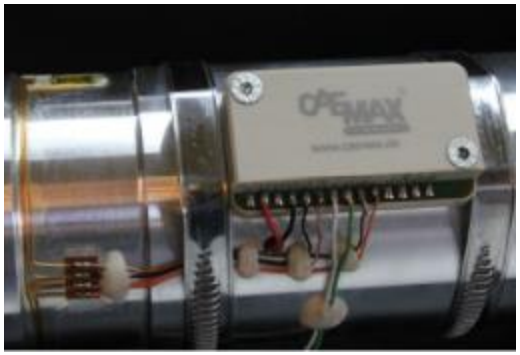
Dx telemetry

Technical data

- Up to 4 transmitters
- 16-Bit digitized signals
- 868 MHz- or 2.4 GHz-Band
- Analog outputs or CAN bus
- Power supplies:
  - Inductive, battery or rechargeable
- Up to 6 channels per transmitter:
  - Strain gauge, temperature, acceleration
- Sampling rate SCT summary:
  - Max. 4.6 kHz (868 MHz)
  - Max. 5 kHz (2.4 GHz)
- Sampling rate RCI summary:
  - Max. 7.2 kHz (868 MHz)
  - Max. 8 kHz (2.4 GHz)

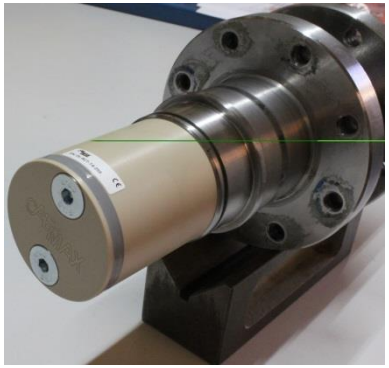
Connection to imc:

- CAN bus
- Analog output



D^x digital multi-channel telemetry

Application solutions



D^x digital multi-channel telemetry

Power supplies

KMT 1-channel telemetry

KMT telemetry for rotating applications

Measurement of voltage, strain gauge, thermocouple and PT100/PT1000

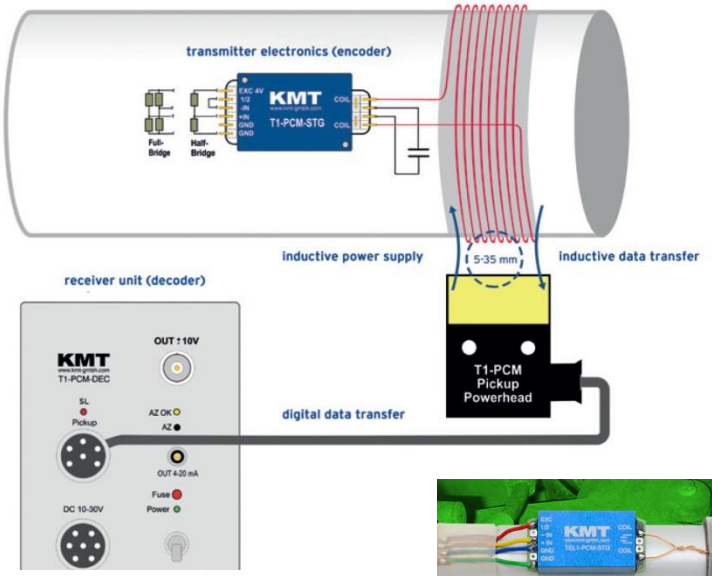
- T1-PCM-STG
- TEL1-PCM
- TEL1-PCM-FLEX

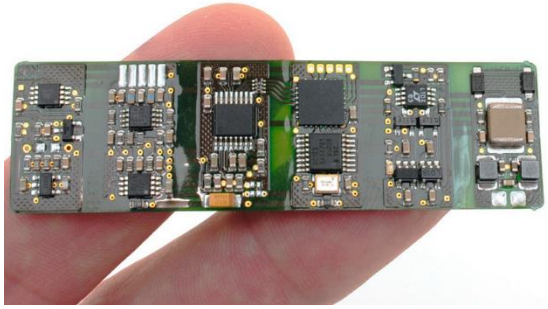
Technical data

- Inductive data transmission
- Output (decoder) analog ±10V
- Max. signal bandwidth 1.2kHz
- Max. sampling rate: 6.41 kHz to 7 kHz
- Operating temperature: 40 °C ... +85 °C
- Resolution: 12 Bit up to 16 Bit
- Gain: 250 to 8000

Connection to imc:

- Analog output





KMT multi-channel telemetry

KMT multi-channel telemetry

Measurement of voltage, strain gauge, thermocouple, PT100/PT1000 and IEPE

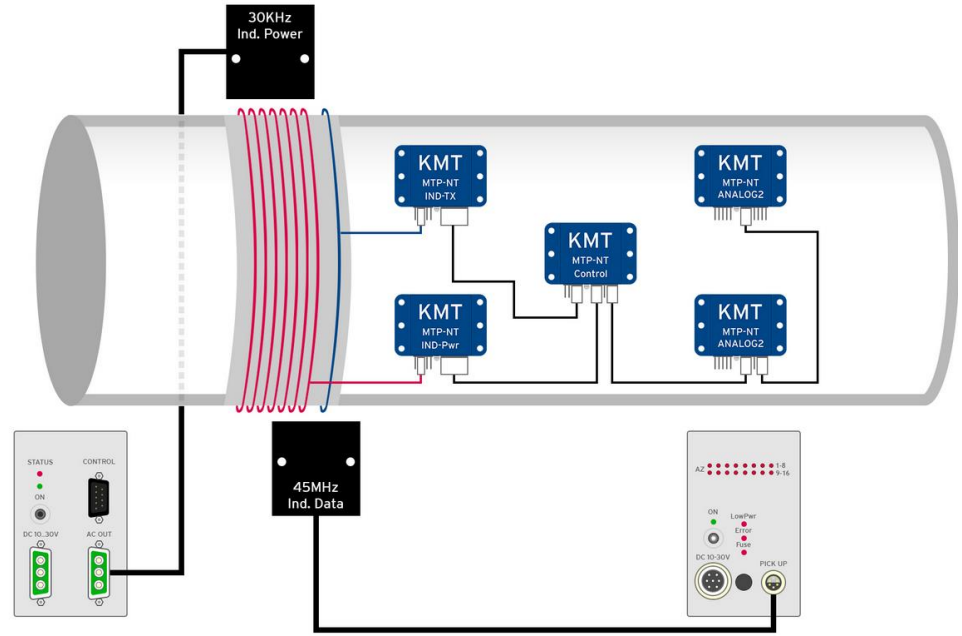
- MTP-NT
- CTP
- CTP-Rotate

Technical data

- Inductive data transmission
- Output (decoder) analog ±10V, Ethernet
- Max. signal bandwidth 24 kHz
- Max. sampling rate: 62.5 kHz to 100 kHz
- Max. data rata: 5 Mbit/s to 10 Mbit/s
- Operating temperature: 40 °C ... +85 °C
- Resolution: 16 Bit
- Distance: 50mm to 2000m

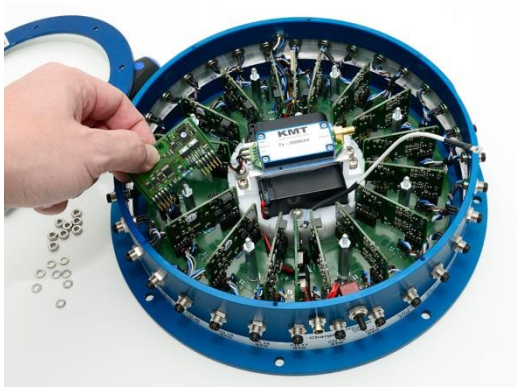
Connection to imc:

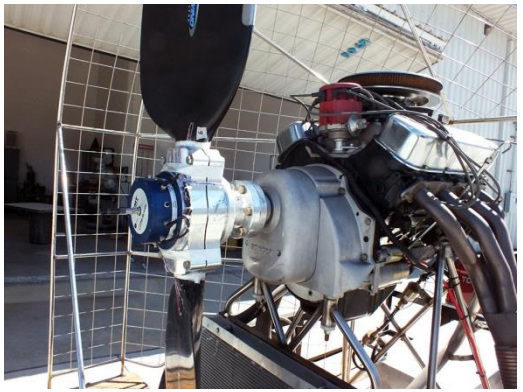
- Analog output
- Ethernet (TELDEC-Interface)



KMT multi-channel-telemetry

Applications





6 component wheel force transducer (WFT-C^{x})

Wheel force transducer

Measurement of all forces and torques acting on the wheel

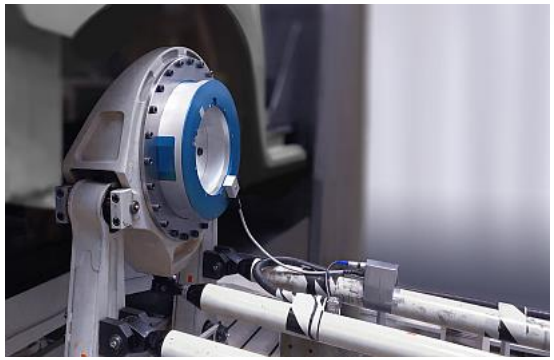
- Very high fatigue strength
- Weatherproof to IP 67
- Shockproof up to 100 g
- Flexible due to modular design
- Precise on test bench **and** in mobile use

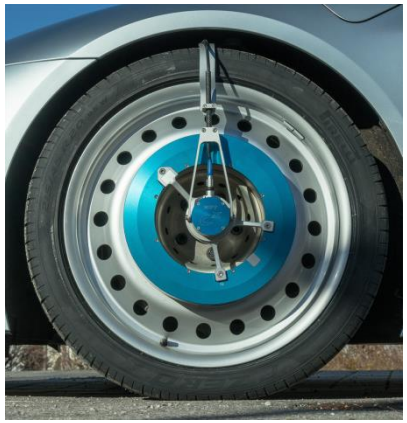
Technical data (aluminum)

Fx, Fz:	±45 kN, **Fy**: ±25 kN
Mx, My, Mz:	8.75 kNm
Angle resolution:	0.072 °
Accuracy:	> 0.2 %
Sampling rate:	up to 5 kHz
Protection class:	IP 67
Temperature:	-40 °C .. 105 °C
Weight:	7.8 kg (w/o adapter)

Connection to imc:

- CAN bus
- Ethernet

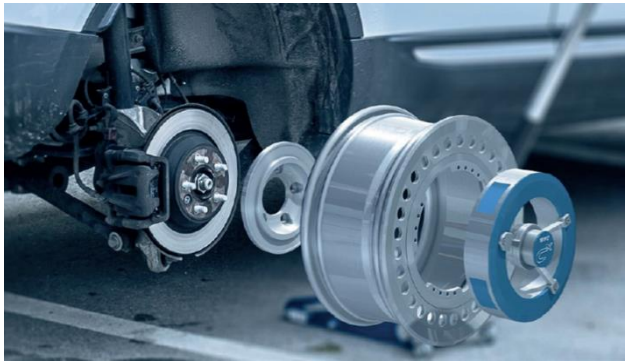




6 component wheel force transducer (WFT-C^{x})

Features!

- Overload protection (mechanical)
- High sensitivity and dynamics increase measurement accuracy
- Rain and/or snow operations
- All off-road tests possible
- High lateral acceleration possible
- Internal spirit level
- Surge protection (power supply)
- No crosstalk of the measurement signals
- Flexible applications with short set-up times
- Compatibility with different tire sizes
- Compatibility with different vehicles
- Quick and easy conversion to other vehicle types without recalibration



6 component wheel force transducer(WFT-C^x)

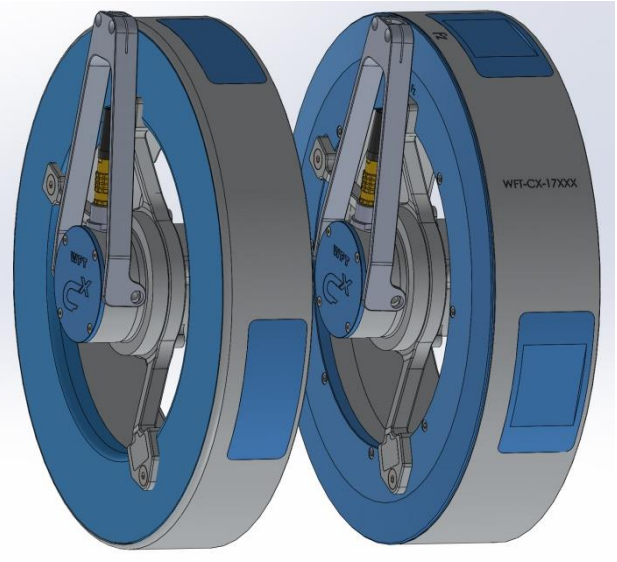
Technical data

Parameter	Value		
Material	Aluminium	Titanium	Steel
Measurement principle	temperature compensated strain gauge application		
Measurement range: forces	Fx, Fz = ±45 kN Fy = ±25 kN	Fx, Fz = ±60 kN Fy = ±30 kN	Fx, Fz = ±60 kN Fy = ±30 kN
Measurement range: torques	Mx, My, Mz = ±8,75 kNm	Mx, My, Mz = ±10 kNm	Mx, My, Mz = ±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		

6 component wheel force transducer (WFT-C^{x})

WFT-C^{x} vs. WFT-C^{xs}

	WFT C^{x} aluminum	WFT C^{xs} aluminum
Measurement range: Force Torque	 Fx, Fz = ±45 kN Fy = ±25 kN Mx, My, Mz = ±8,75 kNm	 Fx, Fz = ±25 kN Fy = ±20 kN Mx, My, Mz = ±6 kNm
Weight	<7.9 kg	<5.9 kg
Outer Diameter(OD) Inner Diameter (ID) Height	317.5 mm 203 mm 76 mm	317.5 mm 203 mm 61 mm
IP Protection	IP66 and IP 67	IP66 and IP67
Temperature range	-40°C – 105°C	-40°C – 105°C
Accuracy	Gain < 0.2% FS Hysteresis < 0.2% Linearity < 0.2% FS Angle Resolution 0,072 ° (5000 Ink)	Gain < 0.2% FS Hysteresis < 0.2% Linearity < 0.2% FS Angle Resolution 0,072 ° (5000 Ink)
Sampling Rate	5 kHz	5 kHz



Designed for high lateral dynamic

1-component wheel torque transducer (WTT-D^x)

Wheel torque transducer for My

Specifications:

- Compatible with 14"... 20" wheels
- Measurement of drive and brake torques
- Waterproof (IP 67)
- Wireless
- Transmitter electronics integrated in measuring body
- My = ±3000 Nm, optionally ±6000 Nm
- Power supply: recha. battery (> 60 hrs runtime)
- Operating temperature: -40 °C ... 105 °C (limited by battery)
- Telemetry display with analog and CAN output
- Simultaneous acquisition of up to 4 WTTs by the proven D^x telemetry receiver
- Weight: approx. 4.75 kg with transmitter unit

Connection to imc:

- CAN bus
- Analog output

Thank you for your attention

More information: www.imc-tm.com