5BAF Series

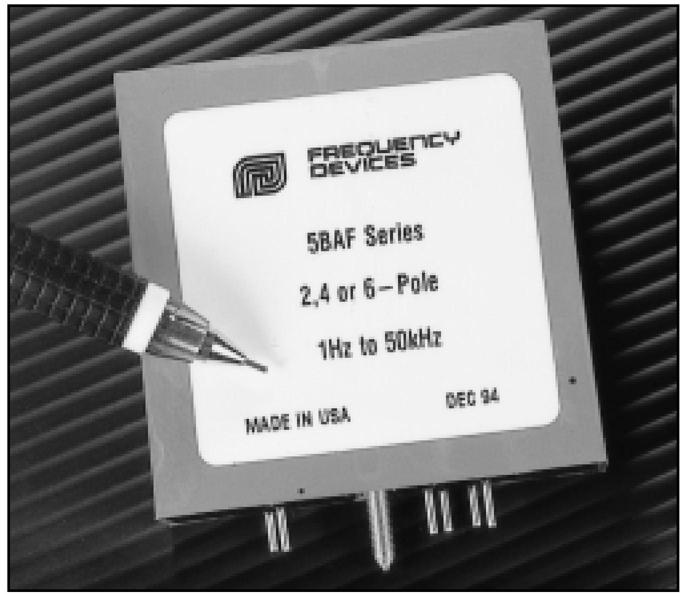
6-Pole

Differential Low-Pass Filters

Description

The 5BAF Series are differential-input 6-Pole Butterworth or Bessel low-pass anti-alias filters that are pin-out and package compatible with industry-standard 5B Series signal conditioning modules. Each filter comes factory tuned to a user-specified corner frequency from 1 Hz to 50 kHz. These filters are ideally suited to sharply limit A/D converter bandwidth to eliminate aliasing higher frequency input signals and noise.

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. A self contained dc-to-dc converter enables the 5BAF filters to operate from a non-critical +5 ±10% volt power source key in many systems since +5V logic power is readily available.



Features/Benefits:

- The 10 volt input range with an overall gain of 1 provides an excellent match to both the transducer output and the data acquisition board input
- 5BAF modules allow for partitioning between system segments providing a means to minimize ground loops
- Factory tuned, no external clocks or adjustments needed
- 5B plug-in compatible provides quick and easy installation
- Broad range of corner frequencies to meet a wide range of applications

Applications

- Anti-alias filtering
- Vibration analysis
- Industrial and process control
- Noise reduction
- Signal reduction
- Test systems

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Differential Low-Pass Filters

6-Pole

Model	5BAF-LPBE6	5BAF-LPBU6		
Product Specifications				
Transfer Function	6-Pole, Bessel	6-Pole, Butterworth		
Size	Std. 5B	Std. 5B		
Range f_c	1 Hz to 50 kHz	1 Hz to 50 kHz		
Theoretical Transfer Characteristics	Appendix A Page 3	Appendix A Page 8		
Impendance	1.0 MΩ min.	1.0 MΩ min.		
Differential Gain	1 ± 0.03%	1 ± 0.03%		
Com. Mode Voltage Range	±20 V	±20 V		
Com. Mode Rejection	74 dB min. @ 1 kHz	74 dB min. @ 1 kHz		
Voltage Range	± 10 V peak	± 10 V peak		
Maximum Safe Voltage (Power ON or OFF)	±40 V	±40 V		
Accuracy	±2% max.	±2% max.		
Stopband Attenuation Rate	36 dB/octave	36 dB/octave		
Filter Attenuation (theoretical)	1.89 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	0.29 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		
Narrow Band Noise	75 µVrms	75 µVrms		

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Pin-Out and Package Data Ordering Information

Specification

Analog Input Characteristics[1]
See transfer function specifications.

Analog Output Characteristics[1,2]

Impedance (Closed Loop)	<1 Ω typ.
	10 Ω max.
Linear Operating Range	±10V pk
Maximum Current	±2.0mA
Offset Voltage	±3mV typ.
Offset Temp. Coeff.	±100 µV/°C
Gain Drift	± 30 ppm/°C
Output Load	**See note 3**

Power Supply (±Vs)

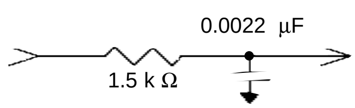
Rated Voltage	+ 5V ± 0.5 Vdc
Quiescent Current	100 mA typ.
(1 kHz to 20 kHz)	125 mA max.
Quiescent Current	120 mA typ.
(20 kHz to 50 kHz)	135 mA max.

Temperature

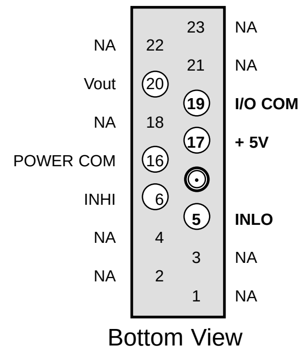
Operating	-25 to + 85°C
Storage	-40 to + 85°C

Notes:

1. Input and output signal voltage referenced to I/O COM.
2. Output is short circuit protected to common. DO NOT CONNECT TO +5V or POWER COM.
3. Output can drive a series 1.5 kΩ resistor and 0.0022 mF capacitor without slew rate limiting with a ± 10 V square wave input.

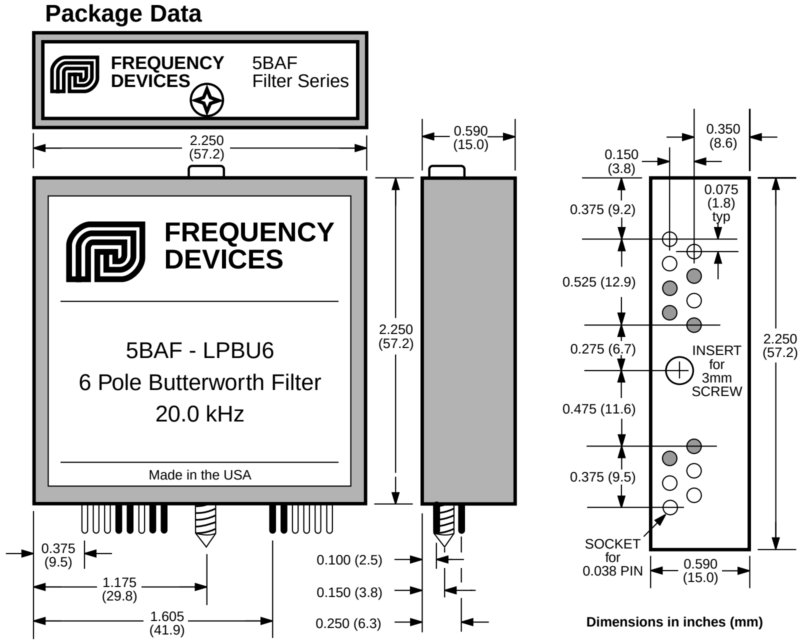


Pin Designations



Bottom View

Package Data



Dimensions in inches (mm)

Ordering Information

5BAF-LPBE6-10.7 kHz

Transfer Function

BU - Butterworth
BE - Bessel

- 3 dB Corner Frequency[4]

e.g., 10.7 kHz
1.00 Hz
50.0 kHz

4. 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 1 Hz to 50 kHz.

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FREQUENCY DEVICES™

Appendix A

Low-Pass

6-Pole Bessel

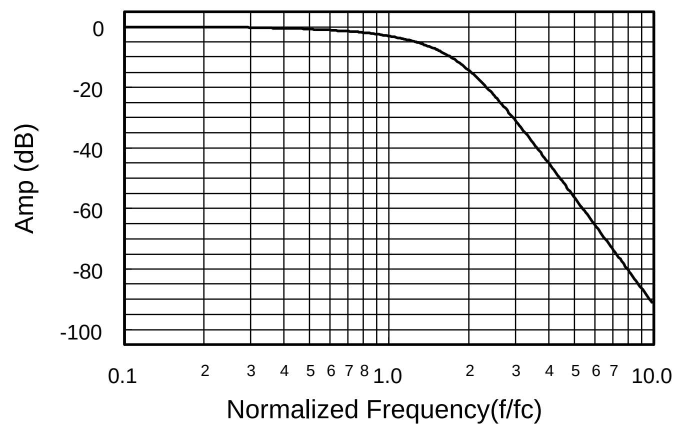
Theoretical Transfer Characteristics

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

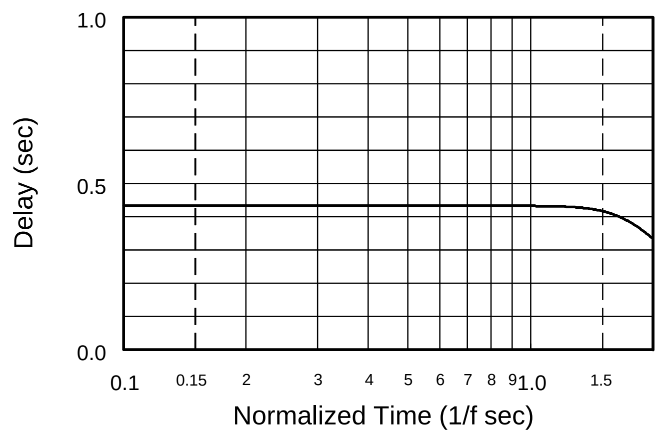
1. **Normalized Group Delay:**
The above delay data is normalized to a corner frequency of 1.0Hz.The actual delay is the normalized delay divided by the actual corner frequency (fc).

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

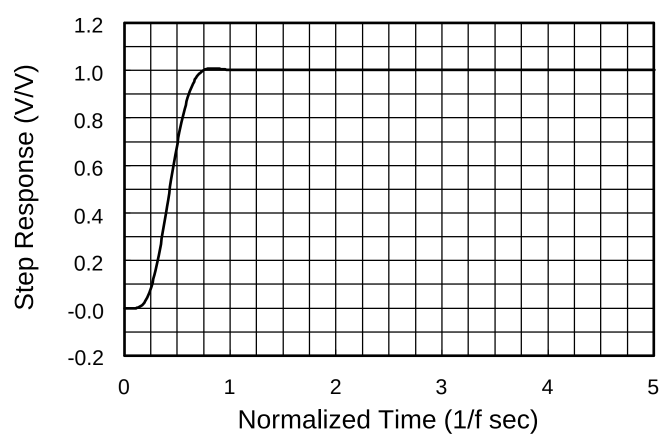
Frequency Response



Delay (Normalized)



Step Response



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FREQUENCY DEVICES™

Appendix A

Low-Pass 6-Pole Butterworth

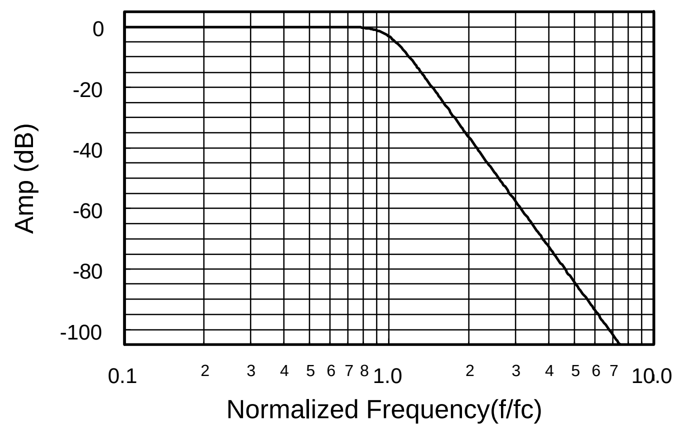
Theoretical Transfer Characteristics

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

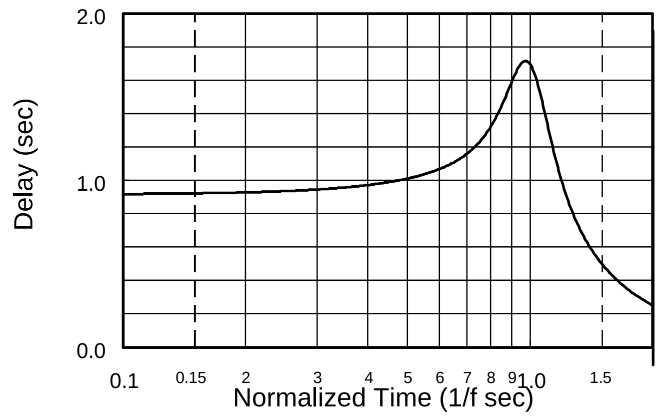
1.**Normalized Group Delay:**
The above delay data is normalized to a corner frequency of 1.0Hz.The actual delay is the normalized delay divided by the actual corner frequency (fc).

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

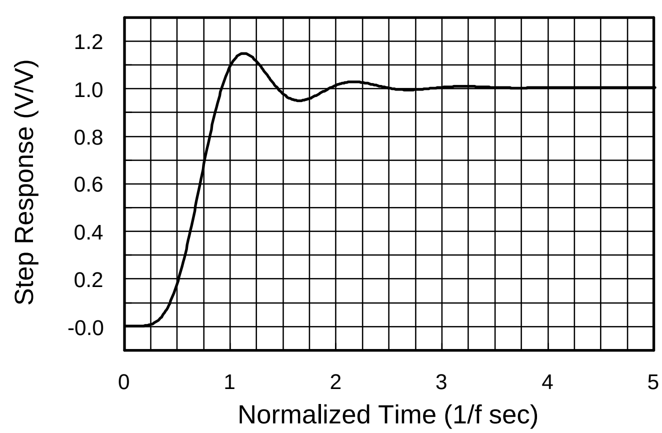
Frequency Response



Delay (Normalized)



Step Response



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