



FEATURES

- Low (94 dB typ) Distortion Floor
- Wide (100 dB typ) Dynamic Range
- Suitable for 15-Bit A/Ds
- Versatile Choice of Most Widely Used Transfer Characteristics
- Plug-in Ready-to-use Fully Finished Filter Component

APPLICATIONS

- Anti-Aliasing Prefiltering
- Data Acquisition Systems
- Industrial Process Control
- Automatic Test Equipment
- Production Test Systems
- Real and Compressed Time Data Analysis
- Signal Conditioning

General Description

The 680 Series are fixed-frequency precision active filters that are available with the following transfer functions:

Low-Pass...

- 8-pole Butterworth
- 8-pole Bessel
- 8-pole 6-zero Constant Delay
- 8-pole 6-zero Elliptic

High-Pass...

- 8-pole Butterworth
- 8-pole 6-zero Elliptic

A new internal configuration enables these filters to operate with low THD distortion over a wide dynamic input

voltage range. This ideally suits them for 15-bit ADCs.

Each model is factory-tuned to a user-specified corner frequency between 100 Hz and 51.2 kHz. These fully finished filters require no external components or adjustments and operate from non-critical ± 5 V to ± 18 V power supplies.

A 20 k Ω input impedance and a 10 Ω output impedance make these compact (2.0" x 3.0" L x 0.4"H) encapsulated modules convenient to use. The Low-Pass models include a terminal for offset trimming if required.

Frequency	25	Haverhill,	(508) 374-0761
Devices	Locust	Massachusetts	TWX 710-347-0314
Incorporated	Street	01830	FAX (508) 521-1839



Stability $\pm 0.01\%/^{\circ}\text{C}$

Analog Input Characteristics¹

Impedance 20 k Ω
 Voltage Range $\pm 10\text{ V}$
 Maximum Safe Voltage $\pm V_s$

Analog Output Characteristics¹

Resistance 10 Ω max.
 Linear Operating Range $\pm 10\text{ V}$
 Maximum Current² $\pm 2\text{ mA}$
 Offset Voltage³ 2 mV typ, 20 mV max

Power Supply

Rated Voltage $\pm 15\text{ Vdc}$
 Operating Range $\pm 5\text{ Vdc to } \pm 18\text{ Vdc}$
 Maximum Safe Voltage $\pm 18\text{ Vdc}$
 Quiescent Current 28 mA typ, 40 mA max

Temperature

Operating 0 $^{\circ}\text{C}$ to +70 $^{\circ}\text{C}$
 Storage -25 $^{\circ}\text{C}$ to +85 $^{\circ}\text{C}$

Deviation from Theoretical Responses

Characteristic Response	At dc for Low-Pass	At f_c , the -3dB	At f_{80dB} , Freq.
	At 100 kHz for High-Pass	Corner Freq.	for -80dB Gain
	-A-	-B-	-C-
Low-Pass	$\pm 0.2\text{ dB}$	$\pm 0.5\text{ dB}$	$\pm 2\text{ dB}$
High-Pass	$\pm 0.5\text{ dB}$	$\pm 0.5\text{ dB}$	$\pm 2\text{ dB}$

The above table defines Low-Pass responses having a dc (100 kHz for High-Pass) gain of 0 dB $\pm A$ (the value in column A), a gain of -3 dB $\pm B$ at corner frequency f_c , or at the 0.01 dB ripple frequency f_r of the elliptic models and a gain of -80 dB $\pm C$ at $f_{80\text{ dB}}$.

In general, filters at frequencies below 20 kHz fall well within the above deviation boundaries. These error bounds on the filter transfer characteristics are approached only as the frequency reaches 20 kHz and above.

NOTES:

1. Input and output signal voltages are referenced to supply common.
2. Output is short-circuit protected to common. DO NOT CONNECT TO $\pm V_s$
3. Adjustable to zero by external potentiometer.

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Corner Frequency

-3 dB	± 2 %
Pass-Band (fc) ¹	100 Hz to 51.2 kHz

Pass-Band Ripple (theoretical)

Butterworth	0.0 dB
Bessel	0.0 dB
Constant Delay	0.15 dB
Elliptic	0.035 dB

Typical Noise (Butterworth, Bessel, Linear Phase)

Narrow Band	50 μ V _{rms} (5 Hz to 50 kHz)
WideBand	200 μ V _{rms} (5 Hz to 2 MHz)

Typical Noise (Elliptic)

Narrow Band	75 μ V _{rms} (5 Hz to 50 kHz)
WideBand	250 μ V _{rms} (5 Hz to 2 MHz)

Phase Match (all models)²

@ f _c (f _r)	± 1.0° typ, ± 2.0° max
Pass-band	± 0.5° typ, ± 1.0° max

Gain Match (all models)²

@ f _c (f _r)	± 0.1 dB typ, ± 0.2 dB max
Pass-band	± 0.05 dB typ, ± 0.1 dB max

Distortion³ (For f_c < 20 kHz all Low-Pass Models)

Typical	0.002 % (-94 dB)
Maximum	0.004 % (-88 dB)

Distortion³ (For f_c > 20 kHz all Low-Pass Models)

Typical	0.004 % (-88 dB)
Maximum	0.025 % (-72 dB)

NOTES:

- The user may specify any frequency in the range shown to three digits of accuracy.*
- Unit to unit match for the same transfer function set to the same frequency.*
- For input signals ≤ 3 V_{rms} the total harmonic distortion is ≤ 0.01 % (-80 dB) for all frequencies.*

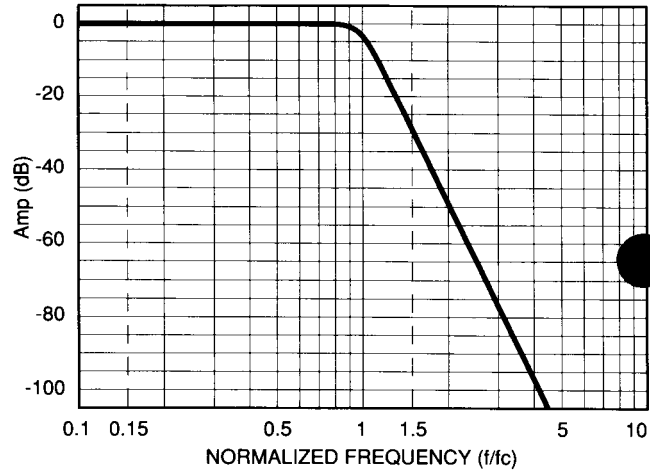
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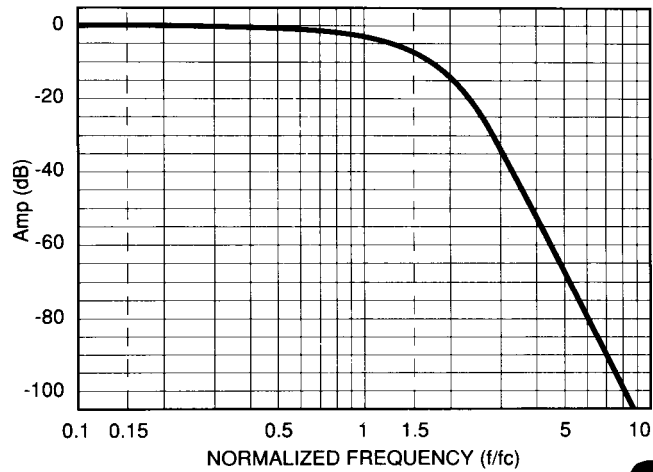
**FREQUENCY
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8-Pole Low-Pass Theoretical Frequency Response Curves

**Butterworth
680LP-BU8**



**Bessel
680LP-BE8**



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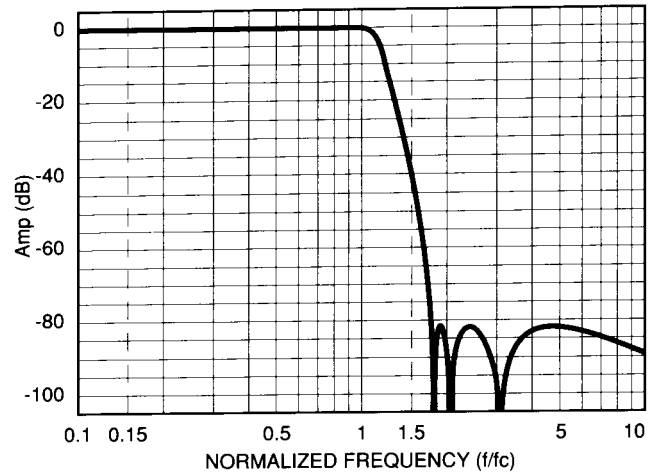
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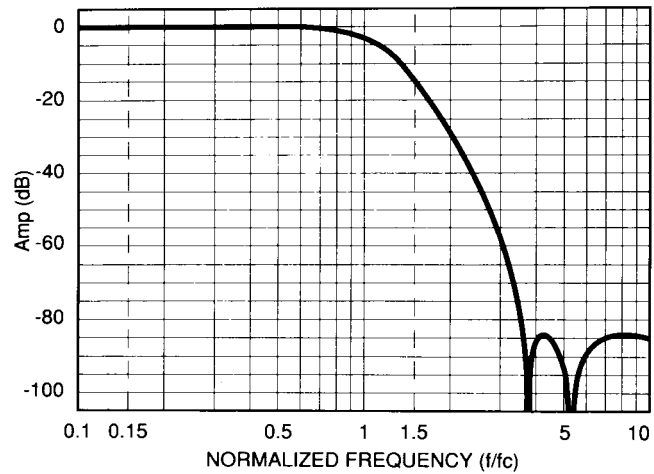
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**8-Pole Low-Pass
Theoretical
Frequency Response
Curves**

**Elliptic
680LP-CE8-6**



**Constant Delay
680LP-CD8-6**



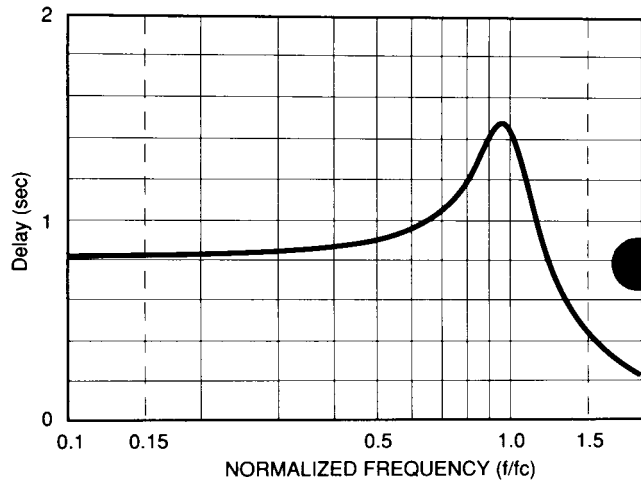
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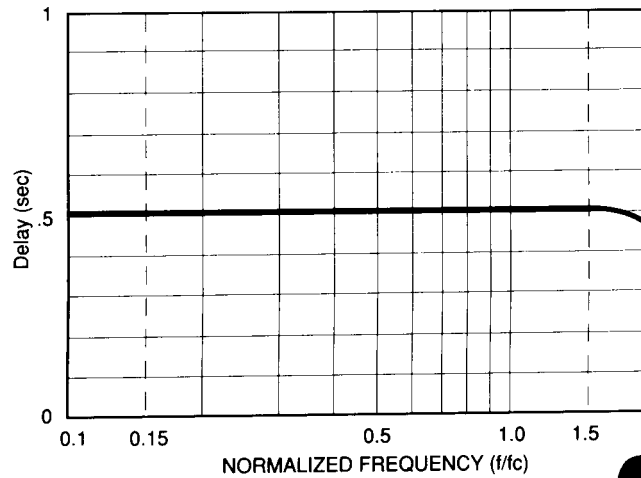
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**8 Pole Low-Pass
Theoretical
Delay
Curves**

**Butterworth
680LP-BU8**



**Bessel
680LP-BE8**



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Frequency
Devices
Manufactured

25
Locust
Street

Haverhill,
Massachusetts
01820

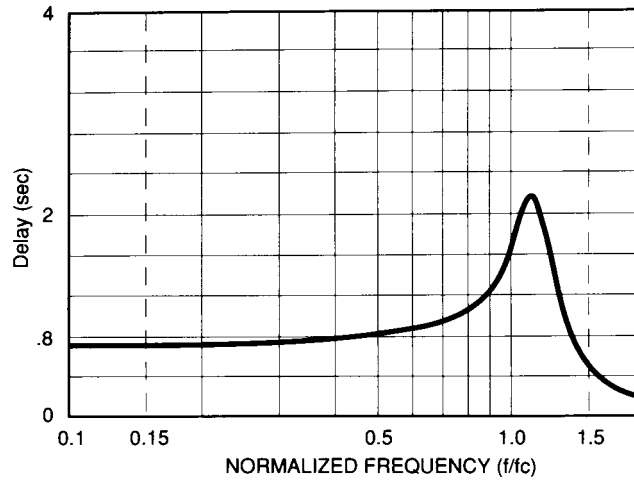
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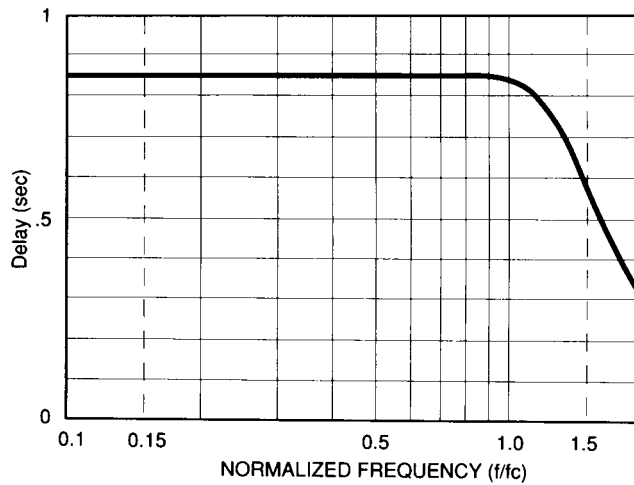
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**8 Pole Low-Pass
Theoretical
Delay
Curves**

**Elliptic
680LP-CE8-6**



**Constant Delay
680LP-CD8-6**



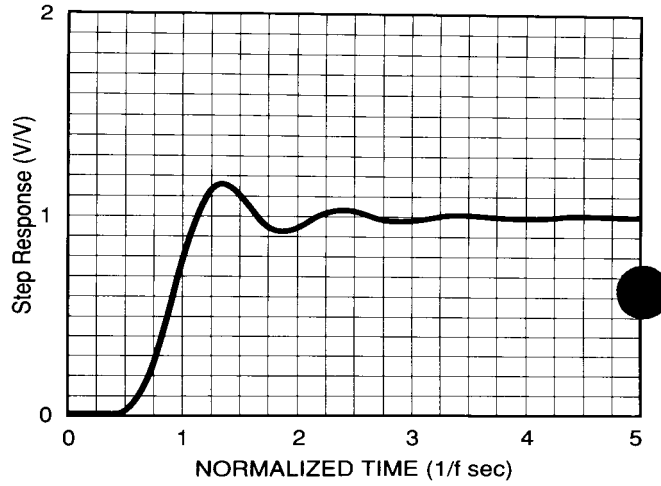
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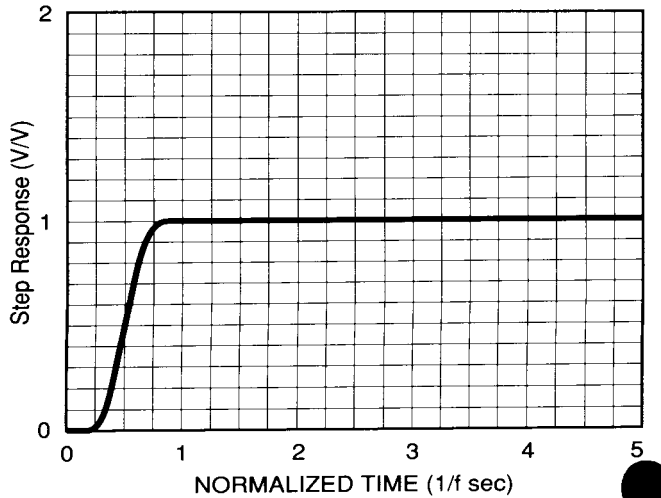
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8-Pole Low-Pass Theoretical Step Response Curves

**Butterworth
680LP-BU8**



**Bessel
680LP-BE8**

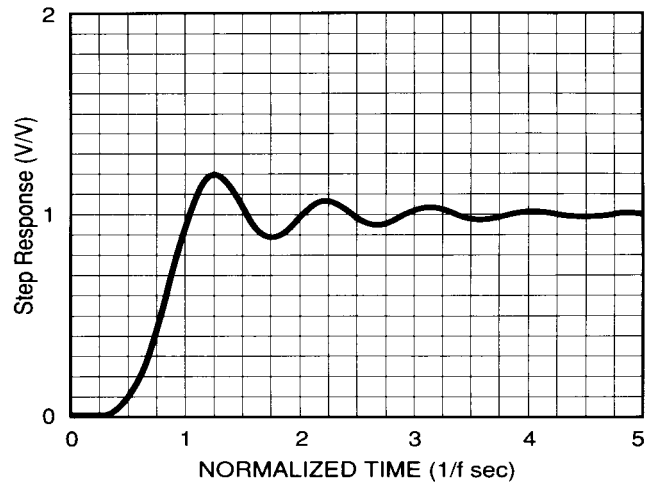




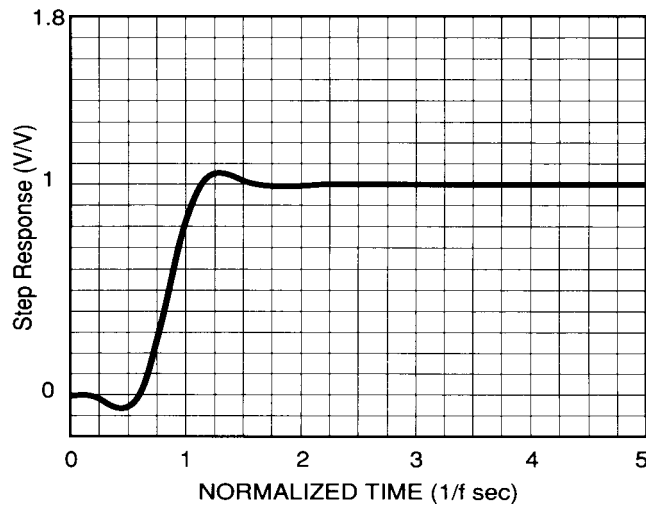
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**8-Pole Low-Pass
Theoretical
Step Response
Curves**

**Elliptic
680LP-CE8-6**



**Constant Delay
680LP-CD8-6**



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**FREQUENCY
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**680LP-BU8 Butterworth
(8-Pole) Low-Pass
Theoretical Response
Data**

f/fc	Amp (dB)	Phase (deg)	Delay (sec)
0.00	0.0	0.0	0.816
0.10	0.0	-29.4	0.819
0.20	0.0	-59.0	0.828
0.30	0.0	-89.1	0.843
0.40	0.0	-119.8	0.867
0.50	0.0	-151.7	0.903
0.60	0.0	-185.0	0.956
0.70	0.0	-220.9	1.042
0.80	-0.1	-260.8	1.190
0.90	-0.7	-307.4	1.404
1.00	-3.0	-360.0	1.456
1.20	-12.9	-444.5	0.873
1.50	-28.2	-511.4	0.448
2.00	-48.2	-568.3	0.226
2.50	-63.7	-600.2	0.139
3.00	-76.3	-620.8	0.094
4.00	-96.3	-646.0	0.052
5.00	-111.8	-661.0	0.033
6.00	-124.5	-670.9	0.023
7.00	-135.2	-677.9	0.017
8.00	-144.5	-683.2	0.013
9.00	-152.7	-687.3	0.010
10.0	-160.0	-690.6	0.008

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**680LP-BE8 Bessel
(8-Pole) Low-Pass
Theoretical Response
Data**

f/fc	Amp (dB)	Phase (deg)	Delay (sec)
0.00	0.0	0.0	0.506
0.10	0.0	-18.2	0.506
0.20	-0.1	-36.4	0.506
0.30	-0.3	-54.7	0.506
0.40	-0.5	-72.9	0.506
0.50	-0.7	-91.1	0.506
0.60	-1.1	-109.3	0.506
0.70	-1.5	-127.5	0.506
0.80	-1.9	-145.7	0.506
0.90	-2.4	-164.0	0.506
1.00	-3.0	-182.2	0.506
1.20	-4.4	-218.6	0.506
1.50	-7.0	-273.2	0.504
2.00	-13.7	-361.9	0.468
2.50	-23.1	-436.4	0.352
3.00	-33.4	-489.2	0.241
4.00	-51.8	-551.8	0.126
5.00	-66.8	-587.3	0.077
6.00	-79.2	-610.2	0.052
7.00	-89.8	-626.3	0.038
8.00	-99.0	-638.2	0.029
9.00	-107.1	-647.4	0.023
10.0	-114.4	-654.8	0.018

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**680LP-CE8-6 Elliptic
(8-Pole) Low-Pass
Theoretical Response
Data**

f/fc	Amp (dB)	Phase (deg)	Delay (sec)
0.00	0.0	0.0	0.713
0.10	0.0	-25.7	0.716
0.20	0.0	-51.6	0.724
0.30	0.0	-77.9	0.740
0.40	0.0	-105.0	0.767
0.50	0.0	-133.4	0.811
0.60	0.0	-163.6	0.872
0.70	0.0	-196.3	0.946
0.80	0.0	-232.0	1.043
0.90	0.0	-272.5	1.232
1.00	0.0	-323.5	1.645
1.20	-8.3	-467.2	1.859
1.40	-29.3	-555.8	0.753
1.60	-51.5	-594.2	0.381
1.70	-65.2	-606.3	0.296
1.80	-113.2	-615.8	0.239
1.85	-83.6	-439.9	0.217
1.90	-82.0	-443.7	0.198
1.95	-83.7	-447.1	0.182
2.00	-87.8	-450.2	0.168
2.20	-85.8	-280.7	0.126
3.00	-99.9	-305.0	0.057
3.50	-87.2	-133.5	0.040
4.00	-83.1	-139.7	0.030
5.00	-82.1	-148.1	0.018
6.00	-83.1	-153.6	0.013
7.00	-84.6	-157.4	0.009
8.00	-86.2	-160.3	0.007
9.00	-87.8	-162.5	0.005
10.0	-89.3	-164.3	0.004



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**680LP-CD8-6 Constant
Delay (8-Pole) Low-Pass
Theoretical Response
Data**

f/fc	Amp (dB)	Phase (deg)	Delay (sec)
0.00	0.0	0.0	0.852
0.10	0.0	-30.7	0.852
0.20	0.1	-61.4	0.852
0.30	0.1	-92.0	0.852
0.40	0.1	-122.7	0.852
0.50	0.0	-153.4	0.852
0.60	-0.2	-184.1	0.852
0.70	-0.5	-214.7	0.852
0.80	-1.1	-245.4	0.851
0.90	-1.9	-276.0	0.849
1.00	-3.0	-306.4	0.841
1.20	-6.4	-365.3	0.783
1.50	-14.1	-439.7	0.582
2.00	-29.1	-517.1	0.312
2.50	-43.4	-560.8	0.189
3.00	-57.6	-588.7	0.127
4.00	-86.3	-442.5	0.069
5.00	-92.8	-462.3	0.044
6.00	-89.9	-295.4	0.030
7.00	-85.1	-304.7	0.022
8.00	-84.1	-311.7	0.017
9.00	-84.3	-317.1	0.013
10.0	-84.9	-321.4	0.011

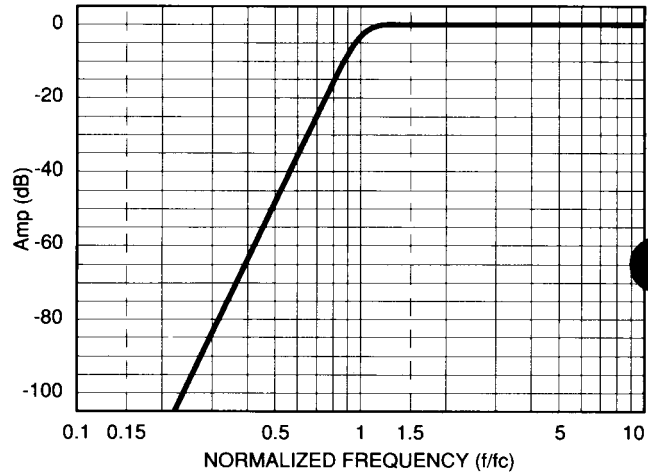
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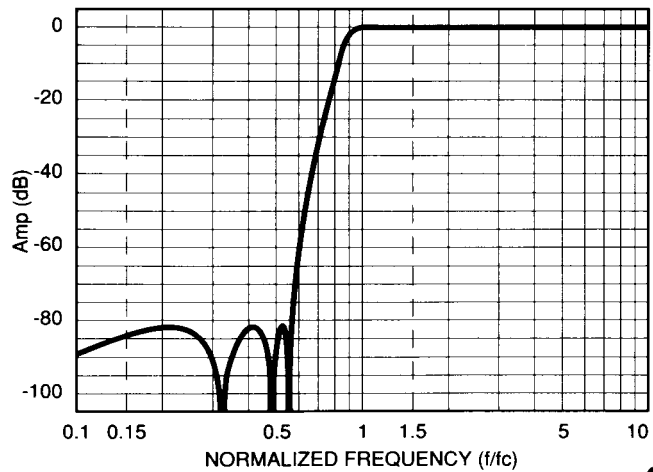
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8-Pole High-Pass Theoretical Frequency Response Curves

**Butterworth
680HP-BU8**



**Elliptic
680HP-CE8-6**





Normalized Theoretical Data Tables

f/fc	Butterworth 680HP-BU8			Elliptic 680HP-CE8-6		
	Amp (dB)	Phase (deg)	Delay (sec)	Amp (dB)	Phase (deg)	Delay (sec)
0.10	-160.0	690.6	0.819	-89.3	164.3	0.440
0.20	-111.8	661.0	0.828	-82.1	148.1	0.459
0.30	-83.7	630.9	0.843	-90.6	131.0	0.495
0.40	-63.7	600.2	0.867	-82.4	292.2	0.559
0.50	-48.5	568.3	0.903	-87.8	450.2	0.671
0.55	-41.5	551.9	0.927	-90.0	437.4	0.761
0.60	-35.5	535.0	0.956	-60.2	602.6	0.890
0.70	-24.8	499.1	1.042	-32.4	563.1	1.370
0.80	-15.6	459.2	1.190	-13.1	497.5	2.353
0.90	-8.1	412.6	1.404	-2.2	401.0	2.663
1.00	-3.0	360.0	1.456	0.0	323.5	1.645
1.20	-0.2	275.5	0.874	0.0	244.8	0.757
1.50	0.0	208.6	0.448	0.0	185.1	0.409
2.00	0.0	151.7	0.226	0.0	133.4	0.203
2.50	0.0	119.8	0.139	0.0	105.0	0.123
3.00	0.0	99.2	0.094	0.0	86.9	0.083
4.00	0.0	74.0	0.052	0.0	64.7	0.046
5.00	0.0	59.0	0.033	0.0	51.6	0.029
6.00	0.0	49.1	0.023	0.0	42.9	0.020
7.00	0.0	42.1	0.017	0.0	36.8	0.015
8.00	0.0	36.8	0.013	0.0	32.1	0.011
9.00	0.0	32.7	0.010	0.0	28.6	0.009
10.0	0.0	29.4	0.008	0.0	25.7	0.007



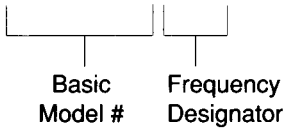
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**680 Series
Ordering Information
and
Package Data**

How to Specify Corner Frequencies

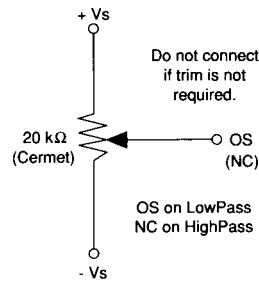
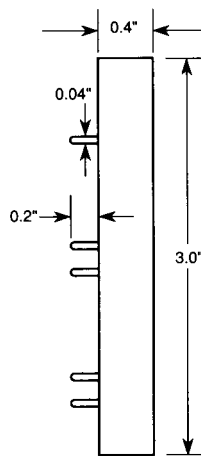
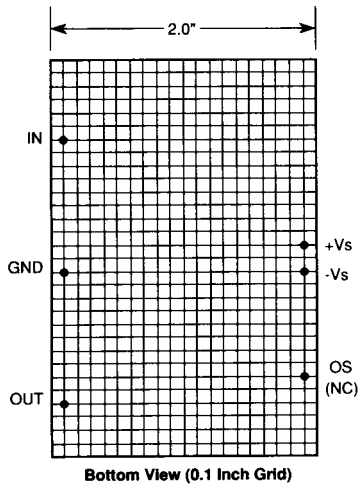
Corner frequencies are specified by attaching a three digit frequency designator to the basic model number. Corner frequency can range from 100 Hz to 51.2 kHz. Please refer to the following examples:

Model Number	Transfer Function	3 dB Corner Frequency
680LP-BU8-.849K	Low-Pass Butterworth	849 Hz
680LP-BE8-2.50K	Low-Pass Bessel	2.50 kHz
680LP-CD8-6-5.49K	Low-Pass Constant Delay	5.49 kHz
680LP-CE8-6-10.3K	Low-Pass Elliptic	10.3 kHz
680HP-BU8-20.0K	High-Pass Butterworth	20.0 kHz
680HP-CE8-6-33.3K	High-Pass Elliptic	33.3 kHz



Socket Available
Order Part Number S1017

Package Data



Offset Potentiometer (Optional)

Frequency Devices, Inc., 25 Locust Street, Haverhill, MA 01830. We hope the information given here will be helpful. The information is based on data and our best knowledge, and we considered the information to be true and accurate. Please read all statements, recommendations or suggestions herein in conjunction with our conditions of sale which apply to all goods supplied by us. We assume no responsibility for the use of these statements, recommendations or suggestions, nor do we intend them as a recommendation for any use which would infringe any patent or copyright.

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