Filter Module Information Sheet

Part Number: 5BS8TB-1k/50kg

The enclosed filter module is 8-pole, 1kHz to 50kHz band-pass with a Butterworth response with unity gain.

The following chart shows the pin connections of the module as shown on the data sheet enclosed.

<table>
<thead>
<tr>
<th>PIN #</th>
<th>CONNECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>dc offset connection</td>
</tr>
<tr>
<td>5</td>
<td>+ V (supply)</td>
</tr>
<tr>
<td>13</td>
<td>+ V (supply)</td>
</tr>
<tr>
<td>35</td>
<td>Input</td>
</tr>
<tr>
<td>38</td>
<td>Ground</td>
</tr>
<tr>
<td>40</td>
<td>Output</td>
</tr>
</tbody>
</table>

1. To verify cutoff accuracy for filters without input gain, you must drive the input from a 10 ohm or less source impedance.

2. The filter has two internal 0.1μF ceramic capacitors, bypassing the supply input to ground. If the supply is unusually dirty with noise or signal, a larger external capacitor is recommended. If necessary, de-coupling resistors of 10 ohms will also help.

NOTE: When using long supply leads to the module (when testing out of circuits), you may have to use 1μF by-pass capacitors at the module to prevent oscillation.
FILTER MODULE INFORMATION SHEET

SIDE VIEW

END VIEW

Pin No.s correspond to a 28 Pin DIP

Case dimension tolerance
+-0.015
+-0.381

Grid dimensions
0.1 x 0.1
2.54 x 2.54
Continuous Time Fixed Frequency
Active Filter Modules

1 and 2 Channel Filter Module Boxes

- Cutoff Frequencies: 1Hz to 1MHz LP/HP
  1Hz to 600kHz HP
- Attenuation Slope: 6dB to 48dB/Octave
- Responses: Butterworth or Bessel
- Functions: Low-Pass, High-Pass and Band-Pass
- Input: Differential and Single-Ended
- 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

- FMB300: Will accept 3A, 3B and 3C Modules
- FMB302: Will accept 2 3A, 3B, 3C and 1 3D Module

DESCRIPTION
The NEW 3A, 3B, 3C and 3D Series of continuous-time fixed-frequency precision active filter modules from Krohn-Hite provide filtering in a 1 to 16-pole compact package, with the choice of cutoff frequencies selectable within the frequency range from 1Hz to 1MHz for low-pass and band-pass, 1Hz to 600kHz high-pass.

Choose between Butterworth or Bessel responses, user-defined input and output gain from 1 to 100 in 1% increments (0dB to 40dB), functionalities of low-pass, high-pass and band-pass. Each one factory tuned to a user-specified cutoff frequency, number of poles, response, function, single-ended or differential 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.

SPECIFICATIONS

AVAILABLE FILTER MODULES

3A Package: 1 to 4-pole,
3B Package: 1 to 4-pole with input gain and output gain; 5 to 8-pole, with no gain.

3C Package: 1 to 8-pole, single-ended or differential with input gain and/or output gain.
3D Package: 8 to 16-pole.
See packaging dimensions.

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

FILTER CHARACTERISTICS
Functions: High-Pass, Low-Pass or Band-Pass.
Number of Poles: 1 to 16.
Response Types: Butterworth or Bessel.
Cutoff Frequency: Any fixed value in the range from 1Hz to 1MHz, low-pass and band-pass. 1Hz to 600kHz, high-pass.
Relative Gain at £1: ±0.1% for both Butterworth and Bessel.
Cutoff Frequency Accuracy: 2% standard, 1% optional (driven from 100Hz or less).
Temperature Coefficient: 0.05%/°C.
Passband Response Deviation from Theoretical (non-inverting):
Low-Pass: 1Hz to 60kHz, ±0.1dB; to 200kHz, ±0.2dB; ±0.5dB to 1MHz.
High-Pass (small signal, 0.1Vp-p): Cutoffs below 100kHz and input frequencies to 600kHz, ±0.1dB; ±6dB point approximately 2.5kHz, cutoffs above 100kHz, ±0.1dB for input frequencies.
### Specifications

**Active Filter Modules**

Models 3A, 3B, 3C and 3D

#### Filter Specifications

- **Low-Pass**
  - Cutoff Frequency: 2MHz
  - Stopband Attenuation (Signal Rejection): Low-Pass: +100dB to 100kHz, +80dB to 1MHz, +60dB to 5MHz; +50dB to 10MHz.
  - High-Pass: +100dB.
  - Signal transition is printed circuit layout dependent. Use good grounding and shielding practices.

**Harmonic Distortion:**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Low-Pass</th>
<th>High-Pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>1kHz</td>
<td>0.001%</td>
<td>0.001%</td>
</tr>
<tr>
<td>5kHz</td>
<td>0.002%</td>
<td>0.002%</td>
</tr>
<tr>
<td>10kHz</td>
<td>0.003%</td>
<td>0.003%</td>
</tr>
<tr>
<td>20kHz</td>
<td>0.005%</td>
<td>0.005%</td>
</tr>
<tr>
<td>50kHz</td>
<td>0.006%</td>
<td>0.006%</td>
</tr>
<tr>
<td>100kHz</td>
<td>0.008%</td>
<td>0.008%</td>
</tr>
</tbody>
</table>

#### Input Characteristics (with no input gain)

- **Impedance:** 10kΩ or greater. Impedance will vary depending upon cutoff frequency selected.
- **Voltage Range:** ±10V peak (typically ±14V peak for ±15V supplies).
- **Reduced in proportion to supply voltages.**
- **Maximum Safe Voltage:** Equal to supply voltages.

#### Input Gain Characteristics

- **Gain:** 1 to 100 in 1% increments (3dB to 40dB in 0.1dB increments).
- **Impedance:** 10kΩ or greater.
- **Maximum Voltage Without Damage:** Equal to supply voltages.
- **Input Type:** Bipolar (PET input available).
- **Bias Current:** Single-ended input: typically 200mA; 600mA max differential input; typically 1A, 1.2x max, (1A max, offset current).
- **Single-Ended Gain:**
  - 38 Package: 1 to 4-poles.
  - 3C Package: 5 to 8-poles.
- **Gain Bandwidth (dB):** Factor for Determining Useful High-Pass Bandwidth:
  - 38 Package: For high-pass cutoff <100kHz, 2MHz GS.
  - All Other Packages: 2MHz GS.
- **Differential Gain:** Available in the 3C module.
- **Common Mode Maximum Signal Amplitude:** (For linear operation with ±5V supplies): (differential signal) × (input gain) × (common mode signal) must be <±50V express reduced in proportion to power supply voltages.
- **CMRR:** +80dB to 1kHz.

#### Maximum Common Mode or Differential Mode Without Damage:

- **Gain Bandwidth:** Typically ±5kHz for unity input gain; ±100kHz for ±5V input gain; ±40kHz for ±15V input gain. Reduced in proportion to supply voltages.

#### Output Characteristics

- **Impedance:** 4Ω to 200Ω.
- **Linear Operating Range:** ±10V peak for ±5V supplies, typically ±12V peak.
- **Reduced in proportion to supply voltages.**

**Low-Pass Maximum Voltage:**

<table>
<thead>
<tr>
<th>Cutoff Frequency</th>
<th>Input Voltages</th>
<th>Output Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1kHz</td>
<td>±100V</td>
<td>±50V</td>
</tr>
<tr>
<td>5kHz</td>
<td>±50V</td>
<td>±25V</td>
</tr>
<tr>
<td>10kHz</td>
<td>±25V</td>
<td>±12.5V</td>
</tr>
<tr>
<td>20kHz</td>
<td>±12.5V</td>
<td>±6.25V</td>
</tr>
<tr>
<td>50kHz</td>
<td>±6.25V</td>
<td>±3.125V</td>
</tr>
<tr>
<td>100kHz</td>
<td>±3.125V</td>
<td>±1.563V</td>
</tr>
<tr>
<td>200kHz</td>
<td>±1.563V</td>
<td>±0.781V</td>
</tr>
<tr>
<td>500kHz</td>
<td>±0.781V</td>
<td>±0.390V</td>
</tr>
<tr>
<td>1GHz</td>
<td>±0.390V</td>
<td>±0.195V</td>
</tr>
</tbody>
</table>

#### Noise and Stability

- **Noise (with input shorted to ground and detector bandwidth of 5Hz to 30kHz):** Typically 2μV 35μV rms max. referred to input.
- **Noise Spectral Density:** ±100μV/√Hz. ±100μV/√Hz to 300kHz; typically 40μV/√Hz.

- **Power Supply (±5%):**
  - Specifications Apply at ±5Vdc to ±10Vdc or single supply from 10Vdc to 30Vdc.
  - Operating Range: ±5Vdc to ±18Vdc.
  - Maximum Safe Voltage: ±18Vdc.
  - Current: 3A and 3C Package: <30mA. 3B Package with gain <30mA.

#### General

- **Operating Temperature Range:** -25°C to 85°C.
- **Storage Temperature Range:** -40°C to 85°C.
- **Specifications apply at 25°C ±5°C.**
- **Specifications subject to change without notice.**
Models 3A, 3B, 3C and 3D

SPECIFICATIONS

Active Filter Modules

3A Module Dimension Information

3C Module Dimension Information

3B Module Dimension Information

3D Module Dimension Information
Active Filter Modules

ORDERING INFO

Models 3A, 3B, 3C and 3D

3C D8TL - 25K N10 U10

Module Package
- 16-Gold, 10 to 8 inputs, LP, HP
- 16-Gold, 8 to 6 inputs, LP, HP
- 16-Gold, 6 to 4 inputs, LP, HP
- 16-Gold, 4 to 2 inputs, LP, HP
- 16-Gold, 2 to 1 inputs, LP, HP
- 16-Gold, 1 to 0 inputs, LP, HP, DP

Input Type
- P - Differential
- S - Single-Ended

Number of Prongs
- 1 to 8

Response
- F - Butterworth
- B - Bessel

Function
- L - Low-Pass
- H - High-Pass
- B - Band-Pass

- Output Gain (if applicable)
  Any value from 0 to 100 in 1% increments

- Input Gain (if applicable)
  Any value from 0 to 100 in 1% increments

- Cutoff Frequency Accuracy
  ± 1% (optional)
  ± 2% (standard)

- Cutoff Frequency
  150 Hz to 15KHz, Low-Pass, Band-Pass
  More to Select, High-Pass

Differential input is only available on the 10 Modules

Application Note

1. To verify full accuracy for filters without input gain, you must drive the input to a 10 ohm resistance source. Most signal generators have a 50 ohm output impedance, arrangement in Figure 1 can be used to accomplish a 10 ohm source impedance.

2. For proper operation, low-pass filters require a dc return path to ground for input bias current of typically 150μA (500μA max.). For filters with FET input gain of below 1000 Hz cutoff frequency, the bias current is less than 1 nA.

3. For single-ended input gain in the 3G package, connect the offset (QS) pin as shown in Figure 2.

R_C = 51 kΩ for ±5V supplies
R_C = 39 kΩ for ±12V supplies
R_C = 0 for ±5V supplies

Figure 1

![Diagram of a circuit with labeled components](image1.png)

Figure 2

![Diagram of a circuit with R_C and V_a connections](image2.png)

KROHN-HITE CORPORATION

For all units in the 3A and 3B package, connect the offset pin as shown in Figure 2:

- R_C = 51 kΩ for ±5V supplies
- R_C = 32 kΩ for ±12V supplies
- R_C = 12 kΩ for ±5V supplies