Data sheet

SOMAT XR

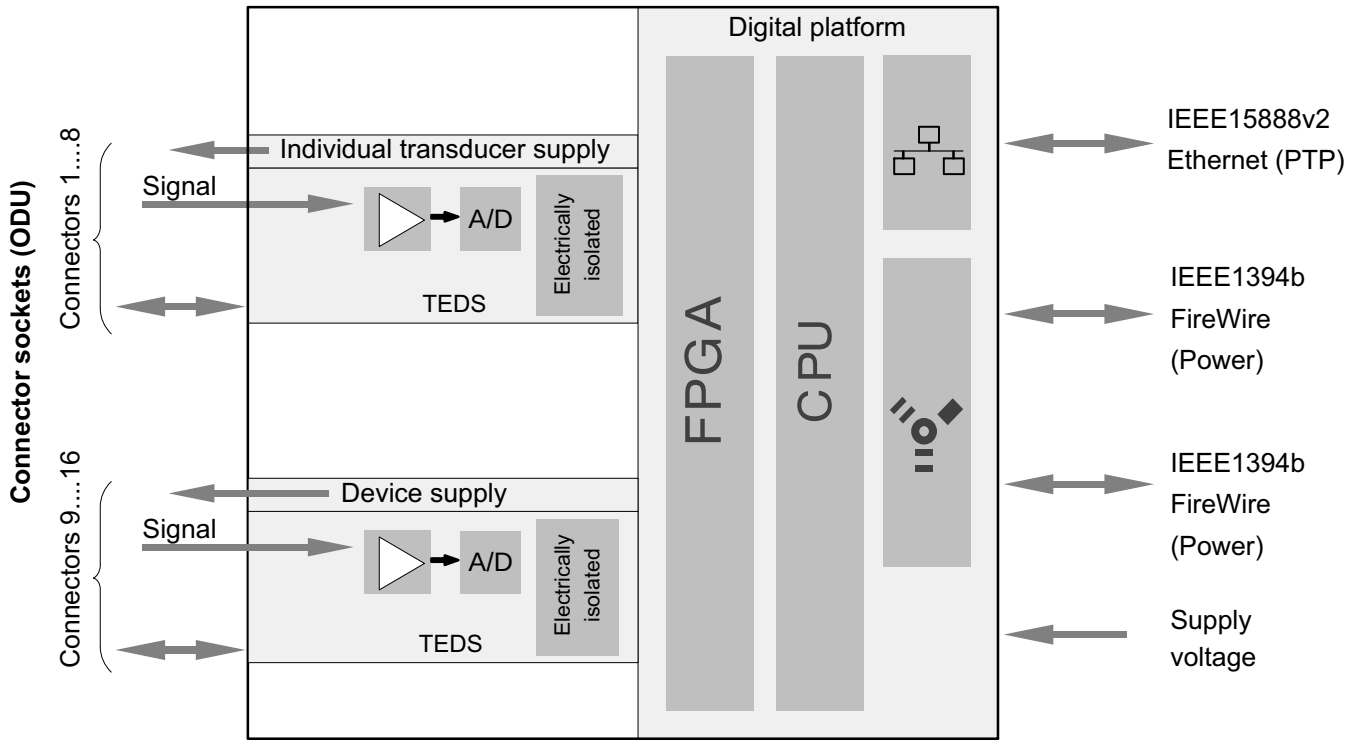
MX1601B-R

Ultra-rugged Standard Amplifier

Special features

- **16 individually configurable inputs (electrically isolated)**
- **Support of 60 V, 10 V, 100 mV, 20 mA or IEPE on all channels**
- **Sample rate: up to 20 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)**

Block diagram



HBM

Specifications MX1601B-R

General specifications		
Inputs	Number	16, electrically isolated channels, to each other and to supply voltage[1)]
Supported transducer technologies		Voltage (± 100 mV, ± 10 V, ± 60 V) Current (20 mA) Current-fed piezoelectric transducers (IEPE / ICP)
A/D converter		24 Bit Delta Sigma Converter
Sample rates	S/s	Decimal: 0.1 … 20,000 HBM Classic: 0.1 … 19,200
Signal bandwidth, max. (-3 dB)	Hz	3800 (Linear Phase FIR filter)
Active low-pass filter	Hz	Bessel, Butterworth, Linear Phase, Filter off[2)]
Transducer identification (TEDS, IEEE 1451.4)		
max. distance of the TEDS module	m	100
Transducer connection		ODU MINI-SNAP, 14 pins
Supply voltage range (DC)	V	10 ... 30 (24 nominal (rated) voltage)
Supply voltage interruption, max. (at 24 V)	ms	5[3)]
Power consumption		
without adjustable transducer supply	W	< 10
with adjustable transducer supply	W	< 13
Transducer Excitation (active transducers)		
Only channel 1... 8:		
Adjustable supply voltage (DC)	V	5 ... 24; adjustable for each channel
Maximum output power	W	0.7 each channel / a total of 2
Only channel 9 ... 16:		
Supply voltage (DC)	V	9 ... 29; Supply voltage of the module -1 V
Maximum output current	mA	30 each channel / a total of 75
Ethernet (data link)		10Base-T / 100Base-TX
Protocol (addressing)	-	TCP/IP (direct IP address or DHCP)
Connector	-	ODU MINI-SNAP, 8 pins
Max. cable length to module	m	100
Synchronization options		
FireWire IEEE1394b		FireWire based synchronization
Ethernet PTPv2 IEEE1588		Ethernet based Precision Time Protocol
Ethernet NTP		Ethernet based Network Time Protocol
IEEE1394b FireWire (optional supply voltage)		IEEE 1394b (HBM modules only)
Max. current from module to module	A	1.5
Connector		ODU MINI-SNAP, 8 pins
Max. cable length between the nodes	m	5
Max. number of modules connected in series (daisy chain)	-	12 (=11 Hops[4)])
Max. number of modules in a IEEE1394b FireWire system (including hubs[5)])	-	24
Max. number of hops	-	14
Nominal (rated) temperature range	°C [°F]	-40... +80 [-40 … +176] dew point resistant
Altitude de-rating	-	-
maximum temperature at 0 m	°C [°F]	+80 [+176]
maximum temperature at 2500 m	°C [°F]	+70 [+158]
maximum temperature at 5000 m	°C [°F]	+55 [+131]
Storage temperature range	°C [°F]	-40 ... +85 [-40 ... +185]
Relative humidity	%	5 ... 100
Protection class		III[6)]
Degree of protection (dust, humidity/water)		IP65/IP67 per EN 60529
EMC requirements		CE conformity test per EN 61326-1
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

1) When variable transducer supply is used, there is no electrical isolation from the supply.
2) „Filter OFF is recommended only for real-time applications to achieve short latencies.
3) Uninterruptible Power Supply (UPS)) for prolonged interruption of power, available as an accessory.
4) Hop: Transition from module to module or signal conditioning / distribution via IEEE1394b FireWire (hub, backplane).
5) Hub: IEEE1394b FireWire node or distributor
6) The DC voltage supply must meet the requirements of IEC 60950-1 on a SELV voltage supply.

Specifications MX1601B-R (Continued)

Operating altitude, max.	m	5,000
Max. input voltage at transducer socket to ground (Pin 4)		transient free
Pin 14 (TEDS)	V	+ 5
Pin 3 (voltage)	V	± 60
Pin 6 (current)	V	± 1.5
Pin 5 (control lead)	V	± 3.3
Dimensions, horizontal (H x W x D)	mm	80 x 205 x 140
Weight, approx.	g/pound	2,300 / 5.07

Voltage ±10 V		
Accuracy class		0.03
Permissible cable length between MX1601B and transducer	m	< 100
Measuring range	V	± 10
Internal resistance of the connected voltage source	kΩ	< 5
Input impedance	MΩ	> 10
Noise (peak to peak) at 25 °C		
at 1 Hz Bessel filter	µV	100
at 10 Hz Bessel filter	µV	100
at 100 Hz Bessel filter	µV	200
at 1 kHz Bessel filter	µV	400
Linearity error	%	< 0.02 of full scale
Common-mode rejection		
at DC common-mode	dB	> 100
at 50 Hz common-mode, typically	dB	95
Max. common-mode voltage (to housing and supply ground)	V	± 60
Zero drift	% / 10 K	< 0.03 of full scale
Full-scale drift	% / 10 K	< 0.03 of measurement value

Voltage ±60 V		
Accuracy class		0.05
Permissible cable length between MX1601B and transducer	m	< 100
Measuring range	V	± 60
Internal resistance of the voltage source	Ω	< 500
Input impedance, typ.	MΩ	1
Noise (peak to peak) at 25 °C		
with filter 1Hz Bessel	µV	< 500
with filter 10Hz Bessel	µV	< 600
with filter 100Hz Bessel	µV	< 800
with filter 1kHz Bessel	µV	< 2,000
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	± 60
Zero drift	% / 10 K	< 0.03 of full scale
Full-scale drift	% / 10 K	< 0.05 of measurement value

Specifications MX1601B-R (Continued)

Voltage ±100 mV		
Accuracy class		0.03
Permissible cable length between MX1601B and transducer	m	< 100
Measuring range	mV	± 100
Internal resistance of the connected voltage source	Ω	< 200
Input impedance	MΩ	> 10
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	 µV µV µV µV	 3 5 12 25
Linearity error	%	< 0.02 of full scale
Common-mode rejection with DC common mode with 50 Hz common mode, typically	 dB dB	 > 100 95
Maximum common-mode voltage (to housing and supply ground)	V	± 60
Zero drift	% / 10 K	< 0.03 of full scale
Full-scale drift	% / 10 K	< 0.03 of measurement value

Specifications MX1601B-R (Continued)

Current 20 mA		
Accuracy class		0.05
Permissible cable length between MX1601B and transducer	m	< 100
Measuring range	mA	± 20
Measuring resistance value	Ω	5
Noise (peak to peak) at 25 °C at 1 Hz Bessel filter at 10 Hz Bessel filter at 100 Hz Bessel filter at 1 kHz Bessel filter	 µA µA µA µA	 1 2 10 40
Linearity error	%	< 0.02 of full scale
Common-mode rejection at DC common-mode at 50 Hz common-mode, typically	 dB dB	 > 100 95
Max. common-mode voltage (to housing and supply ground)	V	± 60
Zero drift	% / 10 K	< 0.05 of full scale
Full-scale drift	% / 10 K	< 0.05 of measurement value

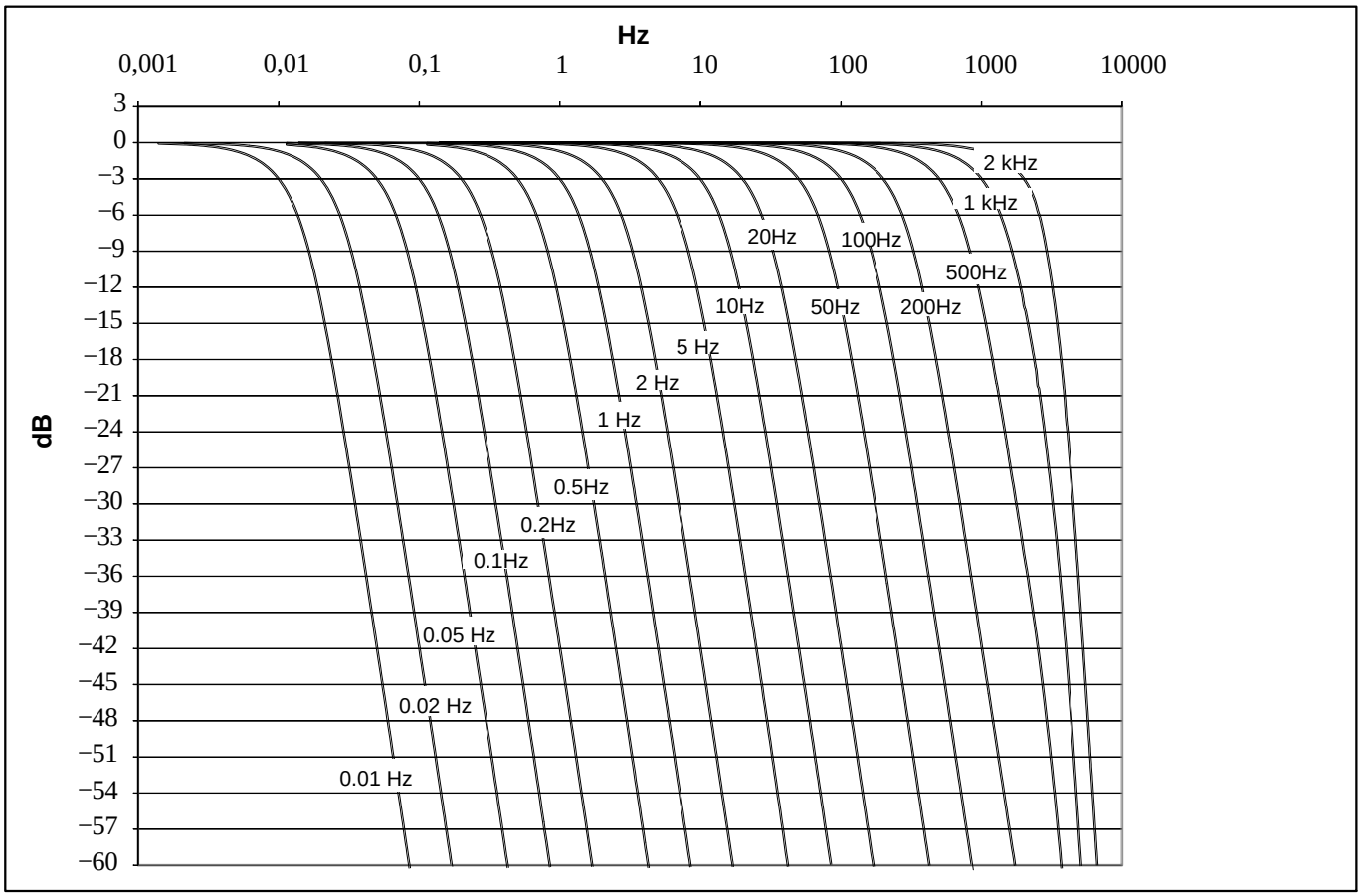
ICP® / IEPE (Current-fed piezoelectric transducers)		
Accuracy class		0.1
Permissible cable length between MX1601B and transducer	m	< 30
Transducer excitation	mA	4.0 mA ± 15%
Measuring range	V	± 10
IEPE compliance voltage, typ.	V	20
Input impedance	MΩ	> 1
Noise (peak to peak) at 25 °C at 1 Hz Bessel filter at 10 Hz Bessel filter at 100 Hz Bessel filter at 1 kHz Bessel filter	 µV µV µV µV	 100 150 400 800
Linearity error	%	< 0.1 of full scale
Common-mode rejection at DC common-mode at 50 Hz common-mode, typically	 dB dB	 > 100 95
Max. common-mode voltage (to housing and supply ground)	V	± 60
Zero drift	% / 10 K	< 0.1 of full scale
Full-scale drift	% / 10 K	< 0.1 of measurement value

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 (S/s)
Bessel	1,203	2,000	3,830	0.088	0.199	4.8	20,000
	596	1,000	2,494	0.232	0.353	1.1	20,000
	298	502	1,278	0.552	0.700	0.9	20,000
	119	200	509	1.56	1.76	0.9	20,000
	59	100	254	3.21	3.51	0.9	20,000
	29.6	50	127.1	6.50	7.01	0.9	20,000
	11.8	20	50.8	16.4	17.6	0.9	20,000
	5.9	10	25.4	32.9	35.1	0.9	20,000
	2.96	5	12.70	69.0	70.1	0.9	10,000
	1.18	2	5.08	168	176	0.9	10,000
	0.59	1	2.54	333	351	0.9	5,000
	0.295	0.5	1.271	663	701	0.9	1,000
	0.118	0.2	0.508	1,660	1,760	0.9	1,000
	0.059	0.1	0.254	3,300	3,510	0.9	500
	0.0295	0.05	0.1271	6,620	7,010	0.9	100
	0.0118	0.02	0.0508	16,500	17,600	0.9	100
	0.0059	0.01	0.0254	33,000	35,100	0.9	50

*) 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! The anti-aliasing filter's delay time (160 µs) is not accounted for as well. Hence, 288 µs need to be added to the “Phase delay”.

Decimal sample rates : Amplitude response Bessel filter

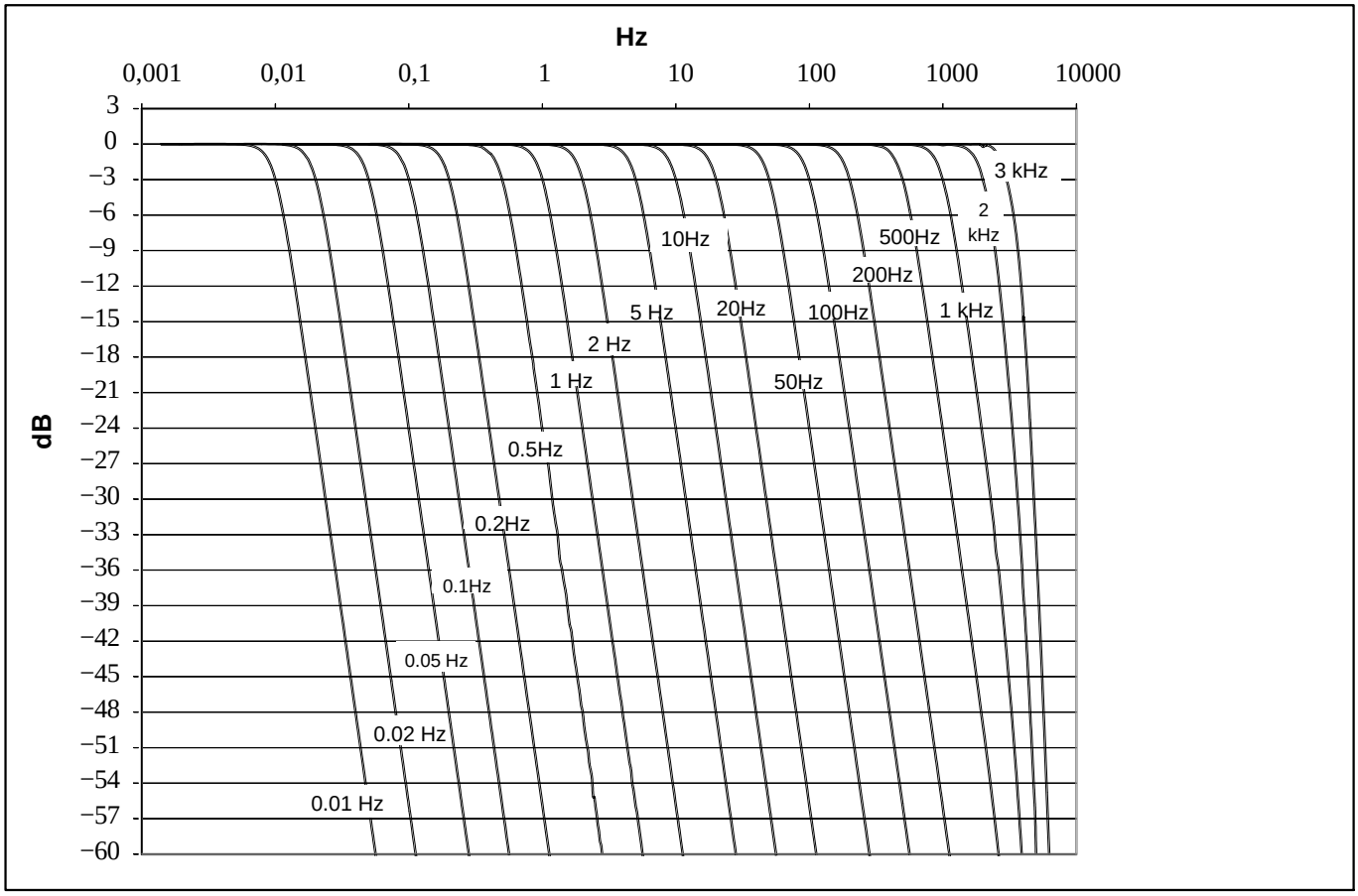


Decimal sample rates and digital low pass filter, type Butterworth 4th order

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay*) (ms)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
Butterworth	2,612	3,000	4,316	0.105	0.161	17.0	20,000
	1,703	2,000	3,600	0.213	0.217	14.2	20,000
	838	1,000	1,746	0.436	0.394	11.3	20,000
	430	500	890	0.884	0.777	11.0	20,000
	169	200	355	2.27	1.94	11.0	20,000
	84	100	178	4.51	3.88	11.0	20,000
	42.2	50	88.8	9.00	7.75	11.0	20,000
	16.9	20	35.5	22.5	19.4	11.0	20,000
	8.4	10	17.8	45.0	38.8	11.0	20,000
	4.22	5	8.88	89.9	77.5	11.0	20,000
	1.68	2	3.55	225	194	11.0	20,000
	0.84	1	1.78	449	387	11.0	20,000
	0.423	0.5	0.888	898	774	11.0	10,000
	0.169	0.2	0.356	2,250	1,940	11.0	10,000
	0.084	0.1	0.178	4,490	3,870	11.0	5,000
	0.0422	0.05	0.0888	8,980	7,740	11.0	1,000
	0.0168	0.02	0.0356	22,500	19,400	11.0	1,000
	0.0085	0.01	0.0178	44,900	38,700	11.0	500

*) 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! The anti-aliasing filter's delay time (160 µs) is not accounted for as well. Hence, 288 µs need to be added to the “Phase delay”.

Decimal sample rates : Amplitude response Butterworth filter

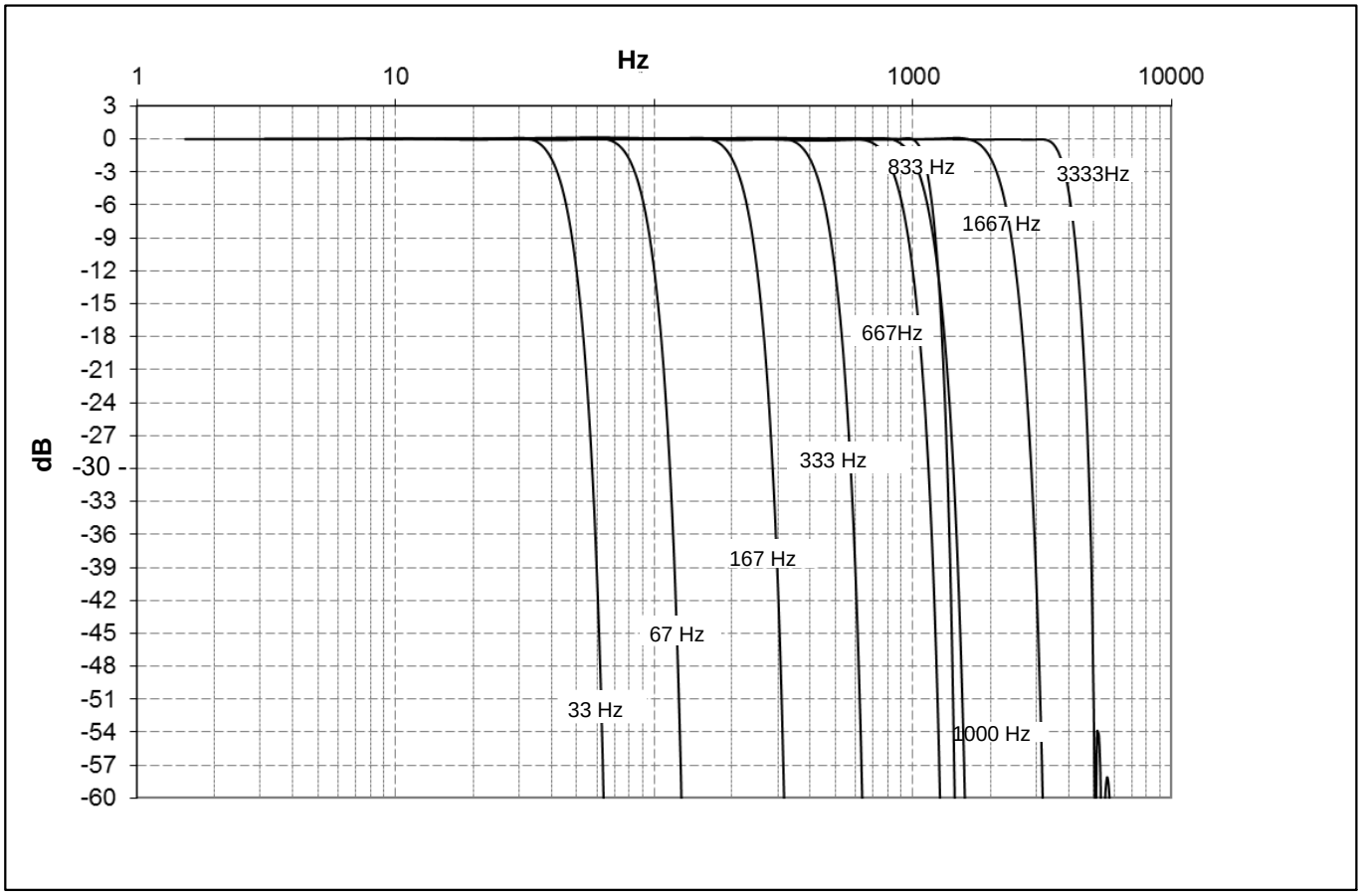


Decimal sample rates and digital low pass filter, Linear Phase (FIR)

Typ	Start of Roll-off (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay*) (ms)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
Linear Phase	3,333	3,800	4,580	0.802	0.121	13.8	20,000
	1,667	1,118	2,694	2.77	0.276	9.4	5,000
	1,000	1,050	1,308	6.21	0.545	8.6	2,500
	833	825	1,346	4.00	0.552	8.6	2,500
	667	838	1,078	4.70	0.696	8.6	1,000
	333	420	539	10.4	1.39	8.6	1,000
	167	210	269	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 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! The anti-aliasing filter's delay time (160 µs) is not accounted for as well. Hence, 288 µs need to be added to the “Phase delay”.

Decimal sample rates : Amplitude response Linear Phase (FIR)

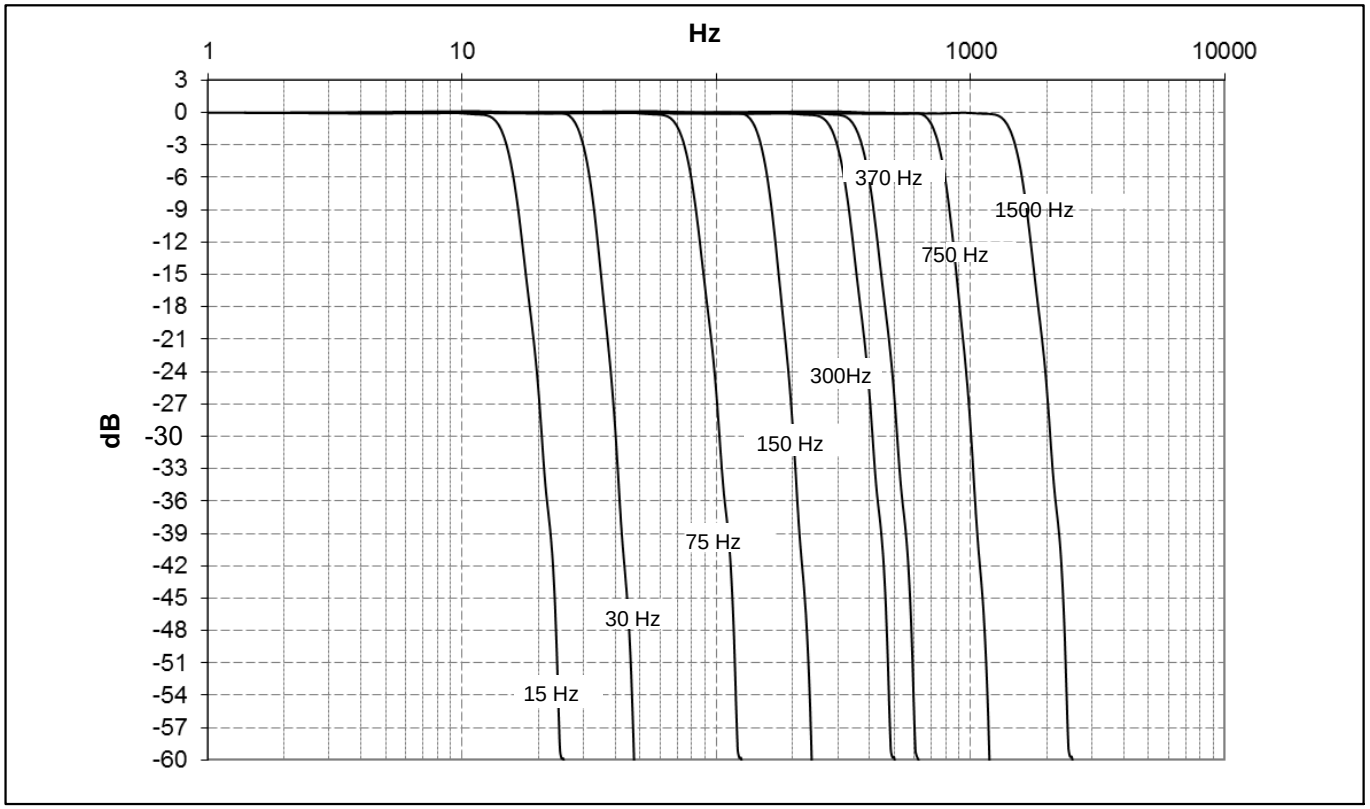


Decimal sample rates and digital low pass filter, Butterworth filter

Typ	Start of Roll-off (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay*) (ms)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
Butterworth	1,384	1,500	1,887	3.47	0.353	18.7	10,000
	698	750	924	5.55	0.669	18.7	5,000
	344	370	471	14.1	1.40	18.7	2,500
	275	300	377	17.3	1.75	18.7	2,000
	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 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! The anti-aliasing filter's delay time (160 µs) is not accounted for as well. Hence, 288 µs need to be added to the “Phase delay”.

Decimal sample rates : Amplitude response Butterworth filter

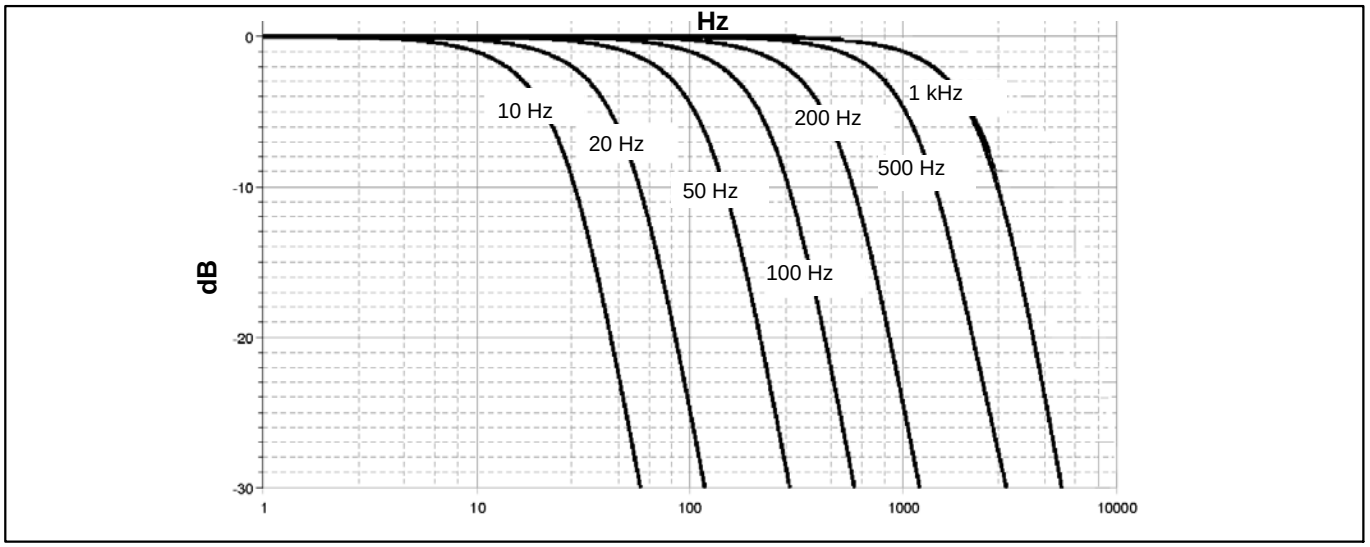


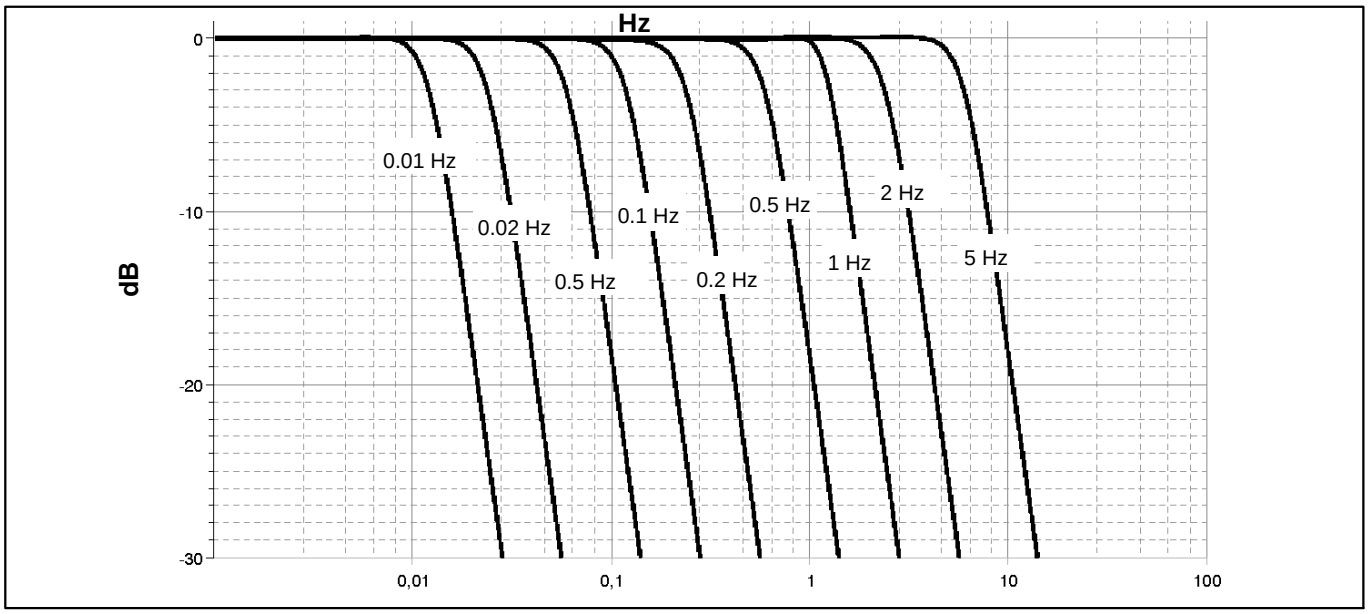
Classic HBM sample rates and digital low pass filter, type Bessel 4th order

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)*)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
Bessel	1,000	1,575	3,611	0.11	0.2	1.4	19,200
	500	812	2,079	0.3	0.38	1.3	9,600
	200	335	860	0.9	1.05	0.8	9,600
	100	168	427	1.8	2.11	0.8	9,600
	50	84	213	3.8	4.18	0.8	9,600
	20	33.7	85	9.6	10.4	0.8	9,600
	10	16.6	43	19.5	21.0	0.8	9,600
	5	8.4	21	39	41.4	0.8	2,400
	2	3.4	8.6	97	102	0.8	2,400
	1	1.6	4.2	197	215	0.8	2,400
	0.5	0.84	2.1	390	418	0.8	300
	0.2	0.34	0.85	980	1,033	0.8	300
	0.1	0.17	0.43	1,950	2,090	0.8	300
	0.05	0.085	0.21	3,660	4,170	0.8	20
	0.02	0.036	0.088	9,800	10,560	0.8	20
	0.01	0.017	0.044	19,500	21,200	0.8	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! The anti-aliasing filter's delay time (160 µs) is not accounted for as well. Hence, 288 µs need to be added to the “Phase delay”.

Classic HBM sample rates : Amplitude response Bessel filter



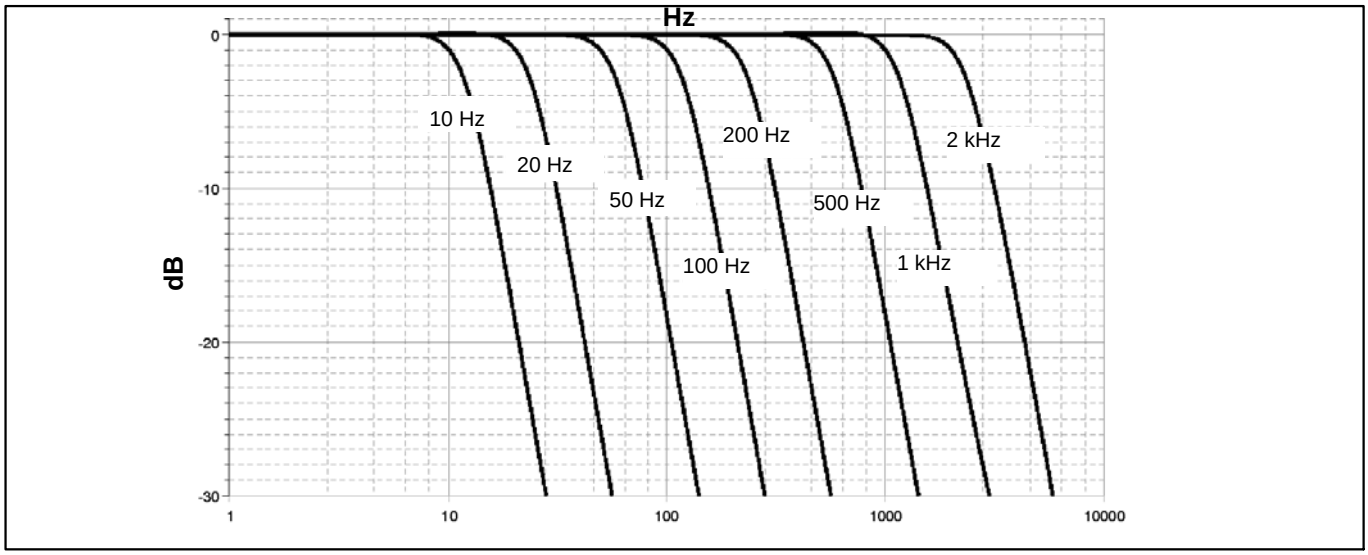


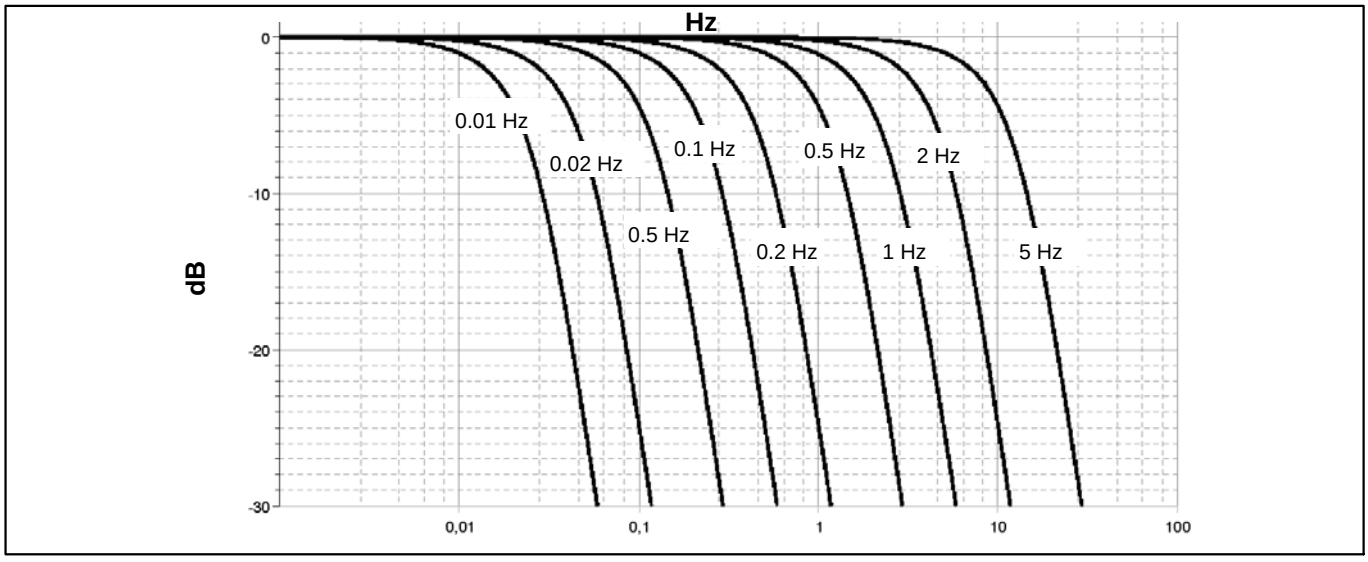
Classic HBM sample rates and digital low pass filter, type Butterworth filter 4th order

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)*)	Rise time (ms)	Overshoot (%)	Sample rate (S/s)
Butterworth	2,000	3,053	5,083	0	0.144	8.5	19,200
	1,000	1,170	2,077	0.27	0.344	11	19,200
	500	587	1,048	0.64	0.652	11	9,600
	200	237	420	1.76	1.64	11	9,600
	100	118	210	3.65	3.28	11	9,600
	50	59	105	7.49	6.29	11	9,600
	20	24	42	18.8	16.15	11	9,600
	10	12	21	37.7	32.29	11	9,600
	5	5.95	10.5	74.9	65.92	11	2,400
	2	2.37	4.24	188	163.6	11	2,400
	1	1.26	2.12	370	315	11	2,400
	0.5	0.59	1.05	756	656	11	300
	0.2	0.241	0.419	1,900	1640	11	300
	0.1	0.122	0.210	3,770	3,280	11	300
	0.05	0.060	0.106	7,490	6,596	11	20
	0.02	0.0245	0.042	18,900	16,200	11	20
	0.01	0.012	0.021	37,700	32,383	11	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! The anti-aliasing filter's delay time (160 µs) is not accounted for as well. Hence, 288 µs need to be added to the “Phase delay”.

Classic HBM sample rates : amplitude response Butterworth filter





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

B04019_04_E00_02 HBM: public