FREQUENCY DEVICES™

D01 Series

Linear Active DIP Filters

Anti-Alias Filters

Description

The D01 Series of small, fixed-frequency, linear active DIP filters provides high performance linear, multi-pole filtering in a compact package, with a broad range of pole configurations. These Butterworth and Bessel low-pass filters combine the excellent performance of linear multi-pole filter design with the space saving of the dual in-line package (DIP). Each model comes factory tuned to a user-specified corner frequency between 100 Hz and 1 MHz. These fully self-contained units require no external components or adjustments. They operate with dynamic input voltage range from non-critical ±2.5V to ±7.5V power supplies.

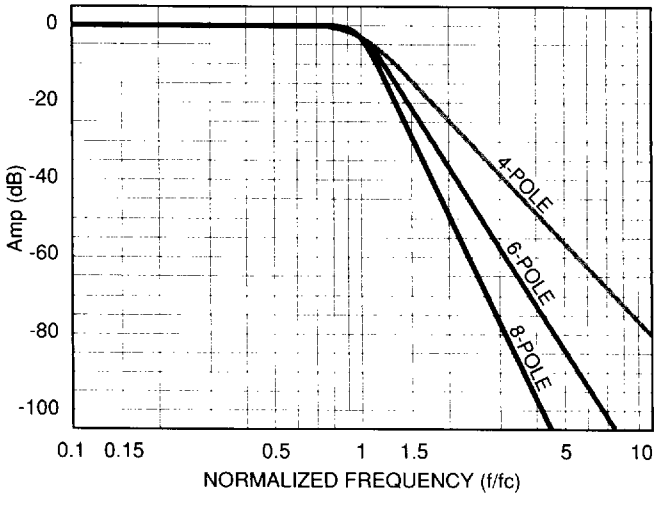
Features/Benefits:

- Compact DIP design minimizes board space requirements
- Plug-in ready-to-use, reducing engineering design and manufacturing time
- Factory tuned, no external clocks or adjustments needed
- Low harmonic distortion and wide signal-to-noise ratio to 12 bit resolution
- Broad range of pole configurations and corner frequencies to meet a wide range of applications

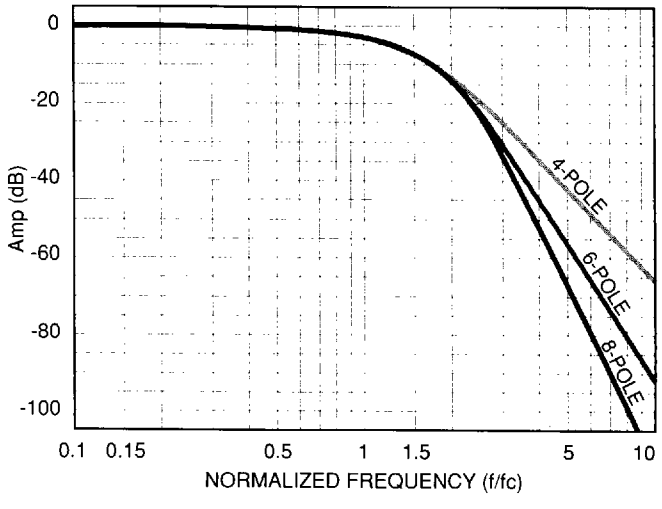
Applications

- Anti-alias filtering
- Data acquisition systems
- Video 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

Butterworth Frequency Response



Bessel Frequency Response



Available Low-Pass Models:

General Specifications:

25 Locust Street • Haverhill, Massachusetts 01830 • (508) 374-0761 • FAX (508) 521-1839

FREQUENCY DEVICES™

Model D01L8B

Linear Active DIP Filters

8-Pole Butterworth Low-Pass Filter

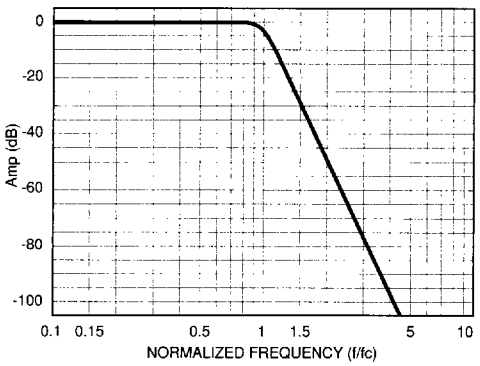
Description

The D01L8B 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.

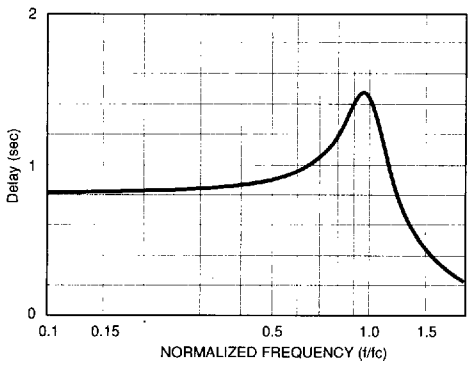
Specifications

Transfer Function	8-pole Butterworth Low-Pass
Size	1.80" x 0.80" x 0.30"
Passband Ripple (theoretical)	0.0 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB typ. 0 ± 0.2 dB max.
Stopband Attenuation Rate	48 dB/octave
Cutoff Frequency f_c (-3 dB)	
Accuracy	± 5 % max.
Stability	± 0.02 % / °c
Range f_c	100 Hz to 1 MHz
Phase Shift	– 360°
Filter Attenuation	(theoretical)
0.12 dB	0.80 f_c
3.01 dB	1.00 f_c
60.0 dB	2.37 f_c
80.0 dB	3.16 f_c
Phase Match [2]	
Amplitude Accuracy [2]	
Total Harmonic Distortion @ 2.5 V_{RMS}	
1 kHz	< – 80 dB typ.
100 kHz	< – 65 dB typ.
Wide Band Noise (20 Hz - 4 MHz)	250 μV_{RMS} typ.
Narrow Band Noise (20 Hz - 100 kHz)	30 μV_{RMS} typ.

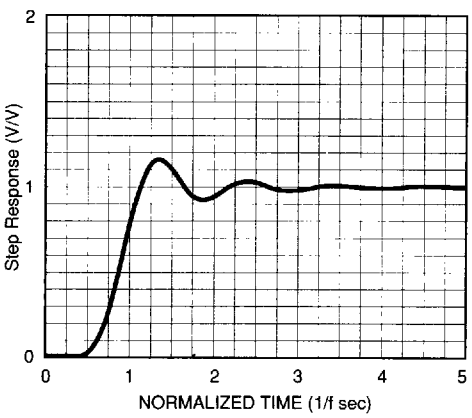
Frequency Response



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. Phase Match and Amplitude Accuracy in the pass band are within ±5% max. of the theoretical transfer characteristics.

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).

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

25 Locust Street • Haverhill, Massachusetts 01830 • (508) 374-0761 • FAX (508) 521-1839

FREQUENCY DEVICES™

Model D01L6B

Linear Active DIP Filters

6-Pole Butterworth Low-Pass Filter

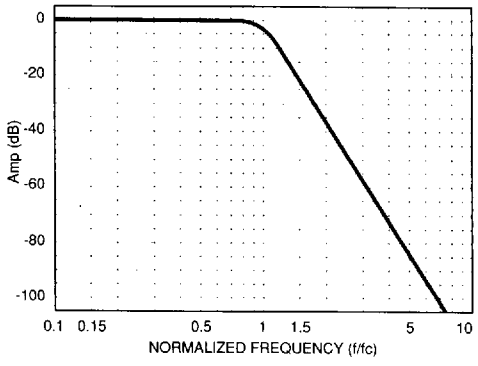
Description

The D01L6B is an 6-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 36 dB/ octave in the stopband.

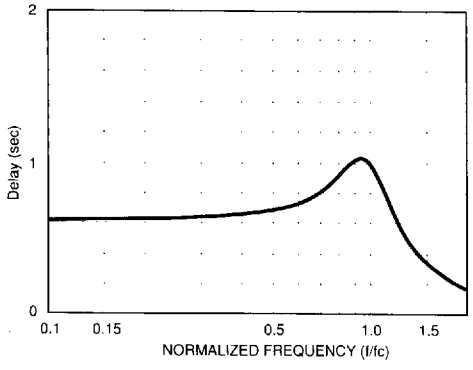
Specifications

Transfer Function	6-pole Butterworth Low-Pass
Size	1.80" x 0.80" x 0.30"
Passband Ripple (theoretical)	0.0 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB typ. 0 ± 0.2 dB max.
Stopband Attenuation Rate	36 dB/octave
Cutoff Frequency f_c (-3 dB)	
Accuracy	±5 % max.
Stability	±0.02 % / °c
Range f_c	100 Hz to 1 MHz
Phase Shift	– 270°
Filter Attenuation	(theoretical)
0.12 dB	0.80 f_c
3.01 dB	1.00 f_c
60.0 dB	3.16 f_c
80.0 dB	4.64 f_c
Phase Match [2]	
Amplitude Accuracy [2]	
Total Harmonic Distortion @ 2.5 V_{RMS}	
1 kHz	< – 80 dB typ.
100 kHz	< – 65 dB typ.
Wide Band Noise (20 Hz - 4 MHz)	160 µV_{RMS} typ.
Narrow Band Noise (20 Hz - 100 kHz)	20 µV_{RMS} typ.

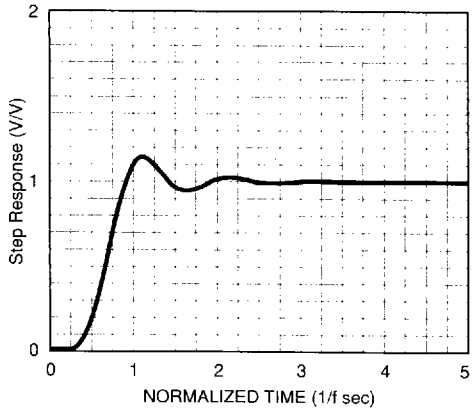
Frequency Response



Delay (Normalized)



Step Response



Theoretical Transfer Characteristics

f/fc (Hz)	Amp (dB)	Phase (deg)	Delay [1] (sec)
0.00	0.00	0.00	.615
0.10	0.00	-22.2	.617
0.20	0.00	-44.5	.624
0.30	0.00	-67.2	.637
0.40	0.00	-90.4	.656
0.50	-0.001	-115	.685
0.60	-0.009	-140	.731
0.70	-0.060	-167	.803
0.80	-0.289	-198	.911
0.85	-0.578	-215	.970
0.90	-1.080	-233	1.02
0.95	-1.88	-252	1.03
1.00	-3.01	-270	1.00
1.10	-6.17	-304	.845
1.20	-9.96	-331	.660
1.30	-13.9	-352	.518
1.40	-17.6	-368	.417
1.50	-21.2	-382	.345
1.60	-24.5	-393	.291
1.70	-27.7	-403	.251
1.80	-30.6	-412	.219
1.90	-33.5	-419	.193
2.00	-36.1	-425	.171
2.25	-42.3	-439	.132
2.50	-47.8	-450	.105
2.75	-52.7	-458	.086
3.00	-57.3	-465	.071
3.25	-61.4	-471	.060
3.50	-65.3	-476	.052
4.00	-72.2	-484	.039
5.00	-83.9	-496	.025
6.00	-93.4	-503	.017
7.00	-101	-508	.012
8.00	-108	-512	.0097
9.00	-115	-515	.0076
10.0	-120	-518	.0062

2. Phase Match and Amplitude Accuracy in the pass band are within ±5% max. of the theoretical transfer characteristics.

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).

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

25 Locust Street • Haverhill, Massachusetts 01830 • (508) 374-0761 • FAX (508) 521-1839

FREQUENCY DEVICES™

Model D01L4B

Linear Active DIP Filters

4-Pole Butterworth Low-Pass Filter

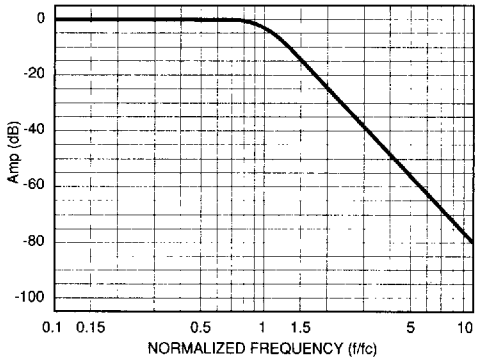
Description

The D01L4B is an 4-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 24 dB/octave in the stopband.

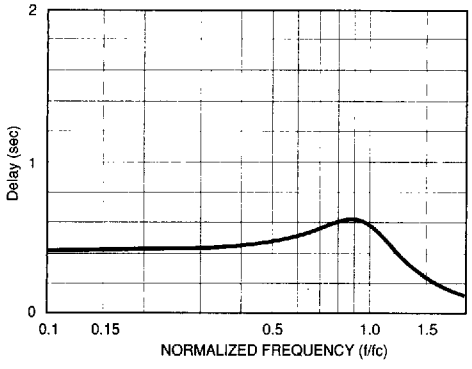
Specifications

Transfer Function	4-pole Butterworth Low-Pass
Size	1.80" x 0.80" x 0.30"
Passband Ripple (theoretical)	0.0 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB typ. 0 ± 0.2 dB max.
Stopband Attenuation Rate	24 dB/octave
Cutoff Frequency f_c (-3 dB)	
Accuracy	± 5 % max.
Stability	± 0.02 % / °c
Range f_c	100 Hz to 1 MHz
Phase Shift	– 180°
Filter Attenuation	(theoretical)
0.12 dB	0.80 f_c
3.01 dB	1.00 f_c
60.0 dB	5.62 f_c
80.0 dB	10.0 f_c
Phase Match [2]	
Amplitude Accuracy [2]	
Total Harmonic Distortion @ 2.5 VRMS	
1 kHz	< – 80 dB typ.
100 kHz	< – 65 dB typ.
Wide Band Noise (20 Hz - 4 MHz)	70 µVRMS typ.
Narrow Band Noise (20 Hz - 100 kHz)	20 µVRMS typ.

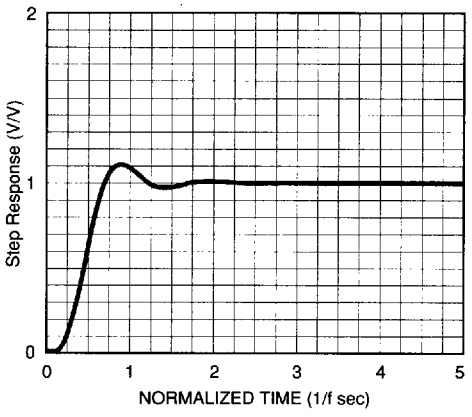
Frequency Response



Delay (Normalized)



Step Response



Theoretical Transfer Characteristics

f/fc (Hz)	Amp (dB)	Phase (deg)	Delay [1] (sec)
0.00	0.00	0.00	.416
0.10	0.00	-15.0	.418
0.20	0.00	-30.1	.423
0.30	-0.00	-45.5	.433
0.40	-0.003	-61.4	.449
0.50	-0.017	-78.0	.474
0.60	-0.072	-95.7	.511
0.70	-0.243	-115	.558
0.80	-0.674	-136	.604
0.85	-1.047	-147	.619
0.90	-1.555	-158	.622
0.95	-2.21	-169	.612
1.00	-3.01	-180	.588
1.10	-4.97	-200	.513
1.20	-7.24	-217	.427
1.30	-9.62	-231	.350
1.40	-12.0	-242	.289
1.50	-14.3	-252	.241
1.60	-16.4	-260	.204
1.70	-18.5	-266	.175
1.80	-20.5	-272	.152
1.90	-22.3	-277	.134
2.00	-24.1	-282	.119
2.25	-28.2	-291	.091
2.50	-31.8	-299	.072
2.75	-35.1	-304	.059
3.00	-38.2	-309	.049
3.25	-41.0	-313	.041
3.50	-43.5	-317	.035
4.00	-48.2	-322	.027
5.00	-55.9	-330	.017
6.00	-62.3	-335	.012
7.00	-67.6	-339	.009
8.00	-72.2	-341	.007
9.00	-76.3	-343	.005
10.0	-80.0	-345	.004

2. Phase Match and Amplitude Accuracy in the pass band are within ±5% max. of the theoretical transfer characteristics.

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).

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

25 Locust Street • Haverhill, Massachusetts 01830 • (508) 374-0761 • FAX (508) 521-1839

4

FREQUENCY DEVICES™

Model D01L8L

Linear Active DIP Filters

8-Pole Bessel Low-Pass Filter

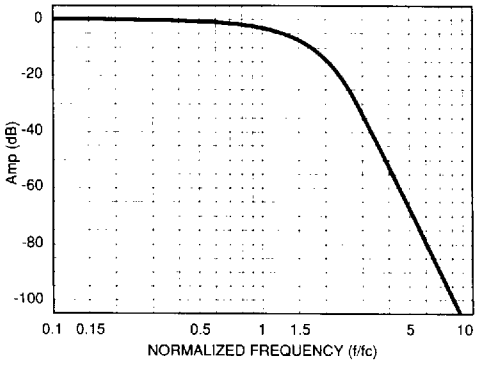
Description

The D01L8L 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.

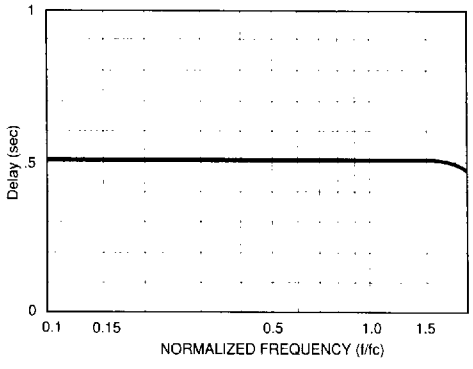
Specifications

Transfer Function	8-pole Bessel Low-Pass
Size	1.80" x 0.80" x 0.30"
Passband Ripple (theoretical)	0.0 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB typ. 0 ± 0.2 dB max.
Stopband Attenuation Rate	48 dB/octave
Cutoff Frequency f_c (-3 dB)	
Accuracy	± 5 % max.
Stability	± 0.02 % / °c
Range f_c	100 Hz to 1 MHz
Phase	– 182°
Filter Attenuation	(theoretical)
1.91 dB	0.80 f_c
3.01 dB	1.00 f_c
60.0 dB	4.52 f_c
80.0 dB	6.07 f_c
Phase Match [2]	
Amplitude Accuracy [2]	
Total Harmonic Distortion @ 250 μVRMS	
1 kHz	< – 80 dB typ.
100 kHz	< – 65 dB typ.
Wide Band Noise (20 Hz - 4 MHz)	250 μVRMS typ.
Narrow Band Noise (20 Hz - 100 kHz)	30 μVRMS typ.

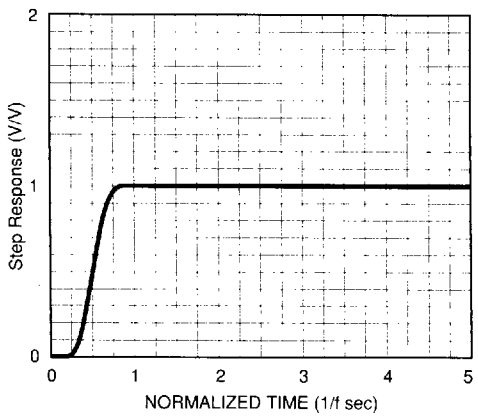
Frequency Response



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. Phase Match and Amplitude Accuracy in the pass band are within ±5% max. of the theoretical transfer characteristics.

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).

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

25 Locust Street • Haverhill, Massachusetts 01830 • (508) 374-0761 • FAX (508) 521-1839

5

FREQUENCY DEVICES™

Model D01L6L

Linear Active DIP Filters

6-Pole Bessel Low-Pass Filter

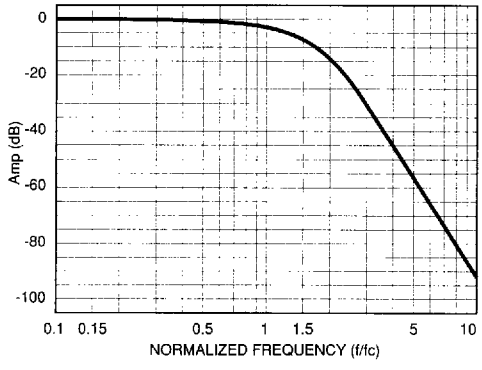
Description

The D01L6L is an 6-pole low-pass Bessel transfer function, has a monotonic roll-off in the passband and the stopband, and its final rolloff rate is 36 dB/octave in the stopband. It exhibits a constant delay in the passband and has an overshoot free step response.

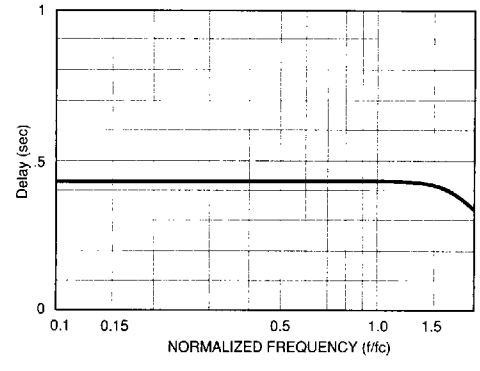
Specifications

Transfer Function	6-pole Bessel Low-Pass
Size	1.80" x 0.80" x 0.30"
Passband Ripple (theoretical)	0.0 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB typ. 0 ± 0.2 dB max.
Stopband Attenuation Rate	36 dB/octave
Cutoff Frequency f_c (-3 dB)	
Accuracy	± 5 % max.
Stability	± 0.02 % / °c
Range f_c	100 Hz to 1 MHz
Phase	– 155°
Filter Attenuation	(theoretical)
1.91 dB	0.80 f_c
3.01 dB	1.00 f_c
60.0 dB	5.41 f_c
80.0 dB	7.99 f_c
Phase Match [2]	
Amplitude Accuracy [2]	
Total Harmonic Distortion @ 2.5 VRMS	
1 kHz	< – 80 dB typ.
100 kHz	< – 65 dB typ.
Wide Band Noise (20 Hz - 4 MHz)	160 µVRMS typ.
Narrow Band Noise (20 Hz - 100 kHz)	20 µVRMS typ.

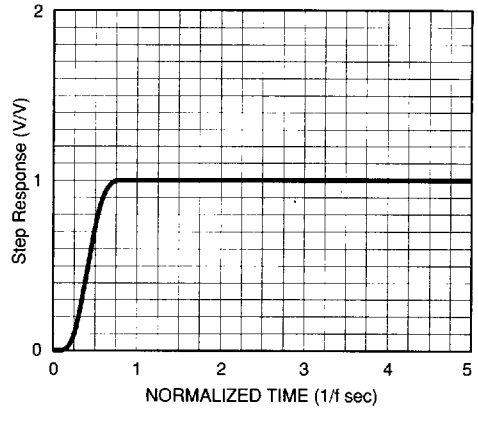
Frequency Response



Delay (Normalized)



Step Response



Theoretical Transfer Characteristics

f/fc (Hz)	Amp (dB)	Phase (deg)	Delay [1] (sec)
0.00	0.00	0.00	.430
0.10	-0.029	-15.5	.430
0.20	-0.116	-31.0	.430
0.30	-0.261	-46.5	.430
0.40	-0.465	-62.0	.430
0.50	-0.728	-77.4	.430
0.60	-1.05	-92.9	.430
0.70	-1.44	-108	.430
0.80	-1.89	-124	.430
0.85	-2.15	-132	.430
0.90	-2.42	-139	.430
0.95	-2.70	-147	.430
1.00	-3.01	-155	.430
1.10	-3.68	-170	.429
1.20	-4.44	-186	.428
1.30	-5.29	-201	.426
1.40	-6.23	-216	.422
1.50	-7.29	-232	.416
1.60	-8.46	-246	.401
1.70	-9.74	-261	.393
1.80	-11.1	-275	.376
1.90	-12.6	-287	.357
2.00	-14.2	-300	.335
2.25	-18.3	-328	.279
2.50	-22.6	-351	.228
2.75	-26.7	-369	.187
3.00	-30.7	-385	.156
3.25	-34.5	-398	.131
3.50	-38.1	-408	.111
4.00	-44.7	-426	.083
5.00	-55.9	-449	.052
6.00	-65.2	-465	.036
7.00	-73.2	-476	.026
8.00	-80.1	-484	.020
9.00	-86.2	-490	.015
10.0	-91.6	-495	.013

2. Phase Match and Amplitude Accuracy in the pass band are within ±5% max. of the theoretical transfer characteristics.

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).

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

25 Locust Street • Haverhill, Massachusetts 01830 • (508) 374-0761 • FAX (508) 521-1839

FREQUENCY DEVICES™

Model D01L4L

Linear Active DIP Filters

4-Pole Bessel Low-Pass Filter

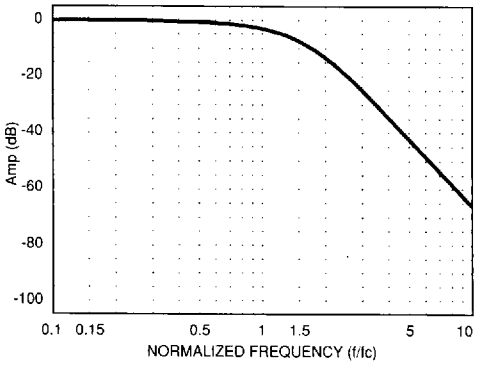
Description

The D01L4L is an 4-pole low-pass Bessel transfer function, has a monotonic roll-off in the passband and the stopband, and its final rolloff rate is 24 dB/octave in the stopband. It exhibits a constant delay in the passband and has an overshoot free step response.

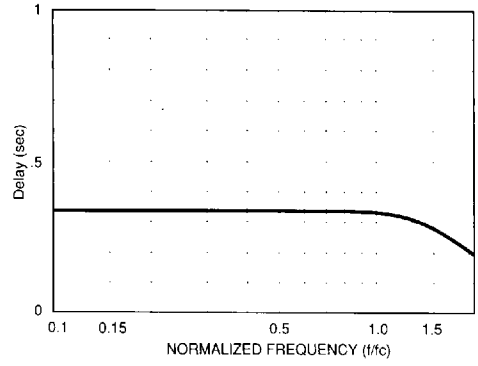
Specifications

Transfer Function	4-pole Bessel Low-Pass
Size	1.80" x 0.8" x 0.30"
Passband Ripple (theoretical)	0.0 dB
DC Voltage Gain (non-inverting)	0 ± 0.1 dB typ. 0 ± 0.2 dB max.
Stopband Attenuation Rate	24 dB/octave
Cutoff Frequency f_c (-3 dB)	
Accuracy	± 5 % max.
Stability	± 0.02 % / °C
Range f_c	100 Hz to 1 MHz
Phase	– 121°
Filter Attenuation	(theoretical)
1.91 dB	0.80 f_c
3.01 dB	1.00 f_c
60.0 dB	8.48 f_c
80.0 dB	15.12 f_c
Phase Match [2]	
Amplitude Accuracy [2]	
Total Harmonic Distortion @ 2.5 V_{RMS}	
1 kHz	< – 80 dB typ.
100 kHz	< – 65 dB typ.
Wide Band Noise (20 Hz - 4 MHz)	70 μV_{RMS} typ.
Narrow Band Noise (20 Hz - 100 kHz)	20 μV_{RMS} typ.

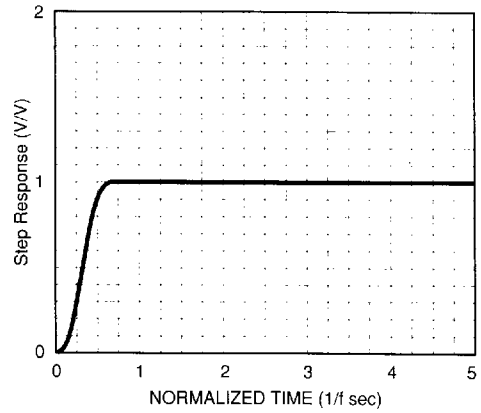
Frequency Response



Delay (Normalized)



Step Response



Theoretical Transfer Characteristics

f/fc (Hz)	Amp (dB)	Phase (deg)	Delay [1] (sec)
0.00	0.00	0.00	.336
0.10	-0.028	-12.1	.336
0.20	-0.111	-24.2	.336
0.30	-0.251	-36.3	.336
0.40	-0.448	-48.4	.336
0.50	-0.705	-60.6	.336
0.60	-1.02	-72.7	.336
0.70	-1.41	-84.8	.336
0.80	-1.86	-96.8	.335
0.85	-2.11	-103	.334
0.90	-2.40	-109	.333
0.95	-2.69	-115	.332
1.00	-3.01	-121	.330
1.10	-3.71	-133	.325
1.20	-4.51	-144	.318
1.30	-5.39	-156	.308
1.40	-6.37	-166	.295
1.50	-7.42	-177	.280
1.60	-8.54	-187	.263
1.70	-9.71	-195	.246
1.80	-10.9	-204	.228
1.90	-12.2	-212	.211
2.00	-13.4	-219	.194
2.25	-16.5	-235	.158
2.50	-19.5	-248	.129
2.75	-22.4	-259	.107
3.00	-25.1	-267	.089
3.25	-27.6	-275	.076
3.50	-30.0	-281	.065
4.00	-34.4	-291	.049
5.00	-41.9	-305	.031
6.00	-48.1	-315	.021
7.00	-53.4	-321	.016
8.00	-58.0	-326	.012
9.00	-62.0	-330	.009
10.0	-65.7	-333	.008

2. Phase Match and Amplitude Accuracy in the pass band are within ±5% max. of the theoretical transfer characteristics.

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).

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

25 Locust Street • Haverhill, Massachusetts 01830 • (508) 374-0761 • FAX (508) 521-1839

7

FREQUENCY DEVICES™

D01 Series

Pin-Out and Package Data Ordering Information

Specification

(@ 25°C and Vs ± 5 Vdc)

Analog Input Characteristics[1]

Impedance	250 Ω min.
Voltage Range	± 3.5 Vpeak
Max. Safe Voltage	± Vs

Analog Output Characteristics

Impedance(Closed Loop)	<1 Ω typ.
Linear Operating Range	± 5 V
Maximum Current[2]	± 30 mA
Offset Voltage[3]	± 10 mV max.
Offset Temp. Coeff.	50 µV /°C

Power Supply (±Vs)

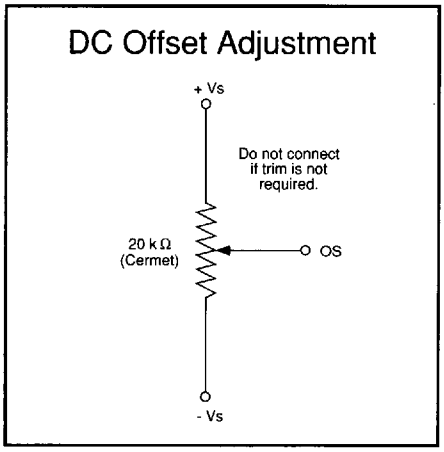
Rated Voltage	± 7.5 Vdc
Operating Range	± 2.5 to ± 7.5 Vdc
Maximum Safe Voltage	± 7.5 Vdc
Quiescent Current 8 Pole	± 30 mA max.

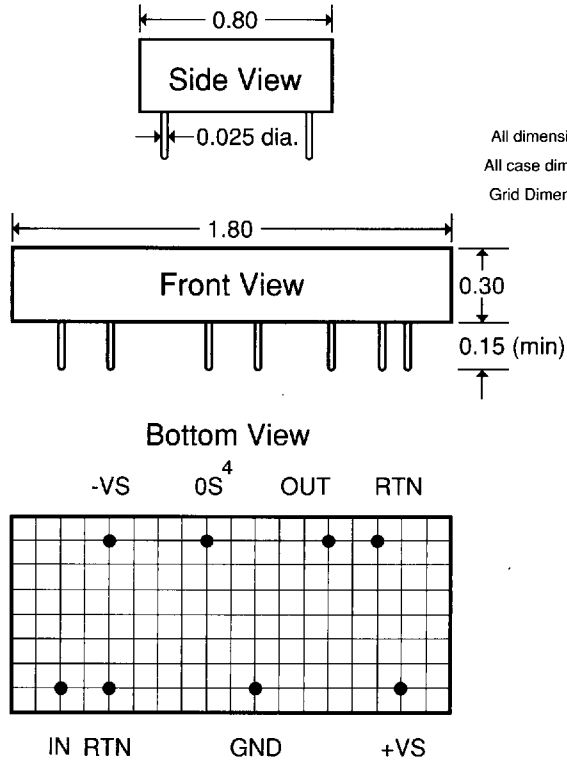
Temperature

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 without offset pin connected.





Ordering Information

Filter Type

L - Low Pass

Transfer Function

B - Butterworth
L - Bessel

D01L8B-976 kHz

No. of Poles

4
6
8

- 3 dB Corner Frequency[5]

e.g., 310 kHz
780 kHz
1 MHz

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 100 Hz to 1 MHz.

25 Locust Street • Haverhill, Massachusetts 01830 • (508) 374-0761 • FAX (508) 521-1839