

PF08DFA Series

Miniature DIP Amplifier/Filter Modules



INTRODUCTION

The PF08DFA Series of amplifier/filter modules provide programmable pre-amplification of x1, 2, 5, 10 and 8-pole filter characteristics with cutoff frequencies available from 1 Hz to 200 kHz. The package is a compact DIP footprint making it ideal for applications in which circuit board area is critical. The PF08DFA is a finished component and requires no external clocks, resistors or capacitors for operation.

Performance is what you'd expect from Precision Filters — typically no more than 0.1 degrees of phase and 0.01 dB of amplitude mismatch between any two modules. The latest active devices (not switched capacitor devices) are used to build the filter meaning that it is extremely stable with temperature and that it has low noise and distortion. Six-sided RF shielding reduces susceptibility to unwanted noise and reduces cross-talk in multi-channel applications. A fully balanced differential pre-amplifier is provided to reject common-mode noise and eliminate system ground loops. Gain is programmed via two CMOS/TTL compatible address lines.

The performance of these modules makes them an excellent choice as a front-end to a high-resolution A/D converter where high accuracy and performance are critical.

Five standard 8-pole filter characteristics are available for the PF08DFA Series: Elliptical low pass, Elliptical high pass, Butterworth low pass, Bessel low pass, and Constant Time Delay low pass.

Of all filters, the Elliptical filter provides the sharpest transition from pass-band to stop-band, making it the ideal choice for amplitude critical applications. Better than 0.1 dB flatness is maintained across the entire pass-band of the filter. The Elliptical filter provides a frequency response superior to all other low pass filter types including the Butterworth and Bessel.

The Time Delay Filter is a linear phase (constant time delay) low pass filter with amplitude response that is far superior to a Bessel. The TD8B Time Delay filter gives better amplitude response characteristics than the Bessel characteristic while still providing linear phase. The TD8B Time Delay filter has more overshoot than a Bessel does in response to a step input. The Time Delay filter is the best choice for transient filtering and for applications where preservation of time domain wave shapes is essential.

Design the PF08DFA Filter Module into your printed circuit board to put Precision Filters' expertise in active filter design to work for you. Today's data acquisition systems need a disciplined filter like the Precision PF08DFA series.

INTRODUCTION (Continued)

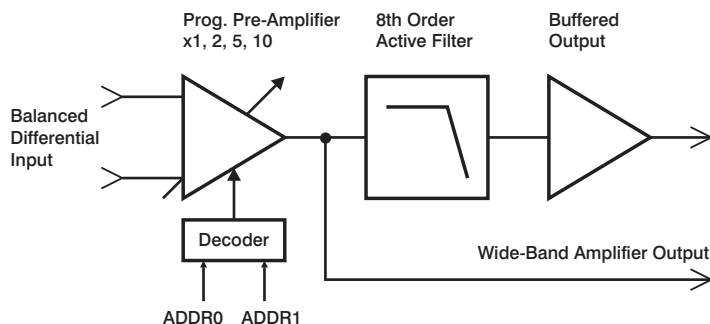
It is not one of those loosely controlled filters with "2% Frequency Accuracy" that can have as much as 20° of phase mismatch between channels at the cutoff frequency. It is a tightly controlled filter with typically less than 0.1° of phase mismatch between channels to the cutoff frequency.

APPLICATIONS

- Anti Aliasing Filters with Programmable Pre-amp
- Automatic Test Equipment
- Data Acquisition
- Signal Conditioning
- Production Test Equipment
- Industrial Process Control
- Reconstruction Filters

SALIENT FEATURES

Filter Technology:	Active
Filter Order:	8th
Power:	± 5 V to ± 15 V
Prog. Pre-Amplifier:	x1, 2, 5, 10
Cutoff Frequencies:	1 Hz to 200 kHz
Phase Match:	0.1° typ., 1° max. DC to F_c , $F_c < 25$ kHz; DC to 0.8 F_c , $F_c \geq 25$ kHz.
Amplitude Match:	0.01 dB typ., 0.1 dB max. DC to F_c , for $F_c < 25$ kHz; DC to 0.8 F_c , $F_c \geq 25$ kHz.
Input Type:	Balanced differential
Output Type:	Buffered single ended
Physical:	Sealed, 6-side shielded case, all pins on 0.1-inch centers



PF08DFA Module Block Diagram

PF08DFA INPUT CHARACTERISTICS

(±15V supplies, 25°C unless otherwise noted)

Type:	DC coupled balanced differential
Z:	20 MΩ differential
CMRR:	90 dB, DC to 400 Hz
Drift:	5 μV/°C RTI
Bias Current:	5 nA typical
Bias Current Drift:	400 pA/°C typical
Level:	±10 Vpk, ±28 Vpk without damage, Power on or off
Level vs. Freq.:	±10 Vpk for $f < 200$ kHz ±10 Vpk x (200 kHz/f) for $f \geq 200$ kHz

AMPLIFIER SPECIFICATIONS

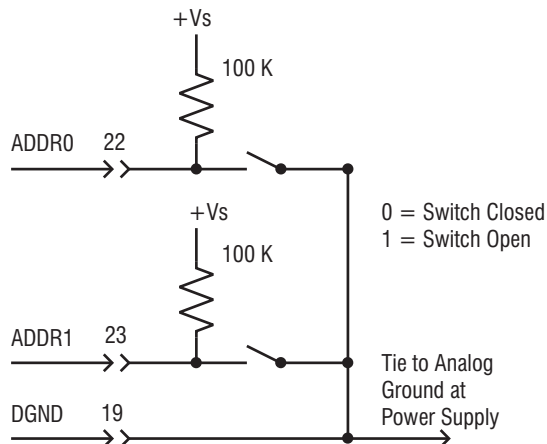
Gain:	Programmable via 2 external pins Range A2: x1, 2, 5, 10
Accuracy:	±0.1%
Wide Band Output Frequency Response (-3 dB):	1 MHz typ. at max gain
Noise:	-153 dBV/√Hz RTI at 1 kHz

Logic Inputs:

	Min	Max
Digital Gnd (DGND)	-Vs + 4.25 V	+Vs - 2.7 V
V _{IL}	D _{GND}	D _{GND} + 2.1 V
V _{IH}	D _{GND} + 2.8 V	+Vs
Logic Input Current		1 μA

Logic Truth Table:

Gain	ADDR0	ADDR1
x1	0	0
x2	1	0
x5	0	1
x10	1	1



Typical Gain Control Circuit

FILTER CHARACTERISTICS

EL8: 8 Pole, 8 Zero Elliptic Low Pass Filter. The EL8 has 0.1 dB pass-band ripple, 0.1 dB of attenuation at the cutoff frequency, 90 dB attenuation at 1.77 F_c and 90 dB minimum stop-band attenuation. The EL8 has 19.8% overshoot in response to a step input. Phase distortion at F_c is 84.9°.

EH8: 8 Pole, 8 Zero Elliptic High Pass Filter with 0.1 dB pass-band ripple, 0.1 dB of attenuation at the cutoff frequency, 90 dB attenuation at 0.564 F_c and 90 dB minimum stop-band attenuation. The EH8 is formulated by performing a low pass to high pass transformation on the EL8 poles.

Cascading an **EH8** filter with an **EL8** filter results in a symmetrical band-pass filter on a log frequency scale.

TD8B: 8 Pole, 8 Zero Constant Time Delay (Linear Phase) Low Pass Filter. The TD8B gives greatly improved pass-band flatness and roll-off when compared to an 8 Pole Bessel while maintaining linear phase over the entire pass-band of the filter. The TD8B has 5% overshoot in response to a step input. Phase distortion is less than 0.23° at F_c. The TD8B amplitude response is 0.1 dB at 0.569 F_c, 3.01 dB at F_c and 80 dB at 3.335 F_c.

BU8: 8 Pole Butterworth Low Pass Characteristic. The Butterworth is flat but monotonically increasing in attenuation. The filter is 0.1 dB at 0.79 F_c, 3.01 dB at F_c and 80 dB at 3.16 F_c. The BU8 overshoots 16.7% in response to a step input and has 66.2° of phase distortion at F_c.

BE8: 8 Pole Bessel Low Pass Characteristic. The Bessel provides a broadly rounded pass-band in exchange for a low overshoot and fast settling step response. Overshoot in response to a step input is 0.34%. The filter has less than 0.1° of phase distortion at F_c. The BE8 is -0.1 dB at 0.19 F_c, 3.01 dB at F_c and 80 dB at 6.07 F_c.

PF08DFA FILTER SPECIFICATIONS

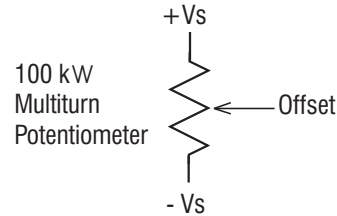
Cutoff Amplitude:	BU8, BE8, TD8B: 3.01 dB EL8, EH8: 0.1 dB
Amplitude Accuracy:	Filter Characteristic ±0.1 dB DC to Fc, Fc ≤ 25 kHz ±0.1 dB DC to 0.8 Fc, Fc > 25 kHz
Phase Match:	0.1° typ., 1° max. DC to Fc, Fc < 25 kHz; DC to 0.8 Fc, Fc ≥ 25 kHz.
Amplitude Match:	0.01 dB typ., 0.1 dB max. DC to Fc, Fc < 25 kHz; DC to 0.8 Fc, Fc ≥ 25 kHz.

OUTPUT CHARACTERISTICS

Type:	Fully Buffered, DC coupled, single ended
Z:	10 Ω, typical
Max Out:	±10 Vpk, ±10 mA pk with short circuit protection
Max Frequency:	±10 Vpk for f < 200 kHz ±10 Vpk x (200 kHz/f) for f ≥ 200 kHz
EH8 Upper 3 dB Small	
Signal Bandwidth:	1 MHz typical at max gain
Offset:	2 mV typical, 10 mV max (trimmable to 0)
DC Offset Stability:	120 μV/°C
DC Gain Stability:	10 ppm/°C typical
THD + Noise:	No more than 0.01% re input w/FC=1 kHz and a 1 Vrms input at 100 Hz
Spectral Noise:	-133 dBV/√Hz at 0.5 Fc for Fc > 1 kHz
Broad Band Noise:	200 μVrms into 20 MHz for LP Filters 300 μVrms into 20 MHz for HP Filters

OFFSET ADJUSTMENT

A potentiometer may be used to externally trim offset. Connect the potentiometer as illustrated below.



POWER SUPPLY (±Vs)

Operating Range:	±5 VDC to ±15 VDC
Quiescent Current:	30 mA Typical
Grounds:	Isolated analog and digital grounds. For applications using separate grounding systems, tie AGND to analog ground system and DGND to digital ground system for best noise performance. AGND and DGND may be tied together and connected to the system ground when only one ground is available.

ABSOLUTE MAXIMUM RATINGS

Power Supply Voltage:	±15 V
Analog Input Protection:	Vs + 13 V to -Vs - 13 V
Logic Input Voltage Range:	±Vs
Storage Temperature Range:	-25°C to +85°C
Operating Temperature Range:	0°C to +70°C
Lead Temp., Soldering (3 Sec):	300°C
Output Short Circuit Duration:	Continuous

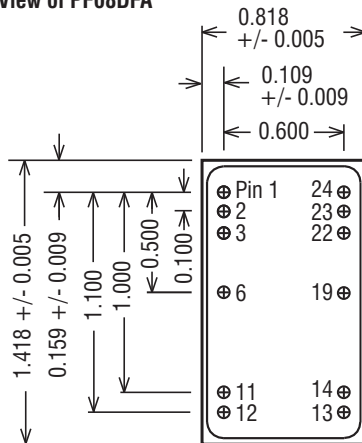
8-Pole Filter Selection Guide					
	EL8	EH8	TD8B	BU8	BE8
Filter Type	LP	HP	LP	LP	LP
Function	Cauer	Cauer	Time Delay	Butterworth	Bessel
Number of Poles, Zeros	8p, 8z	8p, 8z	8p, 8z	8p	8p
DC Gain (dB)	-0.1	-90.75	0	0	0
Pass-Band Ripple (dB p-p)	0.1	0.1	0.2	n/a	n/a
-0.1 dB Frequency	Fc	Fc	0.569 Fc	0.791 Fc	0.185 Fc
-3.01 dB Frequency	1.099 Fc	0.910 Fc	Fc	Fc	Fc
-20 dB Frequency	1.266 Fc	0.790 Fc	1.694 Fc	1.333 Fc	2.347 Fc
-40 dB Frequency	1.441 Fc	0.694 Fc	2.340 Fc	1.778 Fc	3.337 Fc
-60 dB Frequency	1.618 Fc	0.618 Fc	2.951 Fc	2.371 Fc	4.522 Fc
-80 dB Frequency	1.750 Fc	0.571 Fc	3.332 Fc	3.162 Fc	6.069 Fc
Stop-Band Frequency	1.788 Fc	59 Fc	3.332 Fc	n/a	n/a
Stop-Band Attenuation (dB)	90.75	90.75	80.28	n/a	n/a
Phase at Fc (°)	-359.20	359.20	-301.88	-360.00	-182.16
Phase Distortion at Fc (°)	84.9	n/a	0.23	66.2	0.00
Overshoot (%)	19.8	n/a	5.56	16.7	0.34
1% Settling Time (Sec)	5.15/Fc	6.03/Fc	1.54/Fc	3.45/Fc	0.79/Fc
0.1% Settling Time (Sec)	7.97/Fc	9.35/Fc	2.23/Fc	5.08/Fc	1.14/Fc

Note: B.S.L. indicates Best Straight Line.

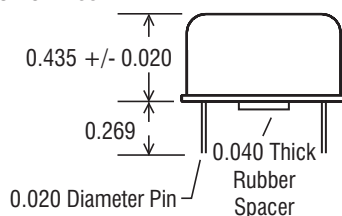
PF08DFA PHYSICAL CHARACTERISTICS

Size (WxLxH): 0.818 x 1.418 x 0.475 inches
 Pin Grid: 0.1" centers
 Recommended Hole: 0.030" diameter
 Operating Temp: 0 to 70°C
 Storage Temp: -25 to 85°C

Top View of PF08DFA



End View of PF08DFA



PF08DFA Module Outline and Pin Identification

PF08DFA Pin Assignments	
Pin	Description
1	+INPUT
2	WIDE BAND AMP OUT
3	-INPUT
6	OFFSET
11	-Vs
12	AGND
13	OUTPUT
14	+Vs
19	DGND
22	ADDR0 Programmable Gain Address
23	ADDR1 Programmable Gain Address
24	Do Not Connect

MATING SOCKETS

Standard

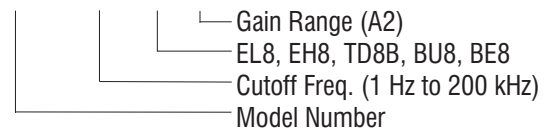
3M ZIF: 2-0024-03344-000-006-002 (Au)
 2-0024-03344-000-006-005 (Ni)
 ARIES ZIF: 24-516-10 (Sn)
 24-516-11 (Au)
 Digi-Key: ED58246-ND
 Mill Max: 115-13-624-41-001 (Au/Au)
 115-93-624-41-001 (Sn/Au)

Ultra-Low Profile (0.094)

Mill Max: 115-13-624-41-003 (Au/Au)
 115-93-624-41-003 (Sn/Au)

ORDERING INFORMATION

PF08DFA-????-XXX-YY



Examples of valid model numbers:

PF08DFA-200K-EL8-A2 Fc = 200 kHz
 8-Pole Elliptic
 Gain x1, 2, 5, 10

PF08DFA-1K32-TD8B-A2 Fc = 1.32 kHz
 8-Pole Constant Delay
 Gain x1, 2, 5, 10

PF08DFA-450-EH8-A2 Fc = 450 Hz
 8-Pole Elliptic High-Pass
 Gain x1, 2, 5, 10

