



*Model 7000*  
*Low Noise Differential Preamplifier*



*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.*

**Model 7000**  
Low Noise Differential Preamplifier

**OPERATING MANUAL**



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# TABLE OF CONTENTS

<b>1.0 SECTION 1 - GENERAL DESCRIPTION .....</b>	<b>5</b>
1.1 INTRODUCTION .....	5
1.1.1 DESCRIPTION .....	5
1.1.2 APPLICATION .....	5
1.2 SPECIFICATIONS .....	5
1.2.1 INPUT .....	5
1.2.2 FILTERS .....	6
1.2.3 OUTPUT .....	6
1.2.4 GENERAL .....	7
1.2.5 FRONT PANEL .....	7
1.2.6 REAR PANEL .....	7
1.2.7 OPTIONS .....	7
1.2.8 ACCESSORIES .....	7
<b>2.0 SECTION 2 – OPERATION .....</b>	<b>9</b>
2.1 INTRODUCTION .....	9
2.2 POWER REQUIREMENTS .....	9
2.3 TURN-ON PROCEDURE .....	9
2.4 REPLACING THE POWER FUSE .....	10
2.5 FRONT PANEL CONTROLS .....	10
2.5.1 GAIN .....	10
2.5.2 DC OFFSET .....	10
2.5.3 INPUT CONNECTIONS .....	11
2.5.4 INPUT COUPLING .....	11
2.5.5 INPUT + AND – BNC CONNECTORS .....	11
2.5.6 BANDWIDTH (FILTERS) .....	11
2.5.7 OUTPUT CONNECTIONS .....	12
2.5.8 OPTIONAL RMS-TO-DC OUTPUT .....	12
<b>3.0 SECTION 3 – INCOMING ACCEPTANCE .....</b>	<b>15</b>
3.1 INTRODUCTION .....	15
3.2 TEST EQUIPMENT REQUIRED .....	15
3.3 CUTOFF FREQUENCY ACCURACY .....	15
3.4 GAIN ACCURACY .....	15
3.5 NOISE CHECK .....	16

3.6	COMMON MODE REJECTION .....	16
3.7	DISTORTION CHECK .....	16
3.8	AC/DC COUPLING CHECK .....	17



**Figure 1.1 - Model 7000 Low Noise Differential Preamplifier**

## **Certification**

Krohn-Hite Corporation certifies that this product meets its published specifications at the time of shipment.

## **Warranty**

This Krohn-Hite Corporation product is warranted against defects in materials and workmanship for a period of one (1) year from the date of shipment.

## **Service**

For warranty or repair service, this product must be returned to a Krohn-Hite Corporation authorized service facility or to Krohn-Hite directly. Contact must be made with Krohn-Hite Corporation or an authorized representative to receive a Return Authorization before returning this product for repair.

## **Safety and Preparation for Use**

Dangerous voltages, capable of causing injury or death, are present in this instrument.

**Warning!** Use extreme caution whenever the instrument covers are removed. Do not remove the covers while the unit is plugged into a live outlet.

### **Line Voltage**

The Model 7000 accommodates any voltage in the range 105Vac to 132Vac or 210Vac to 264Vac, with a frequency in the range 50Hz to 60Hz.

### **Line Fuse**

The line fuse is internal on the Model 7000 and may be accessed at the rear panel AC receptacle. The fuse is a 0.2A slow-blow.

### **Line Cord**

The Model 7000 has a detachable, three-wire power cord for connection to the power source and to a protective ground. The exposed metal parts of the instrument are connected to the outlet ground to protect against electrical shock. Always use an outlet which has a properly connected protective ground.

## **Service**

Do not attempt to service or adjust this instrument unless another person, capable of providing first aid or resuscitation, is present. Do not install substitute parts or perform any unauthorized modifications to this instrument. Contact the factory for instructions on how to return the instrument for authorized service and adjustment. The Model 7000 is not intended for hot-swapping applications. Be certain to switch power off before inserting or removing plug-in cards in the chassis.

# SECTION 1

## GENERAL DESCRIPTION

### 1.1 INTRODUCTION

#### 1.1.1 DESCRIPTION

The Krohn-Hite Model 7000 Differential Preamplifier provides a low noise high gain amplification to 1MHz with an AC output derived from a very low noise FET instrumentation amplifier and an optional DC (RMS-to-DC converted) output. The Model 7000 has fixed gain settings of x1 (0dB), x10 (20dB), x100 (40dB) and x1000 (60dB) over a selectable bandwidths of 100Hz, 1kHz (HP), 3kHz, 30kHz, 100kHz and 1MHz (LP Off). Noise referred to input is  $7nV\sqrt{Hz}$  and common mode rejection is  $>100dB$  at 1kHz.

The Model 7000 also provides momentary pushbutton switches that control coupling, bandwidth, gain and channel on/off selections. BNC connectors are provided for single-ended and differential input, ac output, and dc output (optional) connections.

The Model 7000 is very useful for troubleshooting sources of noise, amplifiers, power supplies and various other electronic circuits. The Model 7000 is an excellent tool as a preamp for amplifying low level input signals to oscilloscopes or other devices.

### 1.2 SPECIFICATIONS

#### 1.2.1 INPUT

**Configurations:** Single-ended and differential.

**Coupling:** AC (0.16Hz) and DC, switch selectable.

**Impedance:** 1M ohm shunted by 40pF. Each input may be independently enabled or grounded.

**Maximum Input Voltage:** 10V peak with gain set to x1.

**Max Safe Voltage:** Any continuous voltage between  $\pm 30V$ .

**Gains:** 2 pushbutton momentary switches, x1 (0dB), x10 (20dB), x100 (40dB), x1000 (60dB).

**Accuracy:**  $\pm 0.3dB$ .

**Stability:** 200ppm/ $^{\circ}C$ .

**Bias Current:** 15pA typical, 50pA max.

#### CMMR

FREQ	GAIN = 1	GAIN = 10 to 1k
50Hz	$>90dB$	$>105dB$
10kHz	$>75dB$	$>90dB$
50kHz	$>60dB$	$>75dB$

## 1.2.2 FILTERS

**Filtering:** Frequency limited by a switch selectable 12dB/octave filter, with -3dB points of 1kHz, high-pass and 100Hz, 3kHz, 30kHz, 100kHz, low-pass. LP OFF position to turn off low-pass filtering, bandwidth is 1MHz.

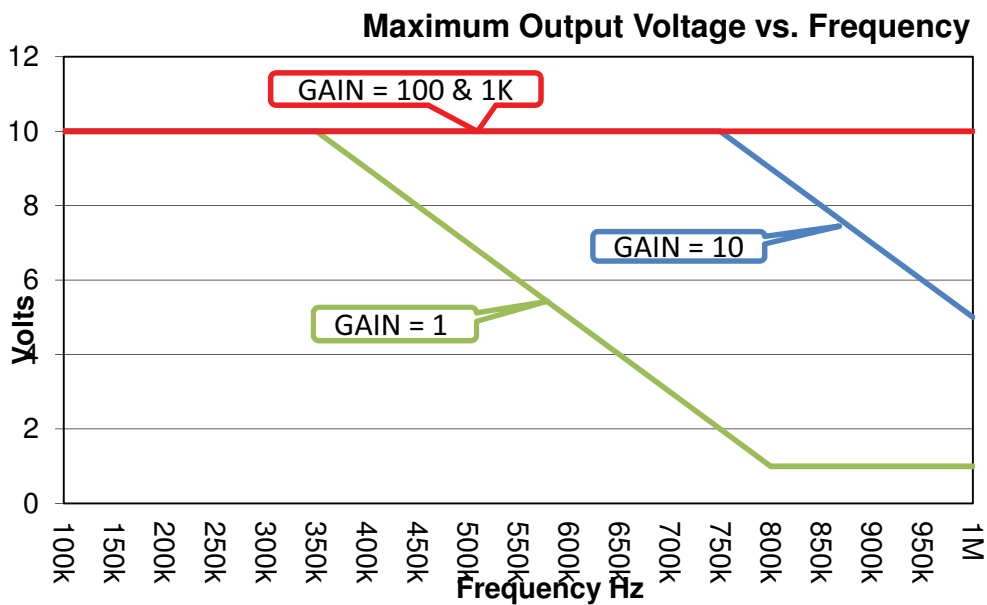
**Wideband Noise (Referred to input, 2MHz Bandwidth Detector)**

GAIN	FILTER OFF (μVrms)	100kHz FILTER (μVrms)
1	120	90
10	14	9
100	10	3.2
1k	10	3.2

**Noise Density (x1k gain setting, all filters off):** 7nV/√Hz typical.

## 1.2.3 OUTPUT

**Maximum Output Voltage:** 10V peak.



**Impedance:** 50 ohms, single-ended.

**Distortion:** 0.005% (-85dB) at 1kHz.

**Offset Voltage:** Adjustable to zero.

## 1.2.4 GENERAL

**Protection:** Input overload protection with automatic recovery.

**Isolation to Chassis:** ±200Vdc.

**Operating Temperature:** 0°C to +45°C.

**Storage Temperature:** -25°C to +70°C.



### 1.2.5 FRONT PANEL

Momentary switches for Coupling, Bandwidth, Input On/Off, and Gain. BNC connectors for + Input, - Input, AC Output and optional RMS-to-DC Output.

### 1.2.6 REAR PANEL

Switch selectable line switch for 115V/230V ac operation, 3-terminal AC line receptacle.

**Power Requirements:** Switch selectable, 105-130, 210-260 volts, single phase, 50-60Hz, 11 watts.

**Dimensions:** 3.5" (9cm) high, 9" (23cm) wide, 8.5" (21.7cm) deep.

**Weight:** Net weight 5 lbs (2.3kg), gross weight 7 lbs (3.2kg).

### 1.2.7 OPTIONS

**RMS to DC Output:** The RMS-TO-DC Output terminal provides a true RMS DC voltage representation of the OUTPUT signal. Range to 10V.

**Frequency Response:**

Amplitude (rms)	1% Error Bandwidth	10% Error Bandwidth
7V	100kHz	1MHz
2V	200kHz	1MHz
1V	200kHz	1MHz
100mV	100kHz	400kHz
10mV	10kHz	40kHz

### 1.2.8 ACCESSORIES

**Rack Mount Kit:** Part No. RK-39 permits the installation of the Model 7000 into a standard, 19" rack spacing.

**CAB-025:** Cable, BNC, 3ft, Low Noise

**Extended 1 Year Warranty:** Part No. EW7000.

Specifications subject to change without notice.

Notes

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## SECTION 2 OPERATION

### 2.1 INTRODUCTION

This section describes the basic operation of the Model 7000. 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 7000 is designed to operate from a single phase, 50-60Hz, ac power source of 105-132, 210-264 volts. This unit is set for 115V operation. A 0.2A (115V) 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).

### 2.3 TURN-ON PROCEDURE

The Model 7000 has been configured for 115V operation and 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.*

The unit is now ready to operate. For low noise applications, it is recommended to use Krohn-Hite's low noise cable, part no. CAB-025.

## 2.4 REPLACING THE POWER FUSE

The top cover of the Model 7000 must be removed to replace the line fuse.

Figure 2.1 below indicates where the fuse is located. The fuse is part number 021039, 0.2A.

### Warning!

Remove the power cord before removing the top cover of the Model 7000.

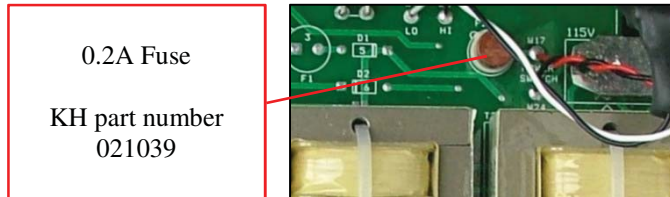
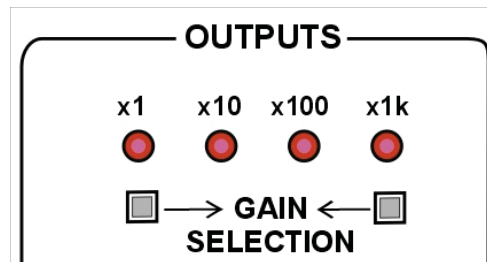


Figure 2.1 – Line Fuse Location

## 2.5 FRONT PANEL CONTROLS

### 2.5.1 GAIN

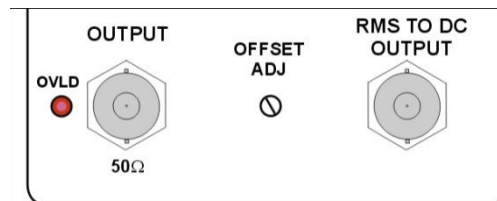
The gain is selectable in 4 steps: x1, x10, x100, x1k. Gain is raised or lowered by pushing [Gain →] or [← Gain] located under the OUTPUTS block on the right side of the panel.



Gain changes are indicated by an illuminated LED below a selected gain setting. Pushing [Gain →] when the gain already selected is x1k, will have no effect. Pushing [← Gain] when the gain already selected is x1, will have no effect.

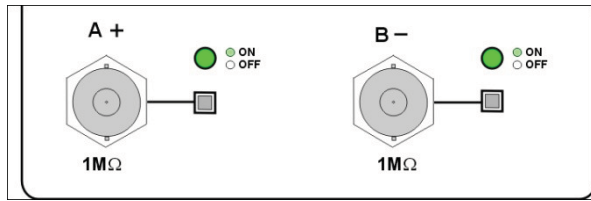
### 2.5.2 DC OFFSET

A DC offset that may appear at the output terminals is adjustable to 0V through a hole in the OUTPUTS block on the front panel. This is accomplished with a small flat head screwdriver and a dc voltmeter connected to the output being adjusted.



### 2.5.3 INPUTS

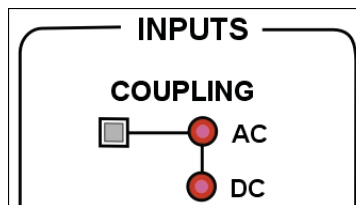
The two input BNC connectors, labeled + and -, are located in the INPUTS block on the front panel. Each Input is selected by pushing the button to the right of each BNC Input Connector. When the LED above the switch illuminates, the input connector is active. When the LED is not illuminated, the input is off.



Each connector accepts a maximum of 10V input and provides an impedance of 1M ohm in parallel with a 40pF. The connector shields are isolated from chassis ground.

### 2.5.4 COUPLING

There are two Input Coupling selections, AC and DC. Pushing the COUPLING button located in the INPUTS block on the front panel will switch between AC or DC input coupling. Each time the button is pushed, either the AC or DC LED located to the right of the button will illuminate. Push the button until the desired setting illuminates.



When coupling is set to AC, a 0.16Hz cutoff high-pass filter is always engaged. The 1kHz high-pass filter can also be selected while AC-coupled.

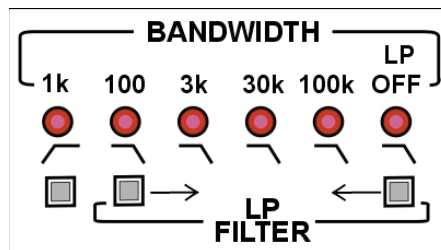
### 2.5.6 INPUT + AND - BNC CONNECTORS

The + and - input BNC connectors have an input impedance of 1M ohm shunted by 40pF. Each input may be independently enabled (on) or disabled (off) by pressing the button to the right of each connector. When both inputs are active and the LEDs are lit, the unit is operating as a differential preamplifier.

### 2.5.5 BANDWIDTH (FILTERS)

The BANDWIDTH block located to the right of the INPUTS block, provide 5 filter selections. One high-pass and four low-pass filters can be selected by pushing the buttons below the LEDs and above the LP FILTER.

Low-Pass Filters reject all frequencies above the selected filter setting at the output. The 1k High-Pass filter rejects all frequencies below 1kHz at the output.



Selecting a LP FILTER is done by pushing [LP FILTER →] or [← LP FILTER] located in the BANDWIDTHS block to the right of INPUTS and the selection is indicated by the illuminated LED below a setting. Settings are 100, 3K, 30K, 100K and LP OFF.

LP OFF deactivates all LP Filters.

Pushing [LP FILTER →] when LP OFF is on will have no effect. Pushing [ ←LP FILTER] when 100 is on will have no effect.

When pushing the 1K button, it toggles the 1kHz filter on and off. The LED below 1K on the panel will illuminate, indicating that the filter is active.

### **2.5.7 OUTPUT**

The OUTPUT terminal provides an output signal from the input signal that has been either amplified and/or filtered. The maximum output voltage is 10V. Signal ground is floating from chassis.

### **2.5.8 OPTIONAL RMS-TO-DC OUTPUT**

The RMS-TO-DC Output terminal provides a true RMS DC voltage representation of the OUTPUT signal. Range is 0V to 10V. Signal ground is floating from chassis.

# SECTION 3

## INCOMING ACCEPTANCE

### 3.1 INTRODUCTION

The following procedure should be used to verify that the Model 7000 preamplifier is operating within specifications. These checks may be used for incoming acceptance and periodic performance checks. Tests must be made with all covers in place and operating for a minimum of 30 minutes to reach operating temperature.

### 3.2 TEST EQUIPMENT REQUIRED

The test equipment below is required to perform the following tests:

- a. Low Distortion RC Oscillator: Krohn-Hite Model 4402B or equivalent.
- b. RC Oscillator: 10Hz to 10MHz.
- c. AC Volt meter: capable of measuring 100 $\mu$ V to 10Vrms, 10MHz bandwidth, Fluke Model 8920A or equivalent.
- d. Frequency Counter.
- e. Distortion Analyzer: Krohn-Hite Model 6900B or equivalent.
- f. 2MHz, Low Noise Filter: Krohn-Hite Model LPNF or equivalent.

### 3.3 CUTOFF FREQUENCY ACCURACY

Place BNC tees on the oscillator's output and the preamplifier's '+' input and set the preamplifier's input to '+ only' (press the B inputs on/off button until the LED is off).

Connect the frequency counter to the oscillator, the oscillator to the preamplifier '+' input, and the AC meter to the preamplifier input.

Set the gain to X1 and set the Lo-pass cutoff frequency to "LP OFF".

Set the preamplifier's high-pass filter to on and set the oscillator to 1 kHz, 1VRMS.

Set the meter to read 0dB (dB and REL mode on the Fluke 8920).

Connect the meter to the preamplifier output; adjust the oscillator frequency to get -3dB.

The frequency on the counter should be 1 kHz  $\pm$ 5%.

Turn off the high-pass filter (using the button under the 1k LED).

Re-reference the volt meter at each new frequency since the amplitude of the generator may change with changes in frequency.

Set the Lo-pass cutoff frequency to 100Hz adjust the oscillator frequency for -3dB; the counter should read 100Hz  $\pm$ 5%.

Repeat the above procedure for 3 kHz, 30 kHz and 100 kHz. Remember to re-reference the volt meter at each new frequency.

### 3.4 GAIN ACCURACY

With a BNC tee, connect both the oscillator and the AC meter to the preamplifier '+' Input.

Set the preamplifier's cutoff frequency to LP OFF and the high-pass filter to off.

With the meter in volts mode, set the oscillator to 1 kHz, and about 700mVrms.

Set the meter to read 0dB (dB and REL mode on the Fluke 8920).

Connect the meter to the preamplifier output. Set the input gain to x 10 (20dB), the meter should read 19.7 to 20.3dB.

Connect the meter to the preamplifier's '+' Input and set it to volts mode.

Set the oscillator to about 70mVrms.

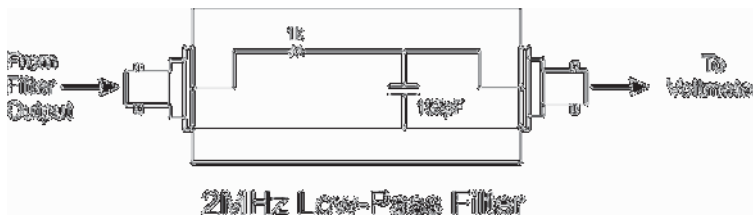
Set the meter to read 0dB (dB and REL mode on the Fluke 8920).  
Connect the meter to the preamplifier's output.  
Set the input gain to x 100 (40dB), the meter should read 39.7 to 40.3dB.

Connect the meter to the preamplifier's '+' input and set it to volts mode.  
Set the oscillator to about 10mVrms.  
Set the meter to read 0dB (dB and REL mode on the Fluke 8920).  
Connect the meter to the preamplifier's output.  
Set the input gain to x 1k (60dB), the meter should read 59.7 to 60.3dB.

It is important that the generator has low noise; passive BNC attenuators if needed produce the best results, placed at the preamplifier's input.

### 3.5 NOISE CHECK

Turn off both inputs of the preamplifier, set the gain to X1, and the cutoff frequency to LP OFF.  
Connect a 2MHz low pass, passive filter, shown in the following Figure to the ac volt meter and, using a short coax BNC cable, connect it to the preamplifier's output.



Volt meter reading should be 90 $\mu$ V or less.  
Set the preamplifier gain to X10. The voltmeter reading should be 130 $\mu$ V or less.  
Set the preamplifier gain to X100. The voltmeter reading should be 1.2mV or less.  
Set the preamplifier gain to X1k. The voltmeter reading should be 12mV or less.

### 3.6 COMMON MODE REJECTION

Set the preamplifier's bandwidth to LP OFF and turn off the high-pass filter.  
Set the gain to x 1k.  
Set the generator to 50 Hz at 7Vrms.  
Connect the generator to the + and – inputs simultaneously.  
Connect the ac volt meter to the preamplifier output. Reading should be < 35mVrms.  
Set the generator to 50 kHz. AC volt meter should read < 1.2Vrms.

### 3.7 DISTORTION CHECK

Set the preamplifier to a cut off frequency of 100 kHz in the low-pass mode with 0dB of gain.  
Connect a low distortion oscillator to the INPUT and apply a 1Vrms signal at 1 kHz.

#### CAUTION:

If the distortion is excessive, verify that the distortion of the oscillator being used is <0.004%. Monitor the OUTPUT of the preamplifier with a distortion analyzer.  
The reading should be <0.005%.

Disconnect oscillator and distortion analyzer.



### **3.8 AC/DC COUPLING CHECK**

Apply a 1Vdc signal to the + INPUT of the preamplifier.

Ground the – input of the preamplifier.

Set the gain to 0dB.

Set the 1 kHz high-pass filter to the off position.

In the DC COUPLED mode, the OUTPUT of the preamplifier should be approximately 1Vdc and approximately 0Vdc in the AC COUPLED mode.

End of Test.

