

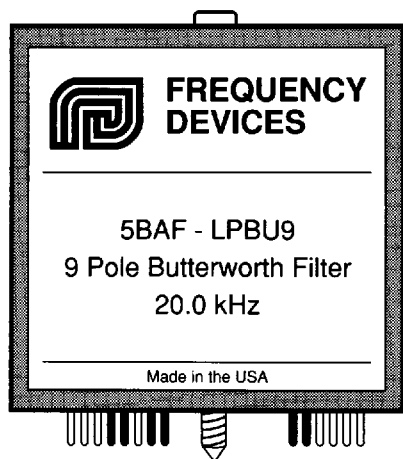


**FREQUENCY
DEVICES™**

5BAF Series T-64.05

FREQUENCY DEVICES INC

Differential
9-Pole
Low-Pass
Anti-Aliasing
Active
Filters





FREQUENCY DEVICES INC

FEATURES

- 5B Series Plug Compatible
- +5 V Power Supply Only
- Differential Input
- Standard Corner Frequencies –
1 kHz, 2 kHz, 5 kHz,
10 kHz, 20 kHz, 50 kHz
- Custom Corner Frequencies –
To Customer Specification

APPLICATIONS

- Prefiltering for Anti-Aliasing
- Data Acquisition Systems
- Industrial Process Control
- Signal Conditioning
- Automatic Test Equipment
- Geophysical Exploration
- Oceanographic Research

General Description

The 5BAF Series are differential-input 9-pole Butterworth and Bessel low-pass anti-aliasing filters that are pin-out and package compatible with industry-standard 5B Series signal conditioning modules and mechanical equivalents. An ultimate roll-off rate of 54 dB per octave ideally suits these filters for sharply limiting A/D converter bandwidth to eliminate aliasing higher frequency input signals and noise.

A self-contained dc-to-dc converter enables all models to operate from a non-critical +5 V $\pm 10\%$ system bus instead of the usual ± 15 V dual power supplies. As an added advantage, these modules allow partitioning between system segments and provide a means for minimizing ground loops.

The Butterworth models exhibit the maximally flat pass-band and monotonic roll-off of the classical Butterworth function. The Bessel models exhibit the overshoot-free transient response, linear phase characteristics, and monotonic roll-off of the classical Bessel function.

To serve real-world applications, all 5BAF Series filters are configured with a differential input having a common mode rejection ratio of 74 dB (min) at 1 kHz and a common mode input impedance of 20 k Ω (typ).

Both models are available with factory-set standard -3 dB corner frequencies of 1 kHz, 2 kHz, 5 kHz, 10 kHz, 20 kHz, and 50 kHz. Custom corner frequencies are optionally available. (See Ordering Information).



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Analog Input Characteristics¹

Voltage Range	$\pm 10\text{ V}$
Differential Gain	$1 \pm 0.03\%$
Common Mode Voltage Range	$\pm 20\text{ V}$
Common Mode Rejection	74 dB min at 1 kHz
Maximum Safe Voltage	$\pm 40\text{ V}$ (Power ON or OFF)
Impedance	$20\text{ k}\Omega \pm 10\%$

Analog Output Characteristics^{1,2}

Offset Voltage	$\pm 3\text{ mV}$
Offset Drift	$\pm 100\text{ }\mu\text{V}/^\circ\text{C}$
Gain Drift	$\pm 30\text{ ppm}/^\circ\text{C}$
Noise (DC to 50 kHz)	75 μV rms
Linear Operating Range	$\pm 10\text{ V}$ @ 2 mA
Resistance	1 Ω typ, 10 Ω max
Output Load	See note 4.

Filter Characteristics

Response Characteristics	9-Pole Low-pass Butterworth or Bessel
Frequency Tolerance	$\pm 2\%$
Corner Frequency (-3dB) ³	1.00 kHz, 2.00 kHz, 5.00 kHz, 10.0 kHz, 20.0 kHz, 50.0 kHz

Power Requirement

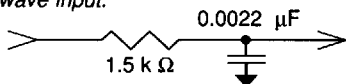
Power Supply	$+5\text{ V} \pm 0.5\text{ V}$ 110 mA typ, 125 mA max for 1 kHz to 20 kHz models 120 mA typ, 135 mA max for 50 kHz model
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Environmental

Operating Temperature	-25°C to $+85^\circ\text{C}$
Storage Temperature	-40°C to $+85^\circ\text{C}$
Altitude	10,000 Feet
Relative Humidity	0 % to 95 % @ 60°C (non-condensing)

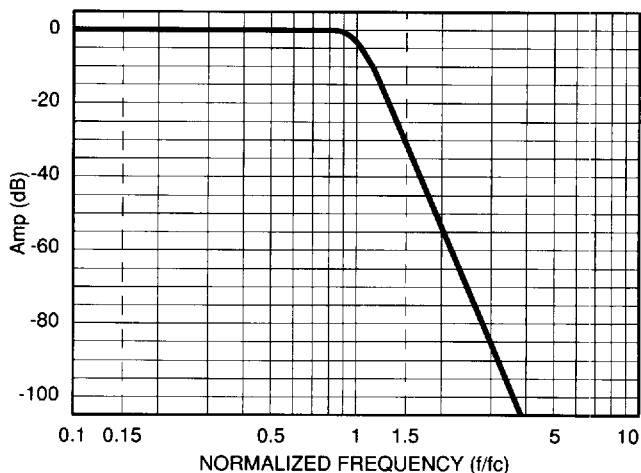
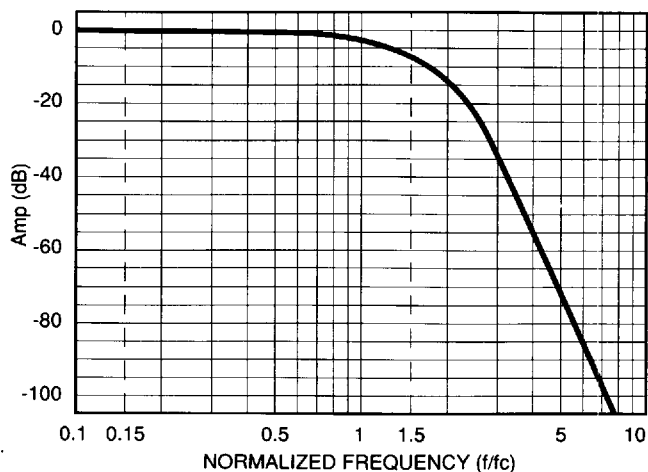
NOTES

- Input and output signal voltages are referenced to I/O COM.
- Output is short-circuit protected to I/O COM. DO NOT CONNECT TO +5V or POWER COM.
- User specified corner frequencies available from 1.00 kHz to 50.0 kHz
- Output can drive a series 1.5 k Ω resistor and 0.0022 μF capacitor without slew rate limiting with a $\pm 10\text{ V}$ square wave input.



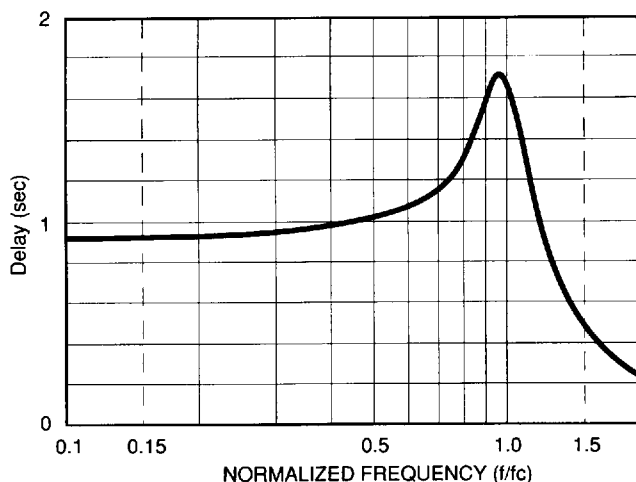
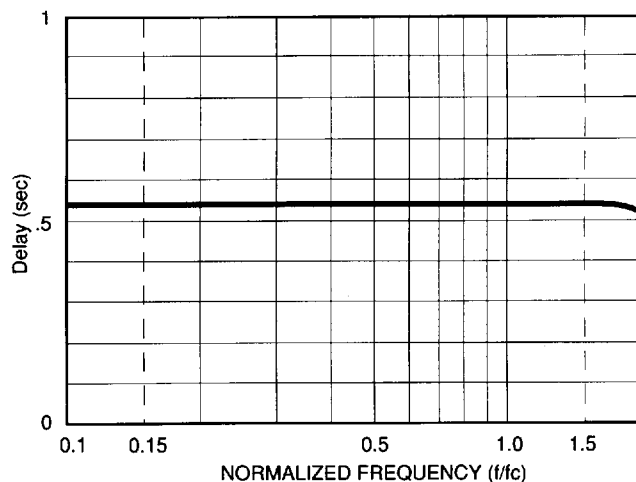

**FREQUENCY
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**9-Pole Low-Pass
Theoretical
Frequency Response
Curves**

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**Butterworth
5BAF-LPBU9**

**Bessel
5BAF-LPBE9**


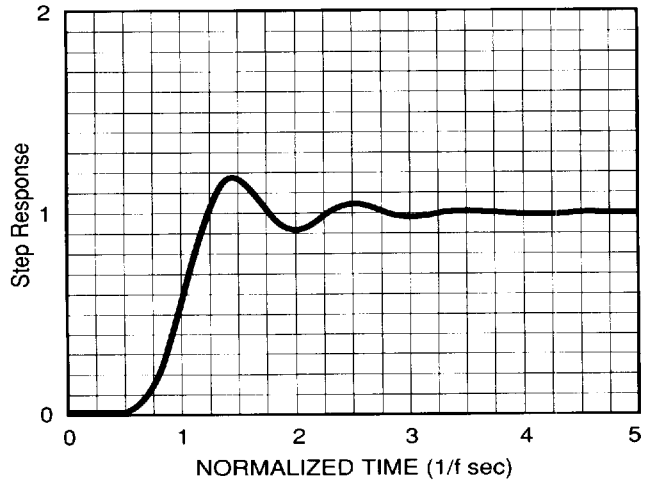
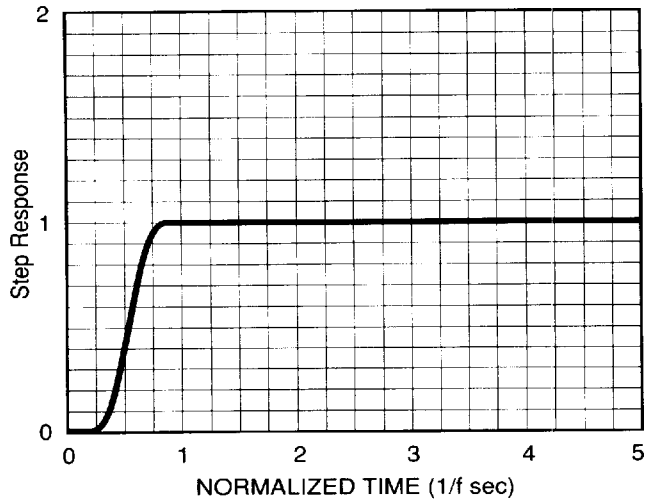

**FREQUENCY
DEVICES™**
**9 Pole Low-Pass
Theoretical
Delay
Curves**

FREQUENCY DEVICES INC

**Butterworth
5BAF-LPBU9**

**Bessel
5BAF-LPBE9**




FREQUENCY DEVICES INC

**Butterworth
5BAF-LPBU9****Bessel
5BAF-LPBE9**


**FREQUENCY
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FREQUENCY DEVICES INC
**5BAF-LPBU9 Butterworth
(9-Pole) Low-Pass
Theoretical Response
Data**

f/fc	Amp (dB)	Phase (deg)	Delay (sec)
0.00	0.0	0.0	0.916
0.10	0.0	-33.0	0.919
0.20	0.0	-66.3	0.929
0.30	0.0	-100.1	0.947
0.40	0.0	-134.6	0.974
0.50	0.0	-170.3	1.013
0.60	0.0	-207.7	1.071
0.70	0.0	-247.8	1.163
0.80	-0.1	-292.3	1.325
0.90	-0.6	-344.5	1.591
1.00	-3.0	-405.0	1.692
1.20	-14.4	-501.4	0.975
1.50	-31.7	-575.9	0.501
2.00	-54.2	-639.7	0.253
2.50	-71.6	-675.4	0.156
3.00	-85.9	-698.5	0.106
4.00	-108.4	-726.9	0.059
5.00	-125.8	-743.7	0.037
6.00	-140.1	-754.8	0.026
7.00	-152.1	-762.8	0.018
8.00	-162.6	-768.7	0.014
9.00	-171.8	-773.3	0.011
10.0	-180.0	-777.0	0.009


**FREQUENCY
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**5BAF-LPBE9 Bessel
(9-Pole) Low-Pass
Theoretical Response
Data**

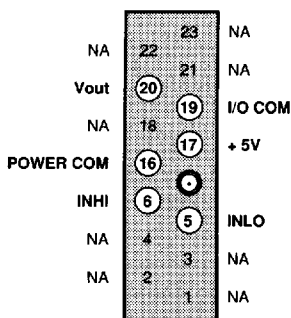
f/fc	Amp (dB)	Phase (deg)	Delay (sec)
0.00	0.0	0.0	0.540
0.10	0.0	-19.4	0.540
0.20	-0.1	-38.9	0.540
0.30	-0.3	-58.3	0.540
0.40	-0.5	-77.7	0.540
0.50	-0.7	-97.2	0.540
0.60	-1.1	-116.6	0.540
0.70	-1.5	-136.0	0.540
0.80	-1.9	-155.5	0.540
0.90	-2.4	-174.9	0.540
1.00	-3.0	-194.3	0.540
1.20	-4.4	-233.2	0.540
1.50	-7.0	-291.5	0.539
2.00	-13.4	-387.6	0.520
2.50	-22.8	-473.5	0.419
3.00	-34.0	-536.8	0.290
4.00	-54.5	-611.9	0.150
5.00	-71.3	-654.0	0.091
6.00	-85.3	-681.1	0.062
7.00	-97.2	-700.0	0.045
8.00	-107.6	-714.0	0.034
9.00	-116.7	-724.9	0.027
10.0	-124.9	-733.5	0.022


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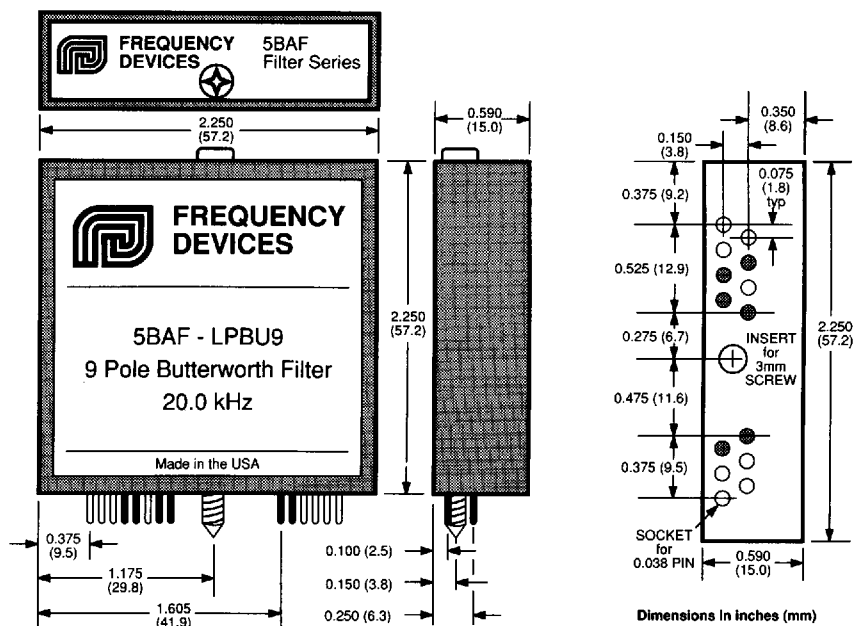
5BAF Series Pin Designation and Package Data

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Pin Designations


Bottom View

Package Data




**FREQUENCY
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**5BAF Series
Ordering
Information**

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Standard Models

Model Numbers		3 dB Corner Frequency
Butterworth	Bessel	
5BAF-LPBU9-1.00K	5BAF-LPBE9-1.00K	1.00 kHz
5BAF-LPBU9-2.00K	5BAF-LPBE9-2.00K	2.00 kHz
5BAF-LPBU9-5.00K	5BAF-LPBE9-5.00K	5.00 kHz
5BAF-LPBU9-10.0K	5BAF-LPBE9-10.0K	10.0 kHz
5BAF-LPBU9-20.0K	5BAF-LPBE9-20.0K	20.0 kHz
5BAF-LPBU9-50.0K	5BAF-LPBE9-50.0K	50.0 kHz

How to specify custom corner frequencies

Custom corner frequencies from 1.00 kHz to 50.0 kHz are specified by attaching a three digit frequency designator to the basic model number, which is 5BAF-LPBU9 for Butterworth filters and 5BAF-LPBE9 for Bessel filters. Please refer to the following examples:

<u>Model Number</u>	<u>Transfer Function</u>	<u>Corner Frequency</u>
5BAF-LPBU9-1.08K	Butterworth	1.08 kHz
5BAF-LPBU9-47.3K	Butterworth	47.3 kHz
5BAF-LPBE9-1.20K	Bessel	1.20 kHz
Basic Model # Frequency Designator		