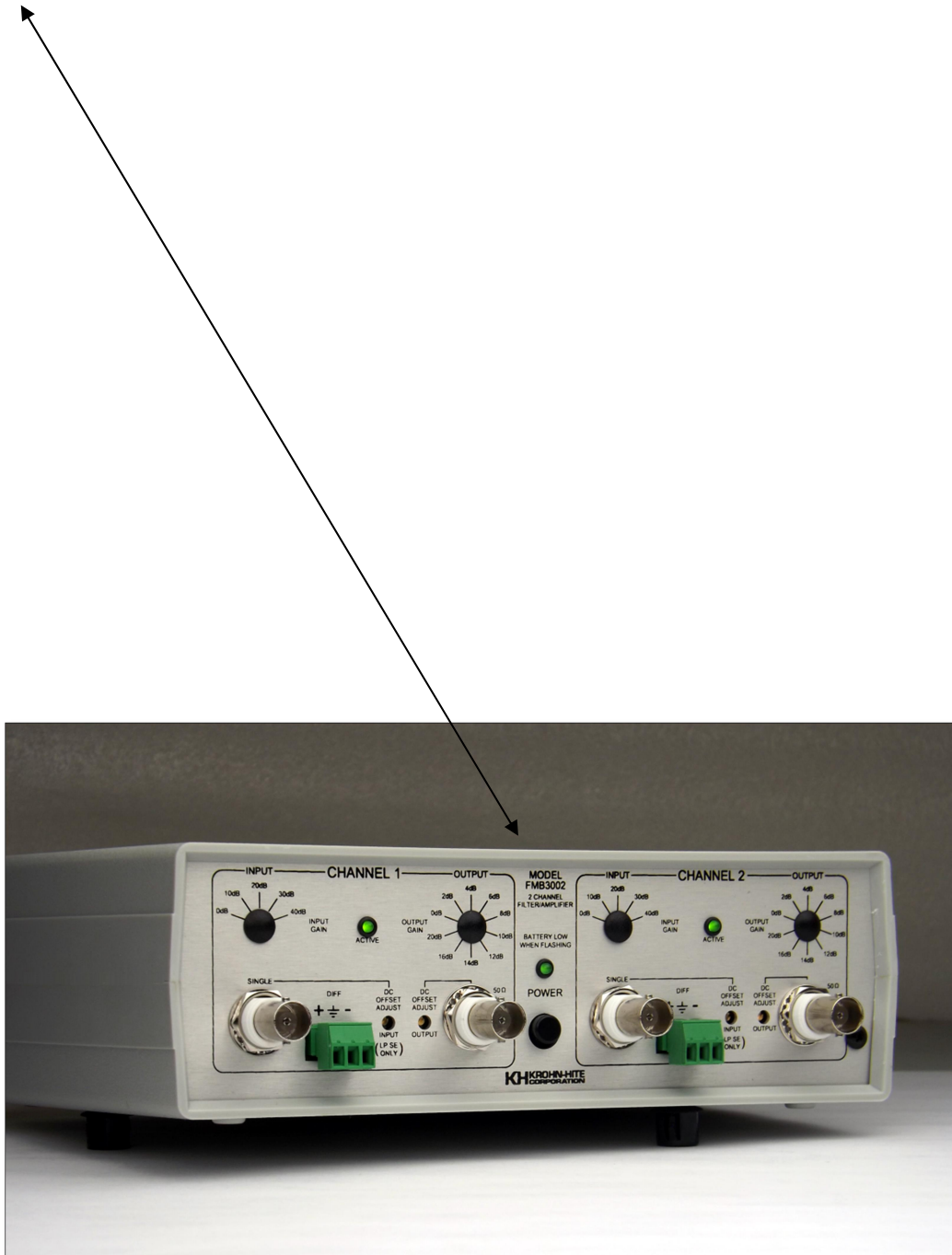




***Model FMB3002***  
***Dual Channel Filter/Amplifier***



***Operating Manual***

## *Service and Warranty*

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*DO NOT return the instrument without our written or verbal authorization to do so. After contacting us, we will issue a Return Authorization Number which should be referenced on the packing slip and purchase order. In most cases, we will be able to supply you with the information necessary to repair the instrument, avoiding any transportation problems and costs. When it becomes necessary to return the instrument to the factory, kindly pack it carefully and ship it to us prepaid.*

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*Modifications to this instrument must not be made without the written consent of an authorized employee of Krohn-Hite Corporation.*

# Dual Channel AC Powered Filter/Amplifier

## OPERATING MANUAL



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**Figure 1.1 Model FMB3002 Filter/Amplifier**

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## **SECTION 1**

# **GENERAL DESCRIPTION**

### **DESCRIPTION**

The Krohn-Hite Model FMB3002 is a two channel, compact filter chassis that provides housing for Krohn-Hite 3F Fixed Frequency Filter/Amplifier Modules. The unit comes completely assembled from the factory with 3F customer specified filter/amplifier module(s) installed in a one or two channel configuration. BNC (single-ended) or screw terminal block (differential) input connectors, as well as BNC output connectors, are provided. Modules are factory installed into sockets making updating to different type filter/amplifiers efficient and easy.

### **DIFFERENTIAL AND SINGLE-ENDED OPERATION**

The FMB3002 has front panel screw-terminals for applications requiring a differential input connection when working with low level signals which may be ideal for improving the signal-to-noise ratio. This connection can also always be used for single-ended operation by simply shorting the minus terminal to ground.

A BNC connection is also available for single-ended operation applications.

### **PRE and POST FILTER GAIN**

The FMB3002 is designed with input (pre-filter) and output (post-filter) gain ability. Installing Option G1 (input gain) and G2 (output gain), the FMB3002 becomes equipped with switch selectable 40dB input gain in 10dB steps and 20dB of switch selectable 20dB output gain in 2dB steps to 16dB and 20dB.

Standard in the FMB3002 are sockets on the main PC card that allow the control of the input and output gain of each channel. By inserting a calculated resistor value, the input and/or output gain can be changed from 1 (0db) to 100 (40dB).

### **APPLICATIONS**

Applications for the FMB3002 includes: 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 and more.

## SPECIFICATIONS

Specifications apply at  $\pm 15\text{Vdc}$  or 120V/240V line unless otherwise noted.

**Maximum Number of Channels:** 2.

### Power Supply Voltage ( $\pm\text{Vs}$ )

**Operating Range:**  $\pm 11\text{Vdc}$  to  $\pm 16\text{Vdc}$ .

**Maximum Safe Voltage:**  $\pm 18\text{Vdc}$ .

Note: Modules plugged into the FMB3002-S (single-ended) or FMB3002-D (differential) chassis and has the gain option installed, must be of the same input type configuration (differential or single-ended). They must not be mixed or the gain function will not work correctly.

### Filter Module Characteristics

The Filter Characteristics are defined by the module installed into the sockets of the FMB3002.

The specifications below apply to all modules that may be installed (specials may vary).

**Functions (customer defined):** Low-pass, high-pass or band-pass.

**Number of Poles (slope, customer defined):** 1 to 8 and 16-pole.

**Type (customer defined):** Butterworth or Bessel.

**Cutoff Frequency (customer defined):** Any specified fixed value between 1Hz to 1MHz, low-pass and band-pass; 1Hz to 600kHz, high-pass. Maximum frequency range is determined by maximum gain selected, consult factory for further details for frequencies above 200kHz.

**Passband Flatness:** 10Hz to 200kHz, 0.2dB.

**Relative Gain at fc:** -3dB.

**Noise (input shorted to ground and 300kHz bandwidth):** 25 $\mu\text{V}$  rms typical, 50 $\mu\text{V}$  rms max referred to input.

**Noise Spectral Density (100Hz to 300kHz):** 40nV/ $\sqrt{\text{Hz}}$  typical, 100nV/ $\sqrt{\text{Hz}}$  max.

**Signal-To-Noise Ratio (@ 7Vrms):** >100dB.

### Input Amplifier Characteristics

#### Single-Ended Input

**Maximum Input:**  $\pm 10\text{V}$  peak.

**Coupling:** DC.

**Impedance:** 1M ohm in parallel with a 50pF.



**Gain:** Any value from 1 (0dB) to 100 (40dB) selectable by inserting a calculated resistor value. Maximum gain is determined by cutoff frequency. Consult factory for gain bandwidth limitations above 200kHz.

**Option G1 Input Gain Switch:** Switch selectable, gain control; 0dB to 40dB in 10dB steps,  $\pm 3\%$ . Maximum gain is determined by cutoff frequency. Consult factory for gain bandwidth limitations above 200kHz.

### Differential Input

In addition to the above specifications, use the following specifications for differential modules.

**CMRR:** >80dB to 1kHz.

**Maximum Common Mode Voltage:** Equation to determine the max gain available for differential modules up to 200kHz.

### Output Amplifier Characteristics

**Maximum Output Voltage:**  $\pm 10V$  peak or  $2V_p \times (1\text{MHz}/f)$  for  $\geq 1\text{MHz}$ .

**Impedance:** 50 ohms.

**Gain:** Any value from 1 (0dB) to 100 (40dB) selectable by inserting a calculated resistor value. Maximum gain is determined by cutoff frequency. Consult factory for gain bandwidth limitations above 200kHz.

**Option G1 Output Gain Switch:** Switch selectable, gain control; 0dB to 16dB in 2dB steps and 20dB,  $\pm 3\%$ . Maximum gain is determined by cutoff frequency. Consult factory for gain bandwidth limitations above 200kHz.

### General

**Output Short Circuit Protection:** Limited to short duration.

**Operating Temperature Range:** 0°C to +50°C.

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

**Dimensions:** 8" (20.32cm) x 6.3" (16.02cm) x 2.5" (6.35cm).

**Weights:** 4 lbs (0.9kg).

### Options

**FMB3002-S:** Single-ended chassis. All modules installed must have a single-ended input configuration.

**S (defined only when G1/G2 gain switch option is installed):**

The S (single-ended only) option must be specified when G1 and G2 gain switch option is installed. If a differential filter/amplifier module is installed with the G1 and/or G2 option, the switched gain values will not be correct.

**FMB3002-D:** Differential chassis. All modules installed must have a differential input configuration.

**D (defined only when G1/G2 gain switch option is installed):**

The D (differential only) option must be specified when G1 and G2 gain switch option is installed. If a single-ended filter/amplifier module is installed with the G1 and/or G2 option, the switched gain values will not be correct.

**Accessories**

**3F Series**

**(plug-in filter/amplifier modules)**

Fixed frequency plug-in filter/amplifier module for the FMB3002.

**CON-045**

Mating connector for differential input, output and rear panel dc power (on FMB3002DC only) connections.



**FUSE, Part No. 021033**

Wickman Siemes 374, 0.125A, slow-blow.



**CAB-018**

Cable, BNC, 3'.



## SECTION 2 OPERATION

### Introduction

This section describes the basic operation of the Model FMB3002. It includes the proper power requirements, the recommended turn-on procedure and a detailed explanation of all operating controls, modes of operation and special optional features.

### Power Requirements

The Model FMB3002 is designed to operate from a single phase, 50-60Hz, ac power source of 105-132, 210-264 volts (FMB3002). A rear panel line switch for selecting power line voltage to 120V or 240V is provided. A 1/8A slow blow fuse is internal and can only be changed by removing the top cover (please remove the power line from the unit before changing the fuse).

### Turn-On Procedure

Set the line switch for the correct voltage range. For 120 volts, set the voltage range to the 120V position. For 220V operation, set the voltage range switch to the 240V.

The FMB3002 is provided with an AC receptacle for AC line operation.

Make sure the POWER switch is in the OFF position.

Plug the line cord into the unit and into an ac outlet.

<b>WARNING!</b>
The chassis of this instrument is connected to ground. For safety purposes, connect the line cord to a grounded, 3 terminal ac outlet.

Turn the POWER switch ON.

<b>CAUTION!</b>
Because of the potentially dangerous voltages that exist within the unit, the cover of this instrument should not be removed when the instrument is connected to an ac power source.

## Front Panel Controls and Connectors

The FMB3002 provides 1 or 2 channels of filtering and amplification by way of plug-in filter/amplifier modules. You can populate with one channel if desired. Each channel has an input (single-ended, BNC and a 3-terminal, differential) connectors, and output connectors (BNC) and an active LED.

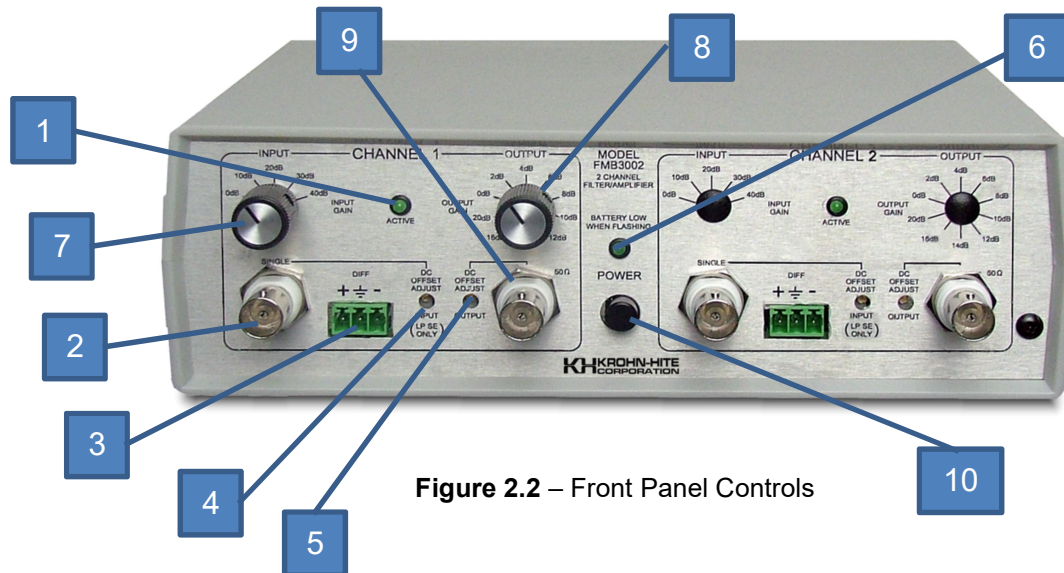


Figure 2.2 – Front Panel Controls

### 1 - Active LED

Indicates when a filter/amplifier module is installed for that channel and that the input and output connectors are active.

### 2 - Input BNC Connectors

Each channel has an associated BNC connector for single-ended input signal connections. Maximum input signal can be 10V. A module with no gain is 10V peak with ac line operation.

### 3 - Terminal Connector

Each channel has an associated 3-terminal connector for differential input signal connections; can be used as a single-ended input when shorting the minus input to ground. Mating plugs are provided.

### 4 - Input DC Offset Adjustments

A dc offset adjustment potentiometer is provided for each channel. This is for adjusting any input dc offset that may appear at the output BNC connector when a differential module is installed. With a single-ended module installed with input gain, this control minimizes the output offset error that may appear with input gain changes.

### 5 - Output DC Offset Adjustment

An internal output dc offset adjustment potentiometer is provided for each channel. This is for adjusting any output dc offset that may appear at the output BNC connector.

## **6 - Power LED Indicator**

LED illuminates when the FMB3002 is powered ON.

## **7 - G1, Optional Input Gain Switch**

5 position switch for input gain settings. Values are 0dB, 10dB, 20dB, 30dB and 40dB unless custom values have been defined.

## **8 - G2, Optional Output Gain Switch**

10 position switch for output gain settings. Values are 0dB, 2dB, 4dB, 6dB, 8dB, 10dB, 12dB, 14dB, 16dB and 20dB unless custom values have been defined.

## **9 - Output BNC Connectors**

Each channel has an associated Output BNC connector. Maximum output signal 10V peak. A module with no gain is 10V peak with ac operation and 2V peak with battery operation.

## **10 - Power Switch**

Press to turn the FMB3002 on or off. Always disconnect the power cord whenever the cover is removed.

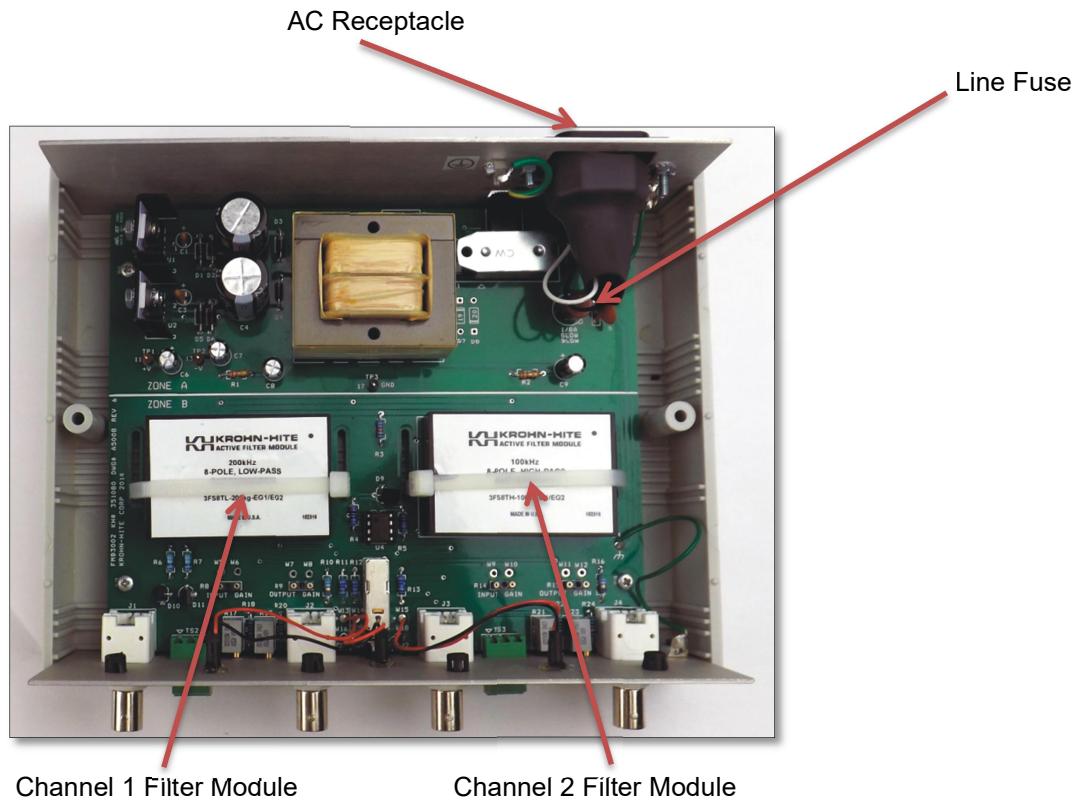
## **FMB3002 Rear Panel**

The rear panel of the FMB3002 provides an ac power receptacle and a line switch. The ac power receptacle is a standard 3-terminal connector and complies with the European I.E.C. standard. A detachable 3-wire line cord is also provided.

The ac line switch is provided to set the proper ac input power requirement of 120V or 240V. A 1/8A slow blow fuse is internal and can only be changed by removing the top cover. Always disconnect the power cord whenever the cover is removed.

## **Operation**

In order for the FMB3002 to operate, one or two model 3F Series Filter/Amplifier Modules must be installed. This is usually done at the factory before delivery. If they are already installed, the unit is ready to operate. If the modules are not installed, take extra care when inserting the module into the sockets. If modules are already installed and you want to change a module with different characteristics, remove the power from the unit, remove the top cover by unscrewing the two cover screws located on the bottom of the unit.



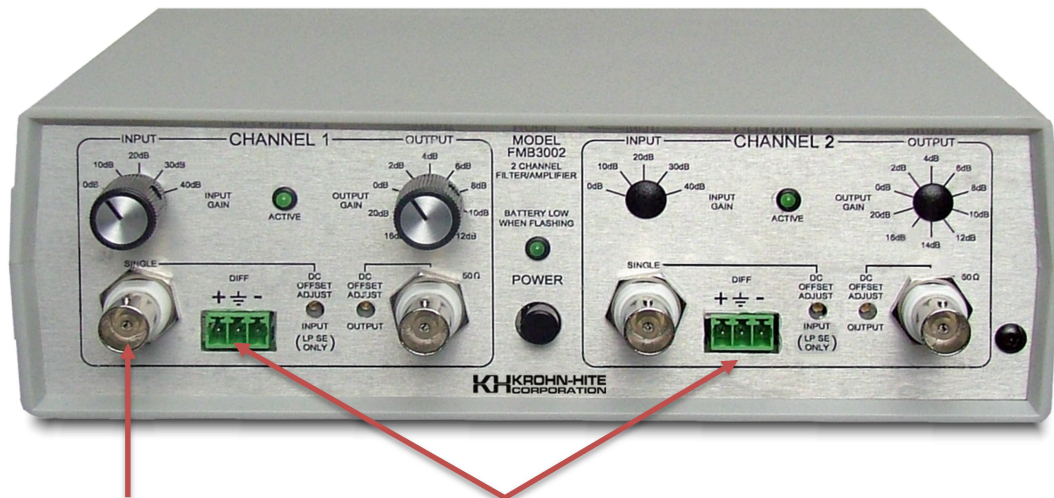
**Figure 2.3** – Filter module and AC and DC Receptacle Location

Locate the modules and carefully remove the desired module. Insert the new module in its place, taking special precaution not to bend any of the pins. Once the module is in place, install the cover, turn the unit back on and the LED for that channel will light indicating that the input and output connectors are active and the module was installed correctly.

### Single-Ended Input Operation

Each channel has Input BNC connectors that are used for single-ended operation.

Note: Single-ended modules with EG1 and/or EG2 options will only work properly in a FMB3002 chassis with the SE option. The gain values will be incorrect when installing a single-ended module in an FMB3002 with the DIFF option.



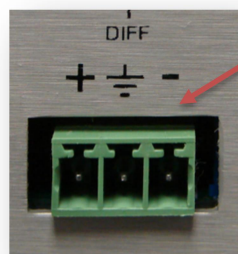
Single-Ended Input BNC Connectors/Differential or Single-Ended Screw-Terminal Connector

**Figure 2.4** – Single-Ended and Differential Connector Locations

### Differential Input Operation

Each channel also provides for differential operation when a differential 3F Filter/Amplifier Module is installed. Connect the input signal to the plus, minus and ground terminals of a channel accordingly.

For S (single-ended) operation with a differential module, ground the minus input.



**Figure 2.5** – Differential Terminal Block Connector

Note: Differential modules will only work properly in a FMB3002 chassis with the D option. The gain values will be incorrect when installing a differential module in an FMB3002 with the S option.

## DC Offset Adjustment

The FMB3002 provides two dc offset adjustments for each channel to correct for any dc offset that may appear at the output BNC. There are different procedures to follow depending on input gain, output gain and the type module installed in each channel.

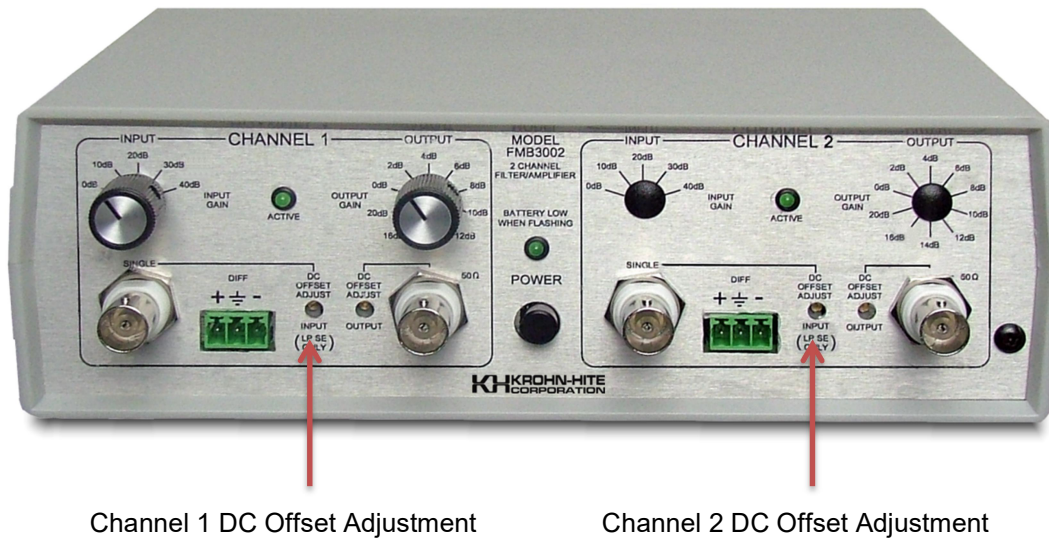


Figure 2.6 – DC Offset Adjustment Locations

## Single-Ended Input

For units with single-ended input and fixed resistor installed for gain, do the following:

1. Short the input BNC to ground of the channel of interest.
2. Connect a DVM set to DC mV scale to the output BNC of the same channel.
3. Adjust the OUTPUT DC Offset Adjust for 0mV.

For units with only input G1 and/or G2 gain option.

1. Short the input BNC to ground of the channel of interest.
2. Connect a DVM set to DC mV scale to the output BNC of the same channel.
3. Set the Input Gain to minimum and the Output Gain to maximum.
4. Adjust the OUTPUT DC Offset Adjust for 0mV. If the adjustment runs out of range, adjust the INPUT DC Offset Adjust for 0mV.
5. Set the Input Gain to maximum and the Output Gain to minimum.
6. Adjust the INPUT DC Offset Adjust for 0mV.
7. Repeat 3 to 7 for fine adjustment.



For units with only output gain, do the following:

### Differential Input

1. Short the both input BNC connectors to ground of the channel of interest.
2. Connect a DVM set to mV scale to the output BNC of the same channel.
3. Check the DVM reading for 0mVdc.
4. Adjust the output DC Offset Adjust for 0mV.

### Fixed Gain (adding calculated resistor)

#### Note

If the FMB3002 has a module with a fixed gain in the module itself, this section does not apply. If ordered with variable gain option, then the gain can be adjusted as shown below.

The FMB3002 provides for input and output gain adjustment by inserting a calculated resistor value to the Input and Output Gain sockets made available on the PC Card.

#### CH1 Input Gain Sockets

#### CH1 Output Gain Sockets

#### CH2 Input Gain Sockets

#### CH2 Output Gain Sockets

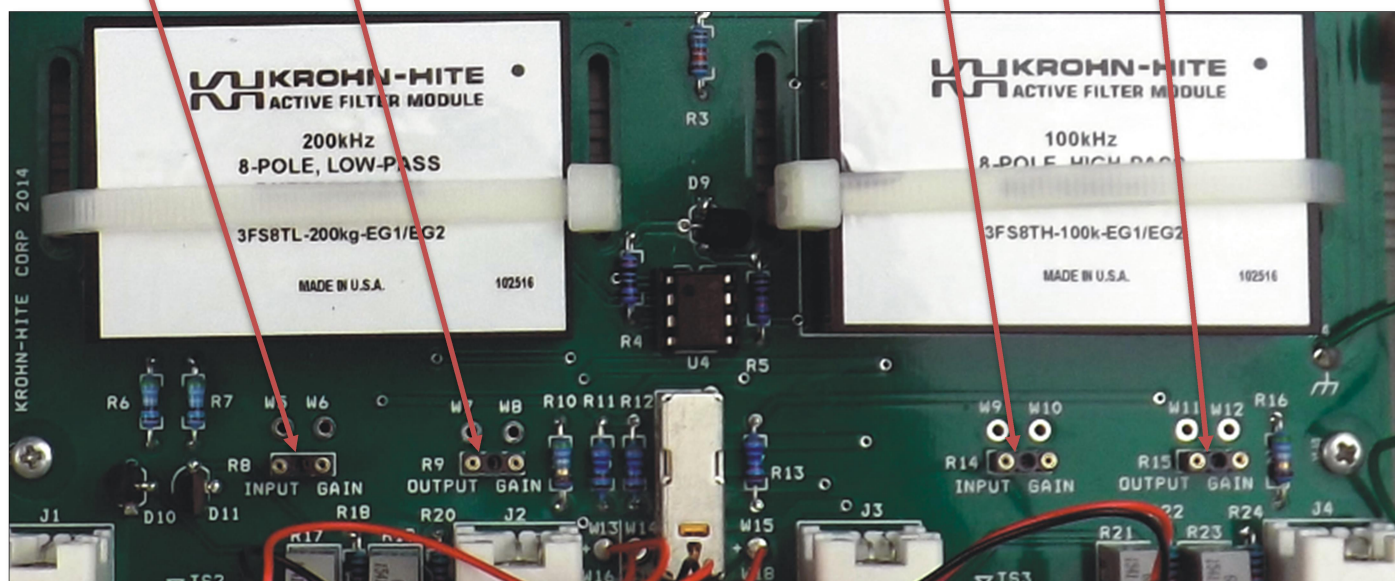


Figure 2.6 - Input/Output Gain Sockets

To calculate the resistor value needed, use the formula below.

Rg = gain resistor value

$$Rg = \frac{1000}{Gain - 1}$$

**Example:** if an input gain of 5 is desired:

$$Rg = \frac{1000}{5-1} \quad Rg = \frac{1000}{4} \quad Rg = \frac{250}{1} = 250 \text{ ohms}$$

So for a gain of 5, a 250 ohm resistor needs to be inserted into the INPUT GAIN Socket of the channel with the needed gain.

Use the same formula for output gain as well.

Gain	Resistor	Gain	Resistor	Gain	Resistor	Gain	Resistor
1	none	26	40	51	20	76	13.3
2	1000.0	27	38.5	52	19.6	77	13.2
3	500.0	28	37.0	53	19.2	78	13.0
4	333.3	29	35.7	54	18.9	79	12.8
5	250.0	30	34.5	55	18.5	80	12.7
6	200.0	31	33.3	56	18.2	81	12.5
7	166.7	32	32.3	57	17.9	82	12.3
8	142.9	33	31.3	58	17.5	83	12.2
9	125.0	34	30.3	59	17.2	84	12.0
10	111.1	35	29.4	60	16.9	85	11.9
11	100.0	36	28.6	61	16.7	86	11.8
12	90.9	37	27.8	62	16.4	87	11.6
13	83.3	38	27.0	63	16.1	88	11.5
14	76.9	39	26.3	64	15.9	89	11.4
15	71.4	40	25.6	65	15.6	90	11.2
16	66.7	41	25.0	66	15.4	91	11.1
17	62.5	42	24.4	67	15.2	92	11.0
18	58.8	43	23.8	68	14.9	93	10.9
19	55.6	44	23.3	69	14.7	94	10.8
20	52.6	45	22.7	70	14.5	95	10.6
21	50.0	46	22.2	71	14.3	96	10.5
22	47.6	47	21.7	72	14.1	97	10.4
23	45.5	48	21.3	73	13.9	98	10.3
24	43.5	49	20.8	74	13.7	99	10.2
25	41.7	50	20.4	75	13.5	100	10.1

**Table 2.1 – Gain Resistor Chart**

### **Option G1 and G2, Front Panel Gain Switches**

The FMB3002 has an optional input (G1) and output (G2) gain switch for each channel. The input gain is selectable in 10dB steps from 0dB to 40dB (gain from 1 to 100). The output gain is selectable in 2dB steps from 0dB to 16dB with a final setting of 20dB (gain from 1 to 10). This will give a total gain of 60dB or a gain of 1,000.

Custom switch selectable gains are also available for the input and output. Consult the factory for details.

### **S (single-ended) and D (differential) Options**

The FMB3002 input configuration must be specified with an FMB3002-S (single-ended) or FMB3302-D (differential) in order for the gain switches provided (G1 and/or G2 option) to operate correctly.