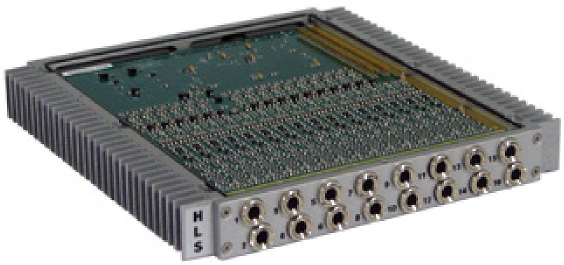
SOMAT

EHLS

eDAQ High Level Analog Layer

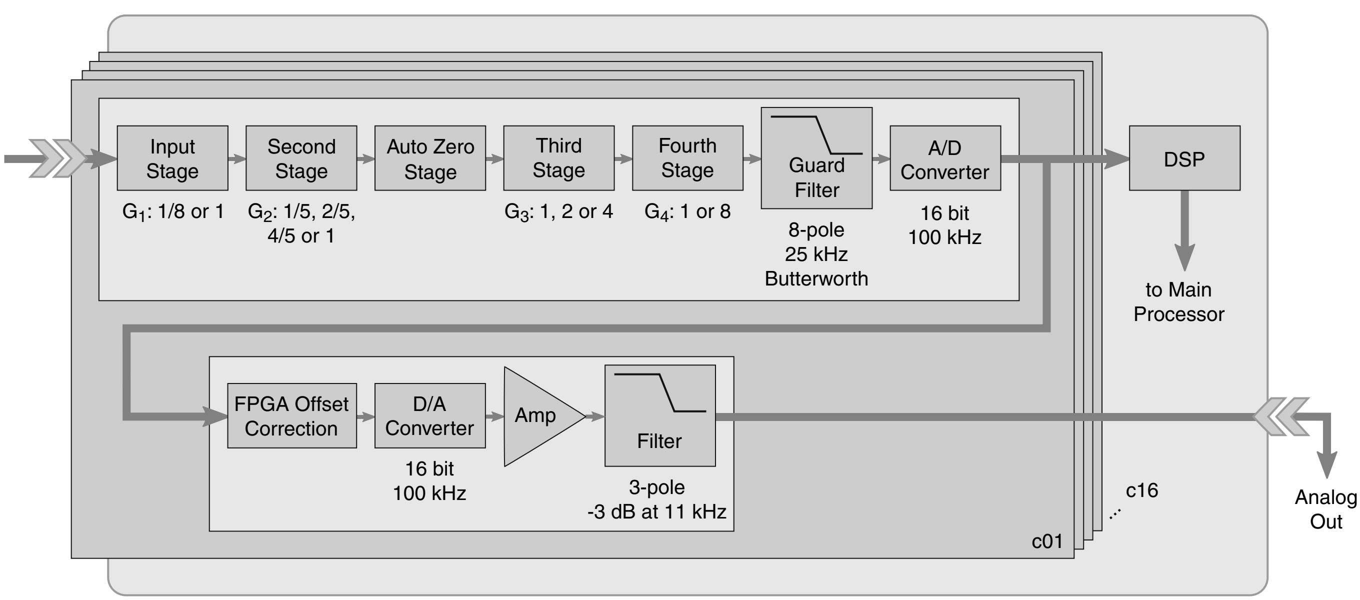
Data Sheet



Special Features

- 16 simultaneously-sampled, high-level differential analog inputs from ±0.0625 to ±74.9 V
- 48 automatic gain states ensuring use of the fullest possible A/D converter range
- Sampling rates up to 100 kHz
- 16-bit A/D converter per channel across full-scale range
- 25 kHz, 8-pole analog Butterworth low-pass filter
- Software selectable sample rates, transducer power and digital filtering

Block Diagram



HBM

Detailed Description

The SoMat EHLS High Level Analog Layer offers 16 simultaneously sampled high-level differential analog inputs through independent connectors. The EHLS can inherently handle any analog input from ±74.9 volts and, together with the SoMat SMART conditioning modules, constitutes a real multi-purpose layer. The EHLS is compatible with practically any input including thermocouples, strain gages, accelerometers, microphones and amplified and un-amplified transducers. Software selectable sample rates, transducer power and digital filtering simplify the set-up of any channel. There are also several calibration options including defined value, external value and multipoint calibrations.

The EHLS may be ordered with an optional analog output function. Outputs are filtered analog output signals that can be used in the creation of time-domain lab durability tests. When setting up the laboratory simulation, bring the SoMat eDAQ system into the lab with the component or vehicle. This practice is highly recommended, as it ensures that all of the transducer instrumentation and properties are identical for the lab simulation as they were for the field data collection. Instead of being recorded, the analog out signals are sent as time series data for the test rig to analyze. The controller can then develop drive files that are played into the test rig reproducing exact field dynamics in the lab. Each output channel is associated with the corresponding (like-numbered) input channel on the EHLS board. Calibration files, directly compatible with popular simulation software, that scale the analog outputs to engineering units are provided. The maximum analog output voltage is ±10 volts. Each of the 16 analog channels contain a three-pole Butterworth filter which attenuates frequencies above 12 KHz. These filters smooth out the stair-steps created by the channel's digital to analog converter.

Ordering Options

Order No.	Description
1-EHLS-B-2	eDAQ High Level Analog Layer - Base Layer Includes: (16) 1-SAC-TRAN-MP-2-2 Transducer Cables
1-EHLS-AO-2	eDAQ High Level Analog Layer - Analog Out Installed Option: Analog Output Includes: (16) 1-SAC-TRAN-MP-2-2 Transducer Cables and (1) 1-SAC-TRAN-AO-2-2 Analog Out Cable

Accessories (Order Separately)

Order No.	Description
1-EICP-B-2	ICP-Type Conditioning Module - BNC Connector In-line signal conditioning module for EHLS Inputs: IEPE (Integrated Electronics Piezoelectric) Transducers Requires (1) Extension Cable (not included)
1-EICP-M-2	ICP-Type Conditioning Module - Microdot Connector In-line signal conditioning module for EHLS Inputs: IEPE (Integrated Electronics Piezoelectric) Transducers Requires (1) Extension Cable (not included)
1-SMSTRB4-120-2	Strain SMART Module - 120-Ohm Completion In-line signal conditioning module for EHLS Integrated 120-Ohm, 1/4-bridge completion resistor Requires (1) Extension Cable (not included)
1-SMSTRB4-350-2	Strain SMART Module - 350-Ohm Completion In-line signal conditioning module for EHLS Integrated 350-Ohm, 1/4-bridge completion resistor Requires (1) Extension Cable (not included)
1-SMITC-2	Thermocouple SMART Module In-line signal conditioning module for EHLS
1-EBB-AO-2	Breakout Box - Analog Output eDAQ EHLS Layers

Cables (Order Separately)

Order No.	Description
1-SAC-TRAN-MP-2-2	Transducer Cable - Male/Pigtail - 2 Meters Length
1-SAC-TRAN-MP-10-2	Transducer Cable - Male/Pigtail - 10 Meters Length
1-SAC-TRAN-AO-2-2	Transducer Cable - Analog Out - 2 Meters Length
1-SAC-EXT-MF-0.4-2	Extension Cable - Male/Female Connectors - 0.4 Meters Length
1-SAC-EXT-MF-2-2	Extension Cable - Male/Female Connectors - 2 Meters Length
1-SAC-EXT-MF-5-2	Extension Cable - Male/Female Connectors - 5 Meters Length
1-SAC-EXT-MF-10-2	Extension Cable - Male/Female Connectors - 10 Meters Length
1-SAC-EXT-MF-15-2	Extension Cable - Male/Female Connectors - 15 Meters Length

Specifications

Parameter	Units	Value
Layer dimensions width length height	 cm cm cm	 23 25 3.3
Layer weight	kg	2.0
Temperature range	°C	-20 ... 65
Relative humidity range, non-condensing	%	0 ... 90
Initial accuracy at 125 mV or 250 mV full scale other	 % of full scale % of full scale	 0.2 0.1
Analog out accuracy	% of full scale	0.25
Common mode range plus signal G_1=1/8 G_1=1	 V V	 ±74.9 ±10
Analog inputs surviving over voltage	V	±125
Transducer power supply voltage range	V	3 ... 28 in 1 V steps
Transducer power supply output power	mW	400
Transducer power supply voltage change over temperature	%	±1
Voltage regulation 4 V out, 2 mA to 150 mA 10 V out, 2 mA to 60 mA 15 V out, 2 mA to 40 mA 20 V out, 2 mA to 30 mA	 mV mV mV mV	 40 30 30 30
Voltage regulation efficiency	%	70
Ripple (at 1.4 MHz)	mV_{pp}	100

Specifications (continued)

Parameter	Units	Value
Power consumption [1]		
no load	W	5.7
SBSTRB4-120-QB (5 V out)	W	9.5
SBSTRB4-120-HB (5 V out)	W	9.5
SBSTRB4-120-FB (5 V out)	W	13.3
SMSTRB4-350-QB (5 V out)	W	6.6
SMSTRB4-350-HB (5 V out)	W	6.6
SBSTRB4-350-FB (5 V out)	W	8.3
SMSTRB4-350-QB (10 V out)	W	13.8
SMSTRB4-350-HB (10 V out)	W	13.8
SMSTRB4-350-FB (10 V out)	W	15.4
SMITC	W	10.5
IEPE plus accelerometer	W	14.83
40 mA load (12 V out)	W	14.9
Minimum input resistance		
G_1= 1	GΩ	2
G_1=1/8	kΩ	108
Analog output channel impedance [2]	Ω	1000 ±50
Gain drift from the mean (-20 to 65 °C) [3]		
G_3G_4=1 (typical)	%	±0.069
G_3G_4=1 (maximum)	%	±0.138
G_3G_4=2 (typical)	%	±0.061
G_3G_4=2 (maximum)	%	±0.123
G_3G_4=4 (typical)	%	±0.045
G_3G_4=4 (maximum)	%	±0.090
G_3G_4=8 (typical)	%	±0.079
G_3G_4=8 (maximum)	%	±0.159
G_3G_4=16 (typical)	%	±0.088
G_3G_4=16 (maximum)	%	±0.176
G_3G_4=32 (typical)	%	±0.097
G_3G_4=32 (maximum)	%	±0.195
DC offset drift (-20 to 65 °C unless otherwise indicated) [3]		
G_3G_4=1 (typical)	% of full scale	±0.052
G_3G_4=1 (maximum)	% of full scale	±0.105
G_3G_4=1 (typical, -10 to 50 °C)	% of full scale	±0.017
G_3G_4=1 (maximum, -10 to 50 °C)	% of full scale	±0.034
G_3G_4=2 (typical)	% of full scale	±0.039
G_3G_4=2 (maximum)	% of full scale	±0.077
G_3G_4=4 (typical)	% of full scale	±0.070
G_3G_4=4 (maximum)	% of full scale	±0.141
G_3G_4=8 (typical)	% of full scale	±0.014
G_3G_4=8 (maximum)	% of full scale	±0.028
G_3G_4=16 (typical)	% of full scale	±0.030
G_3G_4=16 (maximum)	% of full scale	±0.059
G_3G_4=32 (typical)	% of full scale	±0.112
G_3G_4=32 (maximum)	% of full scale	±0.223

[1] Power consumption measurements are taken with the stated load on all 16 channels and include the efficiency of the power supply.

[2] The 1000-ohm stabilization resistor in series with the op-amp at the analog output creates an RC filter in addition to the output filter. Typical cable capacitances (C_{cable}) fall within 18 to 40 picofarads per foot, creating a pole at $1/(2\pi 1000 C_{cable})$.

[3] The drift values depend on the gain of only the last two stages (G_3 and G_4); the attenuation of the first two stages (G_1 and G_2) may be at any setting.

Standards

Category	Standard	Description
Shock	MIL-STD-810F	Method 516.5, Section 2.2.2 Functional Shock - ground vehicle
Vibration	MIL-STD-202G	Method 204D, Test condition C (10 *g* swept sine tested from 5 Hz to 2000 Hz)

Selected Gain Settings

Desired Input Range [1] (V_{pp})	Input Stage Gain, G_1 (1/8 or 1)	Second Stage Gain, G_2 (1/5, 2/5, 4/5 or 1)	Third Stage Gain, G_3 (1, 2 or 4)	Fourth Stage Gain, G_4 (1 or 8)	Overall Gain
149.8	1/8	1/5	1	1	0.025
80	1/8	2/5	1	1	0.05
40	1/8	4/5	1	1	0.1
32	1/8	1	1	1	0.125
20	1	1/5	1	1	0.2
10	1	2/5	1	1	0.4
5	1	4/5	1	1	0.8
4	1	1	1	1	1
2	1	1	2	1	2
1	1	1	4	1	4
0.5	1	1	1	8	8
0.25	1	1	2	8	16
0.125	1	1	4	8	32

[1] The maximum A/D converter input, which is the product of the input range and the overall gain, is 4.096 V_{pp}.

Note: This table is a representative list only and does not show all available gain settings. To check the gain settings for a defined channel, click the Ampl button in the TCE transducer setup window. “Atten1” is the input stage gain, “Atten2” is the second stage gain, “Gain1” is the third stage gain and “Gain2” is the fourth stage gain.

Channel Noise Characteristics

The input-referred noise and the signal to noise ratio (SNR) are defined by the following two equations:

$$\mathrm{InputReferredNoise} = \frac{N}{G_o}$$

$$\mathrm{SNR} = 20\log\left(\frac{4.096}{N}\right)$$

where G_o is the overall gain setting and N is the noise at the input of the A/D converter, defined by one of the following equations depending on the third and fourth stage gains (G_3 and G_4, respectively):

$$N_{G_4 = 1} = 514.1[\mu V]$$

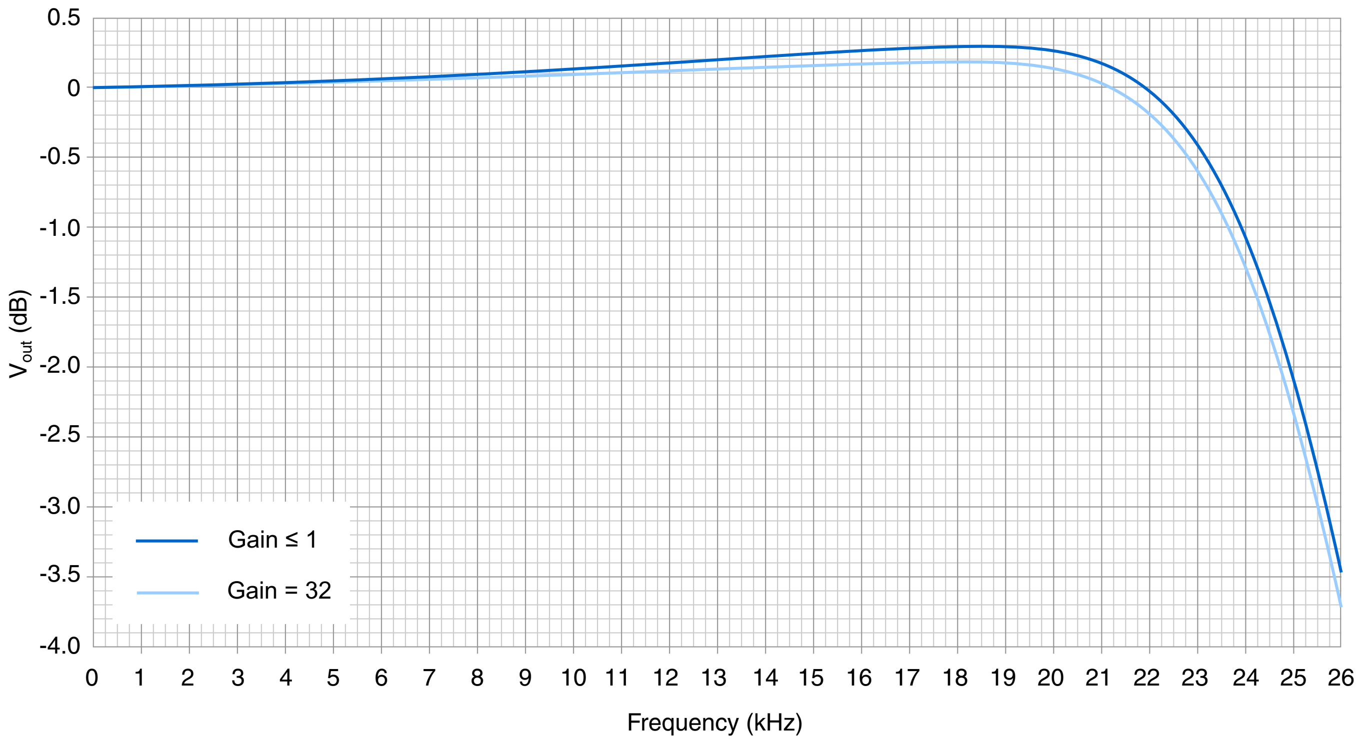
$$N_{G_3 = 1,\, G_4 = 8} = \sqrt{\left(240[\mu V]\sqrt{\frac{x}{24[kHz]}}\right)^2 + (510[\mu V])^2}$$

$$N_{G_3 = 2,\, G_4 = 8} = \sqrt{\left(496[\mu V]\sqrt{\frac{x}{24[kHz]}}\right)^2 + (510[\mu V])^2}$$

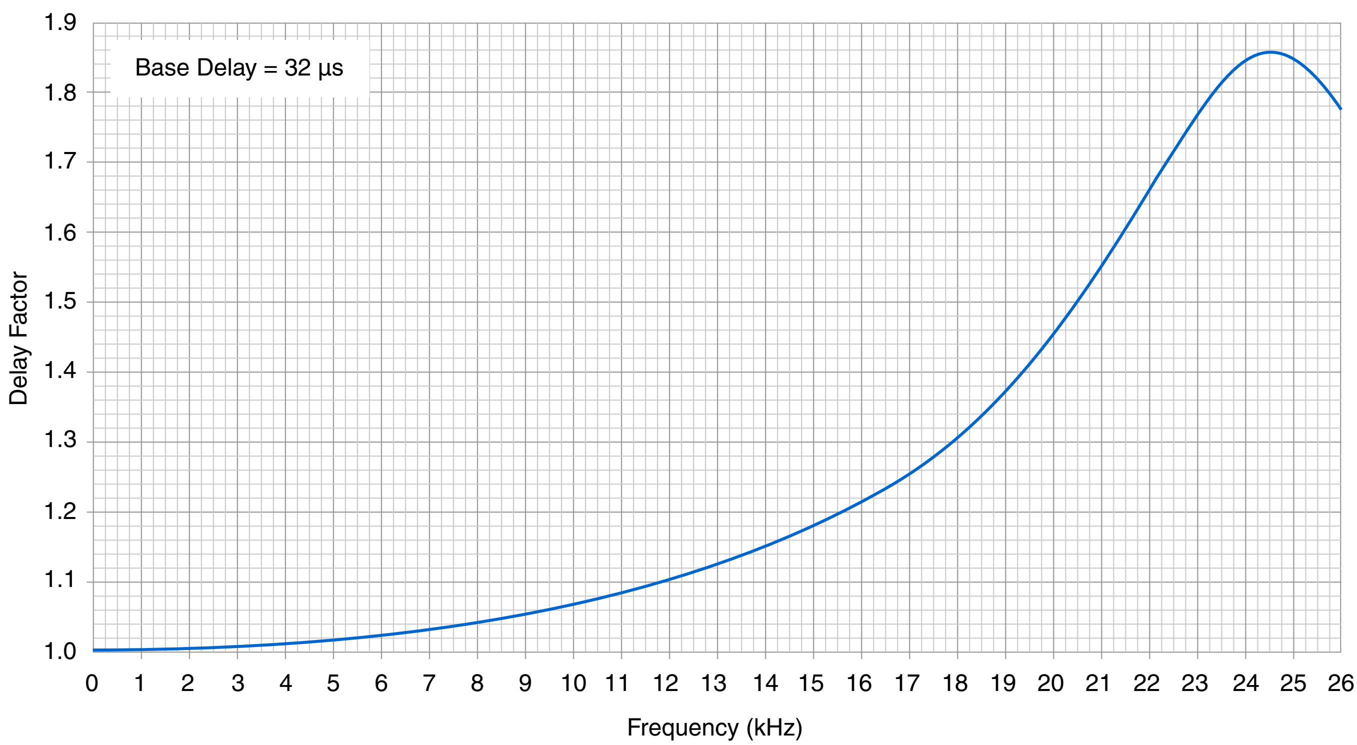
$$N_{G_3 = 4,\, G_4 = 8} = \sqrt{\left(933[\mu V]\sqrt{\frac{x}{24[kHz]}}\right)^2 + (510[\mu V])^2}$$

and where x is the cutoff frequency of the digital or analog filter to a maximum value of 24 kHz. Note that when selecting the sampling rate in TCE, the cutoff frequency of the selected filter is a third of the sampling rate.

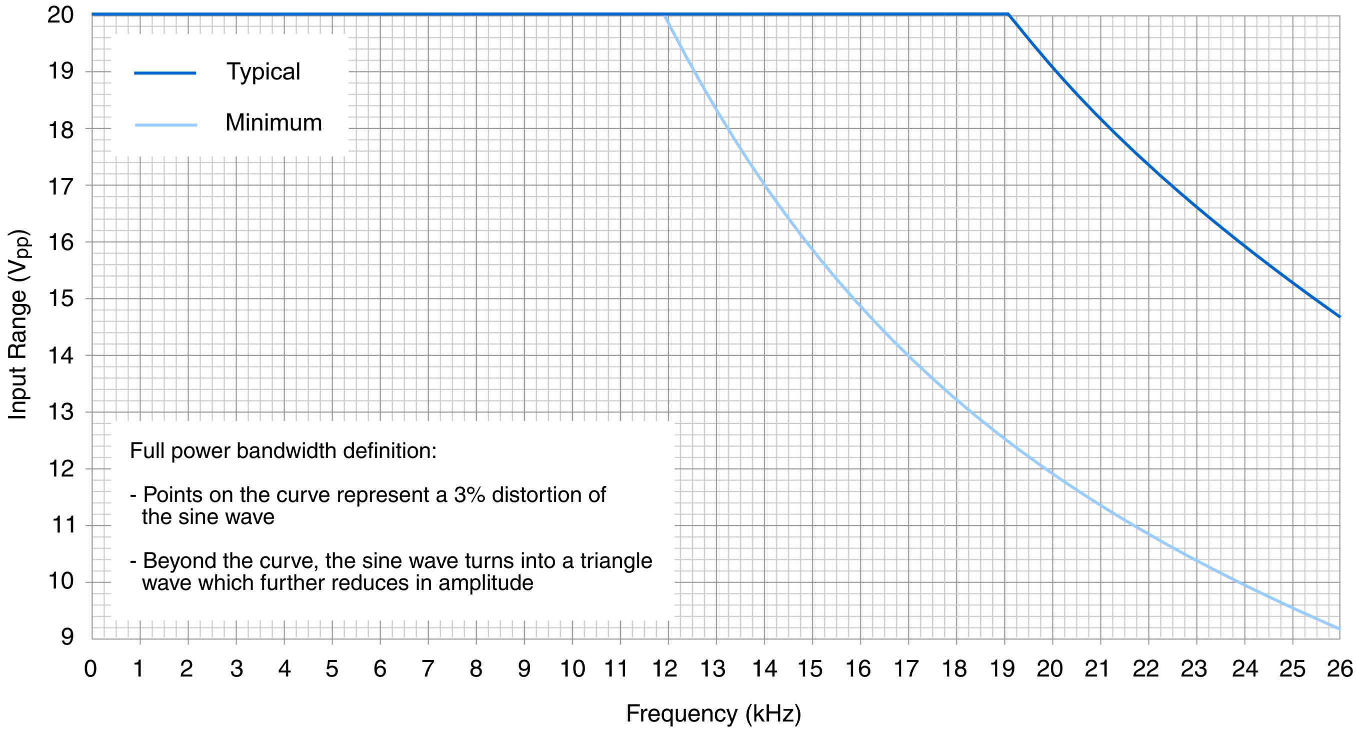
Input Filter Pass Band Frequency Response



Input Filter Delay Factor

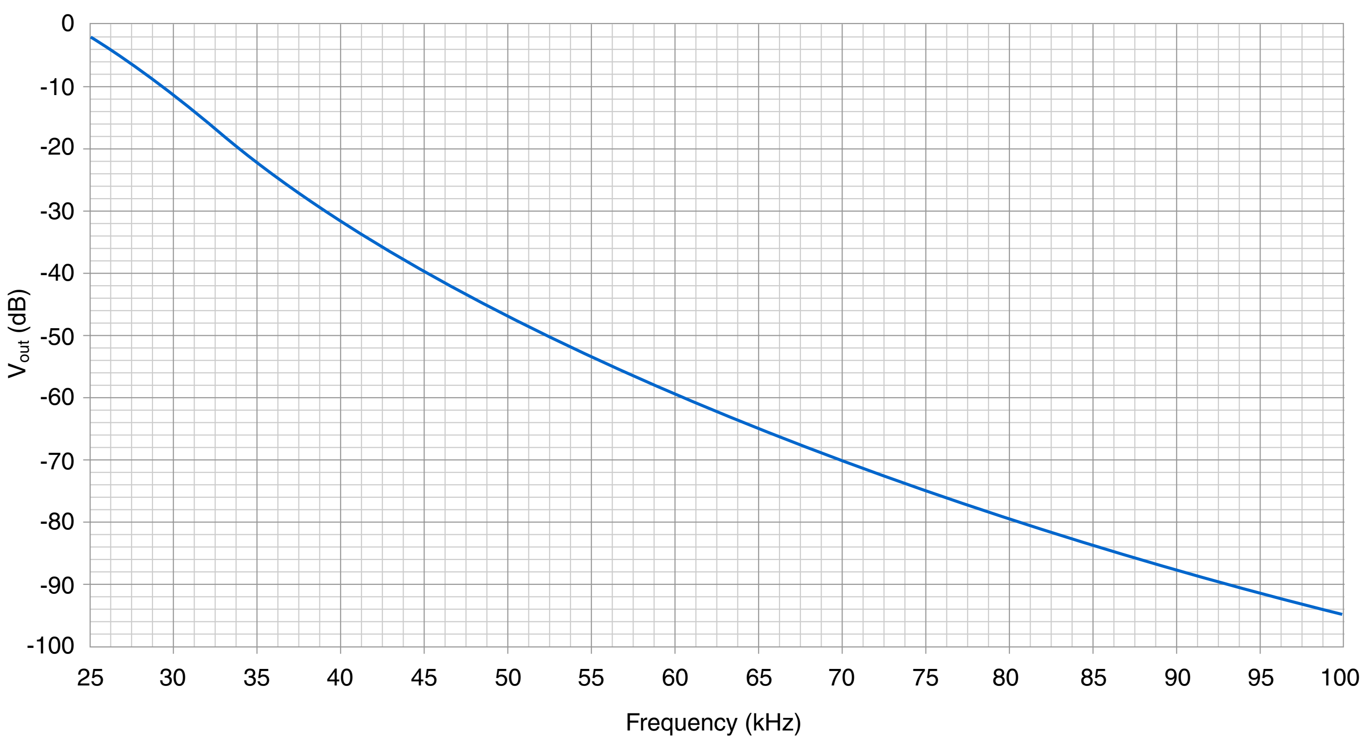


Full Power Bandwidth

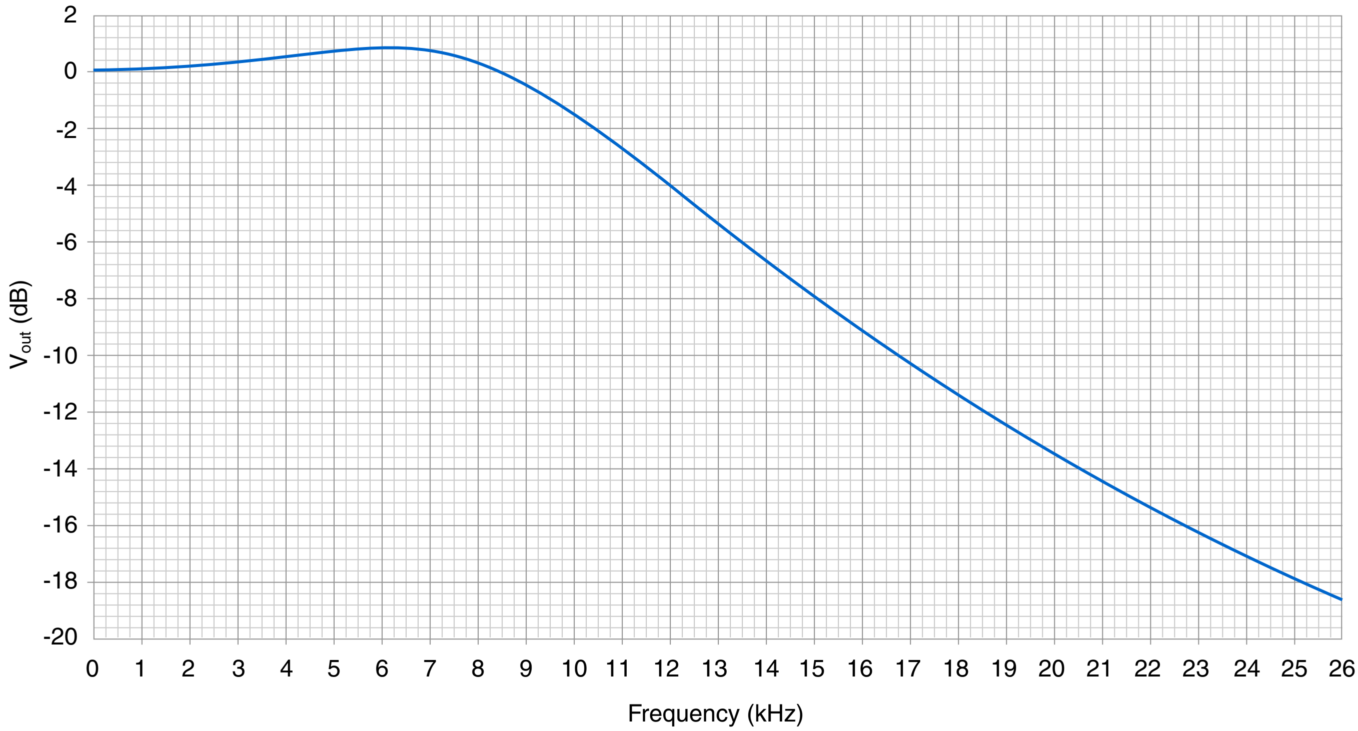


Note: Plot shows full power bandwidth for an overall gain of 0.2 or a 20 V_{pp} input range. For other gain settings, scale the input range by the appropriate value. For example, for an overall gain of 0.05, multiply the 20 V_{pp} scale by 4 for a 80 V_{pp} input range.

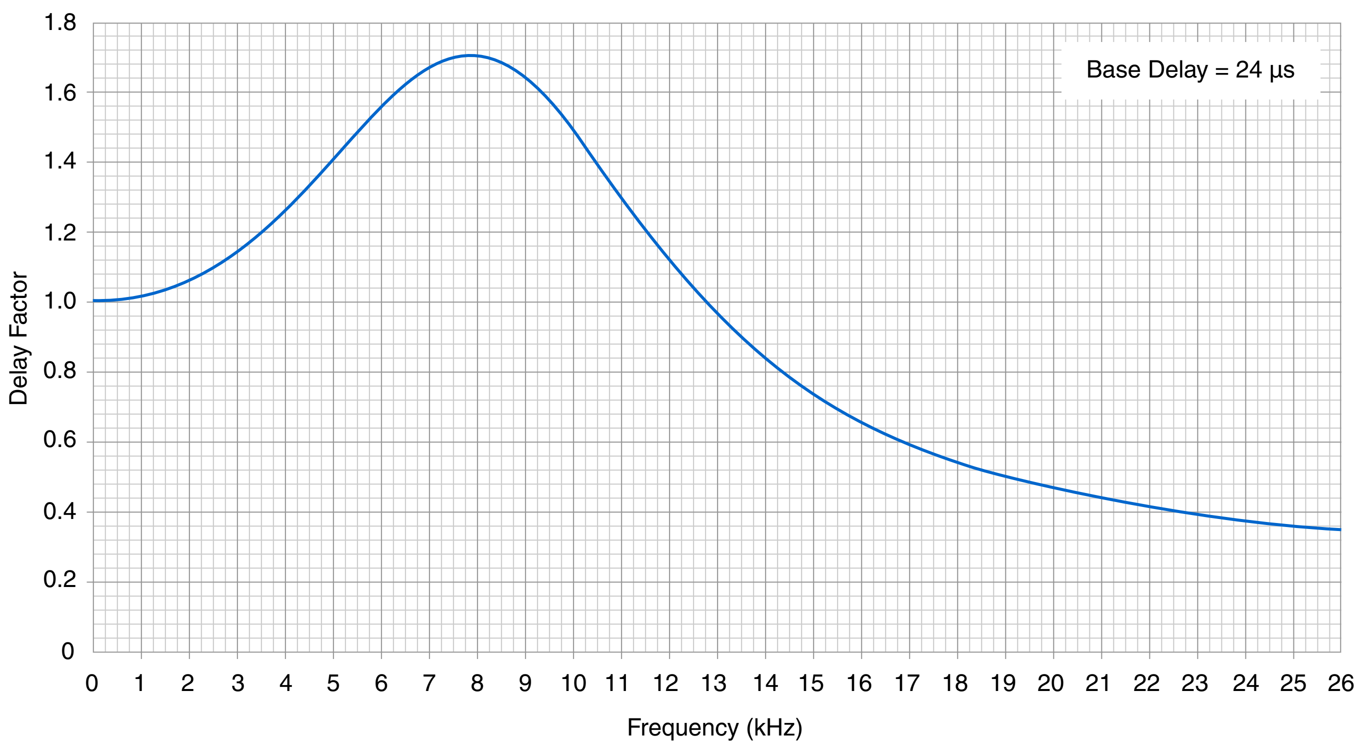
Input Filter Cut-Off Region



Analog Out Frequency Response



Analog Out Filter Delay Factor



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