

imc CANSASfdx-FBG-T8

8-channel CAN measurement module for fiber optic temperature sensors
(Fiber Bragg Grating FBG)



The CAN measurement module imc CANSASfdx-FBG-T8 is an 8-channel fiber-optic interrogator, that allows the measurement of temperatures with FBG sensors. The optical signals of fiber-optic sensors according to the Fiber Bragg grating principle ("FBG") are detected with an opto-electronic unit, digitized, analyzed, processed and output via CAN bus.

The FBG temperature sensors offered for this module are built with glass capillary housings, have a diameter of less than 1 mm, are extremely responsive and thus suitable for measurements directly inside e-motor windings. They easily tolerate the conditions of high voltage, strong alternating magnetic fields and narrow spaces and overcome the limitations of conventional thermocouple and RTD based approaches by avoiding thick insulations, ferromagnetic materials and any susceptibility to interference.

Highlights

- Brings fiber-optic measurement technology up to the usability and price level of conventional electrical technology for the high-voltage environment
- Particularly compact and robust design for industrial operating conditions
- Absolutely immune to electromagnetic interference and EMC (EMI/ESD)
- Inherent galvanic isolation allows measurements in protected and hazardous environments (e.g., HV, hybrid) and avoids the special equipment and training for involved personnel that would be required for conventional measurement technology
- Easy integration into CAN-based measurement and test environments
- Compatible with measurement modules (imc CANSASflex) and CAN data loggers (imc BUSDAQflex) with housings that can be directly coupled, mechanically and electrically.

Typical applications

Robust and industrial grade measurement technology for applications in the areas of:

- Temperature measurement in environments of high voltage and strong electromagnetic fields and interference
- E-mobility, electric and hybrid vehicles, battery technology
- Measurements on high-voltage components such as batteries, fuel cells, power supply circuits, power electronic components, etc.
- Measurements directly in the windings of electric motors and machines
- Guarantee of full personnel safety, even in the event of faults

Measuring principle (FBG)

The module is equipped with a broadband light source that is emitting into the connected fiber-optic sensors. At one point in the fiber, a Bragg grating reflects a certain wavelength of the incoming light, depending on the current value of the measured variable. The wavelength λ of the reflected light of the fiber Bragg grating sensor is proportional to the physical quantity being measured (e.g., temperature). This reflected spectrum is analyzed, converted into physical measured values and output as messages on the CAN bus, where they can be recorded with a CAN data logger such as imc BUSDAQflex.

Software support

The imc CANSAS configuration software allows convenient input of channel-specific parameters that characterize the individual sensor characteristic curve (e.g., from the calibration certificate). This sensor function is implemented in the module as a higher-order polynomial and directly converts into measured temperature values.

Sensors

Operation of the module is recommended with specially designed fiber-optic sensors, which are offered as accessories:

The FBG temperature sensors of type "imc FBG-Temp s/xxs" are based on glass fibers that are integrated in a glass capillary housing with an extremely small diameter and are particularly suitable for demanding applications in the field of e-mobility.

Extension cables are available for plug-in termination with standard fiber-optic connectors of type E2000/APC.

imc CANSASfdx - General Functions and Specifications

As a CAN-bus-based measurement engineering tool, the imc CANSAS*flex* series offers a wide selection of measurement modules which process and digitize sensor signals and output these as CAN-messages.

The imc CANSAS*fdx* family is largely identical and compatible to imc CANSAS*flex*, especially in terms of its mechanical and electrical properties. Differences mainly concern minor details of the software.

The modules of the imc CANSAS*fdx* series (CANFDX) can be joined together mechanically and electrically like imc CANSAS*flex* (CANFX) by means of a latching ("click") mechanism, without the use of any tools nor the need for any extra cables, and also allows the CAN-logger imc BUSDAQ*flex* (BUSFX) to dock on directly. Depending on the module type, they are available in either long (L-), short, or both housing versions.

Besides fixed installations or operation on a laboratory bench, the modules are also designed to fit in a special 19" subrack to provide a convenient solution in test station settings.

Fields of application

- For test rigs, vehicle testing, road trials and all-purpose measurement applications
- Deployable both in decentralized, distributed and in centralized measurement setups
- Operable with CAN-interfaces and CAN-data loggers from either imc or 3rd-party manufacturers

Properties and capabilities

Operating conditions:

- Shock resistance: 50 g (pk over 5 ms)
- Ingress Protection: IP40 (only with optional protective cover on top of the locking slider, otherwise IP20)

CAN-Bus:

- Configurable Baud rate (max. 1 Mbit/s)
- Default configuration ex-factory: Baud rate=500 kbit/s and IDs: Master=2, Slave=3
- Galvanically isolated
- Built-in terminator resistance, manually switchable

Sampling rates and synchronization:

- Configurable CAN data rate
- Simultaneous sampling of all module's channels

Power supply:

- Galvanically isolated power supply input
- DC 10 V to 50 V
- LEMO.0B connector (2-pin); alternative power supply via CAN connector (DSUB-9)

flex- and *fdx-*Series: flexible granulation, topology and block assemblies

Click-mechanism:

- Modules joinable to module-blocks: mechanically and electrically connected (CAN and power supply)
- No tools or additional cabling required
- With guide grooves, magnetic catches and locking slider
- Both short and long housing versions joinable:
with electrical connection: align on rear side; mechanically only: align on front side
- Direct connection of compatible CAN-logger: imc BUSDAQ*flex*

19" rack solution (subrack):

- Modules designed for insertion into special 19" frames ("boom-box") for installation in test stations
- Rack backplane accommodates the power supply, CAN and slot information (only with CANFX: automatically read out configuration information for use in automation software)

Mounting:

- Mountable by means of recessed threaded holes (M3), either individually or jointly as a block
- Rubber bumper rails providing secure placement in laboratory settings
- Various brackets and handles, and DIN top-hat rail mounting kit available as accessories



imc CANSAS*flex* modules connected (Click-mechanism) in a block with imc BUSDAQ*flex* Logger (left)



rear view of this block:
CAN, Power supply, Terminator, Locking slider

Software

Configuration:

- Using imc CANSAS software (free of charge), including dbc-export
- Autostart with saved configuration; also pre-configurable at factory

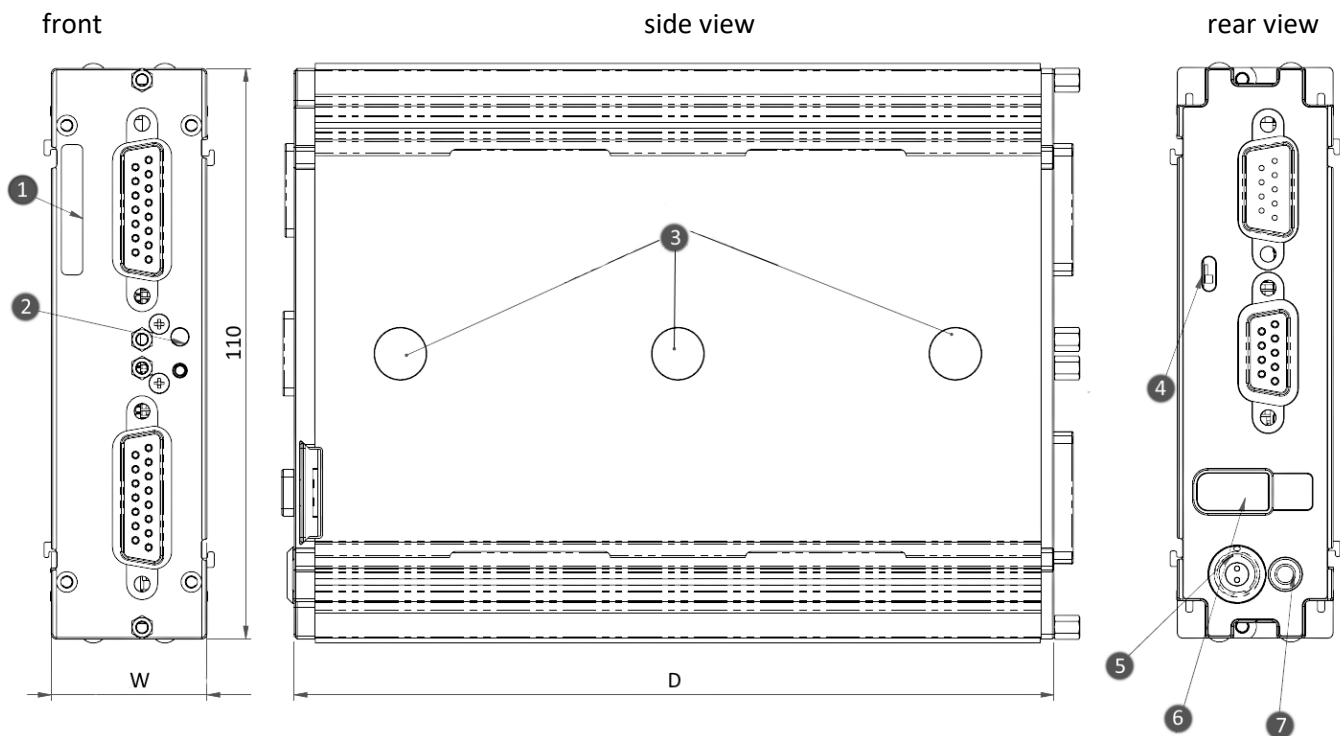
Measurement operation:

- Data logger operation:
Software: imc STUDIO
Hardware: imc measurement system with CAN-Interface, e.g. imc BUSDAQ, imc C-SERIES, imc SPARTAN and imc CRONOS device family (CRFX, CRXT, CRC, CRSL)
- With any desired CAN-interfaces and CAN-loggers from 3rd-party manufacturers

Models and Options

Overview of available imc CANSASfdx-FBG-T8

Order Code	signal connection	option/extra	housing	article number
CANFDX/L-FBG-T8	fiber optic connector type E2000 / APC		L2	12600010



Shown in standard operating orientation: housing type L0; width (W) = 30 mm.

Housing type	S0	S1	S2	L0	L1	L2
W: Width	30 mm	50.3 mm	70.6 mm	30 mm	50.3 mm	70.6 mm
D: Depth	93 mm, with two magnets			146.5 mm, with three magnets		

Legend:

- | | | |
|----------------------------|-----------------------------------|------------------------------|
| 1: Serial number label | 3: magnet
(depending on model) | 5: supply socket (LEMO) |
| 2: Status LED (blue / red) | 4: adjustable CAN terminator | 6: locking slider CAN/supply |
| | | 7: ground connection M3 |

Included accessories

Documents
Getting started with imc CANSAS (one copy per delivery)
Calibration certificate with test equipment verification as per ISO 9001 (manufacturer's calibration certificate)
Miscellaneous
Grounding set consisting of: a spring washer S3 (stainless steel), a flat washer (A3.2 DIN 433 A2) and a pan-head screw M3x8 (mounted on the rear panel).

Optional accessories

Fiber-optic sensors and connectors		
Order Code	Description	Article-No.
FBG/FBG-TEMP	Temperature Sensor FBG-Temp, FBG Technology	12600035
FBG/SMF28-E2000-10M	Fiber optic extension cable E2000/APC, 10 m length (incl. coupler)	12600014
FBG/SMF28-E2000-5M	Fiber optic extension cable E2000/APC, 5 m length (incl. coupler)	12600015
FBG/SMF28-E2000-3M	Fiber optic extension cable E2000/APC, 3 m length (incl. coupler)	12600020
FBG/E2000-COUPLER-10	E2000 coupler (10 pcs.)	12600021
FBG/E2000-CAP-10	Protective caps for E2000 input jacks (10 pcs)	12600xxx
FBG/FIBER-CLEAN	Cleaning tool for fiber-optic connectors	12600016
FBG/FIBER-CHECKER	for visual localization of defective fibers for 2.5 mm ferrules: DIN, E2000, FC, SC, ST	12600027

AC/DC power adaptor 110-230V AC (with appropriate LEMO plug)		
ACC/AC-ADAP-24-60-0B	24 V DC, 60 W, LEMO.0B.302	13500246

Power plug		
ACC/POWER-PLUG3	Power connector for DC supply LEMO FGG.0B.302, solder contact, max. 0.34 mm ²	13500033
ACC/CABLE-LEMO-0B-BAN-2 M5	Power supply cable LEMO/banana 2.5 m	13500276

DSUB-9 plug (CAN)		
CAN/KABEL-TYP2	CAN-Bus connection cable 2x DSUB-9 1:1, 2 m length	10500027

Handle		
CANFX/HANDLE-L	CANFX handle kit (left and right) - long (L)	12500028

Mounting brackets for fixed installations		
CANFX/BRACKET-CON-L	CANFX connection bracket long	12500020
CANFX/RACK	19" Rack	12500094
CANFX/RACK-BLOCK	19" Rack frame for entire block CANFX/BUSFX	12500103

Mounting brackets for DIN Rail		
CANFX/BRACKET-DIN-L2	CANFX DIN Rail mounting bracket - Type L2	12500026

Miscellaneous		
CANFX/RUBBER-1M	silicone strip blue 1 m	12500029
CANFX/COVER-IP40	protective cover on top of the locking slider in compliance with IP40 ingress protection class	12500069
CANFX/USB-P	USB-CAN interface (CAN: DSUB-9, USB 2.0); AC/DC power adaptor, 24 V DC, 60 W, with LEMO.0B plug; CAN cable, DSUB-9 (F, terminated) - DSUB-9 (M, terminated); CAN reset plug; imc CANSAS configuration software (download)	12500043

Technical Specs - FBG-T8

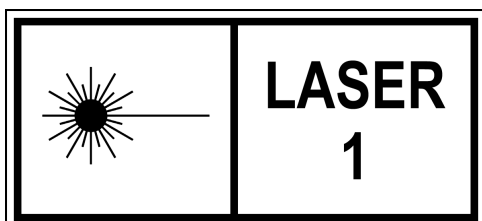
Inputs, measurement modes		
Parameter	Value	Remarks
Inputs	8	8 independent fiber-optic inputs for one sensor per channel
Measurement modes	temperature temperature measurement with balancing	with suitable fiber-optic FBG sensors
Compatible sensors	imc FBG-Temp fiber-type: SMF 28	type FBG (properties: see fiber-optic FBG parameters)
Connectors	fiber optic connector type E2000 / APC	
Sensor characteristics	non-linear	fifth order polynomial, characteristic calculation by device firmware
Sensor parameterization	individual parameters of the sensor characteristic curve	software support for entering individual calibration parameters (according to the calibration certificate of the sensor)
Calibration cycle of the device	2 years	recommended service cycle

Sampling rate, bandwidth, filter		
Parameter	Value	Remarks
Sampling rate	≤ 1 kHz	per channel; output rate of the CAN bus data, individually configurable per channel. Aliasing free thanks to analog filtering
Bandwidth	100 Hz (-3 dB)	8th-order Bessel filter, at 1 kHz sampling rate
Filter Type Characteristic Cut-off frequency	low-pass averaging filter (sinc), AAF $0.44 \cdot f_s$	digital filter at output rates < 1 kHz: adapted automatically, according to selected output rate -3 dB, sinc characteristic f_s : output rate, for $1 \text{ Hz} \leq f_s < 1 \text{ kHz}$
Resolution	24 bit ADC	output on CAN bus: 32 bit Float or 16 bit Integer

Status LED		
Parameter	Value	Remarks
Power-LED green	power active	
Status-LED blue blinking blue, yellow blinking, purple yellow red	multicolor operating, run FW update prepare configuration error	overall status of module
Channel status-LED off green red	multicolor channel passive channel active, OK error	status for each channel errors regarding: signal quality, allowable measuring range, operating temperature, system error

Fiber-optic FBG parameter		
Parameter	Value	Remarks
Wavelength measuring range	1549 ... 1553 nm	calibrated range
Laser source	laser class 1 <10 mW (typ. 1 mW)	
Compatible fiber types	SMF 28	single-mode, Faser-Bragg grating (FBG) sensors
Sensor reflectivity	50 ... 90 %	of the sensor
Full width at half maximum	400 ... 700 pm	FWHM
Side lobe suppression	>15 dB	SLRS

Measurement accuracy			
Parameter	Value typ.	min. / max.	Remarks
Absolute measurement accuracy	±30 pm		operating temperature: 23°C (±3 °C) in conjunction with sensor "imc FBG-Temp": corresponds ±3 °C with sensor sensitivity of approx. 10 pm / °C
Temperature drift	±10 pm		over the entire specified operating temperature range Describes an additional deviation of the displayed measured value during operation of the device under varying environmental conditions.
Reproducibility	typ. 15 pm	max. 30 pm	Is already included in the total absolute measurement accuracy. Comprises polarization-related effects as part of overall accuracy. Related to, for example: <ul style="list-style-type: none"> • movement and deformation of the cable (fiber) • plug-in cycles of the fiber connector
Noise	<1.3 pm		rms



CANFDX/FBG-T8 works with class 1 lasers, which means that the device is safe during normal operation. Nevertheless, looking directly into the beam of the Class 1 laser device may cause irritation to your eyesight. This is possible, for example, if the protective cover has been removed or if the device has been damaged in such a way that laser radiation can be released.

Terminal connections		
Parameter	Value	Remarks
Supply input	type: LEMO.0B (2-pin)	compatible with LEMO.EGE.0B.302 multicoded 2 notches for optional individually power supply compatible with connectors FGG.0B.302 (Standard) or FGE.0B.302 (E-coded, 48 V) pin configuration: (1)+SUPPLY, (2)-SUPPLY
Module connector	via locking slider	for power supply and networking (CAN) of directly connected modules (Click-mechanism) without further cables
CAN bus	2x DSUB-9	CAN and power supply CAN_IN (male) bzw. CAN_OUT (female) all signals on both DSUB-9 directly 1:1 connected

Operating conditions		
Parameter	Value	Remarks
Ingress protection class	IP40	only with optional protective cover (CANFX/COVER-IP40) on top of the locking slider, otherwise IP20 E2000 fiber optic connectors provide integrated protective covers. Plug-on protective covers for unused input sockets E2000
Operating temperature range	-5°C to +75°C	without condensation
Calibrated operating range	-5°C to +60°C	with specified temperature drift
Storage temperature	-40°C to +85°C	
Pollution degree	2	
Shock and vibration resistance	IEC 61373, IEC 60068-2-27 IEC 60062-2-64 Category 1, class A and B MIL-STD-810 Rail Cargo Vibration Exposure U.S. Highway Truck Vibration Exposure	
Weight	820 g	
Dimensions	70.6 x 110 x 146.5 mm	W x H x D

Power supply			
Parameter	Value typ.	min. / max.	Remarks
Input supply voltage	10 V to 50 V DC		
Power consumption	3 W	<4 W	
Module power supply options	power socket (LEMO) CAN socket (DSUB-9) adjacent module		direct connection imc CANSASflex or imc CANSASfdx or imc BUSDAQflex

Pass through power limits for directly connected modules (Click-mechanism)		
Parameter	Value	Remarks
Max. current	8 A	at 25°C current rating of the click connector
	$-50 \text{ mA/K} \cdot \Delta T_a$	Derating with higher operating temperatures T_a , $\Delta T_a = T_a - 25^\circ\text{C}$
Max. power	96 W at 12 V DC	Equivalent pass through power at 25°C typ. DC vehicle voltage
	192 W at 24V DC	AC/DC power adaptor or cabinets
	60 W at 12 V DC 120 W at 24V DC	at +85°C

Available power for supply of additional modules via CAN-cable (DSUB-9, "down stream")		
Parameter	Value	Remarks
Max. current	6 A	at 25°C current rating of DSUB-9 connection (CAN-IN, CAN-OUT); assuming adequate wire cross section!
	$-30 \text{ mA/K} \cdot \Delta T_a$	Derating with higher operating temperatures T_a , $\Delta T_a = T_a - 25^\circ\text{C}$
Max. power	72 W at 12 V DC	Equivalent pass through power at 25°C typ. DC vehicle voltage
	144 W at 24 V DC	AC/DC power adaptor or cabinets
	50 W at 12 V DC 100 W at 24 V DC	at +85°C