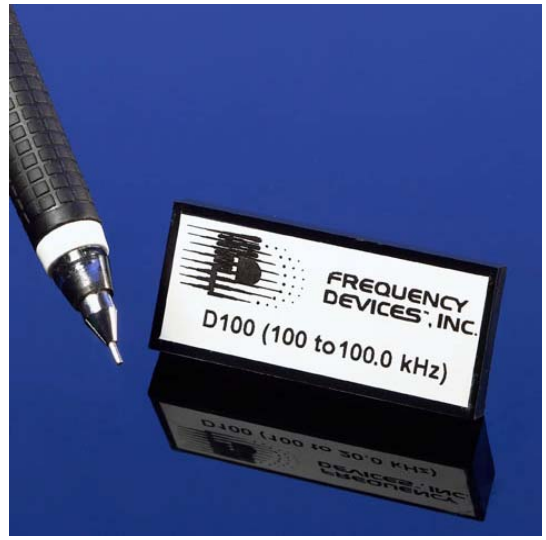
D100L Series

100 Hz to 100 kHz
Low Noise Fixed Frequency

4- and 8- Pole
Low-Pass Filters

Description:
D100L Series filters are low noise and distortion 4- and 8-pole, Butterworth or Bessel fixed frequency low-pass filters. These filters feature near theoretical low noise and distortion performance, by providing up to -120 dB noise floors (20-Bit). D100L's take advantage of FDI's design expertise utilizing high performance amplifiers and surface-mount technology to provide design engineers with precision signal conditioning solutions in a compact package. These fully self-contained units require no external components or adjustments. Each D100L comes factory tuned to a user specified corner frequency between 100 Hz to 100 kHz and operate with low harmonic distortion over an input voltage range to ±10 V.



Features/Benefits:

- Small 32-pin DIP (1.8"L x 0.8"W) footprint 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 corner frequencies to meet a wide range of applications.

Applications

- Transducer output filtering:
- Production test instrumentation
- Medical electronics equipment and research
- Noise and harmonic analysis
- Frequency spectrum analysis

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100 Hz to 100 kHz
Low Noise Fixed Frequency

4- and 8- Pole
Low-Pass Filters

	D100L4B	D100L4L	D100L8B	D100L8L
Product Specifications				
Transfer Function	4-Pole Butterworth	4-Pole Bessel	8-Pole Butterworth	8-Pole Bessel
Size	1.8” x 0.8” x 0.3”	1.8” x 0.8” x 0.3”	1.8” x 0.8” x 0.3”	1.8” x 0.8” x 0.3”
Range f_c	100 Hz to 100 kHz	100 Hz to 100 kHz	100 Hz to 100 kHz	100 Hz to 100 kHz
Theoretical Transfer Characteristics	Appendix A Page 7	Appendix A Page 2	Appendix A Page 9	Appendix A Page 4
Passband Ripple (theoretical)	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DC Voltage Gain (non-inverting)	0 ± 0.2 dB typ. 0 ± 0.4 dB max.	0 ± 0.2 dB typ. 0 ± 0.4 dB max.	0 ± 0.2 dB typ. 0 ± 0.4 dB max.	0 ± 0.2 dB typ. 0 ± 0.4 dB max.
Stopband Attenuation Rate	24 dB/octave	24 dB/octave	48 dB/octave	48 dB/octave
Cutoff Frequency	f_c ± 1% max.	f_c ± 1% max.	f_c ± 1% max.	f_c ± 1% max.
Stability	± 0.01%/°C	± 0.01%/°C	± 0.01%/°C	± 0.01%/°C
Amplitude	-3 dB	-3 dB	-3 dB	-3 dB
Phase	-180°	-121°	-360°	-182°
Filter Attenuation (theoretical)	0.67 dB 0.80 f_c 3.01 dB 1.00 f_c 30.0 dB 2.37 f_c 40.0 dB 3.16 f_c	1.86 dB 0.80 f_c 3.01 dB 1.00 f_c 30.0 dB 3.50 f_c 40.0 dB 4.72 f_c	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	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[1]	0 – f_c ± 2.0° max ± 1.0° typ	0 – f_c ± 2.0° max ± 1.0° typ	0 – f_c ± 2.0° max ± 1.0° typ	0 – f_c ± 2.0° max ± 1.0° typ
Amplitude Accuracy (theoretical)	0 – f_c ±0.2 dB max ±0.1 dB typ	0 – f_c ±0.2 dB max ±0.1 dB typ	0 – f_c ±0.2 dB max ±0.1 dB typ	0 – f_c ±0.2 dB max ±0.1 dB typ
(THD) Total Harmonic Distortion @ 10 Vp-p				
$F_C \leq$1.0 kHz	<-120 dB max.	<-120 dB max.	<-120 dB max.	<-120 dB max.
$F_C \leq$20 kHz	<-120 dB max.	<-120 dB max.	<-120 dB max.	<-120 dB max.
$F_C \leq$100 kHz	<-110 dB max.	<-110 dB max.	<-105 dB max.	<-105 dB max.
Narrow Band Noise 100 kHz BW @ 20V p-p	**(µV rms)**	**(µV rms)**	**(µV rms)**	**(µV rms)**
$F_C \leq$1.0 kHz	7.0 typ., 12 max.	7.0 typ., 12 max.	12 typ., 22 max.	12 typ., 22 max.
$F_C \leq$20 kHz	7.0 typ., 12 max.	7.0 typ., 12 max.	12 typ., 22 max.	12 typ., 22 max.
$F_C \leq$100 kHz	22 typ., 40 max.	22 typ., 40 max.	40 typ., 70 max.	40 typ., 70 max.
Filter Mounting Assembly[2]	FMA-01S	FMA-01S	FMA-01S	FMA-01S

1. Unit to unit match for the same transfer function, set to the same frequency and operating configuration, and from the same manufacturing lot.
2. Use I/O jumpers to bypass input and output buffers, for low noise operation. With FMA, D100 distortion specs at 50k to 100kHz may degrade slightly.

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Specifications
(25ºC and Vs ± 15 Vdc)

Pin-Out and Package Data
Ordering Information

Analog Input Characteristics[1]

Impedance	1.0 kΩ min.
Voltage Range	±10 V_{peak}
Max. Safe Voltage	± Vs

Analog Output Characteristics

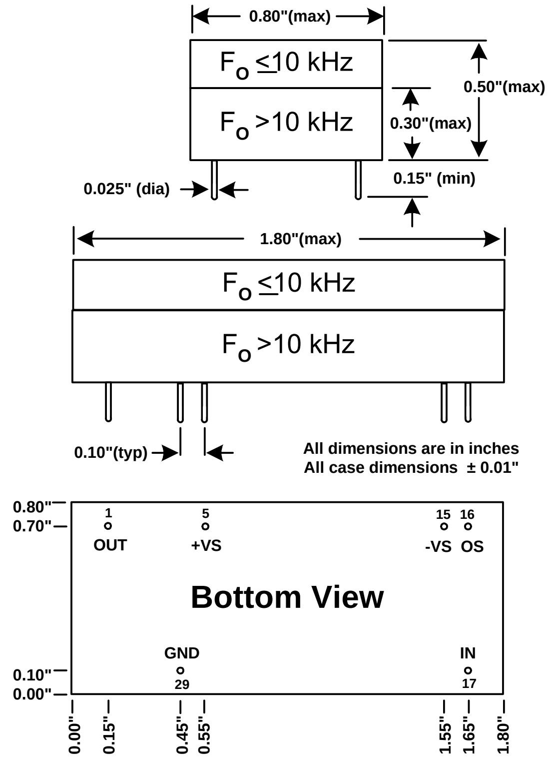
Load impedance	1k Ω min.
Linear Operating Range for THD	± 5V
Operating Range for low Noise	± 10V
Current[2] @ (Vs @ ±15V)	10 mA max.
Offset Voltage[3]	2 mV typ. 20 mV max.
Offset Temp. Coefficient	50 µV/ºC.

Power Supply (±V_S)

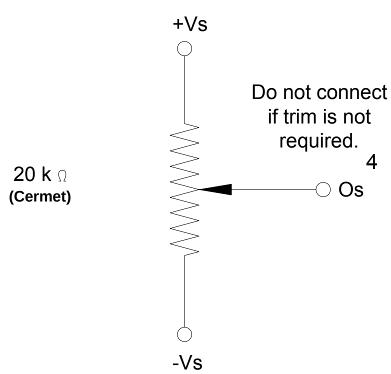
Rated Voltage	±15V
Operating Range	±5V min. ±18V max.
Quiescent Current D100L4	40 mA max.
D100L8	80 mA max.

Temperature Range

Operating	0ºC to +70ºC
Storage	-25ºC to +85ºC



DC Offset Adjustment



ORDERING INFORMATION

D100L4B-10.0 kHz

Filter type
L = Low Pass

Transfer Function
B= Butterworth
L = Bessel

 # Poles
4 or 8

- 3 dB Corner Frequency [5]
e.g., 849 Hz
2.50 kHz
33.3 kHz

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.
5. How to specify Corner Frequency. Corner frequency is specified by attaching a three-digit frequency designator to the basic model number. Corner frequencies can range from 100 Hz to 100 kHz.

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Low-Pass

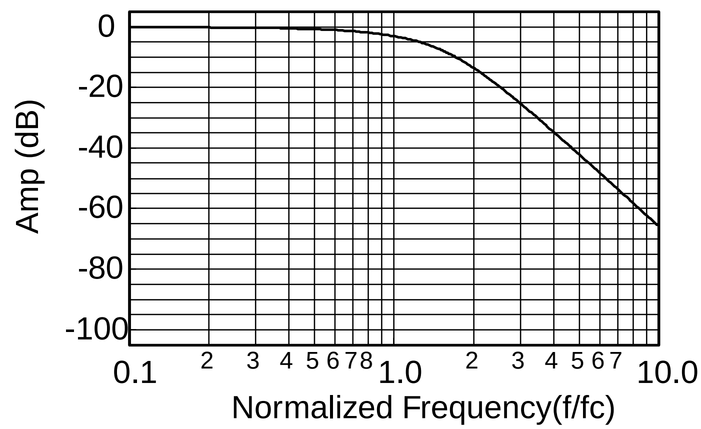
4-Pole

Bessel

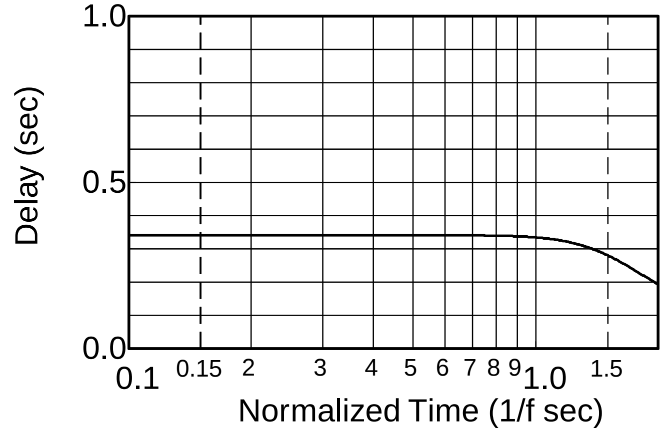
Theoretical Transfer Characteristics

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

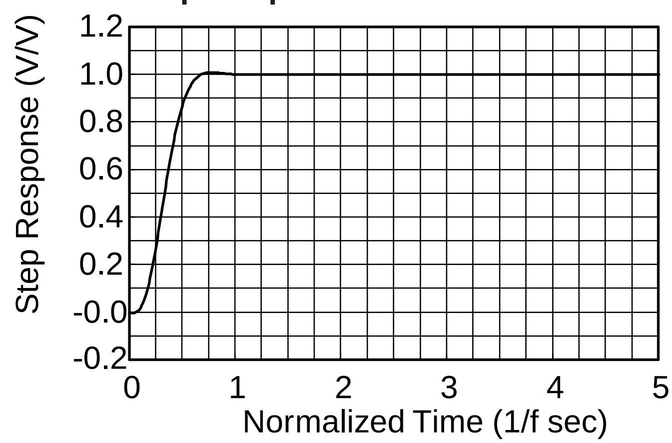
Frequency Response



Delay (Normalized)



Step Response



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).

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

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FREQUENCY DEVICES™, INC.

8-Pole

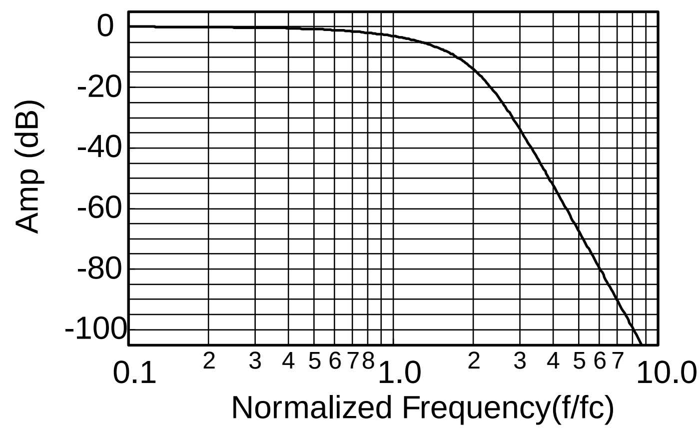
Bessel

Low-Pass

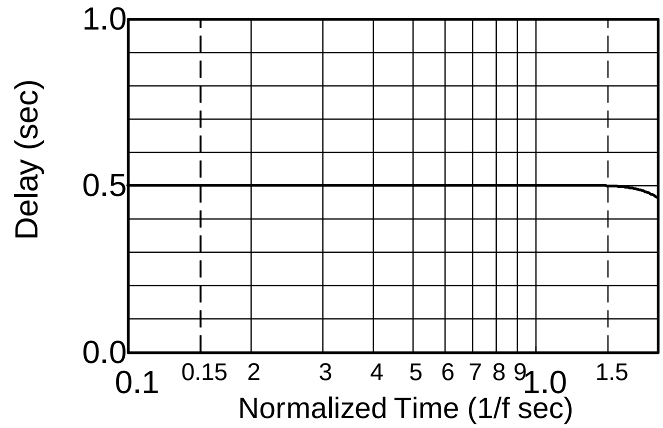
Theoretical Transfer Characteristics

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

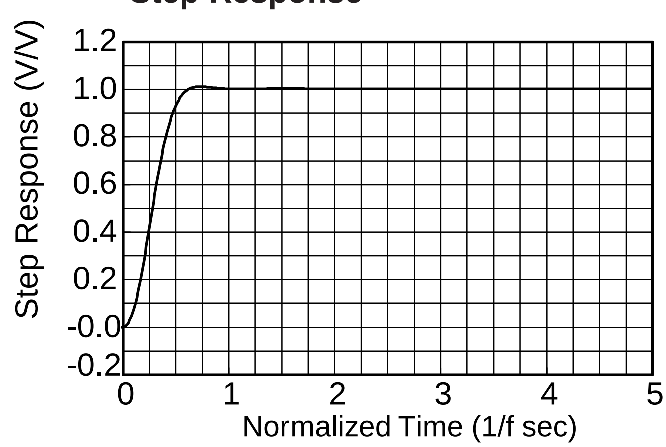
Frequency Response



Delay (Normalized)



Step Response



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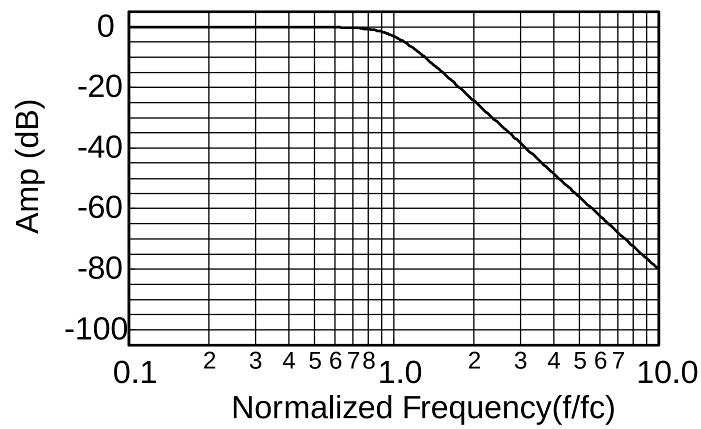
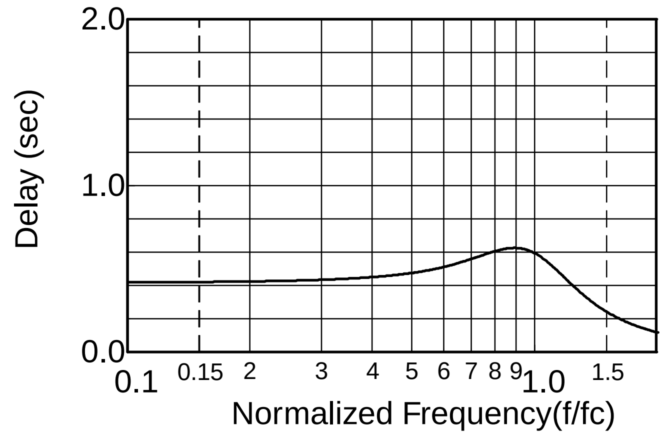
Theoretical Transfer Characteristics

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

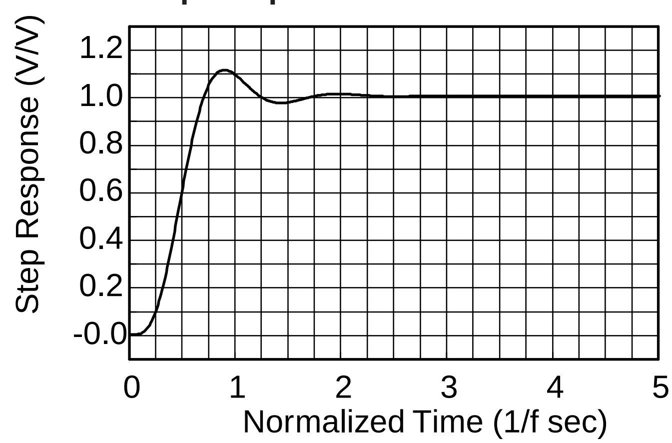
Frequency Response



Delay (Normalized)



Step Response



1. **Normalized Group Delay:**
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$$\text{Actual Delay} = \frac{\text{Normalized Delay}}{\text{Actual Corner Frequency (fc) in Hz}}$$

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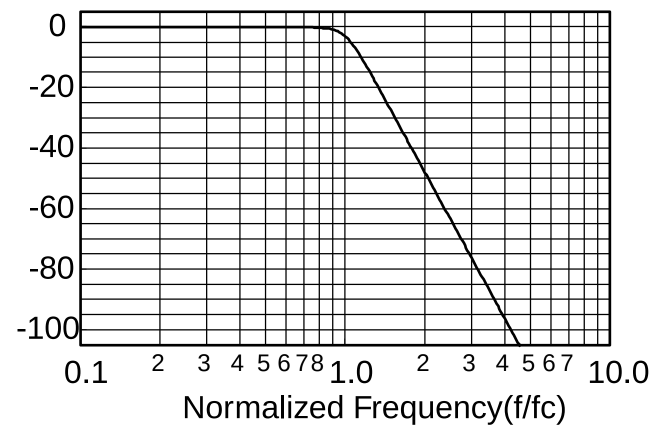
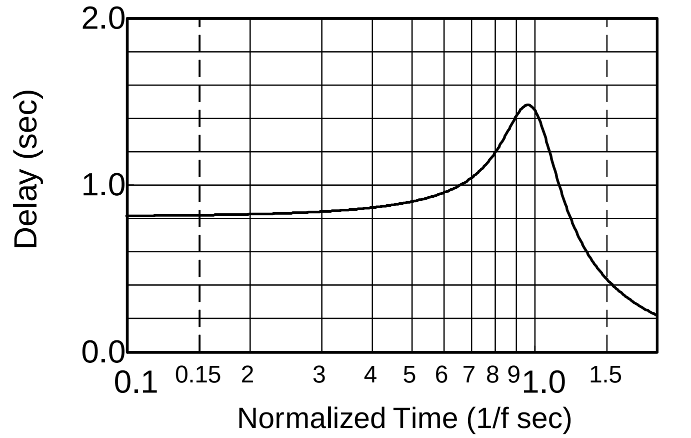
Theoretical Transfer Characteristics

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

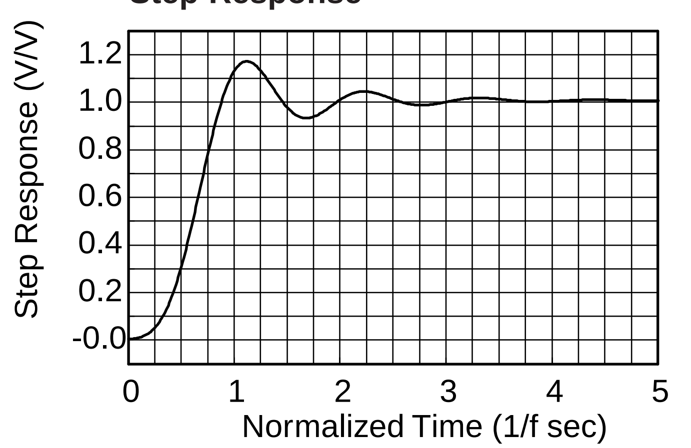
Frequency Response



Delay (Normalized)



Step Response



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