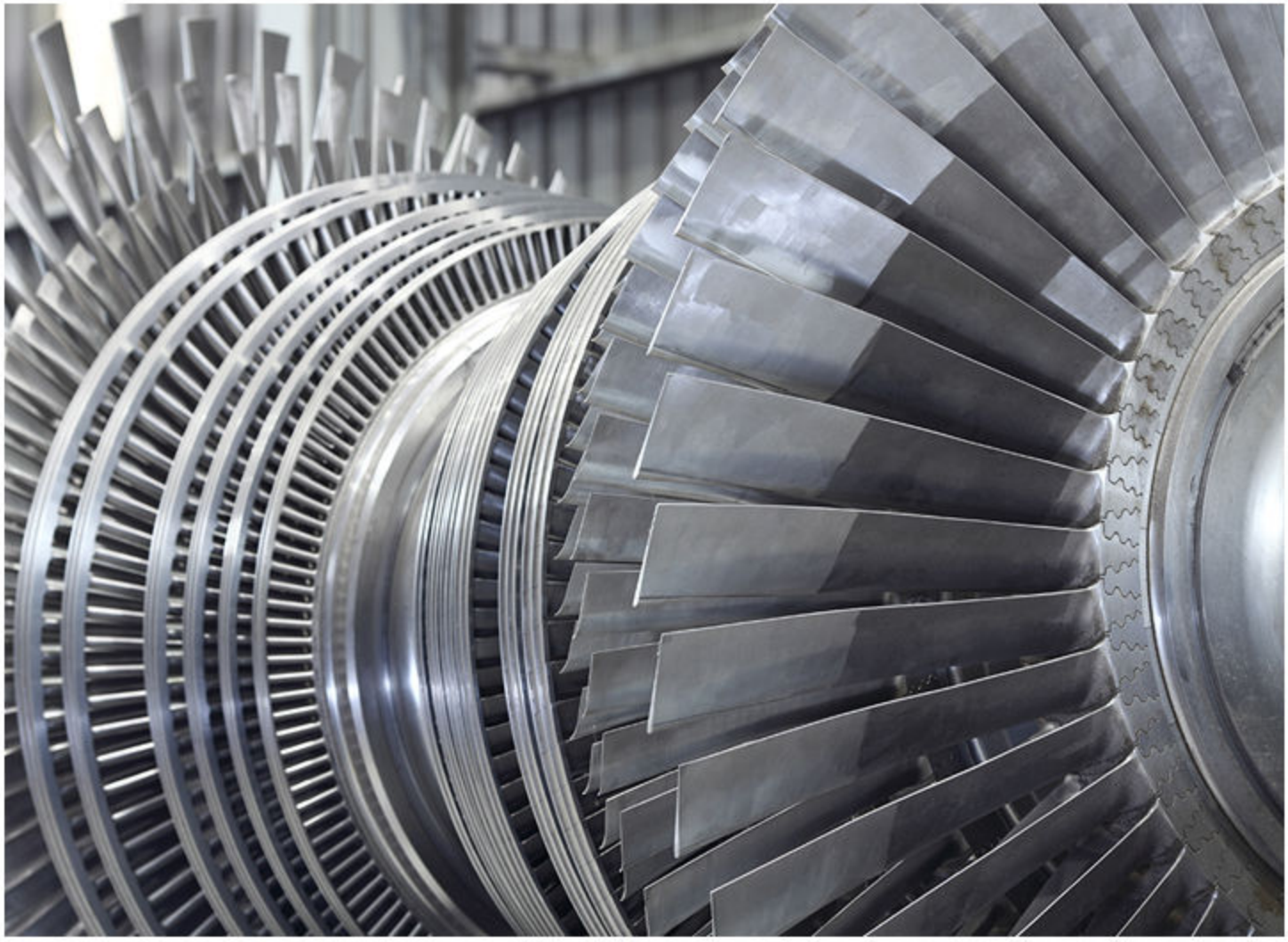
Turbo Control (TC)

4921240692-A

Steam | Turbine

Data sheet

DEIF Improve Tomorrow



1. About Steam turbine controller

2. Technical specifications

3. Legal information

1. About Steam turbine controller

1.1 About the controller

The Steam turbine controller is a standalone solution for control, operation, and protection of small to medium size steam turbines (10 KW to 99 MW). Offering easy supervision, field-programmable software, and remote display (DEIF client).

You can choose **Core**, **Extended**, or **Premium** software package. The software package determines the features and functions available.

1.1.1 Software versions

The information in this document relates to software versions:

Software	Details	Version
Steam turbine controller	Controller application	1.0.0.4
DEIF HMI client	Operation and configuration application	2.01

1.2 Features and functions

Hardware	Core	Extended	Premium
Rack5·x - Controller rack	●	●	●
PCM5·2 - Power and Control Module	●	●	●
PDM5·2 - Power and distributed communication module	●	●	●
IOM5·1 - Input and output module Upto 12 modules	●	●	●
GPM5·1 - Grid protection module (Optional) Upto 1 module		●	●

Operation mode	Core	Extended	Premium
Local	●	●	●
Remote	●	●	●

Startup sequence	Core	Extended	Premium
Manual • Startup state is changed manually. • The valve limiter is controlled by the operator until the configured Turbine Running Speed, then automatically moves to maximum.	●	●	●
Semi-Automatic • Startup state is changed automatically. • The valve limiter is controlled by the operator.	●	●	●
Automatic • Startup state is changed automatically. • The valve limiter is automatically increased to maximum.	●	●	●

Configurable startup state	Core	Extended	Premium
Idle speed 1	●	●	●
Idle speed 2	●	●	●
Critical speed 1	●	●	●
Critical speed 2	●	●	●
Nominal speed	●	●	●

Startup sequence limiter	Core	Extended	Premium
Speed limit idle 1 • Regardless of startup mode, startup is limited to the Idle 1 speed setpoint.	●	●	●
Speed limit idle 2 • Regardless of startup mode, startup is limited to the Idle 2 speed setpoint.	●	●	●
No limit • Regardless of startup mode, the startup sequence proceeds to completion at Nominal Speed.	●	●	●

Control mode	Core	Extended	Premium
Island	●	●	●
Island parallel		●	●
Parallel with grid		●	●

Supported turbine types mode	Core	Extended	Premium
Condensate	●	●	●
Back pressure		●	●
Extraction			●

Auxiliary control	Core	Extended	Premium
Inlet pressure control	●	●	●
Voltage control	●	●	●
Back pressure	●	●	●
Barring gear	●	●	●

Turbine protection	Core	Extended	Premium
Safety chain	●	●	●
Overspeed protection	●	●	●
Peak speed detection	●	●	●
Main state timeout			
Start prepare	●	●	●
Starting	●	●	●
Acceleration 1	●	●	●
Acceleration 2	●	●	●

Turbine protection	Core	Extended	Premium
Acceleration 3	●	●	●
Synchronising		●	●
Synchro connect		●	●
Black closing		●	●
De-load		●	●
Stopping	●	●	●

Electrical protection (Generator) available with GPM5·1	Levels	ANSI	Core	Extended	Premium
Over-voltage (Delta)	1	59		●	●
Over-voltage (Star)	1	59		●	●
Under-voltage (Delta)	1	27		●	●
Under-voltage (Star)	1	27		●	●
Over-frequency	1	81O		●	●
Under-frequency	1	81U		●	●
Over-current	2	50 / 51		●	●
Current asymmetry (unbalance)	1	46		●	●
Under load	1	32		●	●
Over-load	2	49		●	●
Reverse power	2	32		●	●
Over excitation (V/Hz)	1	24		●	●
Under excitation (Loss of field)	1	40		●	●

Electrical protection (Grid / Mains) available with GPM5·1	Levels	ANSI	Core	Extended	Premium
Too Many Mains Failure (lockout)	1	86		●	●
Delayed Synchronization after Trip (Sync Check)	1	25		●	●
(Trip) Over Voltage (Delta)	1	59		●	●
(Trip) Over Voltage (Delta) – Delayed	1	59		●	●
(Trip) Over Voltage (Star)	1	59		●	●
(Trip) Over Voltage (Star) – Delayed	1	59		●	●
(Trip) Under Voltage (Delta)	1	27		●	●
(Trip) Under Voltage (Delta) – Delayed	1	27		●	●
(Trip) Under Voltage (Star)	1	27		●	●
(Trip) Under Voltage (Star) – Delayed	1	27		●	●
(Trip) Over Frequency	1	81O		●	●
(Trip) Over Frequency – Delayed	1	81O		●	●
(Trip) Under Frequency	1	81U		●	●
(Trip) Under Frequency – Delayed	1	81U		●	●
(Trip) Vector Shift	1	78		●	●

Electrical protection (Grid / Mains) available with GPM5·1	Levels	ANSI	Core	Extended	Premium
(Trip) df/dt (Rate of Change of Frequency)	1	81R		●	●
(Trip) Over Voltage (Average)	1	59		●	●
(Trip) Current Asymmetry (Unbalance)	1	46		●	●
(Stop) Over Voltage (Delta)	1	59		●	●
(Stop) Over Voltage (Star)	1	59		●	●
(Stop) Under Voltage (Delta)	1	27		●	●
(Stop) Under Voltage (Star)	1	27		●	●
(Stop) Over Frequency	1	81O		●	●
(Stop) Under Frequency	1	81U		●	●

Emulation	Core	Extended	Premium
Emulation replicates real system behavior in software, enabling safe, fast, and comprehensive testing, validation, and visualization without using actual equipment.			
Manual • The operator manually adjusts emulated signals to test control logic.	●	●	●
Auto • Emulated signals are automatically adjusted by control loops to test control logic.	●	●	●

Logs (Online and service with time stamps)	Core	Extended	Premium
Mains state charge	●	●	●
Parameter changes	●	●	●
Alarm log	●	●	●
Mains state cyclic	●	●	●

Trending	Core	Extended	Premium
High resolution	●	●	●
Normal	●	●	●
Long time	●	●	●

Actuator	Core	Extended	Premium
Configurable output channel	●	●	●
Actuator output type (0 to 20 mA, 4 to 20 mA, 0 to 200 mA)	●	●	●
Lineatization	●	●	●
Tandem HP operation		●	●
HP and LP valve support			●

Speed management	Core	Extended	Premium
Active speed sensor (proximity)	●	●	●
Passive speed sensor (MPU)	●	●	●

Speed management	Core	Extended	Premium
Redundancy on channel	●	●	●
Redundancy on module	●	●	●
Flexibility to measure turbine and alternator side	●	●	●

Configurable input	Core	Extended	Premium
Temperature input 4 levels Upto 72 • Pt100 • Pt1000 • NiCr-Ni	●	●	●
Digital input Upto 120	●	●	●
Analogue input Upto 48 • -20 to 20 mA • -10 to 10 V	●	●	●

Configurable alarm (Limit, wire break, fail class)	Core	Extended	Premium
Temperature input 4 levels Upto 72 • Pt100 • Pt1000 • NiCr-Ni	●	●	●
Digital input Upto 120	●	●	●
Analogue input Upto 48 • -20 to 20 mA • -10 to 10 V	●	●	●

Generator control with GPM5·1	Core	Extended	Premium
GCB close attempts (3)		●	●
Generator breaker synchronisation		●	●
Mains monitoring		●	●
Laod control		●	●

Diagnostic	Core	Extended	Premium
Limit switch	●	●	●
Maintenance counter	●	●	●
Operation counters and hours	●	●	●
Counters	●	●	●

Communication	Core	Extended	Premium
Modbus TCP/IP	●	●	●
RS-485/422 (Master/Slave)	●	●	●
Configurable Modbus memory mapping	●	●	●

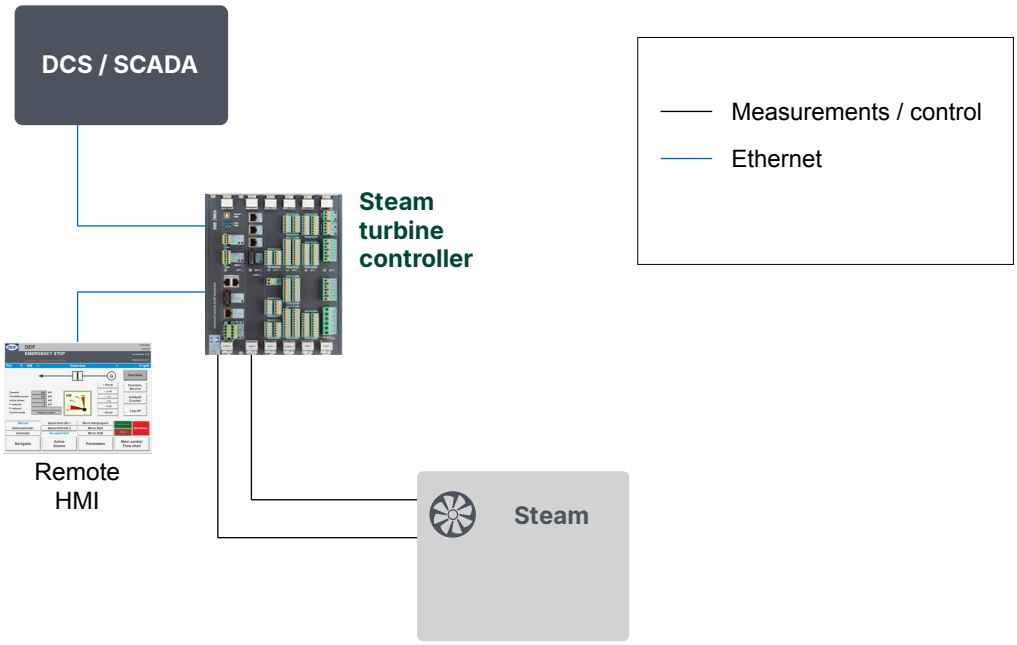
1.3 Applications

Applications include direct control, synchronising generators, critical power, emergency standby, and power production.

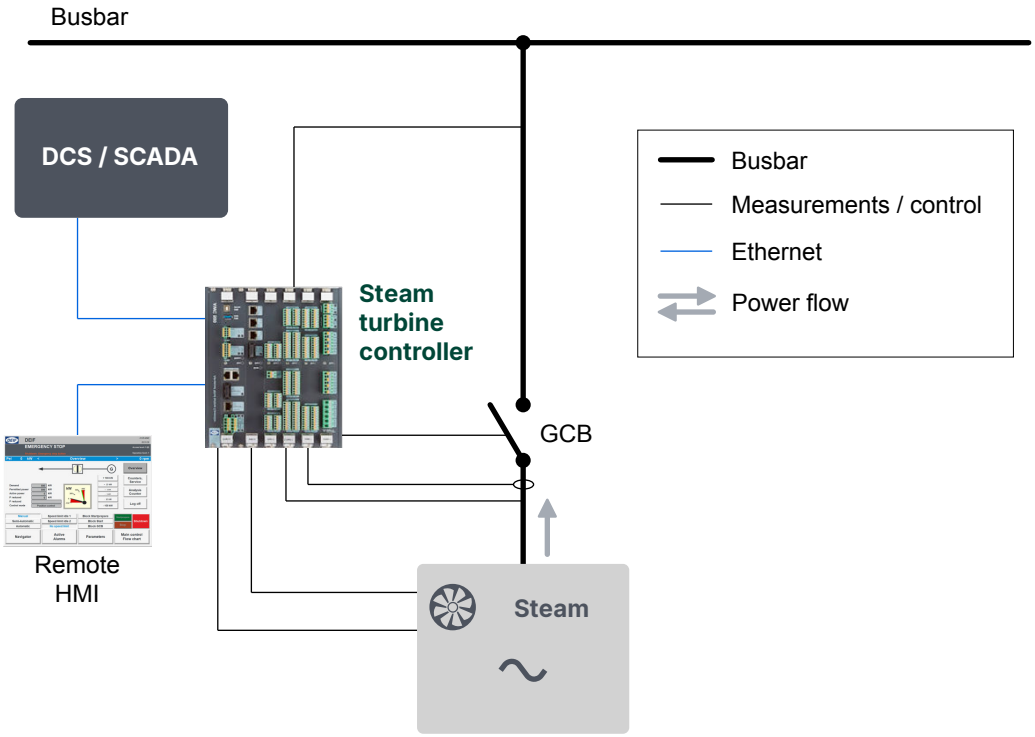
Ethernet communication to remote HMI, DCS, or SCADA.

Monitor and control the controller through DEIF client HMI or remotely.

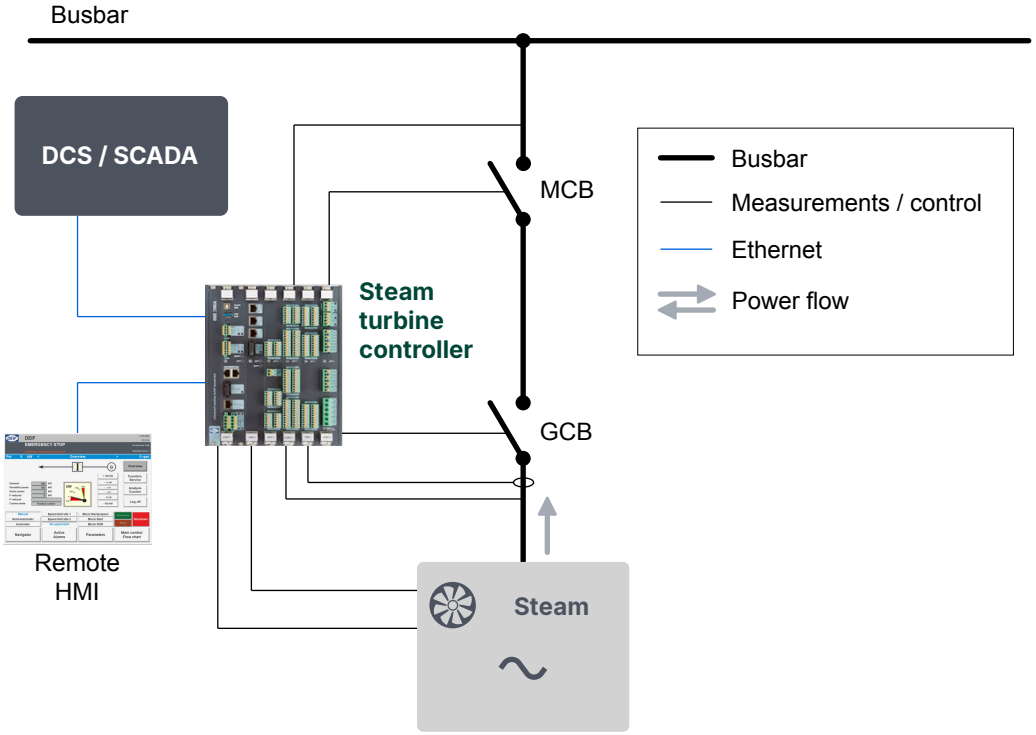
Drive Application



Generator breaker (GCB) application



Generator breaker (GCB) and Mains control breaker (MCB) application



2. Technical specifications

2.1 System specifications

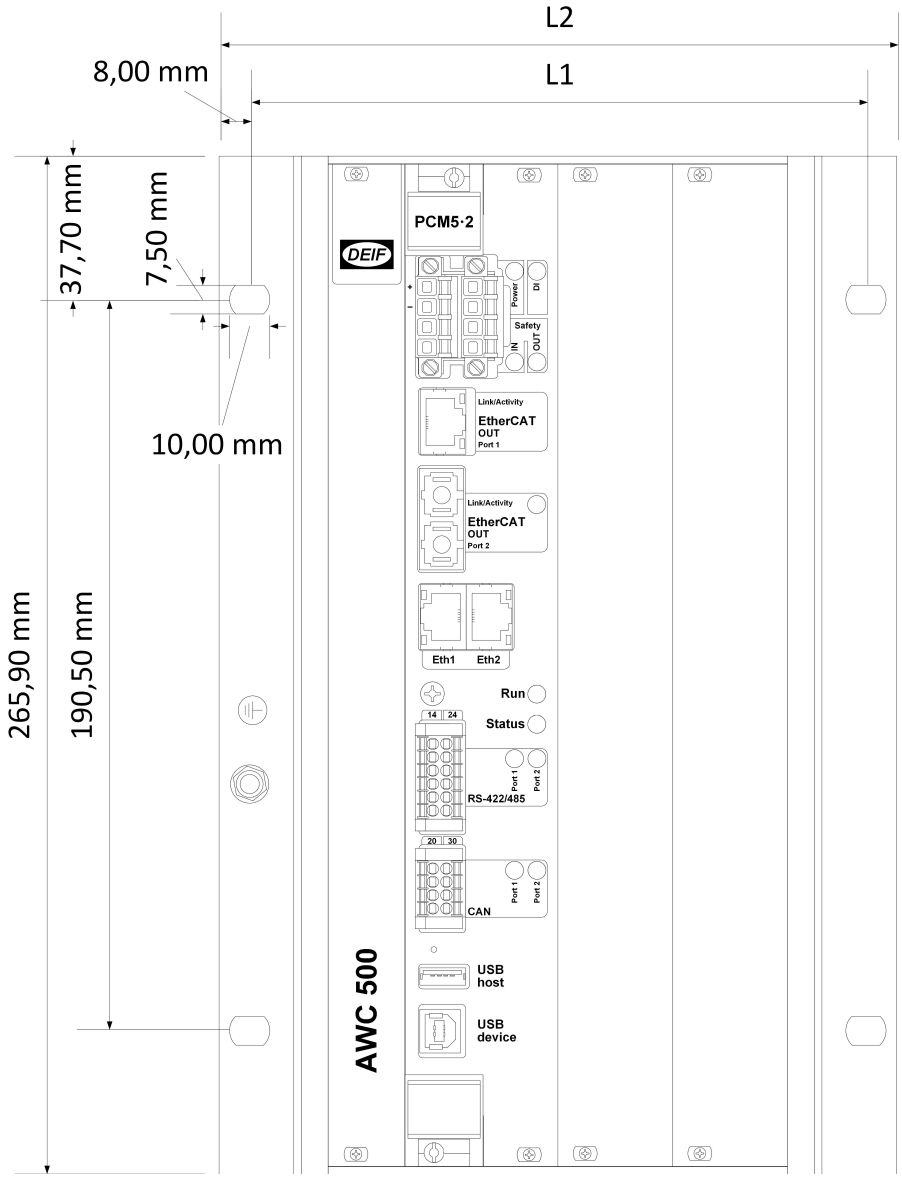
The controller is designed as a highly flexible, modular process controller covering the special demands for power plants in terms of reliability, robustness and flexibility.

Technical specifications		
Default rack size	**Rack5·3** L x H x D: 207.5 x 265.9 x 192.4 mm Rack has one slot reserved for a PCM5·2 and a variable number of I/O modules.	
Temperature	Operating: -40 to 70 °C Storage: -40 to 85 °C Reference: 15 to 30 °C	IEC 60068-2-1 IEC 60068-2-2
Climate	All modules are conformal coated, hence protected against moisture, mold, dust, corrosion and other environmental stresses. 55 °C / 97 % relative humidity, condensing	IEC 60068-2-30, test Db
Altitude	Up-to 4,000 m without de-rating	
Vibration	3 to 13.2 Hz: 6 $mm_{peak-peak}$ 13.2 to 50 Hz: 2.1 *g* 3 to 13.2 Hz: 2.85 $mm_{peak-peak}$ 13.2 to 100 Hz: 1.0 *g*	IEC 60068-2-6, DNV C IEC 60068-2-6, DNV A IACS E10
Shock	50 g, 11 ms, half sine Tested with 3 impacts in each direction in all 3 axes A total of 18 impacts per test	IEC 60068-2-27, test Ea
Bump	25 g, 6 ms, half sine 1,000 bumps in each direction. 2 directions in each axis A total of 6,000 bumps	IEC 60068-2-27, test Ea

NOTE *g* = gravitational force (g-force).

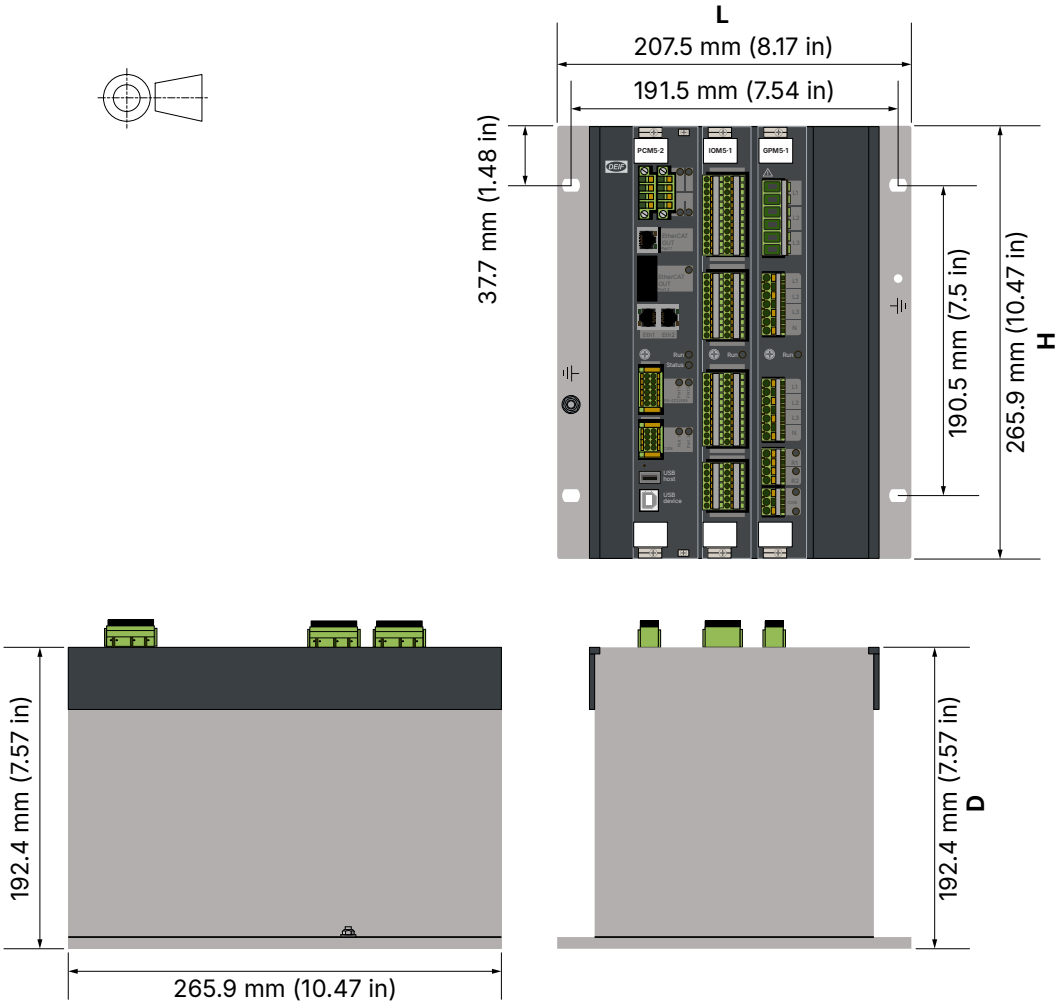
Technical specifications		
EMC/CE	**Electromagnetic compatibility (EMC)**	EN 61000-6-1/2/3/4
	Electrostatic discharge (ESD): Contact: 7.2 kV Air: 9.6 kV	EN 61000-4-2
	Radiated E-field emission: 30 to 230 MHz: 40 dB (µV/m) 230 to 1,000 MHz: 47 dB (µV/m) 1 to 3 GHz: 70 dB (µV/m) peak 1 to 3 GHz: 50 dB (µV/m) average 3 to 6 GHz: 74 dB (µV/m) peak 3 to 6 GHz: 54 dB (µV/m) average	IEC 61000-6-3 (not PCM5·2), IEC 61000-6-4, IEC 60255-26
	Conducted emission:	IEC 60255-26
	Fast transients (burst): Power: 2.4 kV_p Signal: 1.2 kV_p	IEC 60255-22-4, GL, LR, DNV, EN 61000-4-4
	Slow transients (surge): AC power: DM 2 kV_p, CM 4 kV_p DC power: DM 1 kV_p, CM 2 kV_p Signal and I/O: DM 1 kV_p, CM 2 kV_p Frequency input: DM 1 kV_p, CM 1.2 kV_p	IACS E10, IEC60533, EN 60945, IEC 60255-26, EN 61000-4-5
	RF E-field (electric) immunity: 80 to 2,000 MHz: 12 V/m 2 to 3 GHz: 10 V/m	IEC 60255-26, EN60945, GL, LR, BV, DNV, EN 61000-4-3
	RF conducted immunity 0.15 to 80 MHz: 12 V_{RMS}	IEC 60255-26, EN 60945, GL, LR, BV, DNV, EN 61000-4-6
	Power frequency H-field (magnetic) immunity: Field: 400 A/m	IEC 60051, EN 61000-4-8
Safety	Installation (over-voltage) category III, 600 V, pollution degree 2.	EN 61010-1
Protection class	IP30	IEC/EN 60529
Material	Aluminium case and cover plates. All plastic parts are self-extinguishing.	UL94 (V1)
UL/cUL Listing	UL applications: Maximum surrounding temperature 60 °C. Use min. 75/90 °C copper conductors only. Terminal tightening torque 5-7 lb-in or equivalent. Use AWG 30-12 or equivalent wire size. To be installed in accordance with the NEC (United States) or the CEC (Canada).	UL/cUL Listed to UL508 & CSA C22.2 No. 142-M1987

2.2 All rack sizes



Rack width	L1	L2
Rack5·0 (TE 12)	100.1 mm (3.95 in)	116.1 mm (4.57 in)
Rack5·1 (TE 18)	130.5 mm (5.14 in)	146.5 mm (5.77 in)
Rack5·2 (TE 24)	161.0 mm (6.34 in)	177.0 mm (6.97 in)
Rack5·3 (TE 30)	191.5 mm (7.54 in)	207.5 mm (8.17 in)
Rack5·5 (TE 42)	252.5 mm (9.94 in)	268.5 mm (10.57 in)
Rack5·8 (TE 60)	343.9 mm (13.54 in)	359.9 mm (14.17 in)

2.3 Rack 5·3 (TE 30)

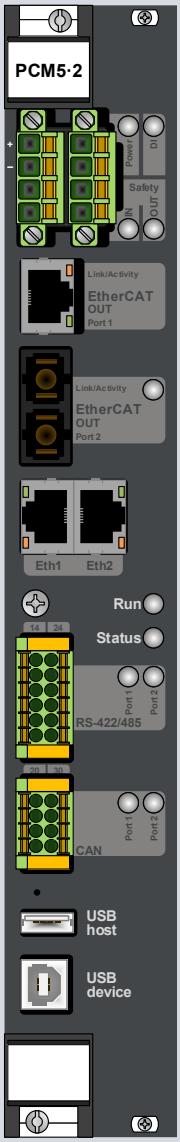


Category	Specification
Type	Rack 5·3 (TE 30)
Dimensions	L 207.5 mm x H 265.9 mm x D 192.4 mm (8.17 in x 10.47 in x 7.57 in) (outer frame)

2.4 Hardware modules

2.4.1 PCM5·2 module specifications

The PCM5·2 module offers a powerful dual core 1 GHz application CPU. It is well suited for extremely demanding applications, ultra fast data logging as well as redundant hot-standby solution for land applications.

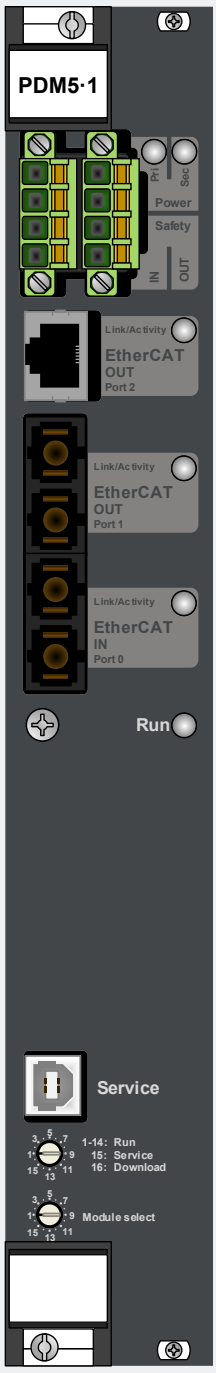
Power and control module		
	Power supply*	50 W internal power supply with 1 s internal UPS. Input level: 24 V, 18 to 32 V
	Input	Digital input (DI): High: 9 to 36 V or -9 to -36 V with reference to common Low: 5 to -5 V with reference to common Impedance: Approximately 4 kΩ Isolation: Optically isolated from other potentials, 550 V 50 Hz
	Safety	Digital input (IN): High: 9 to 36 V or -9 to -36 V with reference to common Low: 5 to -5 V with reference to common Impedance: Approximately 4 kΩ Isolation: Optically isolated from other potentials, 550 V 50 Hz Digital relay output (OUT): 24 V, maximum 1 A resistive
	Interfaces	1 x EtherCAT® OUT (Port 2), electrical: 100BASE-TX, 8P8C (“RJ45”), shielded Cat 5, >0.76 µm gold plating 1 x EtherCAT® OUT (Port 1), optical: 100BASE-FX, SC connectors, multimode fibre 62.5 µm, OM1 2 x Ethernet (Eth1 and Eth2): 1000BASE-T, 8P8C (“RJ45”), shielded Cat 5e, >0.76 µm gold plating 2 x CAN (CAN 1, CAN 2): ISO 11898, shielded twisted copper cable, 50 to 1,000 kbit/s 2 x RS-422/485 (COM1, COM2), Profibus DP slave (COM1) : ANSI/TIA/EIA-422-B and TIA/EIA-485, shielded twisted copper cable 4.8 to 921.6 kbit/s (full duplex)
	USB host	USB 3.0, Mass Storage Class
	USB device	USB 2.0, console on virtual COM port, 115.2 kbit/s (D:8,S:1,P:N,F:N)
	Processor	1 GHz dual-core industrial grade CPU with ECC protected cache
	Operating system	DEIF OS based on real-time embedded Linux. Fail-safe remote SW update.
	Memory	Industrial grade 64 bit ECC protected DDR3 RAM: 1 GB
	Storage	Non-volatile data storage: 2 GB industrial grade flash
	Storage**	SSD, industrial grade: up-to 32 GB (optional)
	Size	8 TE (40.64 mm)
	Power consumption	12 W

*Note: External branch protection of maximum 10 A shall be provided. Any JDYX 10 A @ minimum 50 V DC may be used. If operated in ambient temperatures above 60 °C it must be installed in an area with forced air ventilation.

**Note: Non-industrial grade (0 to 70 °C): for example 120, 250, 500 or 1000 GB.

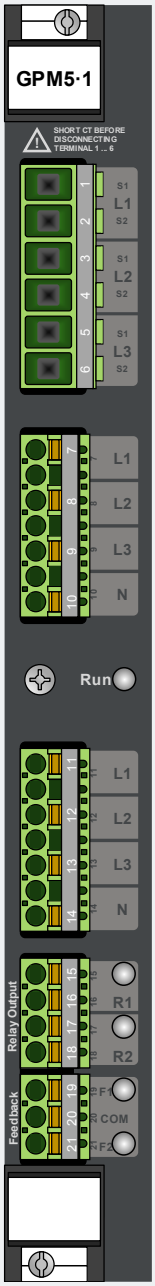
2.4.3 PDM5·1 module specifications

The PDM5•1 module is used as an EtherCAT interface for distributed I/O nodes via fibre optical Ethernet.

Power module and EtherCAT interface		
	Power	50 W internal power supply with redundant inputs and 50 ms full power fail protection. Supporting direct battery and/or UPS supply. Input level: 24 V, +50 %, -25 % (18 to 36 V)
	Safety	Input (IN): High: 9 to 36 V or -9 to -36 V with reference to common Low: 5 to -5 V with reference to common Impedance: Approximately 4 kΩ Isolation: Optically isolated from other potentials, 550 V 50 Hz Digital relay output (OUT): 24 V, maximum 1 A resistive
	Interfaces	1 x EtherCAT® OUT (Port 2), electrical: 100Base-TX, 8P8C (“RJ45”), shielded Cat 5, >0.76 µm gold plating 1 x EtherCAT® OUT (Port 1), optical: 100Base-FX, SC connectors, multimode fibre 62.5 µm, OM1 1 x EtherCAT® IN (Port 0), optical: 100Base-FX, SC connectors, multimode fibre 62.5 µm, OM1
	Service	USB service interface: USB 2.0, console on virtual COM port, 115.2 kbit/s (8/N/1), no flow control
	Size	8 TE (40.64 mm)
	Power consumption	Maximum 6 W

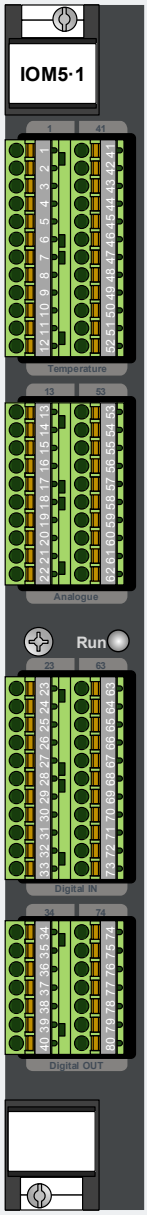
2.4.4 GPM5·1 module specifications

The GPM5•1 module is a class 0.5 grid measurement and protection module which can be fully configured from the main application. For each period of the connected grid, all measurements are available for the main application.

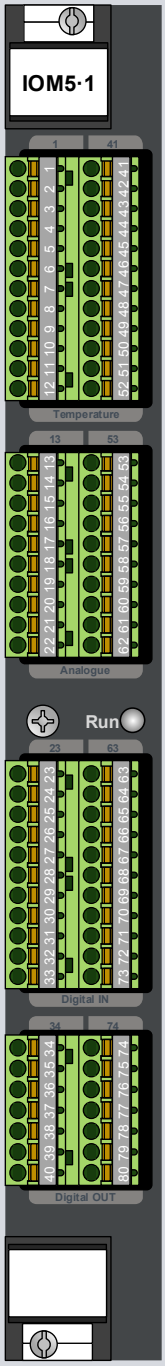
Direct class 0.5 3-phase grid, generator voltage and current measurement		
	Inputs	2 x direct three phase voltage inputs (L1, L2, L3, N) Input range: 0 to 690 V Measure range: 40 to 690 V Frequency: 40 to 70 Hz Load max.: 0.5 mA or 0.3 VA per phase Overload: 130 % continuously, 200 % for 10 s External fuse, maximum 2 A slow-blow UL/cUL: Maximum 600 V L-L, above 2000 m altitude maximum 520 V 1 x direct three phase current input (L1, L2, L3) Input range: 0 to 1 or 0 to 5 A Frequency: 40 to 70 Hz Load max.: 0.4 VA per phase Overload: 20 A for 60 s, < 75 A for 10 s, < 300 A for 1 s UL/cUL: From listed or R/C (XODW2.8) current transformers
	Outputs	2 x digital relay outputs (normally open) with feedback supervision 24 V, maximum 1 A resistive
	Certification class	0.5 measurement of voltage, frequency, current, power, reactive power, phase angle.
	Galvanic separation	3.25 kV 50 Hz isolation between voltage measurement inputs individually and between voltage measurement inputs and all other potentials. 550 V 50 Hz isolation between relay outputs, digital inputs (feedback supervision) and all other potentials.
	Safety	Installation (over-voltage) category III, 600 V, pollution degree 2. EN 61010-1 tested at 50 Hz, 60 s. Each galvanic group tested to other galvanic groups and to Protective Earth, PE.
	Accuracy	0.5 % at reference temperatures 1.0 % at operational temperatures IEC 60688
	Size	6 TE (30.48 mm)
	Power consumption	Maximum 4 W

2.4.5 IOM5·1 module specifications

IOM5•1 is a highly flexible I/O module which holds the most commonly used I/O signals in a wind power plant. IOM5•1 is designed for the rough electrical environments, and all inputs and outputs are protected by optical isolation from other potentials.

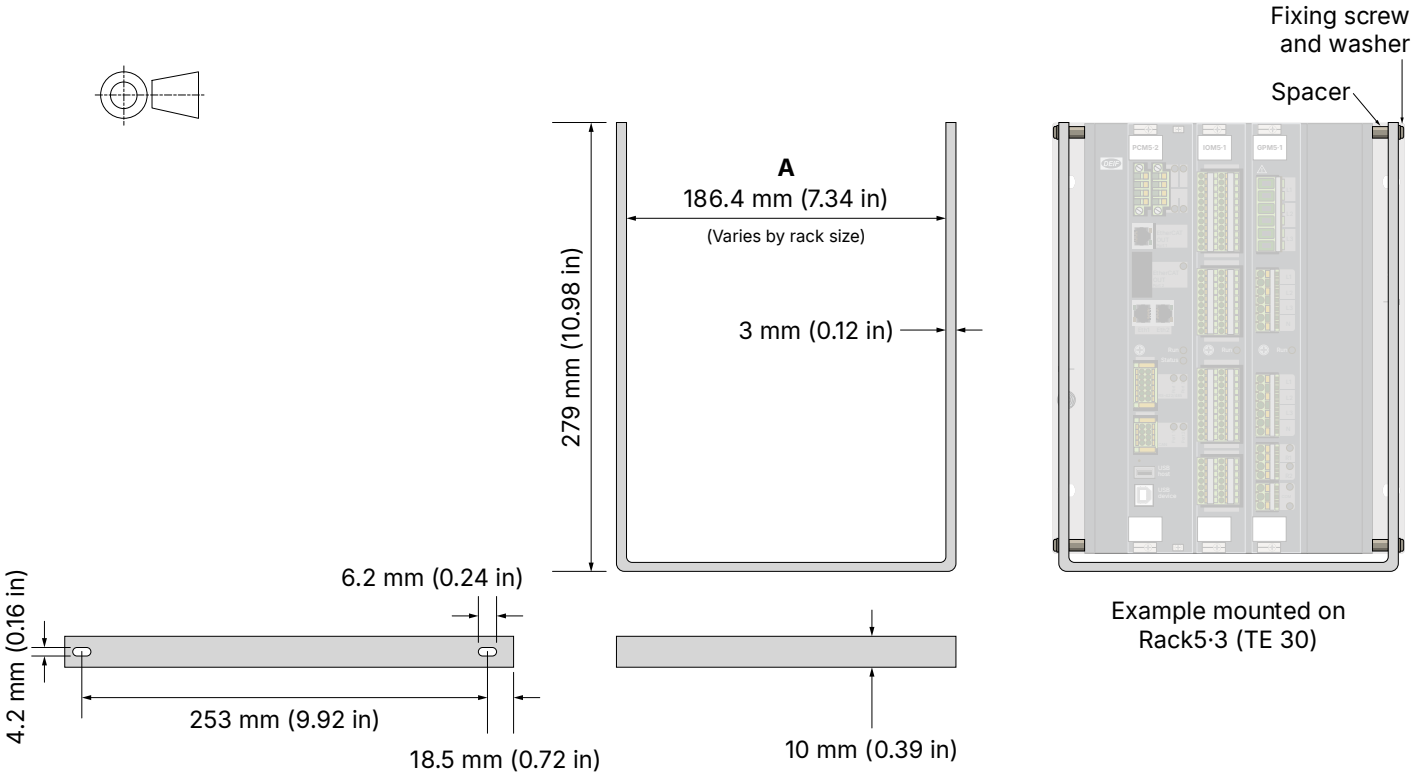
40 channel multi-function I/O module with analogue inputs, temperature inputs, digital inputs, frequency counter inputs, analogue outputs and digital outputs			
	12 digital inputs	Input	High*: 9 to 36 V or -9 to -36 V with reference to common Low: 5 to -5 V with reference to common
		Impedance	Approximately 2.4 kΩ
		Isolation	Optically isolated from other potentials, 550 V 50 Hz
	4 frequency/digital inputs	Input	High*[1]: 9 to 36 V Low: 0 to 5 V
		Impedance	Approximately 2.4 kΩ
		Isolation	Optically isolated from other potentials, 550 V 50 Hz
		Frequency	0 to 125 kHz. (Internal frequency divider for frequency >1 kHz)
		Duty cycle	48 to 52 % at 20 to 125 kHz 40 to 60 % at 1 to 20 kHz 20 to 80 % at 0 to 1 kHz
		Resolution	0.8 µs
	10 digital outputs	Supply	External supply 9 to 36 V
		Voltage	Voltage drop <1 V according to external supply
		Current	For each output: 0 to 2 A source or sink Maximum total for all outputs: 2 A
		Isolation	Optically isolated from other potentials, 550 V 50 Hz
		Protection	Current limited for short-circuit protection or thermal overload

*Note: Above 30 V, some de-rating based on temperature is specified. See the Installation Instruction documentation for details.

40 channel multi-function I/O module with analogue inputs, temperature inputs, digital inputs, frequency counter inputs, analogue outputs and digital outputs			
	6 temperature inputs	Sensor type	Pt100, Pt1000 or NiCr-Ni sensors
		Range	-50 to 200 °C for Pt sensors -50 to 1000 °C for NiCr-Ni sensors
		Wire	2-, 3- or 4-wire connection for Pt sensors
		Cable error	Open input and short-circuit are detected (only open for NiCr-Ni)
		Resolution	0.1 °C
		Accuracy (Pt100, Pt1000 4-wire)	0.5 °C at reference temperature 2.0 °C at operational temperature
		Accuracy (Pt100, Pt1000 2 or 3-wire)	1.0 °C at reference temperature 2.5 °C at operational temperature (2-wire cables must be shorter than 1 m)
		Accuracy (NiCr-Ni sensor)	5.0 °C at reference temperature 20.0 °C at operational temperature
		Isolation	Same potential as analogue inputs and outputs. Optically isolated from other potentials, 550 V 50 Hz.
	4 analogue inputs	Input type	-20 to 20 mA or -10 to 10 V
		Impedance	Approximately 50 Ω (mA-input)/10 kΩ (V-input)
		Resolution	16 bit
		Accuracy	0.5 % of full range input (40 mA/20 V) at reference temperature 1.0 % of full range input (40 mA/20 V) at operational temperature
		Isolation	Same potential as analogue outputs and temperature inputs. Optically isolated from other potentials, 550 V 50 Hz.
	4 analogue outputs	Output	Configurable ramp time: 5 to 1000 ms Range: -20 to 20 mA
		Load	0 to 500 Ω
		Resolution	12 bit
		Accuracy	0.5 % of full range output (40 mA) at reference temperature 1.0 % of full range output (40 mA) at operational temperature
		Isolation	Same potential as analogue inputs and temperature inputs. Optically isolated from other potentials, 550 V 50 Hz.
	Size	6 TE (30.48 mm)	
	Power consumption	Maximum 5 W (all 4 analogue outputs at full load)	

2.5 Accessories

2.5.1 Wire support / cable relief bracket



Rack	Dimensions		Weight
	Internal width (A)	Height	
Rack 5·0 (TE 12)	95 mm (3.74 in)	279 mm (10.98 in)	~155 g (5.47 oz)
Rack 5·1 (TE 18)	125.4 mm (4.94 in)	279 mm (10.98 in)	~157 g (5.54 oz)
Rack 5·2 (TE 24)	156.1 mm (6.15 in)	279 mm (10.98 in)	~162 g (5.7 oz)
Rack 5·3 (TE 30)	186.4 mm (7.34 in)	279 mm (10.98 in)	~174 g (6.13 oz)
Rack 5·5 (TE 42)	247.5 mm (9.74 in)	279 mm (10.98 in)	~188 g (6.63 oz)
Rack 5·8 (TE 60)	339 mm (13.37 in)	279 mm (10.98 in)	~207 g (7.3 oz)

3. Legal information

3.1 Disclaimer and copyright

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