imc C-SERIES: CS-6004-N, CL-6012-N

Strain gauge measurement systems for dynamic DC/CF measurements

device type: CS, 4 analog channels

device type: CL, 12 analog channels

Data Sheet Version 1.1

The devices of the imc C-SERIES CS-6004-N and CL-6012-N are 4 or respectively, 12-channel compact measurement systems for all-purpose measurement with strain gauges, with both DC-voltage supply and carrier frequency supply. They can be software-configured for measurement of quarter-, half- or full bridges; the bridge completion can be adjusted by software between 120 and 350 Ω. To determine stresses and strains, the bridge voltages measured in various setups are converted directly into stresses and strains.

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

The devices of the imc C-SERIES are equipped with a defined standard configuration and available in two different housing types: "CS" in a Alu-Profile housing and "CL" in a dark flat plastic housing with carrying leafs.

Highlights

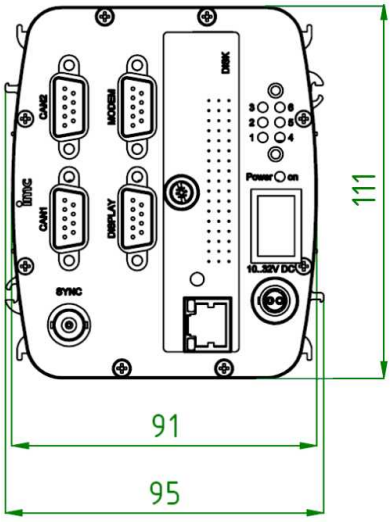
- Stand-alone startup and power-failure control logic
- Real-time signal processing and test control with imc Online FAMOS (as standard equipment)
- intelligent power supply with UPS function and saving of data when power-failure
- integrated CAN-Interface
- Counter inputs (measurement of angle, events, velocity etc.)
- digital inputs and outputs
- analog outputs (DAC)
- Onboard flash storage (CF card) or network-harddrive (NAS etc.)
- complex triggering system PC independent
- possible equipment with internal WiFi (WLAN) adaptor
- supports platform independent remote access via standard interner browser (optionally integrated imc REMOTE Webserver)
- adapted to synchronization with other imc measurement devices via:
  - isolated Sync-Signal (DCF-77, IRIG-B)
  - network based via NTP
  - GPS
- Measurement channel extension via direct connection of measurement modules belonging to imc's CANSAS series
- In conjunction with the operating software imc STUDIO and im c DEVICES the devices are immediately ready to take measurements, and all of their functions are operable.

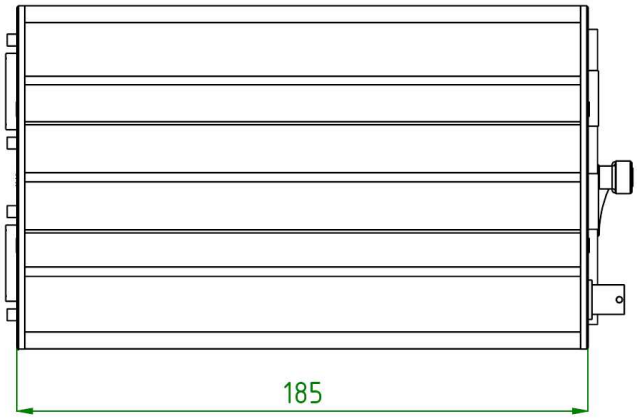
Overview of the available devices

Order Code	Article number	Housing	analog channels	Extra
CS-6004-N	1400077	CS alu profile	4	-
CS-6004-N-ET	1410041			extended temp.- range
CL-6012-N	1400078	CL portable housing	12	-
CL-6012-N-ET	1410042			extended temp.- range

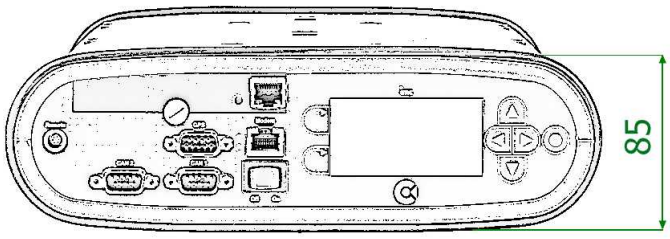
Mechanical drawings with dimensions

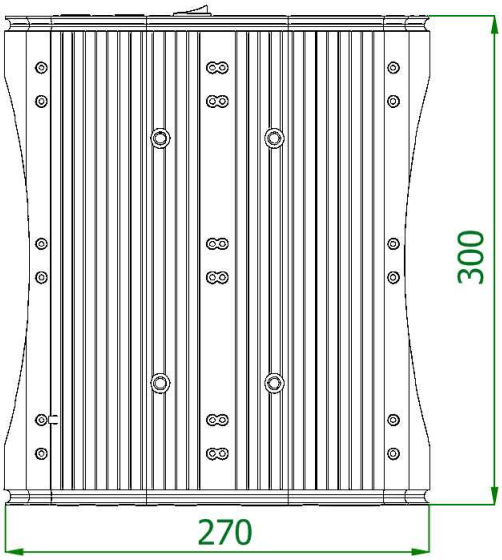
Housing type: CS (95x111x185 mm)





Housing type: CL (270x85x300 mm)





Required software version

- Supported by imc STUDIO 4.0R1 and imc DEVICES 2.8R3, or higher, included with all functions
- imc Plug & Measure (TEDS)
  This device supports TEDS and can be used together with imc SENSORS.

Included accessories

- 230/110 V power adapter (optionally with country-specific power cable)
- "Getting Started with imc C-SERIES" (printed)
- Manufacturer's Calibration Certificate
- 1x Ethernet network cable crossed and 1x uncrossed
- 1x LEMO.1B plug with CS devices and with CL devices 1x LEMO.0B

Terminal connections

• 2x or 6x ACC/DSUB(M)-B2	DSUB-15 plug with screw terminals for 2-channel measurement of strain gauges, bridges and voltage
• 1x ACC/DSUB(M)-DI4-8	DSUB-15 plug with screw terminals for 8 digital inputs
• 1x ACC/DSUB(M)-DO8	DSUB-15 plug with screw terminals for 8 digitale Ausgänge
• 1x ACC/DSUB(M)-ENC4	DSUB-15 plug with screw terminals for 4 counter inputs
• 1x ACC/DSUB(M)-DAC4	DSUB-15 plug with screw terminals for 4 analog outputs

Optional accessories

Terminal connections

• ACC/DSUB(M)-I2	DSUB-15 plug with screw terminals for 2-channel current measurement of up to 50 mA (50 Ω shunt, scaling factor: 0.02A/V)
• ACC/DSUB-ICP2	DSUB-15 plug with screw terminals for conditioning of 2 IEPE/ICP inputs

General technical specs for all devices of imc C-SERIES

Parameter	Value	Remarks
Housing type	Alu profile plastic portable housing	CS CL
Ingress Protection	IP20	
Terminal connection		
Terminal connection (DSUB-15) analog inputs	ACC/DSUB(M)-B2 ACC/DSUB(M)-I2 ACC/DSUB-ICP2	
Terminal connection (DSUB-15) DI, DO, INC, DAC	ACC/DSUB(M)-DI4-8 ACC/DSUB(M)-DO8 ACC/DSUB(M)-ENC4 ACC/DSUB(M)-DAC4	8 digital inputs 8 digital outputs 4 counter inputs 4 analog outputs
Further terminal connections	RJ45 CF-Card slot 2x DSUB-9 DSUB-9 DSUB-9 BNC LEMO FGG.1B.302.CLAD62Z LEMO FGG.0B.302.CLAD62Z	Ethernet (10/100 MBit), PC/network removable storage two CAN-nodes external Display (CS) external GPS module synchronization supply (CS) supply (CL)
Weight without table-top power adapter	approx. 2 kg approx. 3.5 kg	CS CL
Dimensions (WxHxD) in mm	95 x 111 x 185 270 x 85 x 300	CS CL

Power supply		
Parameter	**Value**	**Remarks**
DC input supply voltage	10 V to 32 V DC	
Isolation of supply input	not-isolated isolated	CS CL
Power adapter	110 V / 230 V AC	external adapter, included in delivery
Auto start upon power up	configurable	automatic start of measurement
Automatic shutdown with data saving upon power fail	yes	
UPS	battery: lead-gel	uninterruptable power supply
UPS buffer time constant	1 sec (with CS) 30 sec. (with CL)	maximum duration of a continuous outage before triggering device shutdown
Internal battery voltage	4 V 24 V	CS CL
Effective buffer capacity	 ≥3,5 Wh ≥5,1 Wh	typ. 23°C, battery fully charged CS CL

Power supply		
Parameter	**Value**	**Remarks**
Minimum charging time for 1 min. buffer duration	≤19 min ≤21 min.	for empty battery, 23°C CS CL
Charging time for empty battery	6 h	device activated
Charging capacity	1.1 W 1.5 W	automatic charge control CS CL

Operating conditions	
Operating environment (standard)	dry, non corrosive environment within specified temperature range
Operating temperature (standard)	-10°C to +55°C no condensation
Operating temperature(extended)	-20°C to +85°C with condensation
Operating altitude	up to 2000 m
Relative humidity	80 % for less than 31°C, for more than 31°C linear declining to 50%, according DIN EN61010-1

Data acquisition and hardware options	
Max. aggregate sampling rate	400 kS/s
Sampling rate channel wise configurable in steps of 1-, 2-, 5	✓
Number of simultaneously applicable sampling rates (in one configuration)	2
Monitor channels (doubled channels with independent sampling and trigger configurations)	✓
Multi-triggered data acquisition: multitrigger and multi-shot	✓
Independent trigger machines (start/stop, arbitrary channel assignments)	48
Extensive intelligent trigger functions	✓
Direct onboard data reduction: arithmetic mean, min, max	✓
Extensive real-time calculation and control functions	✓ included in standard deliveries (via imc Online FAMOS)
Synchronization	DCF 77, IRIG-B (auto detect) NTP GPS
External GPS signal receiver	O
Internal WiFi (WLAN) adaptor	O IEEE 802.11g (1 Antenna) max. 54 MBit/s

Data storage	
internal removable storage	CF-Card (covered CF slot)
internal hard drive	O (with CL)
Any memory depth with pre- and post triggering	✓
Circular buffering	✓

Synchronization and time base

Time base per device without external synchronization			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Accuracy internal time base RTC		±50 ppm	balanced (default), at 25°C
Drift	±20 ppm	±50 ppm	-40°C to +85°C operating temperature
Ageing		±10 ppm	@ 25°C; 10 years

Time base per device with external synchronization signal				
Parameter	**GPS**	**DCF77**	**IRIG-B**	**NTP**
Supported formats	NMEA / PPS*		B002 B000, B001, B003**	Version 4 (downwards compatible)
Precision	±1 µs			<5 ms after ca. 12 h
Jitter (max.)	±8 µs			
Voltage level	TTL (PPS*) RS232 (NMEA)	5 V TTL level		---
Input resistance	1 kΩ (pull up)	20 kΩ (pull up)		---
Input connector	DSUB-9 "GPS" non-isolated	BNC connector "SYNC" (isolated) Isolation strength: 300 V (1 minute test voltage)		Ethernet
Shield potential input		BNC connector: isolated Signal-GND (marked by a yellow ring around the BNC plug)		---

* PPS (pulse per second): signal with an impulse >5 ms is necessary ** using BCD information only

Synchronization with DCF77 for several devices (Master/Slave)			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
max. cable length		200 m	BNC cable RG58
max. number of devices		20	Slaves, plus 1 Master
Common mode		max. 50 V	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

Cx-60xx analog inputs

Parameter	Value	Remarks
Inputs	4 12	CS CL
Measurement modes with DSUB	full bridge half bridge quarter bridge LVDT voltage current current-fed sensors IEPE/ICP	Voltage or bridge mode global for all four channels. inductive transducers (CF) with ACC/DSUB(M)-I2 ACC/DSUB-ICP2
Terminal connection	DSUB-15	ACC/DSUB(M)-B2 ACC/DSUB(M)-I2 ACC/DSUB-ICP2

Sampling rate, Bandwidth, Filter, TEDS		
Parameter	**Value**	**Remarks**
Sampling rate	20 kHz (max)	per channel
Bandwidth	8.6 kHz (DC) 3.9 kHz (CF)	-3 dB
Filter cut-off frequency characteristic order	2 Hz to 5 kHz	 Butterworth, Bessel 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 - Transducer Electronic DataSheets	conforming to IEEE 1451.4 Class II MMI	ACC/DSUB(M)-TEDS-xx

General			
Parameter	**Value typ.**	**min. / max**	**Remarks**
Overvoltage protection		±50 V ±80 V	long term (differential- and SENSE-inputs) short-term
Input impedance	10 MΩ 1 MΩ		range ±5 mV to ±2 V range ±5 V to ±50 V and for deactivated device
Input current		40 nA	
Input capacitance	300 pF		
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 proof power per DSUB-plug

Voltage measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input ranges	±50 V / ±25 V / ±10 V ±5 V / ±2 V / ±1 V ±500 mV / ±250 mV / ±100 mV ±50 mV / ±25 mV / ±10 mV / ±5 mV		
Gain uncertainty	0.02 %	≤0.05 %	of reading (measurement value)
Gain drift	60 ppm / K	<100 ppm / K	
Offset drift	0.02%	 ≤0.05% ≤0.1% ≤0.2%	of measurement range range ≥ ±25 mV range = ±10 mV range = ±5 mV
Input offset-drift	0.05 µV / K	0.3 µV / K	DC voltage measurement
Non-linearity	<200 ppm		
Common mode voltage (max.)	±50 V ±2,8 V		ranges ±50 V to ±5 V ranges ±2 V bis ±5 mV
Common mode rejection ratio (CMRR)			
range ±5 mV to ±25 mV range ±50 mV to ±100 mV range ±250 mV to ±2 V range ±5 V to ±50 V		>120 dB >110 dB 95 dB >54 dB	DC
range ±5 mV to ±2 V range ±5 V to ±50 V	>100 dB >68 dB	>90 dB >54 dB	f ≤ 50 Hz
all ranges		>50 dB	f = 5 kHz
SNR (signal to noise ratio)	 >90 dB >88 dB >82 dB >75 dB >69 dB		full-scale / rms-noise full bandwidth ranges ±100 mV to ±50 V range ±50 mV range ±25 mV range ±10 mV range ±5 mV
Input noise, voltage (RTI)	16 nV/√Hz rms 16 µV pk-pk 2 µV rms 0.6 µV pk-pk		DC-Mode (range ±5 mV) spectral noise density 1 kHz 0 Hz to 10 kHz 0 Hz to 10 kHz 0.1 Hz to 10 Hz

Current measurement with shunt plug		
Parameter	**Value**	**Remarks**
Input ranges	±40 mA / ±20 mA / ±10 mA ±5 mA / ±2 mA / ±1 mA ±400 µA / ±200 µA / ±100 µA	
Shunt impedance	50 Ω	shunt plug ACC/DSUB(M)-I2

Bridge measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Mode	DC, CF		
Sensors	LVDT, strain gauge: full-, half-, quarter bridge piezo-resistive bridge transducer potentiometer		directly connectable
Bridge measurement mode	full-, half-, quarter bridge		
Bridge input ranges	±1 mV/V to ±400 mV/V ±2 mV/V to ±800 mV/V ±5 mV/V to ±2000 mV/V		for bridge voltage: 5 V 2.5 V 1 V
Bridge voltage DC CF (5 kHz)	1 V; 2.5 V; 5 V (symmetric) 1 V; 2.5 V; 5 V (peak)		set globally for 4-channel groups corresponding to ±0.5 V, ±1.25 V, ±2.5 V corresponding to RMS: 0.7 V; 1.8 V; 3.5 V
Internal quarter-bridge completion	120 Ω, 350 Ω		selectable
Min. bridge impedance Bridge impedance (max.)	120 Ω, 10 mH full bridge 60 Ω, 5 mH half bridge 5 kΩ		bridge supply = 1 V to 5 V, $I_{load} \leq 42$ mA
Gain uncertainty	<0.05%		of measurement value at 25°C
Offset after bridge balance	<0.02%		of the range at 25°C
Input offset-drift	0.01 µV/V / K	0.06 µV/V / K	DC full bridge (Vb=5 V, 1 mV/V range) without ext. bridge offset
Drift of bridge balance Equivalent offset drift corresponding to balanced ext. bridge offset	50 ppm/K 0.05 µV/V/K	<90 ppm/K 0.09 µV/V/K	of compensated offset value full bridge (DC or CF), ext. bridge offset = 1 mV/V 1 mV/V input range
Half-bridge drift (int. half-bridge)	0.05 µV/V/K	1 µV/V/K	DC or CF
Bridge balancing range	≥ measurement range not less than: ≥±5 mV/V ≥±10 mV/V ≥±25 mV/V		 for bridge supply = 5 V for bridge supply = 2.5 V for bridge supply = 1 V
Cable length (max.)	500 m (one-way length)		A = 0.14 mm², R = 130 mΩ/m, 65 Ω
Lead wire compensation technique	3 schemes available: double Sense simple Sense by means of shunt-calibration		(half-/full bridge) any cables; for symmetric cables of same type; one-time compensation (not continuously adapted)
Automatic shunt-calibration	0.5 mV/V		for 120 Ω and 350 Ω bridges

Bridge measurement			
Parameter	**Value typ.**	**min. / max.**	**Remarks**
Input noise (bridge)			range: 1 µV/V (bridge voltage = 5 V)
DC full bridge	3 $\mu V/V_{pkpk}$, 0.39 $\mu V/V_{rms}$		0 Hz to 10 kHz
	0.9 $\mu V/V_{pkpk}$, 0.12 $\mu V/V_{rms}$		1 kHz, lowpass filter
	0.3 $\mu V/V_{pkpk}$, 0.04 $\mu V/V_{rms}$		100 Hz, lowpass filter
	0.1 $\mu V/V_{pkpk}$		10 Hz, lowpass filter
DC half-/quarter bridge	3.3 $\mu V/V_{pkpk}$, 0.45 $\mu V/V_{rms}$		0 Hz to 10 kHz
	1.1 $\mu V/V_{pkpk}$, 0.15 $\mu V/V_{rms}$		1 kHz, lowpass filter
	0.35 $\mu V/V_{pkpk}$, 0.05 $\mu V/V_{rms}$		100 Hz, lowpass filter
	0.3 $\mu V/V_{pkpk}$		10 Hz, lowpass filter
CF full bridge, half bridge	3.5 $\mu V/V_{pkpk}$, 0.47 $\mu V/V_{rms}$		0 Hz to 10 kHz
	1.7 $\mu V/V_{pkpk}$, 0.22 $\mu V/V_{rms}$		1 kHz, lowpass filter
	0.6 $\mu V/V_{pkpk}$, 0.07 $\mu V/V_{rms}$		100 Hz, lowpass filter
	0.3 $\mu V/V_{pkpk}$		10 Hz, lowpass filter

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	per channel
Isolation strength	±150 V	tested ±200 V isolated to system ground, supply and untereinander
Input configuration	differential	isolated mutually and from supply
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	Reference at level otherwise electrically isolated from system
Terminal connection	DSUB-15	ACC/DSUB(M)-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 (protection ground)
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 following system start	High resistance (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 contacts
Switching time	<100 µs		
Terminal connection	1x DSUB-15 / 8 Bit		ACC/DSUB(M)-DO8

Incremental encoder channels

Parameter	Value		Remarks
Channels	4 + 1 (5 tracks)		Four single-tracks or combining two single- into two-track encoders 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		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		Modulation: 100 mV squarewave
CMRR	70 dB 60 dB	50 dB 50 dB	DC, 50 Hz 10 kHz
Gain uncertainty	<1 %		of input voltage range @ 25 °C
Offset uncertainty	<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/DSUB(M)-ENC4

Analog outputs

Parameter	Value typ.	min. / max.	Remarks
Channels	4		
Output level	±10 V		
Load current	max. ±10 mA / channel		
Resolution	16 Bit		
Non-linearity	±2 LSB	±3 LSB	
Max. output frequency	50 kHz		
Analog bandwidth	50 kHz		-3 dB, low pass 2. order
Gain uncertainty	<±5 mV	<±10 mV	-40 °C to 85 °C
Offset uncertainty	<±2 mV	<±4 mV	-40 °C to 85 °C
Terminal connection	DSUB-15		ACC/DSUB(M)-DAC4

CAN-Bus Interface

Parameter	Value	Remarks
Number of CAN-nodes	2	each node is galvanically isolated (for each CAN IN and CAN OUT)
Terminal connection	2x DSUB-9	
Transfer protocol	CAN High Speed (max. 1 MBaud, conforming ISO 11898) CAN Low Speed (max. 125 KBaud, conforming ISO 11519)	default switchable per software for each node
Baudrate	1 MBit/s ... 5 kBit/s	selectable via software, maximum for each selected protocol (High/Low Speed)
Max. cable length at data transfer rate	25 m at 1000 kBit/s 90 m at 500 kBit/s	CAN High Speed cable delay 5.7 ns/m
Termination	124 Ω	switchable by software for each node
Isolation strength	±50 V	to system ground (protection ground)
Direct parameterize of imc CANSAS modules	yes	via CAN node of the devices with imc STUDIO, imc DEVICES alternatively imc CANSAS software