imc C-SERIES: CS-1016-FD

Compact, intelligent and extensively equipped measurement system for voltage measurements

device type: CS-1016-FD (Fig. similar), 16 analog measurement inputs

The CS-1016 model of the imc C-SERIES is a 16-channel measurement system for tasks that involve voltage measurements at sampling rates of up to 20 kHz per channel. The analog inputs are differential and equipped with individual signal conditioning including filters. They allow direct connection of voltage signals as well as currents (20 mA) and IEPE type sensors (e.g. ICP™) via extension plugs.

Additional pulse counter inputs support direct measurement of RPM, velocity or displacement or event counting. Two integrated CAN FD nodes allows communication with control units (ECUs) and acquisition of vehicle or machine data, CAN based sensors or additional CAN measurement modules of the imc CANSAS series.

imc C-SERIES - complete, compact and portable measurement devices

The imc C-SERIES is a family of device models each having a fixed hardware configuration. These measurement systems can operate in conjunction with a connected PC (via Ethernet) for setup, data storage and visualization, or in autarkic stand alone mode. In case of power outages, full data integrity on the built-in Flash removable memory volume is ensured by means of UPS buffering, which ensures the safe termination and storage of all open measurement data files.

All C-SERIES-FD devices come standard with two CAN interfaces, which can be operated both in standard-CAN mode and in extended CAN FD configuration (FD: flexible Data Rate with an extended data rate of up to 8 MBaud). Since the operation mode can be software-configured separately for each node, the user benefits from a maximum flexibility and 100% backward compatibility with predecessor models such as the C-SERIES-N.

Highlights

- Integrated CAN FD-Interface
- Real-time signal processing and closed loop control and test automation with imc Online FAMOS
- Counter inputs (measurement of RPM, speed, angle, time, events etc.)
- Digital inputs and outputs
- Analog outputs (DAC)
- Data storage to onboard flash media (CF card) or network harddrive (NAS etc.)
- Complex triggering system, PC independent
- Optional internal WiFi (WLAN) adaptor
- Supports platform independent remote access via standard interner browser (optionally integrated imc REMOTE Webserver)
- Networking (TCP/IP) and synchronizable with other imc measurement systems via:
  - isolated Sync-Signal (DCF-77, IRIG-B)
  - network based via NTP
  - GPS
- Measurement channel extension via direct connection of CAN based measurement modules of the imc CANSAS series
- In conjunction with the operating software imc STUDIO the devices are immediately ready to take measurements with all functionality supported.

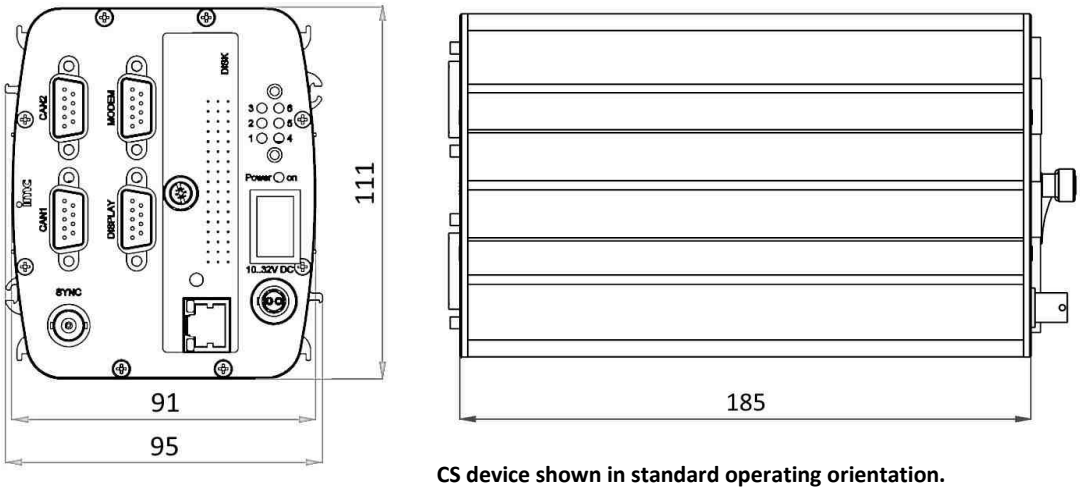
Overview of the available CS-1016 devices

Order code	article no.	housing	analog channels	properties
CS-1016-FD	1400114	CS alu profile	16	CAN FD and Super-Cap UPS
CS-1016-FD-ET	1410054			for extended temperature range

Extra option (factory order option)

- Internal WiFi-adaptor

Mechanical drawings with dimensions



CS device shown in standard operating orientation.

Software minimum requirements

Operation of the "FD" series devices requires operating software of the following group:
imc STUDIO 5.0 R9 associated with firmware and driver package imc DEVICES 2.9 R6.

Accessories and Connectors

Included accessories

- Calibration certificate with test equipment verification as per ISO 9001 (manufacturer's calibration certificate)
- Instruction manual: "Getting started with devices of the C-SERIES"
- 1x Ethernet network cable with latch protection (uncrossed, 2 m)
- 1x LEMO.1B plug (ACC/POWER-PLUG1)

AC/DC power adaptor 110-230V AC (with appropriate LEMO plug)		
CRPL/AC-ADAP-60W-1B	24 V DC, 60 W, LEMO.1B.302	1080066

DSUB-15 plug		
4x ACC/DSUB-U4	DSUB-15 plug with screw terminals for 4-channel voltage measurement	1350166
1x ACC/DSUB-DI4-8	DSUB-15 plug for 8 digital inputs	1350174
1x ACC/DSUB-DO4	DSUB-15 plug for 8 digital outputs	1350173
1x ACC/DSUB-ENC4	DSUB-15 plug for 4 incremental inputs	1350171
1x ACC/DSUB-DAC4	DSUB-15 plug for 4 analog outputs	1350177

Optional accessories

DSUB-15 plug		
ACC/DSUBM-I4	DSUB-15 plug with screw terminals for 4-channel current measurement of up to 50 mA (50 Ω shunt, scaling factor: 0.02 A/V)	1350168
ACC/DSUB-ICP4	DSUB-15 plug for 4 IEPE/ICP sensors, BNC connection	1350032
ACC/DSUBM-ICP2I-BNC	DSUB-15 plug for 2 IEPE/ICP sensors, BNC connection, isolated	1350199

Mounting brackets for fixed installations		
C/CS-BRACKET-90	mounting bracket 90°; mounting CS devices on a flat surface	1400064
C/CS-19"-RACK	19" RACK for up to 4 CS devices	1400091

Miscellaneous		
C/CAL-P	Calibration report set for imc C-SERIES Report set with manufacturer’s calibration certificate and individual readings, as well as list of test equipment used. Meets requirements of DIN EN ISO 17025.	1400035

Further accessories (see separate price list of the accessories)

- recommended and verified removable flash storage media
- external display (via DSUB-9)
- GPS-receiver (with DSUB-9 connection)

General Technical Specs

Terminal connection		
Parameter	**Value**	**Remarks**
Terminal connection	4x DSUB-15	16 analog inputs
Terminal connection DI, DO, INC, DAC	1x DSUB-15 1x DSUB-15 1x DSUB-15 1x DSUB-15	8 digital inputs 8 digital outputs 4 counter inputs 4 analog outputs
Further terminal connection	RJ45 CF-Card Slot 2x DSUB-9 DSUB-9 DSUB-9 BNC LEMO FGG.1B.302	Ethernet (100 MBit), PC/network removable storage two CAN FD nodes external display external GPS module synchronization supply
Weight	ca. 2 kg	
Dimensions (WxHxD) in mm	95 x 111 x 185	

Power supply	**Value**	**Remarks**
Power supply	10 V to 32 V DC	
Isolation of supply input	non-isolated	
AC/DC adaptor	110 V to 230 V AC	external adaptor included in delivery
Auto start upon power up	configurable	automatic start of measurement

UPS and Data integrity	**Value**	**Remarks**
Autarkic operation without PC	✓	
Self start (automatic data acquisition operation)	configurable	timer, absolute time, automatic start when power supply is available
Auto data-saving upon power outage	✓	buffering (UPS) with "auto-stop": auto-stop of measurement, data storage and automatic shutdown
UPS	integrated	Super-Caps
Charging time of the Super-Caps	6 min.	minimum required active operation for full UPS functionality
UPS coverage	entire device	
UPS delay per power outage	1 sec	"buffer time constant": required duration of a continuous outage that will trigger auto shutdown procedure fix parameter: not changeable in device configuration!
Effective buffer capacity	100 mWh	sufficient for auto-stop (max. 12 sec.); with fully charged Super-Caps (after minimum operating duration)

Data acquisition, trigger		
Parameter	**Value**	**Remarks**
Max. aggregate sampling rate	400 kS/s	
Channel individual sampling rates	selectable in 1–2–5 steps	
Number of sampling rates: analog channels, DI and counter	2	usable simultaneously in one configuration
Number of sampling rates: fieldbus channels	arbitrary	
Number of sampling rates: virtual channels	arbitrary	data rates generated via imc Online FAMOS (e.g. via reduction)
Monitor channels	✓ for all channels of the types: analog, DI and counter (incremental encoder) and CAN	doubled channels with independent sampling and trigger settings
Intelligent trigger functions	✓	e.g. logical combination of multiple channel events (threshold, edge) to create triggers that start and stop acquisition of assigned channels
Multi.triggered data acquisition	✓	multiple trigger-machines and multi-shot
Independent trigger-machines	48	start/stop, arbitrary channel assignment
Direct onboard data reduction: arithmetic mean, min, max.	✓	
Extensive real-time calculation and control functions	✓	included in standard delivery (via imc Online FAMOS)
External GPS signal receiver	O	
Internal WiFi (WLAN) adaptor	O IEEE 802.11g (1 antenna) max. 54 MBit/s	

Storage, signal processing		
Parameter	**Value**	**Remarks**
Internal flash storage	CF-card	removable cover for the CF slot
Removable flash storage media	CF	recommended media available at imc; the specified operating temperature range of the media is relevant
Storage on NAS (network storage)	✓	alternatively to onboard Flash storage
Arbitrary memory depth with pre- and post trigger	✓	maximum pretrigger limited by size of Circular Buffer RAM; posttrigger only limited by available mass storage (Flash)
Circular buffer mode	✓	cyclic overwrite of circular buffer memory on mass storage media
Synchronization	DCF 77 GPS IRIG-B NTP	Master / Slave via external GPS-receiver TTL via network

Operating conditions		
Operating environment (Standard)	dry, non corrosive environment within specified temperature range	
Ingress Protection	IP20	
Operating temperature (Standard)	-10°C to 55°C	without condensation
Operating temperature (extended, "-ET")	-40°C to 85°C	condensation temporarily allowed
Rel. humidity	80% up to 31°C, above 31°C: linear declining to 50%, according DIN EN61010-1	
Operating altitude	up to 2000 m	
Shock and vibration resistance	IEC 60068-2-27, IEC 60068-2-64 IEC 61373 category 1, class A and B	
Extended shock and vibration resistance (Upon request)	MIL-STD-810 Rail Cargo Vibration Exposure U.S. Highway Truck Vibration Exposure	

Synchronization and time base

Time base of individual device without external synchronization			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Accuracy RTC		±50 ppm 1 µs (1 ppm)	not calibrated (standard devices), at 25°C calibrated devices (upon request), at 25°C
Drift	±20 ppm	±50 ppm	-40°C to +85°C operating temperature
Ageing		±10 ppm	at 25°C; 10 years

Time base of individual device with external synchronization signal				
Parameter	**GPS**	**DCF77**	**IRIG-B**	**NTP**
Supported formats	NMEA / PPS(1)		B000, B001 B002, B003(2)	Version ≤4
Precision	±1 µs			<5 ms after ca. 12 h(3)
Jitter (max.)	±8 µs			
Voltage level	TTL (PPS) RS232 (NMEA)	5 V TTL level		---
Input impedance	1 kΩ (pull up)	20 kΩ (pull up)		---
Input connection	DSUB-9 "GPS" not isolated	BNC "SYNC" (isolated) (test voltage: 300 V, 1 min.)		RJ45 "LAN"
Cable shield connection		BNC: isolated Signal-GND (marked with yellow ring)		---

Synchronization of multiple devices via DCF (Master/Slave)			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Max. cable length		200 m	BNC cable type RG58 (propagation delay of cable needs to be considered)
Max. number of devices		20	only slaves
Common mode SYNC not-isolated	0 V		with non-isolated BNC connector: devices must have the same ground voltage level, otherwise signal integrity issues (signal artifacts and noise) may result
SYNC isolated		max. 50 V	with isolated BNC connector: SYNC-signal is already internally isolated, for reliable operation even with different ground voltage level (ground loops)
Voltage level	5 V		
DCF input/output	"SYNC" connection		BNC

(1) PPS (Pulse per second): signal with an impulse >5 ms is necessary
(2) using BCD information only
(3) Max. value, concerning the following condition: first-synchronization

CS-1016-FD analog inputs

Inputs, measurement modes		
Parameter	**Value**	**Remarks**
Analog inputs	16	
Measurement modes	voltage measurement current measurement current feed sensors (IEPE/ICP)	 ACC/DSUBM-I4 with DSUB-15 extension plug ACC/DSUB-ICP4, not isolated ACC/DSUBM-ICP2I-BNC, isolated

Sampling rate, Bandwidth, Filter, TEDS		
Parameter	**Value**	**Remarks**
Sampling rate	≤20 kHz	per channel
Bandwidth	0 Hz to 6.6 kHz 0 Hz to 5 kHz	-3 dB (analog AAF 5th order) -0.2 dB
Filter (digital) cut-off frequency characteristic, order	2 Hz to 5 kHz	 Butterworth, Bessel (digital) low pass filter 8. order Anti-aliasing filter: Cauer 8. order with $f_{cutoff} = 0.4\ f_s$
Resolution	16 Bit	internal processing 24 Bit
TEDS	conforming to IEEE 1451.4 Class II MMI	
Characteristic curve linearization	user defined (max. 1023 supporting points)	

General			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Overvoltage protection		±40 V	permanent channel to chassis
Input coupling	DC		
Input configuration	differential		
Input impedance	20 MΩ		differential, >10 kΩ off-state
Auxiliary supply voltage available current internal resistance	 +5 V 0.26 A 1.0 Ω	 ±5% 0.2 A <1.2 Ω	for IEPE/ICP-extension plug independent of integrated sensor supply, short-circuit protected power per DSUB-plug

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±10 V, ±5 V, ±2.5 V, ±1 V, ±500 mV, ±250 mV		
Gain: error drift	0.02 % ±8ppm/K·ΔT_a	≤0.05 % ±30ppm/K·ΔT_a	of reading ΔT_a=|T_a -25°C|; ambient temperature T_a
Offset: error drift	0.02 % ±18 µV/K·ΔT_a ±2 µV/K·ΔT_a	≤0.05 % ±45 µV/K·ΔT_a ±5 µV/K·ΔT_a	of range ±10 V to ±2.5 V ±1 V to ±250 mV ΔT_a=|T_a -25°C|; ambient temperature T_a
Max. common mode voltage		±12 V	
Common mode rejection Ranges ±10 V to ±2.5 V ±1 V to ±250 mV	 -90 dB -108 dB	 -80 dB -97 dB	common mode test voltage: ±10 $V_=$ and 7 V_{rms}, 50 Hz
Channel to channel crosstalk Ranges 10 V to ±2.5 V ±1 V to ±250 mV	 -90 dB -116 dB		test voltage: ±10 $V_=$ and 7 V_{rms}, 0 Hz to 50 Hz; range: ±10 V
Noise	12 μV_{rms}		bandwidth: 0.1 Hz to 1 kHz

Current measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±50 mA, ±20 mA, ±10 mA, ±5 mA		50 Ω shunt in terminal plug
Max. over load	±60 mA		permanent
Input configuration	differential		50 Ω shunt plug (ACC/DSUBM-I4)
Gain: error drift	 0.02 % ±20 ppm/K·ΔT_a	 ≤0.06 % ≤0.1 % ±55 ppm/K·ΔT_a	of reading plus error of 50 Ω shunt ΔT_a=|T_a -25 °C|; ambient temp: T_a
Offset: error drift	 0.02 % ±30 nA/K·ΔT_a	 ≤0.05 % ±60 nA/K·ΔT_a	 of range ΔT_a=|T_a -25 °C|; ambient temp: T_a

Technical Specs: Features (for all devices of imc C-SERIES)

Digital Inputs

Parameter	Value	Remarks
Channels	8	common ground reference for each 4-channel group, isolated from the other input group
Configuration options	TTL or 24 V input voltage range	configurable at the DSUB globally for 8 Bits: • jumper from LCOM to LEVEL:activates TTL-mode • LEVEL unconnected: activates 24 V-mode
Sampling rate	10 kHz	
Isolation strength	±50 V	tested ±200 V isolated to system ground, supply and channel-to-channel
Input configuration	differential	
Input current	max. 500 µA	
Switching threshold	1.5 V (±200 mV) 8 V (±300 mV)	5 V level 24 V level
Switching time	<20 µs	
Supply HCOM	5 V max. 100 mA	electrically isolated from system (case), Configuration signal "LEVEL" is referenced to HCOM, LCOM
Terminal connection	DSUB-15	ACC/DSUBM-DI4-8

Digital outputs

Parameter	Value		Remarks
Channels / bits	8 bit		Group of 8 bits, galvanically isolated; common reference potential ("LCOM“) for each group
Isolation strength	±50 V		to system ground (case, CHASSIS)
Output configuration	totem pole (push-pull) or open-drain		configurable at the DSUB globally for 8 Bits: • jumper from OPDRN to LCOM: totem pole • OPDRN unconnected: open-drain
Output level	TTL or max. U_{ext}-0.8 V		internal, galvanically isolated supply voltage by connecting an external supply voltage U_{ext} with "HCOM", U_{ext} = 5 V to 30 V
State upon system power up	high impedance (High-Z)		Independent of output configuration (OPDRN-pin)!
Activation of the output stage following system start	upon first preparation of measurement		with initial states which can be selected in the experiment (High / Low) in the selected output configuration (OPDRN-pin)
Max. output current (typ.) TTL 24 V-logic open-drain open-drain with intern. 5 V supply	HIGH 15 mA 22 mA --- 	LOW 0.7 A 0.7 A 0.7 A 160 mA	 external clamp diode needed for inductive load for all outputs

Parameter	Value		Remarks
Output voltage TTL 24 V-logic (U_{ext} = 24 V)	HIGH >3.5 V >23 V	LOW ≤0.4 V ≤0.4 V	for load current: I_{high} = 15 mA, I_{low} ≤ 0.7 A I_{high} = 22 mA, I_{low} ≤ 0.7 A
Internal supply voltage	5 V, 160 mA (isolated)		available at terminals
Switching time	<100 µs		
Terminal connection	DSUB-15		ACC/DSUBM-DO8

Incremental encoder channels

Parameter	Value		Remarks
Channels	4 + 1 (5 tracks)		four single-tracks or two two-track channels one index track
Measurement modes	Displacement, Angle, Events, Time, Frequency, Velocity, RPMs		
Sampling rate	50 kHz		per channel
Time resolution of measurement	31.25 ns		Counter frequency: 32 MHz
Data resolution	16 bits		
Input configuration	differential		
Input impedance	100 kΩ		
Input voltage range	±10 V		(differential)
Common mode input range	min. -11 V	max. +25 V	
Switching threshold	-10 V to +10 V		detection level selectable per channel
Hysteresis	min. 100 mV		selectable per channel
Analog bandwidth	500 kHz		-3 dB (full power)
Analog filter	Bypass (no Filter), 20 kHz, 2 kHz, 200 Hz		selectable (per-channel) 2nd order Butterworth
Switching delay	500 ns		signal: 100 mV squarewave
CMRR	70 dB 60 dB	50 dB 50 dB	DC, 50 Hz 10 kHz
Gain error	<1 %		of input voltage range @ 25 °C
Offset error	<1 %		of input voltage range @ 25 °C
Overvoltage strength	±50 V		to system ground
Sensor supply	+5 V, 300 mA		not isolated (reference: GND, CHASSIS)
Terminal connection	DSUB-15		ACC/DSUBM-ENC4

Analog outputs

Parameter	Value typ.	min. / max.	Remarks
Channels	4		
Output level	±10 V		
Load current	max. ±10 mA / channel		
Resolution	16 Bit		15 Bit no missing codes
Non-linearity	±2 LSB	±3 LSB	
Max. output frequency	50 kHz		
Analog bandwidth	50 kHz		-3 dB, low pass 2. order
Gain error	<±5 mV	<±10 mV	-40 °C to 85 °C
Offset error	<±2 mV	<±4 mV	-40 °C to 85 °C
Terminal connection	DSUB-15		ACC/DSUBM-DAC4

CAN FD Bus Interface

Parameter	Value	Remarks
Number of CAN-nodes	2	one galvanically isolated node per connector
Terminal connection	2x DSUB-9	
Topology	bus	
Transfer protocol	configurable per software: CAN FD (ISO Standard) (max. 8 MBaud) non-ISO CAN FD (Draft) (max. 8 MBaud) CAN High Speed (max. 1 MBaud) CAN Low Speed (max. 125 KBaud)	individually for each node current standard according ISO 11898-1:2015 former draft (Bosch) according ISO 11898 according ISO 11519
Operating mode	Multi Master principle	
Direction of data flow	sending and receiving	
Baud rate	5 kBit/s to 8 MBit/s	configurable via software; maximum is depending on selected protocol (FD/High/Low Speed)
Termination	120 Ω	switchable by software for each node
Isolation strength	60 V	to system ground (case, CHASSIS)
Direct access for configuration of imc CANSAS modules	yes	via the CAN node of the device with imc STUDIO (CAN High Speed Mode only)