imc STUDIO

imc STUDIO is the common framework uniting various imc **software components (plug-ins)** to a modular system. Specific combinations of plug-ins comprise **Editions (product packages)**, each designed for particular applications.

⚠ Note	Limited functionality

Components and functions with gray text are not yet implemented in the current version of imc STUDIO.

Editions

The following editions are available for imc STUDIO, and each include a certain basic package of plug-ins/functionalities.

Edition and required licenses	Order code
imc STUDIO Runtime	imc STUDIO-RUN
imc STUDIO Standard	imc STUDIO-STD
imc STUDIO Professional	imc STUDIO-PRO
imc STUDIO Developer	imc STUDIO-DEV

Additional optional or individually licensable plug-ins can also be integrated.

Each edition is able to apply configurations created with a higher edition, but not to modify them.

Installation varieties

For imc STUDIO there are various installation varieties, parts of whose configuration options can differ substantially.

Installation variety	Required licenses	Description
imc STUDIO	One imc STUDIO Edition	imc STUDIO allows **configuring of measurement devices**, **performance of measurements**, and monitoring of instantaneous readings. Data can be viewed and edited live at one work station.
imc STUDIO Monitor [*]	imc STUDIO Monitor [*]	imc STUDIO Monitor makes it possible to **connect with one or more measurement devices during a running measurement**, particularly for the purpose of monitoring the instantaneous readings. Data can be viewed and edited live on multiple workstations.
imc WAVE [*]	imc WAVE Analyzer license [*]	imc WAVE is a software package for **NVH analysis** (Noise Vibration and Harshness). It can be equipped with multiple, separately licensed analyzers. The software enables the user to perform measurements, evaluations, data visualization, and to compose reports specifically for acoustic tests.

[*]: See separate Technical Data Sheet

Available plug-ins/components

Below is a table correlating plug-ins and their functions to the individual editions.

Available plug-ins/components	Description	STD	PRO	DEV
	● : included　　　○ : optional			
imc STUDIO	Framework	●	●	●
	User administration: Access control, roles and rights management		●	●
Setup	Device configuration of imc devices	●	●	●
	Device configuration of 3rd-party (non-imc) devices (e.g. Video or 3rd-party devices, provided appropriate license available)	○	○	○
Panel	Display of measurement data	●	●	●
Widgets: Standard	Gauges and control elements (basic selection)	●	●	●
Widgets: Automotive, Industrial, Designer, Aviation	Extended selection and styles		●	●
Project Management	Display of saved measurement data in the Data Browser	●	●	●
	Projects and Experiment templates		●	●
Sequencer	Batch generator, workflow automation		●	●
Automation (1,2)	Design of real-time test station automation			●
Scripting	Integration of custom specific user code incl. accessing external hardware (actuators, lab equipment and devices etc.)			●
Third Party Device Interface	Integration of devices from manufacturers (Third Party Devices) into imc STUDIO			○
Data Processing	User interface for configuring mathematics functions Interface for processing of data streams	●	●	●
imc Inline FAMOS	Real-time analysis on data streams (PC based platform and license)	○	○	○
Inline Analysis	imc WAVE: NVH analysis on data streams (PC based platform and license)	○	○	○
Bus Decoder	Extension package for decoding of fieldbus log channels	●	●	●
Powertrain Monitoring	Extension package for monitoring powertrains	○	○	○
Video	Synchronized video acquisition	○	○	○
imc STUDIO GoPro	Video-recording with a GoPro video camera	○	○	○
imc SENSORS (2)	Sensor database integration	○	○	○
Sensors (2)	Expansion package for Setup for setting up imc STUDIO sensors and administering the sensors of the imc SENSORS database.	●	●	●

1: Requires additional device based license imc Online FAMOS Professional
2: Applicable with devices of the firmware group A (A4-A7)

Licensing

License activation is performed using the **imc LICENSE Manager**. Find details in the imc LICENSE Manager documentation.

imc STUDIO with the full feature set of its editions (Standard/Pro/Developer) will allow for a **secondary activation** of its license. This licensed installation is intended for a second computer of the same user and may not be operated simultaneously to the primary activation. A secondary activation for imc WAVE including analysators is not granted.

The Edition **imc STUDIO Runtime** is a restricted version, free of charge. The trial **demo version** (offering full functionality of imc STUDIO Developer Edition) is for free as well. Both require activation.

System requirements

Supported operating systems
Windows 10*/11* (64 bit)

*released in conformance with the version of Windows 10/11 applicable at build date of imc software

Minimum requirements for the PC
4-core CPU 2 GHz [1]
8 GB RAM (recommended: 16 GB RAM) [1]
10 GB free hard disk space (recommended: SSD) [2]
Display resolution: 1366 x 768 (recommended: 1920x1080)

1 Requirements and recommended minimum configurations for the applied PC will rise with increasing number of connected devices and the resulting overall system data rate. Another crucial factor will be the extend of used live analysis and visualization functions on the PC (in particular Data Processing, imc Inline FAMOS and active curve windows).
A smooth operation will also heavily rely on sufficient RAM memory resources on the PC: It must ensure to satisfy all vital functions without any outsourcing to slow external swap file (HDD/SSD) in order to guarantee sustainable performance.

2 The hard drive memory requirement increases if measured data are saved to the PC.

Other operating system components

The following components are installed with the imc STUDIO setup if they are not already present:

Component	Version	Folder in "System" directory
Microsoft .NET Framework	4.8	DotNetFx4.8
Microsoft VC 2015-2022	14.38.33135	Microsoft Visual C++ Redistributable\2022
Microsoft VC 2010	10.0.40219.1	Microsoft Visual C++ Redistributable\2010
Microsoft Build Tools 2015	14.0.23107.10	MSBuildTools2015

Plug-in imc STUDIO Setup

Setup is the integrated user interface for the complete configuration of all measurement parameters along with its saving in a system configuration. This user interface can be adapted to individual needs. This provides the ability to link particular settings options to the user's specific level of authorization. Similarly, any interface elements which are not needed can be hidden. As a result, the training required of a user to operate routine experiments is kept to a minimum.

All familiar hardware properties of imc measurement devices are completely supported.

Supported imc measurement device groups

Device groups

Firmware imc DEVICES - firmware group A (A4-A7)

- imc CRONOS*compact*
- imc CRONOS*flex*
- imc CRONOS-SL-N
- imc C-SERIES with sn. 14xxxx and higher
- imc CRONOS-XT
- imc BUSDAQ*flex*
- imc BUSDAQ with sn. 13xxxx and higher
- imc SPARTAN with sn. 13xxxx and higher
- other customized devices with sn. 13xxxx and higher

Firmware imc DEVICEcore - firmware group B (B10-B11)

- imc EOS
- imc ARGUS*fit*

Association of Setup functions with the imc STUDIO editions

Functionality	Description	RUN	STD	PRO	DEV
	● : included　　　　○ : optional ◎ : subset of full feature set				
Setup	Device configuration of imc devices of the groups: **Firmware group A** (A4-A7) via firmware imc DEVICES **Firmware group B** (B10-B11) via firmware imc DEVICEcore	●	●	●	●
	Device configuration of 3rd-party (non-imc) devices (e.g. Video or 3rd-party devices, provided appropriate license available)	○	○	○	○
	Customizing of configuration tables		●	●	●
	Combined parameters, meta data, pictures, doc etc.			●	●
Layout designer	Free design of custom Setup menus (GUI)				●
Meta data	Augmenting data with descriptive meta information	◎	◎	●	●
	Defining custom meta data (additional table columns for experiments and channels)			●	●
imc Online FAMOS	Real-time analysis on data streams (device based platform and license)	○	○	○	○
Sensors	Expansion package for Setup for setting up imc STUDIO sensors and administering the imc SENSORS sensors. 　Firmware group A　　　　● 　Firmware group B　　　　---		●	●	●
imc SENSORS	Sensor database integration 　Firmware group A　　　　● 　Firmware group B　　　　---	○	○	○	○

Special functions and applications

- Uniform operating software for imc's Ethernet-compatible measurement devices (see: Supported imc measurement devices)
- Operation of multiple synchronized devices, networked via Ethernet.
- Setup automatically recognizes the measurement system's capabilities and offers correspondingly adapted configurations (low training requirements - high measurement reliability)
- Setting up a system configuration ("Experiment") is possible without even having a measurement device physically available ("offline")
- Configures auto-start for autonomous autarkic measurement operation (Diskstart/Autostart)
- Supports sensor recognition by means of TEDS conforming IEEE 1451.4. [1]

1: Applicable with devices of the firmware group A

Basic functions	Description
Channel settings	- All inputs and outputs of a measurement system can be set using one single user interface (analog inputs/outputs, digital inputs/outputs, fieldbus channels, virtual channels, etc.) - Per-channel configuration (e.g. name, sampling interval, measurement duration, input range, characteristic curve correction, filters, and much more.) - Opening independent curve windows, which are not connected with a Panel page
Data saving on the PC	- Data saving can be set for each channel separately - Saving of measured data in a different file format (imc Format Converter, e.g. ASCII, EXCEL and more) - Each trigger event can be saved to a separate data file. - Customized storage location for measurement data: Allows the measurements to be saved in varying (including variable-dependent) folders.

Additional software options for devices

Components	Description
imc Online FAMOS	imc Online FAMOS offers a variety of real-time functions for pre-processing and signal analysis. The mathematical analysis functions are executed on the signal analysis platform integrated in the measurement device.
imc Online FAMOS Professional	Extension for imc Online FAMOS: for test rig operation. Among others for monitoring and open- and closed-loop control tasks.
Online class-counting	Extension for imc Online FAMOS: class-counting and rainflow counting for fatigue analysis
Online order tracking	Extension for imc Online FAMOS: order tracking analysis of rotating machinery
Vector database interface	Import of *.dbc CAN configuration files
ECU protocols for CAN Interface	Support for complex ECU protocols (CAN-Bus)

Components	Order code	Gruppe A		Gruppe B	
		CRFX, CRXT, CRC, CRSL, C-SERIES	SPARTAN, BUSDAQ, BUSFX	EOS	ARGFT
imc Online FAMOS	DEV$^{(1)}$/OFA	●	○	---	●
Update of imc Online FAMOS on imc Online FAMOS Professional	DEV$^{(1)}$/OFA-UP	○	○	---	---
Online class-counting	DEV$^{(1)}$/ONLKLASS	○	○	---	---
Online order tracking	DEV$^{(1)}$/ONORDER	○	○	---	---
Vector database linkage	DEV$^{(1)}$/VEC-DATB	○	○	---	---
ECU protocols for CAN Interface	DEV$^{(1)}$/ECU-P	○	○	---	---

● : included   ○ : optional   --- : not available in imc STUDIO

1 :   DEV is to be replaced with the device's order code abbreviation.

Firmware group A - imc DEVICES

Basic functions	Description
Channel settings	• Channel-wise selection of extended output data format (24 bit resolution) for data acquisition with CRFX/CRXT channels
Data saving on the device	• Data saving can be set for each channel separately
	• Storage location on the PC and / or the device or on a network server
	• Each trigger event can be saved to a separate data file
	• Channels can also be parameterized for internal processing only (data not saved)
	• CAN Log data in the file format: Vector(CANAlyser) possible
File Manager Access to the device memory	• Enhances the Windows Explorer®
	• Enables copying and deleting of files and folders from the devices internal storage to a PC.
Trigger-Machine	• Either directly started or triggered measurement
	• Starting and/or stopping by trigger
	• 48 independent triggers supported ("*Multi-Machine Trigger*")
	• Pre-triggers adjustable
	• Various definable events (thresholds, time-in-range, signal edges, etc.)
	• Logical conjunctions of multiple events can form complex trigger conditions
	• Number of trigger releases freely selectable (multitrigger, "*Multi-Shot Trigger*")
	• Event-driven digital output
imc Messaging	• Devices having the associated interface are able to send text messages in response to particular events.
	• Available triggering events include all signal transitions in the virtual bits and ethernet bits.
	• A specific target can be set for each of these message texts.
	• Message type: e-mail (devices from SN 16xxxx)
Balancing and taring function	• Setting of the scaling and balancing performed on a per-channel basis and the results are displayed for the current experiment.
	• Export / import for adjustment settings for all or selected channels
Sensor Recognition	• Readout of sensor information from TEDS
	• Adoption of sensor information in the sensor database (imc SENSORS)

Optional functions	Description
Sensor Database imc SENSORS (optional)	For the purpose of editing sensor information, the turnkey, system- independent sensor database imc SENSORS can be integrated. For more information on the sensor database, see the "imc SENSORS" data sheet.
Application-oriented functions and signal processing (optional)	• Device display (internal display or with hand-held terminal) - Display configuration / Display Editor • Timer start • Autostart / Diskstart • Real-time clock (DCF 77, GPS, NTP[1], PTP[2] or IRIG B002[1] for synchronization of sampling clocks and absolute time) • Synchronized measurement with multiple devices • Master device generates a DCF77 or IRIG-B[1] signal • Support of GPS-receiver for capturing geo-position data • Time zones and switch between daylight saving and standard time • Exchange of display variables via the network • imc Online FAMOS: for device based immediate real-time signal analysis (mathematics, statistics, digital filtering, control commands, closed-loop control, FFT, order-tracking) as well as real-time control. • Synthesizer and PID-controller module • Process vector (single-value state variables: last current value) • Synchronous Tasks (real-time cycles), imc Online FAMOS Professional necessary

1 : supported by devices as of group A5 and higher: SN 13xxxx, SN 14xxxx, SN 16xxxx, SN 19xxxx

2 : supported by devices as of group A7 and higher with the suffix "-GP", as well as CRXT: SN 19xxxx

Supported interfaces	Description
Connection with devices	• Ethernet (LAN or WLAN - depending on the device equipment) • Via appropriate routers: LTE, 5G, etc. • Device configuration via FTP • imc REMOTE access, based on TLS1.2 encryption • The connection to the device can optionally be password-protected • Connections to external clients: Up to 4 (SN > 13xxxx) imc STUDIO Monitor or imc REMOTE plus 3 Windows Explorer connections per device *Example: Device with SN191234 can simultaneously maintain connections with 2 imc STUDIO Monitor, 1 imc REMOTE WebServer and 1 imc REMOTE LinkSecure connections at the same time. Additionally, 3 computers can access the internal data carrier via the Windows Explorer.*
Fieldbusses	• e.g. CAN FD, ARINC, LIN, FlexRay, AFDX, XCPoE, MVB, IPT • imc CANSAS configuration via imc STUDIO Setup, Vector database import (optional)

Data formats	Description
Display variable	Float $\pm 10^{30}$
imc Online FAMOS	Local variable: Float $\pm 10^{30}$
imc Online FAMOS Professional	pv-variable as Float: $\pm 10^{30}$ pv-variable as Integer: $\pm 2^{31}$

Maximum channel count per device		
Active channels within a systems...	512	Active channels of the current configuration: Total number of analog, digital, fieldbus and virtual channels, as well as monitor channels, if any.
...of which active analog channels	198 [1]	Active analog channels of the current configuration (sum of primary channels + monitor channels)
Fieldbus channels	1000	Number of defined channels (active and passive); Currently activated channels are limited by the total number of activated channels (512).
Process vector variables	800	Single value variables, each containing the last measured values. A process vector variable is automatically created for each channel.

Channel type	determined by	without monitor channels				with monitor channels				
		limit (aktive+passive)		activated	total activated	limit (aktive+passive)			activated	total activated
Analog channels	system-expansion	Channel	240	198 [1]	512	Channel	240		198 [1]	512
						Monitor	240			
Incremental counter	system-expansion	Channel	16	16		Channel	16		16	
						Monitor	16		16	
DIO/DAC-Ports	system-expansion	Port	16	16		Port	16		16	
						Monitor	16		16	
Fieldbus channels	flexible	Channel	1000	512		Channel	1000		512	
						Monitor				
Virtual channels (OFA)	flexible	-	-	512		-	-		512	

Occupancy for ports (examples):

- one DO module (e.g. DO-16) occupies 1 port
- one DI8-DO8-ENC4-DAC4 module occupies 3 ports
- one DAC module (e.g. DAC-8 or DAC-4) occupies 1 port

Monitor-ports: DI-ports (respectively channels) have monitor-ports, DO/DAC-ports in contrary do not have monitor-ports

(1): 128 with imc CRONOS*flex* (CRFX) and imc CRONOS-XT (CRXT), incl. output channels of type DAC-8 and DIO-Ports of type DI / DO, incl. 18 channels per CRFX/WFT-2 input

Firmware group B - imc DEVICEcore

Basic functions	Description
Channel settings	• Capture of channel data in 24-bit
Data saving on the device	• Data saving can be set for each channel separately • Storage location on the PC and / or the device • Channels can also be parameterized for internal processing only (data not saved)
Access to the device memory	• Access via Windows network sharing (SMB-protocol via Samba Fileserver) • ftp Fileserver Enables copying and deleting of files and folders from the devices internal storage to a PC.
Trigger-Machine	• Either directly started or triggered measurement • Starting and/or stopping by trigger • 8 independent triggers supported ("Multi-Machine Trigger") • Pre-triggers adjustable • Various definable events (thresholds, time-in-range, signal edges, etc.) • Logical conjunctions of multiple events can form complex trigger conditions • Number of trigger releases freely selectable (multitrigger, "Multi-Shot Trigger")

Optional functions	Description
Application-oriented functions and signal processing (optional)	• Timer start • Autostart / Diskstart • Real-time clock (GPS[1], NTP or IRIG B002 for synchronization of sampling clocks and absolute time) • Synchronized measurement with multiple devices • Master device generates a IRIG-B signal • Support of GPS-receiver for capturing geo-position data[1] • Time zones and switch between daylight saving and standard time • Process vector (single-value state variables: last current value)

1 :   supported by devices as of group B11 and higher: SN 416xxxx

Supported interfaces	Description
Connection with devices	• Ethernet (LAN)
Fieldbusses	• CAN FD

Maximum channel count per device		
Active channels within a systems...	1000	Active channels of the current configuration: Total number of analog, fieldbus and virtual channels, as well as monitor channels, if any.
...of which active analog channels	1000	Active analog channels of the current configuration (sum of primary channels + monitor channels)
For fieldbus log channels	any number of channels	Log channels: non-decoded CAN traffic ("dump")

Plug-in imc STUDIO Panel

The Panel provides, in addition to the imc curve window, a wide scope of new graphical display possibilities.

It is possible to create report pages for documentation of measurement and analysis results.

Association of imc STUDIO Panel functions with the imc STUDIO editions

Functionality	Description	imc STUDIO Edition			
		RUN	STD	PRO	DEV
	● : included ○ : optional				
Panel	Customized visualization of data, including printable pdf reports with measured data		●	●	●
	Individual design and layout, repository		●	●	●
Widgets	Gauges and control elements (basic selection)		●	●	●
	Extended selection and styles (Automotive, Industrial, Designer, Aviation)			●	●
Full screen view	Hidden menus and restricted access (via full screen Panel)			●	●
Data Browser	Management of stored data: browse, search and filter		●	●	●
Panel control elements	Interactive launch of actions/commands via Panel control elements (Sequencer commands such as calling Panel pages, applying imc FAMOS functions to channels, ...)		●	●	●
Runtime functionality	Execute but not modify all functions (incl. Widgets, full screen)	●	●	●	●

Functions

Functionality	Description
Special functions and applications	• The layout of the report pages can be designed freely and be exported in PDF (report mode). • Compositions of Widgets in freely configurable pages (dialog mode) • Special Widgets can be assigned to commands. (e.g. starting measurement or a imc FAMOS analysis)
Basic functions	• Creation of multiple pages in which Widgets (display and control elements) such as curve windows, potentiometers, scales, state indicators can be positioned in any arrangement.

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Data Browser	Description
Display and navigation through data	• Navigation through structured tree diagram for visualization of various measurements • Searching and filtering
Current measurement	• Displays all channels and variables belonging to the current measurement
Saved measurements	• Loads and processes saved measurements • Displays all channels and variables belonging to the saved measurements
User defined variables	Declaration of variables • Numerical, Text
Display	• All available channels and variables can be linked with Widgets • Opening of independent curve windows not associated with the Panel • Opens an independent values window with the current values of certain variables
Export / Import	Export variable • individually or all in one file Import variable (*refill*) • imports value to an existing (device or user-defined) variable Load variable • Creates or replaces a variable with the properties of the variable to be imported (user-defined)

Widgets	Description
Widgets	• imc Curve window • Standard control elements such as state indicators, edit boxes, numeric inputs, tables, buttons, switches etc. • Extended Widgets are available in four pre-defined styles (Automotive, Industrial, Designer, Aviation) • Control elements such as state indicators, edit boxes, potentiometers, thermometer, bar meters, tables, buttons, switches etc. • A repository is available in which settings for the Widgets can be saved
Skin	• Selection among multiple pre-defined skins for Widgets • Definition of one's own skin possible
Extra functions	• Copying and pasting of Widgets • Loading and saving of curve window configurations • Multi-selection of Widgets and various options for orientation and anchoring • Widgets can be grouped

Panel page	Description
Extra functions	• Loading and saving, copying and pasting of pages • Zooming to optimal possible display • Adapting the page to the respective monitor size • Access rights definable for each page separately

Plug-in imc STUDIO Sequencer

imc STUDIO Sequencer is the plug-in to create an automated measurement workflow. A sequence of actions is designed by means of a graphical Editor in an action table. Alternatively, command sequences can be coupled with events. Global, pre-defined system events as well as user-defined events can be used.

Association of imc STUDIO Sequencer functions with the imc STUDIO editions

Functionality	Description	imc STUDIO Edition			
	● : included ○ : optional	RUN	STD	PRO	DEV
Sequencer	Batch generator, workflow automation			●	●
External applications	Launch external code (DLL) and executables (exe)			●	●
Runtime functionality	Execute but not modify	●	●	●	●
imc FAMOS	Create analysis sequences, extensive post processing	○	○	○	○
imc FAMOS Runtime	Execute automated analysis sequences (instant post processing)	○	○	○	○
Python-analysis	Executing analysis sequences with Python (post-processing)			●	●

Analysis with imc FAMOS

For the purpose of performing analysis by means of imc FAMOS, interaction between imc STUDIO and imc FAMOS is possible. The prerequisite is installation of an imc FAMOS version of 2021 or higher, as a Runtime, Professional or Enterprise Edition (see "*Additional imc software products*").

Analysis with Python

The Python command supplies functions which provide a bridge to the Python programming language. imc STUDIO generates an embedded instance of the Python runtime environment, which provides an interpreter for the Python programming language.

For the purpose of analyzing the measured data, a Python code file is selected. The variables to be analyzed with Python can be selected, and the results can be returned in variables.

Data types

The following variable types can be transferred **to Python**:
- single values (numerical),
- standard channels (uniform, equidistantly sampled channels, not time-stamped)
- individual trigger releases of a standard channel (only as "last event")
- segmented channels (e.g. FFT) and
- vectors

What can not be transferred are such channel properties as the sampling rate, time, unit, ...

The following data types can not be used:
- text-variables
- time-stamped, non-equidistant channels (TSA, ...)
- multiple trigger releases of a channel (event-based channels)
- similar data types

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Various **return value types** are supported, e.g:
- single values (numerical) or
- arrays, interpretable as a normalized channel with a sampling interval of: 1.

Transfer and processing of the variables is performed on the basis of the "*Current Measurement*" and not on the basis of any saved (earlier) measurements.

System requirements

Software	Compatible version	Installation	Notes
Python 64-bit	3.13, 3.12, 3.11, 3.10, 3.9, 3.8	required	Support is provided exclusively for the Python reference implementation from the "*Python Software Foundation*" (CPython) in one of the versions listed below; these can be downloaded and installed from https://www.python.org/.
NumPy 64-bit	2.3, 2.2, 2.1, 2.0, 1.23, 1.20, 1.19	optional	The Python bridge provides special support for data types defined in the expansion library "NumPy" (https://numpy.org).

Plug-in imc STUDIO Automation

imc STUDIO Automation allows the implementation of real-time control for test stand automation. Definition and configuration of the control structures and routines is performed on the PC with graphic oriented environment provided by this plug-in. The resulting routines are automatically compiled to code which is directly executed on the measurement device itself. Execution involves the real-time capable platform imc Online FAMOS.

For the purpose of performing analysis by means of imc FAMOS, interaction between imc STUDIO Automation and imc FAMOS is possible. The prerequisite is installation of an imc FAMOS version of 2021 or higher, as a Runtime, Professional or Enterprise Edition (see "*Additional imc software products*").

Measurement device requirements
The same hardware prerequisite apply as for imc STUDIO Setup.
A device of the firmware group A
An extra device option is required: imc Online FAMOS Professional

Association of imc STUDIO Automation functions with the imc STUDIO editions

Functionality	Description	imc STUDIO Edition			
		RUN	STD	PRO	DEV
	● : included ○ : optional				
Automation	Design of real-time teststand automation				●
Runtime functionality	Execute but not modify	●	●	●	●
imc FAMOS	Create analysis sequences, extensive post processing	○	○	○	○
imc FAMOS Runtime	Execute automated analysis sequences (instant post processing)	○	○	○	○

Functions

Functionality	Description
Special functions and applications	- Real-time capable process control (state-based control model) - Trace info (tracking of current states during execution) - Limit value monitoring (background supervision of thresholds) - Exception raising and error handling - Graphically oriented definition of the state model (drag&drop) - Additional integration of PC interactions (running Sequencer commands, calling Panel pages and applying imc FAMOS functions to channel data) - Quick and easy design of individual user interfaces (GUI) by means of drag&drop
Features	- Graphical display of the task flow - Up to five parallel, synchronized tasks can be performed per measurement device, in real-time with selectable cycle intervals of 100 µs to 1 s.

Plug-in imc STUDIO Scripting

The imc STUDIO Scripting is an imc STUDIO plug-in which provides a programming interface (C#, .NET). It comes with the editor SharpDevelop as the development environment.

Along with the ability to freely program routines, Scripting also gives the user access to all major functionalities of imc STUDIO, such as:

- Setup: reading and writing of device and channel configurations,
- Panel: access to the Panel and the Widgets,
- access to the Data Browser: creation, reading and writing of variables,
- processing of channels measurement data with imc FAMOS functions,
- execution of menu actions,
- running Sequencer commands,
- response to events.

The following mechanisms are provided for running scripts:

- as a command
  - in the Sequencer
  - to Widgets
  - in response to events
- in the background
  - linked to a Panel page
  - linked to the experiment or the project

The following script-types are available:

- Script
- Panel script
- Context script
- Type Library script
- Event script
- Third Party Device script

It is possible to export scripts (also in DLL format) and to import them.

Association of imc STUDIO Scripting functions with the imc STUDIO editions

Functionality	Description	imc STUDIO Edition			
		RUN	STD	PRO	DEV
	● : included ○ : optional				
Scripting	Integration of custom specific user code incl. accessing external hardware (actuators, lab equipment and devices etc.)				●
Runtime functionality	Execute but not modify scripts	●	●	●	●

Plug-in imc STUDIO Third Party Device Interface

Using the plug-in imc STUDIO Third Party Device Interface,it is possible to integrate devices from other manufacturers (3rd-party devices) into imc STUDIO and run them in the imc STUDIO system.

For this purpose, a C#-script is implemented which models the 3rd-party device's properties. There is a template which simplifies the process of seamlessly integrating the 3rd-party device and its channels into the existing settings menus and setup tables. In particular, this means that these devices/channels appear in the lists of devices and channels in the imc STUDIO Setup. This thus provides uniform operation style and configuration management. The script must additionally implement the interface to the 3rd-party device in the sense of a **data driver**.

The plug-in 3PDI is specially suited to enhancing a system configuration consisting of imc hardware with supplemental specialty devices and data sources. However, there is also a license available specifically for operation exclusively with 3rd-party devices, without the use of any imc devices.

Besides the developer framework and the licenses to run one's own self-provided scripts, ready-made implementations are also available for purchase.

All runtime licenses (for running 3PDI scripts) can categorically be operated with any edition of imc STUDIO.

A 3rd Party Device Management is available in all imc STUDIO editions, except Runtime.

The advantages of the 3PDI script are:

- integrated and uniform operation via the Setup page
- consistent format for measured data
- synchronized data

Requirements
C# programming skills (for an unmanaged data transfer also C++)
The 3rd-party's interface must be known

Association of imc STUDIO Third Party Device Interface functions with the imc STUDIO editions

Functionality	Description	imc STUDIO Edition			
		RUN	STD	PRO	DEV
	● : included ○ : optional				
Run 3PDI scripts	Usage of 3rd-party devices implemented by 3PDI script. Required License: 3PDI (inclusive/exclusive) [1]	○	○	○	○
Edit 3PDI scripts	Create and edit 3PDI scripts				●
3rd Party Device Management	Add 3PDI scripts (the execution may depends on additional licenses)		●	●	●

Already implemented templates and operative third-party devices

Device	Additionally licenses required for running	Description
AudioDevice	none	With the 3rd-party "*AudioDevice*", it is possible to use the computer's audio devices (such as the microphone input) as a data source.
ChannelLoader	none	The 3rd-party "*ChannelLoader*" enables files in the imc-format to be played back as a signal during a measurement.
FunctionSimulator	none	The 3rd-party "*FunctionSimulator*" simulates various signal types (sine, cosine, trapezoid, square wave, ...).
FunctionSimulatorTemplate	imc STUDIO 3PDI-inclusive or exclusive [1]	The editable template "*FunctionSimulatorTemplate*" simulates various signal types (sine, cosine, trapezoid, square wave, ...).
SimplePollDevice and SimplePushDevice	imc STUDIO 3PDI-inclusive or exclusive [1]	These 3rd-party scripts are executable templates and can be expanded accordingly.
fos4x	imc STUDIO 3PDI-fos4x	Supports devices of the manufacturer Polytech (formerly fos4X) for measurements with fiber-optic sensors and optical strain gauges based on Fibre-Bragg (FBG) and Fabry-Pérot technology.

1   inclusive: at least one imc device is used in addition to the third-party device
    exclusive: the third-party device can be used without any imc device

Plug-in imc STUDIO DataProcessing

imc STUDIO DataProcessing is the interface for the purpose of data stream processing. The following plug-ins require Data Processing:

- imc Inline FAMOS
- Inline Analysis: imc WAVE
- imc STUDIO BusDecoder
- imc STUDIO Powertrain Monitoring

Association of imc STUDIO DataProcessing functions with the imc STUDIO editions

Functionality	Description	imc STUDIO Edition			
		RUN	STD	PRO	DEV
	● : included ○ : optional				
Data Processing	Interface for processing of data streams	●	●	●	●
Data analysis	**Functions package**				
imc Inline FAMOS	Real-time analysis on data streams (PC based platform and license)	○	○	○	○
Inline Analysis	imc WAVE: NVH analysis on data streams (PC based platform and license)	○	○	○	○
Bus Decoder	Extension package for decoding of fieldbus log channels	●	●	●	●
Powertrain Monitoring	Extension package for monitoring powertrains	○	○	○	○

Functions Package imc Inline FAMOS

Processing and analysis of measured data during a running measurement

imc Inline FAMOS is a functions package for Data Processing.

imc Inline FAMOS enables calculations to be performed on data streams from the measurement currently runnning. The calculations are performed on the PC, taking advantage of the PC's processing power. By contrast, with imc Online FAMOS, the calculations are performed by the device.

Functions

Functions	Description
Scope of functions	A number of pre-defined functions are available for calculation purposes. Most of the imc Online FAMOS functions are available in the same way and with the same syntax as in imc Inline FAMOS. There are a few additional functions exclusively in imc Inline FAMOS.
Cross-device calculations	In contrast to imc Online FAMOS, imc Inline FAMOS provides the ability to apply calculation operations to channels belonging to different devices, if the channels are assigned to "*BaseTrigger*" (measurement Start/Stop).
Displaying results	The results generated are treated as device variables/channels. They are configured on the Setup pages (e.g. Storage) and can be displayed on Panel pages.
Tasks	Multiple independent, complete calculation sequences (**Tasks**) can be processed in parallel. The maximum possible scope/amount of these tasks depends on the computational resources required by the functions used, in conjunction with the computational resources available to the PC used.

License:

A license must be purchased in order to use imc Inline FAMOS. In contrast to imc Online FAMOS, this license is not bound to the device used, but rather to the imc STUDIO installation on the PC.

Enhancement kit: imc Inline FAMOS ClassCounting

This expansion kit for imc Inline FAMOS contains not only familiar functions for durability and fatigue analysis but also some very practical new ones. Diverse counting and classification procedures, particularly Rainflow analysis, are available.

License:

A license must be purchased in order to use imc Inline FAMOS ClassCounting.

Functions	Description
Rainflow	The Rainflow matrix and the Residue are calculated on the basis of a loading time function. Numerous options are provided in order to be able to adapt the algorithm to the user's needs.
Standard class-counting procedure	Some class-counting procedures conforming to DIN 45667 (such as level-crossing, Histogram) are available. Particularly helpful are functions for determining one- and two-dimensional histograms. Even one- and two-dimensional revolution class counts can be calculated.
TrueMax procedure	Even in a correctly sampled signal, extreme values do not always coincide with samples. However, for a Rainflow analysis, correct capture of these extremes value is crucial. Simply use the procedure specially designed for this application.

Functions Package Inline Analysis: imc WAVE

The Inline Analyses "imc WAVE Noise", "imc WAVE Vibration" and "imc WAVE Rotation" offer numerous capabilities for spectral examinations in the fields of **acoustics**, **vibration analysis** and **order-tracking analysis**. What this means is taking signals measured over the time domain, typically generated by microphones and accelerometers, and performing spectral frequency analyses, such as Fast Fourier Transformation or 1/3- and octave spectrum analysis, on them in real time. For this purpose, a comprehensive variety of settings options are available in order to allow parameterization of the analyses according to established standards. This includes time- and frequency-weighting with standard procedures and filters, window functions, etc.

The Inline Analysis "imc WAVE Structure" offers functions for 2 channel **spectrum analysis**, e.g. frequency response function or coherence.

Calculation functions and required licenses

With the corresponding license, you are able to activate the following analyzers:

Name and license required	Description
imc WAVE Noise	Functions for noise analysis, e.g. sound pressure level, Leq, sound intensity, FFT-spectra, 1/3-octave and 1/1-octave spectrum. • Sound level meter according to Standard IEC 61672-1 • 1/3- and 1/1-octave analysis as 3D or averaged according to Standard IEC 61260-1 • FFT analysis as 3D or averaged • Determining the sound intensity (time plot, narrow band spectrum and 1/3-octave spectrum) for measurements with an intensity probe
imc WAVE Rotation	Functions for analysis of rotating machinery • Resampling of time-domain channels • Order-tracking analysis as a 3D or averaged • FFT analysis as a 3D or averaged • Calculation of an input signal over time to a channel over RPMs (RPM-presentation) • Calculation of spectrum over time or revolutions, to a 3D-channel over RPMs (RPM-vector-presentation) • Calculation of 3D cross sections
imc WAVE Structure	Functions for 2-channel analysis in the frequency domain • Generation of output signals for the purpose of subsequent modal analysis • Calculation of transfer functions with noisy input- and/or output signals • Calculation of the coherence as a quality indicator • Power rating by means of the cross-power-spectrum and spectral power density • FFT analysis as 3D or averaged
imc WAVE Vibration	Functions for vibration analysis of human vibration and machine diagnostics • Filters (LP, HP, BP, BS, simple/double integration, simple/double differentiation, envelope curve) • Machine diagnostics according to Standard ISO 10816 and ISO 20816 • Human vibration filters according to Standard ISO 2631-1, ISO 8041, DIN EN 12299 • 1/3- and 1/1-octave analysis of vibration as 3D or averaged according to Standard IEC 61260-1 • FFT analysis as 3D or averaged

imc WAVE Noise

Functions	Description
Basic analysis functions	- FFT analysis (up to 131072 data points) as 3D or averaged - simultaneous calculation of octaves and 1/3-octaves in real time - calculation of spectra with constant absolute and relative bandwidth - selectable frequency range for the spectrum analysis - A-, B-, C- and linear frequency weighting selectable - time-weighting: Fast, Slow - window functions: rectangular, Hamming, Hanning, Flattop, Blackman and Blackman-Harris - frequency -weighted sound level with exponential time weighting - calculation of frequency-weighted averaging levels

Typical applications

- acoustics measurements, fully conformant to applicable industry standards
- acceptance and certification measurements with respect to noise emission and sound levels
- product qualification tests
- product optimization in the R&D field
- in-vehicle noise levels: tests for quality assessment and optimization
- comprehensive and wholistic investigations: root cause analysis of origins, propagation paths and effects of noise and vibration
- incorporation of acoustics expertise into general application fields of physical measurement engineering

imc WAVE Rotation

Functions	Description
Basic analysis functions	- FFT analysis (up to 131072 data points) as 3D or averaged - Calculation of order-tracking spectra - Determining of RPMs, and Resample-functions - Window functions: rectangular, Hamming, Hanning, Flattop, Blackman and Blackman-Harris - Class-counting and representation of time data and spectra plotted over the RPMs

Typical applications

- product qualification tests
- product optimization in the R&D field
- End-Of-Line Quality Assurance
- comprehensive investigations of rotating machinery

imc WAVE Structure

Functions	Description
Basic analysis functions	• FFT analysis (up to 131072 data points) as 3D or averaged • Power density spectrum (up to 131072 points) as 3D or averaged • Coherence (up to 131072 points) averaged • Cross power density (up to 131072 points) spectrum as 3D or averaged • Frequency response (up to 131072 points) function as 3D or averaged

Typical applications

- product qualification tests
- product optimization
- evaluation of signal power and structural behavior

imc WAVE Vibration

Functions	Description
Basic analysis functions	• FFT analysis (up to 131072 data points) as 3D or averaged • simultaneous calculation of octaves and 1/3-octaves in real time • calculation of spectra with constant absolute and relative bandwidth • selectable frequency range for the spectrum analysis • Human vibration filter, high-, low-, bandpass and band rejection • time-weighting: Fast, Slow • window functions: rectangular, Hamming, Hanning, Flattop, Blackman and Blackman-Harris • frequency -weighted sound level with exponential time weighting

Typical applications

- standards-conformant measurements for human vibration and machine diagnostics
- acceptance and certification measurements in conjunction with impact of vibration on humans
- in-vehicle seating comfort: Measurements for qualification and optimization
- hand-arm vibration: handheld machinery
- acceptance and certification measurements in conjunction with impact of vibration on machinery
- product qualification tests
- product optimization in the R&D field
- comprehensive and wholistic investigations: root cause analysis of origins, propagation paths and effects of vibration

Functions Package Bus Decoder

Expansion package for decoding Fieldbus log channels

imc STUDIO BusDecoder is a package of functions for [Data Processing](#).

This plug-in allows either all or individual measurement channels belonging to a log-channel to be decoded/extracted. A log-channel can be a logged Fieldbus communication ("Logfile").

The decoding information which is usually located in separate configuration files (e.g. with CAN in *.dcb) is instead in embedded in the log channel. Thus, the log channel contains all information necessary for decoding. This provides more flexibility and dynamic capability for deciding on targeted extraction of individual channels from the compressed logfile.

The decoding is performed on the basis of the data streams of the measurement currently running on the PC. This utilizes the PC's computation resources.

The following functions are available:

- Decoding of either all or individual channels from a log-channel
- Resampling of the channels
- Saving of the result channels

The results generated can be displayed on Panel pages and saved with the associated measurement data. Subsequent processing by means of imc Inline FAMOS is also possible.

Supported fieldbus types

Decoding of the log channels is possible for multiple fieldbusses

Fieldbus type	FW group A	B	Note
CAN	●	---	Per-channel adoption in the blob.
SPI	●	---	All channels are adopted in the blob. No selection is possible.
MVB	●	---	All channels are adopted in the blob. No selection is possible.
FlexRay	●	---	Per-channel adoption in the blob.

Functions Package Powertrain Monitoring

The component imc STUDIO Powertrain Monitoring has been developed in cooperation with the company **GfM** (**Gesellschaft für Maschinendiagnose mbH**) for power train diagnostics.

It is dedicated to diagnosis of powertrains. The powertrains can consist of motors, shift gearboxes and engines as well as devices for braking. The diagnosis can be used in field scenarios, test rigs or end of line tests in production.

Powertrain Monitoring offers two different kinds of diagnosis of vibrations: a **Base diagnosis** on the basis of characteristic values and a **Advanced Diagnosis** on the basis of a frequency selective search of kinematic pattern.

A configuration for a specific gear type is set up in the imc STUDIO project, from where it can be distributed to different test locations.The actual application is run in the experiment by assigning the inputs to the physical measurement channels in accordance with the configuration selected. This makes it possible to use the same configuration on different measurement systems if multiple test locations are driven with the same powertrain type.

For Powertrain Monitoring, an extra license is required, which is available from imc Test & Measurement GmbH. It can be combined and run with various base-editions of imc STUDIO.

Plug-in imc STUDIO Project Management

The component imc STUDIO Project Management administers all files accruing from both the configuration and data acquisition processes. A database is created in which all configurations (experiments) and measured data are stored. Settings applicable across the experiment boundaries, as well as the experiments themselves are saved in projects. These associated settings are available for all experiments belonging to the respective project. Creating multiple projects allows a clear structure to be maintained.

Basic functions

- Management of multiple projects and their respective settings
- Export/Import of projects or selected experiments
- Creation of multiple experiment templates with arbitrary default settings

Association of imc STUDIO Project Management functions with the imc STUDIO editions

Functionality	Description	imc STUDIO Edition			
		RUN	STD	PRO	DEV
	● : included ○ : optional				
Project management	Creation of multiple experiment templates with arbitrary default settings			●	●
	Management of multiple projects and their respective settings Administration and grouping of experiments within projects			●	●
	Export/Import of projects			●	●
	Export/Import of selected experiments		●	●	●
	Display of meta data while selecting experiments		●	●	●
Measurements	Enables displaying of saved measurements in the Data Browser		●	●	●

Plug-in imc STUDIO GoPro

imc STUDIO GoPro enables the capture of video data using the GoPro video camera.

The camera is connected via Bluetooth and WLAN with the controlling PC on which imc STUDIO is running.

The GoPro-plugin includes a remote control mechanism for the camera. Video data from a GoPro and measurement data from imc measurement devices can be captured and saved simultaneously.

The video data are captured by the camera and saved in the camera. After conclusion of the measurement, the video file is downloaded automatically. This process often takes as much time as the capture itself.

During its capture, there is no live transmission of the video image (exception: GoPro HERO8). Only after the measurement is it possible to analyze the video (e.g. using imc FAMOS) in parallel with the measured data.

Since GoPro works independently, direct synchronization of the video data with the imc measurement device is not possible. There is always a small offset which varies with the particular measurement and camera type and which can not be determined automatically. For purposes of synchronizing the video data with the measured data, it is possible to use the imc FAMOS Video-Kit, for example.

Association of imc STUDIO GoPro functions with the imc STUDIO editions

Functionality	Description	imc STUDIO Edition			
		RUN	STD	PRO	DEV
	● : included ○ : optional ◎ : subset of full feature set				
imc STUDIO GoPro	Remote control of a GoPro camera	○	○	○	○

Specifications and Notes

	Description
Connection	• Only connection with a GoPro-camera is supported.
Data capture	• The video data are captured by the camera and saved in the camera. • After conclusion of the measurement, the video file is downloaded automatically and saved to the measurement folder. • Video data are always recorded along with a measurement by a measurement device/3rd-party device (see Requirements).
Visualization	• A Livestream-Widget can be positioned on a Panel page (not one on each page). • Before and after measurement, the Widget returns the camera's current video transmission. • During measurement, the Widget returns the current video transmission of a GoPro HERO8 camera. With the other GoPro variants, live streaming during the measurement is not possible. • Downloaded videos can be displayed in imc FAMOS, for example. Prerequisite: Installation of an LAV-filter for MP4-files.
Trigger	• The camera is independent of the device-triggers. Recording of the video data in the GoPro begins with the start of measurement.
Synchronization	• Since the GoPro works independently, direct synchronization of the video data with the imc measurement device is not possible. There is always a small offset which varies with the particular measurement and camera type and which can not be determined automatically. For purposes of synchronizing the video data with the measured data, it is possible to use the imc FAMOS Video-Kit, for example.

Requirements
Video data belonging to a measurement can only be recorded once either an imc measurement device, or a 3rd-party device, is participating in the measurement.
The GoPro contains a memory card with sufficient write-speed: SD-card with V30 or higher.
The PC is able to establish a connection both via Bluetooth and via WLAN.

Supported Cameras

- GoPro HERO8 Black
- GoPro HERO9 Black
- GoPro HERO10 Black
- GoPro HERO11 Black

Additional imc Software Products (optional)

Product	Description
imc FAMOS	Some imc STUDIO plug-ins (Automation, Sequencer, Panel) are able to integrate imc FAMOS for data analysis purposes (executing sequences). imc FAMOS is a imc software for complex analysis, display and presentation of signals on the PC ("offline"): https://www.imcfamos.com imc FAMOS must be separately purchased and licensed for the PC. Details on imc FAMOS are available in the software documentation. To execute ready to run sequences for analysis in imc STUDIO, an installation of imc FAMOS version of 2021 or higher, as a Runtime, Professional or Enterprise Edition is required.
imc Online FAMOS Professional	Some imc STUDIO plug-ins require devices having imc Online FAMOS Professional. imc Online FAMOS, or its Professional version, is the software which processes data within the measurement device ("online"). imc Online FAMOS Professional must be purchased and licensed **along with the device**.
imc SENSORS	imc STUDIO Setup can use the imc SENSORS database. imc SENSORS is a database application for administering and editing sensor information. In particular, the entries in the sensor's technical data sheet as well as its calibration values are processed and managed. Along with these values for smart sensors (TEDS) defined in IEEE 1451.4, selections of additional sensor properties can be entered. The prerequisite is installation of an imc SENSORS version of 1.3 R3 or higher. Applicable with devices of the firmware group A.
imc CANSAS	Assistant for the configuration of imc CANSAS modules. Applicable with devices of the firmware group A.

Contact imc

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Service and maintenance

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imc ACADEMY - Training center

The safe handling of measurement devices requires a good knowledge of the system. At our training center, experienced specialists are here to share their knowledge.

E-Mail:	schulung@imc-tm.de
Internet:	https://www.imc-tm.com/service-training/imc-academy

International partners

You will find the contact person responsible for you in our overview list of imc partners:

Internet:	https://www.imc-tm.com/imc-worldwide/

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