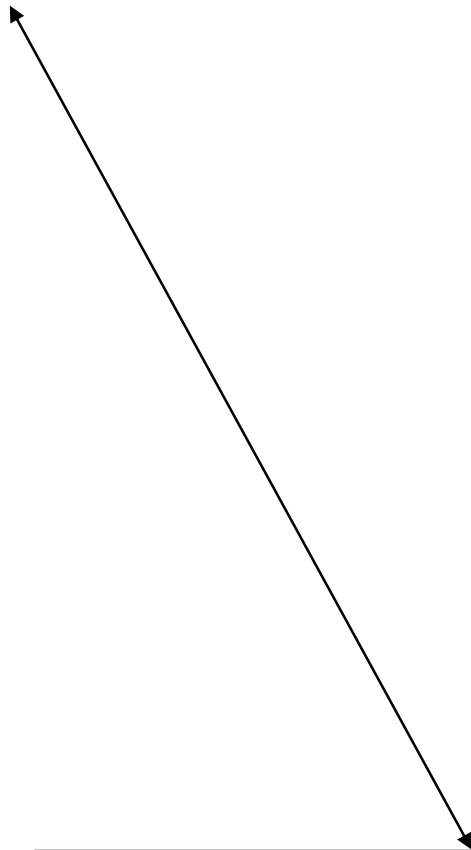




Model FMB3002
2 Channel Filter/Amplifier



Operating Manual

Service and Warranty

Krohn-Hite Instruments are designed and manufactured in accordance with sound engineering practices and should give long trouble-free service under normal operating conditions. If your instrument fails to provide satisfactory service, and you are unable to locate the source of trouble, contact our Service Department at (508) 580-1660, giving all the information available concerning the failure.

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.

All Krohn-Hite products are warranted against defective materials and workmanship. This warranty applies for a period of one year from the date of delivery to the Original Purchaser. Any instrument that is found within the one year warranty period not to meet these standards will be repaired or replaced. This warranty does not apply to fuses or batteries. No other warranty is expressed or implied.

Krohn-Hite Corporation reserves the right to make design changes at any time without incurring any obligation to incorporate these changes in instruments previously purchased.

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

2 Channel, AC/DC Powered Filter/Amplifier Module Box

OPERATING MANUAL



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Figure 1.1 Model FMB3002 Filter/Amplifier

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SECTION 1

GENERAL DESCRIPTION

1.1 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.

AC/BATTERY POWER

The FMB3002 is an ac powered chassis. A rear panel 3-terminal power receptacle is provided for attaching ac source. An ac line switch provided for selecting the proper input line requirement of 120V and 240V. The FMB3002 is also a battery operated chassis that can be powered by two 9V, high energy, lithium batteries. Battery life using the high energy batteries is up to 8 hours when 2 filter modules are installed. Standard alkaline batteries can be used, but the life is typically 2 hours.

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.

BATTERY POWERED

When the FMB3002AC or FMB3002DC is battery operated, two 9V, high energy, lithium batteries are required. High energy batteries are recommended for extended operation. Battery life using the high energy batteries is up to 8 hours when two 3F modules are installed. Standard alkaline battery life is typically 2 hours.

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.

1.2 SPECIFICATIONS

Specifications apply at ±15Vdc or 120V/240V line unless otherwise noted.

Number of Channels: 1 or 2.

Power Supply Voltage (±Vs):

Operating Range: ±11Vdc to ±16Vdc.

Maximum Safe Voltage: ±18Vdc.

Note: Modules plugged into the FMB3002 chassis and the chassis 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.

1.2.1 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): 25µV rms typical, 50µV rms max referred to input.

Noise Spectral Density (100Hz to 300kHz): 40nV/√Hz typical, 100nV/√Hz max.

Signal-To-Noise Ratio (at 7V rms): >100dB.

1.2.2 Input Amplifier Characteristics

1.2.2.1 Single-Ended Input

Maximum Input: ±10V peak.

Coupling: DC.

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

Gain (customer defined): Any fixed value from 1 (0dB) to 100 (40dB), ±3% up to 200kHz. Consult factory for gain bandwidth limitations above 200kHz.

Option G1 (input gain switch): Switch selectable, 0dB to 40dB in 10dB steps, ±3%. Custom values are available. Maximum gain is determined by cutoff frequency. Consult factory for gain bandwidth limitations above 200kHz.

1.2.2.2 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.

For battery operation up to 200kHz, the maximum Common Mode Voltage is less than 9Vdc.

Consult factory for gain bandwidth limitations above 200kHz.

1.2.3 Output Amplifier Characteristics

Maximum Output Voltage: $\pm 10V$ peak.

Maximum Output Voltage: $2V_p \times (1MHz/f)$ for $\geq 1MHz$.

Impedance: 50 ohms.

Gain (customer defined): Any fixed value 1 (0dB) to 100 (40dB), $\pm 3\%$. Consult factory for gain bandwidth limitations above 200kHz.

Option G2 (output gain switch): Switch selectable, 0dB to 16dB in 2dB steps and a final step of 20dB, $\pm 3\%$. Custom values are available. Maximum gain is determined by cutoff frequency. Consult factory for gain bandwidth limitations above 200kHz.

Offset Voltage: Adjustable to zero.

1.2.4 General

Battery Powered Operation: Internal connectors are made available for battery power operation. Recommended batteries are 9V high energy lithium batteries (8 hours) or 9V alkaline (2 hours).

Output Short Circuit Protection: Limited to short duration.

Operating Temperature Range: $0^{\circ}C$ to $+50^{\circ}C$.

Storage Temperature Range: $-25^{\circ}C$ to $+85^{\circ}C$.

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

Weights: 4 lbs (0.9kg).

1.2.5 Options

G1 (input gain control switch):

Switch selectable, 0dB to 40dB in 10dB steps, $\pm 3\%$ up to 200kHz. Custom values are available. Maximum gain is determined by cutoff frequency. Consult factory for gain bandwidth limitations above 200kHz.

Note: *Input type must be selected as differential or single-ended. Modules must not be mixed for gain control to function properly.*

G2 (output gain control switch):

Switch selectable, 0dB to 20dB in 2dB steps to 16dB and 20dB, $\pm 3\%$ up to 200kHz. Custom values are available. Maximum gain is determined by cutoff frequency. Contact factory for gain bandwidth limitations above 200kHz. Note: Input type must be selected as differential or single-ended. Modules must not be mixed for gain control to function properly.

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

The SE (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.

Section 1 – General Description -----

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

The DIFF (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.

1.2.6 Accessories




<p>3F Series (plug-in filter/amplifier modules) Fixed frequency plug-in filter/amplifier module for the FMB3002.</p>	<p>CON-045 Mating connector for differential input, output and rear panel dc power (on FMB3002DC only) connections.</p> 
<p>HEBAT High energy 9V lithium batteries.</p>	<p>CAB-018 Cable, BNC, 3'.</p> 
	<p>FUSE, Part No. 021033 Wickman Siemes 374, 0.125A, slow-blow.</p> 



Figure 1.1 - FMB3002 Front Panel

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SECTION 2 OPERATION

2.1 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.

2.2 POWER REQUIREMENTS

The Model FMB3002 is designed to operate from a single phase, 50-60Hz, ac power source of 105-132, 210-264 volts (FMB3002AC), from an external +/-10V to 15V dc bipolar power source (FMB3002DC), and from $\pm 9V$ batteries (high energy recommended). 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).

For DC battery operation, unplug the FMB3002 from the ac line. The FMB3002 will automatically switch to DC battery operation when batteries have been installed in the unit and the power switch is turned to the ON position.

2.3 TURN-ON PROCEDURE

2.3.1. AC Operation (FMB3002AC)

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 FMB3002AC 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.

WARNING!

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.

CAUTION!

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.

2.3.2. DC Operation (FMB3002DC)

The FMB3002DC is not provided with an AC receptacle for power but is provided with a 3-terminal block connector for connecting the +11 to +15V, -11V to -15V and ground to an external dc bipolar power supply.

To get the maximum output performance, the external supply must be a $\pm 15V$. The output performance will be reduced as explained in the Input and Output Amplifier sections of Section 1.

2.3.3 Battery Operation

When two 9V, high density, lithium batteries are installed, the FMB3002 will automatically switch to battery operation when the ac line power is removed. Plugging the ac line cord into the correct ac power source will automatically switch to ac power. Two 9V, U9VL-J Ultra-life, high density, high energy lithium batteries with a rating of 1.2Ah are recommended. Other 9V batteries may be used with a lower expected operating time.

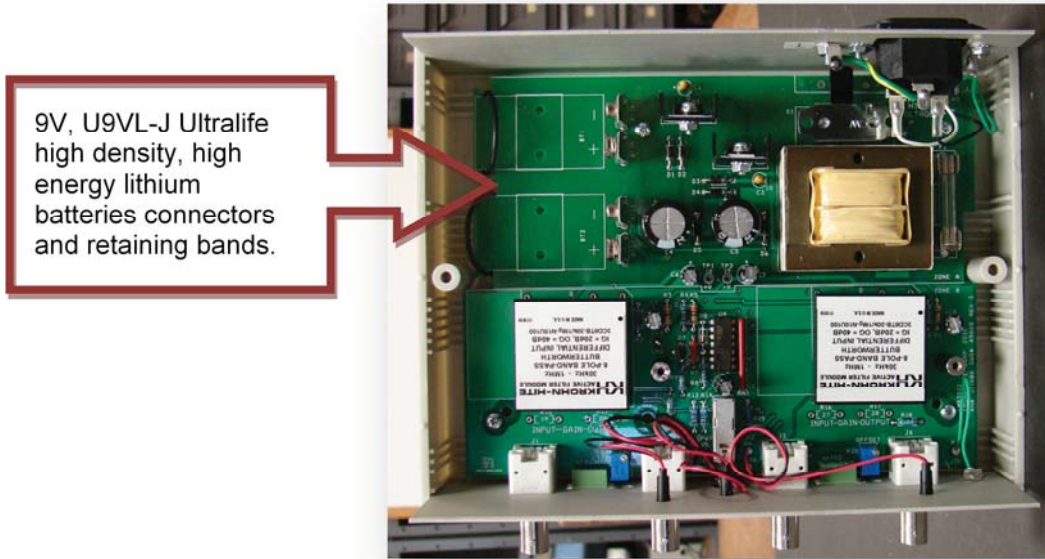


Figure 2.1 - Battery Location

A low battery LED indicator is also provided to warn when the battery life is getting low by flashing on and off.

Note: Always replace both batteries at the same time or performance may be degraded.

2.4 FRONT PANEL CONTROLS AND CONNECTIONS

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.

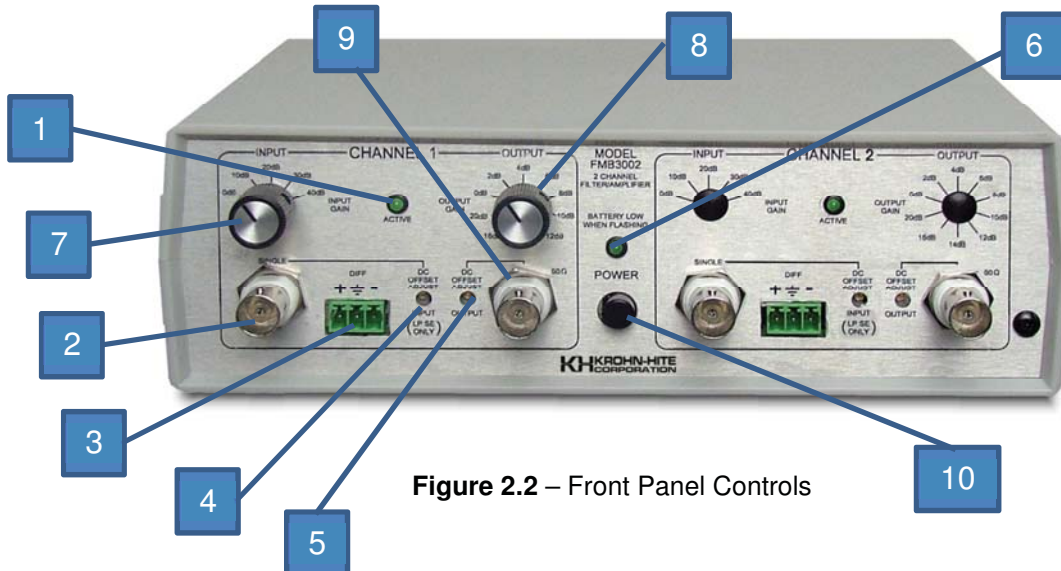


Figure 2.2 – Front Panel Controls

2.4.1. Active LED (1)

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

2.4.2. Input BNC Connectors (2)

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 and 2V peak in battery operation.

2.4.3. 3-Terminal Connector (3)

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.

2.4.4. Input DC Offset Adjustments (4)

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.

2.4.5. Output DC Offset Adjustment (5)

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.

2.4.6. Power LED Indicator (6)

LED to indicate power is on. Flashes when batteries voltage is low.

2.4.7. G1, Optional Input Gain Switch (7)

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

This unit has an ATTENUATION switch with positions of 0dB, -10dB, -20dB, -30dB and -40dB.

2.4.8. G2, Optional Output Gain Switch (8)

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.

2.4.9. Output BNC Connectors (9)

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.

2.4.10. Power Switch (10)

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

2.5 FMB3002AC REAR PANEL

The rear panel of the FMB3002AC 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.**

2.6 FMB3002DC REAR PANEL

The rear panel of the FMB3002DC provides a 3-terminal block connector for applying a bipolar $\pm 11V$ to $\pm 15V$ and ground connection to power the unit.

Section 2 - Operation

2.7 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.

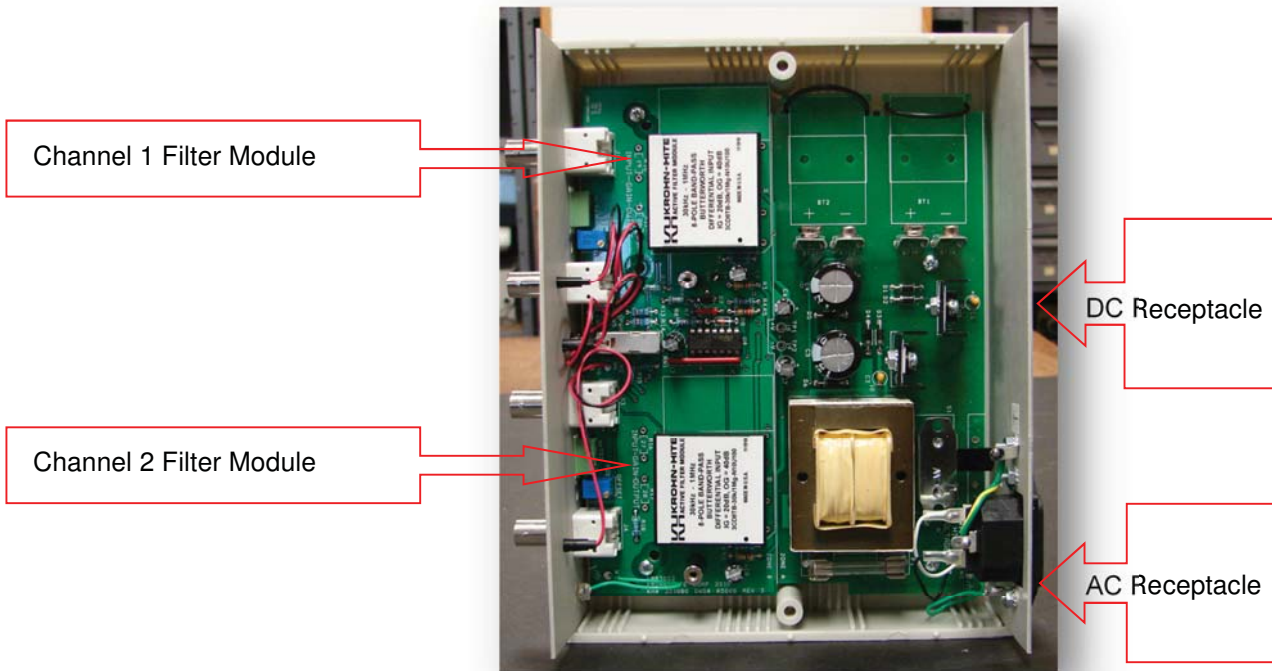


Figure 2.3 – Filter module and AC and DC Receptacle Location

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.

2.7.1 Single-Ended Input Operation

Each channel has Input BNC connectors that are used for single-ended operation. See specifications for max levels in battery mode.

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

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

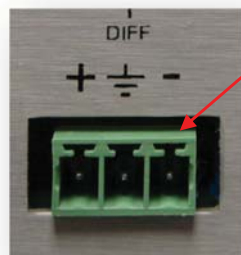


Figure 2.5 – Differential Terminal Block Connector

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

2.7.3 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.

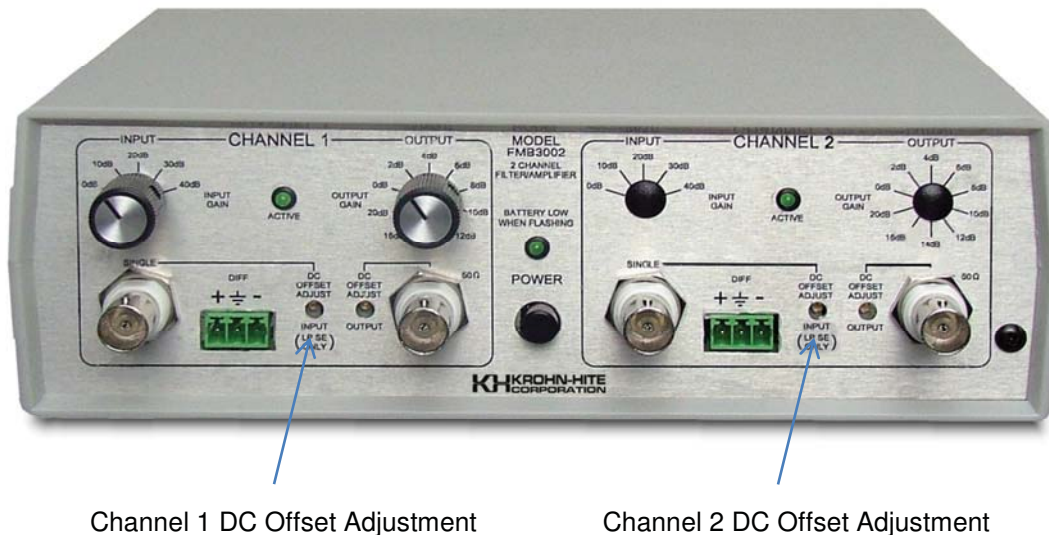


Figure 2.6 – DC Offset Adjustment Locations

2.7.3.1 Single-Ended Input

For units with single-ended input and fixed 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:

2.7.3.2 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.

2.7.4 Option G1 and G2 Front Panel Input (G1) and Output (G2) Gain Switches

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

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

Example of possible 3F module part number with gain options:

1. 3FS8TL-20k-EG1
This is a single-ended input, 8-pole, Butterworth, low-pass with a 20kHz cutoff and External Input Resistor Gain Control.
2. 3FD4SL-1k-EG2
This is a differential input, 4-pole, Bessel, low-pass with a 1kHz cutoff and External Output Resistor Gain Control.
3. 3FD16TH-5-EG1/EG2
This is a differential input, 16-pole, Butterworth, high-pass with a 5Hz cutoff and External Input and Output Resistor Gain Control.

2.7.5 SE and DIFF Options

The FMB3002 must be specified with an SE or DIFF when a 3F Filter Module is installed with the EG1 and/or EG2 options in order for the gain switches provided (G1 and/or G2 option) to operate correctly. If the FMB3002 has not been specified with the SE or DIFF option, and 3F Modules are installed with the EG1 and/or EG2 options, the gain values will not be correct as indicated on the front panel.