



• • • • Integrated measurement & control • • • •

C-Series

Intelligent, compact measurement systems
integrating the full spectrum of instrumentation



Network-capable, self-contained compact measurement devices

Why settle for anything less than state of the art? All-purpose, network-capable, real-time measurement devices with built-in measurement amplifiers and easy-to-use, ready-to-go user interface software are now available in a compact package: The imc C-Series!

Universal measurement device for development, testing and service

The C-Series consists of smart network-capable, fanless compact measurement devices for all-purpose measurement of physical quantities. These devices can operate either in computer-aided or autonomous configurations. They are lightweight, compact, robust, and thus especially well adapted to applications in R&D or in the testing of mechanical and electromechanical components of machines, on board vehicles, or in monitoring tasks in fixed installations.

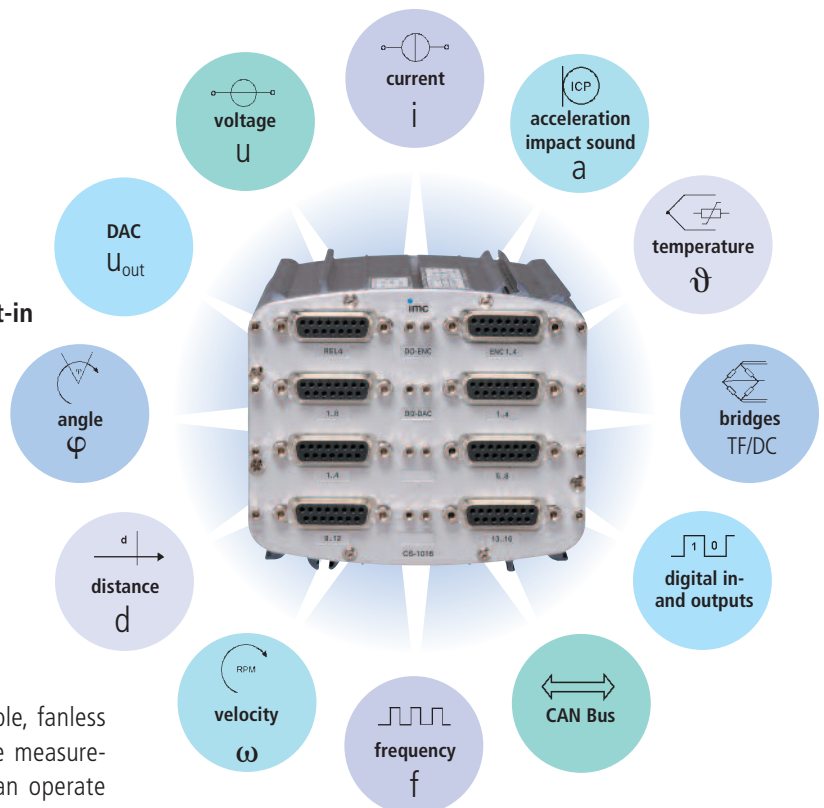
The C-Series includes either differential or isolated universal measurement amplifiers with automatic analog anti-aliasing filters.

The universal amplifiers offer a high degree of flexibility; they are high-precision and low in noise. They are designed for direct connection of:

- voltage- and current signals
- any thermocouples and resistance thermal devices
- strain gauge and/or measurement bridges with voltage supply and adjustment control
- current-fed sensors (e.g. ICP®)

C-Series devices may also include a sensor power supply and TEDS (Transducer Electronic Data Sheet) capability.

Depending on the model, the input channels can be sampled at up to 100kHz, and bandwidths of up to 22.4 kHz.



More than just a universal amplifier

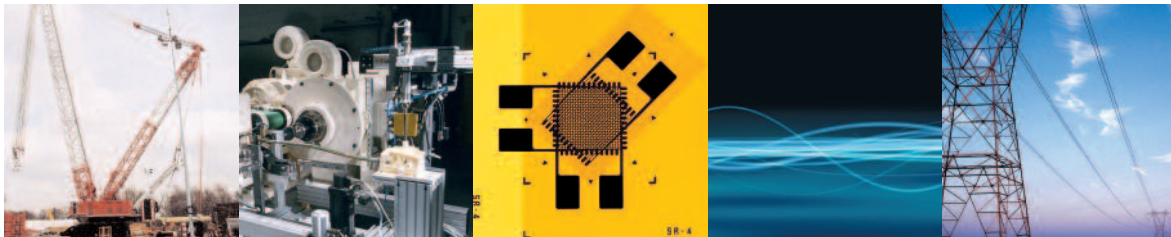
In addition to the analog inputs, all of the C-Series models also come with:

- 8 digital inputs
- 8 digital outputs
- 4 analog outputs
- 4 counter inputs for capture of RPMs, displacements etc.
- CAN-Bus Interface with 2 nodes

Real-time capabilities

For real-time functionality such as mathematical calculations, limit monitoring or closed- and open-loop tasks in the μs range, the C-Series comes standard with Online FAMOS and includes powerful digital signal processors (DSPs) which quickly perform your calculations, in real-time and independent of the PC. Online FAMOS enables freely defined real-time functions and truly transforms the C-Series from a simple data logger into a Personal Analyzer.

Specialized or all-purpose – The choice is yours



**Universal laboratory
and mobile applications**

**Test rig
applications**

**Measurement
with strain gauges**

**Noise and vibration
analysis**

**Power
measurement**

Tough enough for laboratory or field applications

For measurements in complicated field conditions, the C-Series models CS-4108 and CL-4124 offer isolated input channels. Electrically isolated channels avoid signal disturbance even in the presence of ground loops and stray electrical fields.

Noise and vibration analysis

The C-Series is also optimally equipped for noise and vibration analysis. The CS8008 model in particular is a device offering a large analog bandwidth and high sampling rate, as well as the possibility of directly connecting current-fed accelerometers and microphones. Along with simple time-domain signals, the CS8008 can also display linear frequency and 1/3-octave spectra.

Using the software platform imc WAVE, the measurement device is transformed into a true specialized instrument for tasks involving noise and vibration analysis. imc WAVE's individual software modules make order-tracking, spectral and sound power analyses possible with the click of a button.

Universal power measurement

For the full range of power measurements, the model CL-2108 provides the right tools. It can carry out single-, two- and three-phase power measurements. CL-2108 offers a convincing combination of affordable price and high precision. An optional software package for network voltage analysis is also available.

Measuring with strain gauges – Structure Analysis

With five model varieties specially adapted for strain gauge measurements, the C-Series provides the right device for any structure analysis application. For performing strain gauge measurements inexpensively, the models CS5008, CL5016 and CX5032 are available. For dynamic strain gauge measurements of the highest quality, the carrier frequency amplifier models CS6004 and CL6012 are the devices of choice.

The C-Series in test rigs

For test rig applications in particular, it is often desirable to integrate equipment into new or existing environments. In conjunction with imc COM and the LabView interface, C-Series is able to meet this wish.

Different housings for different applications

To meet the wide spectrum of the C-Series' application potential, there are three different housing varieties: the very compact CS frame for up to 16 input channels; the CL variant for up to 32 input channels; and the larger CX frame, which has room for 32 bridge measurement channels.

What the C-Series has to offer

Autonomous or PC-aided

The C-Series devices are optimally suited for PC-less operation as compact smart measurement instruments. A variety of different setups can be stored in the internal device memory or hard drive and recalled as needed. If display of measured values is required, it can be provided by the external display device.

Immediately ready to run a measurement

Like all imc measurement systems, the C-Series devices are run by the operating software imcDevices. This provides ease and convenience of configuration for any test arrangement. Setups can be saved and recalled via the PC.

If the setup is stored on the system itself, and selected via the device keyboard or an external display, it has the extra protection of avoiding setup modification by the operator.

Real-time calculation, open- and closed-loop control

With its digital signal processors (DSP), and in conjunction with Online FAMOS, the C-Series is a customizable Personal Analyzer offering not only general calculation functionality, but also special calculation algorithms such as digital filters, FFT, class-counting and order-tracking analysis, as well as control commands and closed-loop control functions.

Without the need for programming tools, the measurement system can be expanded with application-specific functionality, such as data compression, calculation operations performed on entire channels, control processes and closed-loop control functions. Complete integration of this DSP functionality is easily achieved by means of the operating software imcDevices.

Ethernet network capability

The C-Series is networkable with Ethernet (TCP/IP), or wirelessly via WLAN. Multiple C-Series devices as well as other imc measurement systems can be joined up into a measurement network. The structure of decentralized measurement networks is thus no problem at all and quickly achieved. All devices run in parallel and with complete synchronization of the measurement channels. Messages can be exchanged between the devices.

No data loss from power outages

The C-Series comes with an internal uninterruptible power supply (UPS) and self-activation capability. In a power outage, the measurement device automatically deactivates itself. The measurement is cleanly concluded, and the data files are closed. Once the power supply has been restored, the measurement device can start automatically resuming the measurement.

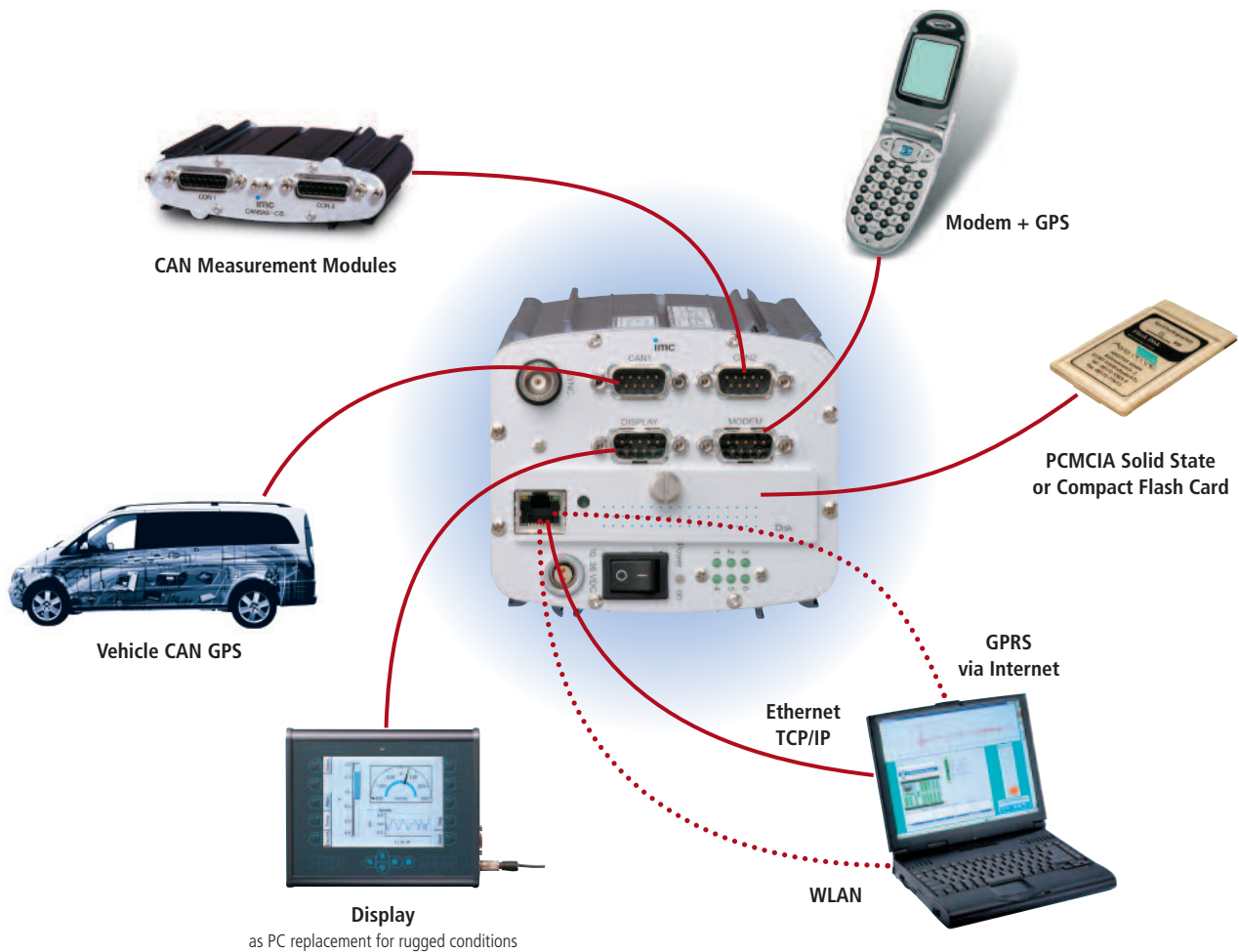
Reading measurement data from field busses

The C-Series is equipped with a dual-node CAN-bus interface which enables the system to read broadcast data and status information from the field bus. Measured data from the bus are processed, displayed and saved in parallel and synchron with conventionally measured data. The C-Series supports CAN High Speed (ISO11898) and CAN Low Speed (ISO11519).

C-Series – Data Analysis

The newest version of the signal analysis software, FAMOS 5.0 offers extensive possibilities for analysis, evaluation and documentation of measurement results.

The C-Series saves the data collected directly in the imc FAMOS data format.



Wireless remote and long-term monitoring via modem and Internet

Maintenance of system performance, localization of sporadic errors and long-term monitoring for the purpose of preemptive maintenance can all be substantially simplified by means of Internet-based remote monitoring. Unmanned monitoring of vehicles, machines or plants, as well as wireless transfer of measurement data all save lots of money and time.

The C-Series can be equipped with a modem which can log itself into the Internet and set up a stable and secure GPRS online connection between the measurement device and the home PC via an Internet-based switching center (server).

When a signal limit is violated, the device automatically sends a report in the form of measured data, status information or alarms via SMS, e-mail or FAX.

Global Positioning System

With the help of a GPS system, it is additionally possible to evaluate the measured data with regard to local circumstances and conditions.



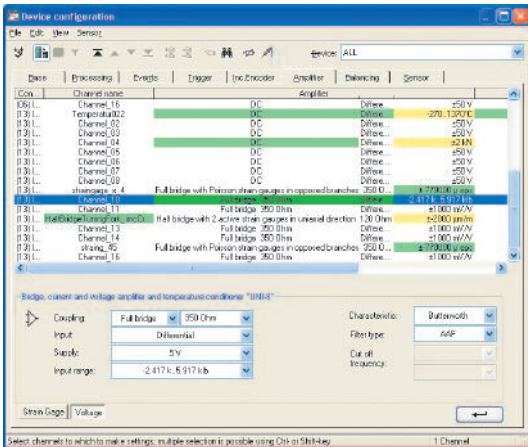
Robust System Architecture

imc operating software – imcDevices – One for all

Along with all other Ethernet-capable measurement device from imc, the C-Series is operated with the same Graphical User Interface software, imcDevices.

imcDevices enables complete manual or automated setting of all measurement parameters, real-time functions, channel, trigger and data saving modes.

Display of measurement curves in the Curve Window, and documentation composition by the Report Generator are integral elements of imcDevices. These functions are naturally accomplished in a menu-driven manner in measurement engineering terminology.



imc Operating Software

- Network Client/Server
- Manual setting of all measurement parameters

Multi-channel CL-models

The C-Series plays in the top league

The C-Series is based on the successful integrated platform and shared component concept embodied by the CRONOS PL family of measurement devices. Practically any signals and sensors used in physical measurement engineering, all the way up to an analog bandwidth of 22.4 kHz, can be directly connected.

All of the C-Series devices come with 8 digital inputs and 8 digital outputs, in addition to the analog inputs, as well as 4 counter inputs and 4 analog outputs.

The measurement devices can operate in both PC-aided or autonomous mode; they are networkable and real-time capable.

Automation

- Class library
- LabVIEW interface
- Independent COM interface
- Programming language-independent

imc Data Analysis Software

- imc FAMOS: signal analysis software
- imc LOOK: off-line data visualization

Efficient System Integration with imc COM, LabVIEW

The imc COM development environment enables programming language-independent system integration.

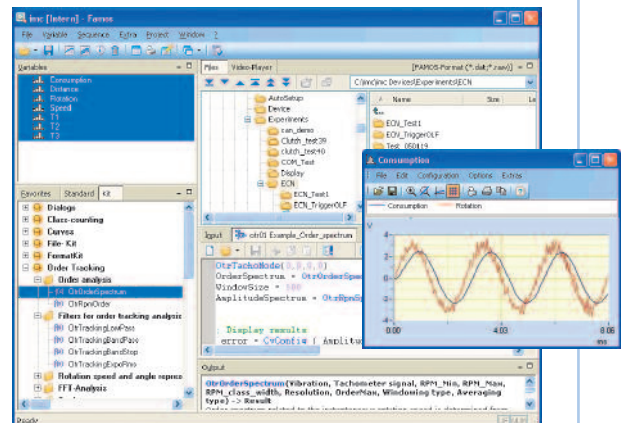
The class libraries can be integrated into all modern programming languages in accordance with the world-wide COM-software standard. They offer access to all functions of any imc hardware or software product families. In conjunction with the Ethernet TCP/IP and CAN interfaces, the imc devices provide open interfaces and documented data formats for system integration tasks and integration capability with non-imc equipment.

C-Series systems can also be easily integrated into existing LabVIEW system environments. imc offers a number of VIs™ and sample implementations which are directly accessible via the LabVIEW™ functions palette.

By means of these VIs™, imc devices can be configured, started/stopped, controlled, and measurement data can be stored and retrieved.

Analysis software – signal analysis quick and to the point

The quickest way to achieve usable results and to process measured data has a name: FAMOS. This signal analysis software which can be applied independent of the measurement hardware is perfectly adapted to the requirements of measurement. The curve window provides extensive possibilities for data display, while the Report Generator simplifies the documentation of measurement and analysis results. Besides the imc Data format, FAMOS supports a variety of other formats, with a File Assistant which can quickly import data from non-imc devices. The entire process can be automated by means of the Sequence Editor.



Especially compact CS models

C-Series

Multiple, network-capable devices – Same software

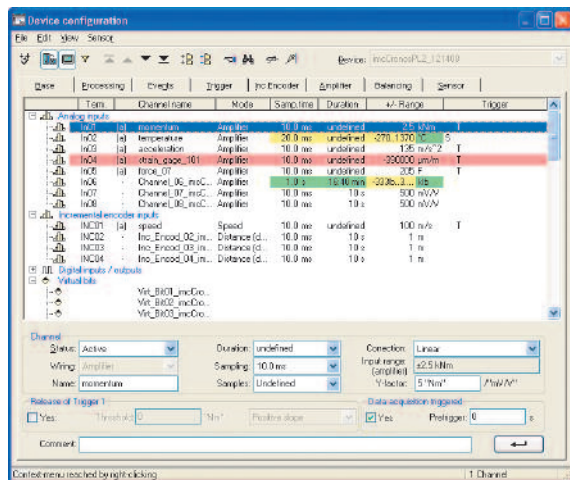
A uniform software package with open system architecture

Use of the imc operating software "imcDevices" is both intuitive and reliable. It recognizes a system's hardware configuration and can start taking measurements at a moment's notice. It enables complete interactive configuration of all measurement parameters such as channel settings, triggering, real-time functions, display of measured data, as well as composition of a measurement report and saving and archiving of data.

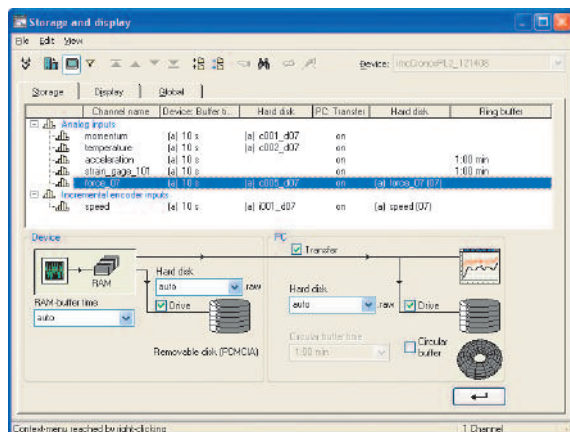
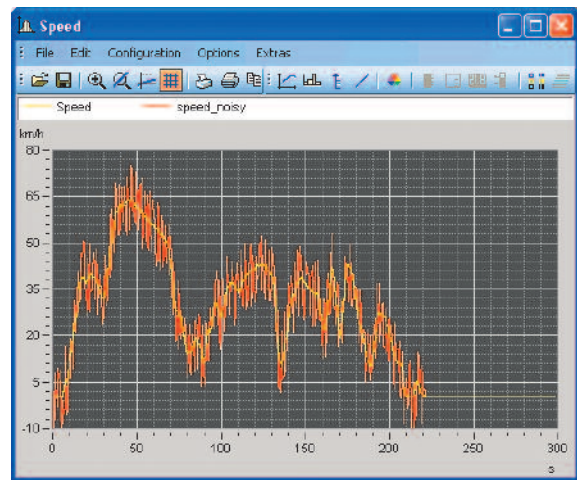
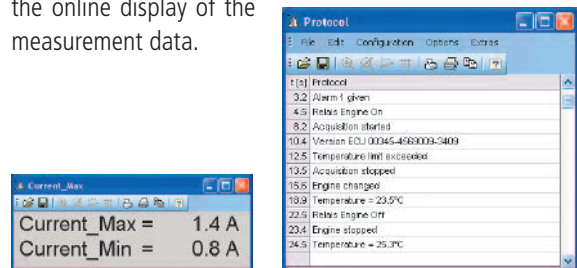
Setups and measured data can be recorded both on the PC and in internal device memory. This enables automated measurement with real-time analysis and response functions, as well as display, documentation and data storage.

Direct display of results

Whenever online display of measured data is desired, it can be obtained either via the graphics terminal or PC-aided. The PC doesn't actually perform any measurement work – it only serves the purpose of setting the measurement system's parameters and the online display of the measurement data.



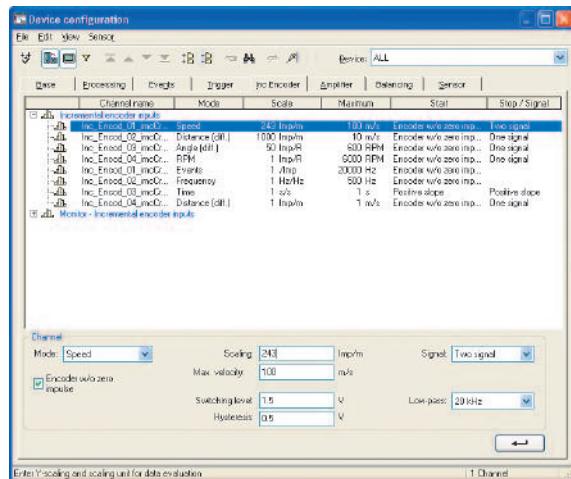
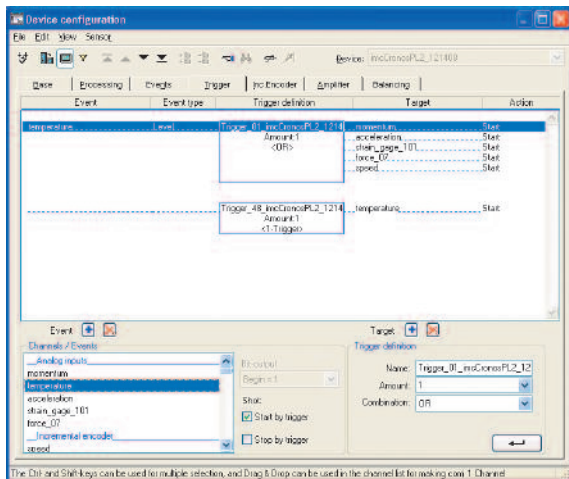
Base menu: Definition of the main measurement parameters



Data are saved to an internal device hard drive and/or on the PC, where a circular buffer memory can also be set.

Low Cost of Ownership

For users of multiple imc systems, the standardized software design dramatically reduces the necessary costs for orientation, training, and updating, as well as of software maintenance. The operating reliability, on the other hand, is significantly increased. Measurement tasks are quicker to solve and can be accomplished at lower cost. The net reduction of the "Cost of Ownership" is considerable.



The trigger machine serves the purpose of intelligent data capture as well as of data reduction. 48 trigger levels are available. Channel associated events can be combined in logical expressions and cause a defined response on the target channels.

Settings menu for frequency / counter quantities such as displacement, angle, velocity and frequency

Assembly of decentralized measurement networks

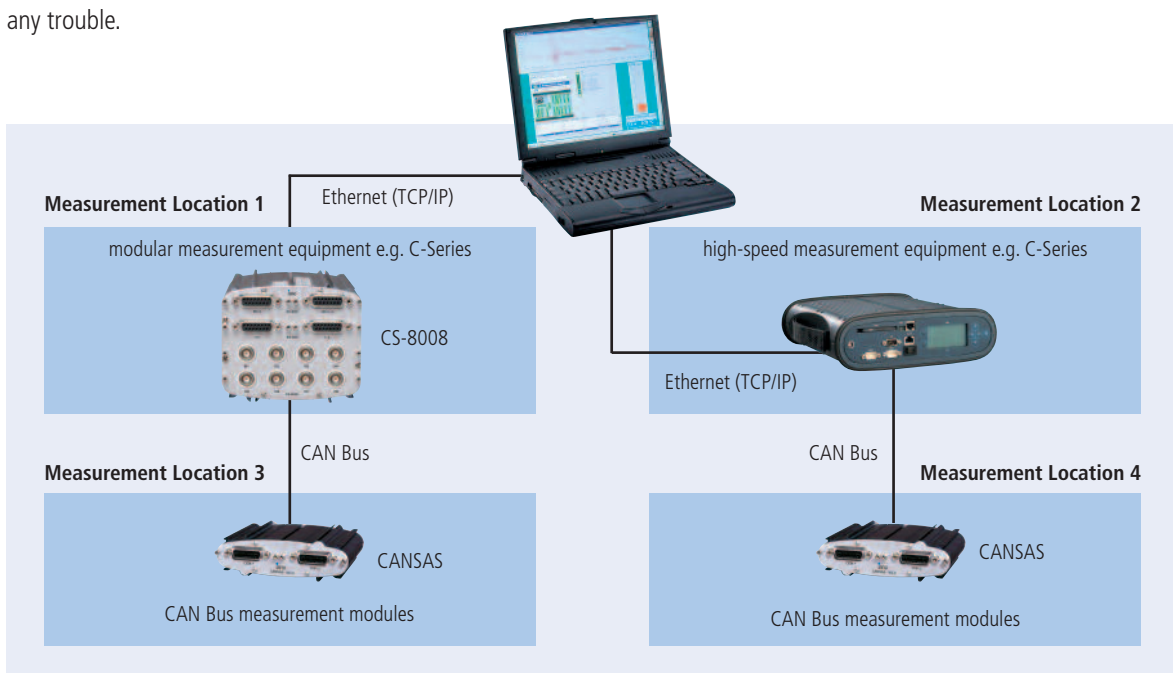
Multiplying channels via the CAN Bus

Network-wide Client/Server operation of devices from the whole range of imc product families can be achieved without any problem using the integrating imcDevices user's interface.

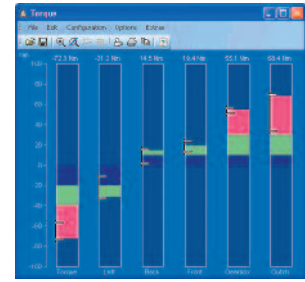
If you find yourself needing more than the available measurement channels, the C-Series can be conveniently supplemented with the CANSAS measurement modules from imc. The CANSAS modules are intelligent, measurement amplifiers for synchronized capture, conditioning and digital processing of analog signals.

The C-Series is operated via an Ethernet TCP/IP network, or via a wireless WLAN network. Multiple C-Series units, along with other imc measurement systems, can be joined via a measurement network. All devices work in parallel, with a uniform software interface, and with fully synchronized measurement channels. Messages can even be exchanged between the devices. Assembling suitable decentralized measurement networks is possible without any trouble.

Different modules can be directly connected to the CAN network interface and parameterized using the operating software imcDevices.



Viewing measurement data live



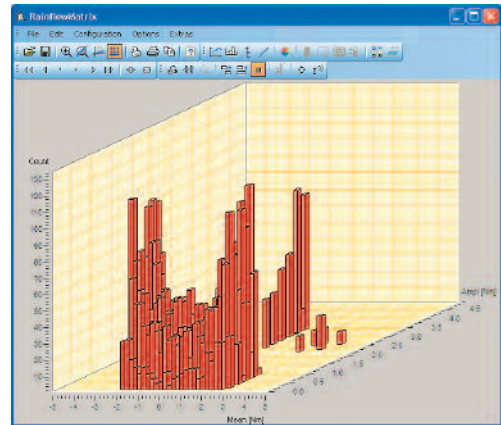
Bar meter with slave pointers

Integral elements of imcDevices: The Curve Window and the Report Generator

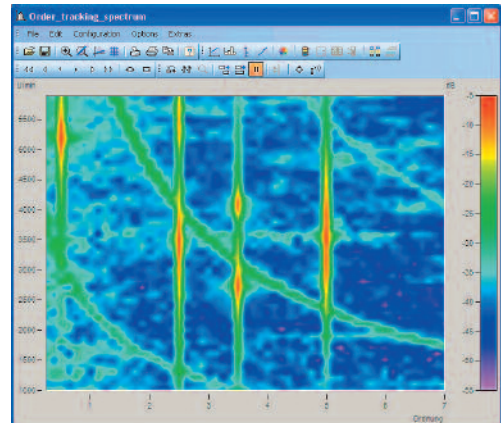
During a measurement all captured data can be displayed at a single click of the mouse. The curve window automatically opens with appropriate scaling, displaying the optimum value range. Subsequent customized re-scaling of the axes and of the display can be performed without interfering with the ongoing measurement.

A truly wide variety of freely configurable display styles are available. Standard (Y/t) display or with stacked Y-axes, single values, measurement value tables, bar meters, and a range of 3-D displays such as Waterfall, color map etc.

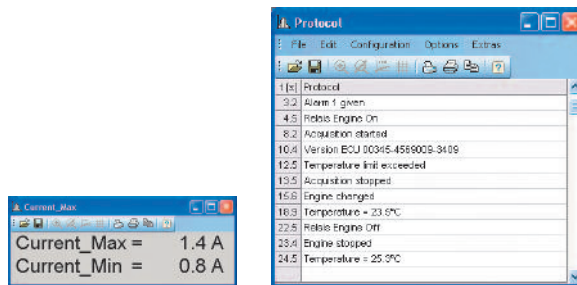
The displayed region can be resized and zoomed to any desired view. The data can also be immediately transferred and subjected to offline processing (e.g. FAMOS 5.0).



3-D class-counting representation

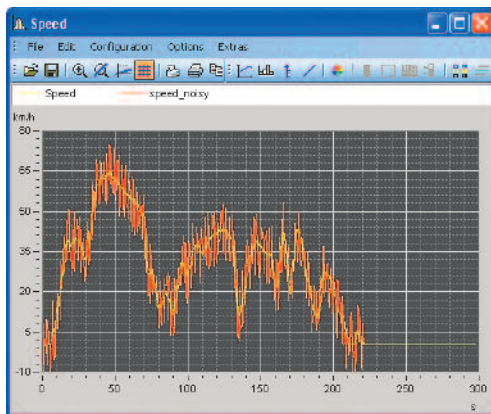


Order line representation of a measurement plotted over the angle

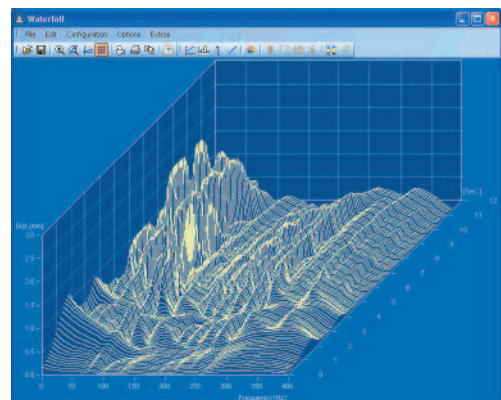


Single values

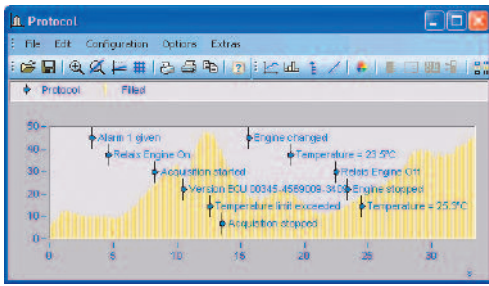
List of time-stamped protocol entries



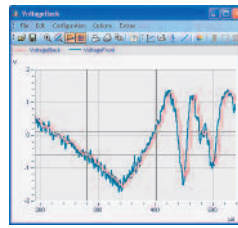
Automatically scaled



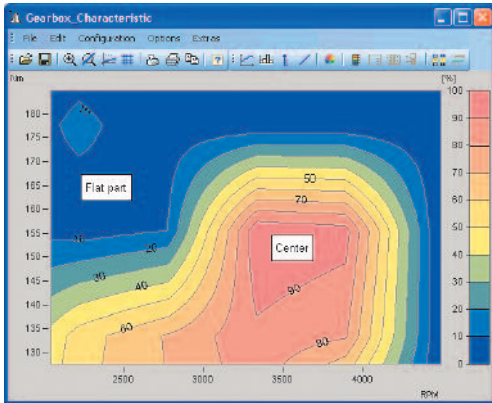
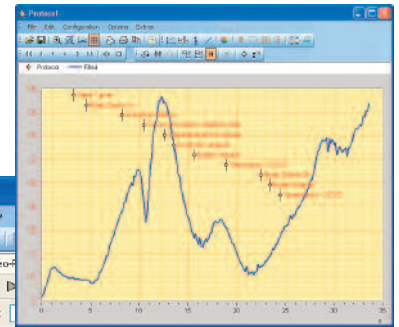
Waterfall display



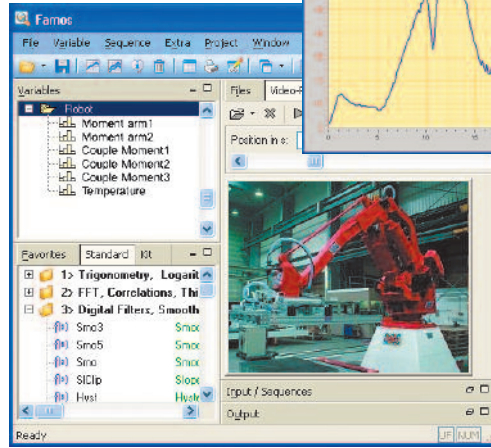
Measurement curve with automatically set time-correct report data



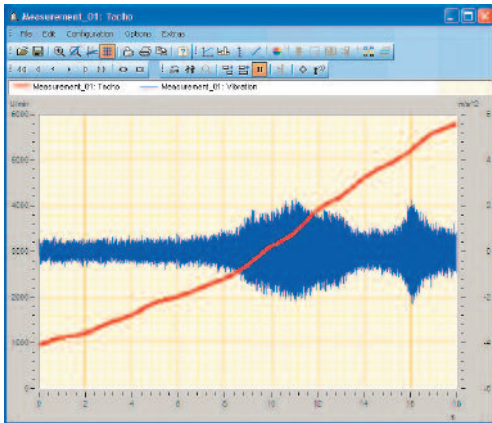
Zoomed signal segment with measurement cursors



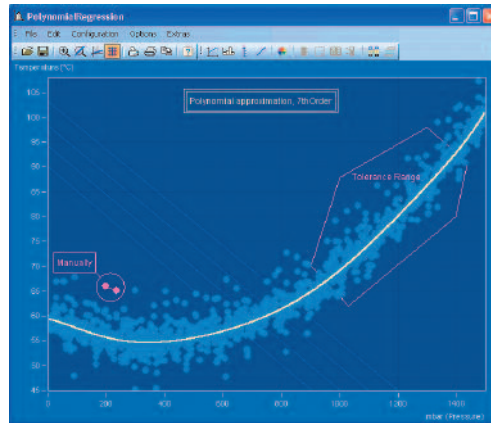
Characteristic curve field in isoline display



Synchronized display of measurement curves and video data



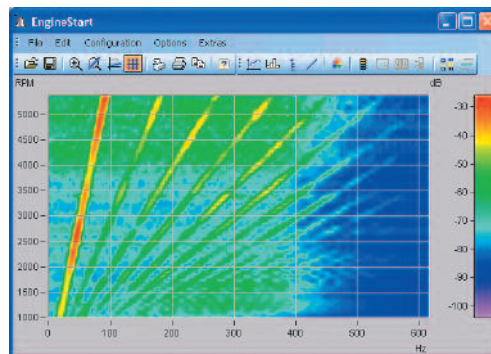
Different line thicknesses



Approximation polynomial

Conspicuity	Distance	Rotation	Speed	T1	T2	T3
-2.25	0	0	0	7,813	31,13	19,81
-2	0	-0,001307	0	7,813	31,13	19,81
-1,75	-0,000121	-0,001633	0	7,813	31,13	19,81
-1,5	-0,000732	0	0	7,813	31,13	19,81
-1	-0,000732	0,000590	0	7,813	31,13	19,81
-0,75	0,0496005	0,005226	0	7,813	31,13	19,81
-0,5	0,005444	0	0	7,813	31,13	19,81
0	0,005444	-0,01207	0	7,813	31,13	19,81
0,25	0,2925	-0,000904	-0,01927	7,813	31,13	19,81
0,5	0,9431	-0,000904	-0,01927	7,813	31,13	19,81
0,75	0,9429	-0,00045	0	7,813	31,13	19,81
1	0,9410	-0,00045	0,04887	7,813	31,13	19,81
1,25	0,9390	0,00045	0,07186	7,813	31,13	19,81
1,5	0,9371	0,000907	0,091	7,813	31,13	19,81
1,75	0,9373	0,00071	0,094	7,813	31,13	19,81
2	0,9416	0,00071	-0,1916	7,813	31,13	19,81
2,25	0,9511	0,00071	0,092	7,813	31,13	19,81
2,5	0,9636	-0,000105	0,092	7,813	31,13	19,81
2,75	0,9704	-0,00094	0,091	7,813	31,13	19,81
3	0,9800	0	0,091	7,813	31,13	19,81
3,25	0,9931	-0,00094	0,091	7,813	31,13	19,81
3,5	1,004	0,00091	0,091	7,813	31,13	19,81
3,75	1,009	0,00091	0,091	7,813	31,13	19,81
4	1,006	0,00091	0,091	7,813	31,13	19,81
4,25	1,151	0,00091	0,091	7,813	31,13	19,81
4,5	1,231	0,00091	0,091	7,813	31,13	19,81
4,75	1,29	0,00091	0,091	7,813	31,13	19,81
5	1,3	0,00091	0,091	7,813	31,13	19,81
5,25	1,376	0,00091	0,091	7,813	31,13	19,81

Display of data with different sampling rates in tabular form



3-D spectral display

Professional report composition

Every test technician's wish is for a measurement report to simply write itself at the push of a button.

imcDevices includes the Report Generator which, with FAMOS 5.0, perfectly implements this dream.

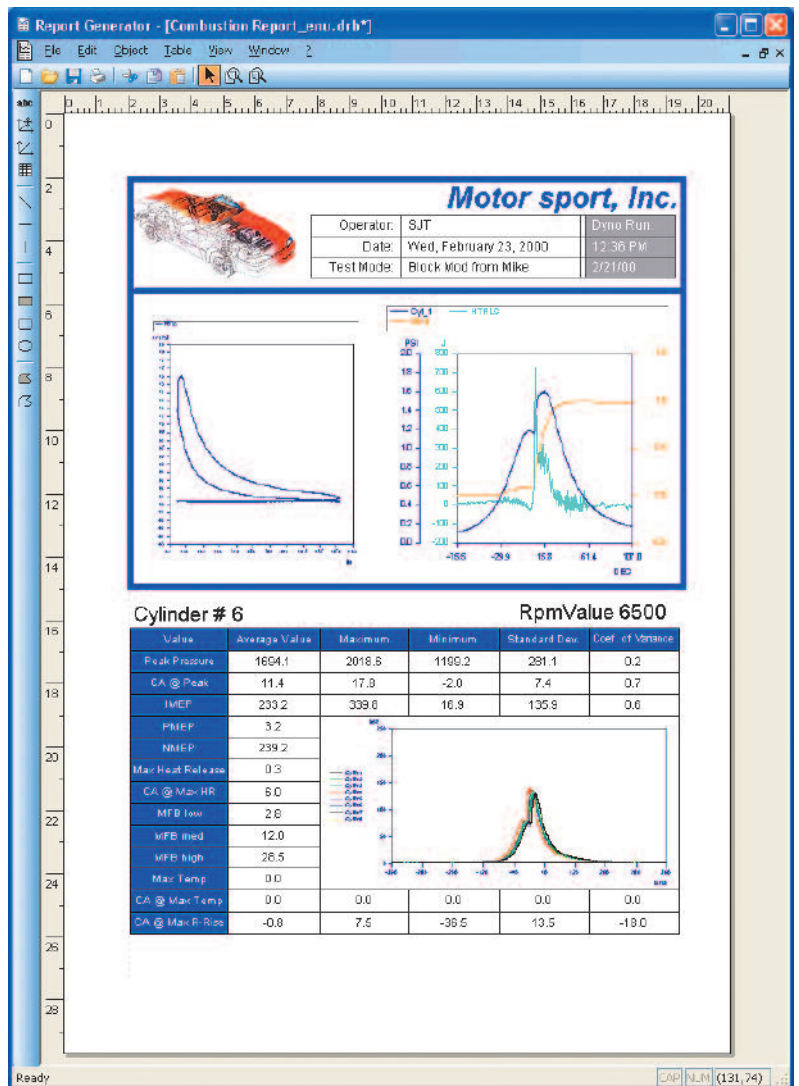
Measurement reports are quick and easy to make, directly printable, and can be transferred and printed out by other programs.

Any measurement signals which can be displayed can also be added to a report at a single click of the mouse – just captured live signals, or previously saved data. The size of the vector graphic can be subsequently changed.

Graphics can be shifted around and snapped to precise grid coordinates.

Text insertions and graphical structure elements such as lines, arrows, company logos etc., are available in a variety of colors, sized and orientation angles.

For especially quick results, you can use the signal analysis software FAMOS 5.0 to create a template to save time and effort in making routine reports.



Manual, partially, or fully-automated creation of measurement reports

Online FAMOS makes the C-Series a Personal Analyzer

Real-time calculations, open- and closed-loop control – Online FAMOS

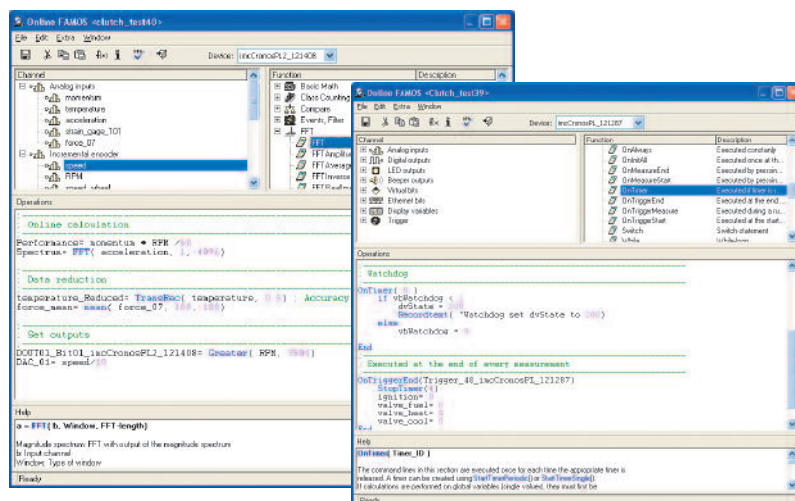
Beyond simple configuration of digitizer parameters, the most important enhancement for imcDevices is the DSP computing unit Online FAMOS, which provides a host of real-time functions.

Real-time execution of the functions is quick and independent of the PC. Online FAMOS enables "free" definition of one's own functions and virtual channels, and transforms the C-Series from a mere data logger, into a Personal Analyzer.

Any or all channels can be subjected to real-time analysis calculations. Data reduction, Transitional Recording, digital filters, frequency, responses, and signal limit violations, for example, are all easily defined by simply entering formulas in "Pocket Calculator" notation into the Formula Editor, and setting function parameters with the help of the Function Assistant's online instructions.

"Result on Demand"

- Freely defined computation of results from the measurement channels
- Limit monitoring of all measurement channels, with alarm / response triggering
- Control commands for measurement process control and communication with other devices
- Closed-loop control algorithms
- Logbook with event-record function

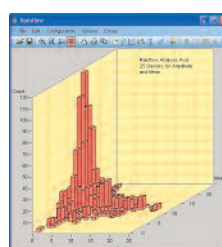


Arbitrary definition of calculation and control instructions in simple notation. Real-time, PC-independent execution with simultaneous display of results.

Durability and material fatigue testing

Online FAMOS can be expanded with the optional Class-counting Kit for the special applications involved in material strength testing.

These include the standard procedures per DIN 45667:



- Rainflow-procedure with numerous options
- 1- and 2-dimensional histograms
- Revolution class-counting

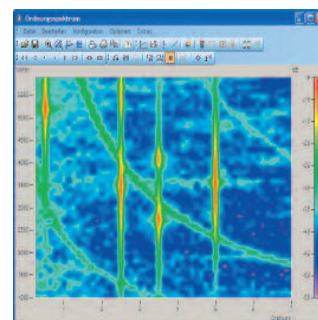
The TrueMax procedure ensures that important minima and maxima are correctly accounted even at low sampling rates.

Order tracking analysis of rotating parts

This Online FAMOS Kit contains an extensive set of mathematics functions and examples for the analysis of signals associated with rotating machinery.

The order spectrum of a machine's run-up or run-down, the RPM-dependent frequency spectrum or even the 1/3-octave spectrum can be calculated in real-time.

The measurement signals or individual order lines can be plotted not only over time, but alternatively over the angle or RPMs.



Universal measurement with strain gauges

Strain gauge measurements are a standard test procedure in a mechanical design and testing. Strain gauges determine mechanical stress and derivative quantities such as force, pressure or torque. Additionally strain gauges are a part of many sensors and transducers.

Examples include fatigue testing and service life tests of individual components such as metal plates and tubes, or more complex components such as vehicle axes or airfoils; up to structure analysis of large systems like entire vehicles or buildings; and everything in between.

Digitalization with 24-bit Sigma-Delta converters

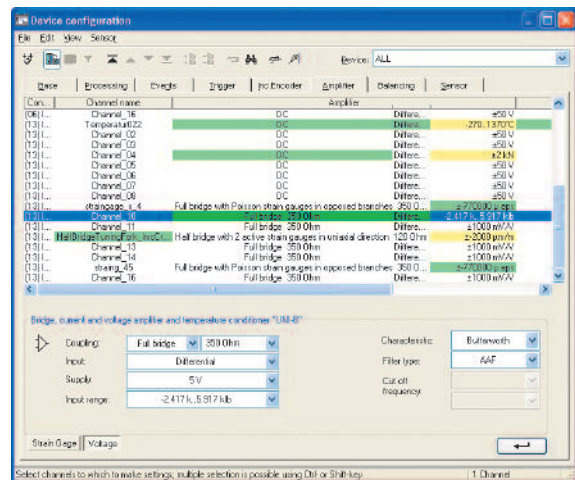
The digital strain gauge measurement amplifiers specially designed for measurement with strain gauge bridge circuits digitalize the analog signals at high speed and high resolution. Built-in, automatically adjustable filters prevent aliasing effects.

Subsequent signal processing is digital, with all the advantages that DSP includes, such as zero-balancing and amplifier scaling, every imaginable filter function, complete voltage analysis, and even rosette calculation and determination of the principle strains and their directions, all in real time.

The strain gauge signal is processed with 24-bit internal resolution, at a sampling rate of 50 kHz per channel and with an analog bandwidth of 14 kHz.

A choice of DC or carrier frequency mode

The measurement amplifiers of the CS-6004 / CL-6012 allow both carrier frequency and DC bridge excitation. Selecting the right connection type ensures that the cable influences in all circuit varieties are completely balanced. This renders certain special, complex circuiting techniques obsolete.



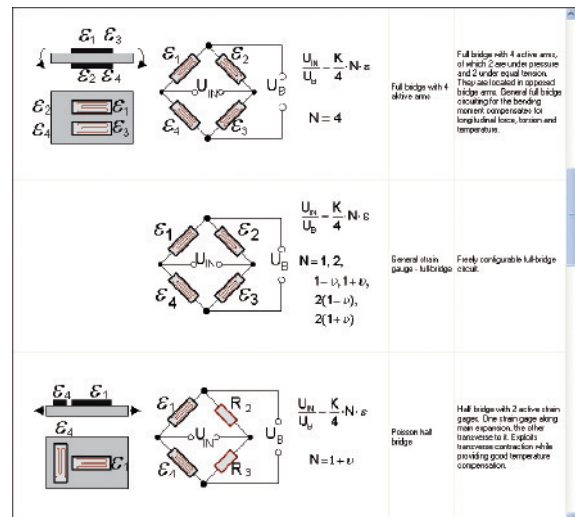
Total graphics-based setting of strain gauge measurement bridges

Keeping it simple with Plug & Measure and wireless LAN

The newest imc measurement amplifiers support TEDS and the imc Plug & Measure technology for highly simplified measurement operation.

Long measurement lines are avoided thanks to a decentralized setup of measurement amplifiers connected via a wired, or wireless, digital data network. This decentralization minimizes the measurement line length, and permits long distance, and interference-free digital data transfer.

Ethernet TCP/IP (also WLAN), both widespread and by very affordable signal transfer and networking standards, serve as the high speed digital signal pathway in this scenario.



Graphical setting of the bridge configuration



The C-Series can handle long measurement lines

Long measurement lines, and the associated problems of frequency dependent impedance, used to be one of the greatest challenges for the measurement equipment used.

Analog signal transmission from distantly located measurement sites is prone to corruption. Voltage drops along long measurement lines must be compensated by the measurement amplifier. Long conductor leads also become very expensive. Often, the investment costs for measurement cables surpass those for the sensor equipment, measurement amplifiers and data acquisition equipment.

In cases where long measurement lines are unavoidable, there is a danger that noise will be coupled in. The imc measurement amplifiers offer a variety of compensation procedures in order to handle long measurement lines in various situations. A software-activated shunt calibration resistor enables compensation of the voltage drop-off along the measurement line in DC measurements, even with four-wire configurations.

Measurement line lengths of up to 500 m can be compensated in the carrier frequency (CF) mode.

When demands are especially high

For such cases there is only one choice: The models CS-6004 / CL-6012 support all bridge configurations in both the DC and carrier frequency (CF) modes. They represent the peak of technical innovation. Nothing else is as dynamic, precise, noise-free, and flexible for your high-performance strain gauge measurements.

For multi-channel, affordable measurement

The models CS-5008, CL-5016 and CX 5032 are recommended for most typical strain gauge measurement applications. With slightly less stringent specifications and DC-only excitation mode, this measurement amplifier offers the highest channel counts while taking up the least space and costing the least budget. Ideal for multi-channel dynamic or quasi-static strain gauge test bench and in-vehicle applications.



CL-5016

Strain gauge measurement networks

Multiple C-Series devices can be networked via Ethernet. Additionally, other CANSAS measurement modules such as the universal measurement amplifier module CANSAS-UNI8 can be connected. Measurement quantities like voltage, current, ICPs®, thermocouples and resistance thermometers can also be captured.

In this way, measurement networks with any number of channels can be set up across long distances. All measured data are synchronously captured in parallel on the Master device.



CS-6004

imc WAVE Software Platform Workstation for Acoustic and Vibration Evaluation

imc WAVE is a software platform which transforms imc measurement devices, especially the compact CS-8008, into specialized instruments tailored to noise and vibration analysis, encompassing seven specific noise and vibration measurement analyzers.

The imc WAVE user interface is well adapted to the features required for noise and vibration analysis. This makes operation of the system reliable, quick and straight-forward for even an inexperienced user. imc WAVE also supports a project-oriented methodology, including a transducer database for tracking microphones, accelerometers, and other auxiliary sensors, and project history for quickly recalling past setups and measurements.

imc WAVE provides ready-made standard analysis tools for a wide variety of tasks, making your job of testing both simpler and more efficient.

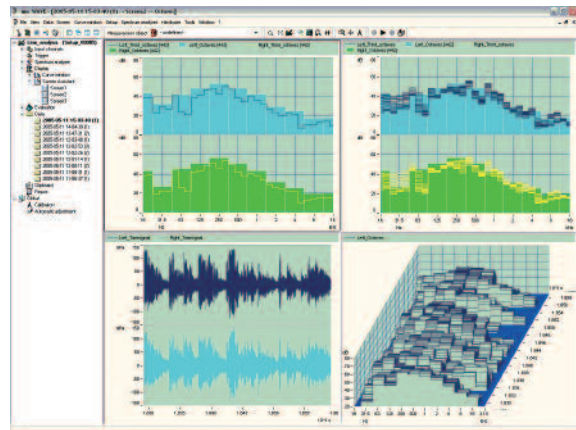


CS-8008

Sampling rate: 50 kHz
Band width: 22. kHz
Output of 1/3-octave spectra
Voltage and ICP connection

Spectrum Analyzer

A wide variety of spectrum representations are possible, including the calculation of 1/3-octaves, octave, and narrow band spectra (FFT-spectra). Configurable options for the time and frequency weighting, as well as selections for the windowing function, are all included.

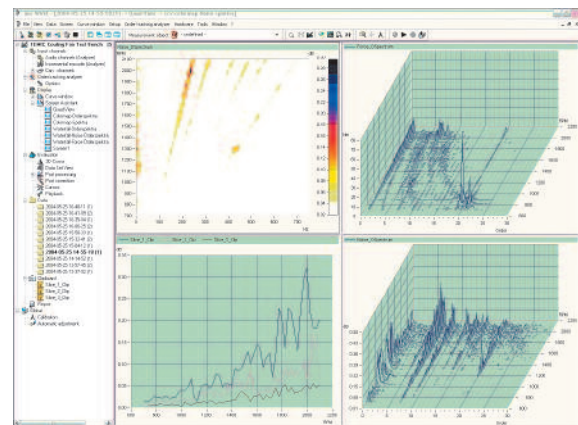


Spectral analysis with imc WAVE

Order tracking analyzer

Along with the various types of FFT analysis of time-domain signals, a special frequency-based analysis of signals over the RPM-domain is also possible. By means of the analysis of harmonics, vibrations which depend on the rotation speed can be investigated and critical rotation frequencies can be isolated and measured.

With order tracking analysis it is possible to distinguish between vibrations caused by external forces, and those due to resonances of the machinery's structure.



Order tracking analysis with imc WAVE

Sound power analyzer

The sound power is determined by means of the average sound pressure level on an enclosing measurement surface. The enclosing surface can be specified as a sphere, hemisphere, or be given by 1 to 6 freely defined surfaces. Measurements according to ISO 3741, 3743, 3744, 3745, 3746 and 11094 are supported.

Standards-compliant measurement of workplace noise

The workplace noise is determined in accordance with ISO 11201. The module can also be used as a plug-in for spectrum analysis in order to avoid time-demanding parallel measurements if sound power levels and workplace noise are required.

Pass-by analysis of motor vehicles

Designed for the special purpose of measuring the noise of passing vehicles in accordance with ISO 362. In this procedure, the vehicle drives at constant speed into the test stretch and undergoes full acceleration in 2nd gear at the measurement's start. During the ride, additional signals from the CAN- or LIN-Bus can be captured in synchronicity.

PersonalWave

PersonalWave enables the performance of specialized analyses which not addresses by the standard imc WAVE analyzers.

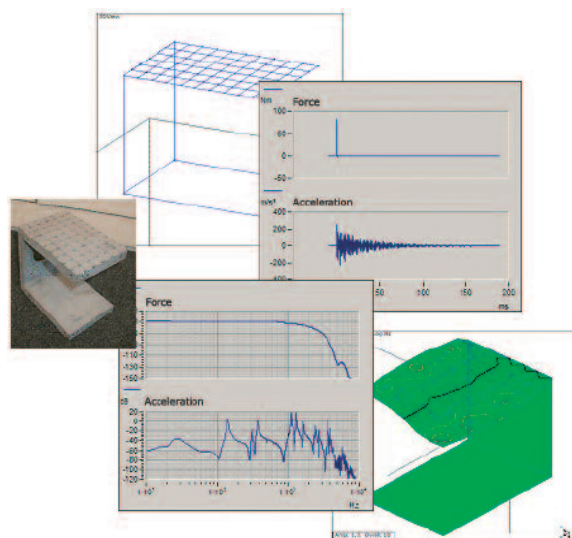
In conjunction with FAMOS 5.0 and Online FAMOS, sequences can be written for the pre- and post-processing of time domain data.

imc WAVE is able to import, transfer and display the quantities computed. For example, standard measurement procedures such as those stipulated by DIN 45657, EN ISO 5349-1 and ISO 2631-1, with site specific requirements and adaptations, can be implemented.

Structure Analyzer

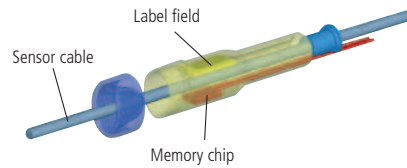
Mechanical structures can be studied for resonances using the procedure of modal analysis and the imc WAVE Structure Analyzer. With a defined force signal applied to the structure with acceleration sensors, simultaneous processing of all signals enables the transfer function to be determined, which in turn completely describes the structure's vibration behavior.

For subsequent processing, not only the signal analysis software FAMOS is available but also an interface for the popular analysis programs **ME'Scope™** and **μ-Remus™**.



Investigating a mechanical structure

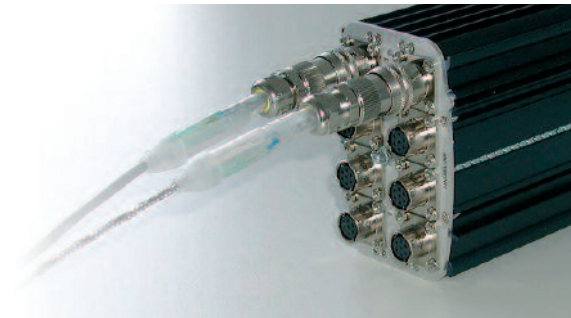
The logical extension of the TEDS standard



imc Plug & Measure – complex configurations are child's play

imc Plug & Measure is based on the TEDS technology set out in IEEE 1451.4. It fulfills the vision of quick and error-free setup even by inexperienced users.

A TEDS sensor, or a conventional sensor equipped with an imc sensor recognition memory unit, is connected to the device. The sensor memory contains a record of the sensor's calibration data and the measurement device settings. The C-Series reads this info and configures itself accordingly. An incorrectly assigned measurement channel is then recognized automatically. What could be simpler?



Particular advantages and applications

- Quick and error-free measurement device setting
- Reduction of routine work
- Recordable measurement channel parameter recommendations (sampling rate, filter settings, etc.)
- Standardization of channel designations for particular sensors used
- Verification of calibration data and their validity
- Quick and unambiguous traceability of calibration data per ISO9000
- Monitoring of calibration intervals
- Measurement device-independent sensor administration

Sensor administration database

In the administration of sensor information, the user is supported by imcSensors (sensor database for the imc Plug & Measure technology). Along with import of information from TEDS, parameters values can also be transferred from the sensor database to a channel's configuration by means of Drag & Drop.

Sensor information can be transferred via the measurement device software from the sensor database to the sensor TEDS memory, and vice versa.

For more advanced sensor administration, the sensor database supports barcode reading devices. Thus, imcSensors makes the use and administration of many different sensors quick, easy and economical by the use of TEDS and imc Plug & Measure.

General		In this group, properties are listed in the order of their importance.
Model	4356	Model descriptor. A unique identifier for the device.
Serial number	0	In general, the serial number is unique for each device.
Supplier	Wattlow	Manufacturer's designator.
Version	C1	System version. Part of the device's identification.
Sensor		Group of the sensor's properties.
Electrical max.	0.05	Electrical sensor output range.
Electrical min.	-0.006	Electrical sensor output range.
Output impedance	48.793 Ohm	Output impedance, in Ohms.
Physical max.	1300	Maximum physical value.
Physical min.	-273	Minimum physical value.
Sensor type	Thermocouple	The main sensor specification.
Thermocouple	Type K: Ni-Cr / Ni	Non-linear characteristic.
Calibration		This group contains properties related to the sensor's calibration.
Calibrated on		Calibration date. The date when the sensor was last calibrated.
Calibration interval	365 Days	Distance in time between two calibrations.
Responsible:		Name of entity responsible for the calibration.
Construction		All properties are listed in this group.
Reaction time	22 ms	Time interval for a non-linear sensor to reach a steady state.
Assembly		In this group all properties related to the sensor's assembly are listed.
Measurement location	0	An integer which identifies the measurement location.
Internal administration		Internal information v...
Messages		
Important note		
Sensor (15357)	The specified electrical input range (-0.00645 not be set exactly. The channel's closest input	

imcSensors is a software expansion for imcDevices. But it also functions as a stand-alone application. imc Sensors is designed to make a sensor's data quickly and comprehensively available.

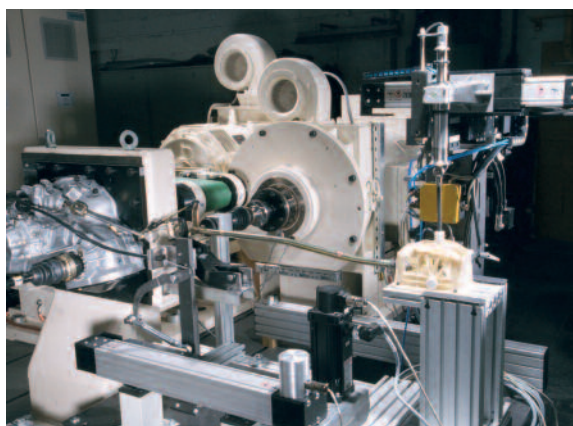
With imcSensors, it is possible to:

- administer sensors in a central database
- parameterize a C-Series system measurement channel
- trace the calibration history
- inspect the spec sheet

In conjunction with TEDS-capable measurement systems, imcSensors supports modern TEDS sensors in accordance with IEEE 1451.4.

Here, either the CS-7008 or CL-7016 unit would be a great choice, since their universal measurement amplifiers allow direct connection of a wide variety of sensors.

Efficient programming environment with COM™ or LabVIEW™



The C-Series in test stands

Test rig and specialized measurement applications require an adapted user interface. Thus the system integrator requires special measurement properties, measurement process control, communication with external devices, such as an automation system, other measurement devices and sensor systems. The solution for such cases is to develop custom test rig or device software.

The efficiency of the programming and the speed at which a software project proceeds are the main issues affecting time and cost of implementation. System maintenance updates and expansions should be made available at a rapid pace and low cost.

The programming interfaces of the C-Series make it possible to easily and efficiently apply imc hardware and software in the system integrator's choice of programming language.

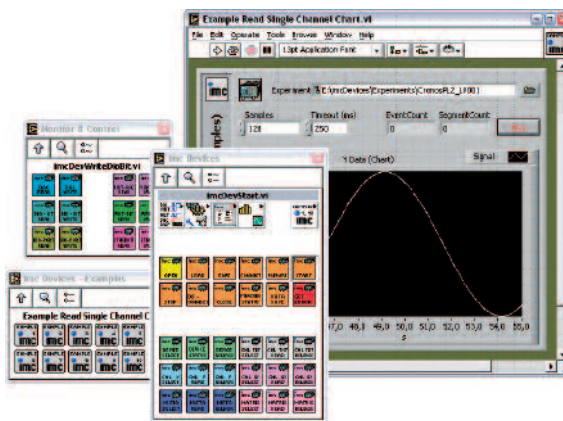
Function calls in a test rig program with only a few lines of code

By means of imcDevices, the entire measurement, including all real-time functions, displays of measured values, online and offline computations, data storage and generation of measurement reports can be set and tested down to the last detail. Then, all the settings can be quickly and easily loaded with just a few lines of code.

The main tasks left for individual programming are just in the measurement process control, communication with other devices and creating a custom user interface.

COM Interface

For professional software developers, all functions for configuration, mathematics, and graphics are available as COM™ libraries. The programmer has a choice of COM™-capable programming languages, including Visual Basic™, C++™, Delphi™ and many more.



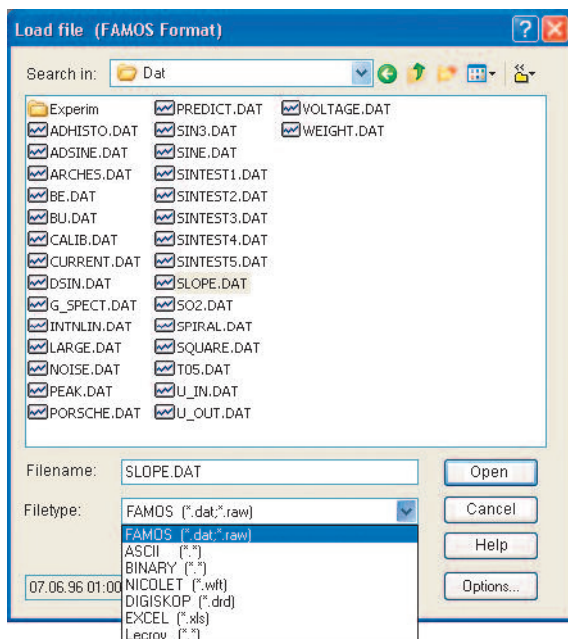
LabVIEW™ Interface

LabVIEW™ is also a widely prevalent programming environment in measurement engineering. The user can appreciate the graphical programming language, because it uses syntax similar to circuit diagrams as well as functions packaged in Virtual Instruments (VIs™).

imc offers a number of VIs and sample implementations which are directly accessible via the LabVIEW™ functions palette. With these VIs™, devices can be configured, started/ stopped, controlled (e.g. DAC, DO,...), and measurement data can be acquired.

Signal analysis software imc FAMOS

The quickest way to process measured data and achieve refined results has a name: FAMOS. Instrument independent, this signal analysis software is perfectly adapted to the needs of measurement engineers and technicians. The curve window provides extensive possibilities for data display. The Report Generator simplifies the documentation of measurement and analysis results. Besides the imc Data format, FAMOS supports a variety of other formats, and includes the File Assistant, which can quickly import data from non-imc devices. The entire process can be automated by means of the Sequence Editor.

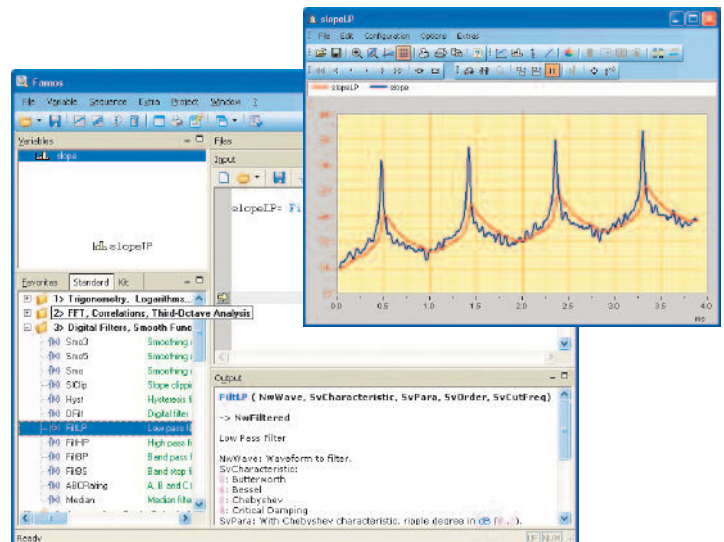


Data exchange

Handling a wide variety of data formats

For trouble-free import and export of non-imc data formats, FAMOS 5.0 includes the File Assistant, and a number of pre-defined import filters. For the purpose of freely defining specialized import and export formats, a .dll based import, and a stand-alone file conversion utility, ImExport, is also available.

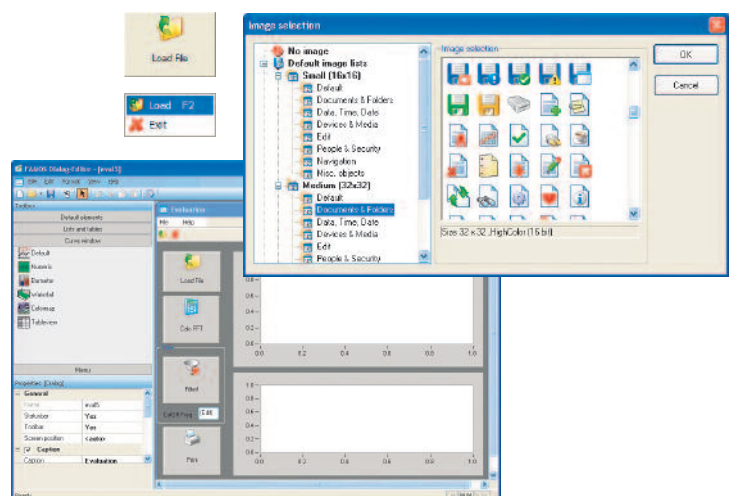
With the new FAMOS 5.0 visualization interface implementing new data formats is fast and easy.



Data Analysis

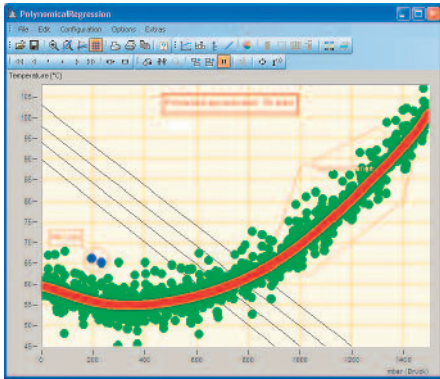
Optimized interface for quick results

To actually understand measured signals, offline analysis is often necessary. FAMOS, the signal analysis system, provides a well-balanced combination of user-friendliness and versatility. With FAMOS 5.0, you can process data sets of any length and generate computation algorithms using normal mathematical notation. Advanced capabilities for displaying data either graphically or in tabular form are provided.



imc FAMOS 5.0 includes the Dialog Editor.

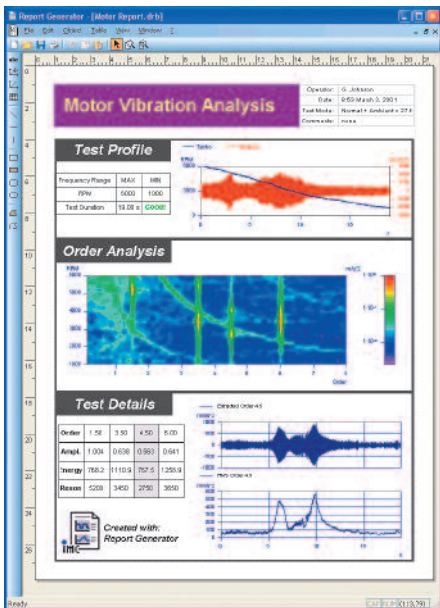
With this tool, it is possible to quickly define settings, control, and user interface dialogs which are tailored to operator's needs.



Data Display

Visualization with the Curve Window

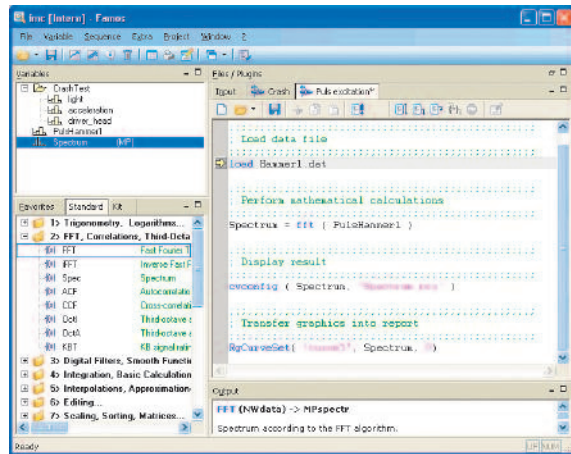
Visual representation and display of measured data is one of the outstanding elements of FAMOS 5.0. The built-in Curve Manager makes it possible to freely configure curve windows, 2D- and 3D-, alphanumeric and tabular displays and bar graphs. Adding channels to curve windows is easy with Drag & Drop. Cursor functions and unlimited zooming, with an overview window, are standard, as is the creation and labeling of curve markers and text.



Documentation

Presentations created using the Report Generator

As every engineer knows, performing the measurement may be the most challenging part of a test, but composing the documentation is the one that takes the most time. That's why all imc software includes the powerful Report Generator, a built-in desktop publisher for the special requirements of a measurement engineering professional. Any graphical representation of the measured signals, as well as tables, pictures and texts, can be pasted into a document by means of Drag & Drop, or automated through the FAMOS 5.0 macro language.

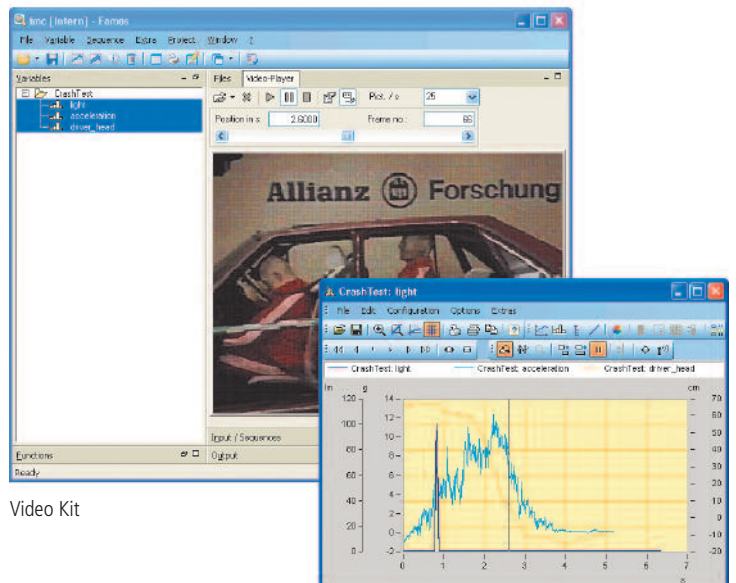


Automation

Gain efficiency – automate routines

FAMOS 5.0 includes the Sequence Editor for automated data analysis, including the capability of loops and decision branches within the calculation procedures.

Any commands which can be executed in the Formula Editor can also be applied in the Sequence Editor by means of Drag & Drop significantly simplifying the creation of macros. Because programming skills are not required, creating macros is made easy, so that complex analyses can be carried out at the push of a button.



Video Kit



imc FAMOS Expansion Kits

For imc FAMOS, a number of enhancement kits are available for special tasks:

- Class-counting analysis
- Order tracking analysis
- Digital filter design
- Enhanced spectral analysis
- Video (picture data and measurement data synchronization)
- ASAM-ODS
- COM class library

www.imcfamos.de

Universal Applications

	<i>Multi-channel & affordable</i>	<i>High-resolution, flexible voltage measurement</i>	<i>High-resolution, flexible voltage measurement Isolated inputs</i>	<i>All-purpose and Powerful</i>
	CS-1016	CS-1208	CS-4108	CS-7008
	CL-1032	CL-1224	CL-4124	CL-7016
Analog inputs	16 / 32	8 / 24	8 / 24	8 / 16
Differential inputs	✓	✓	✓	✓
Isolated	-	-	✓	-
Voltage	✓	✓✓	✓	✓✓
Current	✓	✓	✓	✓
Thermocouples	-	-	✓	✓
PT100	-	-	✓	✓
Strain gauges / bridges	-	-	-	✓
Bridge types and operation	-	-	-	1/4, 1/2, 1/1 DC
Current-fed sensors (ICP)	o	o	o	o
Aggregate sampling rate	320 kHz	400 kHz	400 kHz	400 kHz
Max. sampling rate / channel	20 kHz	100 kHz	50 kHz	100 kHz
Analog bandwidth*	6.6 kHz	14 kHz	8 kHz	14 kHz
Input ranges U:	±250 mV ... ±10 V	±5 mV ... ±50 V	±50 mV ... ±60 V	±5 mV ... ±50 V
I:	±5 mA ... ±50 mA	±100 µA ... ±50 mA	±1 mA ... ±40 mA	±100 µA ... ±50 mA
Bridge:	-	-	-	±0.5 mV/V ... ±1000 mV/V
Sensor supply	✓	✓	✓	✓✓
TEDS	✓	✓	✓	✓
CAN Interface, 2 nodes	✓	✓	✓	✓
4 counter inputs	✓	✓	✓	✓
8 digital inputs	✓	✓	✓	✓
8 digital outputs	✓	✓	✓	✓
4 analog outputs	✓	✓	✓	✓

* 3 dB roll-off frequency

✓✓ = highly suitable
 ✓ = default
 o = optional
 - = not available

Special Applications

Affordable,
DC-measurements
with strain gauges

Top-quality, dynamic
strain gauge
DC/CF-measurement

Noise and
vibration analysis

Power
measurement



CS-5008

CS-6004

CS-8008



CL-5016
CX-5032*

CL-6012

CL-2108

	CS-5008	CS-6004	CS-8008	CL-5016 CX-5032*	CL-6012	CL-2108
Analog inputs	8 / 16 / 32	4 / 12	8	8	8	8
Differential inputs	✓	✓	✓	✓	✓	✓
Isolated	-	-	-	✓✓ (CAT III)	✓✓ (CAT III)	✓✓ (CAT III)
Voltage	✓	✓	✓	✓✓	✓✓	✓✓
Current	✓	✓	✓	✓✓	✓✓	✓✓
Thermocouples	-	-	-	-	-	-
PT100	-	-	-	-	-	-
Strain gauges/ bridges	✓	✓✓	-	-	-	-
Bridge types and operation	1/4, 1/2, 1/1 DC	1/4, 1/2, 1/1 DC/CF	-	-	-	-
Current-fed sensors (ICP)	o	o	✓✓	-	-	-
Aggregate sampling rate	400 kHz	400 kHz	400 kHz	400 kHz	400 kHz	400 kHz
Max. sampling rate / channel	100 kHz	20 kHz	50 kHz	100 kHz	100 kHz	100 kHz
Analog bandwidth	5 kHz	8.6 kHz	22.4 kHz	17 kHz	17 kHz	17 kHz
Input ranges	Voltage: ±5mV ... ±10V Current: ±100µA ... ±50mA Bridge: ±0.5 mV/V ... ±1000 mV/V	±5mV ... ±50V ±100µA ... ±40m ±1 mV/V ... ±2000 mV/V	±25mV ... ±50V - -	±2,5V ... ±1000V ** **	±2,5V ... ±1000V ** **	±2,5V ... ±1000V ** **
Sensor supply	✓✓	✓✓	✓	-	-	-
TEDS	✓	in preparation	✓	✓	✓	✓
CAN Interface, 2 nodes	✓	✓	✓	✓	✓	✓
4 counter inputs	✓	✓	✓	✓	✓	✓
8 digital inputs	✓	✓	✓	✓	✓	✓
8 digital outputs	✓	✓	✓	✓	✓	✓
4 analog outputs	✓	✓	✓	✓	✓	✓

* The CX-5032 for 32-channel strain gauge measurement comes with a special housing (CX).

** current input range depends on transducer

✓✓ = highly suitable
✓ = default
o = optional
- = not available

C-Series hardware configuration

	Housing varieties	
	CS	CL
Network Interface		
Ethernet TCP/IP	✓	✓
CAN-Bus	✓	✓
ECU-Protocols (such as KWP 2000, CCP, etc.)	0	0
Device synchronization		
Synchronous operation of multiple devices via Sync-line connection	✓	✓
CANSAS measurement module connection	✓	✓
Data storage		
Slot for PCMCIA Solid State / WLAN card	✓	✓
Slot for Compact Flash card	0	-
Internal IDE hard drive	-	0
Displays		
Display built into device	-	✓
Connection for external Display / Terminal	✓	-
Hand-held terminal	0	-
Hand-held terminal (Type L)	0	-
B/W Graphics Display	0	-
Color Graphics Display	0	-
Data transfer, Remote Control		
Slot for PCMCIA WLAN card	✓	✓
Connection for external modem*	✓	-
Internal analog modem	-	0
Internal ISDN modem	-	0
Internal GSM radio modem	-	0
Radio Clock, GPS		
Connection for external DCF77 absolute clock signal	✓	✓
Device preparation for external GPS receiver* input	0	0
External GPS receiver "mouse"	0	0
External DCF77 real-time clock	0	0
IRIG-B	in preparation	in preparation
Ambient conditions		
Operating temperature: -10° C ... +55° C	✓	✓
Extended temperature range: -20° C ... +60° C**	0	0
Condensation protection:	0	0
Power supply		
10-36 VDC	✓	✓
Power adapter 110V / 230V	✓	✓
Battery buffer / UPS buffer time	1s / power outage	30s / power outage
Soft shutdown following power outage	✓	✓
Self activation following power application***	✓	✓

✓ = default

0 = optional

- = not available

* = External analog modem and external GPS-mouse can't be connected simultaneously

** = others upon request

*** = CL requires external jumper to enable autostart

Software configuration of all systems

Operating Software	
Universal applications	
imc Devices	✓
imc Report Generator	✓
imc Curve Windows	✓
In-situ configuration for CANSAS modules	0
ECU protocols for CAN Interface	0
Vector database import	0
Noise and vibration analysis	
imc WAVE Order-tracking analyzer	0
imc WAVE Spectrum analyzer	0
imc WAVE Sound Power analyzer	0
imc WAVE Workplace Noise analyzer	0
imc WAVE Pass-by Noise analyzer	0
imc WAVE Structure analyzer	0
imc WAVE PersonalWave	0
Power Quality Analysis	
imc POLARES Software	0
Online Software Options	
Online FAMOS	✓
Online FAMOS Professional *	0
Online Class-counting analysis	0
Online Order-tracking analysis	0
Measurement Data Analysis & Administration	
imc FAMOS signal analysis software	0
imc Sensors sensor database	0
imc LOOK data visualization software	0
Development Environment	
Development Environment	0
LabView™ interface, VI's	✓

* Standard included with CL-2108 and imc WAVE

Weight and Dimensions

	CS**	CL***
Weight****	2 kg	3.5 kg
Width	95 mm	250 mm
Height	111 mm	85 mm
Depth	185 mm	260 mm

- ** For CS-8008, the following values apply:
Weight: approximately 1.8 kg, Width: 110 mm, Height: 120 mm, Depth: 195 mm
- *** For CX-5032, the following values apply:
Weight: approximately 7 kg, Width: 286 mm, Height: 150 mm, Depth: 233 mm
- **** weight approximate



The standard imc interconnections are DSUB terminals. Almost all modules come with tailored connection terminals as part of the standard package. Open measurement lines can easily be connected to the Phoenix screw terminals, with pull relief. The plated interior of the terminal pod provides optimum shielding. Cold junction compensation for the sake of temperature measurement, as well as signal conditioning for ICPs™ are provided within the terminal pod. If custom interconnection are desired, the default connectors can be adapted accordingly.

Support – Training – Special Assistance

High operational availability through adapted system maintenance

The purpose of our customer support is to optimize your operation with our products, and thus to protect the value of your investment for years to come. Tailored system maintenance enables ongoing trouble-free operation while minimizing total cost.

Best Utilization

To obtain the best equipment utilization, it is necessary to be well versed in all of the measurement system's functions. The quickest way to achieve this is to order system training and commissioning along with your system purchase.

Standard, customized and topical training sessions

New customers value our intensive introductory training sessions, and use them to save both time and money. Experienced users appreciate our customized training sessions and specialized workshops on a wide range of measurement engineering topics.

And when you are short handed, or for tricky jobs...

Just call us and we will arrange to send an experienced measurement technician to you.

Problems with the hardware, software, or the testing application?

We maintain a competent and reliable Hotline for addressing your concerns. And if the problem can't be solved over the phone, we can attempt remote maintenance over the Internet, or will arrange an in-person service call.



Selectable system maintenance options

- Commissioning
- Extended guarantee
- System instruction
- Express service
- System inspection
- Remote maintenance
- System revision
- On-site support
- System update
- Technical support
- Training, and much more

"First Aid" required?

For quick help, please visit the imc web site.

The answers for frequently asked questions, tips and tricks, measurement hints and solutions for general problems can be found there. To get instant information simply visit our web site under www.imc-berlin.com and click on 'Customer Support'. Sorted by diverse topics, products and problem, you'll find the assistance you need.

Calibration Certificate



Integrated measurement & control

Data Acquisition System imc C-Series		imc_031105_120265_muster	
Object under Test / Zu testender Gegenstand ¹		Number of Certificate / Kalibrierscheinnummer	
imc CS-6004		120265	
Type / Typ		Serial Number / Seriennummer	
imc Messtechnik GmbH Vollstraße 5 13355 Berlin, Germany Manufacturer / Hersteller		☎ (+4930) 467090-0 FAX: (+4930) 4631576	
Additive GmbH Customer / Auftraggeber		0-05147803 Order No. / Auftragsnummer	imc KAD5/10025 Imc No. / RMA No. / Service No.
PM 215 Calibrator HBM K3607 PM 220 Calibrator Fluke 5500A		s/n 051420188 s/n 7000012	valid until 2005-12-30 valid until 2005-12-30
Measurement standard(s) ² / Normale(n)			
PC station: P522 Calibration Station: PM 242 – MUX, PL-P1 Final Test PC: MB		imcDevCal 2.0.9 imcDevices 2.4 Rev. 11	
Test Station / Prüfplatz			
direct measurement / Direkte Messung ³		23 °C ± 0.5 °C / 40 % ± 0.30 % relative humidity	
Calibration procedure / Kalibrierverfahren			
pass		Measurement Uncertainty: < 0,05 % of measurement range or < 1 K or refer to the protocols Messunsicherheitsangabe: < 0,05 % vom eingestellten Messbereich bzw. < 1 K wenn nicht anders im Protokoll angegeben	
Result / Ergebnis		Remarks / Hinweise	
I. A. Dipl.-Ing. M. Scheibitz ⁴ Adm Quality Assurance Manager / Stamp		MB	03-NOV-2005
Inspected by / Geprüft durch		Issue Date / Ausstellungsdatum	

¹ All tests were performed in accordance with DIN EN ISO 9001 using modern technology. This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI). The user is obliged to have the object recalibrated at appropriate intervals. This test certificate can only be reproduced in its entire form. No excerpts may be used nor may any changes be made without full express consent. Test certificates without signature and seal are not valid.
Die Tests wurden mit aller Sorgfalt und in Anwendung der DIN EN ISO 9001 durchgeführt. Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einhalten in Übereinstimmung mit dem internationalen Einheitensystem (SI). Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich. Dieses Zertifikat darf nur vollständig und unverändert verbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung von imc. Zertifikate ohne Unterschrift oder Stempel sind nicht gültig.

² The testing equipment used is subject to imc's internal test equipment monitoring; it can be identified by the respective "PM" number. Die verwendeten Prüfmittel und Normale werden über die imc Prüfmittelnummer "PM" identifiziert.

³ The calibration was performed by comparing the value indicated by the standard instrument with the value indicated by the calibrated object. All procedures have been developed by imc itself. The certificates and reports of measured values are archived electronically and can be ordered retroactively. The members of our Quality Assurance team are happy to assist you if you have any question about calibration
see www.imc-berlin.de/en => Customer Support (call +49-30-467090-26, email: help@imc-berlin.de)
Die Kalibrierung erfolgte durch Vergleich der Anzeige der voreinstellbaren Normale mit der Anzeige des Kalibriergegenstandes. Sämtliche Verfahren sind von imc selbst entwickelte Verfahren. Die Zertifikate und Messwert-Protokolle werden elektronisch archiviert und sind nachlieferbar. Bei Fragen zur Kalibrierung stehen Ihnen die Mitarbeiter unserer Qualitätssicherung gerne zur Verfügung. siehe auch www.imc-berlin.de => Kundenservice (Tel. +49-30-467090-26, email: help@imc-berlin.de)

⁴ Pass: The device / equipment under test fulfills the manufacturer-specifications or the specifications mentioned in the calibration instruction. / Der Prüfling entspricht den Herstellerspezifikationen bzw. den Toleranzen der Kalibrierschrift.
Fail: The device / equipment under test does not fulfill the manufacturer-specifications nor the specifications mentioned in the calibration instruction. / Der Prüfling entspricht nicht den Herstellerspezifikation bzw. den Toleranzen der Kalibrierschrift.

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Calibration in the framework of measurement equipment monitoring

Test equipment monitoring, as per ISO9000, requires regular verification of all test equipment used. This calibration can be performed by the customer, by an accredited inspection laboratory or by the manufacturer. For greatest convenience, imc offers system inspections at affordable flat rates. All measurement systems include a manufacturer's calibration certificate as per ISO 9001.

Product: CS-6004
Company: imc
Device: CS-6004_120265
Serial number: 120265
Last status: balanced
Basic board: DAB4K4
Serial number: 121693
Test object: BR4
Serial Number: 102588
Procedure: calibration
Start: 03.11.2005 16:39:20
Result: pass
Tested by: FI
Test station: P522
Test equipment: Fluke
Serial number: 7000012
PM number: 220
Calibrated until: 30.12.2005
Protocol file: ...102588muster.prt
Software equipment:
Test program: imc Devices Calibration
Version: 2.0.9
File name: ImcDevCal V2.0.9.exe
ImcDevices
Version: 2.4.11
COM interface
Version: 1.0.23

Module number: 1
Amount of Channels: 4
Channels: 1..4
Serial number: 102588
Last Status: initialised
Last Calibration: 01.11.05
SW Version: 54
HW Version: 1
Layout Version: 1
PLD Version: 0
FPGA Version: 14

FW-Version-Info:
file0: 07.04.2005
file1: 07.04.2005
file2: 07.04.2005

Voltage-Mode: DC-Diff
Gain calibration

Channel Configuration

sampl. time : 500 µs | input : differentiell |
samples : 2000 | filter : low-pass |
coupling : DC | frequ. : 20 Hz |

Range: ±50.000 V

Ch	Reading- (V)	Reading0 (mV)	Reading+ (V)	Gain error (%)	Status
Ref	-50.0000	0.0000	50.0000	±0.0300	limit
1	-50.0058	0.2213	49.9943	0.0013	pass
2	-50.0047	1.3718	49.9966	0.0013	pass
3	-50.0022	-1.1613	49.9962	-0.0016	pass



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