

Model 3A, 3B, 3C, 3D Filter Modules

Continuous Time Fixed Frequency Filter Modules

- Cutoff Frequencies: 1Hz to 600kHz (High-Pass)
1Hz to 2MHz (Low-Pass)
Attenuation Slope: 6dB to 96dB/Octave
- Responses: Butterworth or Bessel
- Functions: Low-Pass, High-Pass and Band-Pass
- Input: Differential and Single-Ended Models
- Input Gain: 1 to 100 (0dB to 40dB)
- Output Gain: 1 to 100 (0dB to 40dB)
- Continuous Time, No Sampling Noise
- Wide Signal-to-Noise Ratio and Low Distortion
- Factory Tuned, No External Adjustments Needed
- Broad Range of Modules to Choose From
- Single and Dual Channel Module Boxes Available
- Optional Battery Operation Available
- See FMB3002AC for AC Operation



Filter Modules 3A, 3B, 3C and 3D



FMB300 Filter Module Box

DESCRIPTION

The Krohn-Hite 3A, 3B, 3C and 3D Series of continuous-time fixed-frequency precision active filter modules provide filtering in a 1 to 8-poles and 16-pole compact package, with the choice of cutoff frequencies, customer selectable from 1Hz to 2MHz low-pass and 1Hz to 600kHz high-pass. Choose between Butterworth and Bessel responses with input and output gain from 1 to 100 in 1% increments (0dB to 40dB). Functions of low-pass, high-pass and band-pass are available.

Each module is factory tuned with customer-specified parameters of cutoff frequency, number of poles, response, function, single-ended or differential input configuration and input gains and output gains.

APPLICATIONS

Applications include: anti-alias filtering, data acquisition systems, aerospace (sonar and navigation), sound and vibration testing, medical electronics, communication systems, real and

compressed time data analysis, noise elimination and signal reconstruction.

AVAILABLE FILTER MODULES

- 3A Package: 1 to 4-pole.
- 3B Package: 4-pole with input gain and output gain; 5 to 8-pole, with no gain.
- 3C Package: 8-pole, single-ended or differential with input gain and/or output gain.
- 3D Package: 16-pole, single-ended or differential with input gain and/or output gain.

OPTIONAL FMB300 and FMB302 MINI FILTER BOX

The Module Filter Boxes FMB300 (single channel) and FMB302 (two channel) provide housing for any Krohn-Hite filter module. Each is provided with input BNC connectors for differential or single-ended input signals, a BNC connector for the output and a barrier strip for applying $\pm 5Vdc$ to $\pm 15Vdc$ bi-polar power to the unit. Internal sockets are provide for easy installation and removal of the modules.

SPECIFICATIONS

Specifications apply at 25°C ±5°C.

USER-DEFINED CHARACTERISTICS

Number of poles, function, response type, cutoff frequency, cutoff frequency accuracy, differential or single-ended input gain, output gain,

FILTER CHARACTERISTICS (single-ended)

Functions: High-Pass, Low-Pass or Band-Pass (total of 2 to 8-poles for band-pass modules).

Number of Poles: 1 to 8 and 16.

Response Types: Butterworth or Bessel.

Cutoff Frequency: Any fixed value in the range from 1Hz to 1MHz, High-Pass; 0.1Hz to 2MHz, Low-Pass. Gain bandwidth limitations apply.

Relative Gain at fc: -3.01dB.

Cutoff Frequency Accuracy: 2%.

Temperature Coefficient: 0.05%/°C.

Passband Response Deviation from Theoretical (non-inverting):

Low-Pass: 1Hz to 50kHz, ±0.1dB; to 200kHz, ±0.2dB.

High-Pass (small signal, 0.4Vp-p): Cutoffs below 100Hz and input frequencies to 200kHz, ±0.1dB, -3dB point approximately 2.5MHz; cutoffs above 100Hz, ±0.1dB for input frequencies to 2MHz, ±0.2dB for input frequencies to 5MHz, +2dB to -3dB for input frequencies to 25MHz.

Stopband Attenuation (Signal Rejection):

Low-Pass: >100dB to 100kHz, >80dB to 1MHz, >60dB to 5MHz, >50dB to 10MHz.

High-Pass: >100dB.

Signal rejection is printed circuit layout dependent. Use good grounding and shielding practices.

Harmonic Distortion:

LOW-PASS

Cutoff Freq.	Input Freq.	Distortion	
		10Vp-p	20Vp-p
<100Hz	All	0.005% (-86dB)	0.01% (-80dB)
100Hz to 10kHz	All	0.003% (-90dB)	0.006% (-84dB)
10kHz to 200kHz	<10kHz	0.005% (-86dB)	0.01% (-80dB)
10kHz to 200kHz	>10kHz	0.015% (-76dB)	0.03% (-70dB)

Distortion will rise by 6dB (factor of 2) at 1/2 the cutoff frequency for 8-pole Butterworth filter types.

HIGH-PASS

Cutoff Freq.	Input Freq.	Distortion	
		10Vp-p	20Vp-p
<100Hz	<2kHz	0.003% (-90dB)	0.006% (-84dB)
	2kHz to 20kHz	0.015% (-76dB)	0.03% (-70dB)
	20kHz to 200kHz	0.15% (-56dB)	0.3% (-50dB)
>100Hz	<10kHz	0.003% (-90dB)	0.006% (-84dB)
	10kHz to 100kHz	0.015% (-76dB)	0.03% (-70dB)
	100kHz to 500kHz	typically 0.2% (-54dB)	
	500kHz to 2MHz	typically 1% (-40dB)	

INPUT CHARACTERISTICS (with no input gain)

Impedance: 10k ohm or greater. Impedance will vary depending upon cutoff frequency selected.

Voltage Range: ±10V peak (typically ±12V peak for ±15V supplies). Reduced in proportion to supply voltages.

Maximum Safe Voltage: Equal to supply voltages.

INPUT GAIN CHARACTERISTICS

Gain: 1 to 100, ±1%.

Input Impedance: 1M ohm or greater.

Maximum Voltage Without Damage: Equal to supply voltages.

Input Type: Bipolar (FET input available).

Bias Current: Single-ended input, typically 200nA, 600nA max.; differential input, typically 4µA, 12µA max., (1µA max. offset current).

Single-Ended with Gain:

3B Package: 1 to 4-poles.

3C Package: 5 to 8-poles.

3D Package: 16-poles.

Gain Bandwidth (GB) Factor for Determining Useful High-Pass Bandwidth: 3B Package, for high-pass cutoffs <100Hz, 2MHz GB; all other packages: 20MHz GB.

Differential Gain: Available in the 3C and 3D modules.

Common Mode Maximum Signal Amplitude (For linear operation with ±15V supplies): (differential signal) X (input gain) + (common mode signal) must be <±10V peak reduced in proportion to power supply voltages.

CMMR: >80dB to 1kHz.



Maximum Common Mode or Differential Mode Without Damage: Equal to supply voltages.

Gain Bandwidth: Typically 5MHz with unity input gain; 700kHz, X100 input gain; full power bandwidth, typically 240kHz.

OUTPUT CHARACTERISTICS

Impedance: <0.1 ohm to 200kHz.

Linear Operating Range: ±10V peak for ±15V supplies, (typically ±12V peak). Reduced in proportion to supply voltages.

Low-Pass Maximum Voltage: 20Vp-p (24p-p typical), 1Hz to 200kHz.

High-Pass Maximum Voltage:

Cutoff Frequency	Input Frequencies	Output Voltage
1Hz to 99Hz	1Hz to 200kHz	20Vp-p
	200kHz to 500kHz	10Vp-p
	500kHz to 1MHz	4Vp-p
100Hz to 200kHz	100Hz to 2MHz	20Vp-p
	2MHz to 3MHz	10Vp-p
	3MHz to 5MHz	5Vp-p
	5MHz to 10MHz	1Vp-p

The above specifications are without input and output gain performance limits and apply to modules with ±15V supplies. Reduce output performance in proportion to the reduced supply voltage, and input and output gain bandwidth limits.

Maximum Current (2k load): ±5mA peak with 10V output.

Offset Voltage: <10mV settable to zero with offset control.

Offset Temperature Coefficient: <0.2mV/°C.

Noise (with input shorted to ground and detector bandwidth of 5Hz to 300kHz): typically 25µV, 50µVrms max. referred to input.

Noise Spectral Density: <100nV/√Hz, 100Hz to 300kHz, typically 40nV/√Hz. For 8-pole Butterworth modules specification may be 3 times higher near the cutoff region.

Signal-to-Noise Ratio (at 7Vrms): >100dB.

OUTPUT GAIN CHARACTERISTICS

Output gain is available in 1 to 4-pole modules in the 3B package, 4 to 8 poles modules in the 3C package and 9 to 16 poles in the 3D package.

Gain: 1 to 100, ±1%.

Gain Bandwidth: 100MHz for output gains of 5 or greater. For gains less than 5, max. useful bandwidth is a fixed 20MHz.

POWER SUPPLY (±Vs)

Specifications Apply at ±5Vdc to ±15Vdc or single supply from 10Vdc to 30Vdc.

Operating Range: ±5Vdc to ±18Vdc.

Maximum Safe Voltage: ±18Vdc.

Current:

3A and 3B Package, <15mA

3C Package with gain, <30mA.

3D Package with gain, <35mA.

Consult factory for ultra-low power version.

GENERAL

Output Short Circuit Protection: Limited to short duration.

Operating Temperature Range: 0°C to +70°C.

Storage Temperature Range: -25°C to +85°C.

OPTIONS

FMB300: Single Channel Filter Module Box for use with any Krohn-Hite Filter Modules. (requires bipolar +15V and -15V supplies)

Connectors: BNC, input and output.

Barrier Strip: Connections for +, - and ground dc power connections.

FMB300B: Single Channel Battery Powered Filter Module Box for use with any Krohn-Hite Filter Modules.

Connectors: BNC, input and output.

Battery Powered: 9.0V, 1.2Ah, high energy density battery. (Filter output voltage will be limited by the battery voltage.)

FMB302: 2 Channel Filter Module Box for use with any Krohn-Hite Filter Modules. (requires bipolar +15V and -15V supplies)

Connectors: BNC, input and output.

Barrier Strip: Connections for +, - and ground dc power connections.

FMB300B: Single Channel Battery Powered Filter Module Box for use with any Krohn-Hite Filter Modules.

Connectors: BNC, input and output.

Battery Powered: 9.0V, 1.2Ah, high energy density battery. (Filter output voltage will be limited by the battery voltage.)



Specifications subject to change without notice.

If the filter you need is not listed on this data sheet, consult factory for other variations and options that may fill your requirement.

How To Order

The following is a description on how to construct the Filter Module part number.

Example:

For a 25kHz Low-Pass Butterworth with a Differential Input and Input Gain of 5 Output Gain of 10.

Part Number: 3CD8TL-25kg-N5U10

Example Information	Description	Available Options
3C	Filter Module Package	3A = no gain, 1 to 4-pole 3B = no gain, 5 to 8-pole 3B = 2 to 8-pole band-pass 3B = gain, 1 to 4-pole 3C = gain, 5 to 8-pole 3C = differential input, with or without gain 3D = 16-pole, low-pass, high-pass, band-pass
D	Input Type	D = Differential S = Single-Ended
8	Number of Poles	1 to 8 Poles
T	Filter Response	T = Butterworth S = Bessel
L	Function	L = low-pass H = high-pass B = band-pass
25k	Cutoff Frequency	Any frequency between 1Hz to 1MHz (1% increments)
g	Cutoff Accuracy	F = 1% (optional) g = 2% (standard)
N5	Input Gain (if required)	Any value from 1 to 100 in 1% increments
U10	Output Gain (if required)	Any value from 1 to 100 in 1% increments