Anti-Alias Filters

D68 Series

Linear Active Filters

Description

The D68 Series of small, fixed-frequency, precision active filters provides high-performance linear, multi-pole filtering in a compact package, with a broad range of corner frequencies and a choice of transfer functions. Individual D68 filters can serve in low-pass or high-pass applications or be combined to create custom band-pass or band-reject filters. Each model comes factory tuned to a user-specified corner frequency between 10Hz and 100kHz. These fully self-contained units require no external components or adjustments. They operate with low total harmonic distortion over a wide dynamic input voltage range from non-critical ± 5V to ± 18V power supplies.

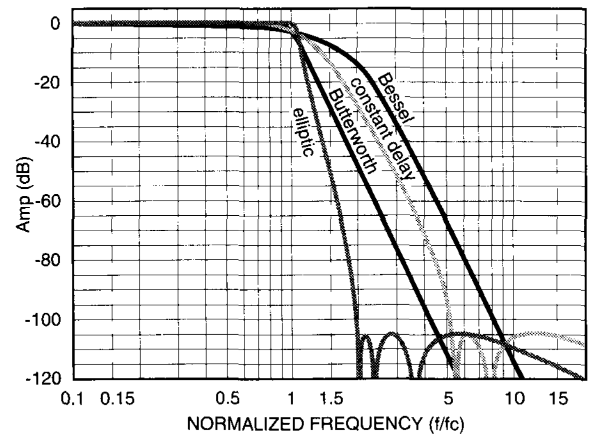
Features/Benefits:

- Low harmonic distortion and wide signal-to-noise ratio to 16 bit resolution
- Compact 1.8" x 0.8" x 0.3" size minimizes board space requirements
- Plug-in ready-to-use, reducing engineering design and manufacturing cycle time
- Factory tuned, no external clocks or adjustments needed
- Broad range of transfer characteristics and corner frequencies to meet a wide range of applications

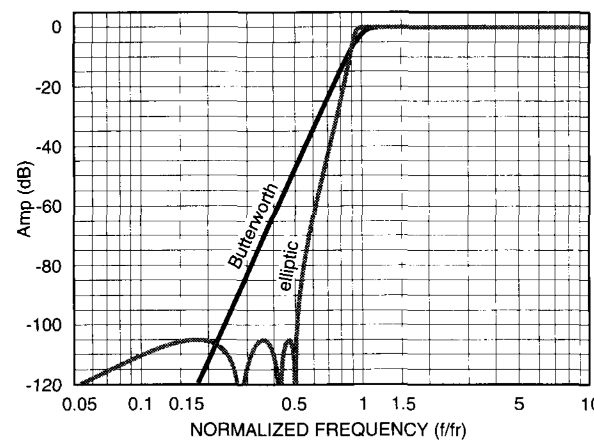
Applications

- Anti-alias filtering
- Data acquisition systems
- Communication systems and electronics
- Medical electronics equipment and research
- Aerospace, navigation and sonar applications
- Sound and vibration testing
- Real and compressed time data analysis
- Noise elimination
- Signal reconstruction

Low-Pass Frequency Response



High-Pass Frequency Response



FREQUENCY DEVICES™

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FREQUENCY DEVICES™

Model D68L8B

Linear Active Filters

8-Pole Butterworth Low-Pass Filter

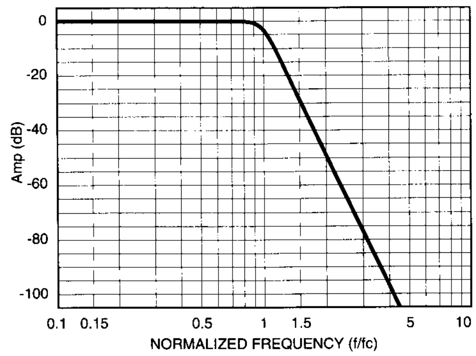
Description

The D68L8B is an 8-pole low-pass Butterworth transfer function, is maximally flat, has no ripple in the passband, and has a monotonic roll-off at the rate of 48 dB/octave in the stopband.

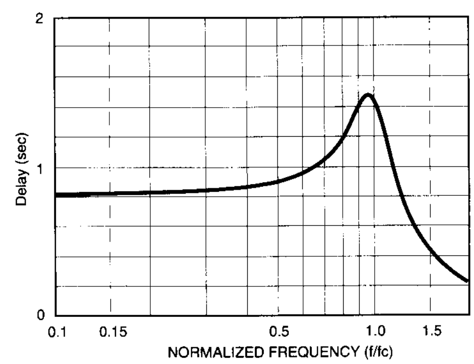
Specifications

Transfer Function	8-pole Butterworth Low-Pass
Size	1.8" x 0.8" x 0.3"
Range fc	10 Hz to 100 kHz
Passband Ripple (theoretical)	0.0 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB max. 0 ± 0.05 dB typ.
Stopband Attenuation Rate	48 dB/octave
Cutoff Frequency fc (-3 dB)	± 1 % max.
Stability	± 0.01 % / °c
Phase	– 360°
Filter Attenuation	(theoretical)
0.12 dB	0.80 fc
3.01 dB	1.00 fc
60.0 dB	2.37 fc
80.0 dB	3.16 fc
Phase Match[2]	
0 - 0.8 fc	± 2° max. ± 1° typ.
0.8 fc - 1.0 fc	± 3° max. ± 1.5° typ.
Amplitude Accuracy	(theoretical)
0 - 0.8 fc	± 0.2 dB max. ± 0.1 dB typ.
0.8 fc - 1.0 fc	± 0.3 dB max. ± 0.15 dB typ.
Total Harmonic Distortion @ 1 kHz	< – 100 dB typ.
Wide Band Noise (5 Hz - 2 MHz)	200 µVRMS typ.
Narrow Band Noise (5 Hz - 100 kHz)	50 µVRMS typ.

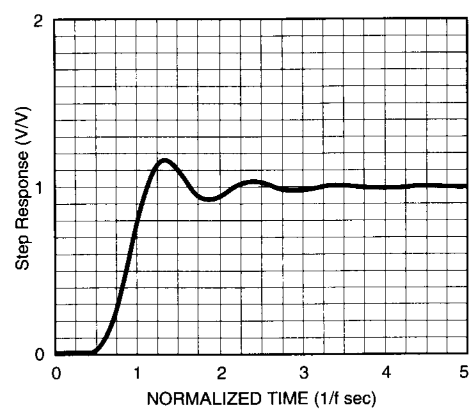
Frequency Response



Delay (Normalized)



Step Response



Theoretical Transfer Characteristics

f/fc (Hz)	Amp (dB)	Phase (deg)	Delay [1] (sec)
0.00	0.00	0.00	.816
0.10	0.00	-29.4	.819
0.20	0.00	-59.0	.828
0.30	0.00	-89.1	.843
0.40	0.00	-120	.867
0.50	0.00	-152	.903
0.60	-0.001	-185	.956
0.70	-0.014	-221	1.04
0.80	-0.121	-261	1.19
0.85	-0.311	-283	1.29
0.90	-0.738	-307	1.40
0.95	-1.58	-333	1.48
1.00	-3.01	-360	1.46
1.10	-7.48	-408	1.17
1.20	-12.9	-445	.873
1.30	-18.2	-472	.672
1.40	-23.4	-494	.540
1.50	-28.2	-511	.448
1.60	-32.7	-526	.380
1.70	-36.9	-539	.328
1.80	-40.8	-550	.287
1.90	-44.6	-560	.253
2.00	-48.2	-568	.226
2.25	-56.3	-586	.174
2.50	-63.7	-600	.139
2.75	-70.3	-611	.113
3.00	-76.3	-621	.094
3.25	-81.9	-629	.080
3.50	-87.1	-635	.069
4.00	-96.3	-646	.052
5.00	-112	-661	.033
6.00	-125	-671	.023
7.00	-135	-678	.017
8.00	-144	-683	.013
9.00	-153	-687	.010
10.0	-160	-691	.008

2. Unit to unit match for the same transfer function, set to the same frequency and operating configuration, and from the same manufacturing lot.

1. Normalized Group Delay: The above delay data is normalized to a corner frequency of 1.0 Hz. The actual delay is the normalized delay divided by the actual corner frequency (fc).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Corner Frequency (fc) in Hz}}$$

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Model D68L8E

8-Pole, 6-Zero Elliptic, 1.77 Low-Pass Filter

FREQUENCY DEVICES™

Linear Active Filters

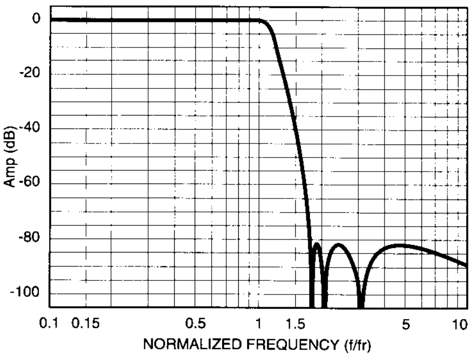
Description

The D68L8E is an 8-pole, 6-zero elliptic low-pass filter, with a theoretical passband ripple of ± 0.035 dB. This response is a modified Cauer-elliptic function designed by FDI to minimize section "Qs", while maintaining a 0.035 dB / 80 dB shape factor of 1.77, an 82 dB stopband floor, and a 2-pole monotonic roll-off at high frequency.

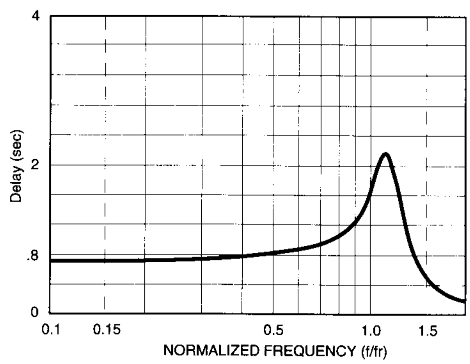
Specifications

Transfer Function	8-pole, 6-zero Elliptic Low-Pass
Size	1.8" x 0.8" x 0.3"
Range f_r	10 Hz to 100 kHz
Passband Ripple	(theoretical)
0 - f_r	±0.035 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB max.
	0 ± 0.05 dB typ.
Stopband Attenuation	80 dB min.
Cutoff Frequency $f_{r(-3dB)}$	± 1 % max.
Stability	± 0.01 % / °C
Amplitude	− 0.035 dB
Phase	− 323.5°
Filter Attenuation	(theoretical)
0.035 dB	1.00 f_r
3.01 dB	1.13 f_r
60.0 dB	1.67 f_r
80.0 dB	1.77 f_r
Phase Match[2]	
0 - 0.8 f_r	± 2° max.
	± 1° typ.
0.8 f_r - 1.0 f_r	± 4° max.
	± 2° typ.
Amplitude Accuracy	(theoretical)
0 - 0.8 f_r	± 0.2 dB max.
	± 0.1 dB typ.
0.8 f_r - 1.0 f_r	± 0.3 dB max.
	± 0.15 dB typ.
Total Harmonic Distortion @ 1 kHz	< − 100 dB typ.
Wide Band Noise (5 Hz - 2 MHz)	200 µV_{RMS} typ.
Narrow Band Noise (5 Hz - 100 kHz)	50 µV_{RMS} typ.

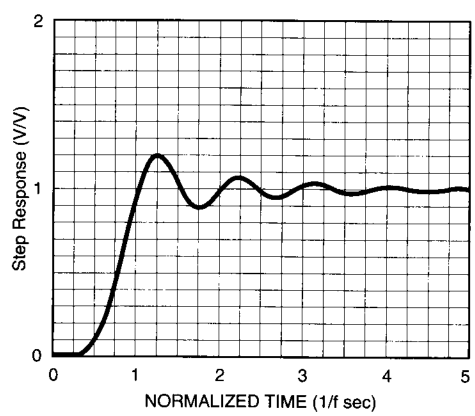
Frequency Response



Delay



Step Response



2. Unit to unit match for the same transfer function, set to the same frequency and operating configuration, and from the same manufacturing lot.

Theoretical Transfer Characteristics

f/fr (Hz)	Amp (dB)	Phase (deg)	Delay[1] (sec)
0.00	0.00	0.00	0.713
0.10	-0.004	-25.7	0.716
0.20	-0.014	-51.6	0.724
0.30	-0.024	-77.9	0.740
0.40	-0.020	-105	0.767
0.50	0.007	-133	0.811
0.55	0.022	-148	0.840
0.60	0.033	-163	0.872
0.65	0.031	-179	0.908
0.70	0.014	-196	0.946
0.75	-0.015	-213	0.989
0.80	-0.041	-232	1.04
0.85	-0.046	-251	1.12
0.90	-0.016	-272	1.23
0.95	-0.025	-296	1.40
1.00	-0.035	-323	1.65
1.10	-1.76	-392	2.14
1.20	-8.28	-467	1.86
1.30	-18.4	-522	1.19
1.40	-29.3	-558	0.753
1.50	-40.1	-578	0.517
1.60	-51.5	-594	0.381
1.70	-65.2	-606	0.296
1.75	-75.0	-611	0.265
1.80	-113.0	-616	0.239
1.85	-83.6	-440	0.217
1.90	-82.0	-444	0.198
1.95	-83.7	-447	0.182
2.00	-87.8	-450	0.168
2.20	-85.8	-280	0.126
2.40	-82.0	-289	0.099
2.60	-83.5	-295	0.081
2.80	-88.2	-301	0.067
3.00	-99.9	-305	0.057
3.50	-87.2	-134	0.040
4.00	-83.1	-140	0.030
5.00	-82.1	-148	0.018
6.00	-83.1	-154	0.013
7.00	-84.6	-157	0.009
8.00	-86.2	-160	0.007
9.00	-87.8	-163	0.005
10.0	-89.3	-164	0.004

1. Normalized Group Delay: The above delay data is normalized to a ripple frequency of 1.0 Hz. The actual delay is the normalized delay divided by the actual ripple frequency (fr).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Ripple Frequency (fr) in Hz}}$$

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Model D68L8EX

8-Pole, 6-Zero Elliptic, 1.56 Low-Pass Filter

FREQUENCY DEVICES™

Linear Active Filters

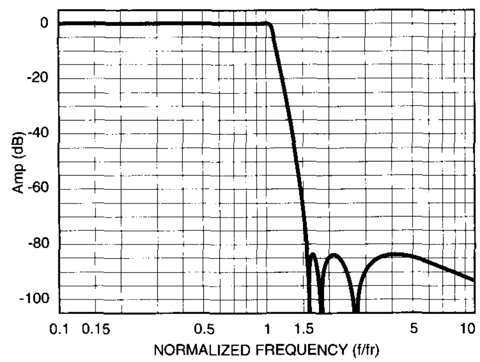
Description

The D68L8EX is an 8-pole, 6-zero Cauer elliptic low-pass filter, with a theoretical passband ripple of 0.05 dB. This response has a 0.05 dB / 80 dB shape factor of 1.56, an 84 dB stopband floor and a 2-pole monotonic roll-off at high frequency.

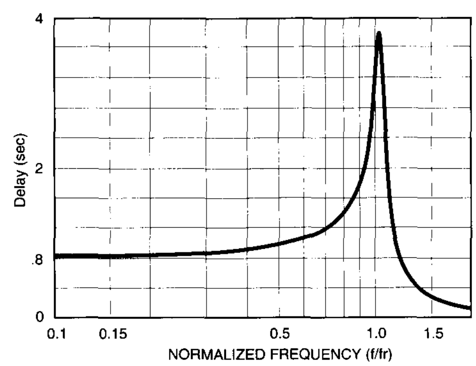
Specifications

Transfer Function	8-pole, 6-zero Elliptic Low-Pass
Size	1.8" x 0.8" x 0.3"
Range f_r	10 Hz to 100 kHz
Passband Ripple	(theoretical)
0 - f_r	0.05 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB max. 0 ± 0.05 dB typ.
Stopband Attenuation	80 dB min.
Cutoff Frequency $f_{r\,(-3dB)}$	± 1 % max.
Stability	±0.01 % / °C
Phase	– 414°
Filter Attenuation	(theoretical)
0.05 dB	1.00 f_r
3.01 dB	1.05 f_r
60.0 dB	1.45 f_r
80.0 dB	1.56 f_r
Phase Match[2]	
0 - 0.8 f_r	± 3° max. ± 1.5° typ.
0.8 f_r - 1.0 f_r	± 4° max. ± 2° typ.
Amplitude Accuracy	(theoretical)
0 - 0.8 f_r	± 0.2 dB max. ± 0.1 dB typ.
0.8 f_r - 1.0 f_r	± 0.5 dB max. ± 0.25 dB typ.
Total Harmonic Distortion @ 1 kHz	< – 88 dB typ.
Wide Band Noise (5 Hz - 2 MHz)	250 µV_{RMS} typ.
Narrow Band Noise (5 Hz - 100 kHz)	75 µV_{RMS} typ.

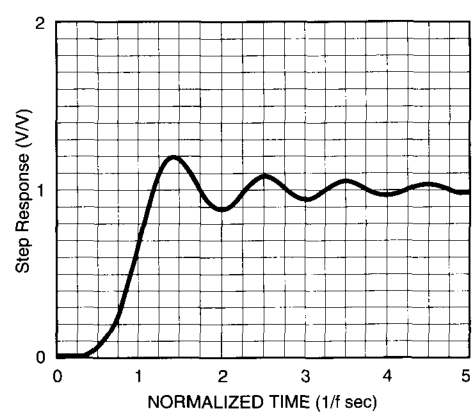
Frequency Response



Delay



Step Response



2. Unit to unit match for the same transfer function, set to the same frequency and operating configuration, and from the same manufacturing lot.

Theoretical Transfer Characteristics

f/fr (Hz)	Amp (dB)	Phase (deg)	Delay[1] (sec)
0.00	0.00	0.00	0.823
0.10	-0.001	-29.7	0.829
0.20	-0.013	-59.8	0.844
0.30	-0.040	-90.5	0.865
0.40	-0.049	-122	0.904
0.50	-0.018	-156	0.972
0.55	-0.003	-174	1.016
0.60	-0.002	-192	1.064
0.65	-0.019	-212	1.116
0.70	-0.042	-233	1.178
0.75	-0.049	-255	1.264
0.80	-0.026	-279	1.388
0.85	-0.001	-305	1.557
0.90	-0.024	-335	1.767
0.95	-0.045	-369	2.111
1.00	-0.050	-414	3.062
1.10	-10.48	-531	2.043
1.20	-25.96	-576	0.814
1.30	-39.45	-598	0.493
1.40	-52.87	-614	0.348
1.50	-69.11	-624	0.265
1.60	-89.09	-453	0.211
1.70	-85.32	-459	0.174
1.75	-89.95	-463	0.156
1.80	-103.5	-465	0.147
1.85	-95.94	-288	0.158
1.90	-89.31	-290	0.126
1.95	-86.44	-292	0.117
2.00	-84.96	-295	0.110
2.20	-84.54	-302	0.087
2.40	-88.65	-307	0.069
2.60	-99.78	-311	0.057
2.80	-99.97	-135	0.048
3.00	-90.20	-139	0.041
3.50	-85.09	-145	0.029
4.00	-84.04	-150	0.022
5.00	-84.76	-156	0.014
6.00	-86.45	-160	0.009
7.00	-88.31	-163	0.007
8.00	-90.11	-165	0.005
9.00	-91.82	-167	0.004
10.0	-93.41	-168	0.003

1. Normalized Group Delay: The above delay data is normalized to a ripple frequency of 1.0 Hz. The actual delay is the normalized delay divided by the actual ripple frequency (fr).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Ripple Frequency (fr) in Hz}}$$

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FREQUENCY DEVICES™

Model D68L8EY

8-Pole, 6-Zero Elliptic, 2.00 Low-Pass Filter

Linear Active Filters

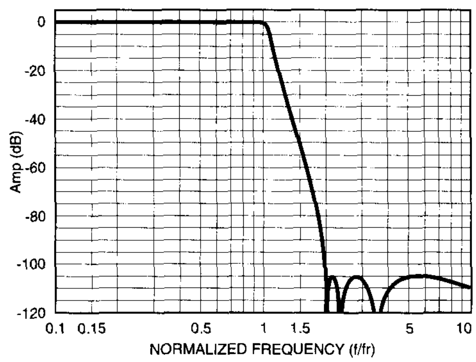
Description

The D68L8EY is a, 8-pole, 6-zero elliptic low-pass filter, with a theoretical pass-band ripple of 0.05 dB. This response is a Cauer-elliptic function with a 0.05 dB / 100 dB shape factor of 2.00, an 105 dB stopband floor, and a 2-pole monotonic roll-off at high frequency.

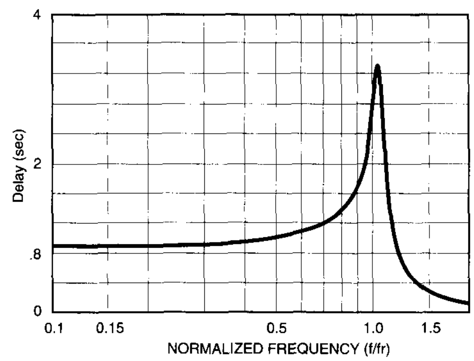
Specifications

Transfer Function	8-pole, 6-zero Elliptic Low-Pass
Size	1.8" x 0.8" x 0.3"
Range f_r	10 Hz to 100 kHz
Passband Ripple	(theoretical)
0 - f_r	0.05 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB max. 0 ± 0.05 dB typ.
Stopband Attenuation	100 dB min.
Cutoff Frequency f_r (-3dB)	± 2 % max.
Stability	± 0.01 % / °c
Phase	– 419°
Filter Attenuation	(theoretical)
0.035 dB	1.00 f_r
3.01 dB	1.06 f_r
80.0 dB	1.83 f_r
100.0 dB	2.00 f_r
Phase Match[2]	
0 - 0.8 f_r	± 3° max. ± 1.5° typ.
0.8 f_r - 1.0 f_r	± 4° max. ± 2° typ.
Amplitude Accuracy	(theoretical)
0 - 0.8 f_r	± 0.2 dB max. ± 0.1 dB typ.
0.8 f_r - 1.0 f_r	± 0.5 dB max. ± 0.25 dB typ.
Total Harmonic Distortion @ 1 kHz	< – 88 dB typ.
Wide Band Noise (5 Hz - 2 MHz)	250 µVRMS typ.
Narrow Band Noise (5 Hz - 100 kHz)	75 µVRMS typ.

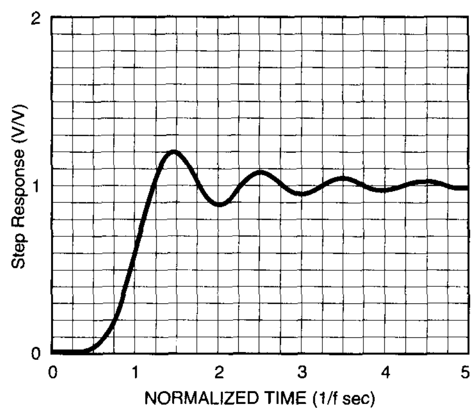
Frequency Response



Delay



Step Response



2. Unit to unit match for the same transfer function, set to the same frequency and operating configuration, and from the same manufacturing lot.

Theoretical Transfer Characteristics

f/fr (Hz)	Amp (dB)	Phase (deg)	Delay[1] (sec)
0.00	0.00	0.00	0.885
0.10	-0.001	-31.9	0.891
0.20	-0.015	-64.2	0.903
0.30	-0.040	-97.0	0.922
0.40	-0.042	-131	0.958
0.50	-0.001	-166	1.020
0.55	0.000	-185	1.057
0.60	-0.007	-204	1.099
0.65	-0.027	-225	1.140
0.70	-0.045	-245	1.193
0.75	-0.040	-268	1.269
0.80	-0.014	-291	1.377
0.85	-0.001	-317	1.513
0.90	-0.031	-346	1.677
0.95	-0.036	-378	1.960
1.00	-0.046	-419	2.681
1.10	-7.910	-525	2.127
1.20	-21.06	-573	0.856
1.30	-31.96	-597	0.509
1.40	-41.51	-612	0.357
1.50	-50.35	-623	0.271
1.60	-58.90	-632	0.216
1.70	-67.54	-639	0.177
1.75	-72.04	-642	0.162
1.80	-76.79	-645	0.149
1.85	-81.93	-647	0.138
1.90	-87.78	-650	0.128
1.95	-95.04	-652	0.119
2.00	-106.6	-654	0.111
2.20	-106.0	-481	0.087
2.40	-121.3	-307	0.070
2.60	-106.5	-311	0.058
2.80	-105.0	-315	0.049
3.00	-106.4	-318	0.042
3.50	-123.6	-325	0.030
4.00	-111.5	-149	0.022
5.00	-105.4	-156	0.014
6.00	-105.1	-160	0.010
7.00	-106.0	-163	0.007
8.00	-107.3	-165	0.005
9.00	-108.6	-167	0.004
10.0	-110.0	-168	0.003

1. Normalized Group Delay: The above delay data is normalized to a ripple frequency of 1.0 Hz. The actual delay is the normalized delay divided by the actual ripple frequency (fr).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Ripple Frequency (fr) in Hz}}$$

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FREQUENCY DEVICES™

Model D68L8L

Linear Active Filters

8-Pole Bessel Low-Pass Filter

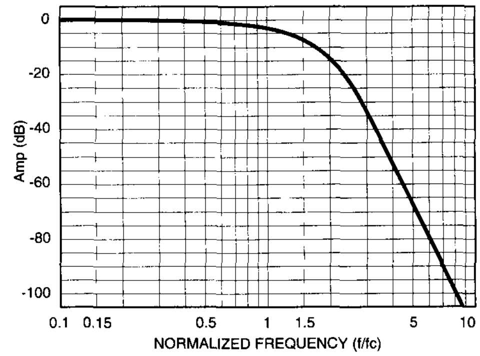
Description

The D68L8L is an 8-pole low-pass Bessel transfer function, has a monotonic roll-off in the passband and the stopband, and its final rolloff rate is 48 dB/octave in the stopband. It exhibits a constant delay in the passband and has an overshoot free step response.

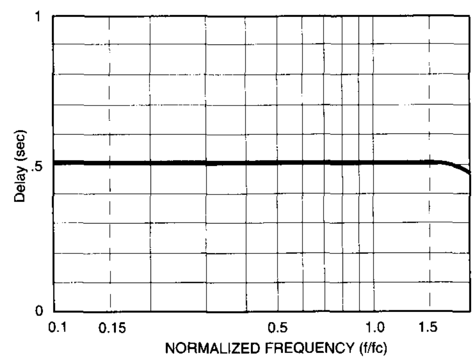
Specifications

Transfer Function	8-pole Bessel Low-Pass
Size	1.8" x 0.8" x 0.3"
Range fc	10 Hz to 100 kHz
Passband Ripple (theoretical)	0.0 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB max. 0 ± 0.05 dB typ.
Stopband Attenuation Rate	48 dB/octave
Cutoff Frequency fc (-3 dB)	± 1 % max.
Stability	± 0.01 % / °C
Phase	– 182°
Filter Attenuation	(theoretical)
1.91 dB	0.80 fc
3.01 dB	1.00 fc
60.0 dB	4.52 fc
80.0 dB	6.07 fc
Phase Match[2] 0 - fc	± 2° max. ± 1° typ.
Amplitude Accuracy 0 - fc	(theoretical) ± 0.2 dB max. ± 0.1 dB typ.
Total Harmonic Distortion @ 1 kHz	< – 100 dB typ.
Wide Band Noise (5 Hz - 2 MHz)	200 μVRMS typ.
Narrow Band Noise (5 Hz - 100 kHz)	50 μVRMS typ.

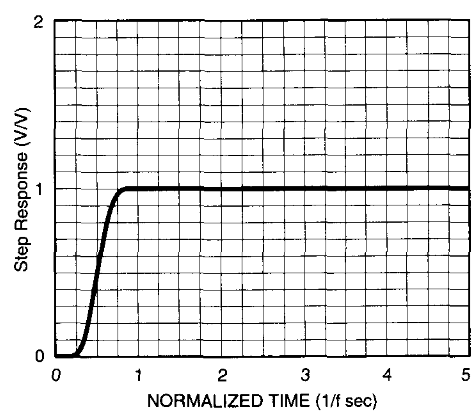
Frequency Response



Delay (Normalized)



Step Response



Theoretical Transfer Characteristics

f/fc (Hz)	Amp (dB)	Phase (deg)	Delay [1] (sec)
0.00	0.00	0.00	.506
0.10	-0.029	-18.2	.506
0.20	-0.117	-36.4	.506
0.30	-0.264	-54.7	.506
0.40	-0.470	-72.9	.506
0.50	-0.737	-91.1	.506
0.60	-1.06	-109	.506
0.70	-1.45	-128	.506
0.80	-1.91	-146	.506
0.85	-2.16	-155	.506
0.90	-2.42	-164	.506
0.95	-2.71	-173	.506
1.00	-3.01	-182	.506
1.10	-3.67	-200	.506
1.20	-4.40	-219	.506
1.30	-5.20	-237	.506
1.40	-6.10	-255	.505
1.50	-7.08	-273	.504
1.60	-8.16	-291	.502
1.70	-9.36	-309	.498
1.80	-10.7	-327	.492
1.90	-12.1	-345	.482
2.00	-13.7	-362	.468
2.25	-18.1	-402	.417
2.50	-23.1	-436	.352
2.75	-28.3	-465	.291
3.00	-33.4	-489	.241
3.25	-38.3	-509	.201
3.50	-43.1	-526	.170
4.00	-51.8	-552	.126
5.00	-66.8	-587	.077
6.00	-79.2	-610	.052
7.00	-89.8	-626	.038
8.00	-99.0	-638	.029
9.00	-107	-647	.023
10.0	-114	-655	.018

2. Unit to unit match for the same transfer function, set to the same frequency and operating configuration, and from the same manufacturing lot.

1. Normalized Group Delay: The above delay data is normalized to a corner frequency of 1.0 Hz. The actual delay is the normalized delay divided by the actual corner frequency (fc).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Corner Frequency (fc) in Hz}}$$

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FREQUENCY DEVICES™

Model D68L8D

8-Pole, 6-Zero Constant Delay Low-Pass Filter

Linear Active Filters

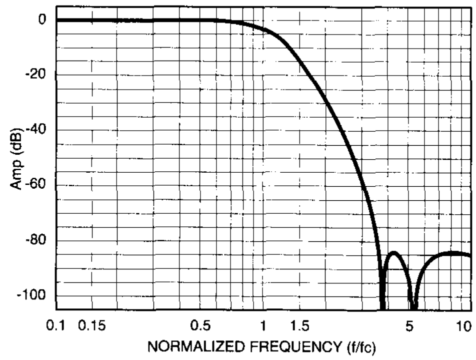
Description

The D68L8D is an 8-pole, 6-zero constant delay low-pass filter which combines the pole configuration of an 8-pole Bessel low-pass filter with passband and stopband zeros. Compared to a Bessel filter, this function exhibits a flatter response in the passband and a much higher roll off rate in the stopband to the specified 80 dB floor. This response maintains a constant delay in the pass band.

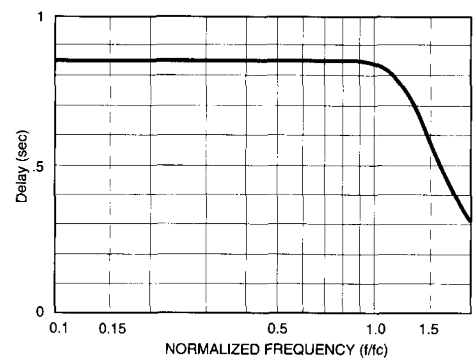
Specifications

Transfer Function	8-pole, 6-zero Constant Delay Low-Pass
Size	1.8" x 0.8" x 0.3"
Range fc	10 Hz to 100 kHz
Passband Ripple (theoretical)	0.15 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB max. 0 ± 0.05 dB typ.
Stopband Attenuation	80 dB min
Cutoff Frequency fc (-3 dB)	± 1 % max.
Stability	± 0.01 % / °C
Phase	– 306°
Filter Attenuation	(theoretical)
3.01 dB	1.00 fc
60.0 dB	3.08 fc
80.0 dB	3.57 fc
Phase Match[2] 0 - fc	± 2° max. ± 1° typ.
Amplitude Accuracy	(theoretical)
0 - 0.8 fc	± 0.2 dB max. ± 0.1 dB typ.
0.8 fc - 1.0 fc	± 0.3 dB max. ± 0.15 dB typ.
Total Harmonic Distortion @ 1 kHz	< – 100 dB typ.
Wide Band Noise (5 Hz - 2 MHz)	200 µVRMS typ.
Narrow Band Noise (5 Hz - 100 kHz)	50 µVRMS typ.

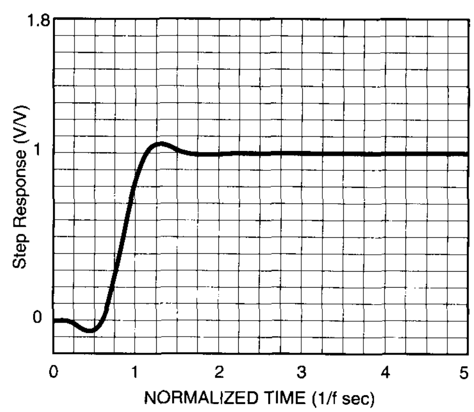
Frequency Response



Delay



Step Response



2. Unit to unit match for the same transfer function, set to the same frequency and operating configuration, and from the same manufacturing lot.

Theoretical Transfer Characteristics

f/fc (Hz)	Amp (dB)	Phase (deg)	Delay[1] (sec)
0.00	0.00	0.00	.852
0.10	0.017	-30.7	.852
0.20	0.058	-61.3	.852
0.30	0.099	-92.0	.852
0.40	0.105	-123	.852
0.50	0.034	-153	.852
0.60	-0.157	-184	.852
0.70	-0.510	-215	.852
0.80	-1.07	-245	.851
0.85	-1.44	-261	.850
0.90	-1.89	-276	.849
0.95	-2.41	-291	.846
1.00	-3.01	-306	.841
1.10	-4.50	-336	.821
1.20	-6.39	-365	.783
1.40	-11.3	-417	.656
1.60	-17.1	-459	.512
1.80	-23.2	-492	.396
2.00	-29.1	-517	.312
2.25	-36.3	-542	.239
2.50	-43.4	-561	.189
2.75	-50.3	-576	.153
3.00	-57.6	-589	.127
3.25	-62.5	-599	.107
3.50	-75.4	-608	.092
3.75	-98.3	-616	.079
4.00	-86.3	-442	.069
4.25	-84.1	-448	.061
4.50	-85.1	-454	.054
4.75	-87.9	-458	.049
5.00	-92.8	-462	.044
5.25	-104	-466	.040
5.50	-101	-289	.036
5.75	-93.3	-293	.033
6.00	-89.9	-295	.030
6.50	-86.6	-300	.026
7.00	-85.1	-305	.022
8.00	-84.1	-312	.017
9.00	-84.3	-317	.013
10.0	-84.9	-321	.011

1. Normalized Group Delay: The above delay data is normalized to a corner frequency of 1.0 Hz. The actual delay is the normalized delay divided by the actual corner frequency (fc).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Corner Frequency (fc) in Hz}}$$

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FREQUENCY DEVICES™

Model D68L8D10

8-Pole, 6-Zero Constant Delay Low-Pass Filter

Linear Active Filters

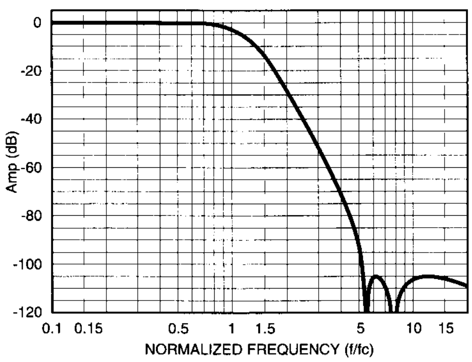
Description

The D68L8D10 is a, 8-pole, 6-zero constant delay low-pass filter which combines the pole configuration of an 8-pole Bessel low-pass filter with passband and stopband zeros. Compared to a Bessel filter, this function exhibits a flatter response in the passband and a much higher roll off rate in the stopband to the specified 100 dB floor. This response maintains a constant delay in the pass band.

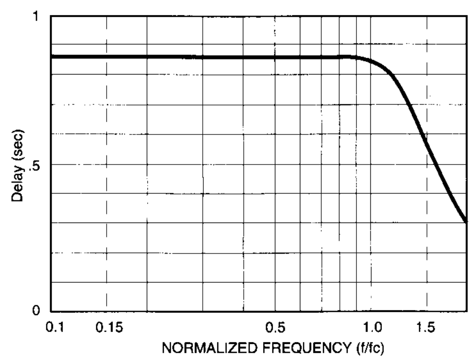
Specifications

Transfer Function	8-pole, 6-zero Constant Delay Low-Pass
Size	1.8" x 0.8" x 0.3"
Range fc	10 Hz to 100 kHz
Passband Ripple (theoretical)	0.15 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB max. 0 ± 0.05 dB typ.
Stopband Attenuation	100 dB min
Cutoff Frequency fc (-3dB)	± 2 % max.
Stability	± 0.01 % / °C
Phase	− 311°
Filter Attenuation	(theoretical)
3.01 dB	1.00 fc
80.0 dB	4.45 fc
100.0 dB	5.20 fc
Phase Match[2] 0 - fc	± 2° max. ± 1° typ.
Amplitude Accuracy	(theoretical)
0 - 0.8 fc	± 0.2 dB max. ± 0.1 dB typ.
0.8 fc - 1.0 fc	± 0.3 dB max. ± 0.15 dB typ.
Total Harmonic Distortion @ 1 kHz	< − 88 dB typ.
Wide Band Noise (5 Hz - 2 MHz)	200 µVRMS typ.
Narrow Band Noise (5 Hz - 100 kHz)	50 µVRMS typ.

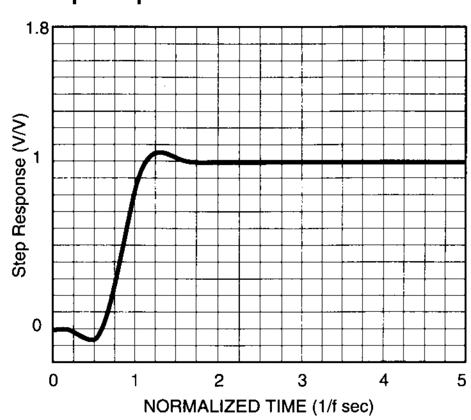
Frequency Response



Delay



Step Response



Theoretical Transfer Characteristics

f/fc (Hz)	Amp (dB)	Phase (deg)	Delay[1] (sec)
0.00	0.00	0.00	.865
0.10	0.015	-31.1	.865
0.20	0.051	-62.3	.865
0.30	0.085	-93.4	.865
0.40	0.085	-125	.865
0.50	0.010	-156	.865
0.60	-0.182	-187	.865
0.70	-0.532	-218	.865
0.80	-1.09	-249	.864
0.85	-1.45	-265	.863
0.90	-1.89	-280	.861
0.95	-2.41	-296	.857
1.00	-3.01	-311	.851
1.10	-4.50	-341	.828
1.20	-6.38	-370	.785
1.40	-11.2	-422	.650
1.60	-16.8	-464	.504
1.80	-22.5	-496	.389
2.00	-28.0	-520	.306
2.25	-34.5	-544	.235
2.50	-40.5	-563	.186
2.75	-46.1	-578	.151
3.00	-51.4	-591	.125
3.50	-61.5	-610	.090
4.00	-71.2	-624	.068
4.50	-81.3	-635	.054
5.00	-93.4	-643	.043
5.50	-142	-651	.036
6.00	-105	-476	.030
6.20	-105	-478	.028
6.50	-106	-481	.025
7.00	-110	-486	.022
8.00	-122	-312	.017
9.00	-109	-318	.013
10.0	-106	-322	.011
12.0	-105	-328	.007
14.0	-106	-333	.005
16.0	-107	-336	.004
18.0	-108	-339	.003
20.0	-109	-341	.003

2. Unit to unit match for the same transfer function, set to the same frequency and operating configuration, and from the same manufacturing lot.

1. Normalized Group Delay: The above delay data is normalized to a corner frequency of 1.0 Hz. The actual delay is the normalized delay divided by the actual corner frequency (fc).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Corner Frequency (fc) in Hz}}$$

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FREQUENCY DEVICES™

Model D68H8B

Linear Active Filters

8-Pole Butterworth High-Pass Filter

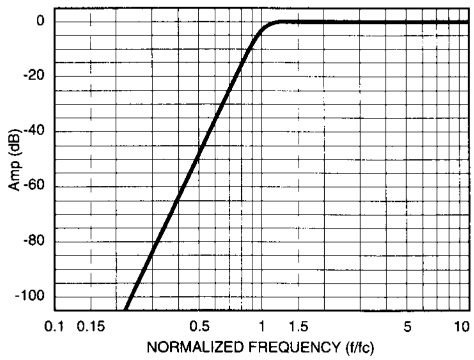
Description

The D68L8B is an 8-pole high-pass filter, is maximally flat, has no ripple in the passband, and has a monotonic roll-up at the rate of 48 dB/octave in the stopband.

Specifications

Transfer Function	8-pole Butterworth High-Pass
Size	1.8" x 0.8" x 0.3"
Range f_c	10 Hz to 100 kHz
Passband Ripple (theoretical)	0.0 dB
DC Voltage Gain (non-inverting)	0 ±0.2 dB to 100 kHz 0 ±0.5 dB to 120 kHz
Power Bandwidth	120 kHz
Small Signal Bandwidth	(-6 dB) 1 MHz
Stopband Attenuation Rate	48 dB/octave
Cutoff Frequency $f_{c\,(-3\,dB)}$	±1 % max.
Stability	±0.01 % / °C
Phase	- 360°
Filter Attenuation	(theoretical)
80 dB	0.31 f_c
60 dB	0.42 f_c
3.01 dB	1.00 f_c
0.00 dB	2.00 f_c
Phase Match[2]	
f_c - 100 kHz	±3° max. ±1.5° typ.
Amplitude Accuracy	(theoretical)
1.0 - 1.25 f_c	±0.30 dB max. ±0.15 dB typ.
1.25 f_c - 100 kHz	±0.20 dB max. ±0.10 dB typ.
Total Harmonic Distortion @ 1 kHz	< – 88 dB typ.
Wide Band Noise (5 Hz - 2 MHz)	400 μVRMS typ.
Narrow Band Noise (5 Hz - 100 kHz)	100 μVRMS typ.

Frequency Response



Theoretical Transfer Characteristics

f/fc (Hz)	Amp (dB)	Phase (deg)	Delay[1] (sec)
0.10	-160	691	0.819
0.20	-112	661	0.828
0.30	-83.7	631	0.843
0.40	-63.7	600	0.867
0.50	-48.2	568	0.903
0.60	-35.5	535	0.956
0.70	-24.8	499	1.04
0.80	-15.6	459	1.19
0.85	-11.6	437	1.29
0.90	-8.06	413	1.40
0.95	-5.15	386	1.48
1.00	-3.01	360	1.46
1.20	-0.229	275	0.873
1.40	-0.020	226	0.540
1.60	-0.002	194	0.380
1.80	0.00	170	0.287
2.00	0.00	152	0.226
2.50	0.00	120	0.139
3.00	0.00	99.2	0.094
4.00	0.00	74.0	0.052
5.00	0.00	59.0	0.033
6.00	0.00	49.0	0.023
7.00	0.00	42.1	0.017
8.00	0.00	36.8	0.013
9.00	0.00	32.7	0.010
10.0	0.00	29.4	0.008

2. Unit to unit match for the same transfer function, set to the same frequency and operating configuration, and from the same manufacturing lot.

1. Normalized Group Delay: The above delay data is normalized to a corner frequency of 1.0 Hz. The actual delay is the normalized delay divided by the actual corner frequency (fc).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Corner Frequency (fc) in Hz}}$$

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FREQUENCY DEVICES™

Model D68H8E

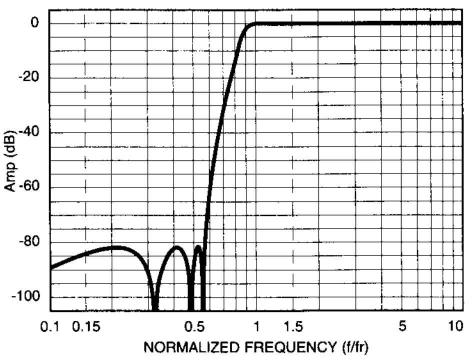
8-Pole, 6-Zero Elliptic, 1.77 High-Pass Filter

Linear Active Filters

Description

The D68H8E is an 8-pole, 6-zero elliptic high-pass filter with a theoretical pass-band ripple of ± 0.035 dB. This response function is a modified Cauer elliptic function designed by FDI to minimize section "Qs", while maintaining a .035 dB/80 dB shape factor of 1.77, an 82 dB stopband floor, and a 2-pole monotonic roll-up at low frequency.

Frequency Response



Specifications

Transfer Function	8-pole, 6-zero Elliptic High-Pass
Size	1.8" x 0.8" x 0.3"
Range f_r	10 Hz to 100 kHz
Passband Ripple	(theoretical)
0 - f_r	±0.035 dB
DC Voltage Gain (non-inverting)	0±0.2 dB to 100 kHz 0±0.5 dB to 120 kHz
Power Bandwidth	120 kHz
Small Signal Bandwidth	(-6 dB) 1 MHz
Stopband Attenuation Floor	80 dB
Cutoff Frequency $f_{r\,(-3\,dB)}$	±1 % max.
Stability	±0.01 % / °C
Phase	– 323.5°
Filter Attenuation	(theoretical)
80.0 dB	0.56 f_r
60.0 dB	0.60 f_r
3.01 dB	0.88 f_r
0.03 dB	1.00 f_r
0.00 dB	2.00 f_r
Phase Match[2]	
0 - 0.8 f_r	±4° max. ±2° typ.
0.8 f_r - 100 kHz	±2° max. ±1° typ.
Amplitude Accuracy	(theoretical)
1.00 - 1.25 f_r	±0.3 dB max. ±0.15 dB typ.
1.25 f_r - 100 kHz	±0.2 dB max. ±0.1 dB typ.
Total Harmonic Distortion @ 1 kHz	< – 88 dB typ.

Wide Band Noise (5 Hz - 2 MHz)	400 µVRMS typ.
Narrow Band Noise (5 Hz - 100 kHz)	100 µVRMS typ.

Theoretical Transfer Characteristics

f/fr (Hz)	Amp (dB)	Phase (deg)	Delay[1] (sec)
0.10	-89.3	164.3	0.440
0.20	-82.1	148.1	0.459
0.30	-90.6	131.0	0.495
0.40	-82.4	292.2	0.559
0.50	-87.8	450.2	0.671
0.55	-90.0	437.4	0.761
0.60	-60.2	602.6	0.890
0.70	-32.4	563.1	1.37
0.80	-13.1	497.5	2.35
0.85	-6.28	450.8	2.77
0.90	-2.21	401.0	2.66
0.95	-0.51	357.5	2.15
1.00	-0.03	323.5	1.64
1.10	-0.01	276.6	1.04
1.20	-0.05	224.8	0.757
1.30	-0.03	220.6	0.596
1.40	0.01	201.2	0.486
1.50	0.03	185.1	0.409
1.60	0.03	171.6	0.347
1.70	0.03	160.0	0.299
1.80	0.02	150.0	0.260
1.90	0.01	141.1	0.229
2.00	0.01	133.4	0.203
2.50	-0.02	105.0	0.123
3.00	-0.02	86.9	0.083
4.00	-0.02	64.7	0.046
5.00	-0.01	51.6	0.029
6.00	-0.01	42.9	0.020
7.00	-0.01	36.8	0.015
8.00	-0.01	32.1	0.011
9.00	-0.01	28.6	0.009
10.0	0.00	25.7	0.007

2. Unit to unit match for the same transfer function, set to the same frequency and operating configuration, and from the same manufacturing lot.

1. Normalized Group Delay: The above delay data is normalized to a ripple frequency of 1.0 Hz. The actual delay is the normalized delay divided by the actual ripple frequency (fr).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Ripple Frequency (fr) in Hz}}$$

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FREQUENCY DEVICES™

Model D68H8EX

8-Pole, 6-Zero Elliptic, 1.56 High-Pass Filter

Linear Active Filters

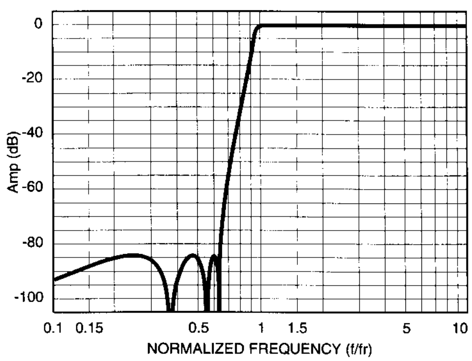
Description

The D68H8EX is an 8-pole, 6-zero Cauer elliptic high-pass filter with a theoretical passband ripple of 0.05 dB. This response has a 0.05 dB/80 dB shape factor of 1.56, an 84dB stopband floor, and a 2-pole monotonic roll-up at low frequency.

Specifications

Transfer Function	8-pole, 6-zero Elliptic High-Pass
Size	1.8" x 0.8" x 0.3"
Range fr	10 Hz to 100 kHz
Passband Ripple	(theoretical)
0 - fr	0.05 dB
DC Voltage Gain (non-inverting)	0 ±0.2 dB to 100 kHz 0 ±0.5 dB to 120 kHz
Power Bandwidth	120 kHz
Small Signal Bandwidth	(-6 dB) 1 MHz
Stopband Attenuation Floor	 80 dB
Cutoff Frequency fr (-3dB)	±1 % max.
Stability	±0.01 % / °C
Phase	– 414°
Filter Attenuation	(theoretical)
80.0 dB	0.64 fr
60.0 dB	0.69 fr
3.01 dB	0.95 fr
0.05 dB	1.00 fr
0.00 dB	2.00 fr
Phase Match[2]	
0 - 0.8 fr	±4° max. ±2° typ.
0.8 fr - 100 kHz	±2° max. ±1° typ.
Amplitude Accuracy	(theoretical)
1.00 - 1.25 fr	±0.5 dB max. ±0.25 dB typ.
1.25 fr - 100 kHz	±0.2 dB max. ±0.1 dB typ.
Total Harmonic Distortion @ 1 kHz	 < – 88 dB typ.
Wide Band Noise (5 Hz - 2 MHz)	500 µVRMS typ.
Narrow Band Noise (5 Hz - 100 kHz)	150 µVRMS typ.

Frequency Response



Theoretical Transfer Characteristics

f/fr (Hz)	Amp (dB)	Phase (deg)	Delay[1] (sec)
0.10	-93.4	168.0	0.334
0.20	-84.8	155.8	0.344
0.30	-86.0	143.1	0.363
0.40	-92.6	309.6	0.392
0.50	-85.0	294.7	0.439
0.55	-114	286.5	0.472
0.60	-84.1	457.7	0.515
0.70	-57.0	616.9	0.652
0.80	-32.8	588.8	0.962
0.85	-22.6	568.6	1.325
0.90	-12.3	538.1	2.198
0.95	-3.08	482.7	3.993
1.00	-0.05	414.4	3.062
1.10	-0.03	340.7	1.498
1.20	-0.01	295.8	1.039
1.30	-0.04	263.6	0.773
1.40	-0.05	238.9	0.612
1.50	-0.03	218.9	0.505
1.60	-0.01	202.3	0.426
1.70	0.00	188.1	0.364
1.80	0.00	175.9	0.315
1.90	-0.01	165.3	0.275
2.00	-0.02	156.0	0.243
2.50	-0.05	122.3	0.145
3.00	-0.05	101.0	0.097
4.00	-0.03	75.1	0.053
5.00	-0.01	59.8	0.034
6.00	-0.01	49.7	0.023
7.00	0.00	42.5	0.017
8.00	0.00	37.2	0.013
9.00	0.00	33.0	0.010
10.0	0.00	29.7	0.008

2. Unit to unit match for the same transfer function, set to the same frequency and operating configuration, and from the same manufacturing lot.

1. Normalized Group Delay: The above delay data is normalized to a ripple frequency of 1.0 Hz. The actual delay is the normalized delay divided by the actual ripple frequency (fr).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Ripple Frequency (fr) in Hz}}$$

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FREQUENCY DEVICES™

Model D68H8EY

8-Pole, 6-Zero Elliptic, 2.00 High-Pass Filter

Linear Active Filters

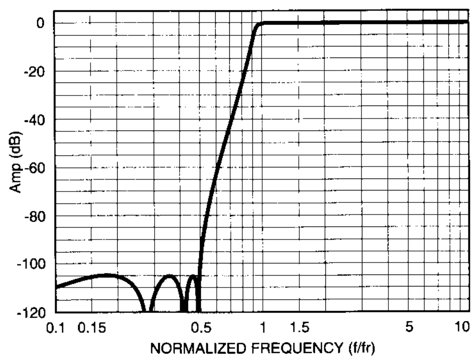
Description

The D68H8EY is a, 8-pole, 6-zero elliptic high-pass filter with a theoretical pass-band ripple of 0.05 dB. This response function is a Cauer elliptic function with a 0.05 dB/100 dB shape factor of 2.00, an 105 dB stopband floor, and a 2-pole monotonic roll-up at low frequency.

Specifications

Transfer Function	8-pole, 6-zero Elliptic High-Pass
Size	1.8" x 0.8" x 0.3"
Range f_r	10 Hz to 100 kHz
Passband Ripple	(theoretical)
0 - f_r	0.05 dB
DC Voltage Gain	0 ± 0.2 dB to 100 kHz
(non-inverting)	0 ± 0.5 dB to 120 kHz
Power Bandwidth	120 kHz
Small Signal Bandwidth	(-6 dB) 1 MHz
Stopband Attenuation Floor	100 dB
Cutoff Frequency f_r (-3dB)	±2 % max.
Stability	±0.01 % / °C
Phase	– 419°
Filter Attenuation	(theoretical)
100.0 dB	0.50 f_r
80.0 dB	0.55 f_r
3.01 dB	0.94 f_r
0.03 dB	1.00 f_r
0.00 dB	2.00 f_r
Phase Match[2]	
0 - 0.8 f_r	±4° max.
	±2° typ.
0.8 f_r - 100 kHz	±2° max.
	±1° typ.
Amplitude Accuracy	(theoretical)
1.00 - 1.25 f_r	±0.5 dB max.
	±0.25 dB typ.
1.25 f_r - 100 kHz	±0.2 dB max.
	±0.1 dB typ.
Total Harmonic Distortion @ 1 kHz	< – 88 dB typ.
Wide Band Noise (5 Hz - 2 MHz)	500 µVRMS typ.

Frequency Response



Narrow Band Noise (5 Hz - 100 kHz)	150 µVRMS typ.

Theoretical Transfer Characteristics

f/fr (Hz)	Amp (dB)	Phase (deg)	Delay[1] (sec)
0.10	-110.0	167.9	0.338
0.20	-105.4	155.6	0.348
0.30	-113.7	322.7	0.367
0.40	-109.9	309.0	0.397
0.50	-106.6	653.9	0.445
0.55	-78.60	645.6	0.480
0.60	-64.62	636.6	0.524
0.70	-44.09	615.4	0.669
0.80	-26.73	586.3	1.001
0.85	-18.19	565.1	1.401
0.90	-9.460	532.8	2.315
0.95	-2.162	478.3	3.604
1.00	-0.046	419.2	2.681
1.10	-0.038	351.6	1.416
1.20	-0.001	308.4	1.018
1.30	-0.032	276.5	0.773
1.40	-0.046	251.7	0.618
1.50	-0.034	231.4	0.514
1.60	-0.016	214.4	0.436
1.70	-0.004	199.8	0.376
1.80	0.000	187.1	0.328
1.90	-0.003	176.1	0.288
2.00	-0.010	166.3	0.255
2.50	-0.042	130.8	0.153
3.00	-0.045	108.2	0.103
4.00	-0.028	80.55	0.057
5.00	-0.015	64.22	0.036
6.00	-0.008	53.41	0.025
7.00	-0.005	45.72	0.018
8.00	-0.003	39.97	0.014
9.00	-0.002	35.51	0.011
10.0	-0.001	31.94	0.009

2. Unit to unit match for the same transfer function, set to the same frequency and operating configuration, and from the same manufacturing lot.

1. Normalized Group Delay: The above delay data is normalized to a ripple frequency of 1.0 Hz. The actual delay is the normalized delay divided by the actual ripple frequency (fr).

$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Ripple Frequency (fr) in Hz}}$$

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FREQUENCY DEVICES™

D68 Series

Pin-Out and Package Data Ordering Information

Specification

(@ 25°C and Vs ± 15 Vdc)

Analog Input Characteristics[1]

Impedance	10 kΩ min.
Voltage Range	± 10 Vpeak
Max. Safe Voltage	± Vs

Analog Output Characteristics

Impedance(Closed Loop)	1 Ω typ. 10 Ω max.
Linear Operating Range	± 10 V
Maximum Current[2]	± 2 mA
Offset Voltage[3]	2 mV typ. 20 mV max.
Offset Temp. Coeff.	50 µV / °C

Power Supply (±Vs)

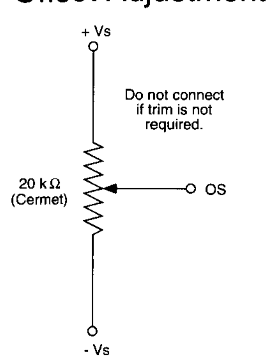
Rated Voltage	± 15 Vdc
Operating Range	± 5 to ± 18 Vdc
Maximum Safe Voltage	± 18 Vdc
Quiescent Current 8 Pole	± 25 mA typ. ± 40 mA max.

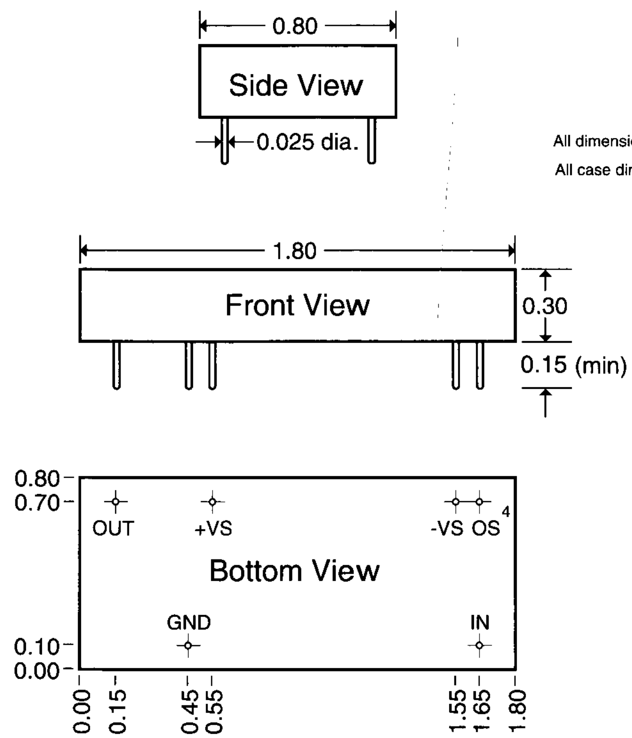
Temperature

Operating	0 to + 70 °C
Storage	- 25 to + 85 °C

Notes:
1. Input and output signal voltage referenced to supply common.
2. Output is short circuit protected to common. DO NOT CONNECT TO ±Vs.
3. Adjustable to zero.
4. Units operate with or with out offset pin connected.

DC Offset Adjustment





All dimensions are in inches

All case dimensions ± 0.01"

Ordering Information

Filter Type
- **L** - Low Pass
- **H** - High Pass

Transfer Function
- **B** - Butterworth
- **L** - Bessel
- **D** - constant delay (-80 dB)
- **D10** - constant delay (-100 dB)
- **E** - elliptic 1.77 (-80 dB)
- **EX** - elliptic 1.56 (-80 dB)
- **EY** - elliptic 2.00 (-100 dB)

D68L8B-849 Hz

No. of Poles

- 3 dB Corner Frequency[5]

e.g., 849 Hz
2.50 kHz
33.3 kHz

5. How to Specify Corner Frequencies: Corner frequencies are specified by attaching a three digit frequency designator to the basic model number. Corner frequencies can range from 10 Hz to 100 kHz.