FREQUENCY DEVICES™, INC.

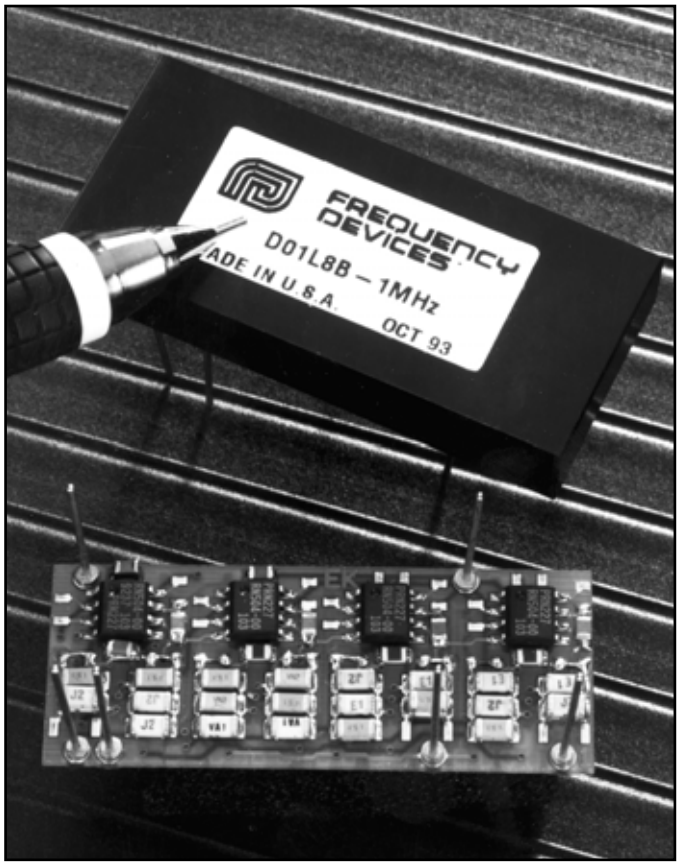
D01 Series

100 Hz to 1.00 MHz Fixed Frequency

32-Pin DIP 8-, 6-, 4-Pole Filters

Description

The D01 Series of small, fixed-frequency, linear active DIP filters provide 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 100Hz 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:

- Low harmonic distortion and wide signal-to-noise ratio to 12 bit resolution
- 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
- 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

Available Low-Pass Models:

General Specifications:

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e-mail: sales@freqdev.com • Web Address: http://www.freqdev.com

Model	D01L8B	D01L6B	D01L4B	
Product Specifications				
Transfer Function	8-Pole, Butterworth	6-Pole, Butterworth	4-Pole, Butterworth	
Size	1.80" x 0.80" x 0.30"	1.80" x 0.80" x 0.30"	1.80" x 0.80" x 0.30"	
Range f_c	100 Hz to 1 MHz	100 Hz to 1 MHz	100 Hz to 1 MHz	
Theoretical Transfer Characteristics	Appendix A Page 9	Appendix A Page 8	Appendix A Page 7	
Passband Ripple (theoretical)	0.0 dB	0.0 dB	0.0 dB	
DC Voltage Gain (non-inverting)	0 ± 0.1 dB max. 0 ± 0.02 dB typ.	0 ± 0.1 dB max. 0 ± 0.02 dB typ.	0 ± 0.1 dB max. 0 ± 0.2 dB typ.	
Stopband Attenuation Rate	48 dB/octave	36 dB/octave	24 dB/octave	
Cutoff Frequency **Stability** **Amplitude** **Phase**	f_c ± 5% max. ± 0.02%/°C -3 dB -360°	f_c ± 5% max. ± 0.02%/°C -3 dB -270°	f_c ± 5% max. ± 0.02%/°C -3 dB -180°	
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	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	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[1]				
Amplitude Accuracy[1]				
Total Harmonic Distortion @ 2.5 V_{RMS}	1 kHz < -80 dB typ. 100 kHz < -65 dB typ.	1 kHz < -80 dB typ. 100 kHz < -65 dB typ.	1 kHz < -80 dB typ. 100 kHz < -65 dB typ.	
Wide Band Noise (20 Hz - 4 MHz)	250 µVrms typ.	160 µVrms typ.	70 µVrms typ.	
Narrow Band Noise (20 Hz - 100 kHz)	30 µVrms typ.	20 µVrms typ.	20 µVrms typ.	
Filter Mounting Assembly	NA	NA	NA	

1. Phase Match and Amplitude Accuracy in the pass band are within ± 5% max. of the theoretical transfer characteristics.
NA - Not available

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Model	D01L8L	D01L6L	D01L4L	
Product Specifications				
Transfer Function	8-Pole, Bessel	6-Pole, Bessel	4-Pole, Bessel	
Size	1.80" x 0.80" x 0.30"	1.80" x 0.80" x 0.30"	1.80" x 0.80" x 0.30"	
Range f_c	100 Hz to 1 MHz	100 Hz to 1 MHz	100 Hz to 1 MHz	
Theoretical Transfer Characteristics	Appendix A Page 4	Appendix A Page 3	Appendix A Page 2	
Passband Ripple (theoretical)	0.0 dB	0.0 dB	0.0 dB	
DC Voltage Gain (non-inverting)	0 ± 0.1 dB max. 0 ± 0.2 dB typ.	0 ± 0.1 dB max. 0 ± 0.2 dB typ.	0 ± 0.1 dB max. 0 ± 0.2 dB typ.	
Stopband Attenuation Rate	48 dB min.	36 dB/octave	24 dB/octave	
Cutoff Frequency	f_c ± 5% max.	f_c ± 5% max.	f_c ± 5% max.	
Stability	± 0.02%/°C	± 0.02%/°C	± 0.02%/°C	
Amplitude	-3 dB	-3 dB	-3 dB	
Phase	-182°	-155°	-121°	
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	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	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[1]				
Amplitude Accuracy[1]				
Total Harmonic Distortion @ 2.5 VRMS	1 kHz < -80 dB typ. 100 kHz < -65 dB typ.	1 kHz < -80 dB typ. 100 kHz < -65 dB typ.	1 kHz < -80 dB typ. 100 kHz < -65 dB typ.	
Wide Band Noise	250 µVrms typ.	160 µVrms typ.	70 µVrms typ.	
Narrow Band Noise	30 µVrms typ.	20 µVrms typ.	20 µVrms typ.	
Filter Mounting Assembly	NA	NA	NA	

1. Phase Match and Amplitude Accuracy in the pass band are within ± 5% max. of the theoretical transfer characteristics.
NA - Not available

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Specification

(25°C and Vs ± 5 Vdc)

Analog Input Characteristics[1]

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

Analog Output Characteristics

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

Power Supply (±V)

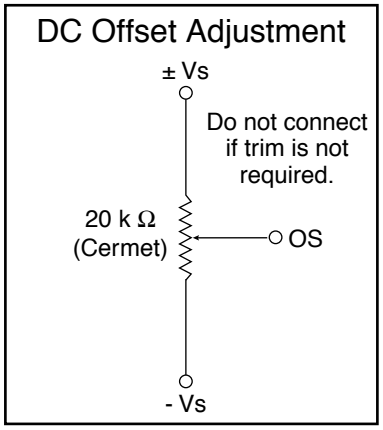
Rated Voltage	±7.5 Vdc
Operating Range	±2.5 to ±7.5 Vdc
Maximum Safe Voltage	±7.5 Vdc
Quiescent Current	
8-Pole	±30 mA max.
6-Pole	±23 mA max.
4-Pole	±15 mA max.

Temperature

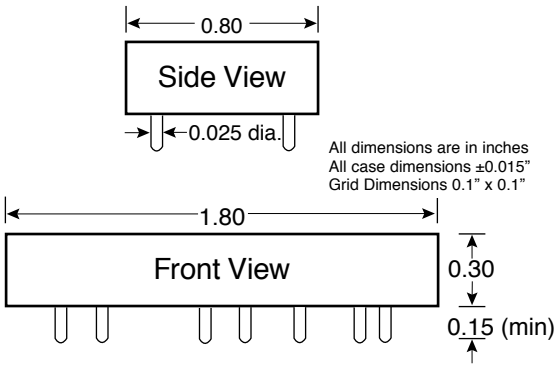
Operating	0 to +70°C
Storage	-25 to +85°C

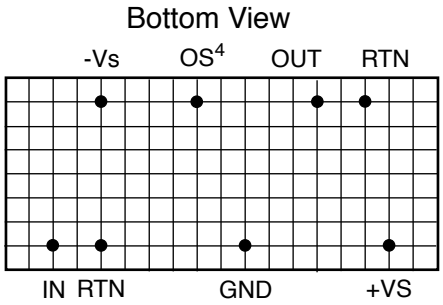
Notes:

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.



Pin-Out and Package Data
Ordering Information





Ordering Information

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 100Hz to 1 MHz.

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FREQUENCY DEVICES™, INC.

Low-Pass

4-Pole

Bessel

Appendix A

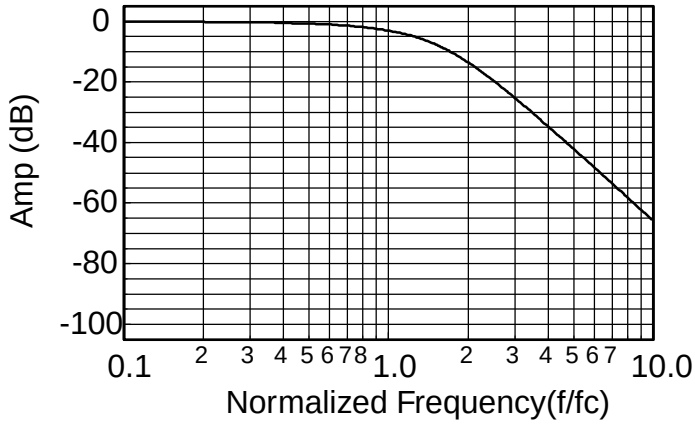
Theoretical Transfer Characteristics

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

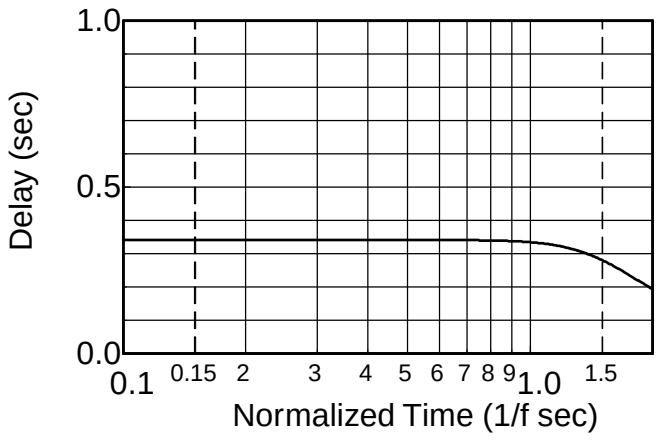
1.**Normalized Group Delay:**
The above delay data is normalized to a corner frequency of 1.0Hz.The actual delay is the normalized delay divided by the actual corner frequency (fc).

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

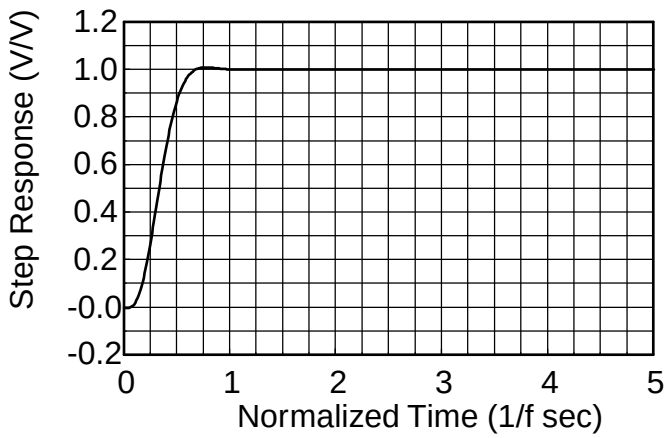
Frequency Response



Delay (Normalized)



Step Response



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FREQUENCY DEVICES™, INC.

Low-Pass

6-Pole

Bessel

Appendix A

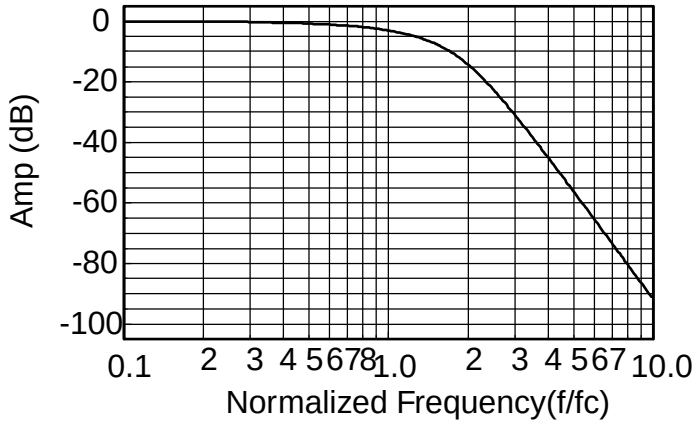
Theoretical Transfer Characteristics

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

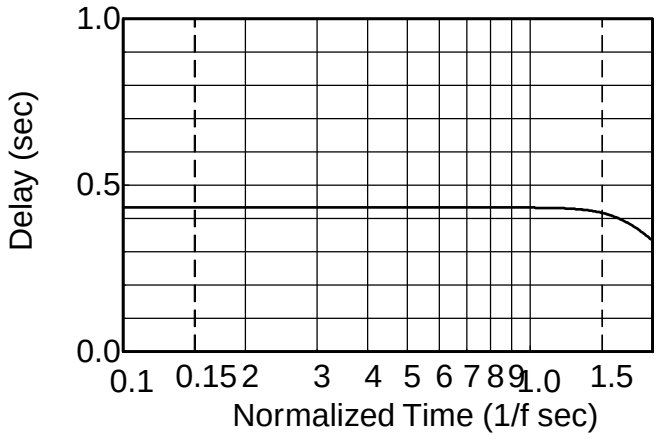
1.**Normalized Group Delay:**
The above delay data is normalized to a corner frequency of 1.0Hz.The actual delay is the normalized delay divided by the actual corner frequency (fc).

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

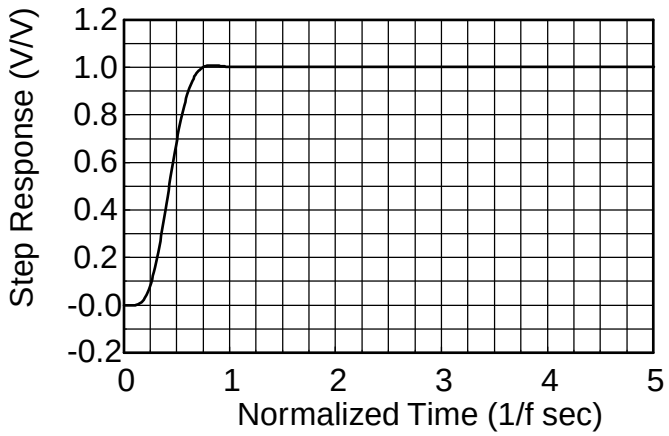
Frequency Response



Delay (Normalized)



Step Response



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FREQUENCY DEVICES™, INC.

8-Pole

Bessel

Low-Pass

Appendix A

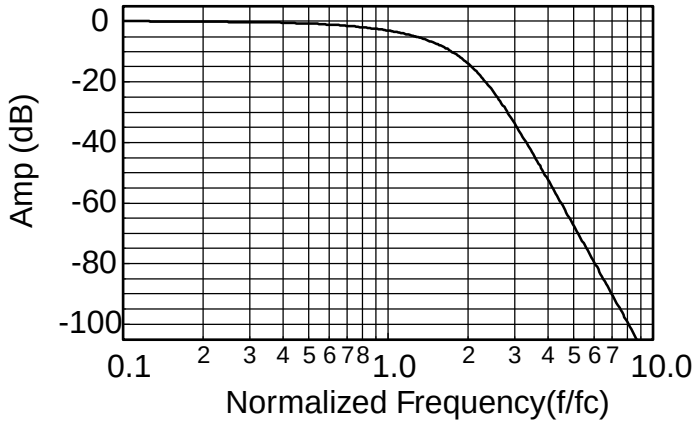
Theoretical Transfer Characteristics

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

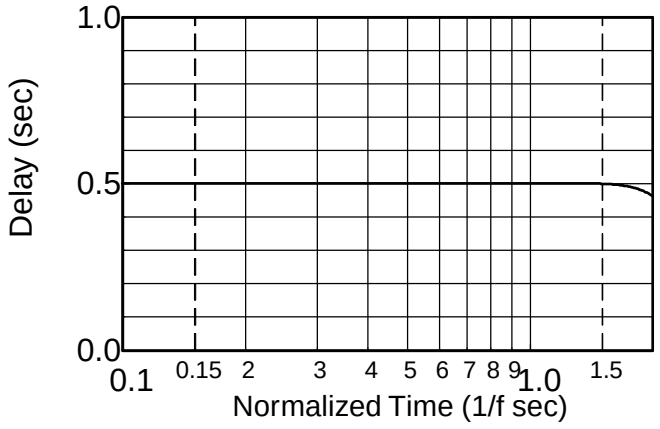
1.**Normalized Group Delay:**
The above delay data is normalized to a corner frequency of 1.0Hz.The actual delay is the normalized delay divided by the actual corner frequency (fc).

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

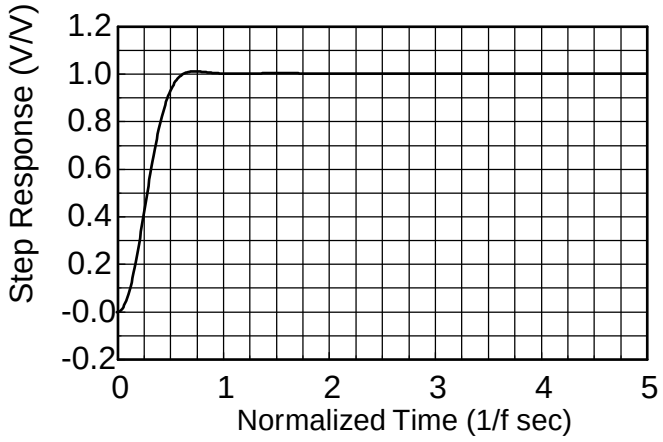
Frequency Response



Delay (Normalized)



Step Response



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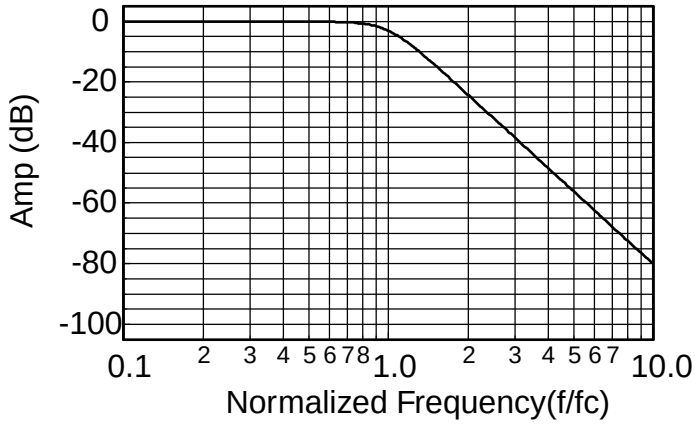
Theoretical Transfer Characteristics

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

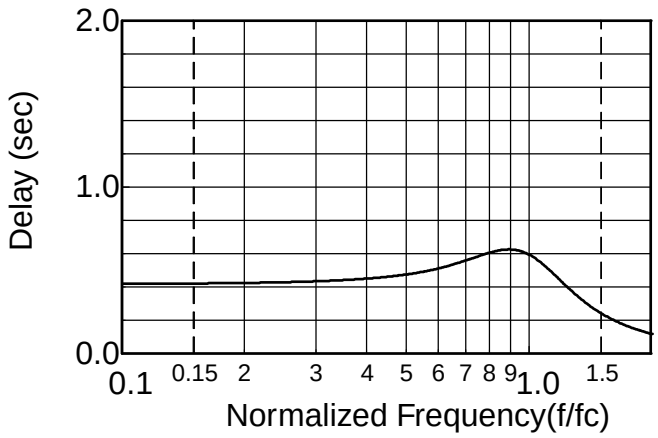
1. **Normalized Group Delay:**
The above delay data is normalized to a corner frequency of 1.0Hz.The actual delay is the normalized delay divided by the actual corner frequency (fc).

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

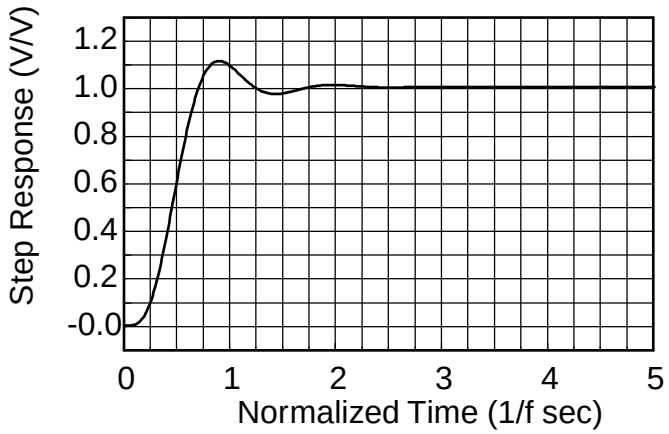
Frequency Response



Delay (Normalized)



Step Response



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FREQUENCY DEVICES™, INC.

Low-Pass

6-Pole

Butterworth

Appendix A

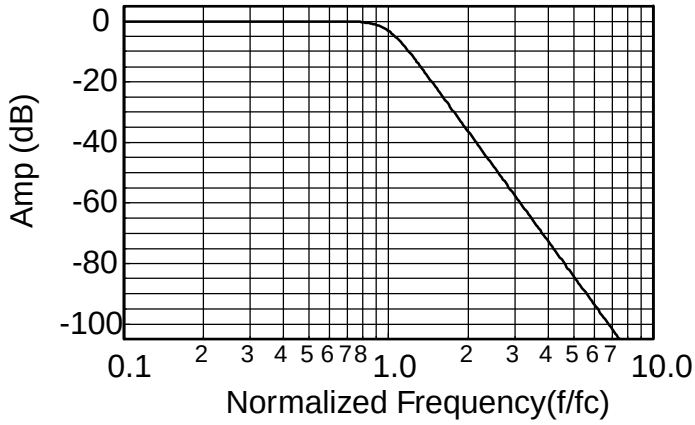
Theoretical Transfer Characteristics

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

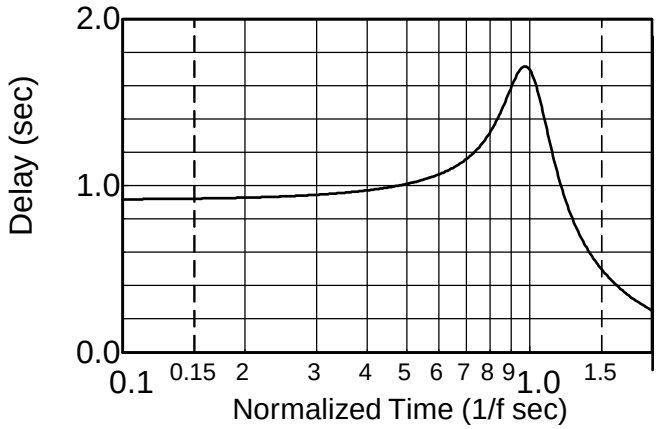
1.**Normalized Group Delay:**
The above delay data is normalized to a corner frequency of 1.0Hz.The actual delay is the normalized delay divided by the actual corner frequency (fc).

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

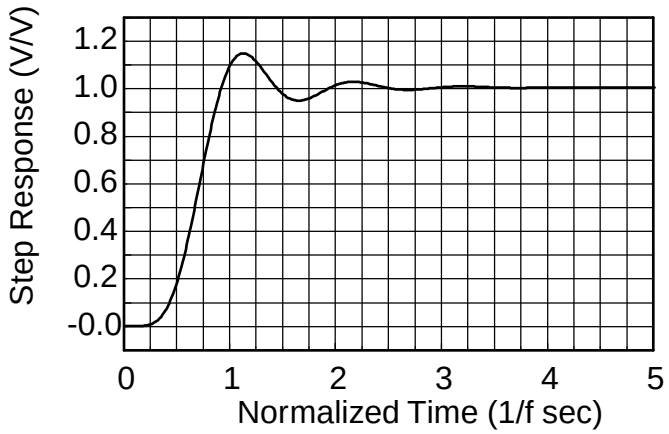
Frequency Response



Delay (Normalized)



Step Response



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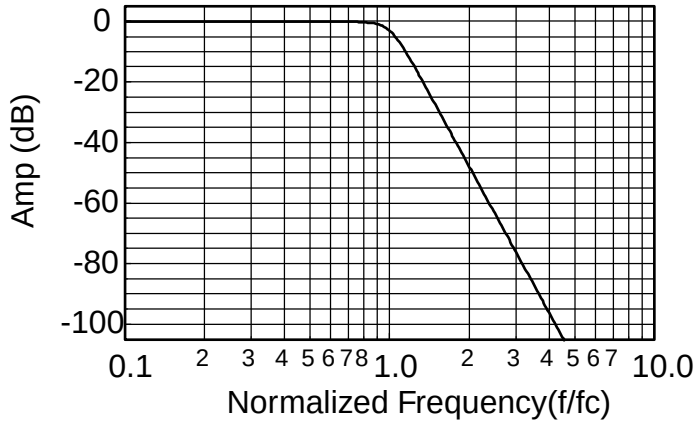
Theoretical Transfer Characteristics

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

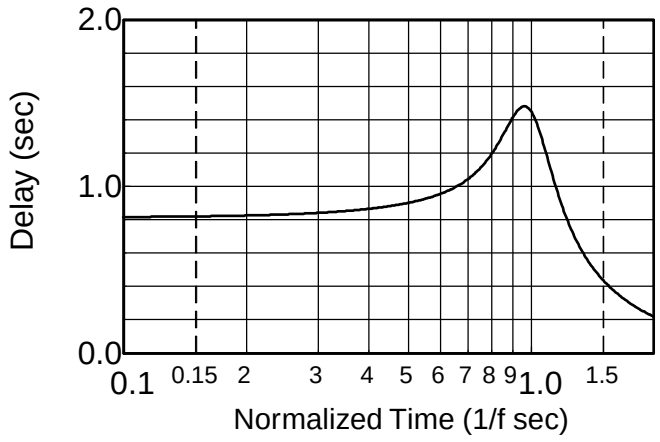
1.**Normalized Group Delay:**
The above delay data is normalized to a corner frequency of 1.0Hz.The actual delay is the normalized delay divided by the actual corner frequency (fc).

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

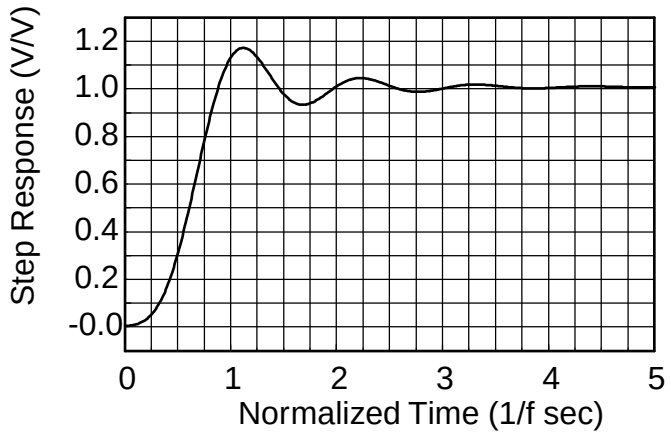
Frequency Response



Delay (Normalized)



Step Response



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