DATA SHEET

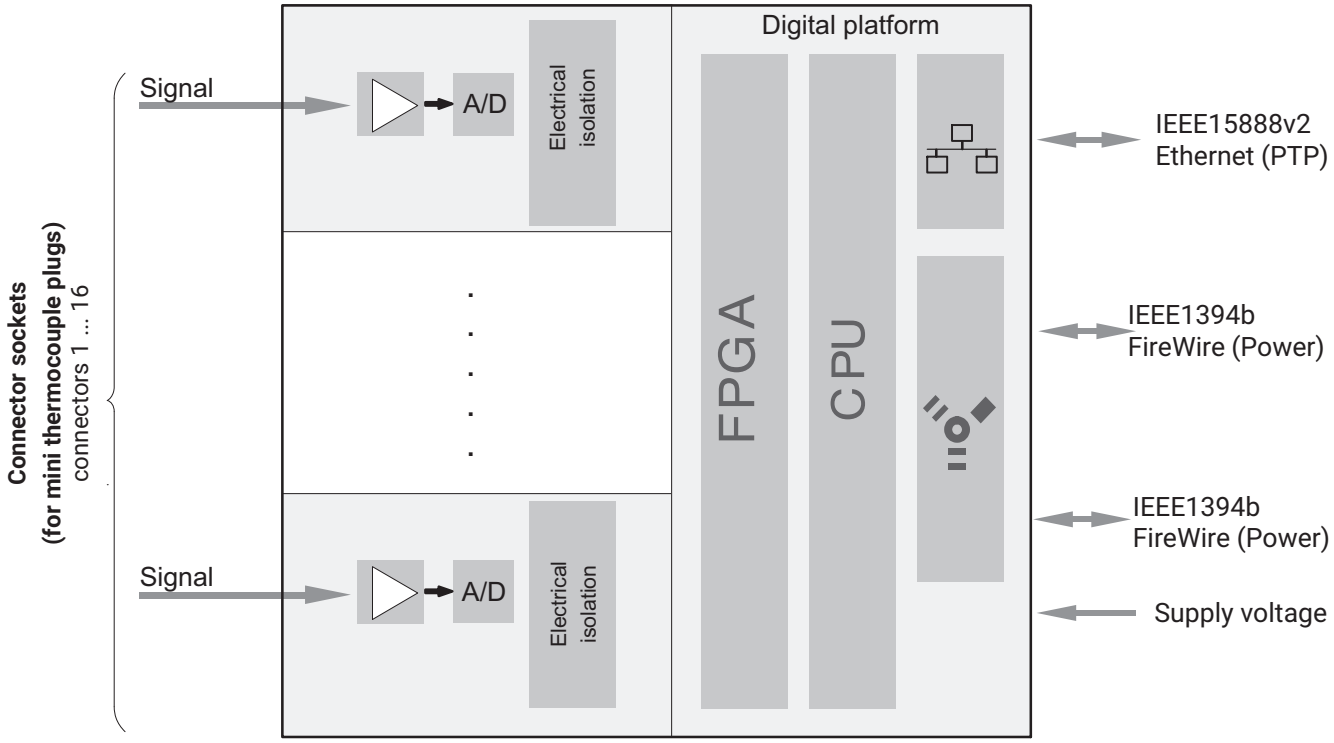
SOMAT XR

MX1609KB-R/TB-R
Ultra-rugged Thermo Amplifier

SPECIAL FEATURES

- 16 individually configurable inputs (electrically isolated)
- Thermocouple mini type K (MX1609KB-R)
- Thermocouple mini type T (MX1609TB-R)
- Sample rate up to 600 S/s per channel
- Internal cold junction
- Use in harsh environments (shock, vibration, temperature, dewing, moisture)

BLOCK DIAGRAM



SPECIFICATIONS MX1609KB-R: THERMOCOUPLES TYPE K (NICR-NIAL)

General specifications, valid for all measuring ranges		
Inputs	number	16, electrically isolated channels, to each other and to supply voltage
A/D-Converter		24-Bit Delta Sigma Converter
Sample rates	S/s	Decimal: 0.1 … 200 (600) HBM Classic: 0.1 … 600
Signal bandwidth, max. (-3 dB)	Hz	0 … 20
Active low-pass filter		Bessel, Butterworth
Transducer connection		MX1609KB-R: mini-thermocouple socket Type K (green)
Permissible cable length between module and transducer	m	< 30
Supply voltage range (DC)	V	10 ... 30 (24 nominal (rated) voltage)
Supply voltage interruption, max. (at 24 V)	ms	5[1)]
Power consumption	W	< 6
Ethernet (data link) Protocol (addressing) Connector Max. Cable length to module	 - - m	10Base-T / 100Base-TX TCP/IP (direct IP address or DHCP) ODU MINI-SNAP, 8 pins 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 supply voltage) Max. current from module to module Connector Max. cable length between the nodes Max. number of modules connected in series (daisy chain) Max. number of modules in a IEEE1394b FireWire system (including hubs[3)]) Max. number of hops	 A - m - - -	IEEE 1394b (HBM modules only) 1.5 ODU MINI-SNAP, 8 pins 5 12 (=11 Hops[2)]) 24 14
Nominal (rated) temperature range Altitude de-rating maximum temperature a 0 m maximum temperature a 2500 m maximum temperature a 5000 m	°C [°F] - °C [°F] °C [°F] °C [°F]	-40... +80 [-40 … +176] dew point resistant - +80 [+176] +70 [+158] +55 [+131]
Storage temperature range	°C [°F]	-40 ... +85 [-40 ... +185]
Relative humidity	%	5 ... 100
Protection class		III[4)]
Degree of protection (dust, humidity/water)		IP65/IP67 per EN 60529
EMC requirements		CE conformity test per EN 61326
Mechanical test Vibration Acceleration Duration Frequency Shock Acceleration Pulse duration Number of impacts	 m/s^2 min Hz m/s^2 ms -	 accord. MIL-STD202G, Method 204D, Test condition C 100 450 5 bis 2,000 accord. MIL-STD202G, Method 213B, Test condition B 750 6 18
Operating altitude, max.	m	5,000
Maximum input voltage at transducer socket (to housing and supply ground)	V	60 (without transients)
Dimensions, horizontal (H x W x D)	mm	80 x 205 x 140
Weight, approx.	g [pound]	2,000 [4.41]

Thermocouples		
Linearization range	˚C [°F]	-100 ... +1,300 [-148 … +2,372]
Transducer impedance	Ω	< 500
Noise (peak to peak) at 25 °C and type K at 0.1 Hz Bessel filter at 1 Hz Bessel filter at 10 Hz Bessel filter	 K K K	 0.1 0.2 0.4
Total error limit at 22 ºC ambient temperature	K	± 0.7
Temperature drift	K/10 K	± 0,2 (-20ºC… +65ºC) [-4 ... +149°F] ± 0,4 (-40ºC… -20ºC) [-40 ... -4°F] and +65ºC … +80ºC [+149. ... +176°F]
Optional post-scaling of the temperature values Number of pairs of values in the MX1609, max. Number of pairs of values from TEDS, max. (from Template Calibration Table)		 64 14 [5)]

1) Uninterruptible Power Supply (UPS)) for prolonged interruption of power, available as an accessory.
2) Hop: Transition from module to module or signal conditioning / distribution via IEEE1394b FireWire (hub, backplane)
3) Hub: IEEE1394b FireWire node or distributor
4) The DC voltage supply must meet the requirements of IEC 60950-1 on a SELV voltage supply.
5) Restrictions when using several templates; delete additional templates, such as the name template, if required.

SPECIFICATIONS MX1609TB-R: THERMOCOUPLES TYPE T (CU-CUNI)

General specifications, valid for all measuring ranges		
Inputs	number	16, electrically isolated channels, to each other and to supply voltage
A/D-Converter		24-Bit Delta Sigma Converter
Sample rates	S/s	Decimal: 0.1 … 600 HBM Classic: 0.1 … 600
Signal bandwidth, max. (-3 dB)	Hz	0 … 20
Active low-pass filter		Bessel, Butterworth
Transducer connection		MX1609TB-R: mini-thermocouple socket Type T (brown)
Permissible cable length between module and transducer	m	< 30
Supply voltage range (DC)	V	10 ... 30 (24 nominal (rated) voltage)
Supply voltage interruption, max. (at 24 V)	ms	5[1)]
Power consumption	W	< 6
Ethernet (data link) Protocol (addressing) Connector Max. Cable length to module	 - - m	10Base-T / 100Base-TX TCP/IP (direct IP address or DHCP) ODU MINI-SNAP, 8 pins 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 supply voltage) Max. current from module to module Connector Max. cable length between the nodes Max. number of modules connected in series (daisy chain) Max. number of modules in a IEEE1394b FireWire system (including hubs[3)]) Max. number of hops	 A - m - - -	IEEE 1394b (HBM modules only) 1.5 ODU MINI-SNAP, 8 pins 5 12 (=11 Hops[2)]) 24 14
Nominal (rated) temperature range Altitude de-rating maximum temperature a 0 m maximum temperature a 2500 m maximum temperature a 5000 m	°C [°F] - °C [°F] °C [°F] °C [°F]	-40... +80 [-40 … +176] dew point resistant - +80 [+176] +70 [+158] +55 [+131]
Storage temperature range	°C [°F]	-40 ... +85 [-40 ... +185]
Relative humidity	%	5 ... 100
Protection class		III[4)]

Degree of protection (dust, humidity/water)		IP65/IP67 per EN 60529
EMC requirements		CE conformity test per EN 61326
Mechanical test		
Vibration		accord. MIL-STD202G, Method 204D, Test condition C
Acceleration	m/s^2	100
Duration	min	450
Frequency	Hz	5 bis 2,000
Shock		accord. MIL-STD202G, Method 213B, Test condition B
Acceleration	m/s^2	750
Pulse duration	ms	6
Number of impacts	-	18
Operating altitude, max.	m	5,000
Maximum input voltage at transducer socket (to housing and supply ground)	V	60 (without transients)
Dimensions, horizontal (H x W x D)	mm	80 x 205 x 140
Weight, approx.	g [pound]	2,000 [4.41]
Thermocouples		
Linearization range	°C [°F]	-100 ... +400 [-148 … +752]
Transducer impedance	Ω	< 500
Noise (peak to peak) at 25 °C and type K		
at 0.1 Hz Bessel filter	K	0.1
at 1 Hz Bessel filter	K	0.2
at 10 Hz Bessel filter	K	0.4
Total error limit at 22 °C ambient temperature	K	± 0.7
Temperature drift	K/10 K	± 0,2 (-20°C… +65°C) [-4 ... +149°F] ± 0,4 (-40°C… -20°C) [-40 ... -4°F] and +65°C … +80°C [+149. ... +176°F]
Optional post-scaling of the temperature values		
Number of pairs of values in the MX1609, max.		64
Number of pairs of values from TEDS, max. (from Template Calibration Table)		14 [5]

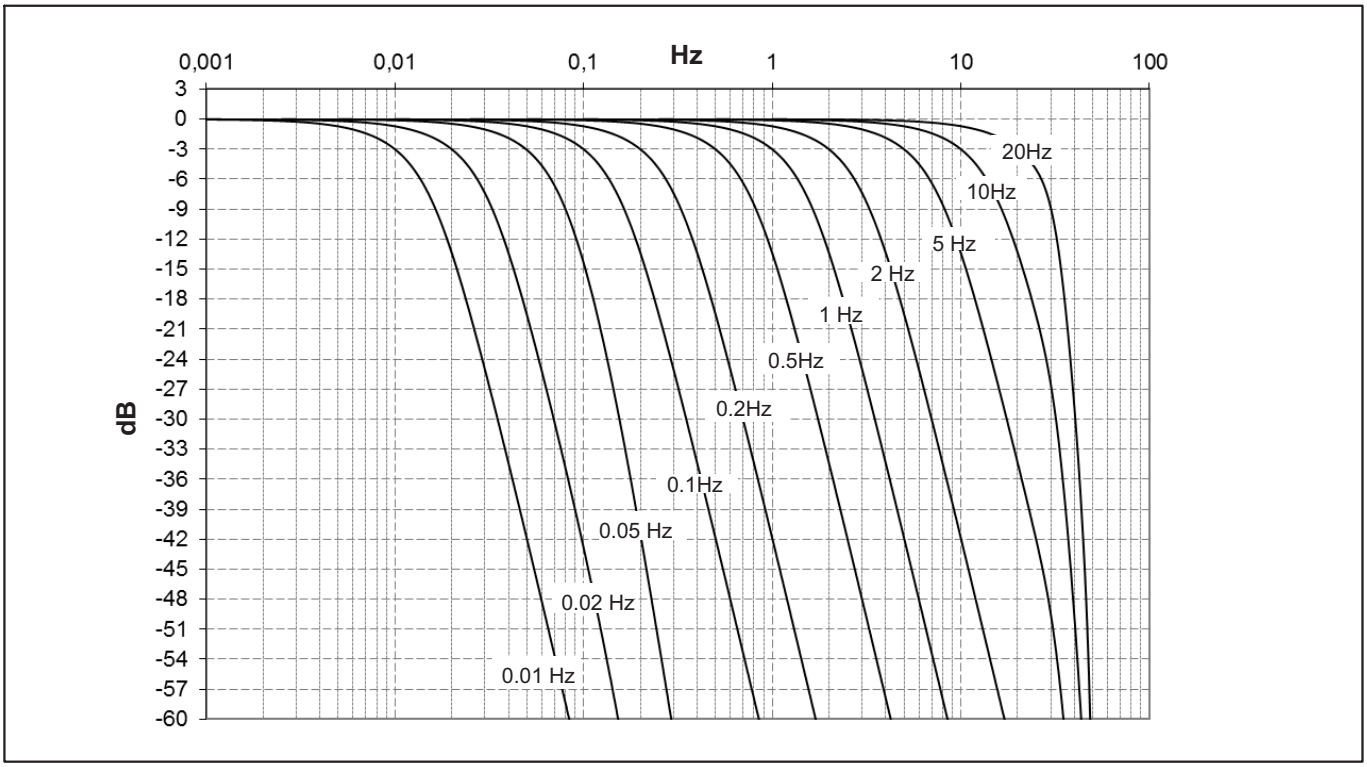
[1] Uninterruptible Power Supply (UPS)) for prolonged interruption of power, available as an accessory.
[2] Hop: Transition from module to module or signal conditioning / distribution via IEEE1394b FireWire (hub, backplane)
[3] Hub: IEEE1394b FireWire node or distributor
[4] The DC voltage supply must meet the requirements of IEC 60950-1 on a SELV voltage supply.
[5] Restrictions when using several templates; delete additional templates, such as the name template, if required.

DECIMAL SAMPLE RATES AND DIGITAL LOW-PASS FILTERS, TYPE BESSEL 4TH ORDER

Typ	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)*)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
Bessel	11.9	20	36.3	36.8	20.0	5.5	600
	5.9	10	25.3	52.3	35.2	1.0	600
	3.0	5	12.7	85.0	70.1	0.9	600
	1.2	2	5.1	185	176	0.9	600
	0.6	1	2.5	350	351	0.9	600
	0.30	0.5	1.27	681	701	0.9	600
	0.12	0.2	0.51	1,680	1,760	0.9	600
	0.06	0.1	0.25	3,330	3,520	0.9	600
	0.030	0.05	0.127	7,280	6,850	0.9	20
	0.012	0.02	0.051	18,600	17,300	0.9	20
	0.006	0.01	0.025	35,100	35,000	0.9	20

*) The analog-to-digital converter's delay time is 128 µs for all data rates and has not been accounted for in the "Phase delay" column!

DECIMAL SAMPLE RATES : AMPLITUDE RESPONSE BESSEL FILTER

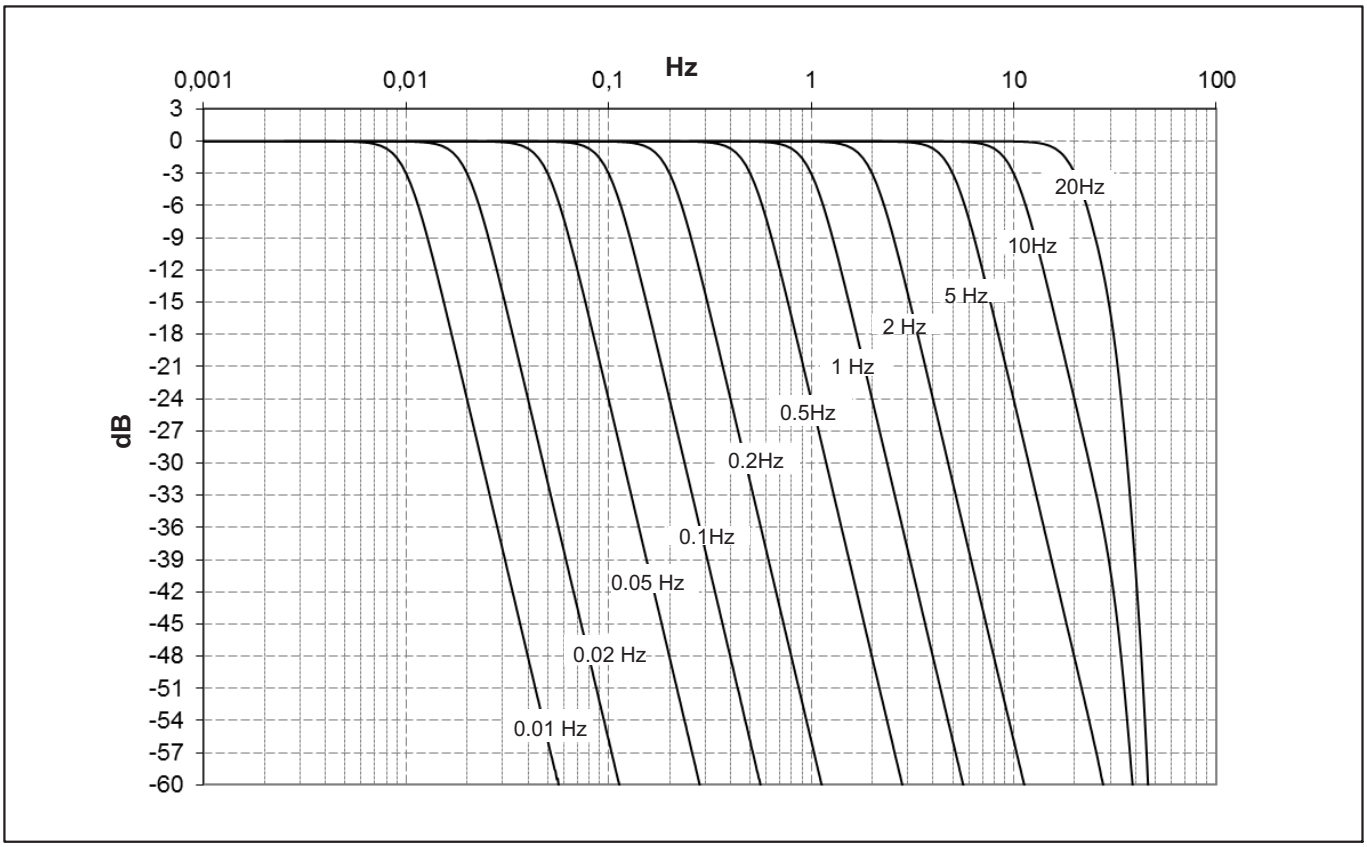


DECIMAL SAMPLE RATES AND DIGITAL LOW-PASS FILTERS, TYPE BUTTERWORTH 4TH ORDER

Typ	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)*)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
Butterworth	16.9	20	32.1	45.4	21.3	13.0	600
	8.4	10	17.7	67.3	39.1	11.0	600
	4.2	5	8.9	113	77.6	11.0	600
	1.7	2	3.6	248	194	11.0	600
	0.8	1	1.8	473	388	11.0	600
	0.42	0.5	0.89	924	774	11.0	600
	0.17	0.2	0.36	2,280	1,960	11.0	600
	0.08	0.1	0.18	4,810	3,840	11.0	20
	0.042	0.05	0.089	9,330	7,750	11.0	20
	0.017	0.02	0.036	22,900	19,500	11.0	20
	0.008	0.01	0.018	45,300	38,900	11.0	20

*) The analog-to-digital converter's delay time is 128 µs for all data rates and has not been accounted for in the "Phase delay" column!

DECIMAL SAMPLE RATES : AMPLITUDE RESPONSE BUTTERWORTH FILTER

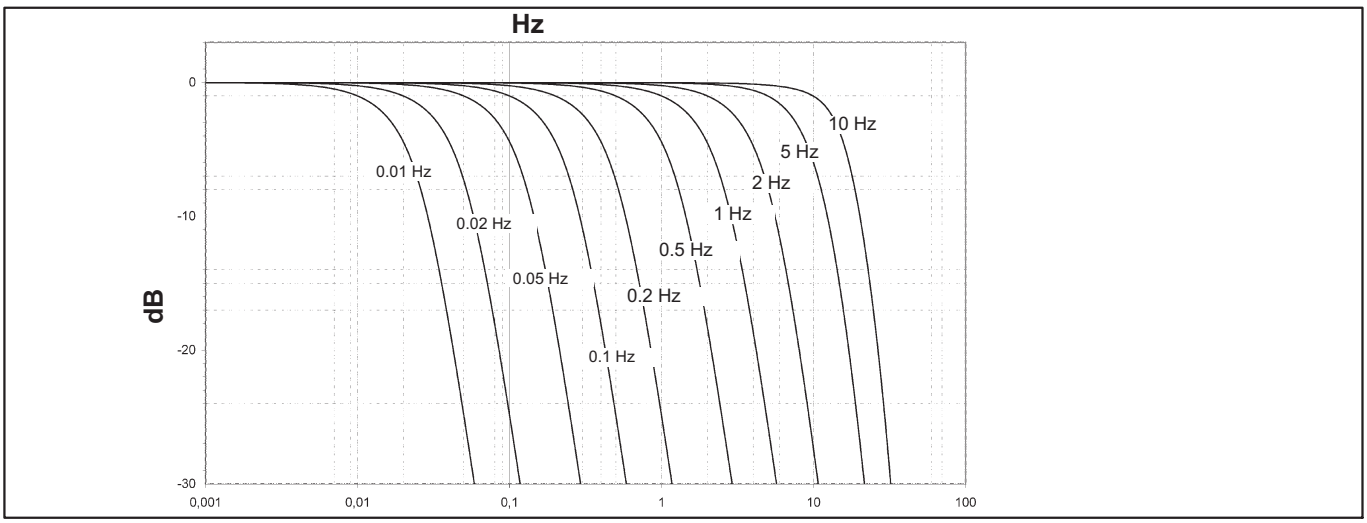


CLASSIC HBM SAMPLE RATES AND DIGITAL LOW-PASS FILTERS, TYPE BESSEL 4TH ORDER

Typ	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)*)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
Bessel	10	14.1	26.7	44.6	27.4	6.7	600
	5	7.7	17.1	63.4	46.6	3.2	600
	2	3.3	8.1	122.3	107.1	1.3	600
	1	1.7	4.2	221.8	210.2	1.0	600
	0.5	0.84	2.12	418.8	418.4	0.9	300
	0.2	0.34	0.85	1,020.9	1,045.0	0.9	300
	0.1	0.17	0.43	2,023.4	2,090.1	0.9	300
	0.05	0.085	0.214	3,938.8	4,184.2	0.9	20
	0.02	0.034	0.086	9,959.6	10,420.4	0.9	20
	0.01	0.017	0.043	19,995.0	20,900.9	0.9	20

*) The analog-to-digital converter's delay time is 128 µs for all data rates and has not been accounted for in the "Phase delay" column!

CLASSIC HBM SAMPLE RATES : AMPLITUDE RESPONSE BESSEL FILTER

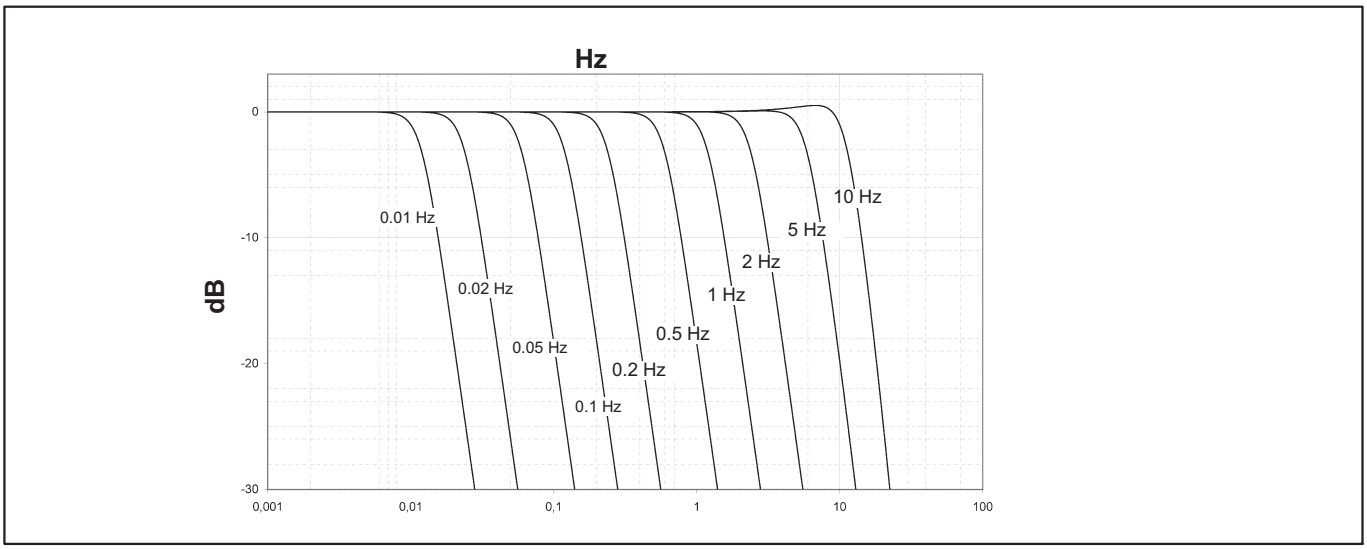


CLASSIC HBM SAMPLE RATES AND DIGITAL LOW-PASS FILTERS, TYPE BUTTERWORTH 4TH ORD.

Typ	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)*)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
Butterworth	10	11.3	18.4	76.6	35.4	16.0	600
	5	5.9	10.1	126.1	66.7	12.0	600
	2	2.4	4.2	283.3	164.6	11.0	600
	1	1.2	2.1	546.5	328.3	11.0	600
	0.5	0.60	1.05	1,069.7	656.7	11.0	300
	0.2	0.24	0.42	2,646.9	1,631.6	11.0	300
	0.1	0.12	0.21	5,278.4	3,263.3	11.0	300
	0.05	0.059	0.106	10,452.6	6,566.6	11.0	20
	0.02	0.024	0.042	26,253.9	16,316.3	11.0	20
	0.01	0.012	0.021	52,588.9	32,632.6	11.0	20

*) The analog-to-digital converter's delay time is 128 µs for all data rates and has not been accounted for in the "Phase delay" column!

CLASSIC HBM SAMPLE RATES : AMPLITUDE RESPONSE BUTTERWORTH FILTER



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