Data sheet

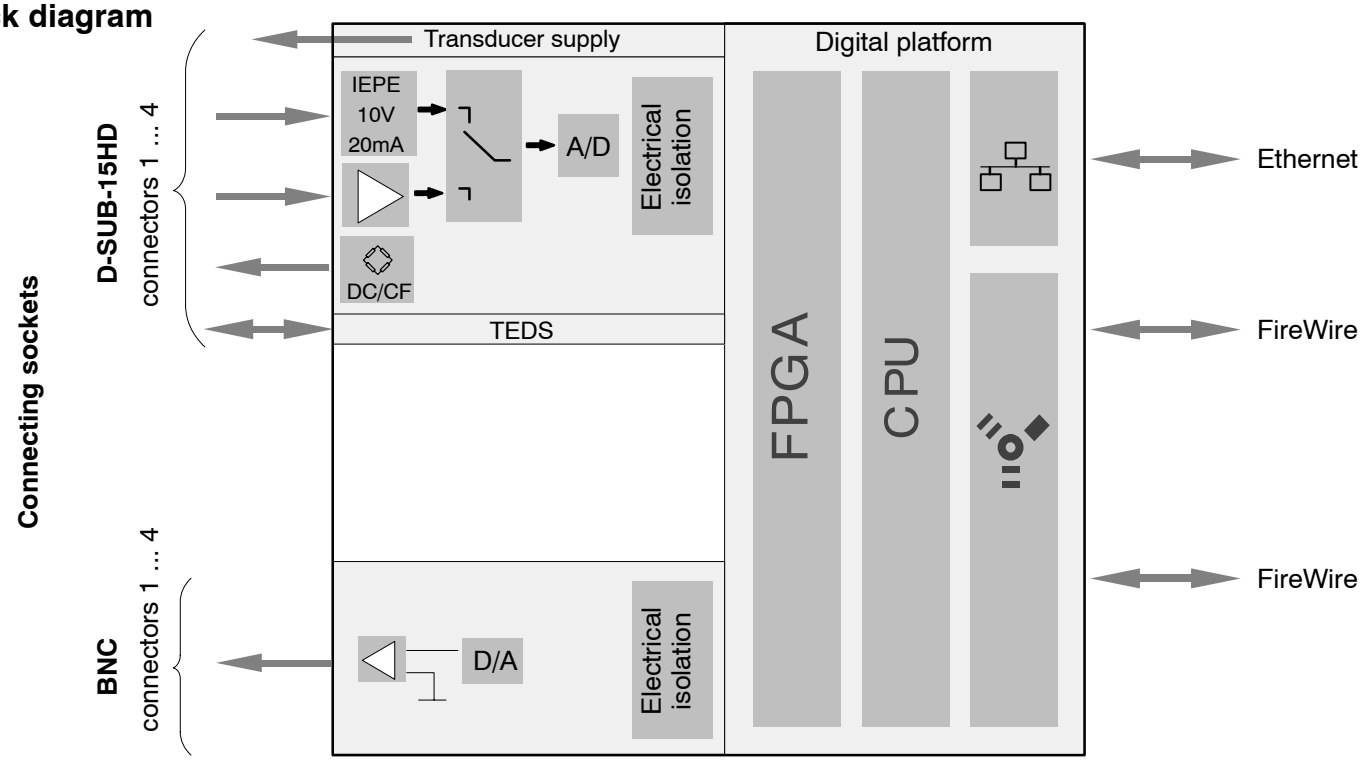
QUANTUMX MX410

Highly dynamic
universal amplifier

Special features

- **4 individually configurable inputs (electrically isolated)**
- **Connection of more than 5 transducer technologies**
- **Data rate: up to 96,000 Hz 19,2000 with 2 channels**
- **24-bit A/D converter per channel for synchronous, parallel measurements**
- **Active low-pass filter**
- **4 analog outputs**
- **Real-time computation (Peak, RMS)**
- **Supply voltage (DC) for active transducers: 5 V ... 24 V**

Block diagram



Specifications

General specifications		
Inputs	number	4, electrically isolated from each other and from supply[1)]
Transducer technologies per connector		Strain gage, half and full bridge (carrier frequency or DC), piezoelectric transducers (resistiv, current-fed) / IEPE, Inductive half and full bridge, voltage, (10 V) current (20 mA)
A/D conversion		24−bit delta-sigma converter
Data rate	Hz	0.1 ... 96,000 per channel, adjustable individually or 0.1 ... 192000 with 2 channels adjustable individually
Bandwidth	kHz	38 with 96,000 Hz data rate 78 with 192,000 Hz data rate
Active low pass filter (Bessel/Butterworth, adjustable)	Hz	0.1 ... 20,000
Transducer identification (TEDS, IEEE 1451.4)		
max. TEDS module distance	m	100
Transducer connection		D-SUB-15HD
Analog outputs		4 (BNC), electrically isolated to measurement inputs and to supply (not to one another)
Supply voltage range (DC)	V	10 ... 30 (nominal (rated) voltage 24 V)
Supply voltage interruption		max. for 5 ms at 24 V
Power consumption		
without adjustable transducer excitation	W	< 12
with adjustable transducer excitation	W	< 15
Supply voltage (active transducers)		
Adjustable transducer excitation (DC)	V	5 ... 24; adjustable channel by channel
Maximum output power	W	0.7 per channel / 2 in total
Ethernet (data link)		10Base-T / 100Base-TX
Protocol/addressing	–	TCP/IP (direct IP address or DHCP)
Plug connection	–	8P8C-modular plug (RJ-45) with twisted pair cable (CAT-5)
Max. cable length to module	m	100
FireWire (module synchronization, data link, optional supply voltage)		IEEE 1394b (HBM modules only)
Baud rate	MBaud	400 (approx. 50 MBytes/s)
Max. current from module to module	A	1.5
Max. cable length between nodes	m	5
Max. number of modules connected in series (daisy chain)	–	12 (= 11 hops)
Max. number of modules in a FireWire system (incl. hubs[2)], backplane)	–	24
Max. number of hops[3)]	–	14
Synchronization options EtherCAT NTP IRIG−B (B000 to B007; B120 to B127)		FireWire (automatically, recommended) via CX27 via Ethernet via MX440A- or MX840A input channel
Nominal (rated) temperature range	°C [°F]	−20 ... +60 [−4 ... +140]
Operating temperature range	°C [°F]	−20 ... +65 [−4 ... +149]
Storage temperature range	°C [°F]	−40 ... +75 [−40 ... +167]
Relative humidity	%	5 ... 95 (non-condensing)
Protection class	–	III
Degree of protection		IP20 per EN60529
Mechanical tests[4)]		
Vibration (30 min)	m/s^2	50
Shock (6 ms)	m/s^2	350
EMC requirements		per EN 61326
Maximum input voltage at transducer socket to ground (PIN 6 or PIN 9)		
PIN 1, 2, 3, 4, 5, 7, 8, 10 (bridge and TEDS)	V	±5.5
PIN 14 (voltage)	V	±40
PIN 13 (current)	V	± 1.5
PIN 4, 15 (control circuits)	V	+ 3.3
Dimensions, horizontal (H x W x D)	mm	52.5 x 200 x 122 (with case protection)
	mm	44 x 174 x 119 (without case protection)
Weight, approx.	g	990

1) When variable transducer supply is used, there is no electrical isolation from the supply.
2) Hub: FireWire node point or distributor
3) Hop: transition from module to module/signal conditioning
4) Mechanical stress is tested in accordance with European standards EN60068−2−6 for vibration and EN60068−2−27 for shock. The devices are exposed to an acceleration of 50 m/s^2 within the frequency range 5...65 Hz in all 3 axes. Duration of this vibration test: 30 minutes per axis. The shock test is implemented at a nominal (rated) acceleration of 350 m/s^2 for a duration of 6 ms, half sine and with shocks in each of the six possible directions.

Specifications (continued)

Strain gage full bridge and half bridge 4 mV/V CF with excitation 1 V or 2.5 V or 5 V (AC, effective)		
Accuracy class		0.05
Carrier frequency (sine)	Hz	4,800 + 2
Bridge excitation voltage (effective)	V	1 ; 2.5; 5 (±5 %)
Transducers that can be connected		Strain gage and inductive full and half bridges
Permissible cable length between MX410 and transducer	m	100
Measuring ranges at 5 V excitation at 2.5 V excitation at 1 V excitation	 mV/V mV/V mV/V	 ±4 ±8 ±20
Measurement frequency range (–3 dB)	Hz	0 ... 1,600
Transducer impedance at 5 V excitation at 2.5 V excitation at 1 V excitation	 Ω Ω Ω	 300 ... 1,000 110 ... 1,000 80 ... 1,000
Noise at 25 °C and 2.5 V excitation (peak to peak) at 1 Hz Bessel filter at 10 Hz Bessel filter at 100 Hz Bessel filter at 1 kHz Bessel filter	 µV/V µV/V µV/V µV/V	 < 0.1 < 0.2 < 0.5 < 1.5
Linearity error	%	< 0.02 of full scale value
Zero drift (full bridge with excitation 5 V)	% / 10 K	< 0.02 of full scale value
Full-scale drift (excitation 5 V)	% / 10 K	< 0.05 of measured value

Strain gage full bridge and half bridge 4 mV/V DC with excitation 1 V or 2.5 V or 5 V or 7.5 V (DC)		
Accuracy class		0.05
Bridge excitation voltage (DC)	V	1 ; 2.5; 5; 7.5 (±8 %)
Transducers that can be connected		Strain gage full and half bridges
Permissible cable length between MX410 and transducer	m	100 (at U_B=7.5 V: 50 m)
Measuring ranges at 7.5 V excitation at 5 V excitation at 2.5 V excitation at 1 V excitation	 mV/V mV/V mV/V mV/V	 ±4 ±4 ±10 ±20
Measurement frequency range (–3 dB)	Hz	0 … 39,300 with 96,000 Hz data rate 0 … 78,600 with 192,000 Hz data rate
Transducer impedance at 7.5 V excitation at 5 V excitation at 2.5 V excitation at 1 V excitation	 Ω Ω Ω Ω	 300 ... 5,000 (max. 50 m cable) 110 ... 5,000 110 ... 5,000 80 ... 5,000
Noise at 25 °C and 5 V excitation (peak to peak) at 1 Hz Bessel filter at 10 Hz Bessel filter at 100 Hz Bessel filter at 1 kHz Bessel filter at 10 kHz Bessel filter at filter Off	 µV/V µV/V µV/V µV/V µV/V µV/V	 < 0.15 < 0.3 < 0.16 < 2 < 9 < 10
Linearity error	%	< 0.02 of full scale value
Zero drift (full bridge with excitation 5 V)	% / 10 K	< 0.05 of full scale value
Full-scale drift (excitation 5 V)	% / 10 K	< 0.05 of measured value

Specifications (continued)

Strain gage full bridge and half bridge 100 mV/V CF with excitation 1 V or 2.5 V (AC, effective)		
Accuracy class		0.05
Carrier frequency (sine)	Hz	4,800 + 2
Bridge excitation voltage (effective)	V	1 ; 2.5; (±8 %)
Transducers that can be connected		Strain gage and inductive full and half bridges
Permissible cable length between MX410 and transducer	m	100
Measuring ranges at 2.5 V excitation at 1 V excitation	 mV/V mV/V	 ±100 ±250
Measurement frequency range (–3 dB)	Hz	0 ... 1,600
Transducer impedance at 2.5 V excitation at 1 V excitation	 Ω Ω	 110 ... 1,000 80 ... 1,000
Noise at 25 °C and 2.5 V excitation (peak to peak) at 1 Hz Bessel filter at 10 Hz Bessel filter at 100 Hz Bessel filter at 1 kHz Bessel filter	 µV/V µV/V µV/V µV/V	 < 2 < 4 < 12 < 40
Linearity error	%	< 0.02 of full scale value
Zero drift (full bridge with excitation 2.5 V)	% / 10 K	< 0.01 of full scale value
Full-scale drift (excitation 2.5 V)	% / 10 K	< 0.05 of measured value

Piezoresistive strain gage full bridge and half bridge 100 mV/V DC with excitation 2.5 V or 5 V (DC)		
Accuracy class		0.05
Bridge excitation voltage (DC)	V	2.5; 5 (±5 %)
Transducers that can be connected		Strain gage full and half bridges
Permissible cable length between MX410 and transducer	m	100
Measuring ranges at 5 V excitation at 2.5 V excitation	 mV/V mV/V	 ±50 ±100
Measurement frequency range (–3 dB)	Hz	0 … 39,300 with 96,000 Hz data rate 0 … 78,600 with 192,000 Hz data rate
Transducer impedance at 5 V excitation at 2.5 V excitation	 Ω Ω	 110 ... 5,000 110 ... 5,000
Noise at 25 °C and 5 V excitation (peak to peak) at 1 Hz Bessel filter at 10 Hz Bessel filter at 100 Hz Bessel filter at 1 kHz Bessel filter at 10 kHz Bessel filter at filter Off	 µV/V µV/V µV/V µV/V µV/V µV/V	 < 2 < 3 < 8 < 25 < 130 < 150
Linearity error	%	< 0.02 of full scale value
Zero drift (full bridge with excitation 5 V)	% / 10 K	< 0.03 of full scale value
Full-scale drift (excitation 5 V)	% / 10 K	< 0.05 of measured value

Specifications (continued)

Voltage 10 V (DC)		
Accuracy class		0.03
Transducers that can be connected		Voltage sensor ±10 V
Permissible cable length between MX410 and transducer	m	100
Measuring range	V	±10
Measurement frequency range (–3 dB)	Hz	0 … 39,300 with 96,000 Hz data rate 0 … 78,600 with 192,000 Hz data rate
Internal resistance of the connected voltage source	kΩ	< 5
Input impedance	MΩ	> 10
Noise at 25 °C (peak to peak) at 1 Hz Bessel filter at 10 Hz Bessel filter at 100 Hz Bessel filter at 1 kHz Bessel filter at 10 kHz Bessel filter at filter Off / 96000 values/s	 µV µV µV µV µV µV	 < 150 < 300 < 600 < 3,000 < 13,000 < 15,000
Linearity error	%	< 0.02 of full scale value
Common-mode rejection at DC common-mode at 50 Hz common-mode	 dB dB	 > 100 75
Max. common-mode voltage (to housing and supply ground)	V	±60
Zero drift	% / 10 K	< 0.02 of full scale value
Full-scale drift	% / 10 K	< 0.03 of measured value

Current 20 mA (DC)		
Accuracy class		0.03
Transducers that can be connected		Transducer with 4 ... 20 mA current output
Permissible cable length between MX410 and transducer	m	100
Measuring range	mA	±20
Measurement frequency range (–3 dB)	Hz	0 … 39,300 with 96,000 Hz data rate 0 … 78,600 with 192,000 Hz data rate
Measuring resistance value	Ω	50
Noise at 25 °C (peak to peak) at 1 Hz Bessel filter at 10 Hz Bessel filter at 100 Hz Bessel filter at 1 kHz Bessel filter at 10 kHz Bessel filter at filter Off	 µA µA µA µA µA µA	 < 0.5 < 1.5 < 10 < 20 < 28 < 30
Linearity error	%	< 0.02 of full scale value
Common-mode rejection at DC common-mode at 50 Hz common-mode	 dB dB	 > 100 typically
Max. common-mode voltage (to housing and supply ground)	V	±60
Zero drift	% / 10 K	< 0.02 of full scale value
Full-scale drift	% / 10 K	< 0.03 of measured value

Specifications (continued)

Current–fed piezoelectric transducers (IEPE, Integrated electronics Piezo electric)		
Accuracy class		0.1
Transducer technology		Current-fed piezoelectric transducer via adapter D-SUB-15HD to BNC
Permissible cable length between MX410 and transducer	m	< 30
Transducer excitation	mA	5.5mA ±15%
Measuring ranges	V	±2; ±10
Measurement frequency range (–3 dB)	Hz	0 … 39,300 with 96,000 Hz data rate 0 … 78,600 with 192,000 Hz data rate
Noise at 25 °C and measuring range ±10 V (peak to peak)		
at 1 Hz Bessel filter	µV	< 100
at 10 Hz Bessel filter	µV	< 300
at 100 Hz Bessel filter	µV	< 600
at 1 kHz Bessel filter	µV	< 3,000
at 10 kHz Bessel filter	µV	< 13,000
at filter Off	µV	< 15,000
Linearity error	%	< 0.1 of full scale value
Common-mode rejection		
at DC common-mode	dB	> 100
at 50 Hz common-mode, typically	dB	75
Max. common-mode voltage (to housing and supply ground)	V	±60
Zero drift	% / 10 K	< 0.1 of full scale value

Analog outputs		
Number of outputs		4 (input1 to output1 etc.)
Type of connection		BNC
Nominal (rated) voltage	V	±10
Reference signal		Common ground for all outputs, electrically isolated from supply and measurement inputs
D/A converter resolution	bits	16
Noise (peak to peak)	mV	< 10
Permissible load impedance	Ω	> 2,000 / <2 nF
Crosstalk attenuation	dB	> 65
Min. settling time	µs	120
Zero drift	% / 10 K	< 0.02 of full scale value
Full-scale drift	% / 10 K	< 0.05 of output value

Real-time computation on the module		
Root-mean-square unit (RMS)		4
Peak-value unit		
Number of peak values		8
Max. output rate	Hz	4800

Active low-pass filter data

(4th order Bessel/Butterworth with data rate < 96,000 Hz; 6th order with data rate=96,000 Hz)

Type	–1dB (Hz)	–3dB (Hz)	–20dB (Hz)	Phase delay*) (ms)	Rise time (ms)	Overshoot (%)	Data rate (Hz)
Bessel	20000	29250	43000	0.002	0.016	4.1	96000
	10000	16810	40260	0.008	0.023	1.5	96000
	5000	8510	19906	0.027	0.042	0.9	96000
	2000	3515	8275	0.094	0.1	0.6	96000
	1000	1715	4070	0.22	0.2	0.6	96000
	500	852	2008	0.47	0.41	0.6	96000
	200	341	803	1.22	1.01	0.8	96000
	100	171	402	2.5	2.01	0.8	96000
	50	84.2	215	4	4.08	1	19200
	20	33.7	86	10	10.2	1	9600
	10	16.9	43	20	20.6	1	9600
	5	8.41	21.5	40	41	1	4800
	2	3.37	8.6	98	102.8	1	1200
	1	1.68	4.3	196	206.4	1	600
	0.5	0.84	2.15	392	411.2	1	600
	0.2	0.34	0.86	982	1026	1	300
	0.1	0.17	0.43	1968	2052	1	150
Butterworth	20000	21700	27500	0.025	0.02	15.6	96000
	10000	11100	15500	0.06	0.04	15.6	96000
	5000	5585	8100	0.13	0.08	14.5	96000
	2000	2238	3280	0.3	0.2	14.5	96000
	1000	1119	1640	0.6	0.4	14.5	96000
	500	560	820	1.2	0.8	14.5	96000
	200	237	420	2.1	1.6	11	19200
	100	118	210	4	3.3	11	19200
	50	59	105	7.8	6.6	11	19200
	20	24	42	19.4	16.1	11	4800
	10	11.8	21	38.6	32.4	11	2400
	5	5.9	10.5	76.6	65	11	1200
	2	2.4	4.2	191	163	11	600
	1	1.2	2.1	382	325	11	300
	0.5	0.59	1.05	760	653	11	300
	0.2	0.24	0.42	1900	1630	11	150
	0.1	0.12	0.21	3790	3260	11	150

*) The delay of the A/D converter is 293 µs for all data rates, it has not been accounted for in the “Phase delay” column!

Active low-pass filter data (High-speed mode)

(4th order Bessel/Butterworth with data rate < 192,000 Hz; 6th order with data rate = 192,000 Hz)

Type	–1dB (Hz)	–3dB (Hz)	–20dB (Hz)	Phase delay*) (ms)	Rise time (ms)	Overshoot (%)	Data rate (Hz)
Bessel	40000	58500	86000	0.001	0.008	1.6	192000
	20000	33620	80520	0.004	0.012	1.5	192000
	10000	17020	39812	0.0135	0.021	0.9	192000
	4000	7030	16550	0.047	0.05	0.6	192000
	2000	3430	8140	0.11	0.1	0.6	192000
	1000	1704	4016	0.235	0.21	0.6	192000
	400	682	1606	0.61	0.51	0.8	192000
	200	342	804	1.25	1.00	0.8	192000
	100	168.4	430	2	2.04	1	192 00
	40	67.4	172	5	5.1	1	19200
	20	33.8	86	10	10.3	1	19200
	10	16.82	43	20	20.5	1	9600
	4	6.74	17.2	49	51.4	1	2400
	2	3.36	8.6	98	103.2	1	1200
	1.0	1.68	4.3	196	205.6	1	1200
	0.4	0.68	1.72	491	513	1	600
	0.2	0.34	0.86	984	1026	1	300
Butterworth	40000	43400	55000	0.013	0.01	17.8	192000
	20000	22200	31000	0.03	0.02	15.6	192000
	10000	11170	16200	0.07	0.04	14.5	192000
	4000	4476	6560	0.15	0.1	14.5	192000
	2000	2238	3280	0.3	0.2	14.5	192000
	1000	1120	1640	0.6	0.4	14.5	192000
	400	474	840	1.05	0.8	14.5	19200
	200	236	420	2	1.65	11	19200
	100	118	210	3.9	3.3	11	19200
	40	48	84	9.7	8.05	11	9600
	20	23.6	42	19.3	16.2	11	4800
	10	11.8	21	38.3	32.5	11	2400
	4	4.8	8.4	95.5	81.5	11	1200
	2	2.4	4.2	191	162.5	11	600
	1	1.18	2.1	380	326.5	11	600
	0.4	0.48	0.84	950	815	11	300
	0.2	0.24	0.42	1895	1630	11	300

*) The delay of the A/D converter is 141 µs for all data rates, it has not been accounted for in the “Phase delay” column!

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 I_A	 V A	 24 1.25
Static output data U_A I_A U_{Br} (output ripple voltage; peak to peak))	 V A mV	 24 ± 4% 0 ... 1.25 ≤ 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

Accessories, to be ordered separately

MX410 accessories		
Article	**Description**	**Order no.**
Adapter DSub HD 15-pin to DSub 15-pin.	Adapter DSub HD 15-pin to DSub 15−pin for connecting transducers with pre-assembled DSub plugs on MX410 (length approx. 0.3 m) Note: ready-made for full-bridge (6-wire).	1−KAB416
Adapter DSub HD 15-pin to BNC	Adapter for connecting current-fed piezoelectric sensors (IEPE) with BNC connection to MX410; DSub HD 15-pin plug to BNC-socket, (length approx. 5 cm)	1−IEPE−MX410
General accessories		
Article	**Description**	**Order no.**
DSub HD 15-pin plug set with TEDS chip	Plug kit DSub HD 15-pin (male) with TEDS chip for storing a sensor data sheet; housing: Metallized plastic with knurled screws. Note: the TEDS chip is blank.	1−SUBHD15−MALE
AC/DC power pack / 24 V	Input: 100 ... 240 V AC (±10 %), 1.5 m cable Output: 24 V DC, max. 1.25 A, 2 m cable with ODU plug	1−NTX001
3 m cable − QuantumX supply	3 m cable for voltage supply of QuantumX modules; suitable plug (ODU Medi-Snap S11M08−P04MJGO−5280) at one end and exposed wires at the other.	1−KAB271−3
Ethernet cross over cable	Ethernet cross over cable for direct operation between a PC or Notebook and a modul / device, length 2 m, type CAT5+	1−KAB239−2
FireWire IEEE PC−Card	FireWire IEEE 1394b PC−Card (PCMCIA adapter) to connext QuantumX modules to a Notebook or a PC	1−IF001
3 m FireWire cable, PC to module	FireWire cable connector from PC to first module. For data transmission from QuantumX modules to PC. Fitted with suitable plugs at both ends. Length: 3 m.	1−KAB275−3
FireWire cable, (module to module)	FireWire cable connector between QuantumX modules, fitted with suitable plugs at both ends. Lengts 0.2 m/2 m/5 m. Note: Voltage can also be supplied to the QuantumX modules via the cable (max. 1.5 A, from source to last acceptor).	1−KAB269−0.2 1−KAB269−2 1−KAB269−5
Connecting elements for QuantumX modules	Connecting elements (clips) for QuantumX modules; set comprising 2 case clips including assembly material for fast connection of 2 modules.	1−CASECLIP
Connecting elements for QuantumX modules	Fitting panel for mounting of QuantumX modules using case clips (1−CASECLIP), lashing strap or cable tie. Basic fastening by 4 screws.	1−CASEFIT

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