SOMAT XR

MX460B-R

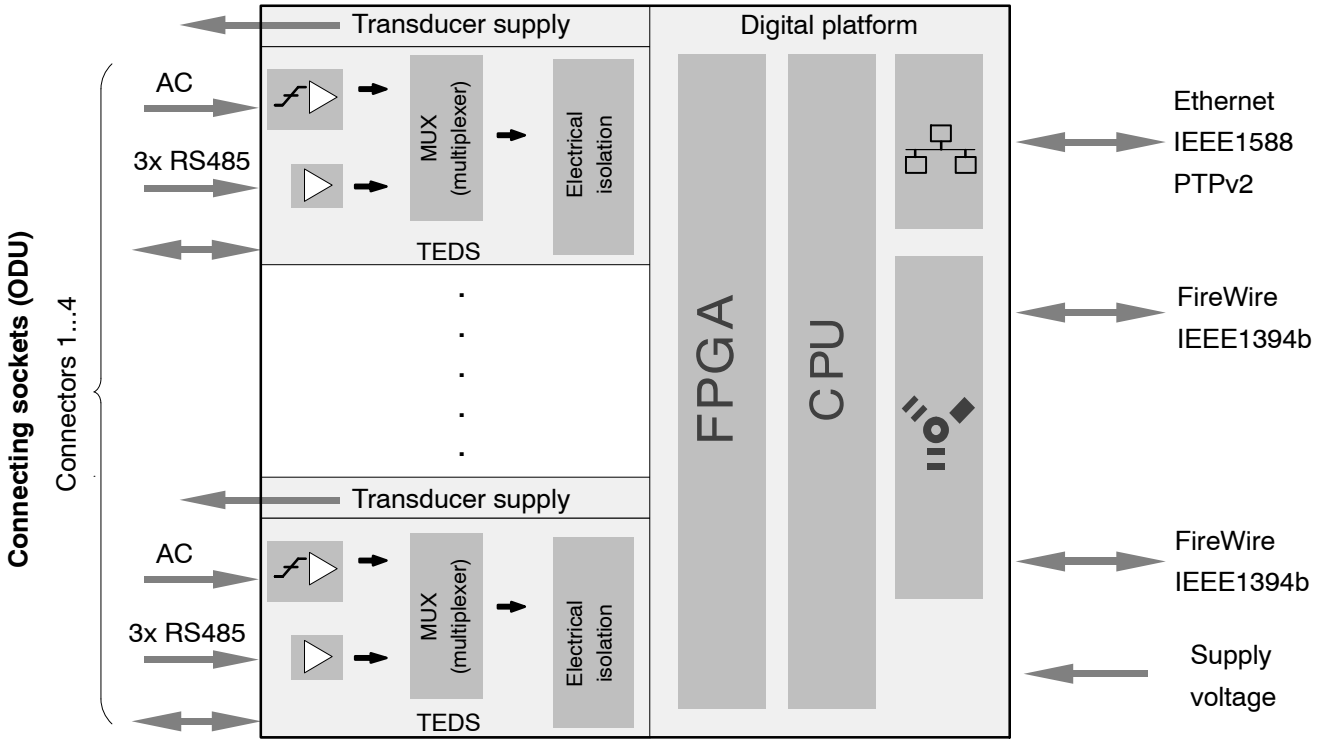
Rugged pulse- and frequency measuring module

Data sheet

Special features

- **Four individually configurable inputs (electrically isolated)**
- **Measure any kind of digital signals up to 1 Mhz for measurement of speed, torque (HBM), angle, position, displacement and PWM**
- **Sample rates up to 100 kS/s per channel, active low pass filter**
- **Real-time torsional vibration analysis (TVA) and differential angle detection**
- **TEDS support**
- **Use in harsh environments (shock, vibration, temperature, dewing, moisture)**
- **Supply voltage (DC) for active transducers: 5 V ... 24 V**

Block diagram



HBM

MX460B-R Specifications

General specifications		
Inputs	Number	4, electrically isolated from each other and from the supply[1)]
Transducer technologies		Digital pulses and frequencies in general: counters, torque transducers from HBM, rotary encoders / pickups (AC coupled), shaft encoders (single or dual lane, with/without index), PWM (pulse-width / time, duty cycle).
Sample rates	S/s	Decimal: 0.1 … 100,000 HBM Classic: 0.1 … 96,000
Signal Bandwidth, max. (–3 dB)[2)]	Hz	0 … 40,000 (Filter off)
Active low-pass filter		Bessel, Butterworth, Linear Phase, Filter off
Transducer identification (TEDS, IEEE 1451.4) max. TEDS module distance		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[3)]
Power consumption		
without adjustable transducer excitation	W	< 6
with adjustable transducer excitation	W	< 9
Transducer excitation (active transducers)		
Adjustable 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
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)		IEEE1394b (only HBM modules)
Max. current from module to module	A	1.5
Plug	–	ODU MINI–SNAP, 8 Pins
Max. cable length between nodes	m	5 (optical 100)
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 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 [°F]	–40 ... +85 [–40 ... +185]
Relative humidity	%	5 ... 100
Protection class		III[6)]
Degree of protection		IP65/IP67 per EN 60529
EMC requirements		EN 61326–1
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
Dimensions, horizontal (H x W x D)	mm	80 x 205 x 140
Weight, approx.	g	1,900

1) When the variable transducer supply is used, there is no electrical isolation from the supply voltage.
2) Conditions: FM with F0= 500 kHz and ΔF = 100 kHz
3) Uninterruptible Power Supply (UPS) for prolonged interruption of power, available as an accessory
4) Hop: transition from module to module/signal conditioning
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.

MX460B–R Specifications (Continued)

Transducer technology Technical Data		
Accuracy class (Frequenzmessung und Zählen)		0.01
Transducers that can be connected **RS485 inputs** **AC input**		torque transducer, incremental encoder, frequency signal source (square1-wave), Crankshaft sensor with gap detection, internal mapping of channels from, e.g., 1 to 2 for computation of angle and rotational speed signals with a single sensor type. passive inductive speed sensor, frequency signal source (pickup‘s)
Input frequency range RS485 inputs AC input	 Hz Hz	 0.1 ... 1,000,000 10 ... 50,000
Measuring ranges frequency measurement	kHz	20; 200; 1,000
Resolution frequency measurement, min. Measuring range 20 kHz Measuring range 200 kHz Measuring range 1000 kHz	mHz	 1 (signal range: 0.1 ... 8,192 Hz) 2 (signal range: 8,193 ... 16,384 Hz) 4 (signal range: 16,385 ... 32,768 Hz) 10 (signal range: 0.1 ... 65,536 Hz) 16 (signal range: 65,537 ... 131,072 Hz) 32 (signal range: 131,073 ... 262,144 Hz) 125 (signal range: 0.1 ... 1,048,576 Hz)
Square-wave signal measurement (RS485 inputs) F1 (+/–) F2 (+/–) Zero index (+/–)		Quadrature signals with index Frequency or pulse signals Directional signal offset by 90° to F1 Zero position signal
Input level (RS485 inputs) for single-pole mode **Source at signal (+) and ground, signal (–) connected to V_{ref} (Pin 9 DSUB)** Low level High level	 V V	 < 2.3 > 2.7
Input level (RS485 inputs) for differential signal mode **Push-pull signal at signal (+) and signal (–)** Low level High level	 mV mV	 signal (+) < signal (–) –200 signal (+) < signal (–) –50
Input voltage range (RS485 inputs) Common-mode voltage range (to ground) max. permissible voltages (to ground)	 V V	 –7 ... +12 ±40
Input level for AC input (F1) (peak to peak) minimum level maximum level	 V V V V	 0.1 (to 1 kHz) 1 (at 10 kHz) 5 (at 50 kHz) 40
Input impedances RS485 inputs connectable termination resistor RS485 inputs AC input	 kΩ Ω kΩ	 > 45 125 > 100
CAL calibration signal output (Pin 15 DSUB) Level (at 10 mA) CAL active	 V	 4.5 min.
Frequency measurement Frequency (RS485 inputs) Frequency (AC inputs)	 Hz Hz	 10 ... 1,000,000 10 ... 50,000
Counter (RS485 inputs) Frequency Increments	 Hz –	 0 ... 1,000,000 ±2,000,000

MX460B–R Specifications (Continued)

Pulse-width modulated signals (PWM) Frequency Pulse width/duty ratio	 Hz %	 0.1 ... 100,000 5 ... 95
Pulse duration/High-level or Low-level duration	ms	0 ... 5,000
Period duration	ms	0 ... 5,000
Internal sampling frequency	MHz	98.3
Glitch filter time constant (adjustable)	µs	0.1; 1; 10; 100
Permissible cable length between MX460B and transducer	m	100
Frequency measurement deviation	%	< 0.01 of measured value
PWM deviation	%/kHz	0.3
Pulse duration deviation	ns	500
Periodic time deviation	ns	200
Zero drift	% / 10 K	0
Full scale drift	% / 10 K	< 0.01 of measured value

Real-time computations on the module		
Peak-value unit Number of peak values		 8
Analysis functions		Differential angle Torsional vibration analysis (differential angle to uniform angular velocity)

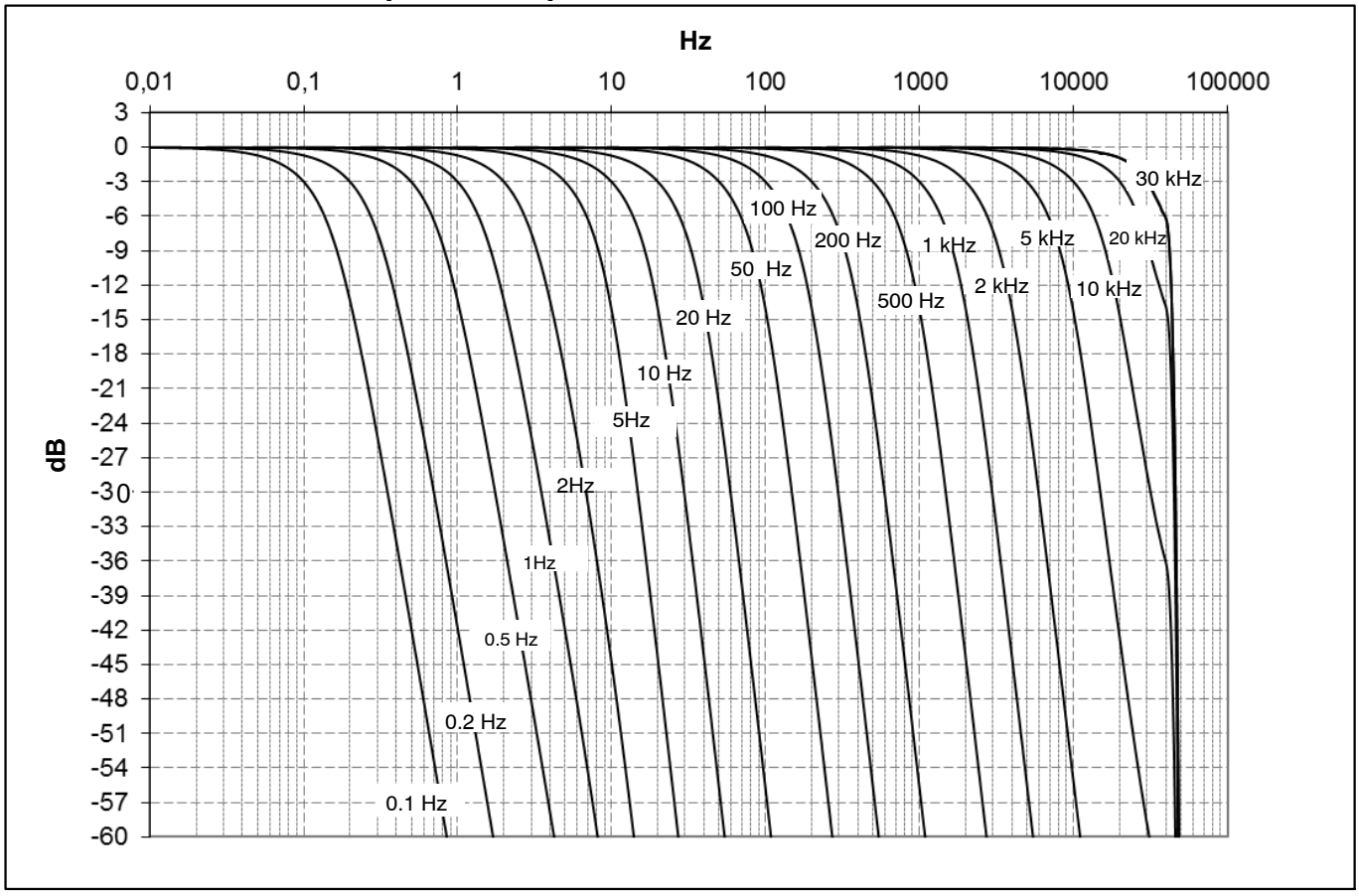
Decimal sample rates and digital low pass filter, type Bessel

(4th order Bessel with data rate < 100,000 Hz; 6th order with data rate= 100,000 Hz)

The data is given for the modulation frequency Fm under the following conditions: sinusoidal FM with the carrier frequency F0 = 500 kHz and a deviation ΔF = 100 kHz.

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)	Rise time (ms)	Overshoot (%)	Data rate (Hz)
Bessel	20,616	30,000	44,600	0.002	0.01	2.8	100,000
	12,373	20,000	43,000	0.005	0.02	1.0	100,000
	5,917	10,000	23,465	0.021	0.04	0,8	100,000
	2,929	5,000	11,715	0.06	0,07	0.8	100,000
	1,164	2,000	4,700	0.19	0.2	0,8	100,000
	584	1,000	2,350	0.40	0,3	0.6	100,000
	292	500	1,175	0.82	0.7	0,6	100,000
	117	200	470	2.1	1,7	0.6	100,000
	58	100	235	4,2	3.5	0,6	100,000
	29.2	50	117,5	8.5	7	0,6	100,000
	11.7	20	47	21,3	17	0.6	100,000
	5,8	10	23.5	42,7	35	0.6	100,000
	2,91	5	11.74	85,5	70	0.6	100,000
	1,19	2	5.04	187	175	0,9	2,000
	0.59	1	2,54	351	350	0.8	2,000
	0,30	0.5	1,27	680	700	0.8	2,000
	0,12	0.2	0,51	1,669	1,751	0.8	2,000
	0,06	0.1	0,25	3,315	3,499	0..8	2,000

Decimale data rates : Amplitude response Bessel filter



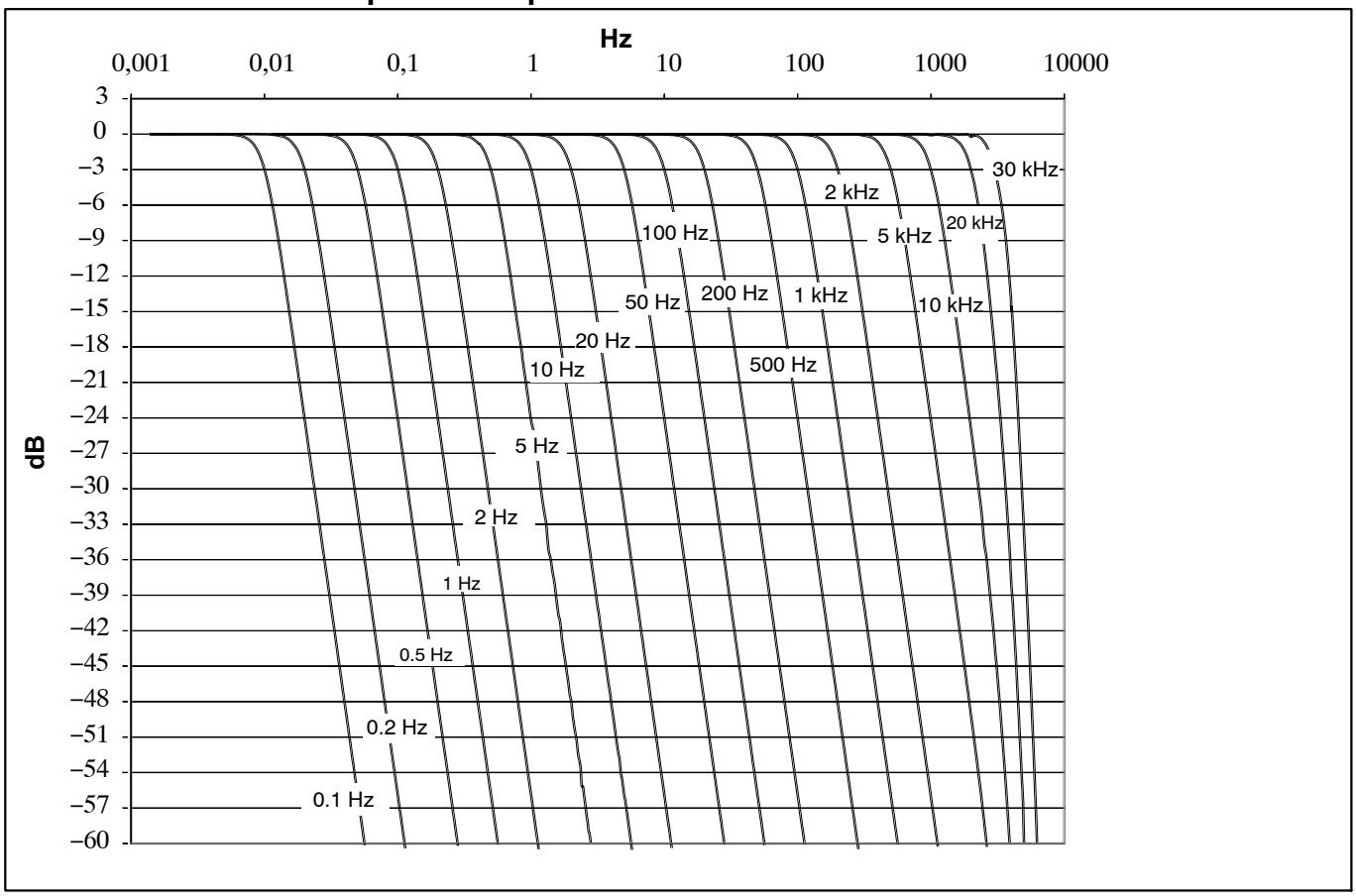
Decimal sample rates and digital low pass filter, type Butterworth

(4^{th} order Butterworth with data rate < 100,000 Hz; 6^{th} order with data rate= 100,000 Hz)

The data is given for the modulation frequency Fm under the following conditions: sinusoidal FM with the carrier frequency F0 = 500 kHz and a deviation ∆F = 100 kHz.

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phjase delay (ms)	Rise time (ms)	Overshoot (%)	Data rate (Hz)
Butterworth	28,269	30,000	35,359	0.02	0,02	193	100,000
	18,328	20,000	26,009	0.03	0.03	17.6	100,000
	8,994	10,000	14,155	0,06	0.04	15,5	100,000
	4,475	5,000	7,265	0.1	0.09	15	100,000
	1,787	2,000	2,929	0.3	0,2	14	100,000
	894	1,000	1,466	0.7	0.4	14	100,000
	447	500	733	1.3	0,8	14	100,000
	179	200	293	3.3	2	14	100,000
	89	100	147	6.6	4	14	100,000
	44.7	50	73,3	13	8	14	100,000
	17.9	20	29.3	33	21	14	100,000
	8.9	10	14,7	66	43	14	100,000
	4.47	5	7.33	132	85	14	100,000
	1.69	2	3,55	248	194	11	2,000
	0.84	1	1.78	471	387	11	2,000
	0.42	0,5	0.89	921	774	11	2,000
	0.17	0.2	0,35	2,266	1,934	11	2,000
	0.08	0.1	0.18	4,510	3,869	11	2,000

Decimal data rates : Amplitude response Butterworth filter

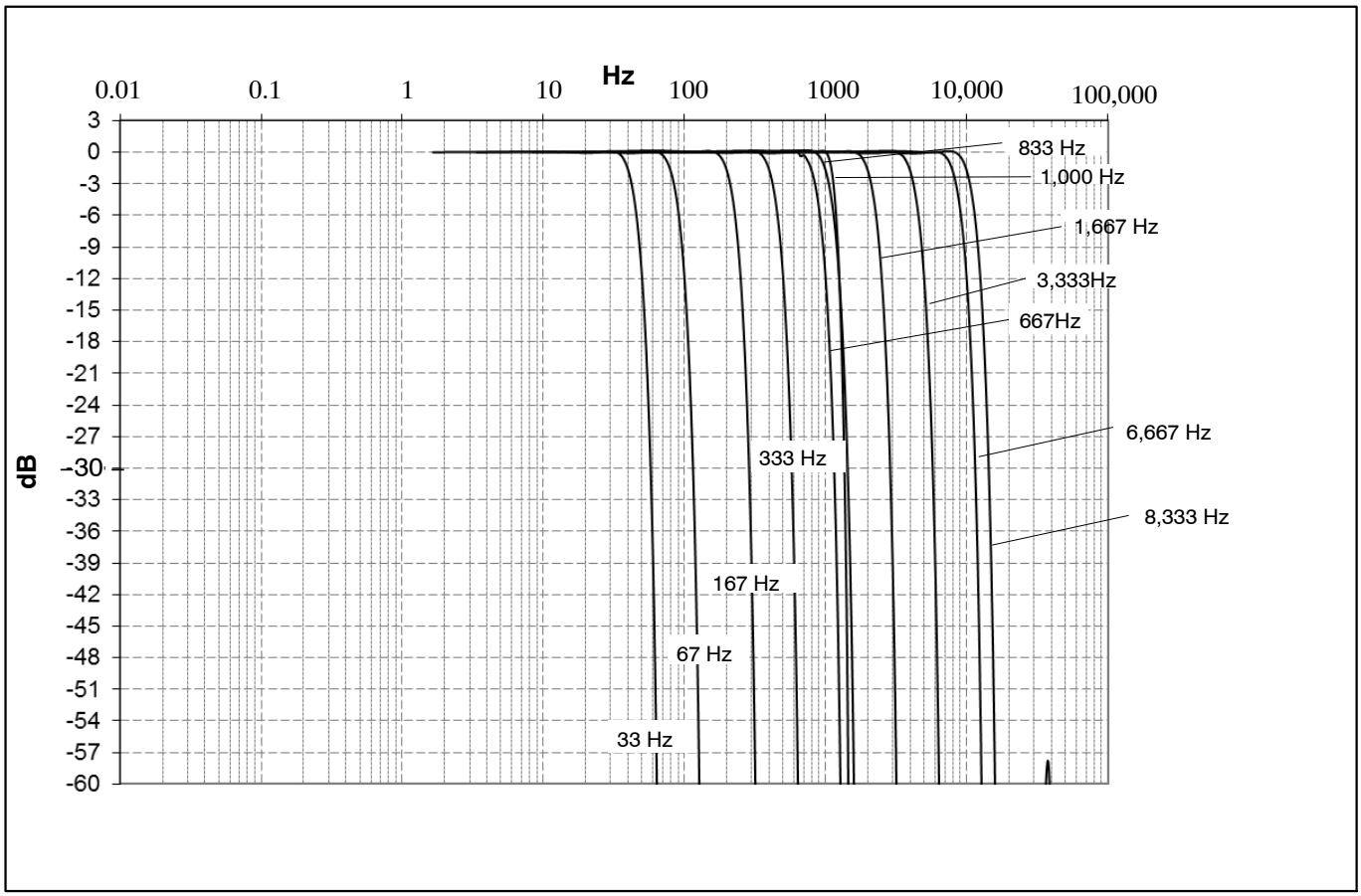


Decimal sample rates and digital low-pass filters, linear phase (FIR)

The data is given for the modulation frequency Fm under the following conditions: sinusoidal FM with the carrier frequency F0 = 500 kHz and a deviation ▵F = 100 kHz.

Type	Start of level drop	-3 dB (Hz)	-20 dB (Hz)	Runtime (ms)	Rise time (ms)	Overshoot (%)	Sample rate (Hz)
Linear phase	8,333	10,530	13,460	0.36	0,055	8,6	25,000
	6,667	8,380	10,780	0.41	0,07	8,6	20,000
	3,333	3,900	4,580	0.78	0.12	8.6	10,000
	1,667	2,100	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	838	1,080	4.80	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

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

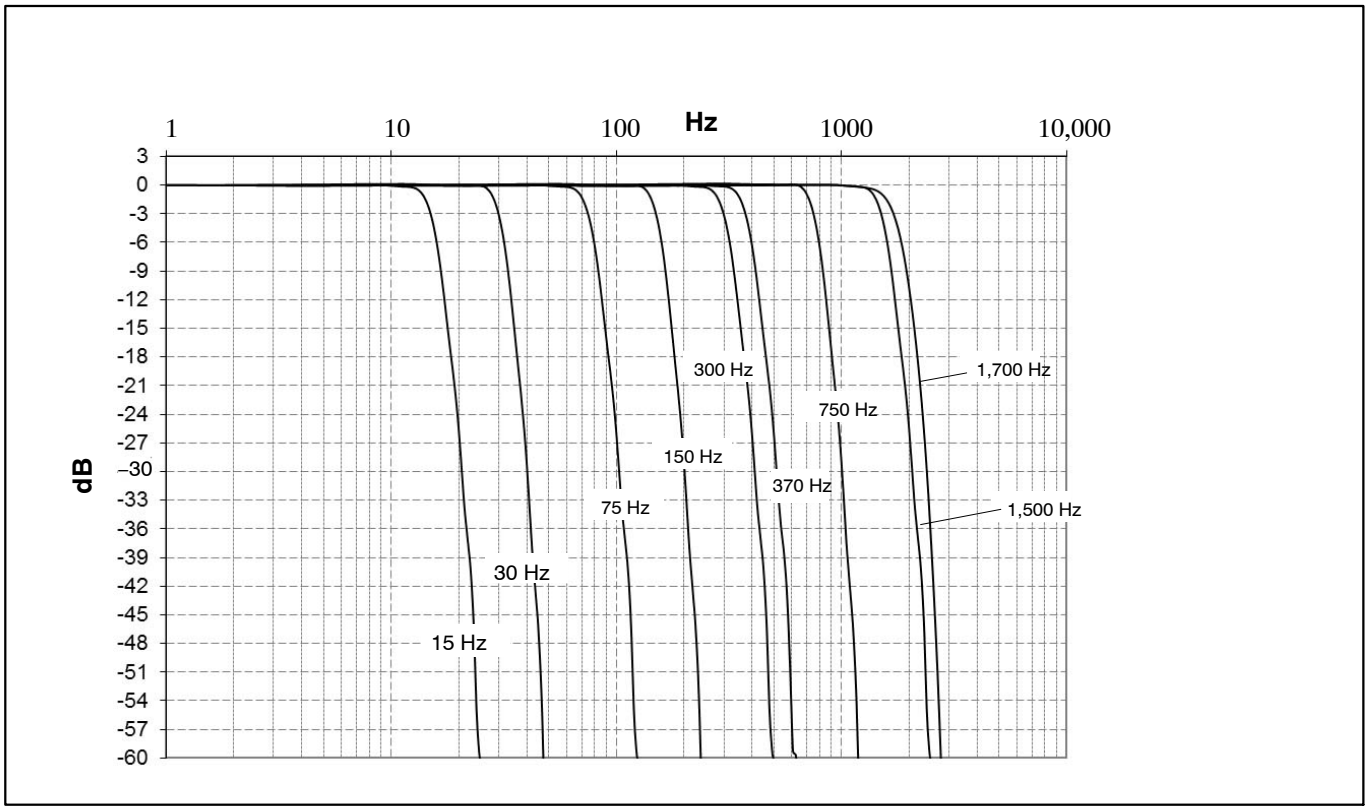


Decimal sample rates and digital low-pass filters, Butterworth filter (FIR)

The data is given for the modulation frequency Fm under the following conditions: sinusoidal FM with the carrier frequency F0 = 500 kHz and a deviation ΔF = 100 kHz.

Type	Start of level drop	-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	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

Decimal sample rates: Butterworth filter amplitude response (FIR)



Classic HBM data rates and active low-pass filters, type Bessel

(4th order Bessel/Butterworth with data rate < 96,000 Hz; 6th order with data rate = 96,000 Hz)

The data is given for the modulation frequency Fm under the following conditions: sinusoidal FM with the carrier frequency F0 = 500 kHz and a deviation ΔF = 100 kHz.

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)	Rise time (ms)	Overshoot (%)	Data rate (Hz)
Bessel	20,000	29,250	43,000	0.002	0.016	4.1	96,000
	10,000	16,810	40,260	0.008	0.023	1.5	96,000
	5,000	8,510	19,906	0.027	0.042	0.9	96,000
	2,000	3,515	8,275	0.094	0.1	0.6	96,000
	1,000	1,715	4,070	0.22	0.2	0.6	96,000
	500	852	2,008	0.47	0.41	0.6	96,000
	200	341	803	1.22	1.01	0.8	96,000
	100	171	402	2.5	2.01	0.8	96,000
	50	84.2	215	4	4.08	1	19,200
	20	33.7	86	10	10.2	1	9,600
	10	16.9	43	20	20.6	1	9,600
	5	8.41	21.5	40	41	1	4,800
	2	3.37	8.6	98	102.8	1	1,200
	1	1.58	4.3	196	206.4	1	600
	0.5	0.84	2.15	392	411.2	1	600
	0.2	0.34	0.86	982	1,026	1	300
	0.1	0.17	0.43	1,968	2,052	1	150

Classic HBM data rates and active low-pass filters, type Butterworth

(4th order Bessel/Butterworth with data rate < 96,000 Hz; 6th order with data rate = 96,000 Hz)

The data is given for the modulation frequency Fm under the following conditions: sinusoidal FM with the carrier frequency F0 = 500 kHz and a deviation ΔF = 100 kHz.

Type	-1dB (Hz)	-3dB (Hz)	-20dB (Hz)	Phase delay (ms)	Rise time (ms)	Overshoot (%)	Data rate (Hz)
Butterworth	20,000	21,700	27,500	0.025	0.02	15.6	96,000
	10,000	11,100	15,500	0.06	0.04	15.6	96,000
	5,000	5,585	8,100	0.13	0.08	14.5	96,000
	2,000	2,238	3,280	0.3	0.2	14.5	96,000
	1,000	1,119	1,640	0.6	0.4	14.5	96,000
	500	560	820	1.2	0.8	14.5	96,000
	200	237	420	2.1	1.6	11	19,200
	100	118	210	4	3.3	11	19,200
	50	59	105	7.8	6.6	11	19,200
	20	24	42	19.4	16.1	11	4,800
	10	11.8	21	38.6	32.4	11	2,400
	5	5.9	10.5	76.5	65	11	1,200
	2	2.4	4.2	191	163	11	600
	1	1.2	2.1	382	325	11	300
	0.5	0.59	1.05	760	653	11	300
	0.2	0.24	0.42	1,900	1,630	11	150
	0.1	0.12	0.21	3,790	3,260	11	150

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