Data sheet

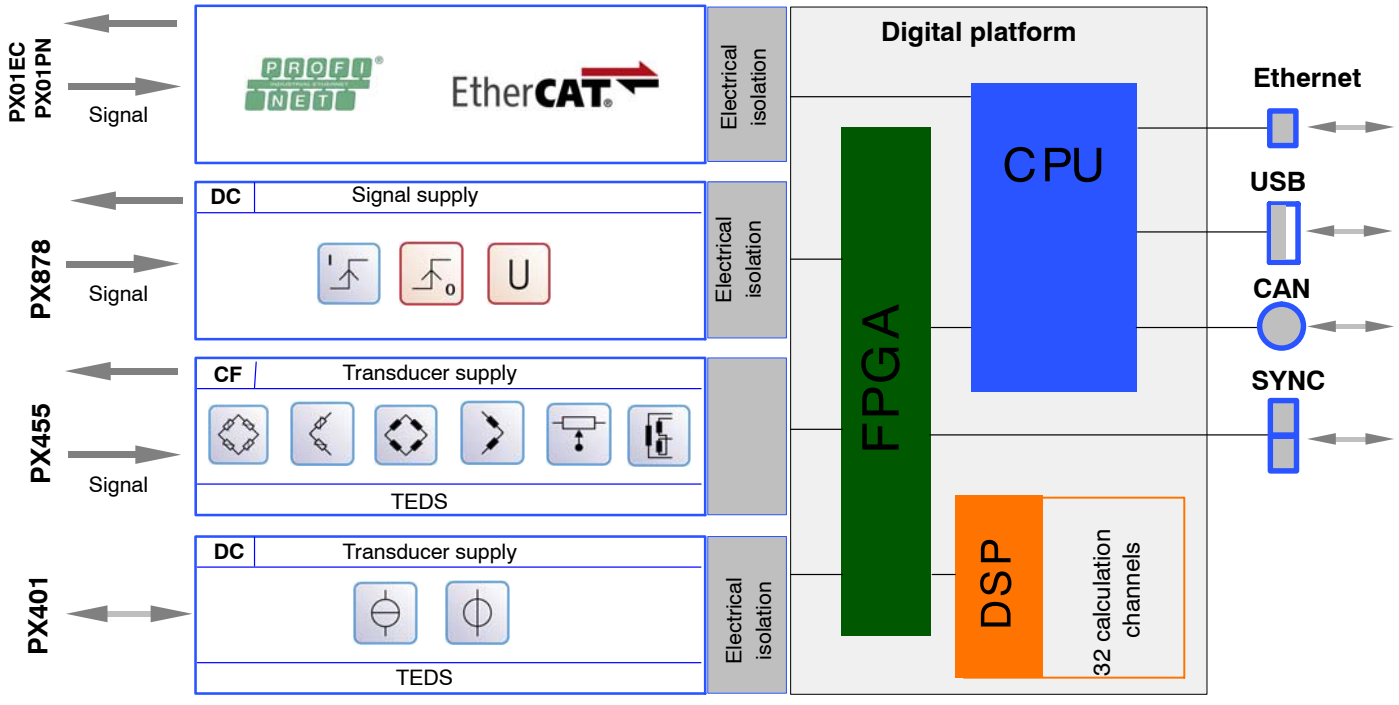
PMX

Modular measuring amplifier system

Characteristic features

- Up to 16 measurement inputs
- 24 Bit A/D converter and 19200 Hz sampling rate per channel
- TEDS sensor detection
- Automatic synchronization of several devices
- 32 calculation channels with peak/limit values and mathematical functions
- Digital inputs/outputs, analog outputs
- Intuitive web server for parameterization/visualization
- Fast PROFINET/EtherCAT®
- Robust DIN rail or wall mounting

Block diagram



Specifications

Basic device		WG001/002
Racks	Number	1 communication card, 4 measuring cards
Supply voltage range	V_{DC}	10 ... 30 (nominal (rated) voltage 24 V)
Supply voltage interruption (based on PLC standard DIN EN 61131−2)		
24 V (− 10 %)	ms	10
12 V (− 10 %)	ms	1
Power consumption at 24 V supply voltage		
Basic device	W	3
per PX455	W	1.6
per PX401	W	0.75
per PX878	W	2
EtherCAT®[1] Field bus module PX01EC	W	1.9
PROFINET Field bus module PX01PN	W	2.3
Ethernet (data connection)		IEEE802.3.; 10 Base−T / 100 Base−TX
Protocol/addressing		TCP/IP (direct IP address or DHCP)
Plug connection		RJ45, 8 pin
Cable type		Standard LAN, CAT5, SFTP
Max. cable length to module	m	100
Synchronization		
NTP protocol	−	Time via Ethernet
HBM protocol		Measured values in measuring raster and carrier frequency (module to module)
Plug connection		RJ45, 8 pin
Cable type		Standard LAN, CAT5, SFTP
Number of devices		20
Line lengths between neighboring devices, max.	m	30
USB connection		USB 2.0 Host
CAN connection		CAN connection only with WG001 (CAN ISO11898)
Real time calculation in device		
Sum sampling rate	MW/s	400,000
Calculation channels	Quantity	32 in real time
Refresh rate	Hz	19200
Function		Peak values, limit values, mean values, effective values (RMS), tolerance bands, mathematic calculation channels, logic functions, signal characteristics, signal generators, 2-point scaling, 2-point controllers, PID controllers, filters, multiplexers, sample-hold, time calculation, counters, triggers, 3x3 matrices calculation, SG-rosette calculation, coordinate calculation (polar <−> cartesian)
Peak value memory		
Number		32
Function		Min./ Max., peak-to-peak
Update rate	µs	52
Delete		
via digital inputs	ms	1
via fieldbus	ms	20
Nominal (rated) temperature range	°C	0 ... 50
Operating temperature range (no condensation allowed/module not immune to water condensation)	°C	−10 ... +60
Storage temperature range	°C	−20 ... + 70
Rel. air humidity	%	5 ... 95 (non-condensing)
Protection class (height up to 2000 m, degree of pollution 2)		III
Degree of protection		IP20 per EN60529
Mechanical stress capability		
(test similar to DIN IEC EN600068, Part 2−6)		
Oscillation (30 min. in each direction)	m/s^2	25 (5 … 65 Hz)
Impact (3 times in each direction; impact duration 11 ms) (test similar to IEC/EN 60068, Part 2−27)	m/s^2	200

[1] EtherCAT® is a registered brand and patented technology, licensed by Beckhoff Automation GmbH, Germany

Specifications (basic device continued)

EMC requirements		as per EN 61326 and EN 55011 (class B) Relevant directive: 2004/108/EC Relevant standards: Immunity from interference; DIN EN61326−1, Issue 2006−10 Table 2 (industrial environments) Interference emissions DIN EN61326−1, Issue 2006−10, Class B
EMC update		The scope of inspection was updated with the requirements of the ”EMC integration guideline for achieving electromagnetic compatibility in electrical systems in the automotive industry” Version 1−03: EN61000−4−4: Burst test 2 kV EN55022: Interference current, interference voltage: Expansion of frequency range 9 kHz − 30 MHz
Quality requirements EMC requirements Long-term stability		The evaluation criteria A was met in all EMC tests. This means that the operating behavior, i.e. accuracy and functions, is maintained within the specified data of the data sheet even during EMC-loading. All PMX components are pre-aged for 7 hours in an oven run to improve long-term stability.
Fuses Automatic current limitation Short-circuit resistance		Per device and per device card Synchronization/fieldbus/input and output signals are secured against mix-ups and short circuits
Dimensions (H x W x D)	mm	200 x 200 x 122
Weight (fully equipped), approx.	g	2750

Specifications

Measurement cards

SG and inductive full/half bridge, 4.8 kHz CF		**PX455**		
Accuracy class		0.1		
Carrier frequency (sine)	Hz	4800 ±0.1%		
Bridge excitation voltage (effective)	V	2.5 ±5%		
Connectable transducers [1)3)] in six or five wire circuit SG half and full bridges Inductive half and full bridges, LVDTs	 Ω mH	 120…1000 4 … 33		
Potentiometer		Deviations in accuracy class		
Cable length	m	1	50	100
1 kΩ	%	< 0.1	< 0.2	< 0.5
5 kΩ	%	< 0.1	< 3	< 8
Measurement frequency range (–3 dB)	kHz	2		
Sampling rate, max.	Hz	19200 ±0.1%		
Active low-pass filter (Bessel/Butterworth)	Hz	0.1 … 2000		
TEDS, IEEE1451.4		0-wire[2)4)]		
Permissible cable length between PX455 and transducer	m	100[4)]		
Measurement range SG Inductive LVDT	 mV/V mV/V mV/V	 ±4 ±100, ±1000 ±500		
Nominal (rated) temperature range	°C	0 ... 50		
Operating temperature range (no condensation allowed/module not immune to water condensation)	°C	–10 ... +60		
Storage temperature range	°C	–20 ... + 70		
Rel. air humidity	%	5 ... 95 (non-condensing)		
Protection class (height up to 2000 m, degree of pollution [2)])		III		
Degree of protection		IP20 per EN60529		
EMC requirements		As per EN 61326 and EN 55011 (class B)		
Non-linearity	%	0.03		
Zero drift (excitation, 2.5 V) at 4 mV/V rel. to full scale value	% / 10 K	Full bridge: 0.05	Half bridge: 0.1	
Full scale drift (excitation, 2.5 V) at 4 mV/V rel. to full scale value	% / 10 K	Full bridge: 0.05	Half bridge: 0.05	
Half-bridge offset (at 350 Ohm and a cable length of < 5 m)	µV/V	< ±50		
SG full bridge 4 mV/V				
Noise at 25 °C and 2.5 V excitation (peak-to-peak) with filter 0.1 Hz Bessel with filter 1 Hz Bessel with filter 10 Hz Bessel with filter 100 Hz Bessel with filter 1 kHz Bessel with filter 2 kHz Bessel	 µV/V µV/V µV/V µV/V µV/V µV/V	 0.1 0.2 0.3 0.5 1.5 3		
Inductive full bridge 100 mV/V				
Noise at 25 °C and 2.5 V excitation (peak-to-peak) with filter 0.1 Hz Bessel with filter 1 Hz Bessel with filter 10 Hz Bessel with filter 100 Hz Bessel with filter 1 kHz Bessel with filter 2 kHz Bessel	 µV/V µV/V µV/V µV/V µV/V µV/V	 2 3 4 5 10 15		

1) With bridge resistances from RB > 500 Ohm or cable lengths > 30 m: Lay transducer side resistances RB/2 in the feedback lines.
4) Transducer side TEDS cannot be read after RB/2>300 Ohm
2) When using transducers with integrated 0-wire-TEDS, RB/2 must be reduced by 100 Ohm in each sense line.
3) With transducers >350 Ohm, the zero point must be measured in with cables >50m (tare/zero setting)

Specifications (PX455 continued)

Inductive full bridge 1000 mV/V		
Noise at 25 °C and 2.5 V excitation (peak-to-peak)		
with filter 0.1 Hz Bessel	µV/V	20
with filter 1 Hz Bessel	µV/V	30
with filter 10 Hz Bessel	µV/V	40
with filter 100 Hz Bessel	µV/V	50
with filter 1 kHz Bessel	µV/V	100
with filter 2 kHz Bessel	µV/V	200
SG half bridge 4 m/V		
Noise at 25 °C and 2.5 V excitation (peak-to-peak)		
with filter 0.1 Hz Bessel	µV/V	1
with filter 1 Hz Bessel	µV/V	2
with filter 10 Hz Bessel	µV/V	3
with filter 100 Hz Bessel	µV/V	4
with filter 1 kHz Bessel	µV/V	5
with filter 2 kHz Bessel	µV/V	10
Inductive full bridge 100 m/V		
Noise at 25 °C and 2.5 V excitation (peak-to-peak)		
with filter 0.1 Hz Bessel	µV/V	2
with filter 1 Hz Bessel	µV/V	3
with filter 10 Hz Bessel	µV/V	4
with filter 100 Hz Bessel	µV/V	5
with filter 1 kHz Bessel	µV/V	15
with filter 2 kHz Bessel	µV/V	30
Inductive half bridge 500 m/V, LVDT, potentiometer		
Noise at 25 °C and 2.5 V excitation (peak-to-peak)		
with filter 0.1 Hz Bessel	µV/V	20
with filter 1 Hz Bessel	µV/V	30
with filter 10 Hz Bessel	µV/V	40
with filter 100 Hz Bessel	µV/V	50
with filter 1 kHz Bessel	µV/V	100
with filter 2 kHz Bessel	µV/V	200

Cut-off frequency (Hz) (–3 dB)		Runtime (ms)	
		Bessel	Butterworth
2000		0.16	0.23
1000		0.42	0.60
500		0.85	1.24
200		2.00	3.10
100		4.15	6.17
50		8.45	12.5
20		21.4	30.7
10		39	47
5		74	91
2		174	216
1		340	430
0.5		680	840
0.2		1680	2090
0.1		3360	4200

Specifications

Current module, voltage module		PX401
Accuracy class		0.1
Sampling rate	1/s	19200
Measurement frequency range (-3 dB)	kHz	3
Filter (Bessel/Butterworth)	Hz	0.1… 3000
TEDS, IEEE1451.4		1-wire
Transducer excitation (active transducer)		
Voltage (DC)	V	Equivalent to device excitation
Current limitation	A	400 mA/card
Potential isolation		60 V DC voltage between plug-in card and supply
Channels, individually switchable current/voltage	Number	4
Max. Common-mode voltage (to housing and supply ground)	V	50
Nominal (rated) temperature range	°C	0 ... 50
Operating temperature range (no condensation allowed/module not immune to water condensation)	°C	–10 ... +60
Storage temperature range	°C	–20 ... + 70
Rel. air humidity	%	5 ... 95 (non-condensing)
Protection class (height up to 2000 m, degree of pollution 2)		III
Degree of protection		IP20 per EN60529
EMC requirements		As per EN 61326 and EN 55011 (class B)
Voltage (DC) ±10 V		
Measuring range	V	10.5 ... + 10.5
Input impedance	MΩ	> 1
Noise at 25 °C (peak-to-peak)		
with filter 1 Hz Bessel	mV	0.25
with filter 10 Hz Bessel	mV	0.3
with filter 100 Hz Bessel	mV	0.5
with filter 1 kHz Bessel	mV	1
Common-mode rejection		
for DC common mode	dB	100
at 50/60 Hz common mode, typ.	dB	80
Non-linearity at 25 °C	%	0.05
Zero drift rel. to full scale value	% / 10 K	0.1
Full scale drift rel. to full scale value	% / 10 K	0.05
Current (DC) ±20 mA		
Measuring range	mA	±20
Value of load resistance	Ω	50 ±1%
Noise at 25 °C (peak-to-peak)		
with filter 1 Hz Bessel	µA	0.5
with filter 10 Hz Bessel	µA	0.6
with filter 100 Hz Bessel	µA	1
with filter 1 kHz Bessel	µA	2
Non-linearity	%	0.05
Zero drift	% / 10 K	0.1
Full-scale drift	% / 10 K	0.1

Specifications (PX401 continued)

Cut-off frequency (Hz) (-3 dB)		Runtime (ms)	
		Bessel	Butterworth
3000		0.10	0.14
2000		0.20	0.28
1000		0.42	0.61
500		0.86	1.23
200		2.00	3.10
100		4.15	6.17
50		8.45	12.5
20		21.4	30.7
10		39	47
5		74	91
2		174	216
1		340	430
0.5		680	840
0.2		1680	2090
0.1		3360	4200

The following applies for the measuring card **PX401**:

If the digital filter is switched off, only the hardware filter will function with a cut-off frequency of 3900 Hz (-3dB).

Specifications

Input / Output

Analog output and digital input/output card		PX878
Connection method		Plug (terminals/screws)
Refresh rate of all output signals	kHz	19.2
Nominal (rated) temperature range	°C	0 ... 50
Operating temperature range (no condensation allowed/module not immune to water condensation)	°C	–10 ... +60
Storage temperature range	°C	–20 ... + 70
Rel. humidity at 31 °C	%	5 ... 95 (non-condensing)
Protection class (height up to 2000 m, degree of pollution 2)		III
Degree of protection		IP20 per EN60529
EMC requirements		As per EN 61326 and EN 55011 (class B)
Galvanic isolation		60V DC voltage between plug-in card and supply
Analog outputs		
Number		5
Accuracy class		0.1
Signal sources		Real measurement signals and calculated signals
Rated voltage (output)	V	±10
D/A converter resolution	bit	16
Output rate, max.	kHz	19.2
Cut-off frequency (3 dB), approx.	kHz	3
Output resistance	Ω	< 10
Permissible load impedance		10 KΩ ‖ 20 nF
Noise (peak-to-peak)	mV	< 10
Reference signal (common)		For all 5 outputs
Non-linearity (INL) Integral Non Linearity	LSB	±16
Crosstalk attenuation	dB	> 90
Zero drift	mV / 10 K	10
Full-scale drift	mV / 10 K	10
Cable length, max.	m	100
Digital inputs		
Number		8
Functions		Zeroing, taring, control signal for calculation channels such as: Multiplexers, peak values, mean values, effective values, sample/hold, capture, PID controller, time measurement, triggers, counters, logic modules
Switching time	ms	1
Input signal range	V	0 … 30
Maximum permitted input level	V	30
Input low state	V	0 … 5
Input high state	V	10 … 30
Input resistance (nominal)	kΩ	7.5
Cable length, max.	m	100
Cable type (required for disruptive interference)		Shielded
Digital outputs		
Number		8
Functions		Limit values, fieldbus signals, digital inputs, parameter set numbers, calculation channel results
Switching time	ms	1
Input voltage (24 V nominal) U_{IN}	V	10 ... 30
Output current per output, max.	mA	200
Output current (sum outputs), max.	A	1.6
Minimum voltage level when loaded with 200 mA		Typ. U_{IN} – 0.7 V
Cable length, max.	m	100

Specifications

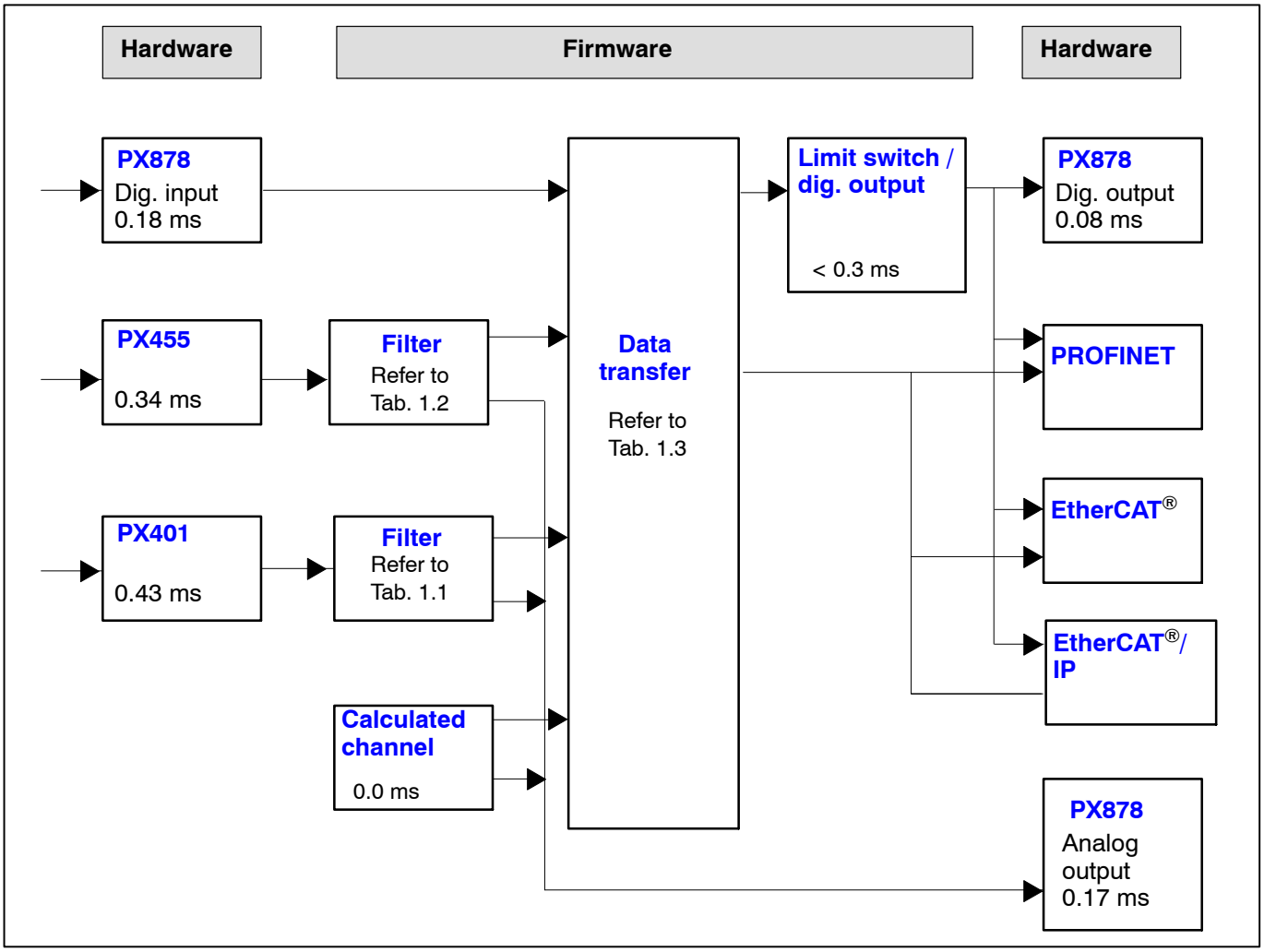
Communication cards

EtherCAT® fieldbus module		**PX01EC**
Type		EtherCAT® complex slave
Data Transport Layer		Ethernet II, IEEE802.3
Power consumption, max.	W	2
Potential isolation		60 V DC voltage between plug-in card and supply
Cable type		Standard CAT–5, shielded
Cable length, max.	m	100
Connecting socket		RJ45 (IN/OUT)
Communication		
Baud rate	Mbit/s	100
Refresh rate	KHz	1.2; 2.4; 4.8; 9.6
Slave synchronization	–	No
Cyclic process input data, max. (Slave –> Master)	bytes	400
Cyclic process output data, max. (Slave –> Master)	bytes	200

PROFINET-IO field bus module		**PX01PN**
Data Transport Layer		Ethernet II, IEEE802.3
Power consumption, max.	W	2.4
Potential isolation		60 V DC voltage between plug-in card and supply
Cable type		Standard CAT–5, shielded
Cable length, max.	m	100
Connecting socket		RJ45 (Port 1 / Port 2)
Communication		
Baud rate	Mbit/s	100
Refresh rate	kHz	1
Slave synchronization		No
Cyclic process input data, max. (Device –> Controller)	bytes	400
Cyclic process output data, max. (Controller –> Device)		
Minimum cycle time	bytes	200
	ms	1
Supported protocols		RTC (Real Time Cyclic) Class 1 unsynchronized Class 3 synchronized (IRT)
		RTA – Real Time Acyclic
		DCP – Discovery and Configuration
		CL–RPC – Connectionless Remote Procedure
		LLDP – Link Layer Discovery
		SNMP – Simple Network Management
		MRP client – Media Redundancy
Topology recognition		LLDP, SNMP, MIB2, physical device
VLAN and Priority Tagging (setting priorities)		Yes
Identification and maintenance		I&M0 ... I&M4 read and write
Unsupported protocols		RT via UDP
		Multicast communication
		DHCP
		Fast Startup
		Media redundancy (except MRP client)
		Supervisor-AR (Supervisor-DA–AR **is** supported)
		Maximum one input CR and one output CR

Specifications

Signal runtimes (ms)



Cut-off frequency fc [Hz] (–3dB)	Runtime [ms]	
	Bessel	Butterworth
3000	0.10	0.14
2000	0.20	0.28
1000	0.42	0.61
500	0.86	1.23
200	2.00	3.10
100	4.15	6.17
50	8.45	12.5
20	21.4	30.7
10	39	47
5	74	91
2	174	216
1	340	430
0.5	680	840
0.2	1680	2090
0.1	3360	4200

Tab. 1.1: Runtimes for **PX401**

Cut-off frequency fc [Hz] (-3dB)	Runtime [ms]	
	Bessel	Butterworth
2000	0.16	0.23
1000	0.42	0.60
500	0.85	1.24
200	2.00	3.10
100	4.15	6.17
50	8.45	12.5
20	21.4	30.7
10	39	47
5	74	91
2	174	216
1	340	430
0.5	680	840
0.2	1680	2090
0.1	3360	4200

Tab. 1.2: Runtimes for **PX455**

Data transfer rate [Hz]	minimum [ms]	typical [ms]	maximum [ms]
1200	0.1	0.52	0.93
2400 (factory default)	0.1	0.31	0.52
4800	0.1	0.21	0.31
9600	0.1	0.16	0.21

Tab. 1.3: Data runtimes

Example:

Signal runtime of a sensor signal via the analog output with filter:

Signal path PX455 → 2 kHz Bessel→ PX878

0.34*) + 0.16 (Table 1.2) + 0.17*) ms = 0.67 ms

*) See diagram on Page 10.

Delay until signal appears in cyclical data frame.

Protocol	Data copy rate [Hz]	typical [ms]	maximum [ms]
PROFINET	1200 (standard and max.)	1.8 + frame_cycle /2	2.4 + frame_cycle
EtherCAT	2400 (standard) 4800 9600 (max)*	1.0 + frame_cycle /2	1.5 + frame_cycle

Tab. 1.4: Fieldbus runtimes

"Data Copy Rate" is the time in which the data are copied to the fieldbus module in slot 0. frame_cycle is the rate of the cyclical data frame that is set by the bus configuration tool.

* The EtherCAT data copy rate only has minor effects on the signal runtime. This is 0.16 ms between copy rates of 2.4 and 9.6 kHz.

Example:

Signal runtime of a sensor signal via the EtherCAT fieldbus:

Signal path PX455 → 2 kHz Bessel → Data transfer @2.4 Hz → EtherCAT@2.4 kHz PX01EC

0.34*) + 0.16 (Table 1.2) + 0.31 ms + 1.2 ms = 2.00 ms (average signal runtime from input terminal to EtherCAT fieldbus

*) See diagram on Page 10.

Accessories and replacement parts

Accessories	Order number
Ethernet crossover cable for direction operation of devices on a PC or notebook, length 2 m, type CAT5+	1-KAB239-2
AC/DC power supply unit; Input: 90 V … 240 VAC, 1.5 m cable, output: 24 V DC, max. 1.25 A, 2 m cable with ODU plug	1-NTX001
Spare parts	**Order number**
Blue blanking plate (for communication module)	1-PX01
White blanking plate (for measuring card module)	1-PX02
1 set DIN rail clips (2 pieces)	1-RAILCLIP
Phoenix plug terminals	
1 set plug-in screw terminals (push-in) for PMX plug-in cards (4 pieces, incl. coding plug and labeling sheet)	1-CON-S1008
1 set screw terminals (screw in) for PMX plug-in cards (4 pieces, incl. coding plug and labeling sheet)	1-CON-S1009
Screw-in screw terminals for PMX voltage supply (incl. coding plug and labeling sheet)	1-CON-S1010

In general, the mating connectors are always included for all plug-in cards (PX401, PX455, PX878).

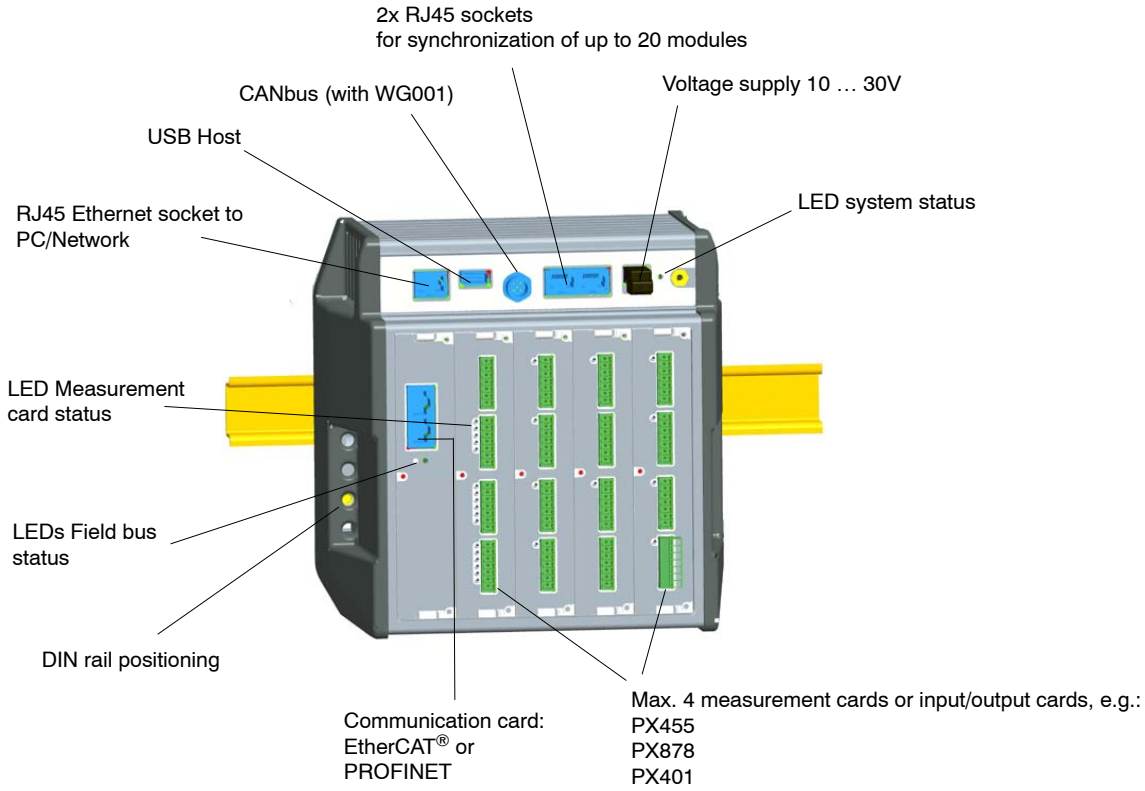
When ordering a PMX basic device, the delivery includes DIN rail mounting and wall mounting elements.

Specifications NTX001 power pack

NTX001		
Nominal (rated) input voltage (AC)	V	100 ... 240 (±10 %)
No-load power consumption at 230 V	W	0.5
Nominal (rated) loading		
U_A	V	24
I_A	A	1.25
Static output data		
U_A	V	24 ± 4%
I_A	A	0 – 1.25
U_{Br} (output ripple voltage; peak-to-peak)	mV	≤120
Current limiting, typically from	A	1.6
Isolation primary – secondary		Electrical, by optical coupler and converter
Creepage and clearance distances	mm	≥8
High-voltage test	kV	≥4
Ambient temperature	°C	0 ... +40
Storage temperature	°C	–40 ... +70

Specifications (continued)

Connections

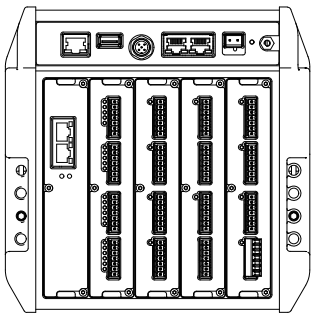


Combination options

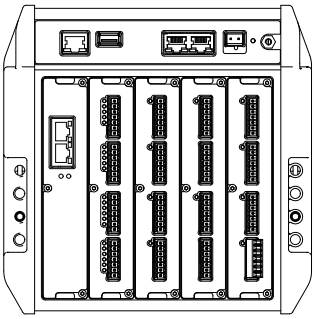
	Slot 0	Slot 1	Slot 2	Slot 3	Slot 4	Number of plug-ins
Field bus or realtime Ethernet	x	–	–	–	–	0–1
PX401	–	x	x	x	x	0–4
PX455	–	x	x	x	x	0–4
PX878	–	x	x	–	–	0–2

Housing variants

Basic device **WGX001** (with CANbus)



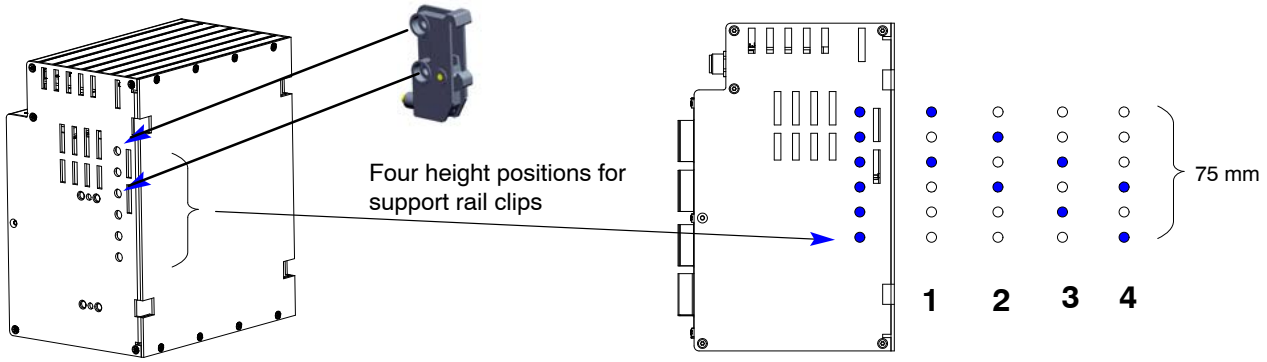
Basic device **WGX002** (without CANbus)



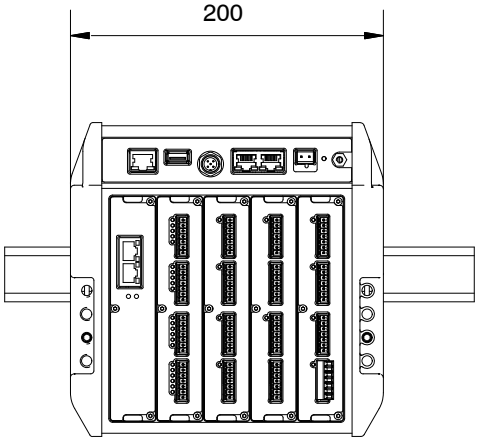
Specifications (continued)

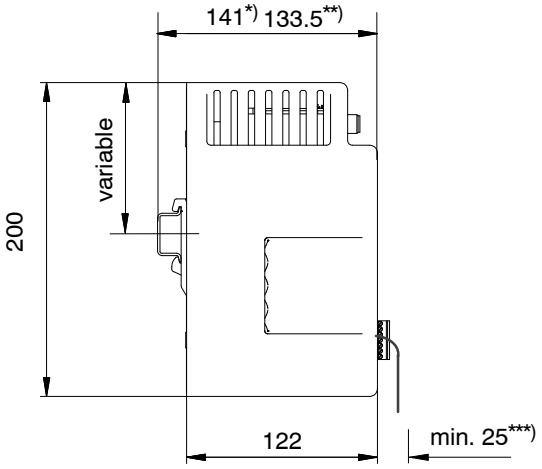
Mounting

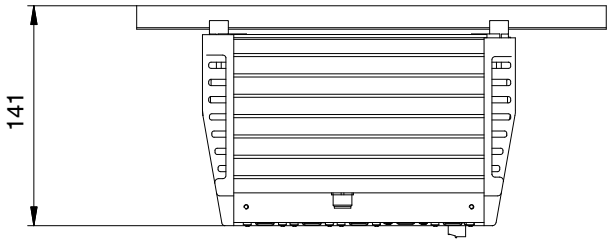
Support rail clips (included in scope of delivery)



Basic device **WG001** (including CANbus) for max. 5 plug-in cards







*) Height of support rail 15 mm

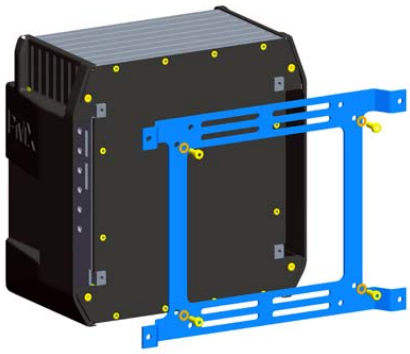
**) Height of support rail 7.5 mm

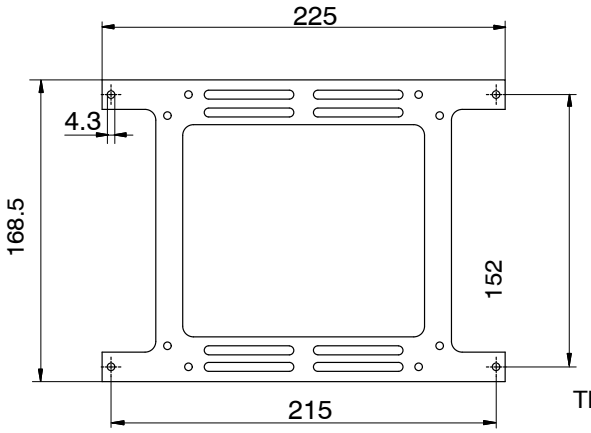
***) Min. dimension: Connector plus sensor cable

Specifications (continued)

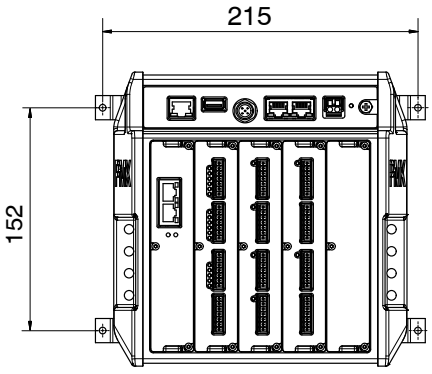
Mounting

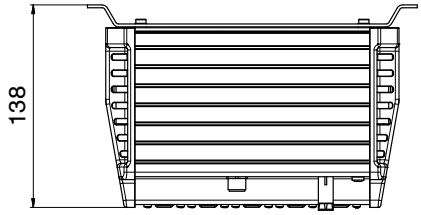
Wall mountings (included in scope of delivery)

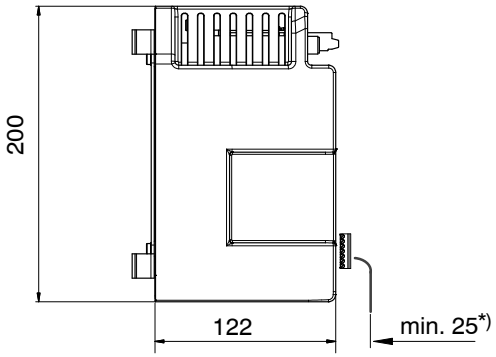




The wall mountings can also be fitted turned through 90°.







*) Min. dimension: Connector plus sensor cable

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