Data sheet

QUANTUMX

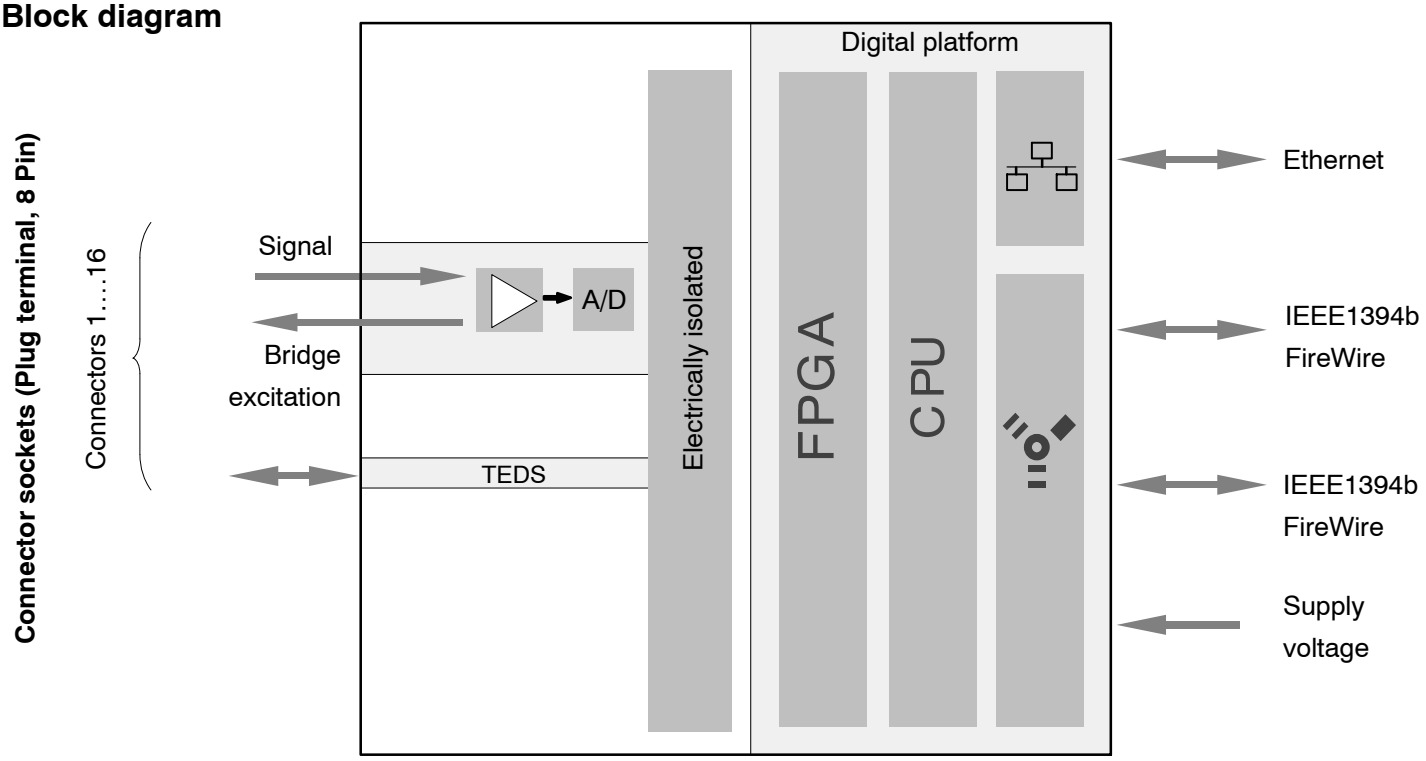
MX1615

Bridge/strain gauge amplifier

Special features

- **16 individually configurable inputs**
- **Connection of strain gauges in quarter- , half- and full-bridge**
- **Bridge excitation : DC or carrier frequency**
- **Internal shunt resistor**
- **Connection of standard voltage, PT100, resistor**
- **Data rate up to 19200 Hz per channel**
- **3000 Hz bandwidth**
- **24–bit A/D converter per channel for synchronous, parallel measurements**
- **Active low pass filter**
- **TEDS support**

Block diagram



HBM

Specifications MX1615

General specifications		
Inputs	Number	16, electrically isolated from the supply
Transducer technologies, can be adjusted individually		Strain gauges in full- , half- or quarter-bridge configuration. Selectable bridge excitation voltage : DC voltage or carrier frequency (AC/CF, 1200 Hz)
		SG-quarter bridges SG-half bridges SG-full bridges — Three wire and four wire five wire six wire
		Resistor, Resistance thermometer (PT100), connection in four-wire configuration
		Voltage (±10 V differential, 0 … 30 V unipolar) without transducer supply
A/D converter per channel		24 Bit Delta Sigma converter
Data rate per channel, max.	Hz	0.1 … 19,200, can be individually adjusted per channel
Bandwidth	kHz	3.0 0.4 using carrier frequency
Active low-pass filter (Bessel/Butterworth, can be switched off)	Hz	0.01 … 3,000
Transducer identification (TEDS, IEEE 1451.4) max. distance of the TEDS module	m	100
Transducer connection		Phönix Contact FMC–1,5/8–ST–3,5–RF plug terminal Plug included
Supply voltage range (DC)	V	10 ... 30 (24 V nominal (rated) voltage)
Supply voltage interruption		max. 5 ms at 24 V
Power consumption	W	< 12
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 (CAT-5)
Max. cable length to module	m	100
Synchronization options EtherCAT®[1] NTP IRIG–B (B000 to B007; B120 to B127)		IEEE1394b FireWire (only QuantumX, automatically, recommended) via CX27 via Ethernet via MX440A - or MX840A 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 .... +60 [–4 ... +140]
Operating 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
EMC requirements		per EN 61326–1
Max. input voltage at transducer socket to ground, transient free Pin 6 and 7 to Pin 1, 2, 3, 4 or 5	V	±18
Dimensions, horizontal (W x H x D)	mm	52.5 x 200 x 122 (with case protection) 44 x 174 x 119 (without case protection)
Weight, approx.	g	980

1) EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany

2) Hub: IEEE1394b FireWire node or distributor

3) Hop: Transition from module to module or signal conditioning / distribution via IEEE1394b FireWire (hub, backplane)

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.

Specifications MX1615 (Continued)

4 mV/V CF strain gauge full and half bridge with 1 V; 2.5 V or 5 V excitation (AC, square)		
Accuracy class		0.05 [1]
Carrier frequency (square)	Hz	1,200 ±2
Bridge excitation voltage (effective)	V	1; 2.5; 5 (±5 %)
Transducers that can be connected		strain gauge full and half bridges
Permissible cable length between MX1615 and transducer	m	< 100
Measuring ranges		
at 5 V excitation	mV/V	±4
at 2.5 V excitation	mV/V	±8
at 1 V excitation	mV/V	±20
Control signal (Shunt)		
Full bridge	mV/V	−1.066 ±0.3% (at 350 Ohm)
Half bridge	mV/V	+1.008 ±0.3% (at 350 Ohm) [2]
Measurement frequency range (–3 dB)	Hz	0 ... 400
Transducer impedance		
at 5 V excitation	Ω	300 ... 1,000
at 2.5 V excitation	Ω	110 ... 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	< 0.2
with filter 10 Hz Bessel	µV/V	< 0.5
with filter 100 Hz Bessel	µV/V	< 1.5
Linearity error	%	< 0.02 of full scale
Zero drift (Full bridge with 5 V excitation)	% / 10 K	< 0.02 [1] of full scale
Full-scale drift (5 V excitation)	% / 10 K	< 0.05 of measurement value

[1] 0.1 with half bridge

[2] When using a half bridge, the control signal may only be used when signals 1 (Pin 6) and 4 (Pin 7) are bridged.

4 mV/V CF strain gauge full and half bridge with1 V; 2.5 V or 5 V excitation (DC)		
Accuracy class		0.05 [1]
Bridge excitation voltage (DC)	<	1; 2.5; 5; (±5 %)
Transducers that can be connected		strain gauge half and full bridges
Permissible cable length between MX1615 and transducer	m	< 100
Measuring ranges		
at 5 V excitation	mV/V	±4
at 2.5 V excitation	mV/V	±8
at 1 V excitation	mV/V	±20
Control signal (Shunt)		
Full bridge	mV/V	−1.066 ±0.3% (at 350 Ohm)
Half bridge	mV/V	+1.008 ±0.3% (at 350 Ohm) [2]
Measurement frequency range (–3 dB)	Hz	0 ... 3,000
Transducer impedance		
at 5 V excitation	Ω	300 ... 1,000
at 2.5 V excitation	Ω	110 ... 1,000
at 1 V excitation	Ω	80 ... 1,000
at 0.5 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	< 0.2
with filter 10 Hz Bessel	µV/V	< 0.4
with filter 100 Hz Bessel	µV/V	< 1
with filter 1 kHz Bessel	µV/V	< 3
Linearity error	%	< 0.02 of full scale
Zero drift (Full bridge with 5 V excitation)	% / 10 K	< 0.05 [1] of full scale
Full-scale drift (5 V excitation)	% / 10 K	< 0.05 of measurement value

[1] with half bridge : 0.1; with 10 V/m electromagnetic field strength (EN61000–4–3) : 0.2

[2] When using a half bridge, the control signal may only be used when signals 1 (Pin 6) and 4 (Pin 7) are bridged.

Specifications MX1615 (Continued)

5 mV/V CF strain gauge single bridge with 0.5 V; 1 V; 2.5 V or 5 V excitation (AC, square)		
Accuracy class		0.1
Carrier frequency (square)	Hz	1200 ± 2
Bridge excitation voltage (effective)	V	0.5; 1; 2.5; 5 (± 5 %)
Transducers that can be connected		SG quarter bridge in four wire circuit
Permissible cable length between MX1615 and transducer	m	< 100
Measuring ranges at 5 V excitation (only at 350 Ohm strain gauge) at 2.5 V excitation at 1 V excitation at 0.5 V excitation	 mV/V mV/V mV/V mV/V	 ± 4 ± 8 ± 20 ± 40
Control signal (Shunt)	mV/V	1.008 ± 0,1 % (at 350 Ohm)
Measurement frequency range (–3 dB)	Hz	0 ... 400
Internal completion resistors	Ω	120 and 350
Noise at 25 °C and 5 V excitation (peak to peak) with filter 1 Hz Bessel with filter 10 Hz Bessel with filter 100 Hz Bessel	 µV/V µV/V µV/V	 < 0.3 < 0.6 < 1.5
Linearity error[1)]	%	< 0.05 of full scale
Zero drift[1)] (5 V excitation)	% / 10 K	< 0.1 of full scale
Full-scale[1)] drift (5 V excitation)	% / 10 K	< 0.1 of measurement value

1) With 350 ohm resistor

5 mV/V CF strain gauge single bridge with 0.5 V; 1 V; 2.5 V or 5 V excitation (DC)		
Accuracy class		0.1[1)]
Bridge excitation voltage (DC)	V	0.5; 1; 2.5; 5 (± 5 %)
Transducers that can be connected		SG quarter bridges in four wire or three wire circuit
Permissible cable length between MX1615 and transducer	m	< 100
Measuring ranges at 5 V excitation (only at 350 Ohm strain gauge) at 2.5 V excitation at 1 V excitation at 0.5 V excitation	 mV/V mV/V mV/V mV/V	 ± 4 ± 8 ± 20 ± 40
Control signal (Shunt)	mV/V	1.008 ± 0,1 % (at 350 Ohm)
Measurement frequency range (–3 dB)	Hz	0 ... 3,000
Internal completion resistors	Ω	120 and 350
Noise at 25 °C and 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	 < 0.4 < 0.6 < 1.5 < 3
Linearity error[2)]	%	< 0.05 of full scale
Zero drift[2)] (5 V excitation)	% / 10 K	<0.1 of full scale
Full-scale[2)] drift (5 V excitation)	% / 10 K	< 0.1 of measurement value

1) with 10 V/m electromagnetic field strength (EN61000–4–3) : 0.2
The accuracy class does not take into account measurement errors resulting from asymmetrical cable resistances when using a three-wire circuit.

2) With 350 ohm resistor and connection using a four-wire circuit.

Specifications MX1615 (Continued)

Voltage 10 V (DC)		
Accuracy class		0.05
Transducers that can be connected		Voltage sources
Permissible cable length between MX1615 and transducer	m	100
Measuring range	V V	±10 differential, 0 30 unipolar
Measurement frequency range (–3 dB)	Hz	0 ... 3,000
Internal resistance of the connected voltage source	Ω	< 500
Input impedance (symmetrical)	MΩ	> 1.5
Noise at 25 °C (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	 150 300 600 2000
Linearity error	%	< 0.02 of full scale
Common-mode rejection at DC common-mode at 50 Hz common-mode, typically	 dB dB	 > 100 75
Max. common-mode voltage Channel from housing and supply ground Channel from channel	 V V	 ±60 ±5
Zero drift	% / 10 K	< 0.03 of full scale
Full-scale drift	% / 10 K	< 0.05 of measurement value

Specifications MX1615 (Continued)

Resistance		
Accuracy class		0.1
Transducers that can be connected		PTC, NTC, KTY, TT-3, resistances generally (connection with four wire configuration)
Permissible cable length between MX1615 and transducer	m	100
Measuring range	Ω	0 ... 1,000[1)]
Excitation current	mA	0.37 ... 1.43
Measurement frequency range (–3 dB)	Hz	0 ... 3,000
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	%	< 0.05 of full scale
Zero drift	%/10K	< 0.02 of full scale
Full-scale drift	% / 10 K	< 0.1 of measurement value

1) Measuring range can be modulated up to 5 kΩ, in this case: accuracy class 2

Resistance thermometer (PT100)		
Accuracy class		0.1
Transducers that can be connected		PT100 (connection with four wire configuration)
Permissible cable length between MX1615 and transducer	m	100
Linearization range	°C [°F]	–200 ... +848 [–328 ... +1,558.4]
Excitation current	mA	0.67 ... 1.36
Measurement frequency range (–3 dB)	Hz	0 ... 3,000
Noise at 25 °C (peak to peak)		
with filter 1 Hz Bessel	K	< 0.02
with filter 10 Hz Bessel	K	< 0.04
with filter 100 Hz Bessel	K	< 0.1
with filter 1 kHz Bessel	K	< 0.3
Linearity error	K	< ± 0.3
Zero drift	K / 10 K	< 0.2
Full-scale drift	K / 10 K	< 0.5

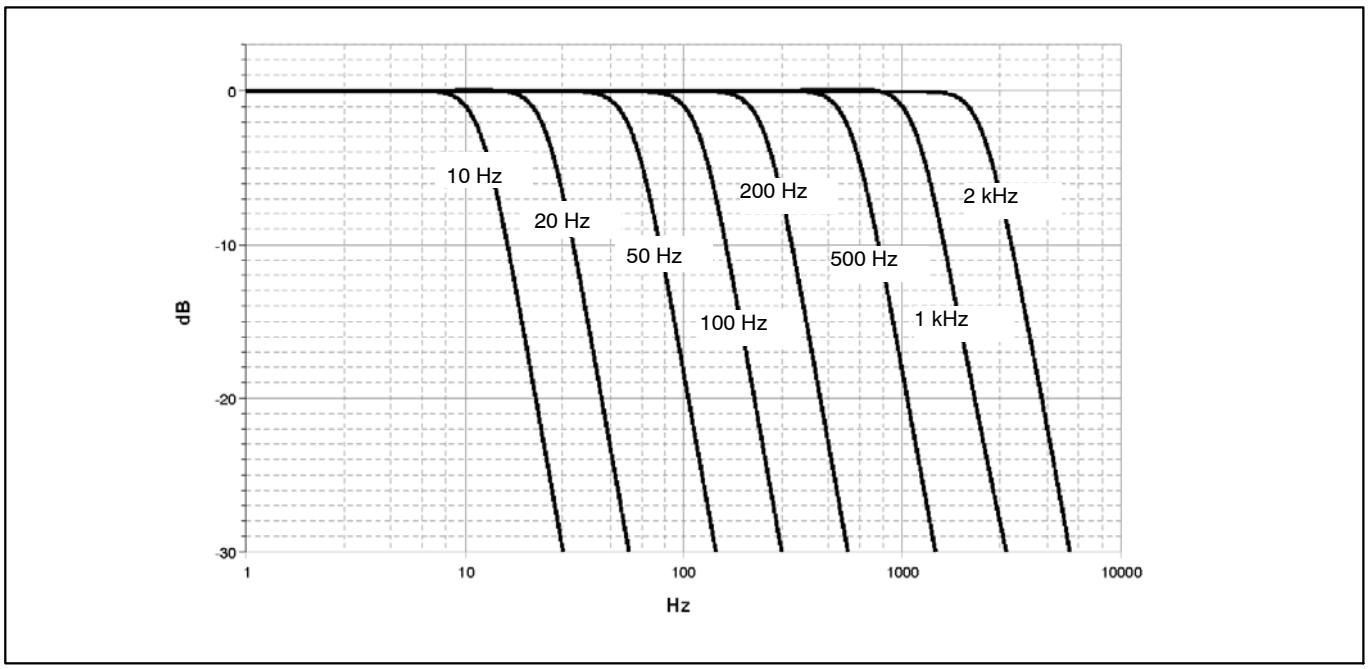
Active low pass filter data MX1615

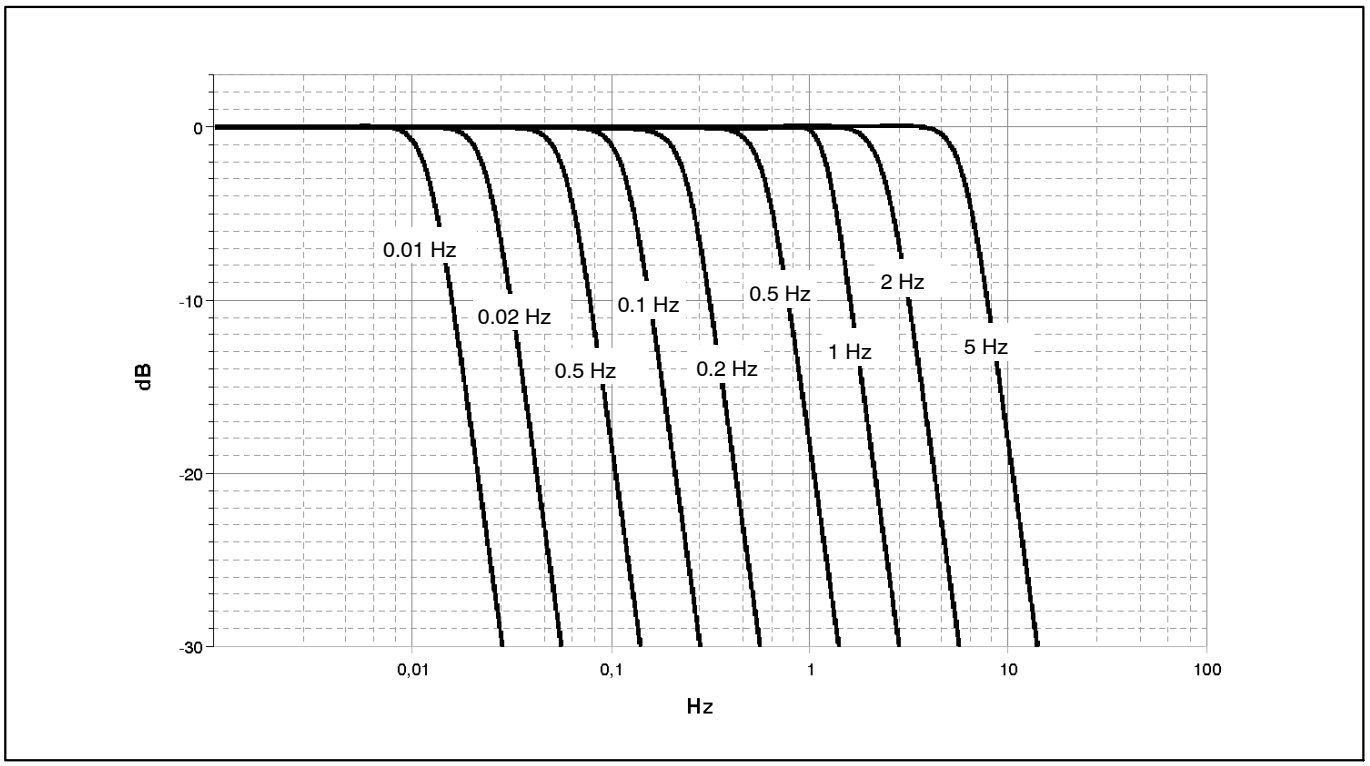
(4th order Bessel/Butterworth, with CF supply only valid for $f_g \leq 100$ Hz)

Type	–1dB (Hz)	–3dB (Hz)	–20dB (Hz)	Phase delay (ms)	Rise time (ms)	Overshoot (%)	Data rate (Hz)
Bessel	1000	1575	3611	0.11	0.2	1.4	19200
	1000	1575	3612	0.11	0.2	1.4	9600
	500	812	2079	0.3	0.38	1.3	9600
	200	335	860	0.9	1.05	0.8	9600
	100	168	427	1.8	2.11	0.8	9600
	50	84	213	3.8	4.18	0.8	9600
	20	33.7	85	9.6	10.4	0.8	9600
	10	16.6	43	19.5	21.0	0.8	9600
	5	8.4	21	39	41.4	0.8	2400
	2	3.4	8,6	97	102	0.8	2400
	1	1.6	4,2	197	215	0.8	2400
	0.5	0.84	2,1	390	418	0.8	300
	0.2	0.34	0,85	980	1033	0.8	300
	0.1	0.17	0,43	1950	2090	0.8	300
	0.05	0.085	0,21	3860	4170	0.8	20
	0.02	0.036	0,088	9800	10560	0.8	20
	0.01	0.017	0,044	19500	21200	0.8	20
Butterworth	2000	3053	5083	0	0.144	8.5	19200
	1000	1170	2077	0.27	0.344	11	19200
	1000	1171	2078	0.27	0.378	11	9600
	500	587	1048	0.64	0.652	11	9600
	200	237	420	1.76	1.64	11	9600
	100	118	210	3.65	3.28	11	9600
	50	59	105	7.49	6.29	11	9600
	20	24	42	18.8	16.15	11	9600
	10	12	21	37.7	32.29	11	9600
	5	5.95	10.5	74.9	65.92	11	2400
	2	2.37	4.24	188	163.6	11	2400
	1	1.26	2.12	370	315	11	2400
	0.5	0.59	1.05	756	656	11	300
	0.2	0.241	0.419	1900	1640	11	300
	0.1	0.122	0.210	3770	3280	11	300
	0.05	0.060	0.106	7490	6596	11	20
	0.02	0.0245	0.042	18900	16200	11	20
	0.01	0.012	0.021	37700	32383	11	20

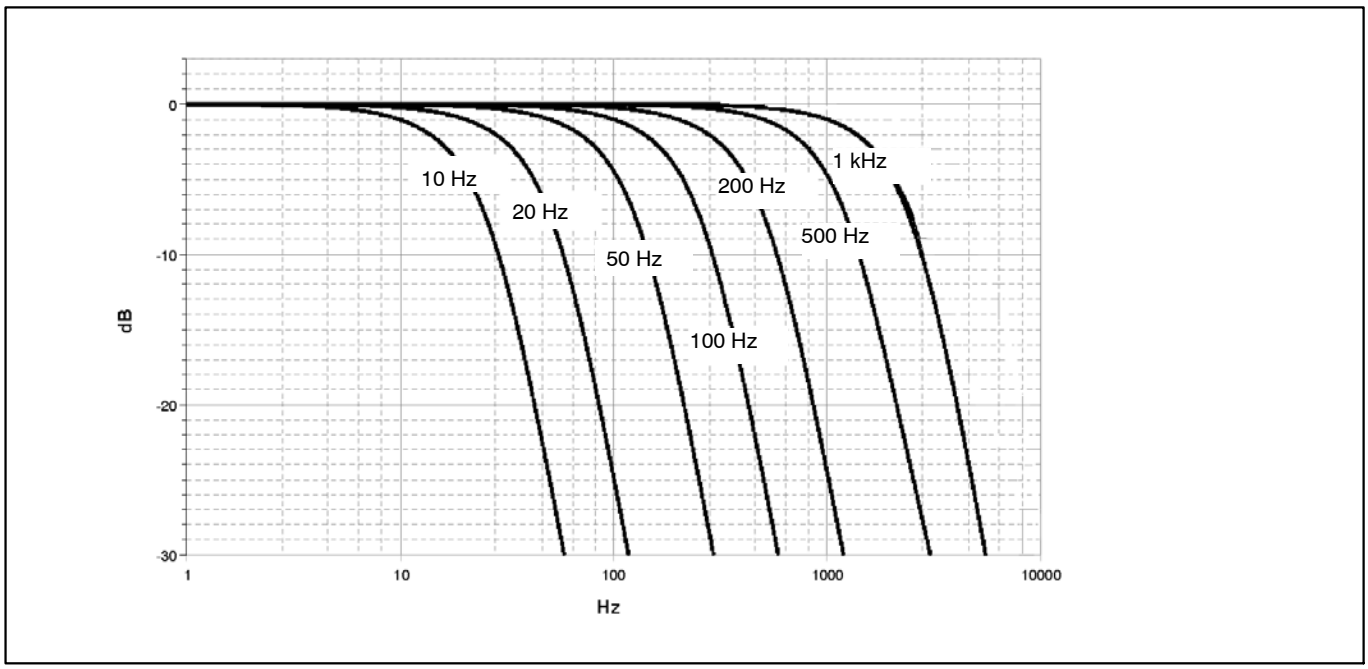
*) The analog-to-digital converter's delay time is 128 µs for all data rates and has not been accounted for in the "Phase delay" column!

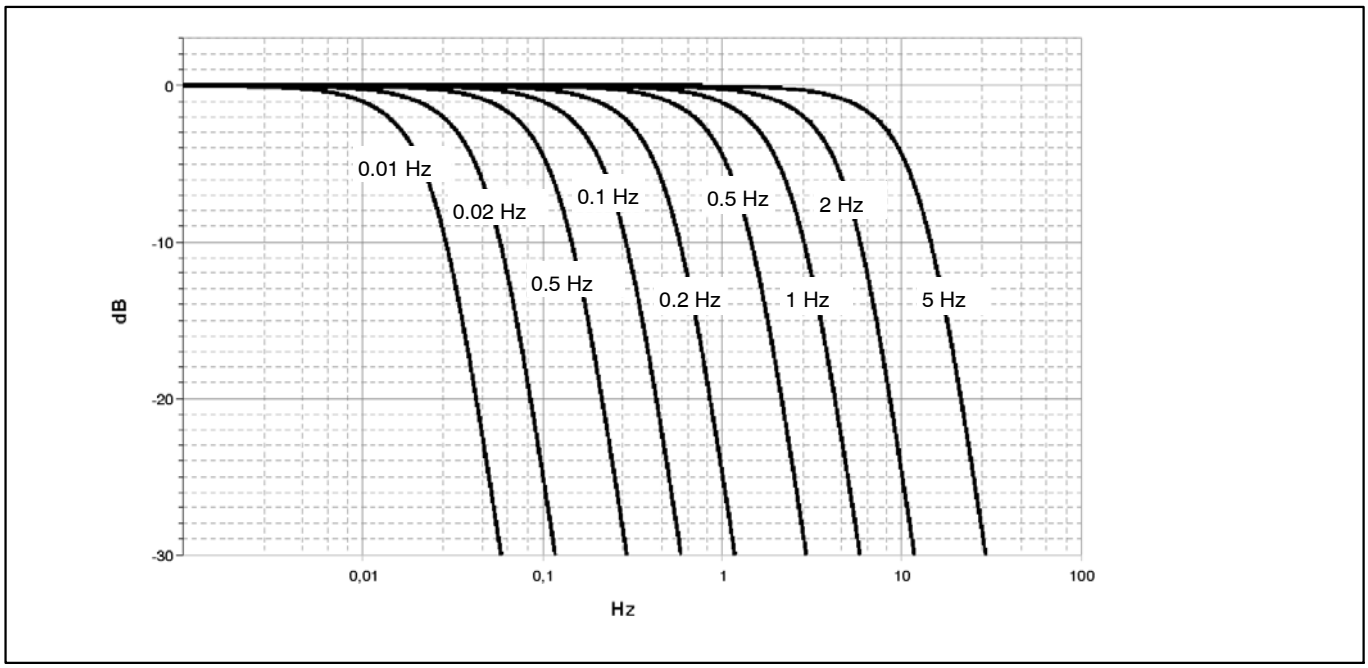
Amplitude response of MX1615 Butterworth filter





Amplitude response of MX1615 Bessel 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

MX1615 accessories		
Article	**Description**	**Order No.**
Voltage supply		
AC-DC power supply / 24 V	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		
IEEE1394b FireWire cable (module-to-module)	FireWire connection cable for QuantumX modules; with matching plugs on both sides. Lengths 0.2 m/2 m/5 m Note: The cable enables QuantumX modules to be supplied with voltage (max. 1.5 A, from the source to the last drain).	1–KAB269–0.2 1–KAB269–2 1–KAB269–5
IEEE1394b FireWire IEEE PC–Card	FireWire IEEE 1394b PC–Card (PCMCIA adapter) to connect QuantumX modules to a notebook or PC	1–IF001
IEEE1394b FireWire IEEE ExpressCard	FireWire IEEE 1394b ExpressCard (ExpressCard/34) to connect QuantumX modules to a notebook or PC	1–IF002
IEEE1394b FireWire cable PC-to-module	Firewire connection cable from the PC to the first module for data transfer from QuantumX modules to the PC; With matching plugs on both sides; Length: 3 m.	1–KAB270–3
IEEE1394b FireWire cable, hub-to-module, 3 m	FireWire connection cable between HUB and module.	1–KAB275–3
FireWire Extender SCM–FW	Package including 2 in-line elements for extension of the FireWire connection up to 40 m; required parts: 2 x 1-KAB269-x and Industrial Ethernet cable (M12, CAT5e/6, max. 30 m). KAB270-3 connection is not possible!	1–SCM-FW
Ethernet cross over cable	Ethernet cross-over cable for direct operation of devices on a PC or notebook, length 2 m, type CAT5+	1–KAB239–2
Mechanical data		
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
Fitting panel 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 (Standard)	QuantumX backplane – Standard for a maximum of 9 modules, IP 20 version; – 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

Accessories, to be ordered separately (continued)

MX1615 accessories		
Article	**Description**	**Order No.**
Transducer side		
Push-In connector (8 pins)	10 Push-In-connectors, Phönix Contact, 8 pins	1−CON−S1005
1−Wire−EEPROMS	Package of 10 pieces of 1-wire EEPROMS DS24B33 (IEEE1451.4 TEDS)	1−TEDS−PAK
Software and product packages		
MX1615 + catman®EASY	Package including: - MX1615 amplifier (1-MX1615) - Power supply (1-NTX001) - 4 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−MX1615−PAKEASY
MX1615 + catman®AP	Package including: - MX1615 amplifier (1-MX1615) - Power supply (1-NTX001) - 4 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−MX1615−PAKAP
DIAdem® driver	QuantumX driver for DIAdem® software from National Instruments. German user interface only.	1−DIADEM−DRIVER
CANape® driver	QuantumX driver for CANape® software from Vector Informatik. CANape versions from 10.0 are supported.	1−CANAPE−DRIVER
QuantumX system CD	QuantumX Assistant, LabVIEW driver, programming interface (.NETAPI), TEDS editor	free

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