QUANTUMX

MX440B

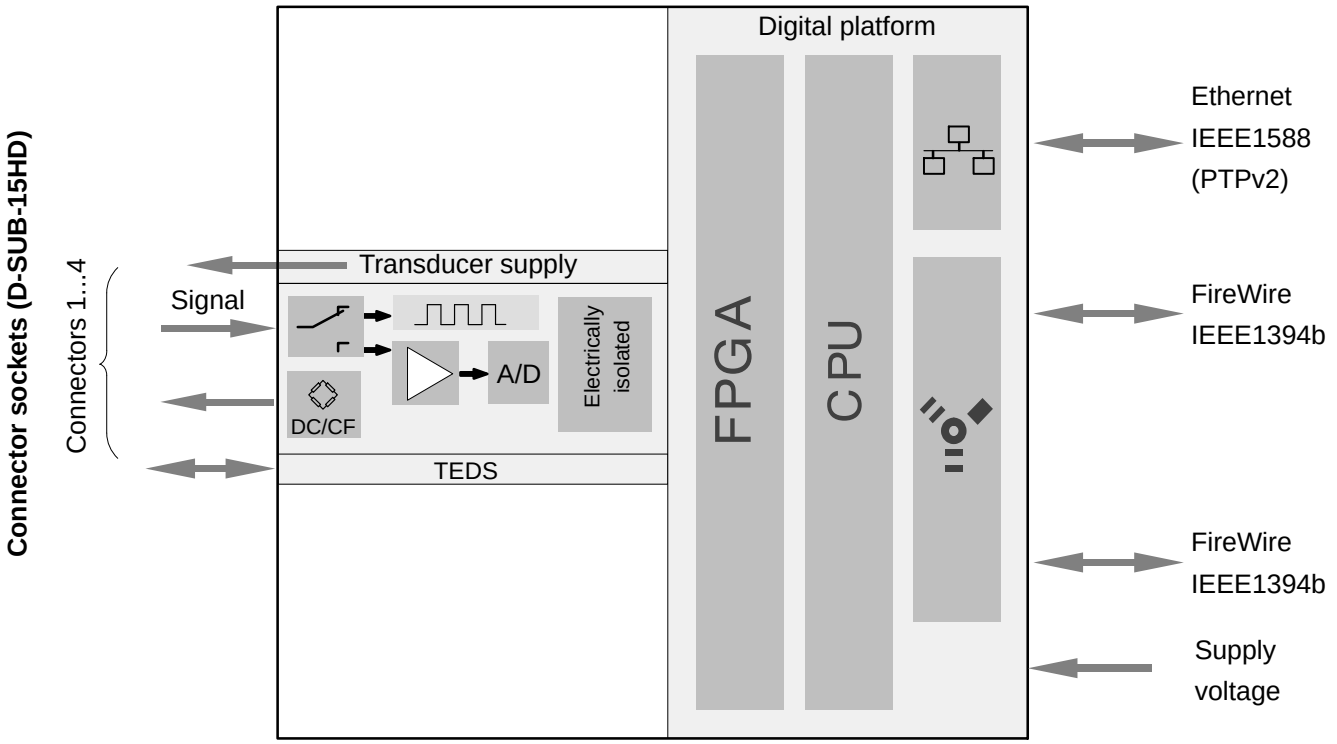
Universal amplifier

Data sheet

Special features

- **4 individually configurable inputs (electrically isolated)**
- **Connection of more than 16 different transducer types**
- **Individual sample rates up to 40kHz per channel, active low pass filter**
- **24-bit A/D converter per channel for synchronous, parallel measurements**
- **TEDS support**
- **Supply voltage for active transducers (DC): 5 V ... 24 V**

Block diagram



HBM

Specifications MX440B

General specifications		
Inputs	Number	4, electrically isolated from each other and from the supply voltage[1)]
Transducer technologies		Strain gauge full and half bridge, quarter-bridge with 1-SCM-SG120/350, inductive full and half bridge, piezoresistive full bridge, current-fed piezoelectric transducer IEPE (ICP®), potentiometric transducer, electric voltage (100 mV, 10 V or 60 V, up to 300 V CAT II with 1-SCM-HV, electric current (20 mA); resistance (e. g. PTC, NTC, KTY); resistance thermometer (Pt100, Pt500, Pt1000); thermocouples (K, N, E, T, S, ...) with cold junction in the plug (1-THERMO-MXBOARD) Frequency, incremental rotary encoder, speed sensor (rpm), pulse counter, HBM torque, SSI protocol
A/D converter		24 Bit Delta Sigma converter
Data rates (adjustable by software, default: HBM Classic)	S/s	Decimal: 0,1 . . . 40,000 HBM Classic: 0,1 … 38,400
Signal bandbwidth	Hz	7,770 (-3dB) with linear phase filter at 6,667 Hz
Active low-pass filter	Hz	Bessel, Butterworth, linear phase 0.01 ... 5,000 (-3 dB), Filter OFF
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		
Firewire		IEEE1394b (2 ports pro device)
Ethernet		IEEE1588 (PTPv2) or NTP
EtherCAT®[5)]		via CX27 EtherCAT Gateway module
IRIG-B		IRIG-B (B000 bis B007; B120 bis 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 EN 60529
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 MX440B (Continued)

EMC requirements		per EN 61326
Max. input voltage at transducer socket to ground PIN 1, 2, 3, 4, 5, 7, 8, 10, 13, 15 to Pin 6 PIN 14 (voltage) to Pin 9	 V V	 + 5.5 (no transients) ±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		0.05
Carrier frequency (sine)	Hz	4,800 ±1.5
Bridge excitation voltage (effective)	V	1 and 2.5 (±5 %)
Transducers that can be connected		strain gage full bridges
Permissible cable length between MX440B and transducer	m	100
Measuring ranges at 2.5 V excitation at 1 V excitation	 mV/V mV/V	 ±5 ±10
Signal bandwidth (-3 dB)	Hz	0 ... 1,600
Transducer impedance at 2.5 V excitation at 1 V excitation	 Ω Ω	 300 ... 1,000 80 ... 1,000
Noise at 25 °C and 2.5 V excitation (peak to peak) with filter 1 Hz Bessel with filter 10 Hz Bessel with filter 100 Hz Bessel with filter 1 kHz Bessel	 µV/V µV/V µV/V µV/V	 < 0.1 < 0.2 < 0.6 < 3
Linearity error	%	< 0.02 of full scale
Zero drift (2.5 V excitation)	% / 10 K	0.02 of full scale
Full-scale drift (2.5 V excitation)	% / 10 K	< 0.05 of measurement value

Strain gauge half bridge, 5 or 10 mV/V measuring range, bridge excitation AC / carrier frequency		
Accuracy class		0.1
Carrier frequency (sine)	Hz	4,800 ±1.5
Bridge excitation voltage (effective)	V	1 and 2.5 (±5%)
Transducers that can be connected		strain gage half bridges
Permissible cable length between MX440B and transducer	m	100
Measuring ranges at 2.5 V excitation at 1 V excitation	 mV/V mV/V	 ±5 ±10
Signal bandwidth (-3 dB)	Hz	0 ... 1600
Transducer impedance at 2.5 V excitation at 1 V excitation	 Ω Ω	 300 ... 1,000 80 ... 1,000
Noise at 25 °C and 2.5 V excitation (peak to peak) with filter 1 Hz Bessel with filter 10 Hz Bessel with filter 100 Hz Bessel with filter 1 kHz Bessel	 µV/V µV/V µV/V µV/V	 < 0.1 < 0.2 < 0.6 < 3
Linearity error	%	< 0.02 of full scale
Zero drift (2.5 V excitation)	% / 10 K	0.1 of full scale
Full-scale drift (2.5 V excitation)	% / 10 K	< 0.1 of measurement value

Specifications MX440B (Continued)

Strain gauge full bridge, 5 or 10 mV/V measuring range, bridge excitation DC / DC voltage		
Accuracy class		0.1
Bridge excitation voltage (effective)	V	1 and 2.5 (±5 %)
Transducers that can be connected		strain gauge full bridges
Permissible cable length between MX440B and transducer	m	100
Measuring ranges		
at 2.5 V excitation	mV/V	±5
at 1 V excitation	mV/V	±10
Transducer impedance		
at 2.5 V excitation	Ω	300 ... 1,000
at 1 V excitation	Ω	80 ... 1,000
Noise at 25 °C and 2.5 V excitation (peak to peak)		
with filter 1 Hz Bessel	µV/V	< 1
with filter 10 Hz Bessel	µV/V	< 1.2
with filter 100 Hz Bessel	µV/V	< 1.5
with filter 1 kHz Bessel	µV/V	< 2
Linearity error	%	< 0.02 of full scale
Zero drift (2.5 V excitation)	% / 10 K	0.1 of full scale
Full-scale drift (2.5 V excitation)	% / 10 K	< 0.05 of measurement value

Strain gauge half bridge, 5 or 10 mV/V measuring range, bridge excitation DC / DC voltage		
Accuracy class		0.1
Bridge excitation voltage (effective)	V	1 and 2.5 (±5 %)
Transducers that can be connected		strain gauge half bridges
Permissible cable length between MX440B and transducer	m	100
Measuring ranges		
at 2.5 V excitation	mV/V	±5
at 1 V excitation	mV/V	±10
Transducer impedance		
at 2.5 V excitation	Ω	300 ... 1,000
at 1 V excitation	Ω	80 ... 1,000
Noise at 25 °C and 2.5 V excitation (peak to peak)		
with filter 1 Hz Bessel	µV/V	< 1
with filter 10 Hz Bessel	µV/V	< 1.2
with filter 100 Hz Bessel	µV/V	< 1.5
with filter 1 kHz Bessel	µV/V	< 2
Linearity error	%	< 0.02 of full scale
Zero drift (2.5 V excitation)	% / 10 K	0.1 of full scale
Full-scale drift (2.5 V excitation)	% / 10 K	< 0.1 of measurement value

Resistive (strain gauge) full bridge, 100 mV/V measuring range, bridge excitation DC / DC voltage e.g. for piezoresistive transducers		
Accuracy class		0.05
Excitation voltage (DC)	V	2.5 ±5%
Transducers that can be connected		piezoresistive strain gauge full bridges
Permissible cable length between MX440B and transducer	m	100
Measuring range	mV/V	±100
Transducer impedance	Ω	300 ... 1,000
Noise at 25 °C (peak to peak)		
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	< 10
Linearity error	%	< 0.02 of full scale
Zero drift	% / 10 K	< 0.02 of full scale
Full-scale drift	% / 10 K	< 0.05 of measurement value

Specifications MX440B (Continued)

Resistive full bridge, 1000 mV/V measuring range, bridge excitation DC / DC voltage e.g. for piezoresistive transducers		
Accuracy class		0.05
Bridge excitation voltage (DC)	V	2.5 ±5%
Transducers that can be connected		piezoresistive strain gauge full bridges
Permissible cable length between MX440B and transducer	m	100
Measuring range	mV/V	±1,000
Transducer impedance	Ω	300 ... 1,000
Noise at 25 °C (peak to peak)		
with filter 1 Hz Bessel	µV/V	< 10
with filter 10 Hz Bessel	µV/V	< 20
with filter 100 Hz Bessel	µV/V	< 40
with filter 1 kHz Bessel	µV/V	< 100
Linearity error	%	< 0.02 of full scale
Zero drift	% / 10 K	< 0.02 of full scale
Full-scale drift	% / 10 K	< 0.05 of measurement value

Inductive full bridge, 100 mV/V measuring range, bridge excitation AC		
Accuracy class		0.05
Carrier frequency (sine)	Hz	4,800 ±1.5
Bridge excitation voltage (effective)	V	1 and 2.5 (±5 %)
Transducers that can be connected		inductive full bridges
Permissible cable length between MX440B and transducer	m	100
Measuring ranges		
at 2.5 V excitation	mV/V	±100
at 1 V excitation	mV/V	±300
Signal bandwidth (-3 dB)	Hz	0 ... 1,600
Transducer impedance		
at 2.5 V excitation	Ω	300 ... 1,000
at 1 V excitation	Ω	80 ... 1,000
Noise at 25 °C and 2.5 V excitation (peak to peak)		
with filter 1 Hz Bessel	µV/V	< 1
with filter 10 Hz Bessel	µV/V	< 2
with filter 100 Hz Bessel	µV/V	< 5
with filter 1 kHz Bessel	µV/V	< 15
Linearity error	%	< 0.02 of full scale
Zero drift (2.5 V excitation)	% / 10 K	< 0.02 of full scale
Full-scale drift (2.5 V excitation)	% / 10 K	< 0.05 of measurement value

Inductive full bridge, 1000 mV/V measuring range, bridge excitation AC		
Accuracy class		0.1
Carrier frequency (sine)	Hz	4,800 ±1.5
Bridge excitation voltage (effective)	V	1 (±5 %)
Transducers that can be connected		inductive full bridges
Permissible cable length between MX440B and transducer	m	100
Measuring range	mV/V	±1,000
Signal bandwidth (-3 dB)	Hz	0 ... 1,600
Transducer impedance	Ω	80 ... 1,000
Noise at 25 °C (peak to peak)		
with filter 1 Hz Bessel	µV/V	< 10
with filter 10 Hz Bessel	µV/V	< 30
with filter 100 Hz Bessel	µV/V	< 100
with filter 1 kHz Bessel	µV/V	< 300
Linearity error	%	< 0.02 of full scale
Zero drift	% / 10 K	< 0.02 of full scale
Full-scale drift	% / 10 K	< 0.1 of measurement value

Specifications MX440B (Continued)

Inductive half bridge, 100 mV/V measuring range, bridge excitation AC		
Accuracy class		0.1
Carrier frequency (sine)	Hz	4,800 ±1.5
Bridge excitation voltage (effective)	V	1 and 2.5 (±5 %)
Transducers that can be connected		inductive half bridges
Permissible cable length between MX440B and transducer	m	100
Measuring ranges at 2.5 V excitation at 1 V excitation	 mV/V mV/V	 ±100 ±300
Signal bandwidth (-3 dB)	Hz	0 ... 1,600
Transducer impedance at 2.5 V excitation at 1 V excitation	 Ω Ω	 300 ... 1,000 80 ... 1,000
Noise at 25 °C and 2.5 V excitation (peak to peak) with filter 1 Hz Bessel with filter 10 Hz Bessel with filter 100 Hz Bessel with filter 1 kHz Bessel	 µV/V µV/V µV/V µV/V	 < 1 < 2 < 5 < 15
Linearity error	%	< 0.02 of full scale
Zero drift (2.5 V excitation)	% / 10 K	< 0.1 of full scale
Full-scale drift (2.5 V excitation)	% / 10 K	< 0.1 of measurement value

LVDT, displacement transducer, Linear Variable Differential Transformer, bridge excitation AC		
Accuracy class		0.1
Carrier frequency (sine)	Hz	4,800 ± 1.5
Bridge excitation voltage (effective)	V	1 (±5 %)
Transducers that can be connected		LVDT
Permissible cable length between MX440B and transducer	m	100
Measuring range	mV/V	±3,000
Signal bandwidth (-3 dB)	Hz	0 ... 1,600
Transducer impedance	mH	4 ... 33
Noise at 25 °C (peak to peak) with filter 1 Hz Bessel with filter 10 Hz Bessel with filter 100 Hz Bessel with filter 1 kHz Bessel	 µV/V µV/V µV/V µV/V	 < 10 < 30 < 100 < 300
Linearity error	%	< 0.02 of full scale
Zero drift	% / 10 K	< 0.1 of full scale
Full-scale drift	% / 10 K	< 0.1 of measurement value

Potentiometric transducer / potentiometer		
Accuracy class		0.1
Excitation voltage (DC)	V	2.5 (±5 %)
Transducers that can be connected		potentiometric transducers
Permissible cable length between MX440B and transducer	m	100
Measuring range	mV/V	±500
Transducer impedance	Ω	300 ... 5,000
Noise at 25 °C (peak to peak) with filter 1 Hz Bessel with filter 10 Hz Bessel with filter 100 Hz Bessel with filter 1 kHz Bessel	 µV/V µV/V µV/V µV/V	 < 10 < 20 < 40 < 100
Linearity error	%	< 0.02 of full scale
Zero drift (1 V excitation)	% / 10 K	< 0.1 of full scale
Full-scale drift (1 V excitation)	% / 10 K	< 0.1 of measurement value

Specifications MX440B (Continued)

Current-fed piezoelectric transducers (IEPE - Integrated Electronics Piezo Electric, ICP®)		
Accuracy class		0.1
Transducer technology		IEPE (BNC adapter available: 1-SUBHD15-BNC)
Permissible cable length between MX440B and transducer May be laid inside closed buildings only	m	< 30
Transducer identification (TEDS, IEEE 1451.4)		only version 1.0
Transducer excitation	mA	4,0mA ± 15%
Measuring ranges (AC)	V	± 8
IEPE Compliance voltage, typ.	V	21
Noise at 25 °C and measuring range ± 10 V (peak to peak) at 1 Hz Bessel filter at 10 Hz Bessel filter at 100 Hz Bessel filter at 1 kHz Bessel filter	 µV µV µV µV	 < 200 < 300 < 500 < 1,500
Linearity error	%	< 0.1 of full scale value
Common-mode rejection at DC common-mode at 50 Hz common-mode, typically	 dB dB	 > 100 75
Max. common-mode voltage (to housing and supply ground)	V	± 60
Zero drift	% / 10 K	< 0.1 of full scale value

± 10 V standardized electrical voltage		
Accuracy class		0.05
Transducers that can be connected		voltage generator up to ± 10 V
Permissible cable length between MX440B and transducer	 m	BNC adapter available: 1-SUBHD15-BNC 100
Measuring range	V	± 10
Internal resistance of the voltage source	Ω	< 500
Internal impedance, typ.	MΩ	1
Noise at 25 °C (peak to peak) with filter 1 Hz Bessel with filter 10 Hz Bessel with filter 100 Hz Bessel with filter 1 kHz Bessel	 µV µV µV µV	 < 200 < 300 < 500 < 1,500
Linearity error	%	< 0.02 of full scale
Common-mode rejection with DC common mode with 50 Hz common mode, typ.	 dB dB	 > 100 75
Maximum common-mode voltage (to housing and supply ground)	 V	 ± 60
Zero drift	% / 10 K	< 0.02 of full scale
Full-scale drift	% / 10 K	< 0.05 of measurement value

Specifications MX440B (Continued)

±60 V DC voltage		
Accuracy class		0.05
Transducers that can be connected		voltage generator up to ±60 V
Permissible cable length between MX440B and transducer	m	100
Measuring range	V	±60
Internal resistance of the voltage source	Ω	< 500
Input impedance, typ.	MΩ	1
Noise at 25 °C (peak to peak) with filter 1Hz Bessel with filter 10Hz Bessel with filter 100Hz Bessel with filter 1kHz Bessel	 µV µV µV µV	 < 300 < 400 < 1,000 < 3,000
Linearity error	%	< 0.02 of full scale
Common-mode rejection with DC common mode with 50 Hz common mode, typ.	 dB dB	 > 100 75
Maximum common-mode voltage (to housing and supply ground)	V	±60
Zero drift	% / 10 K	< 0.02 of full scale
Full-scale drift	% / 10 K	< 0.05 of measurement value

±100 mV voltage		
Accuracy class		0.05
Transducers that can be connected		voltage generator
Permissible cable length between MX440B and transducer	m	100
Measuring range	mV	±100
Input impedance	MΩ	> 20
Noise at 25 °C (peak to peak) with filter 1 Hz Bessel with filter 10 Hz Bessel with filter 100 Hz Bessel with filter 1 kHz Bessel	 µV µV µV µV	 < 5 < 10 < 30 < 100
Linearity error	%	< 0.02 of full scale
Common-mode rejection with DC common mode with 50 Hz common mode, typ.	 dB dB	 > 90 75
Maximum common-mode voltage (to housing and supply ground)	V	±30
Zero drift	% / 10 K	< 0.05 of full scale
Full-scale drift	% / 10 K	< 0.05 of measurement value

Specifications MX440B (Continued)

±20 mA (0 / 4 … 20 mA) standardized electrical signal current		
Accuracy class		0.05
Transducers that can be connected		transducers with current output (0 ... 20 mA or 4 ... 20 mA)
Permissible cable length between MX440B and transducer	m	100
Measuring range	mA	±30
Measurement resistance value, typ.	Ω	10
Noise at 25 °C (peak to peak)		
with filter 1 Hz Bessel	µA	< 1
with filter 10 Hz Bessel	µA	< 1.5
with filter 100 Hz Bessel	µA	< 15
with filter 1 kHz Bessel	µA	< 40
Linearity error	%	< 0.02 of full scale
Common-mode rejection		
with DC common mode	dB	> 100
with 50 Hz common mode, typ.	dB	75
Maximum common-mode voltage (to housing and supply ground)	V	±30
Zero drift	% / 10 K	< 0.05 of full scale
Full-scale drift	% / 10 K	< 0.05 of measurement value

Ohmic resistance		
Accuracy class		0.1
Transducers that can be connected		PTC, NTC, KTY, TT-3, resistances generally (connection with 4 wire configuration)
Permissible cable length between MX440B and transducer	m	100
Measuring ranges	Ω	0 ... 5,000
Speisestrom	mA	0.4 ... 0.8
Noise at 25 °C (peak to peak)		
with filter 1 Hz Bessel	K	< 0.1
with filter 10 Hz Bessel	K	< 0.2
with filter 100 Hz Bessel	K	< 0.5
with filter 1 kHz Bessel	K	< 1.5
Linearity error	%	< ±0.02 of full scale
Zero drift	%/10K	<0.02 of full scale
Full-scale drift	% / 10 K	<0.1 of measurement value

Resistance thermometer (Pt100, Pt500, Pt1000)		
Accuracy class		0.1
Transducers that can be connected		Pt100, Pt500, Pt1000 (connection with 4 wire configuration)
Permissible cable length between MX440B and transducer	m	100
Linearization range	°C [°F]	-200 ... +848 [-328 ... +1,558.4]
Noise at 25 °C (peak to peak)		
with filter 1 Hz Bessel	K	< 0.1
with filter 10 Hz Bessel	K	< 0.2
with filter 100 Hz Bessel	K	< 0.5
with filter 1 kHz Bessel	K	< 1.5
Linearity error	K	< ±0.3
Zero drift		
with Pt100, Pt500	K / 10 K	<0.2
with Pt1000	K / 10 K	<0.1
Full-scale drift		
with PTt00	K / 10 K	<0.5
with PT500	K / 10 K	<0.8
with Pt1000	K / 10 K	<1

Specifications MX440B (Continued)

Thermocouple[1)]		
Transducers that can be connected		Thermocouples (type B, E, J, K, N, R, S, T)
Permissible cable length between MX440B and transducer	m	100
Measuring range	mV	± 100
Linearization ranges		
Type B (Pt-30 % Rh and Pt-6 % Rh)	°C [°F]	+100 ... +1,820 [+212 ... +3,308]
Type E (Ni-Cr and Cu-Ni)	°C [°F]	-200 ... +900 [-328 ... +1,652]
Type J (Fe and Cu-Ni)	°C [°F]	-210 ... +1,200 [-346 ... +2,192]
Type K (Ni-Cr and Ni-Al)	°C [°F]	-270 ... +1,372 [-454 ... +2,501.6]
Type N (Ni-14,2 % Cr and Ni-4,4 % Si-0,1 % Mg)	°C [°F]	-270 ... +1,300 [-454 ... +2,372]
Type R (Pt-13 % Rh and Pt)	°C [°F]	-50 ... +1,768 [-58 ... +3,214.4]
Type S (Pt-10 % Rh and Pt)	°C [°F]	-50 ... +1,768 [-58 ... +3,214.4]
Type T (Cu and Cu-Ni)	°C [°F]	-270 ... +400 [-454 ... +752]
Transducer impedance	Ω	< 500
Noise Type K (peak to peak)		
with Filter 1 Hz Bessel	K	0.05
with Filter 10 Hz Bessel	K	0.1
with Filter 100 Hz Bessel	K	0.5
with Filter 1 kHz Bessel	K	1
Total error limit at 22 °C ambient temperature		
Type E, J, K, T	K	± 1.5
Type R, S	K	± 4
Type B	K	± 15
Temperature drift (type K)	K/10K	< ± 0.5
Cold junction 1-THERMO-MXBOARD		
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]

1) One of the following cold junctions is required for connecting thermocouples to the MX440B (ordering no.: 1-THERMO-MXBOARD; 1-SCM-TCK; 1-SCM-TCE; 1-SCM-TCJ; 1-SCM-TCT).

Specifications MX440B (Continued)

Frequency or pulse counting (connections 5 ... 8)		
Accuracy class		0.01
Transducers that can be connected		HBM-torque transducers, Frequency signal sources (square), incremental encoder, pulse counters, SSI transducers
Permissible cable length between MX440B and transducer	m	50
Signals F_1 (±) F_2 (±) Zero index (±)		 Frequency or pulse signal Direction of rotation signal shifted by ±90° to F_1 or static Zero position signal
Input level with differential operation Low level High level		 Differential inputs (RS422): Signal (+) < Signal (-) -200 mV Differential inputs (RS422): Signal (+) > Signal (-) +200 mV
Input level with unipolar operation Low level High level	 V V	 <1.5 > 3.5
Maximum input voltage at transducer socket to ground (pin 6)	V	5.5 (no transients)
Measuring ranges Frequency Pulse counting	 Hz pulses	 0.1 ... 1,000,000 0 ... 1,000,000
Input impedance, typ.	kΩ	10
Temperature drift	%/10K	< 0,01 of measurement value
SSI mode (differentially)		
Shift clock	kHz	100, 200, 500, 1,000
Word length	Bit	12-31
Code		dual or gray
Input level Low level High level		 Differential inputs (RS422): Signal (+) < Signal (-) -200 mV Differential inputs (RS422): Signal (+) > Signal (-) +200 mV
Signals Data Shift clock		 Data+, Data- (RS-422) Clk+, Clk- (RS-422)

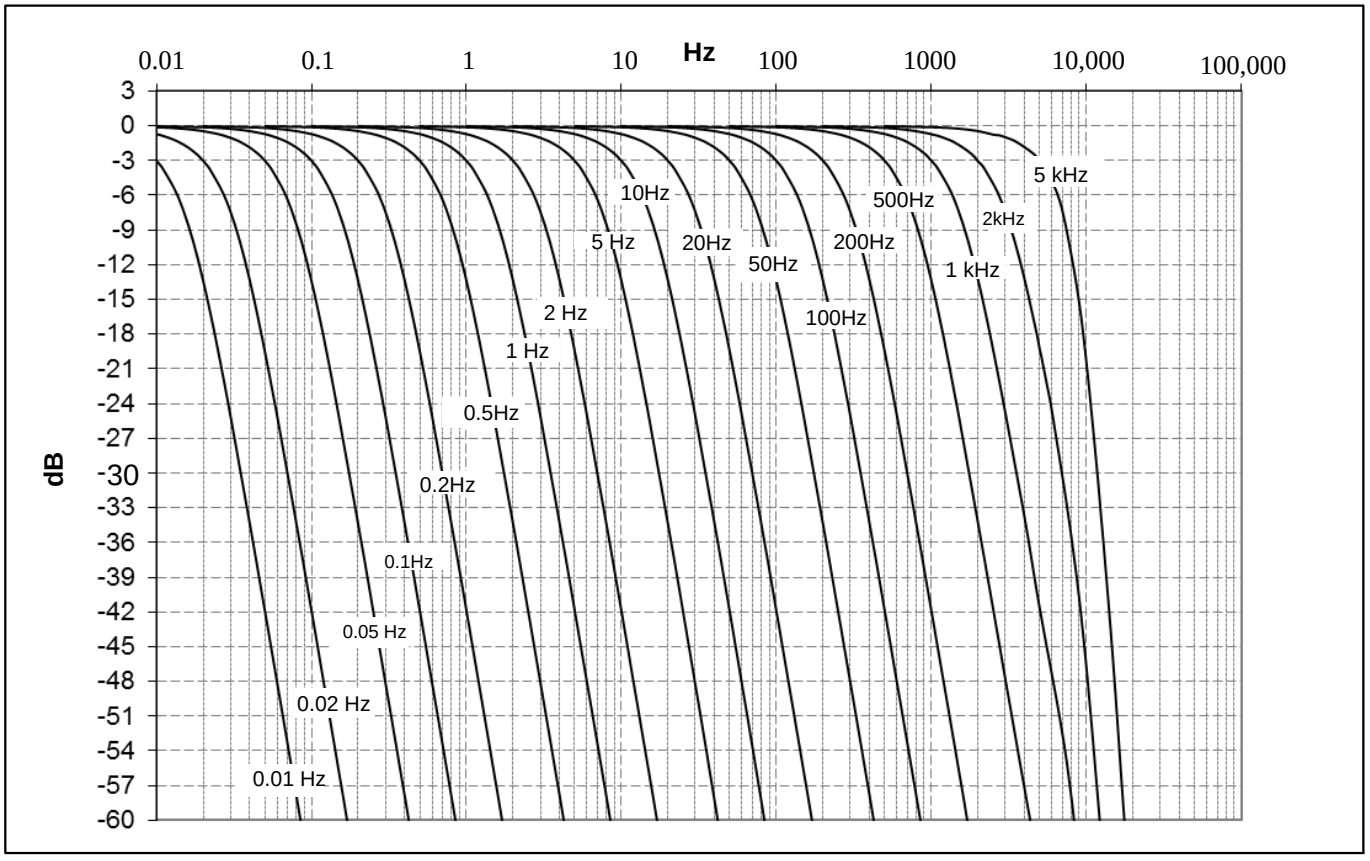
Digital control output (e.g. for triggering of external shunts, reset of external charge amplifiers)		
Output type		High side switch
Reference potential		Pin 6 (ground)
High level		
Output unloaded, typ.	V	5
I_{out} = 5 mA	V	> 4.5
Permissible load impedance	kΩ	> 1

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	3,041	5,000	9,935	0.043	0.08	3.6	40,000
	1,188	2,000	5,141	0.13	0.2	0.9	40,000
	594	1,000	2,561	0.29	0.3	0.85	40,000
	296	500	1,273	0.62	0.7	0.8	40,000
	118	200	508	1.6	1.7	0.8	40,000
	59	100	254	3.2	3.5	0.8	40,000
	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 delay time of the ADC is 65 µs for the sample rate 38,400 Hz and 128 µs for the all other sample rates. This value has not been accounted in the “phase delay” column above.

Decimal sample rates : Amplitude response Bessel filter

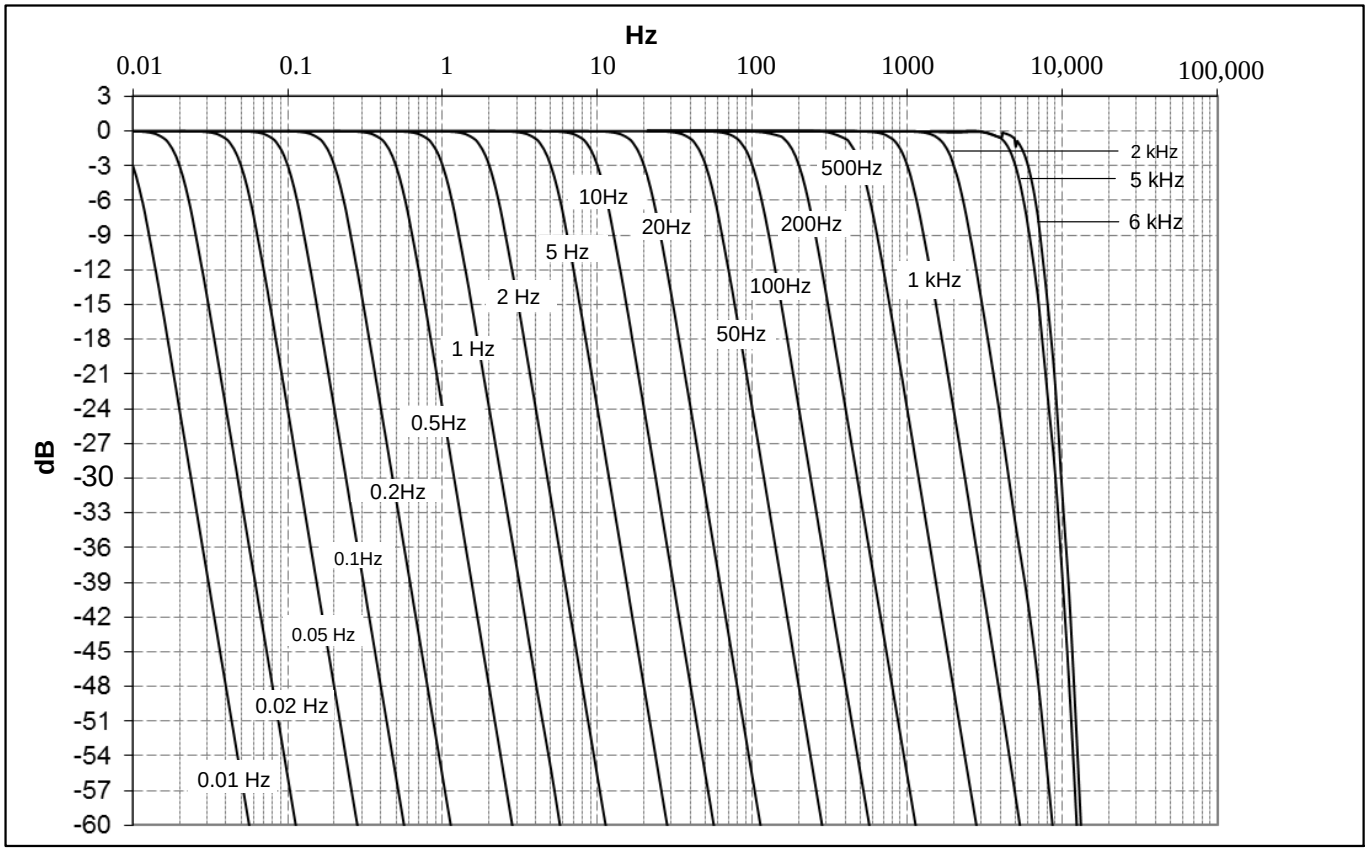


Decimal sample rates and digital low pass filter, type Butterworth 4th order

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay*) (ms)	Rise time (ms)	Overshoot (%)	Sample rate (Hz)
Butterworth	5,198	6,090	8,722	0.08	0.08	15.2	40,000
	4,274	5,000	7,667	0.10	0.09	13.7	40,000
	1,690	2,000	3,491	0.23	0.2	11	40,000
	844	1,000	1,768	0.46	0.4	10.9	40,000
	422	500	888	0.9	0.8	10.8	40,000
	169	200	355	2.2	1.9	10.8	40,000
	84	100	178	4.5	3.9	10.8	40,000
	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 delay time of the ADC is 65 µs for the sample rate 38,400 Hz and 128 µs for the all other sample rates. This value has not been accounted in the "phase delay" column above.

Decimal sample rates : Amplitude response Butterworth filter

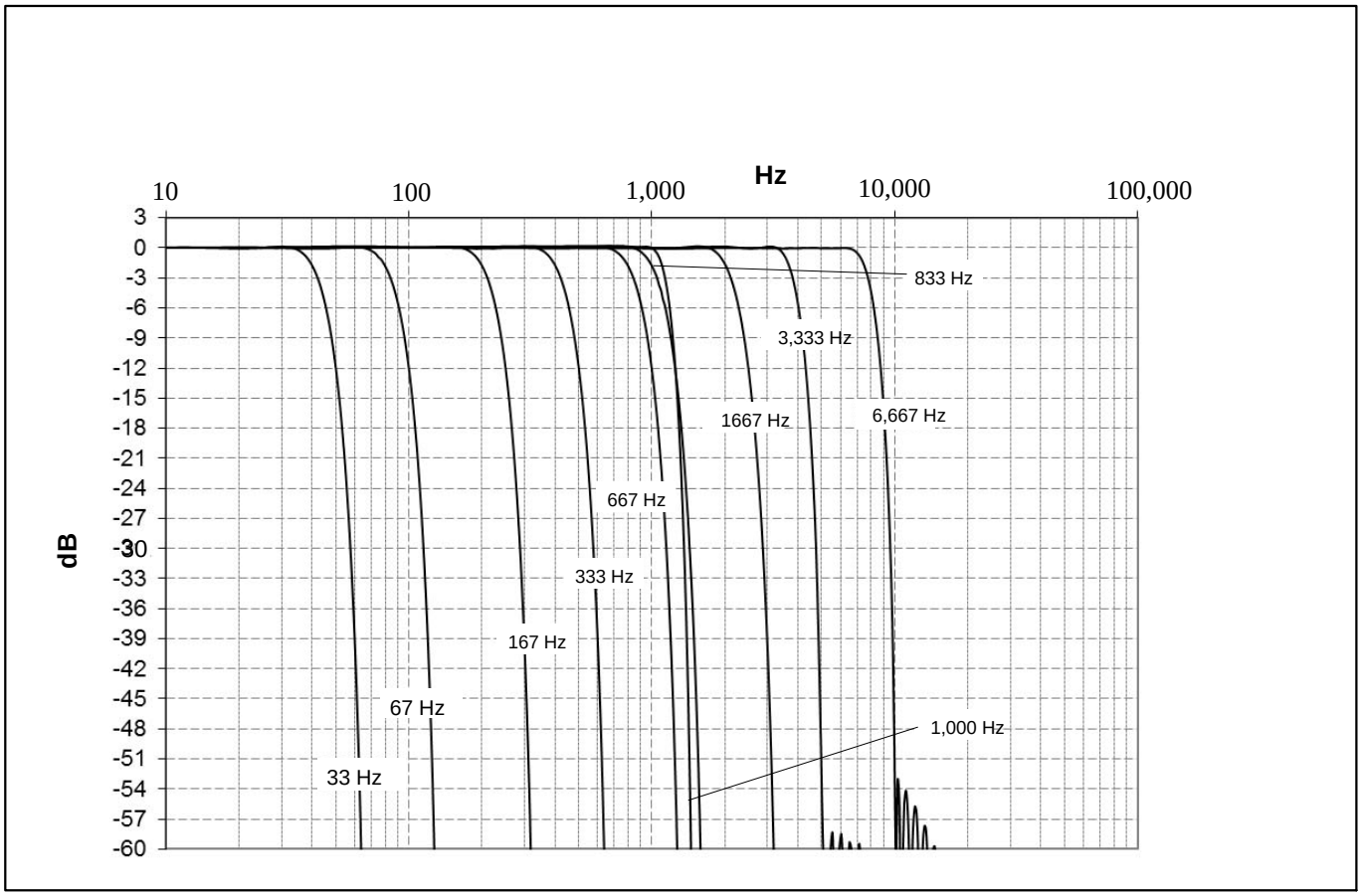


Decimal sample rates and digital low-pass filters, linear phase (FIR)

Type	Start of level drop (Hz)	-3 dB (Hz)	-20 dB (Hz)	Runtime*) (ms)	Rise time (ms)	Overshoot (%)	Sample rate (Hz)
Linear Phase	6,667	7,770	9,220	0.41	0.06	8.6	40,000
	3,333	3,800	4,540	0.78	0.12	8.6	40,000
	1,667	2,120	2,700	2.41	0.28	8.6	5,000
	1,000	1,130	1,300	6.21	0.544	8.6	2,500
	833	1,050	1,345	4.01	0.551	8.6	2,500
	667	840	1,080	4.8	0.694	8.6	1,000
	333	420	540	10.4	1.39	8.6	1,000
	167	210	270	26.9	2.73	8.6	500
	67	84	108	50.2	6.88	8.6	200
	33	42	54	108	13.8	8.6	100

*) The A/D converter's delay time for all sample rates is 65 µs and this is not taken into account in the “runtime" column!

Decimal sample rates: amplitude response, linear phase (FIR)

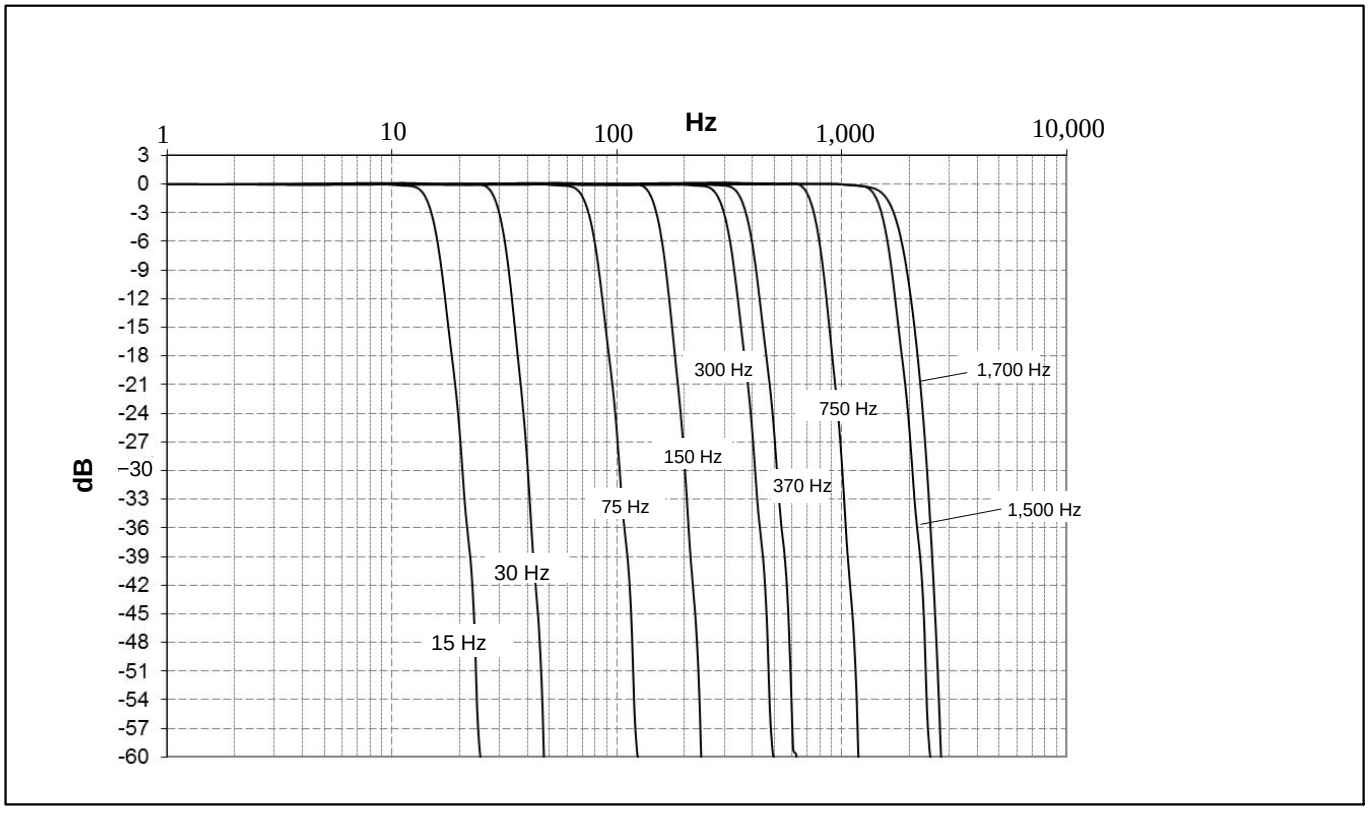


Decimal sample rates and digital low-pass filters, Butterworth (FIR)

Type	Start of level drop (Hz)	-3 dB (Hz)	-20 dB (Hz)	Runtime*) (ms)	Rise time (ms)	Overshoot (%)	Sample rate (Hz)
Butterworth	1,498	1,700	2,220	3.2	0.285	15.6	10,000
	1,384	1,500	1,887	3.48	0.346	18.7	10,000
	698	750	924	5.56	0.682	18.7	5,000
	344	370	471	14.1	1.40	18.7	2,500
	275	300	377	17.3	1.75	18.7	1,000
	140	150	185	27.6	3.41	18.7	1,000
	69	75	94	71.8	6.97	18.7	500
	28	30	37	139	17.0	18.7	200
	14	15	19	358	34.9	18.7	100

*) The A/D converter's delay time for all sample rates is 65 µs and this is not taken into account in the “runtime" column!

Decimal sample rates: Butterworth filter amplitude response (FIR)

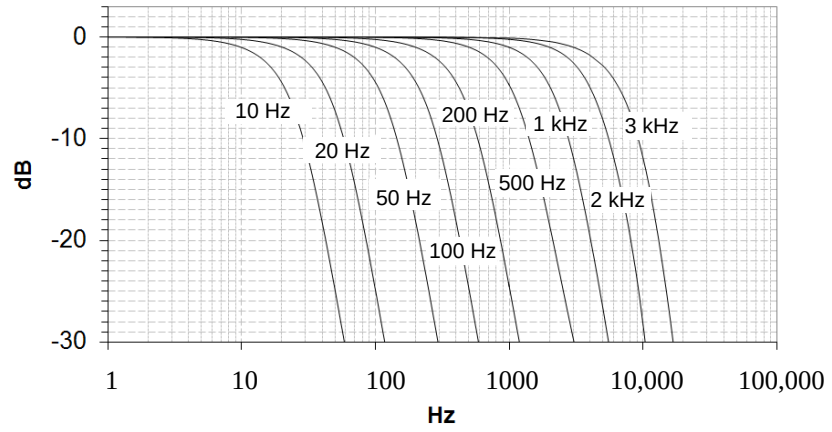


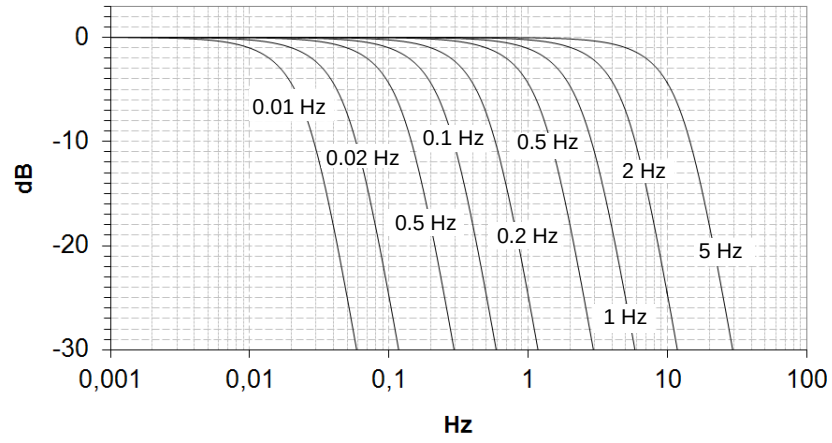
Classic HBM sample rates and digital low pass filter, type Bessel 4th order

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)*)	Rise time (ms)	Overshoot (%)	Sample rate (Hz)
Bessel	3,000	5,161	13,086	0.012	0.07	0.157	38,400
	2,000	3,210	8,100	0.15	0.1	1.5	19,200
	1,000	1,630	4,050	0.24	0.2	1.4	19,200
	1,000	1,640	5,150	0.21	0.2	0.7	9,600
	500	820	2,120	0.4	0.43	1.4	9,600
	200	335	860	1	1.04	1	9,600
	100	167	430	2	2.1	0.8	9,600
	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 delay time of the ADC is 65 µs for the sample rate 38,400 Hz and 128 µs for the all other sample rates. This value has not been accounted in the “phase delay” column above.

Classic HBM sample rates : Amplitude response Bessel filter



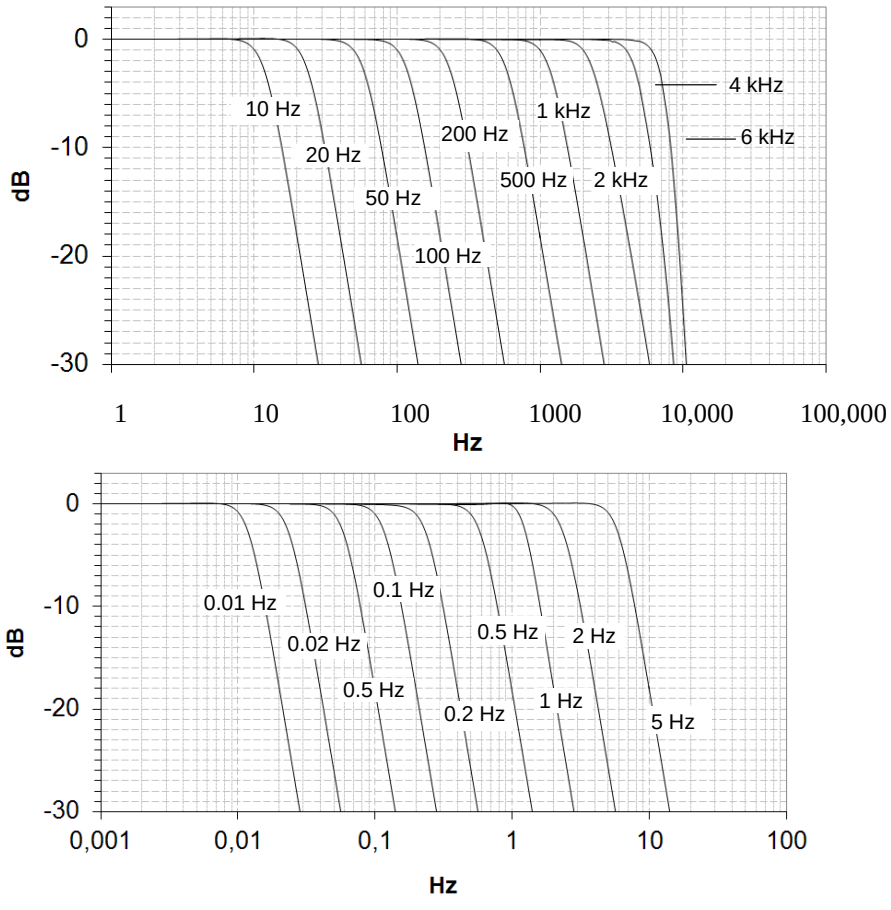


Classic HBM sample rates and digital low pass filter, type Butterworth 4th order

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)*)	Rise time (ms)	Overshoot (%)	Sample rate (Hz)
Butterworth	6,000	6,868	9,433	0.07	0.07	15.90	38,400
	4,000	4,660	7,324	0.10	0.09	13.52	38,400
	2,000	2,360	4,331	0.2	0.15	8.5	19,200
	1,000	1,178	2,100	0.38	0.3	11	19,200
	1,000	1,168	2,140	0.32	0.32	11	9,600
	500	586	1,050	0.66	0.66	11	9,600
	200	235	420	1.7	1.6	11	9,600
	100	118	210	3.46	3.2	11	9,600
	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 delay time of the ADC is 65 µs for the sample rate 38,400 Hz and 128 µs for the all other sample rates. This value has not been accounted in the “phase delay” column above.

Classic HBM sample rates : Amplitude response Butterworth filter



Specifications Power pack NTX001

NTX001		
Nominal input voltage (AC)	V	100 ... 240 (± 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 ± 4% 0 ... 1.25 ≤ 120
Current limiting, typically from	A	1.6
Primary - secondary separation		galvanically, by optocoupler and converter
Creep distance and clearance	mm	≥ 8
High-voltage test	kV	≥ 4
Ambient temperature range	°C [°F]	0... +40 [+32 ... +104]
Storage temperature	°C [°F]	-40 ... +70 [-40 ... +158]

Accessories, to be ordered separately

MX440B accessories		
Article	**Description**	**Order No.**
Power		
AC-DC power supply / 30 W	Input : 100 ... 240 V AC (± 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		
Ethernet cable	Ethernet patch cable for direct operation between a PC or Notebook and a module / device, length 2 m, type CAT6A	1-KAB239-2
IEEE1394b FireWire cable (module-to-module)	FireWire connection cable for QuantumX or SomatXR-modules; with matching plugs on both sides. Length 0.2 m (angled) / 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-W-0.2 1-KAB272-2 1-KAB272-5

Accessories, to be ordered separately (continued)

Accessories MX440B		
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 (small)	QuantumX Backplane - for a maximum of 5 modules - Connection of external modules by FireWire possible - Power supply: 24 V DC / max. 3.75 A (90 W)	1-BPX003
QuantumX Backplane (big)	QuantumX Backplane - for a maximum of 9 modules - 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 (Rack)	QuantumX Backplane - Rack for maximum 9 modules - 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		
Thermocouple Type K Adapter	Thermo Mini coupling type K adapter at QuantumX input with thermocouple support, integrated cold junction (THERMO-MXBOARD), TEDS, DSubHD-15 device connection	1-SCM-TCK
Thermocouple Type T Adapter	Thermo Mini coupling type T adapter at QuantumX input with thermocouple support, integrated cold junction (THERMO-MXBOARD), TEDS, DSubHD-15 device connection	1-SCM-TCT
Thermocouple Type E Adapter	Thermo Mini coupling type E adapter at QuantumX input with thermocouple support, integrated cold junction (THERMO-MXBOARD), TEDS, DSubHD-15 device connection	1-SCM-TCE
Thermocouple Type J Adapter	Thermo Mini coupling type J adapter at QuantumX input with thermocouple support, integrated cold junction (THERMO-MXBOARD), TEDS, DSubHD-15 device connection	1-SCM-TCJ
Cold junction for thermocouples	Electronics for temperature compensation for measurements with thermocouples including: - Pt1000 cold junction - incl. TEDS chip for transducer identification Note: Installation in DSubHD 15-pole transducer plug.	1-THERMO-MXBOARD
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; DSubHD device connection.	1-SCM-SG120
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; DSubHD device connection.	1-SCM-SG350
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; DSubHD device connection.	1-SCM-SG1000
High-voltage signal conditioner	High-voltage signal conditioner for differential measurement of voltages up to 300 V CAT II with type MX840, MX840B, MX410 and MX440A QuantumX modules, with DSubHD connector and fixed, 1-m-long measuring leads with 4-mm laboratory plugs.	1-SCM-HV
DSubHD 15-pol. to-BNC pole adapter	Adapter for QuantumX, BNC socket to DSubHD 15-pole (pin 14), for connecting 60 V, +/10 V or IEPE / ICP®), provided that the amplifier supports this function	1-SUBHD15-BNC
DSubHD 15-pole connector kit with TEDS chip	DSubHD 15-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
TEDS-Package (10 piece)	Package of TEDS chips. Package of 10 1-wire-EEPROM DS24B33 (IEEE 1451.4 TEDS)	1-TEDS-PAK
Port saver, DSubHD 15 pol.	4 x DSubHD 15 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

Accessories, to be ordered separately (continued)

Accessories MX440B		
Article	**Description**	**Order No.**
Software and product packages		
catman®AP 	Complete package including catman®Easy functionality plus additional modules such as integration of video cameras (EasyVideoCam), complete post-process analysis (EasyMath), automation of recurring processes (EasyScript), offline preparation of measurement projects (EasyPlan) as well as additional functions such as calculating electrical power, special filters, frequency spectrum, etc. More details at www.hbm.com\catman\	1-CATMAN-AP
catman®EASY 	The basic software package for measurement data acquisition comprises convenient channel parameterization using TEDS or the sensor database, measurement job parameterization, individual visualization, data storage and reporting.	1-CATMAN-EASY
catman®PostProcess 	Post Process edition for visualization, preparation and analysis of measurement data, including many mathematical functions, data export and reporting.	1-CATEASY-PROCESS
MX440B + catman®EASY	Package including: - amplifier - Power supply (1-NTX001) - 8 transducer plugs with TEDS (1-SUBHD15-MALE) - Ethernet Cross-over cable (1-KAB239-2) - catman®Easy software from HBM (1-CATMAN-EASY) - Including software maintenance for the first 12 months	1-MX440-PAKEASY
MX440B + 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-MX440-PAKAP
LabVIEW™-driver[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

[1)] More drivers and partners at www.hbm.com\quantumX\

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