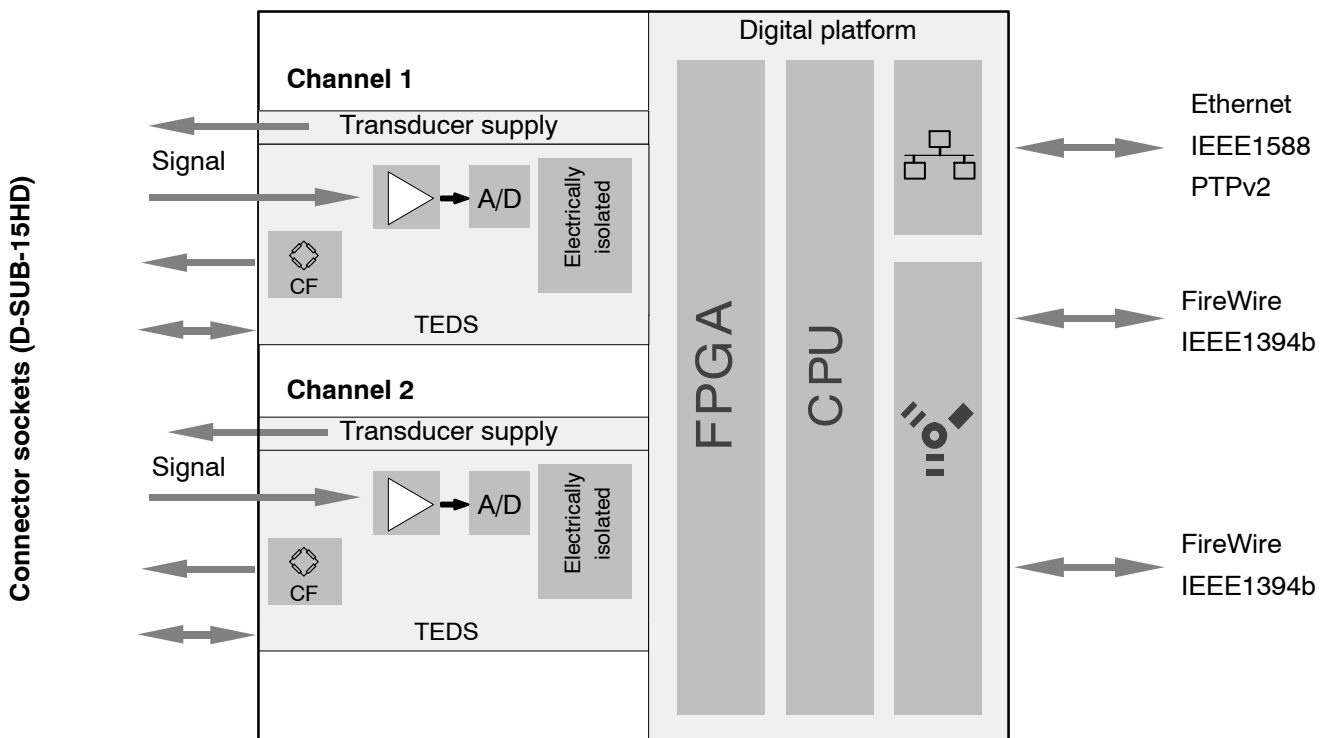# QUANTUM X

MX238B

Precision amplifier

Special features

- **0.0025 accuracy class**
- **Two precision strain gauge full bridge measuring channels**
- **24–bit A/D converter per channel**
- **225 Hz carrier frequency**
- **Patented background calibration**
- **TEDS automatic channel parameterization**

Block diagram

Specifications MX238B

General specifications			
Inputs	Number	2, galvanically isolated from each other and from the supply voltage[1]	
Transducer technologies		Strain gauge full bridge	
A/D converter		24 Bit Delta Sigma converter	
Signal bandbwidth	Hz	50	
Active low-pass filter	Hz	Bessel, Butterworth, 0.01 ... 50	
Sample rate (Data output rate adjustable by software, default: HBM Classic)	S/s	Decimal: 0.1 …40,000	
		HBM Classic: 0.1 … 9,600	
Transducer identification (TEDS, IEEE 1451.4)			
max. distance of the TEDS module	m	100	
Transducer connection		D-SUB-15HD	
Supply voltage range (DC)	V	10 ... 30 (24 V nominal (rated) voltage)	
Supply voltage interruption		max. 5 ms at 24 V	
Power consumption			
without adjustable transducer excitation	W	< 7	
with adjustable transducer excitation	W	< 10	
Transducer Excitation (active transducers)			
Adjustable supply voltage (DC)	V	5 ... 24; adjustable for each channel	
Maximum output power	W	0.7 each channel / a total of 2	
Ethernet (data link)		10Base-T / 100Base-TX	
Protocol/addressing	–	TCP/IP (direct IP address or DHCP)	
Connection	–	8P8C plug (RJ-45) with twisted pair cable, Streaming (CAT-5)	
Max. cable length to module	m	100	
Synchronization options			
Firewire		IEEE1394b	
Ethernet		IEEE1588 (PTPv2) or NTP	
EtherCAT[®5]		via CX27B EtherCAT Gateway module	
IRIG-B (B000 bis B007; B120 bis B127)		IRIG–B (B000 up to B007; B120 up to B127) via MX440B / MX840B input channel	
IEEE1394b FireWire (module synchronization, data link, optional supply voltage)		IEEE 1394b (HBM modules only)	
Baud rate	MBaud	400 (approx. 50 MByte/s)	
Max. current from module to module	A	1.5	
Max. cable length between the nodes	m	5	
Max. number of modules connected in series (daisy chain)	–	12 (=11 Hops)	
Max. number of modules in a IEEE1394b FireWire system (including hubs[2], backplane)	–	24	
Max. number of hops[3]	–	14	
Nominal (rated) temperature range	°C [°F]	–20 ... +65 [–4 ... +149]	
Storage temperature range	°C [°F]	–40 ... +75 [–40 ... +167]	
Rel. 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	

[1] When the variable transducer supply is used, there is no electrical isolation from the supply voltage.

[2] Hub: IEEE1394b FireWire node or distributor

[3] Hop: Transition from module to module/signal conditioning

[4] Mechanical stress is tested according to European Standard EN60068–2–6 for vibrations and EN60068–2–27 for shock. The equipment is subjected to an acceleration of 50 m/s^2 in a frequency range of 5...65 Hz in all 3 axes. Duration of this vibration test: 30min per axis. The shock test is performed with a nominal acceleration of 350 m/s^2 for 6 ms, half sine pulse shape, with 3 shocks in each of the 6 possible directions.

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

Specifications MX238B (Continued)

EMC requirements		per EN61326
Max. input voltage at transducer socket to ground		
PIN 1, 2, 3, 4, 5, 7, 8, 10, 13, 15 to Pin 6	V	+ 5.5 (no transients)
PIN 14 (voltage) to Pin 9	V	$\pm$ 60 (no transients)/
Dimensions, horizontal (W x H x D)	mm	52.5 x 200 x 121 (with case protection) 44 x 174 x 116.5 (without case protection)
Weight, approx.	g	850

|		
Strain gauge full bridge, 5 or 10 mV/V measuring range, bridge excitation AC / carrier frequency		
Accuracy class		0.0025[1]
Carrier frequency (sine)	Hz	225 $\pm$ 0.5
Bridge excitation voltage (effective)	V	2.5; 5.0 ($\pm$ 5 %)
Transducers that can be connected		strain gage full bridges (6 wire and 4 wire connection)
Permissible cable length between module and transducer	m	100
Measuring ranges		
at 5 V excitation	mV/V	$\pm$ 2.5; $\pm$ 5.0
at 2.5 V excitation	mV/V	$\pm$ 2.5, $\pm$ 5.0
Additional shunt resistor can be activated (control signal)	kΩ	100 $\pm$ 0.1 % (typ. $-$0.886 mV/V at 350 Ohm)
Measurement frequency range	Hz	0 ... 50
Transducer impedance		
at 5 V excitation	Ω	150 ..5,000
at 2.5 V excitation	Ω	75 ... 5,000
Input resistance	MΩ	> 100
Noise at 25 °C , 350 Ω Impedanz for 2 Sigma (95%), (peak to peak)		
with filter 1 Hz Bessel	μV	< 0.06
with filter 10 Hz Bessel	μV	< 0.20
Linearity error	%	< 0.002 of full scale
Common-mode rejection	dB	> 120
Zero drift	% / 10 K	0.0005[1] of full scale
Full-scale	% / 10 K	< 0.001[1] of measurement value
Short time drift	% / 24h	< 0.001[1]
Long time drift	% / a	< 0.0015[1]

[1] During background calibration

Decimal sample rates and digital low pass filter, type Bessel 4th order

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay*) (ms)	Rise time (ms)	Overshoot (%)	Sample rate (Hz)
Bessel	30	50	127	6,5	7	0.8	40,000
	12	20	51	16,4	17.5	0.8	40,000
	6	10	25	34,5	35	0.8	20,000
	3	5	13	69	70	0.8	10,000
	1,2	2	5.1	168	175	0.8	10,000
	0.6	1	2.5	332	350	0.8	5,000
	0.3	0.5	1.3	663	700	0.8	1,000
	0.1	0.2	0.5	1,652	1,750	0.8	1,000
	0.06	0.1	0.25	3,299	3,500	0.8	500
	0.03	0.05	0.13	6,598	7,003	0.8	100
	0,01	0.02	0.05	16,495	17,508	0.8	100
	0.006	0.01	0.02	32,989	35,016	0.8	50

*) The analog-to-digital converter and prefilter's delay time is 3.2 ms for all sample rates and has not been accounted for in the "Phase delay" column!

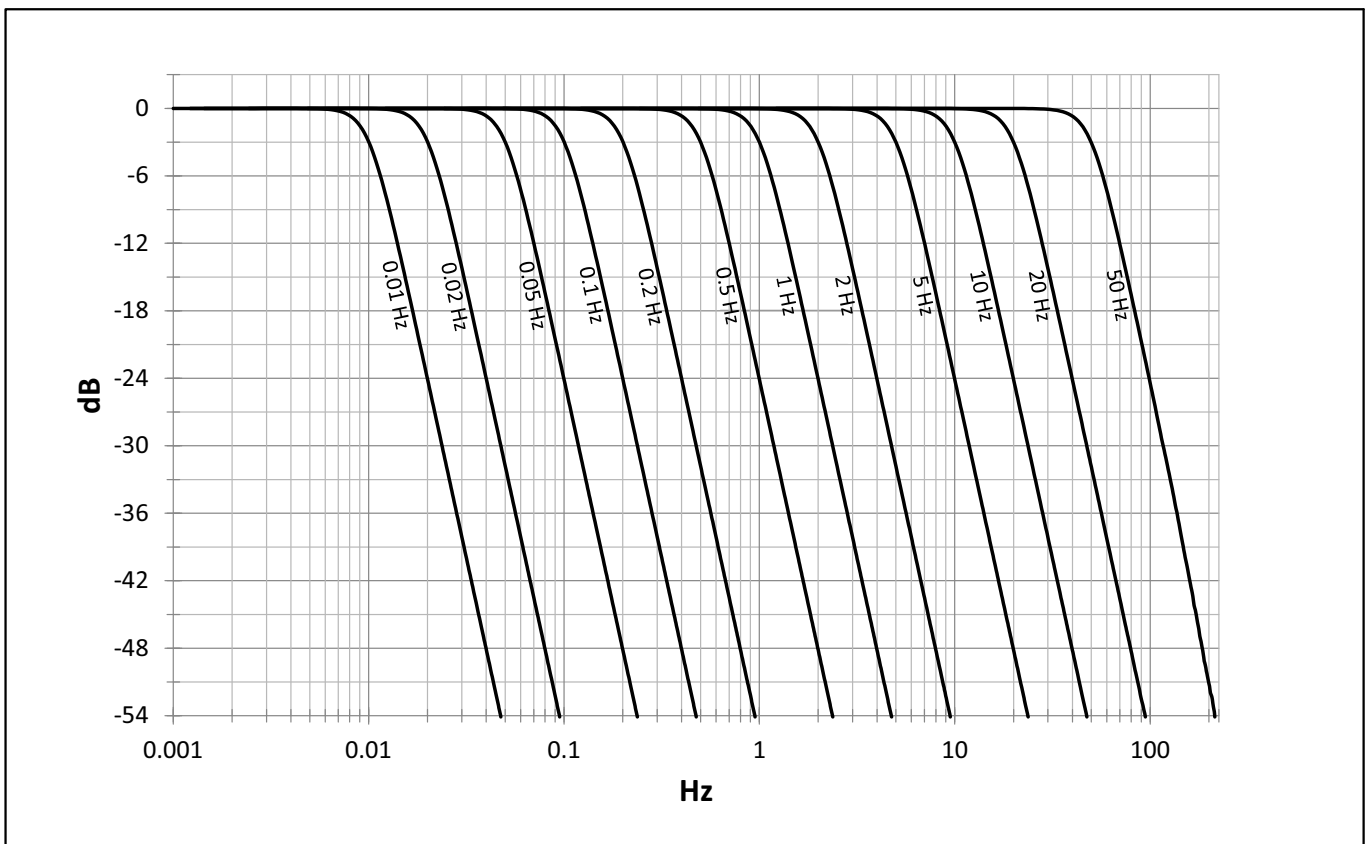# Decimal data rates : Amplitude response Bessel filter
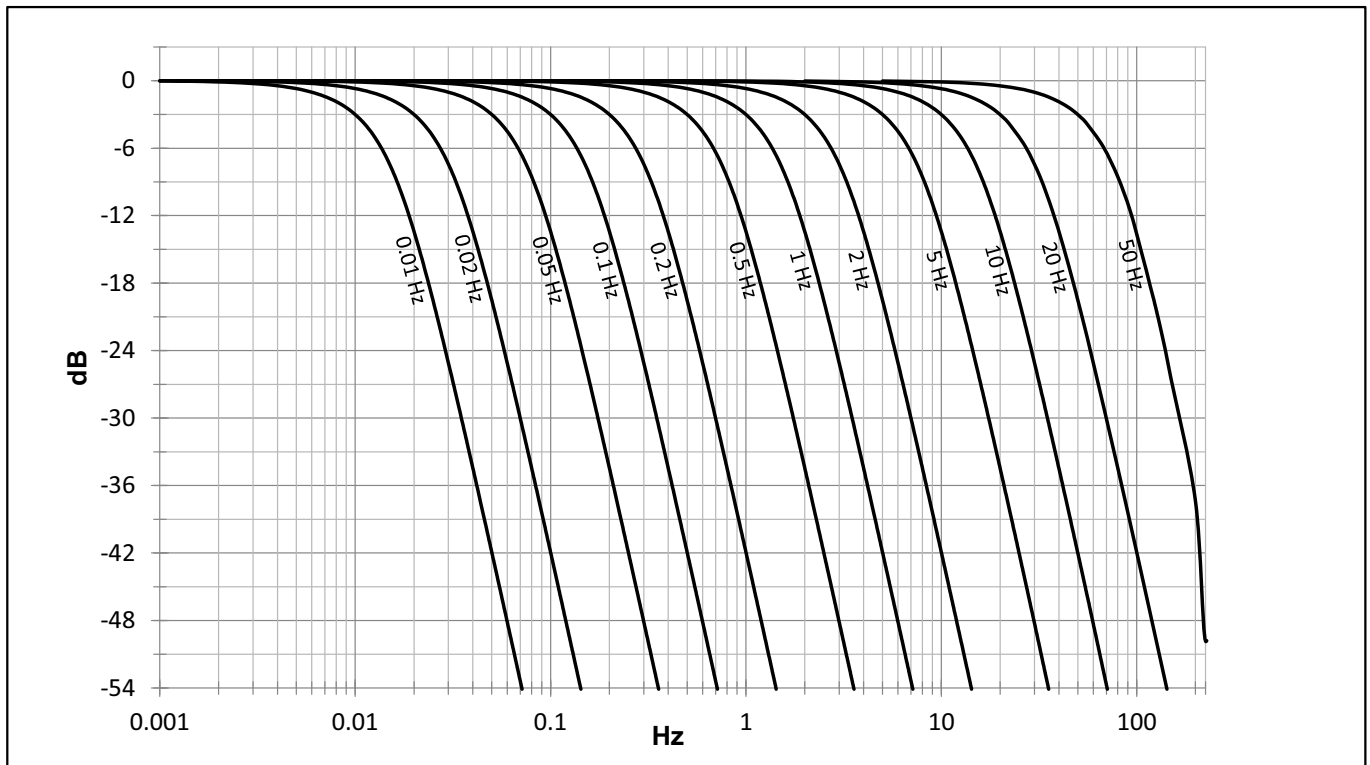
Decimal sample rates and digital low pass filter, type Butterworth 4th order

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay[*) (ms)	Rise time (ms)	Overshoot (%)	Sample rate (Hz)
Butterworth	42	50	89	9.2	7.7	10.8	20,000
	17	20	35.5	23	19,3	10.8	20,000
	8,4	10	17.8	45	39	10.8	20,000
	4	5	8.9	90	77	10.8	20,000
	1.7	2	3.5	225	193	10.9	20,000
	0.8	1	1.8	449	387	10.8	20,000
	0.4	0.5	0.9	898	774	10.8	10,000
	0.17	0.2	0.3	2,241	1,930	10.9	10,000
	0.08	0.1	0.18	4,481	3,861	10.9	5,000
	0.04	0.05	0.09	8,962	7,721	10.9	1,000
	0.02	0.02	0.03	22,405	19,303	10.9	1,000
	0.008	0.01	0.02	44,810	38,606	10.9	500

[*) The analog-to-digital converter and prefilter's delay time is 3.2 ms for all sample rates and has not been accounted for in the "Phase delay" column!

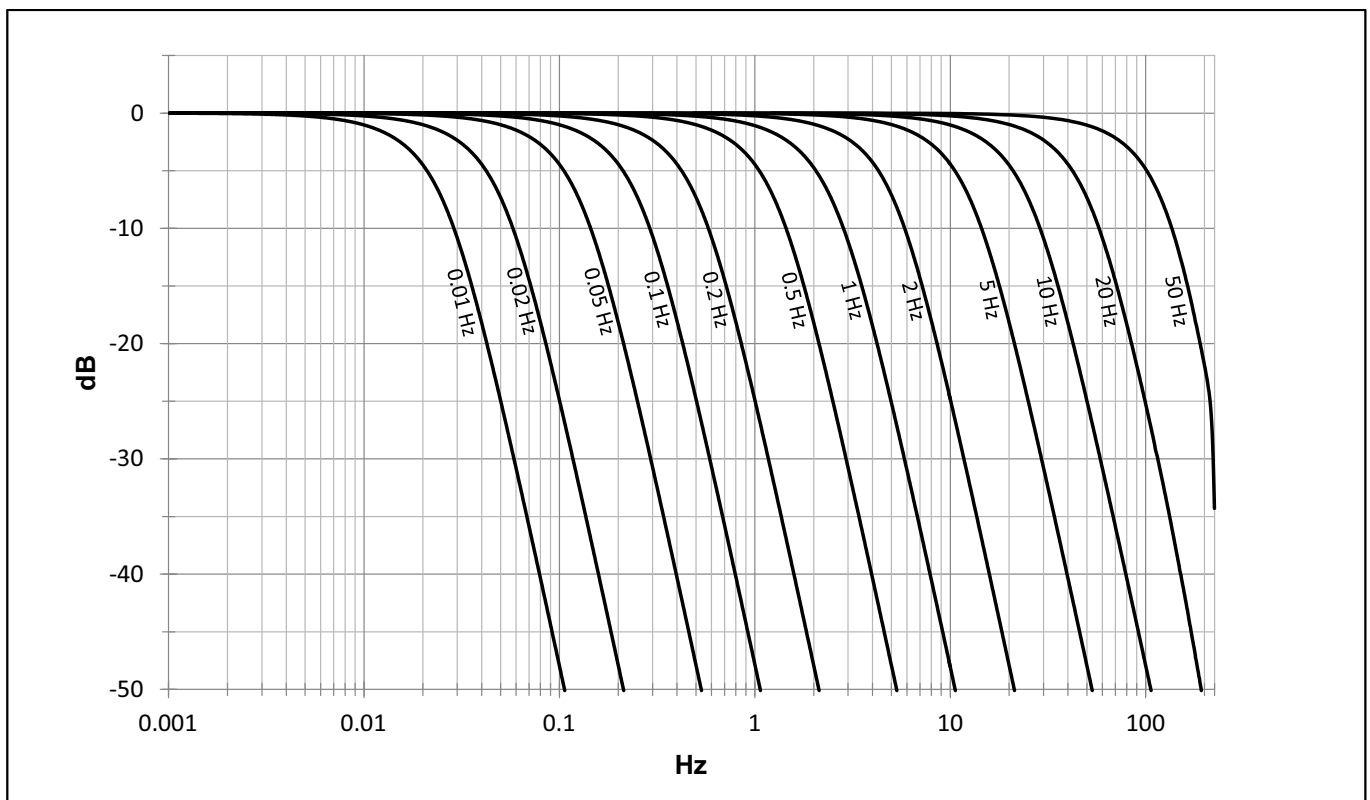## Decimal data rates : Amplitude response Butterworth filter

Classic HBM sample rates and digital low pass filter, type Bessel 4th order

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)[*]	Rise time (ms)	Overshoot (%)	Data rate (Hz)
Bessel	50	83	215	4	4.28	0.8	9,600
	20	33.7	85	10	10.6	0.8	9,600
	10	16.5	42	20	21.3	0.8	9,600
	5	8.4	21	40	41.6	0.8	2,400
	2	3.4	8,5	99	104	0.8	2,400
	1	1.6	4,2	200	214	0.8	2,400
	0.5	0.83	2.1	400	420	0.8	300
	0.2	0.34	0.85	1,000	1,060	0.8	300
	0.1	0.17	0.43	2,000	2,130	0.8	300
	0.05	0.084	0.21	3,940	4,200	0.8	20
	0.02	0.033	0.085	10,000	10,600	0.8	20
	0.01	0.017	0.042	20,100	21,300	0.8	20

[*] The analog-to-digital converter and prefilter's delay time is 3.3 ms for all sample rates and has not been accounted for in the "Phase delay" column!

# Classic HBM sample rates : Amplitude response Bessel filter

Classic HBM sample rates and digital low pass filter, type Butterworth 4th order

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)[*)]	Rise time (ms)	Overshoot (%)	Data rate (Hz)
Butterworth	50	59	105	6.98	6.6	11	9,600
	20	24	42	17.3	16	11	9,600
	10	12	21	34.9	32	11	9,600
	5	5.95	10.5	69	66	11	2,400
	2	2.37	4.24	173	160	11	2,400
	1	1.26	2.1	347	320	11	2,400
	0.5	0.59	1.05	701	660	11	300
	0.2	0.236	0.421	1,760	1,600	11	300
	0.1	0.118	0.21	3,510	3,200	11	300
	0.05	0.059	0.105	6,950	6,600	11	20
	0.02	0.0235	0.042	17,500	1,600	11	20
	0.01	0.012	0.021	34,600	3,200	11	20

[*)] The analog-to-digital converter and prefilter's delay time is 3.3 ms for all sample rates and has not been accounted for in the "Phase delay" column!

Classic HBM sample rates : Amplitude response Butterworth filter
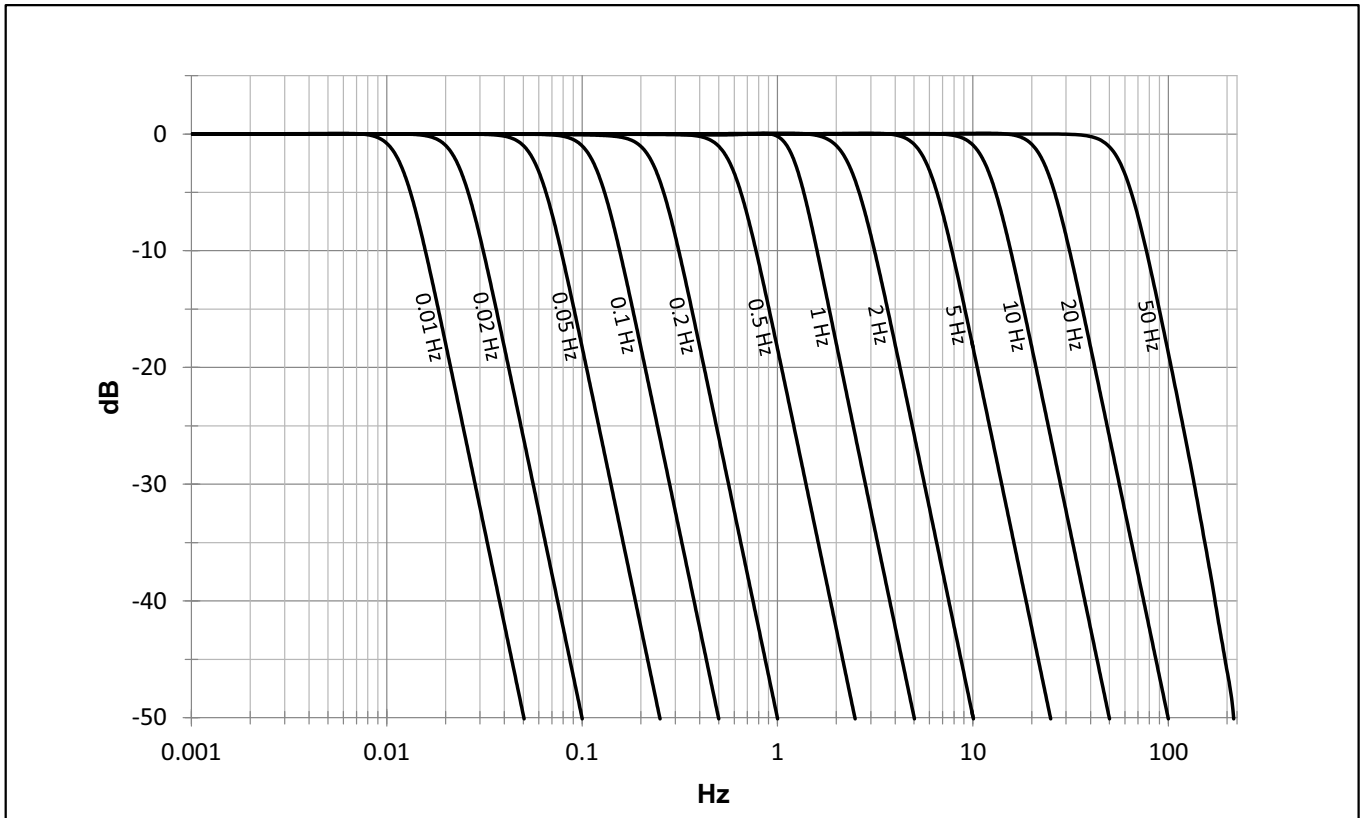
Specifications Power pack NTX001

NTX001		
Nominal input voltage (AC)	V	100 ... 240 ($\pm$10%)
Stand–by power consumption at 230 V	W	0.5
Nominal load U_A I_A	 V A	 24 1.25
Static output characteristics U_A I_A U_{Br} (Output voltage ripple; peak to peak)	 V A mV	 24 $\pm$ 4% 0 ... 1.25 $\leq$120
Current limiting, typically from	A	1.6
Primary – secondary separation		galvanically, by optocoupler and converter
Creep distance and clearance	mm	$\geq$8
High-voltage test	kV	$\geq$4
Ambient temperature range	ºC [°F]	0 ... +40 [+32 ... +104]
Storage temperature	ºC [°F]	–40 ... +70 [–40 ... +158]

Accessories, to be ordered separately

MX238B accessories		
Article	**Description**	**Order No.**
Power		
AC-DC power supply / 24 V	Input : 100 ... 240 V AC ($\pm$10%), 1.5 m cable Output: 24 V DC, max. 1.25 A, 2 m cable with ODU connector	1–NTX001
3m cable – QuantumX supply	3 m cable for voltage supply of QuantumX modules; Suitable plug (ODU Medi-Snap S11M08–P04MJGO–5280) on one side and open strands on the other end.	1–KAB271–3
Communication		
IEEE1394b FireWire cable (module-to-module)	FireWire connection cable for QuantumX or SomatXR-modules; with matching plugs on both sides. Length 0.2 m/2 m/5 m Note: The cable enables QuantumX modules to be supplied with power (max. 1.5 A, from the source to the last drain).	1–KAB272–0.2 1–KAB272–2 1–KAB272–5
IEEE1394b IEEE1394b FireWire IEEE ExpressCard	FireWire IEEE 1394b ExpressCard (ExpressCard/34) to connect QuantumX modules to a notebook or PC	1–IF–002
IEEE1394b FireWire cable PC-to-module, IP20/IP68	Firewire connection cable from the PC to the first module for data transfer from QuantumX modules to the PC; With matching plugs on both sides; Length: 3 m. Connection via KAB293 not possible.	1–KAB293–5
IEEE1394b IEEE1394b FireWire cable from hub to module, IP68	FireWire connection cable between HUB and module (IP20). For data transfer from QuantumX modules to the HUB. Fitted with suitable plugs at both ends. Length: 3 m	1–KAB276–3
IEEE1394b FireWire Extender SCM–FW, IP68	Package including 2 in-line elements for extension of the FireWire connection up to 40 m; Required parts: 2 x 1-KAB269-x and Industrial Ethernet cable (M12, CAT5e/6, max. 30 m). KAB270-3 connection is not possible!	1–SCM-FW
Ethernet cross over cable	Ethernet cross over cable for direct operation between a PC or Notebook and a module / device, length 2 m, type CAT5+	1–KAB239–2

Accessories MX238B, to be ordered separately (continued)

Accessories MX238B		
Article	**Description**	**Order No.**
Mechanic		
Connecting elements for QuantumX modules	Connecting elements (clips) for QuantumX modules; Set comprising 2 case clips including mounting 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
QuantumX Backplane (Standard)	QuantumX Backplane − Standard for a maximum of 9 modules, IP 20 version; General: − Mounting on wall or control cabinet (19") - Connection of external modules by FireWire possible; - Power supply: 24 V DC / max. 5 A (150 W);	1−BPX001
QuantumX Backplane	QuantumX Backplane − Rack for maximum 9 modules in IP 20; - 19" rack mounting with handles left and right; - Connection of external modules via FireWire possible; - Power supply: 24 V DC / max. 5 A (150 W).	1−BPX002
Transducer side		
D−sub−HD15 adapter 15 pole-to-D−Sub 15 pole	Two D−sub−HD15 pole-to-D−Sub 15 pole adapter for connection of strain gauge full bridge transducers with pre-wired D−sub plug (length approx. 0.3 m); Note: Pre-wired for full bridge (6-wire).	1−KAB416
D−sub−HD15 jack adapter to MS socket	Two adapters for strain gauge full bridge transducers in 6−wire configuration with MS plug at QuantumX. Design: MS socket, 30 cm cable, 6−wire, D−sub−HD15 plug	1−KAB144
D−sub−HD15-pole connector kit with TEDS chip	D−sub−HD15-pole connector kit (male) with TEDS chip for storage of a sensor data sheet; Housing: Metallized plastic with knurled screws. Note: The TEDS chip comes blank.	1−SUBHD15−MALE
Port saver, D−sub−HD 15 pol.	4 x D−sub−HD15 pin male to female port savers; protecting the wear and tear for frequent plugging and unplugging. Extends contact durability by min. 500. Adaptor attaches securely with screws 4-40 UNC.	1−SUBHD15−SAVE
TEDS-Package	Package of TESDS chips. Package of 10 1−wire−EEPROM DS24B33 (IEEE 1451.4 TEDS)	1−TEDS−PAK
1000 ohm strain gauge quarter bridge module	Signal conditioning of strain gauge quarter bridge at QuantumX full bridge input. Integrated 1000−ohm completion resistor; soldering points for transducer cable (3 wire); TEDS; D−sub−HD device connection	1−SCM−SG1000
700 ohm strain gauge quarter bridge module	Signal conditioning of strain gauge quarter bridge at QuantumX full bridge input. Integrated 700−ohm completion resistor; soldering points for transducer cable (3 wire); TEDS; D−sub−HD device connection	1−SCM−SG700
350 ohm strain gauge quarter bridge module	Signal conditioning of strain gauge quarter bridge at QuantumX full bridge input. Integrated 350−ohm completion resistor; soldering points for transducer cable (3 wire); TEDS; D−sub−HD device connection	1−SCM−SG350
120 ohm strain gauge quarter bridge module	Signal conditioning of strain gauge quarter bridge at QuantumX full bridge input. Integrated 120−ohm completion resistor; soldering points for transducer cable (3 wire); TEDS; D−sub−HD device connection	1−SCM−SG120

Accessories MX238B, to be ordered separately (continued)

Accessories MX238B		
Article	**Description**	**Order No.**
Software and product packages		
MX238B + catman®AP	Package including: - amplifier - Power supply (1-NTX001) - 8 transducer plugs with TEDS (1-SUBHD15-MALE) - Ethernet Cross-over cable (1-KAB239-2) - catman®AP software from HBM (1-CATMAN-AP) - Including software maintenance for the first 12 months	1−MX238B−PAKAP
LabVIEW™-Treiber[1]	Universal driver from HBM for LabVIEW™.	1−LabVIEW−DRIVER
CANape® driver	QuantumX driver for the software CANape® from Vector Informatik. CANape versions from 10.0 are supported.	1−CANAPE−DRIVER

measure and predict with confidence

HBM

B4278-2.0 en HBM: public