SOMAT XR

MX840B-R

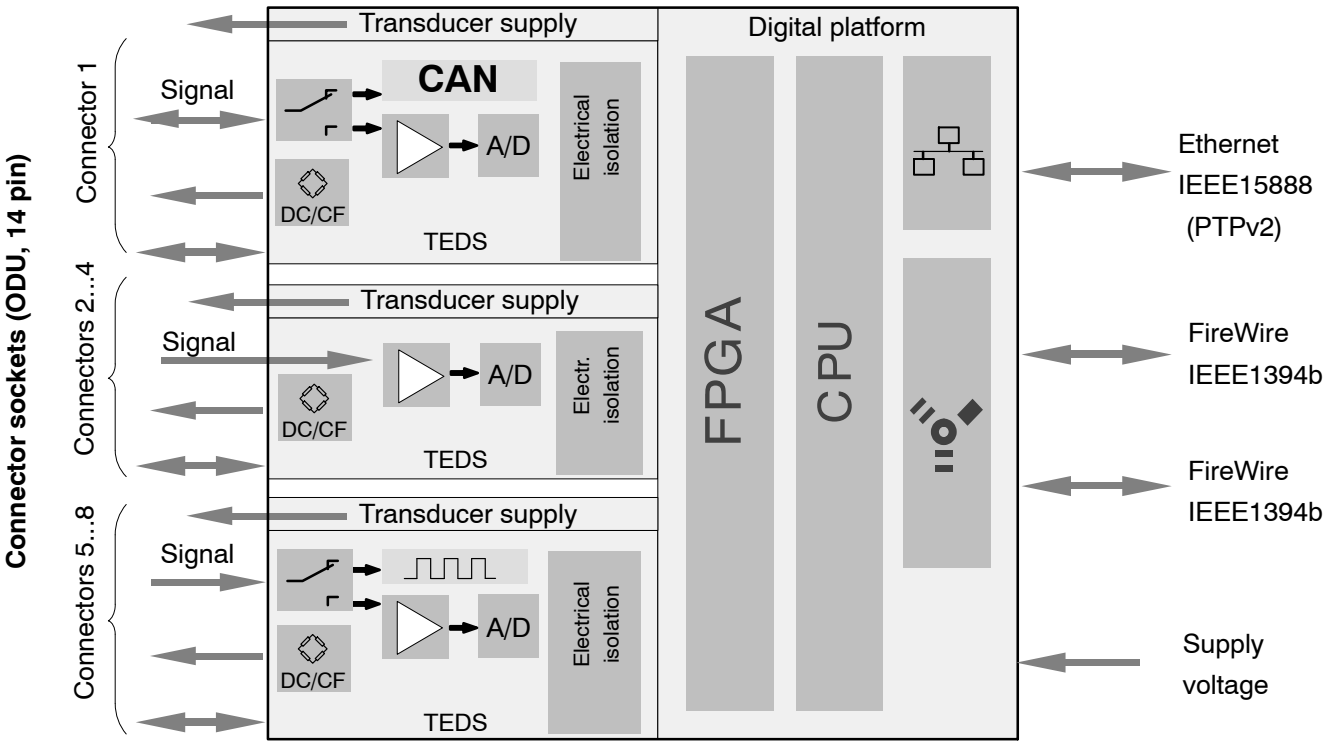
Ultra-rugged universal amplifier

Data sheet

Special features

- **8 individually configurable inputs (electrically isolated)**
- **Connection of more than 16 transducer technologies per channel**
- **Sampling rates of up to 40 kS/s per channel, active low-pass filter**
- **TEDS support**
- **Use in harsh environments (shock, vibration, temperature, dewing, moisture)**
- **Supply voltage for active transducers (DC): 5 V ... 24 V**
- **CANbus Input/Output (port 1)**

Block diagram



Specifications MX840B-R

General specifications		
Inputs	number	8, electrically isolated from each other and from the supply[1)]
Transducer technologies per connector		SG full and half bridge, inductive full and half bridge, piezoresistive full bridge, Current-fed piezoelectric transducers (IEPE / ICP®), LVDT, potentiometric transducers, voltage (±100 mV, ±10 V, ±60 V), current (20 mA), resistor (e.g. PTC, NTC, KTY), resistance thermometer (PT100, PT1000), thermocouple (type K)
		Receive CAN signals or transmit measurement signals on CAN (ISO 11898, connector 1 only)
		Frequency, pulse counting, SSI, incremental rotary encoder (connectors 5-8 only)
A/D conversion per channel		24-bit delta-sigma converter
Signal bandwidth, max. (–3 dB)	Hz	0 … 7,770 (Linear Phase FIR filter), 0 … 1,600 at carrier frequency
Sample rates	S/s	Decimal: 0.1 … 40,000 HBM Classic: 0.1 … 38,400[2)]
Active low-pass filter		Bessel, Butterworth, Linear Phase, Filter off[3)]
Transducer identification (TEDS, IEEE 1451.4)		
max. TEDS module distance	m	100
Transducer connection		ODU MINI-SNAP, 14 pins
Supply voltage range (DC)	V	10 ... 30 (nominal (rated) voltage 24 V)
Supply voltage interruption, max. (at 24 V)	ms	5[4)]
Power consumption		
without adjustable transducer excitation	W	< 9
with adjustable transducer excitation	W	< 12
Transducer excitation (active transducers)		
Adjustable supply voltage (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	–	ODU MINI-SNAP, 8 pins
Max. cable length to module	m	100
Synchronization options FireWire IEEE1394b Ethernet PTPv2 IEEE1588 Ethernet NTP		 FireWire based synchronization Ethernet based Precision Time Protocol Ethernet based Network Time Protocol
IEEE1394b FireWire (optional voltage supply)		IEEE 1394b (HBM modules only)
Max. current from module to module	A	1.5
Plug	–	ODU MINI-SNAP, 8 pins
Max. cable length between nodes	m	5
Max. number of modules connected in series (daisy chain)	–	12 (= 11 hops[5)])
Max. number of modules in a IEEE1394b FireWire system (including hubs[6)])	–	24
Max. number of hops	–	14
Nominal (rated) temperature range	°C [°F]	–40... +80 [–40 … +176] dew point resistant
Altitude de-rating	–	–
maximum temperature a 0 m	°C [°F]	+80 [+176]
maximum temperature a 2500 m	°C [°F]	+70 [+158]
maximum temperature a 5000 m	°C [°F]	+55 [+131]
Storage temperature range	°C	–40 ... +85
Relative humidity	%	5 ... 100
Protection class		III[7)]
Degree of protection		IP65/IP67 per EN 60529
EMC requirements		per EN 61326–1

1) When using variable transducer excitation voltage, clear the electrical isolation from the supply.
2) When bridge excitation with carrier frequency (CF) is used, the maximum sample rate is 19.2 kS/s per channel.
3) Filter OFF is recommended only for real–time applications to achieve short latencies.
4) Uninterruptible Power Supply (UPS)) for prolonged interruption of power, available as an accessory.
5) Hop: transition from module to module or signal conditioning/distribution via IEEE1394b FireWire (hub, backplane)
6) Hub: IEEE1394b FireWire node or distributor
7) The DC voltage supply must meet the requirements of IEC 60950–1 on a SELV voltage supply.

Specifications MX840B–R (Continued)

Mechanical tests		
Vibration		as per MIL–STD202G, method 204D, test condition C
Acceleration	m/s^2	100
Duration	min	450
Frequency	Hz	5 to 2,000
Impact		as per MIL–STD202G, method 213B, test condition B
Acceleration	m/s^2	750
Pulse duration	ms	6
Number of impacts	–	18
Operational height, max.	m	5,000
Maximum input voltage at transducer socket to ground (Pin 13), transient-free		
PIN 1, 2, 5, 6, 7, 8, 11, 12, 14	V	+ 5.5
PIN 3 (voltage)	V	± 60
Dimensions, horizontal (H x W x D)	mm	80 x 205 x 140
Weight, approx.	g	2,100

SG full bridge, bridge excitation voltage: carrier frequency		
Accuracy class		0.05
Carrier frequency (sine)	Hz	4,800 ± 1.5
Bridge excitation voltage	V	1 and 2.5 (± 5 %)
Permissible cable length between module and transducer	m	< 100
Measuring ranges		
at 2.5 V excitation	mV/V	± 5
at 1 V excitation	mV/V	± 10
Transducer impedances		
at 2.5 V excitation	Ω	300 ... 1,000
at 1 V excitation	Ω	80 ... 1,000
Noise (peak-to-peak) at 25 °C and 2.5 V excitation		
with 1 Hz Bessel filter	µV/V	< 0.1
with 10 Hz Bessel filter	µV/V	< 0.2
with 100 Hz Bessel filter	µV/V	< 0.6
with 1 kHz Bessel filter	µV/V	< 3
Non-linearity	%	< 0.02 of full scale value
Zero drift (excitation 2.5 V)	% / 10 K	< 0.02 of full scale value
Full-scale drift (excitation 2.5 V)	% / 10 K	< 0.05 of measured value

SG half bridge, bridge excitation voltage: carrier frequency		
Accuracy class		0.1
Carrier frequency (sine)	Hz	4,800 ± 1.5
Bridge excitation voltage	V	1 and 2.5 (± 5%)
Permissible cable length between module and transducer	m	< 100
Measuring ranges		
at 2.5 V excitation	mV/V	± 5
at 1 V excitation	mV/V	± 10
Transducer impedances		
at 2.5 V excitation	Ω	300 ... 1,000
at 1 V excitation	Ω	80 ... 1,000
Noise (peak-to-peak) at 25 °C and 2.5 V excitation		
with 1 Hz Bessel filter	µV/V	< 0.1
with 10 Hz Bessel filter	µV/V	< 0.2
with 100 Hz Bessel filter	µV/V	< 0.6
with 1 kHz Bessel filter	µV/V	< 3
Non-linearity	%	< 0.02 of full scale value
Zero drift (excitation 2.5 V)	% / 10 K	< 0.1 of full scale value
Full-scale drift (excitation 2.5 V)	% / 10 K	< 0.1 of measured value

Specifications MX840B–R (Continued)

SG full bridge, bridge excitation voltage: DC voltage		
Accuracy class		0.1
Bridge excitation voltage (DC)	V	1 and 2.5 (±5 %)
Permissible cable length between module and transducer	m	< 100
Measuring ranges		
at 2.5 V excitation	mV/V	±5
at 1 V excitation	mV/V	±10
Transducer impedances		
at 2.5 V excitation	Ω	300 ... 1,000
at 1 V excitation	Ω	80 ... 1,000
Noise (peak-to-peak) at 25 °C and 2.5 V excitation		
with 1 Hz Bessel filter	µV/V	< 1
with 10 Hz Bessel filter	µV/V	< 1.2
with 100 Hz Bessel filter	µV/V	< 1.5
with 1 kHz Bessel filter	µV/V	< 2
Non-linearity	%	< 0.02 of full scale value
Zero drift (excitation 2.5 V)	% / 10 K	< 0.1 of full scale value
Full-scale drift (excitation 2.5 V)	% / 10 K	< 0.05 of measured value

SG half bridge, bridge excitation voltage: DC voltage		
Accuracy class		0.1
Bridge excitation voltage (DC)	V	1 and 2.5 (±5%)
Permissible cable length between module and transducer	m	< 100
Measuring ranges		
at 2.5 V excitation	mV/V	±5
at 1 V excitation	mV/V	±10
Transducer impedances		
at 2.5 V excitation	Ω	300 ... 1,000
at 1 V excitation	Ω	80 ... 1,000
Noise (peak-to-peak) at 25 °C and 2.5 V excitation		
with 1 Hz Bessel filter	µV/V	< 1
with 10 Hz Bessel filter	µV/V	< 1.2
with 100 Hz Bessel filter	µV/V	< 1.5
with 1 kHz Bessel filter	µV/V	< 2
Non-linearity	%	< 0.02 of full scale value
Zero drift (excitation 2.5 V)	% / 10 K	< 0.1 of full scale value
Full-scale drift (excitation 2.5 V)	% / 10 K	< 0.1 of measured value

Resistive full bridge, 100 mV/V measuring range, bridge excitation: DC voltage		
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 module and transducer	m	< 100
Measuring range	mV/V	±100
Transducer impedance	Ω	300 ... 1,000
Noise (peak-to-peak) at 25 °C		
with 1 Hz Bessel filter	µV/V	< 3
with 10 Hz Bessel filter	µV/V	< 4
with 100 Hz Bessel filter	µV/V	< 5
with 1 kHz Bessel filter	µV/V	< 10
Non-linearity	%	< 0.02 of full scale value
Zero drift	% / 10 K	< 0.02 of full scale value
Full-scale drift	% / 10 K	< 0.05 of measured value

Specifications MX840B–R (Continued)

Resistive full bridge, 1000 mV/V measuring range, bridge excitation: DC voltage		
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 module and transducer	m	< 100
Measuring range	mV/V	±1,000
Transducer impedance	Ω	300 ... 1,000
Noise (peak-to-peak) at 25 °C		
with 1 Hz Bessel filter	µV/V	< 10
with 10 Hz Bessel filter	µV/V	< 20
with 100 Hz Bessel filter	µV/V	< 40
with 1 kHz Bessel filter	µV/V	< 100
Non-linearity	%	< 0.02 of full scale value
Zero drift	% / 10 K	< 0.02 of full scale value
Full-scale drift	% / 10 K	< 0.05 of measured value

Inductive full bridge, 100 mV/V measuring range, bridge excitation: DC voltage		
Accuracy class		0.05
Carrier frequency (sine)	Hz	4,800 ±1.5
Bridge excitation voltage	V	1 and 2.5 (±5 %)
Permissible cable length between module and transducer	m	< 100
Measuring ranges		
at 2.5 V excitation	mV/V	±100
at 1 V excitation	mV/V	±300
Transducer impedances		
at 2.5 V excitation	Ω	300 ... 1,000
at 1 V excitation	Ω	80 ... 1,000
Noise (peak-to-peak) at 25 °C and 2.5 V excitation		
with 1 Hz Bessel filter	µV/V	< 1
with 10 Hz Bessel filter	µV/V	< 2
with 100 Hz Bessel filter	µV/V	< 5
with 1 kHz Bessel filter	µV/V	< 15
Non-linearity	%	< 0.02 of full scale value
Zero drift (excitation 2.5 V)	% / 10 K	< 0.02 of full scale value
Full-scale drift (excitation 2.5 V)	% / 10 K	< 0.05 of measured value

Inductive full bridge, 1000 mV/V measuring range, bridge excitation: DC voltage		
Accuracy class		0.1
Carrier frequency (sine)	Hz	4,800 ±1.5
Bridge excitation voltage (effective)	V	1 (±5 %)
Permissible cable length between module and transducer	m	< 100
Measuring range	mV/V	±1,000
Transducer impedance	Ω	80 ... 1,000
Noise (peak-to-peak) at 25 °C		
with 1 Hz Bessel filter	µV/V	< 10
with 10 Hz Bessel filter	µV/V	< 30
with 100 Hz Bessel filter	µV/V	< 100
with 1 kHz Bessel filter	µV/V	< 300
Non-linearity	%	< 0.02 of full scale value
Zero drift	% / 10 K	< 0.02 of full scale value
Full-scale drift	% / 10 K	< 0.1 of measured value

Specifications MX840B–R (Continued)

Inductive half bridge, 100 mV/V measuring range, bridge excitation: carrier frequency		
Accuracy class		0.1
Carrier frequency (sine)	Hz	4,800 ±1.5
Bridge excitation voltage	V	1 and 2.5 (±5 %)
Permissible cable length between module and transducer	m	< 100
Measuring ranges at 2.5 V excitation at 1 V excitation	 mV/V mV/V	 ±100 ±300
Transducer impedances at 2.5 V excitation at 1 V excitation	 Ω Ω	 300 ... 1,000 80 ... 1,000
Noise (peak-to-peak) at 25 °C and 2.5 V excitation with 1 Hz Bessel filter with 10 Hz Bessel filter with 100 Hz Bessel filter with 1 kHz Bessel filter	 µV/V µV/V µV/V µV/V	 < 1 < 2 < 5 < 15
Non-linearity	%	< 0.02 of full scale value
Zero drift (excitation 2.5 V)	% / 10 K	< 0.1 of full scale value
Full-scale drift (excitation 2.5 V)	% / 10 K	< 0.1 of measured value

LVDT displacement transducer, Linear Variable Differential Transformer, bridge excitation: carrier frequency		
Accuracy class		0.1
Carrier frequency (sine)	Hz	4,800 ±1.5
Bridge excitation voltage (effective)	V	1 (±5 %)
Permissible cable length between module and transducer	m	< 100
Measuring range	mV/V	±3,000
Transducer impedance	mH	4 ... 33
Noise (peak-to-peak) at 25 °C with 1 Hz Bessel filter with 10 Hz Bessel filter with 100 Hz Bessel filter with 1 kHz Bessel filter	 µV/V µV/V µV/V µV/V	 < 10 < 30 < 100 < 300
Non-linearity	%	< 0.02 of full scale value
Zero drift	% / 10 K	< 0.1 of full scale value
Full-scale drift	% / 10 K	< 0.1 of measured value

Potentiometric transducers		
Accuracy class		0.1
Excitation voltage (DC)	V	2.5 ±5 %
Permissible cable length between module and transducer	m	< 100
Measuring range	mV/V	±500
Transducer impedance	Ω	300 ... 5,000
Noise (peak-to-peak) at 25 °C with 1 Hz Bessel filter with 10 Hz Bessel filter with 100 Hz Bessel filter with 1 kHz Bessel filter	 µV/V µV/V µV/V µV/V	 < 10 < 20 < 40 < 100
Non-linearity	%	< 0.02 of full scale value
Zero drift	% / 10 K	< 0.1 of full scale value
Full-scale drift	% / 10 K	< 0.1 of measured value

Specifications MX840B–R (Continued)

Current-fed piezoelectric transducers (IEPE, ICP®)		
Accuracy class		0.1
Permissible cable length between module and transducer May be laid inside closed buildings only	m	< 30
Transducer excitation	mA	4.0 ±15%
Measuring range (AC)	V	±8
IEPE compliance voltage, typ.	V	21
Noise (peak-to-peak) at 25 °C with 1 Hz Bessel filter with 10 Hz Bessel filter with 100 Hz Bessel filter with 1 kHz Bessel filter	 µV µV µV	 < 200 < 300 < 500 < 1,500
Non-linearity	%	< 0.1 of full scale value
Common-mode rejection for DC common mode at 50 Hz common mode, typical	 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
Full-scale drift	% / 10 K	< 0.05 of measured value

Voltage ±10 V		
Accuracy class		0.05
Permissible cable length between module and transducer	m	< 100
Measuring range	V	±10
Internal resistance of voltage source	Ω	< 500
Input impedance, typical	MΩ	1
Noise (peak-to-peak) at 25 °C with 1 Hz Bessel filter with 10 Hz Bessel filter with 100 Hz Bessel filter with 1 kHz Bessel filter	 µV µV µV µV	 < 200 < 300 < 500 < 1,500
Non-linearity	%	< 0.02 of full scale value
Common-mode rejection for DC common mode at 50 Hz common mode, typical	 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	< 0.05 of measured value

Specifications MX840B–R (Continued)

Voltage ±60 V		
Accuracy class		0.05
Permissible cable length between module and transducer	m	< 100
Measuring range	V	±60
Internal resistance of voltage source	Ω	< 500
Input impedance, typical	MΩ	1
Noise (peak-to-peak) at 25 °C with 1 Hz Bessel filter with 10 Hz Bessel filter with 100 Hz Bessel filter with 1 kHz Bessel filter	 µV µV µV µV	 < 300 < 400 < 1,000 < 3,000
Non-linearity	%	< 0.02 of full scale value
Common-mode rejection for DC common mode at 50 Hz common mode, typical	 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	< 0.05 of measured value

Voltage ±100 mV		
Accuracy class		0.05
Permissible cable length between module and transducer	m	< 100
Measuring range	mV	±300
Input impedance	MΩ	> 20
Noise (peak-to-peak) at 25 °C with 1 Hz Bessel filter with 10 Hz Bessel filter with 100 Hz Bessel filter with 1 kHz Bessel filter	 µV µV µV µV	 < 5 < 10 < 30 < 100
Non-linearity	%	< 0.02 of full scale value
Common-mode rejection for DC common mode at 50 Hz common mode, typical	 dB dB	 > 90 75
max. Common-mode voltage (to housing and supply ground)	 V	 ±30
Zero drift	% / 10 K	< 0.05 of full scale value
Full-scale drift	% / 10 K	< 0.05 of measured value

Specifications MX840B–R (Continued)

Current 20 mA		
Accuracy class		0.05
Permissible cable length between module and transducer	m	< 100
Measuring range	mA	±20
Measuring resistance value, typical	Ω	10
Noise (peak-to-peak) at 25 °C with 1 Hz Bessel filter with 10 Hz Bessel filter with 100 Hz Bessel filter with 1 kHz Bessel filter	 µA µA µA µA	 < 1 < 1.5 < 15 < 40
Non-linearity	%	< 0.02 of full scale value
Common-mode rejection for DC common mode at 50 Hz common mode, typical	 dB dB	 > 100 75
max. Common-mode voltage (to housing and supply ground)	V	±30
Zero drift	% / 10 K	< 0.05 of full scale value
Full-scale drift	% / 10 K	< 0.05 of measured value

Resistance		
Accuracy class		0.1
Transducers that can be connected		PTC, NTC, KTY, TT-3, resistors in general
Permissible cable length between module and transducer	m	< 100
Measuring ranges	Ω	0 ... 5,000
Feed current	mA	0.4 ... 0.8
Noise (peak-to-peak) at 25 °C and 5 kΩ detuning with 1 Hz Bessel filter with 10 Hz Bessel filter with 100 Hz Bessel filter with 1 kHz Bessel filter	 Ω Ω Ω Ω	 < 0.1 < 0.2 < 0.5 < 1.5
Non-linearity	%	< 0.02 of full scale value
Zero drift	% / 10 K	< 0.02 of full scale value
Full-scale drift	% / 10 K	< 0.1 of measured value

Resistance thermometer (PT100, PT1000)		
Accuracy class		0.1
Permissible cable length between module and transducer	m	< 100
Linearization range	°C	–200 ... +848
Noise (peak-to-peak) at 25 °C with 1 Hz Bessel filter with 10 Hz Bessel filter with 100 Hz Bessel filter with 1 kHz Bessel filter	 K K K K	 < 0.1 < 0.2 < 0.5 <1.5
Non-linearity	K	< ±0.3
Zero drift with PT100 with PT1000	 K / 10 K K / 10 K	 < 0.2 < 0.1
Full-scale drift with PT100 with PT1000	 K / 10 K K / 10 K	 < 0.5 < 1

Specifications MX840B–R (Continued)

Thermocouples[1]		
Transducers that can be connected		Thermocouples (type K[2])
Permissible cable length between module and transducer	m	< 100
Measuring range	mV	±100
Linearization ranges Type K (Ni-Cr and Ni-Al)	°C [°F]	–270 ... +1,372 [–454 ... +2,501.6]
Transducer impedance	Ω	< 500
Noise (peak to peak) at 25 °C with Filter 1 Hz Bessel with Filter 10 Hz Bessel with Filter 100 Hz Bessel with Filter 1 kHz Bessel	 K K K K	 0.05 0.1 0.5 1
Total error limit at 22 °C ambient temperature Type K	 K	 ±1
Temperature drift (type K)	K / 10 K	< 0.5

1) An adapter with an external cold junction is required for connecting these thermocouples to the MX840B–R (Order no. type K: 1–SCM–R–TCK–2).

2) A suitable adapter with a cold junction is required for other thermocouple types (B, C, E, J, N, R, S, T).

Frequency and pulse counting (connectors 5 ... 8)		
Accuracy class		0.01
Transducers that can be connected		In general timer-based digital signal sources (single lane, dual lane, with/without index), pulse counter, incremental rotary encoder, HBM–torque transducer (digital), SSI transducers (absolute position)
Permissible cable length between module and transducer	m	< 50
Signals F_1 (±) F_2 (±) Zero index (±)		 Frequency or pulse signal Directional signal shifted by ±90° to F_1 or static Zero position signal
Input signal range in differential mode Low level High level		 Differential inputs (RS–422): Signal (+) < Signal (–) –200 mV Differential inputs (RS–422): Signal (+) > Signal (–) +200 mV
Input signal range in single-pole mode Low level High level	 V V	 < 1.5 > 3.5
Maximum input voltage at transducer socket to ground (pin 6), without transients	V	5.5
Measuring ranges Frequency Pulse counting	 Hz pulses/s	 0.1 ... 1,000,000 0 ... 1,000,000
Input impedance, typical	kΩ	10
Temperature drift	% / 10 K	< 0.01 of measured value
SSI mode (differential) Clock shift Word length Coding Input signal range Low level High level Signals Data Clock shift	 kHz bit 	 100, 200, 500, 1,000 12–31 binary or gray Differential inputs (RS–422): Signal (+) < Signal (–) –200 mV Differential inputs (RS–422): Signal (+) > Signal (–) +200 mV Data+, Data– (RS-422) Clk+, Clk– (RS-422)

Specifications MX840B–R (Continued)

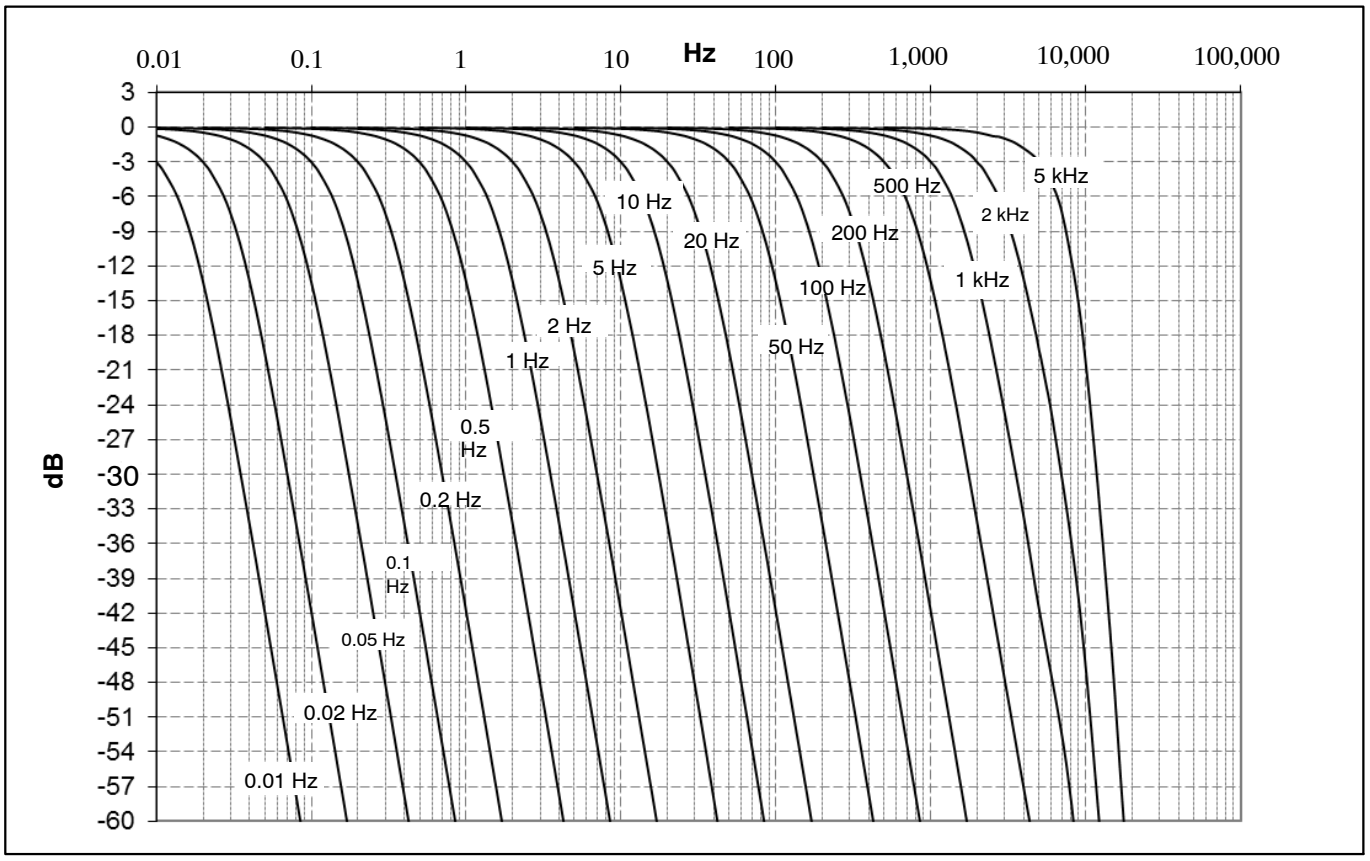
CAN (connector 1)									
Supported protocols		CAN 2.0A, CAN 2.0B							
Number of CAN ports		connector 1 only							
Bus link		Two-wire, as per ISO11898							
Bus termination resistor (internal, can be activated via Software)	Ω	approx. 120							
Bit rates	kBit/s	1,000	800	666.6	500	400	250	125	100
Max. cable lengths	m	25	50	80	100	100	250	500	500
Bit sequence		Intel standard, Motorola forward MSB							
Receiving, can be parameterized via CANdb *.dbc Rate in total Number of CAN signals CAN signal types	1/s	 max. 10,000 ≤ 128 standard, mode-dependent, mode signal							
Transmitting, via MX Assistant Transmission rate per signal (max.) Number of analog input signals (module-internal only) Generate dbc file	1/2	 100 per signal 7 with MX Assistant							

Decimal sample rates and digital low-pass filters, 4th order Bessel

Type	-1 dB (Hz)	-3 dB (Hz)	-20 dB (Hz)	Runtime*) (ms)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
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 A/D Converter's delay time for the sample rate 40 kS/s is 65 µs and for all other rates it is 128 µs. This delay time is not taken into account in the "runtime" column. The anti–aliasing filter's delay time (160 µs) is not accounted for as well. Hence 225 µs or 288 µs need to be added to the "runtime".

Decimal sample rate : Bessel filter amplitude response

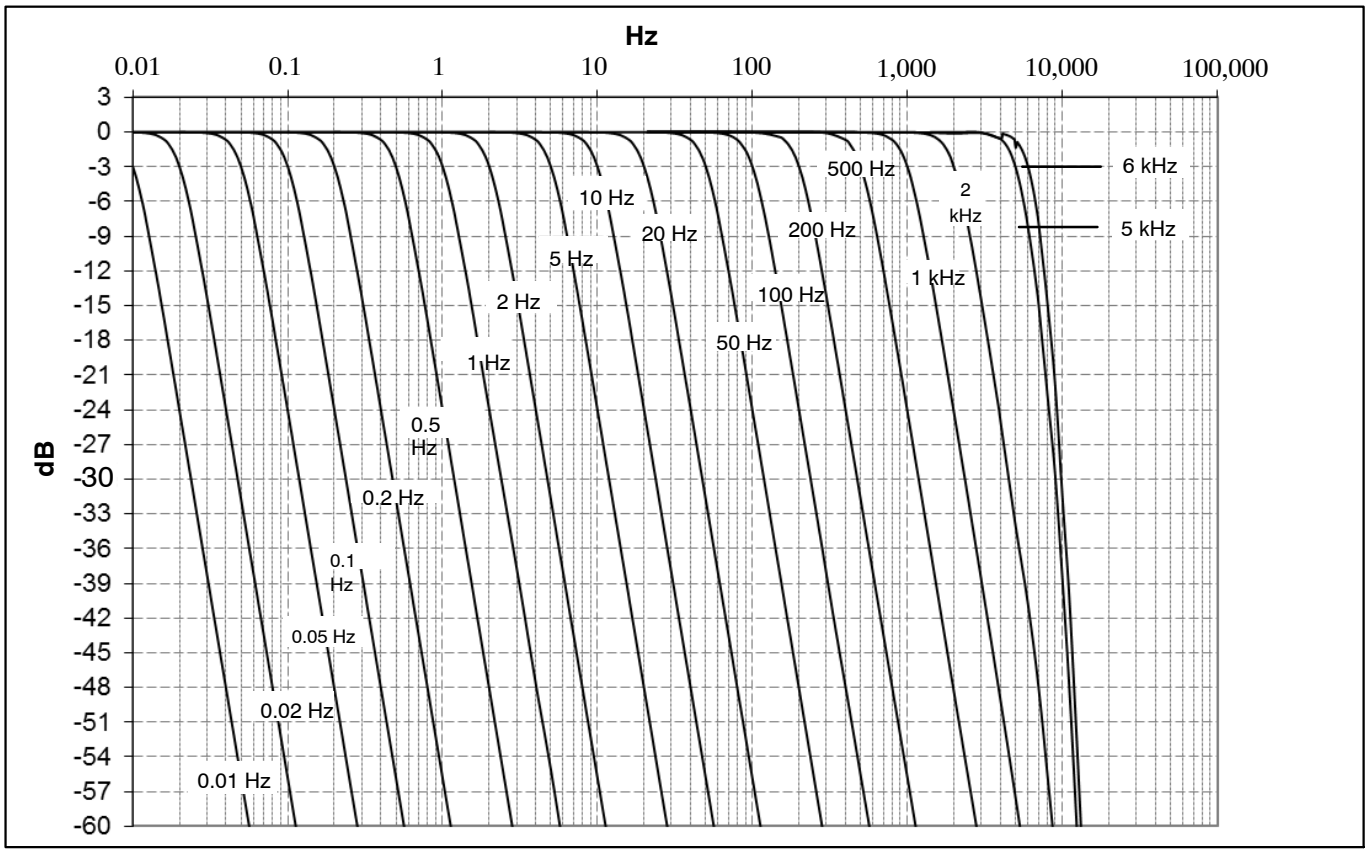


Decimal sample rates and digital low-pass filters, 4th order Butterworth

Type	-1 dB (Hz)	-3 dB (Hz)	-20 dB (Hz)	Runtime (ms)*)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
Butterworth	5,198	6,000	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	11	40,000
	422	500	888	0.9	0.8	11	40,000
	169	200	355	2.2	1.9	11	40,000
	84	100	178	4.5	3.9	11	40,000
	42	50	89	9.2	7.7	11	20,000
	17	20	35.5	23	19.3	11	20,000
	8.4	10	17.8	45	39	11	20,000
	4	5	8.9	90	77	11	20,000
	1.7	2	3.5	225	193	11	20,000
	0.8	1	1.8	449	387	11	20,000
	0.4	0.5	0.9	898	774	11	10,000
	0.17	0.2	0.3	2,241	1,930	11	10,000
	0.08	0.1	0.18	4,481	3,861	11	5,000
	0.04	0.05	0.09	8,962	7,721	11	1,000
	0.02	0.02	0.03	22,405	19,303	11	1,000
	0.008	0.01	0.02	44,810	38,606	11	500

*) The A/D Converter's delay time for the sample rate 40 kS/s is 65 µs and for all other rates it is 128 µs. This delay time is not taken into account in the "runtime" column. The anti–aliasing filter's delay time (160 µs) is not accounted for as well. Hence 225 µs or 288 µs need to be added to the "runtime".

Decimal sample rates : Butterworth filter amplitude response

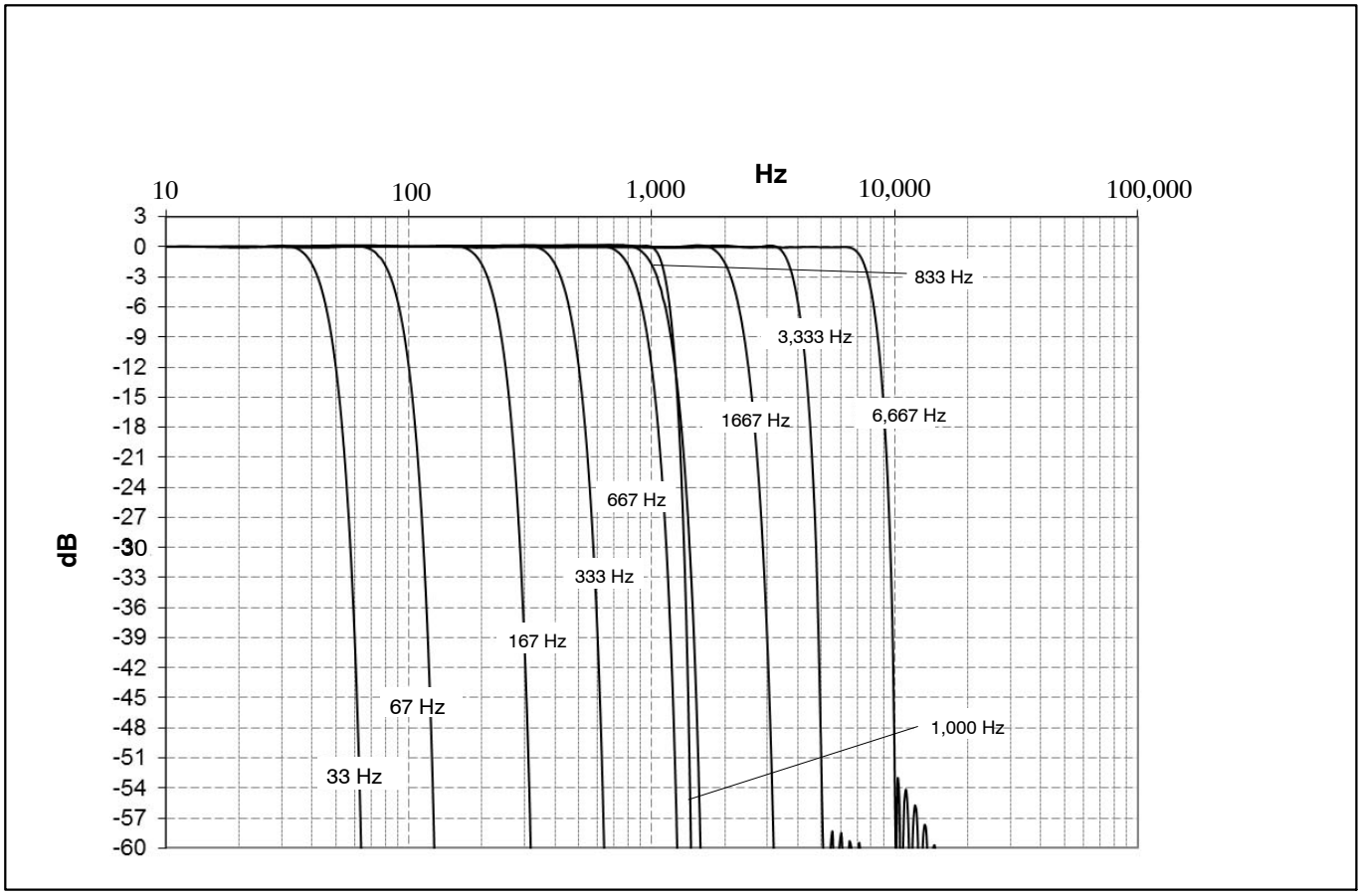


Decimal sample rates and digital low-pass filters, linear phase (FIR)

Type	Start of level drop (Hz)	-3 dB (Hz)	-20 dB (Hz)	Runtime*) (ms)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
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 the sample rate 40 kS/s is 65 µs and for all other rates it is 128 µs. This delay time is not taken into account in the "runtime" column. The anti−aliasing filter's delay time (160 µs) is not accounted for as well. Hence 225 µs or 288 µs need to be added to the "runtime".

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

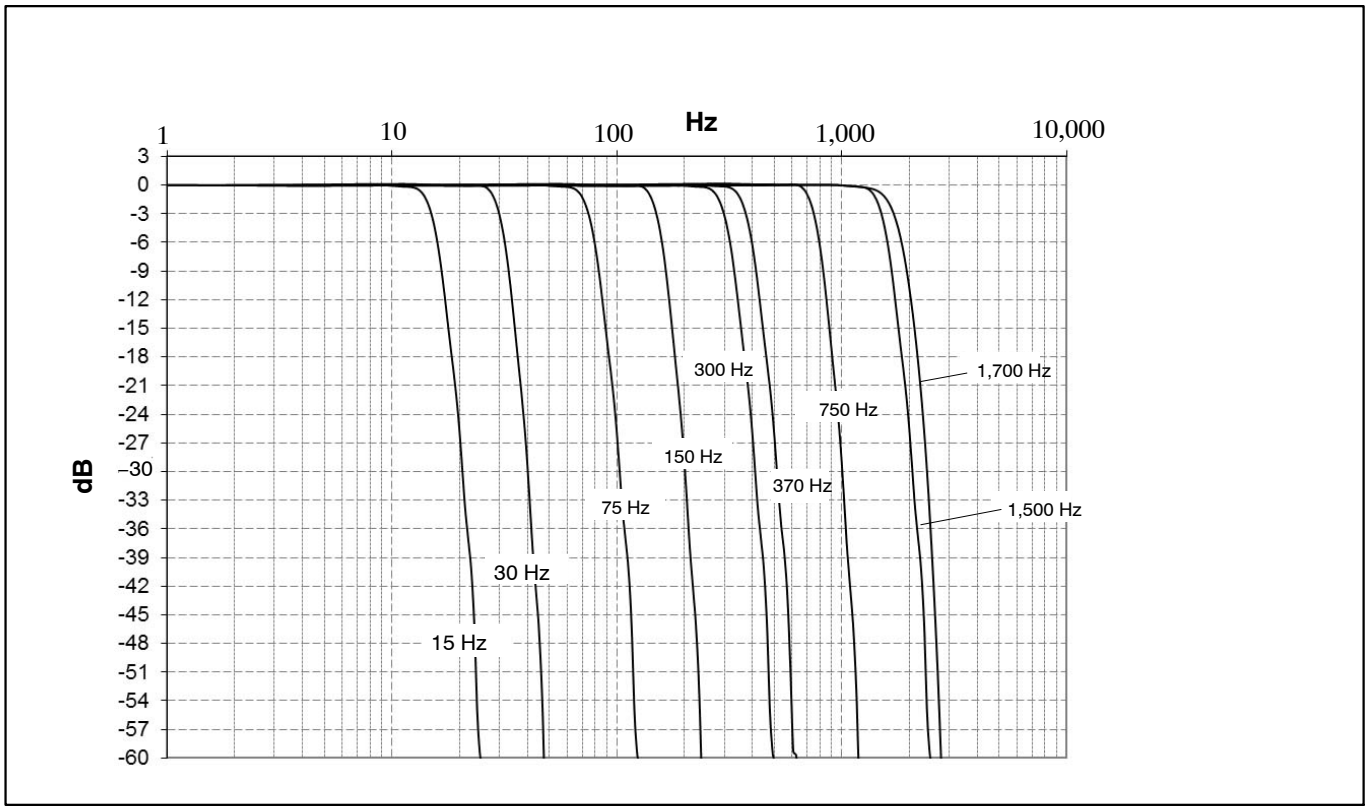


Decimal sample rates and digital low-pass filters, Butterworth (FIR)

Type	Start of level drop (Hz)	-3 dB (Hz)	-20 dB (Hz)	Runtime*) (ms)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
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 is 128 μs. This delay time is not taken into account in the "runtime" column. The anti−aliasing filter's delay time (160 μs) is not accounted for as well. Hence 288 μs need to be added to the "runtime".

Decimal sample rates: Butterworth filter amplitude response (FIR)

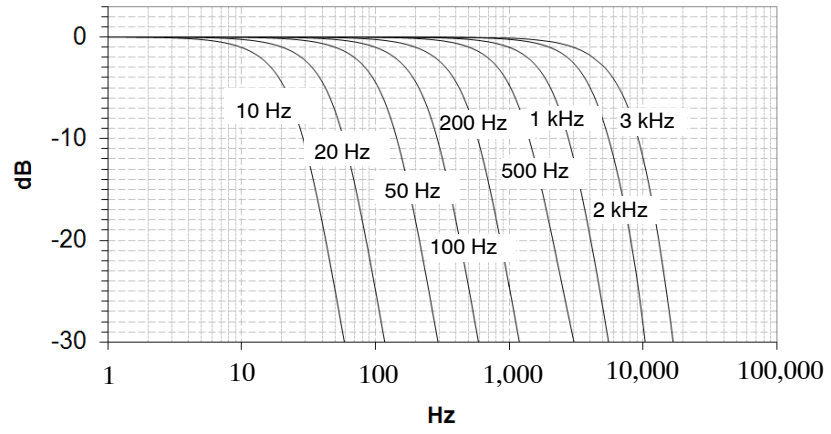


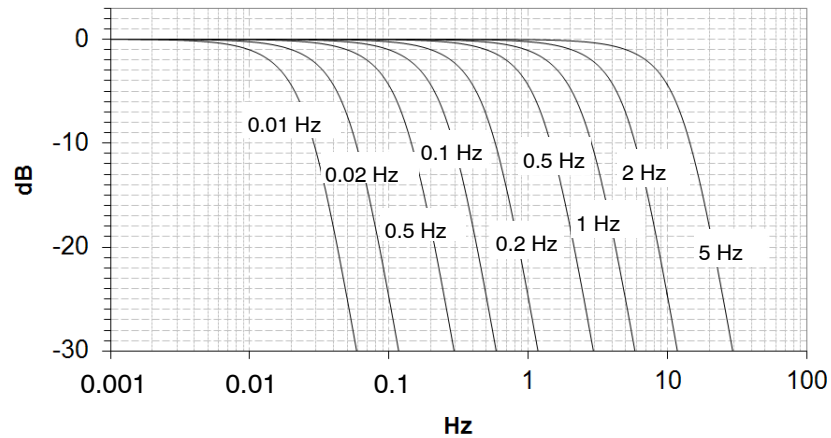
Classic HBM sample rates and digital low-pass filters, 4th order Bessel

Type	-1 dB (Hz)	-3 dB (Hz)	-20 dB (Hz)	Runtime (ms)*)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
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
	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

*) This value has not been accounted in the “phase delay” column above.The A/D Converter’s delay time for the sample rate 38.4 kS/s is 65 µs and for all other rates it is 128 µs. This delay time is not taken into account in the ”runtime” column. The anti−aliasing filter’s delay time (160 µs) is not accounted for as well. Hence 225 us or 288 µs need to be added to the “runtime”.

Classic HBM sample rates : Bessel filter amplitude response



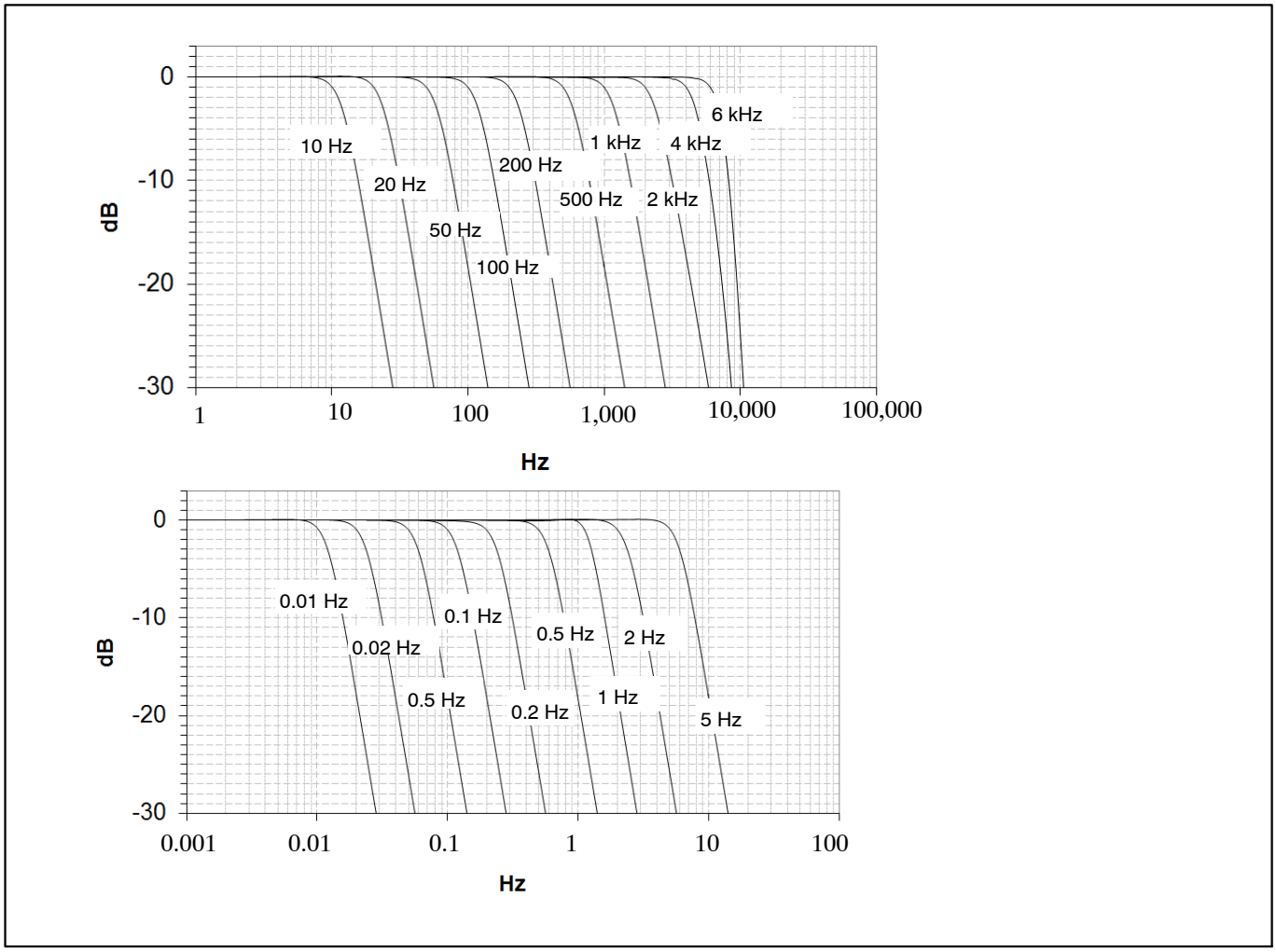


Classic HBM sample rates and digital low-pass filters, 4th order Butterworth

Type	-1 dB (Hz)	-3 dB (Hz)	-20 dB (Hz)	Runtime (ms)*)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
Butterworth	6,000	6,868	9,433	0.0681	0.0715	15.9	38,400
	4,000	4,660	7,324	0.105	0.0944	13.5	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
	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	6	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	0.6	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

*) This value has not been accounted in the “phase delay” column above.The A/D Converter’s delay time for the sample rate 38.4 kS/s is 65 µs and for all other rates it is 128 µs. This delay time is not taken into account in the ”runtime” column. The anti−aliasing filter’s delay time (160 µs) is not accounted for as well. Hence 225 us or 288 µs need to be added to the “runtime”.

Classic HBM sample rates : Butterworth filter amplitude response



Hottinger Baldwin Messtechnik GmbH
Im Tiefen See 45 · 64293 Darmstadt · Germany
Tel. +49 6151 803-0 Fax +49 6151 803-9100
Email: info@hbm.com · www.hbm.com

measure and predict with confidence

B4309-3.0 en HBM: public