Model 7008

Remote Programmable
Up to 8 Channel Low Noise
Differential Preamplifier

KROHN-HITE CORPORATION

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 7008

Remote Programmable 8 Channel
Low Noise Differential Preamplifier

OPERATING MANUAL

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Model 7008, 8 Channel Low Noise Differential Preamplifier

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GENERAL INFORMATION

Certification - Krohn-Hite certifies that this product meets 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.

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 7008 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 located on the rear of the 7008. The fuse is a 3/4A slow-blow for 120V applications and a 3/8A slow-blow for 240V applications.

Line Cord - The Model 7008 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.

Warranty 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.

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 7008 is not intended for hot-swapping applications. Be certain to switch power off before inserting or removing plug-in cards in the chassis.

Repackaging for Shipment - The original packing materials should be saved for reshipment of the Model 7008 if needed. If the original packing materials are not available, wrap the instrument in polyethylene sheeting or equivalent and place in a strong box, cushioning it on all sides by at least three inches of high-density foam or other filler material.

Definitions - A Bracket set [ ] indicates a button.

SECTION 1
GENERAL DESCRIPTION

1.1 INTRODUCTION

The Krohn-Hite Model 7008 is a two to eight channel Differential Preamplifier providing low noise and high gain amplification to 1MHz. The output of the 7008 is derived from using a very low noise FET instrumentation amplifier. Noise referred to input is 7nVvHz and common mode rejection is >100dB at 1kHz. The Model 7008 has fixed gain settings of x1 (0dB), x10 (20dB), x100 (40dB) and x1000 (60dB).

The 7008 provides momentary pushbutton switches that control input coupling, 100kHz filtering, gain, channel selection, shunt resistor for low level signal applications, input configuration and local/remote/edit selections. BNC connectors are provided for single-ended and differential input configurations, and for the amplified output. All settings can be edited and monitored with the 16 character, 2-line front panel display.

Optional USB or LAN remote control is available for the 7008. All front panel functions, with the exception of power on, can be controlled remotely with either option. See Section 3 for programming information.

The 7008 is an excellent preamp for amplifying low level input signals to oscilloscopes or other devices. The 7008 is also very useful for troubleshooting sources of noise, amplifiers, power supplies and various other electronic circuits.

1.2 SPECIFICATIONS

1.2.1 INPUT

Configurations: Single-ended and differential, selectable.
Coupling: AC (0.16Hz, 0.16mHz for optional 7008-10) and DC, selectable.
Impedance: 1M ohm (1G ohm for Model 7008-10) shunted by 40pF. Each input may be independently enabled or grounded.
Input Shunt Resistor: 50, 500, 5k and 50k ohm ±0.3%, and open, selectable.

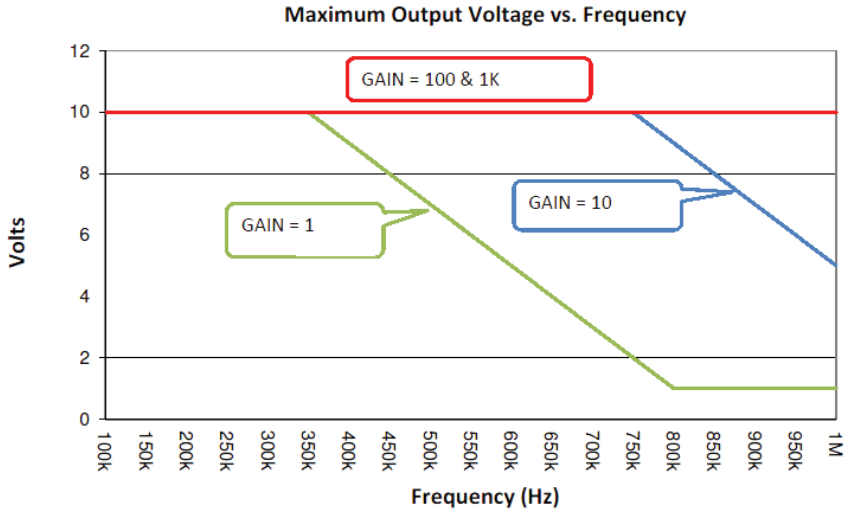
Resistor Value (1/4W, ohms)	Maximum Current (amps)	Maximum Voltage	Maximum Power Across Shunt Resistor (watts)
50	0.05	2.5	0.125
500	0.016	8	0.128
5,000 (5k)	0.002	10*	0.020
50,000 (50k)	0.0002	10*	0.002
*Maximum power limited by maximum voltage of 10V.			

Maximum Input Voltage: 10V peak with gain set to x1.
Max Safe Voltage: Any continuous voltage between ±30V (for 7008-10 option: ±15V).
Gains: x1 (0dB), x10 (20dB), x100 (40dB), x1000 (60dB), selectable.
Accuracy: ±0.3dB.
Stability: 200ppm/°C.
Bias Current: ±5pA typical, 50pA max.
CMMR:

Freq	Gain = 1	Gain = 10 to 1k
50Hz	>90dB	>102dB
10kHz	>75dB	>87dB
50kHz	>60dB	>72dB

1.2.2 OUTPUT

Maximum Output Voltage: 10V peak.
Frequency Response:



Wideband Noise (RMS - 2MHz Bandwidth Detector)

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

Noise Density (x1k gain setting, filter off): 7nV/√Hz typical.
Impedance: 50 ohms, single-ended.
Distortion: 0.005% (-85dB) at 1kHz.
Offset Voltage: Adjustable to zero.

1.2.3 100kHz FILTER

Cutoff Frequency: 100kHz, 2-pole, 12dB/octave; selectable. Selections are on and off.

1.2.4 FRONT PANEL

Momentary Pushbutton Switches: For setting Channel, Input Configuration, 100kHz Filter, Input Coupling, Gain,
Shunt Resistor and Local/Remote/Edit modes of operation.
DC Offset Adjustment Potentiometer: Range, approximately ±30mVdc.
Display: 2-line, 16 character.

1.2.5 GENERAL

Power Requirements: Switch selectable, 90-130, 210-260 volts, single-phase, 50-60Hz, 50W.
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.
Dimensions: 4“ (10.28cm) high with feet, 3.5" (9cm) high without feet; 14.15" (36.36cm) wide; 14.3” (36.75cm) deep.
Weights: 12 lbs (5.4kg) net, 14 lbs (6.3kg) shipping.
Certification: A Certificate of Compliance is issued with each new instrument to certify the calibration and traceability to N.I.S.T.
Warranty: ONE FULL YEAR warranty on parts and labor includes specifications and performance.

1.2.6 OPTIONS

LAN-COM: LAN remote control.
USB-COM: USB remote control.
7008-10: Input impedance is 1G ohm.
Extended 1 Year Warranty: Part No. EW7008.

1.2.7 OPTIONAL ACCESSORIES

Rack Mount Kit: Part No. RK-314 consists of 2 angle brackets with handles that permit the installation of the Model 7008 into a standard, 19" rack spacing.

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

Specifications is subject to change without notice.

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SECTION 2
OPERATION

2.1 INTRODUCTION

This section describes the basic operation of the Model 7008. 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.

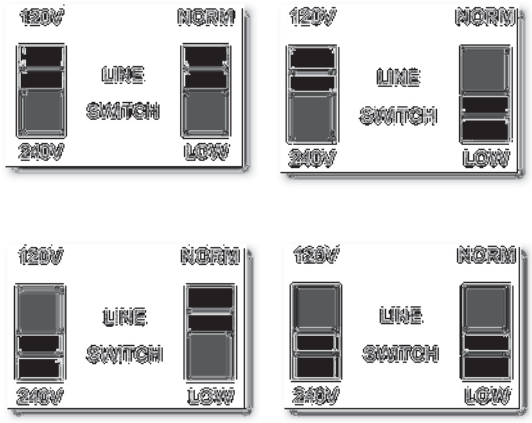
2.2 POWER REQUIREMENTS

The Model 7008 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 at the time of shipment. Fuse requirement is 0.75A (120V) or 0.375A (230V) slow, blow with a 250V rating.

2.3 TURN-ON PROCEDURE

Before turning on the 7008, check to see that the line switches on the rear panel are set to the correct AC Power Line requirements for your area. Refer to the chart below.

LINE SWITCH SETTING		
LINE	OPERATING RANGE	
120V	NORM	103V - 132V
	LOW	95V - 116V
240V	NORM	210V - 264V
	LOW	190V - 244V



Make sure the POWER switch is in the OFF position. Plug the line cord into the unit and then into the ac outlet.

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

CAUTION!
Because of the potentially dangerous voltages that exist within the unit, the cover 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 number CAB-025.

2.4 FRONT PANEL DISPLAY AND CONTROLS

The Model 7008 provides a 16-character, 2-line DISPLAY that indicates the status of all parameters and modes of each channel as shown in Figure 2.1 below. When turn-on, the display will indicate: Krohn-Hite 7008. All functions are available by front panel control and remote control. An audible beep for tactile feel is provided and will sound with each button press.

2.4.1 MODE

The 7008 provides 3 Modes of operation, Remote, Local and Edit. Remote and local modes are controlled by pressing the [LOCAL/REMOTE] button. Edit mode becomes active when a parameter is changed when in the local mode. See EDIT below for full details.

a) LCL, local control
b) REMOTE, remote control
c) EDIT, Edit mode (You will need to press [SAVE EDIT] to change output settings once altered.)

2.4.1.1 LCL (local mode)

When LCL is displayed all front panel controls are active. Pressing the [LOCAL/REMOTE] button will return the 7008 to remote control.

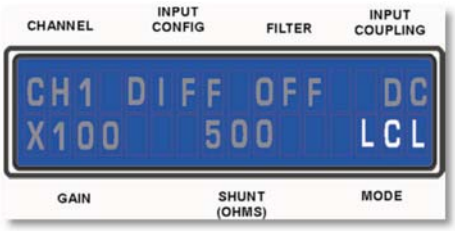


Figure 2.1 – Local Mode Display

2.4.1.2 EDIT (edit mode)

The EDIT mode becomes active whenever a parameter button is pressed. In this mode you can changed the settings of any or all channels if desired and saved to non-volatile memory.

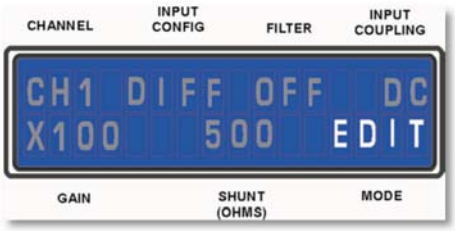


Figure 2.2 – EDIT Mode Display

Once the parameter change(s) are set, pressing the [SAVE EDIT] button will save the setting for that channel. If in ALL channel, all parameter changes will be saved to all channels.

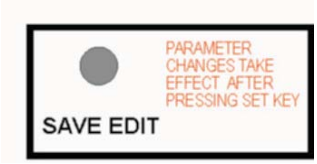


Figure 2.3 – [SAVE EDIT] Mode Button

Parameters are changed by pressing the button associated with that parameter. When a button is pressed, the LCL display will change to EDIT indicating that you have entered the EDIT mode and will need to press the [SAVE EDIT] button to save one or all changes made to that channel.

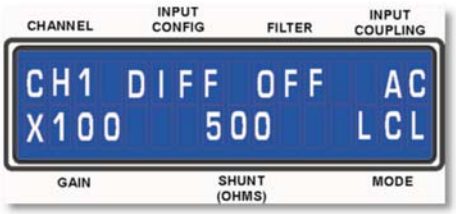


Figure 2.4 – Front Panel Display

When the CHANNEL display indicates ALL, dashes will appear in the display, indicating that a parameters need to be set. In this mode, all parameters have to be entered with a value or the display will indicate the following:

Not All
Parameters Set

If a Channel is defective or there is no card in a Channel slot, the display will indicate a NO CHANNEL with the Channel number that is missing or defective as indicated in Figure 2.5 below.

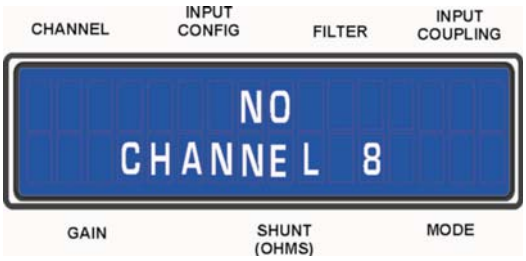


Figure 2.5 – Missing or Defective Card

2.4.1.3 REMOTE (remote mode)

When REM is displayed all front panel control are disabled, with the exception of the [LOCAL/REMOTE] button. When in Remote mode, pressing this button will return the 7008 to local control.

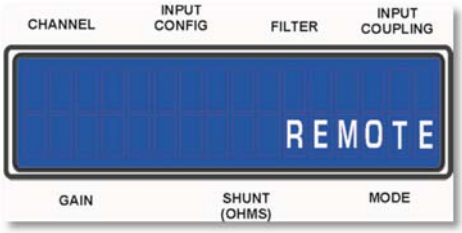


Figure 2.6 – Remote Mode Display

ERROR INDICATOR

When the 7008 is placed into the REMOTE mode, a beep tone is activated. When any parameter button is pressed, a beep tone will sound, indicating the 7008 is in REMOTE operation. Pressing the [REMOTE/LOCAL] button toggles between REMOTE and LOCAL, and when the 7008 is in REMOTE, will return the unit to LOCAL operation.

2.4.2 CHANNEL UP, CHANNEL DOWN CONTROL

Pressing the [CHANNEL UP] and [CHANNEL DOWN] buttons will display each channel's current set-up.

Figure 2.7 – [Channel Up] Button

Figure 2.8 [Channel Down] Button

Each channel's parameters are entered independently or all at one time in the ALL channel mode. When setting or changing a specific channel's parameters, the output signal for that channel will not change until the [SAVE EDIT] button is pressed. The same is true for the ALL channel mode.

A single parameter can be changed on a channel and pressing the [SAVE EDIT] button will accept the change; but when ALL Channel is selected, all parameters must be entered in order to be accepted by the [SAVE EDIT] action. If all the parameters are not entered, the display will indicate: Not All Parameters Set. The display will then returns with the settings that were already set before the [SAVE EDIT] button was pressed, while ---- indicate the remaining parameters that need to be set. Pressing [SAVE EDIT] will complete the changes made.

If a parameter is changed and [CHANNEL UP] or [CHANNEL DOWN] button is pressed, and [SAVE EDIT] button is not pressed, the parameters will not change.

2.4.3 SETTING PARAMETERS

Each parameter of the Model 7008 can be set either manually or by remote control. The following information will describe what parameter can be set and how to set them.

2.4.3.1 INPUT CONFIGURATION

There are two input connectors located at the INPUT section of the front panel. The following will describe how to select either single-ended (+ or -), differential (DIFF), or OFF (ground) the inputs. The + and - inputs are voltage inputs with 1 MΩ (1G optional) in parallel with a 40pF, input impedance. Their connector shields are completely isolated from chassis ground, but can be made common with chassis ground by connecting the shield of the BNC connector to chassis ground.

When connected in this manner, the chassis of the unit is always be connected to the grounding conductor of the AC power cord. The inputs are protected to 30V, however to prevent clipping, the input should never exceed 10V peak with a gain of X1. The maximum DC input before overload depends on the gain value selected.

Preventing Ground Loops

Ground loops are troublesome in analog measurements and can degrade the signal by adding unwanted noise to the system. To achieve the lowest possible noise, proper grounding techniques are important.

To minimize the possibility of a ground loop when connecting to the 7008, connect all equipment, if possible, to the same AC strip and make certain that all third wire ground pins are on the plugs. Use a central ground point for your entire test setup. If you are using shielded cables, connect the shield to only one end and keep all wiring and cabling as short as possible; avoid looping wires and cables.

There are 4 ways to configure the input of the 7008. Pressing the [INPUT CONFIG] button will cycle through the desired settings.

Figure 2.9 – [Input Config] Button

+SE: Plus
Plus single-ended input BNC active, -input BNC is grounded.

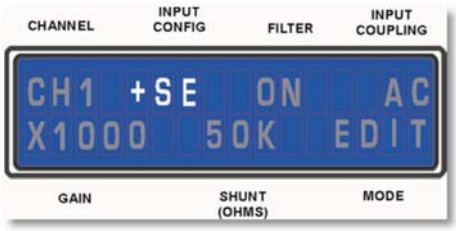


Figure 2.10 – Plus Single-Ended Input Display Setting

-SE: Minus
Minus single-ended input BNC active, +input BNC is grounded.

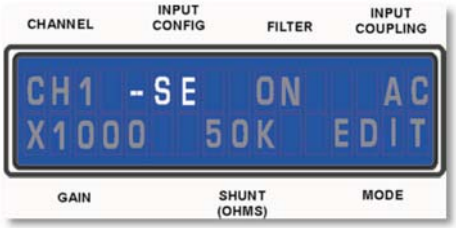


Figure 2.11 – Minus Single-Ended Input Display Setting

DIFF (lowest noise configuration)
Differential input, both input BNC's active, BNC shield grounded. When used with a single-ended output, connect the minus to the source ground.

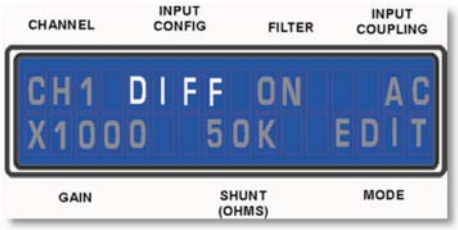


Figure 2.12 – Differential Input Display Setting

OFF
Both inputs are grounded. Useful for nulling dc offsets.

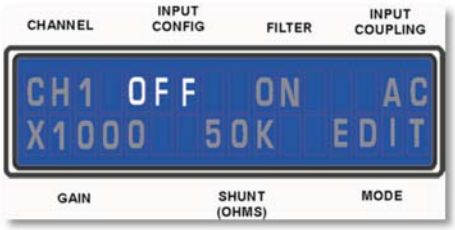


Figure 2.13 – OFF, Both Inputs Grounded Display Setting

Figure 2.14 – [SAVE EDIT] Button

Note: While changes are made to the Input Configuration, the selected configuration of the channel displayed will not change until the [SAVE EDIT] button is pressed. You can press [SAVE EDIT] as each parameter is changed, or you can wait until all changes to each parameter are made.

2.4.3.2 100kHz LOW-PASS FILTER

A 100kHz, 2-Pole (12dB/octave), low-pass filter is provided on the 7008 to limit the bandwidth of the signal to reduce any high frequency noise within the signal. The normal operating frequency of the 7008 is DC to 1MHz in the DC coupled mode and 0.16Hz (0.16mHz with the 7008-10 option) to 1MHz in the AC coupled mode. When the FILTER is activated, the 7008's upper frequency output is limited to 100kHz.

Pressing the [FILTER] button shown below will cycle the 100kHz filter ON and OFF.

Figure 2.15 – [FILTER] Button

Figure 2.16 - 100kHz, Low-Pass Filter ON Display Setting

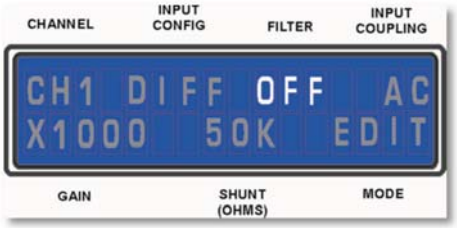


Figure 2.17 - 100kHz Filter OFF Display Setting

> Note: While changes are made to FILTER, the filter value selected on the channel displayed will not change until the [SAVE EDIT] button is pressed.

2.4.3.3 INPUT COUPLING

Pressing the [INPUT COUPLING] button, shown in the Figure 2.19, will switch between AC or DC input coupling.

The 7008 provides AC and DC coupling of the input signal. AC coupling consists of using a capacitor to filter out the DC signal component from a signal with both AC and DC components in it. When AC coupled, the DC component of the signal acts as a voltage offset, and removing it from the signal can increase the resolution of signal measurements. The capacitor in the 7008 is in series with the signal and will pass all AC frequencies from 0.16Hz (0.16mHz with 7008-10 option) to 1MHz. The 100kHz low-pass filter can also be selected while AC-coupled.

DC coupling is described as any voltage signal acquisition where both AC and DC components are measured.

Figure 2.19 – [Input Coupling] Button

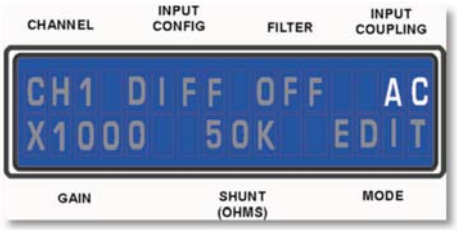


Figure 2.20 – AC Coupling Display Setting
Display Setting

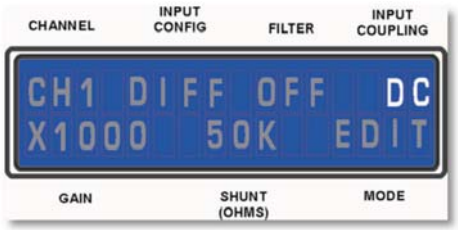


Figure 2.21 – DC Coupling

Note: While changes are made to INPUT COUPLING, the coupling value selected on the channel displayed will not change until the [SAVE EDIT] button is pressed.

2.4.3.4 GAIN

A preamplifier is often placed close to a sensor to reduce the effects of noise and interference on the input signal. It is used to amplify the signal to drive the cable to the data collection instrument without significantly degrading the signal-to-noise ratio of the signal. The noise performance of a preamplifier is critical. When the gain of the preamplifier is high, the signal-to-noise ratio of the final signal is determined by the signal-to-noise ratio of the input signal and the noise of the preamplifier.

The Model 7008 incorporates 4 GAIN selections for improving the signal-to-noise ratio of the input signal. They are:

a) X1, Unity gain or no gain
b) X10, 20dB
c) X100, 40dB
d) X1000, 60dB

To select the desired gain, press the [GAIN] button, shown in Figure 6 below, until the desired gain is achieved.

Figure 2.22 – [Gain] Button

X1 (Unity Gain, 0dB)

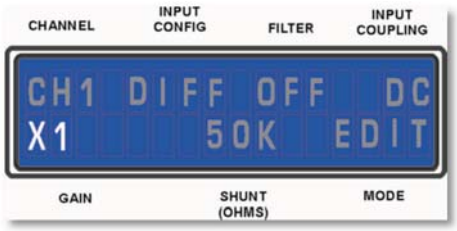


Figure 2.23 – X1 Gain Display Setting

X100 (40dB Gain)

Figure 2.24 – X100 Gain Display Setting

X10 (20dB Gain)

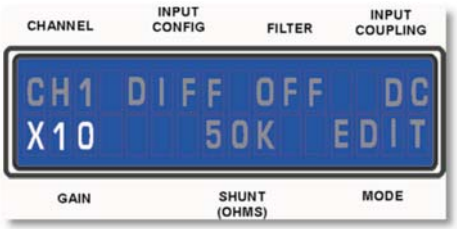


Figure 2.25 – X10 Gain Display Setting

X1000 (60dB Gain)

Figure 2.26 - X1000 Gain Display Setting

Note:	While changes are made to GAIN, the Gain value selected on the channel displayed will not change until the [SAVE EDIT] button is pressed.

2.4.3.5 SHUNT (OHMS)

A selectable input shunt resistor is provided in the 7008. This shunt resistor provides a means to measure the source current from the source device by connecting a current meter across the input terminals of the 7008.

Resistor Value (1/4W, ohms)	Maximum Current (amps)	Maximum Voltage (volts)	Maximum Power Across Shunt Resistor (watts)
50	0.05	2.5	0.125
500	0.016	8	0.128
5,000 (5k)	0.002	10*	0.020
50,000 (50k)	0.0002	10*	0.002
*Maximum power limited by maximum voltage of 10V.			

To select the desired shunt resistor, press the [SHUNT] button, shown in the Figure 2.27 below, until the desired resistor is selected.

Figure 2.27 – [Shunt Resistor] Button

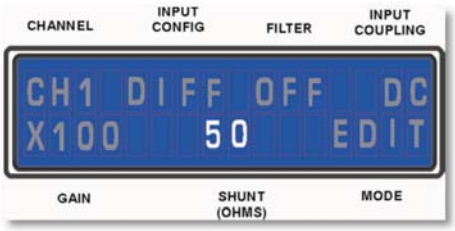


Figure 2.28 – 50 Ohm Shunt Display Setting

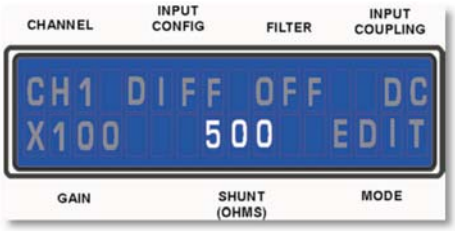


Figure 2.29 – 500 Ohm Shunt Display Setting

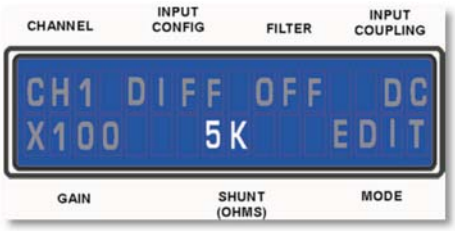


Figure 2.30 – 5k Shunt Display Setting

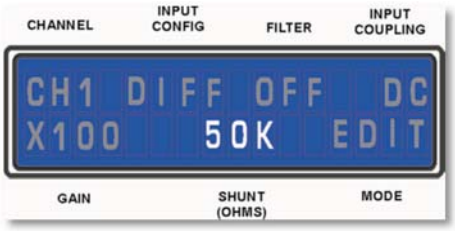


Figure 2.31 – 50k Shunt Display Setting

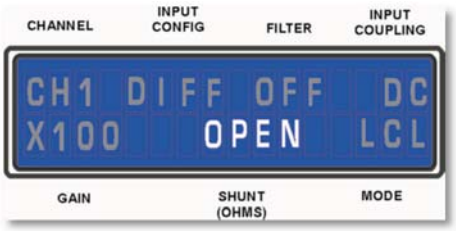


Figure 2.32 – OPEN Shunt Display Setting

Note: While changes are made to the Shunt value, the resistor value selected of the channel displayed will not change until the [SAVE EDIT] button is pressed.

2.4.4 DC OFFSET

A DC offset that may appear at the output terminals is adjustable to 0V by an independent DC OFFSET ADJUST located on the front panel of each channel. The DC Offset can be adjusted using a small flat screwdriver and a dc voltmeter connected to the output of the channel being adjusted. Both input terminals for that channel need to be shorted to ground before making the adjustment.

Figure 2.33 – DC Offset Adjust

2.4.5 INPUT + AND - BNC CONNECTORS

The + and – input BNC connectors have an input impedance of 1G ohm shunted by 40pF. Each input is independently controlled by pressing the [INPUT CONFIG] button for the channel selected. See paragraph 2.4.3.1 Input Configuration.

Figure 2.34 – Input/Output BNC Connectors

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SECTION 3
INCOMING ACCEPTANCE

3.1 INTRODUCTION

The following procedure should be used to verify that the Model 7008 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 Voltmeter: Capable of measuring 100µV to 10Vrms, 10MHz bandwidth. Fluke Model 8920A or equivalent.
d. Frequency Counter.
e. Distortion Analyzer: Krohn-Hite Model 6900B or equivalent.
f. 2MHz Low-Pass Filter, Krohn-Hite Model LPNF or equivalent.

3.3 GAIN ACCURACY

1. With a BNC tee, connect both the oscillator and the AC meter to the preamplifier '+' Input.
2. Set the preamplifier's FILTER to OFF.
3. With the meter in volts mode, set the oscillator to 1 kHz, and about 700mVrms.
4. Set the meter to read 0dB (dB and REL mode on the Fluke 8920).
5. Connect the meter to the preamplifier output. Set the input gain to x 10 (20dB), the meter should read 19.7 to 20.3dB.
6. Connect the meter to the preamplifier's '+' Input and set it to volts mode.
7. Set the oscillator to about 70mVrms.
8. Set the meter to read 0dB (dB and REL mode on the Fluke 8920).
9. Connect the meter to the preamplifier's output.
10. Set the input gain to x 100 (40dB), the meter should read 39.7 to 40.3dB.
11. Connect the meter to the preamplifier's '+'input and set it to volts mode.
12. Set the oscillator to about 10mVrms.
13. Set the meter to read 0dB (dB and REL mode on the Fluke 8920).
14. Connect the meter to the preamplifier's output.
15. 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.

3.4 NOISE CHECK

1. Turn off both inputs of the preamplifier, set the gain to X1.
2. 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.

Figure 3.1 – Model 7008 Preamplifier and Model LPNF 2MHz Low-Pass Filter

3. Voltmeter reading should be 90µV or less.
4. Set the preamplifier gain to X10. The voltmeter reading should be 130µV or less.
5. Set the preamplifier gain to X100. The voltmeter reading should be 1.2mV or less.
6. Set the preamplifier gain to X1k. The voltmeter reading should be 12mV or less.

3.5 COMMON MODE REJECTION

1. Set the preamplifier's FILTER to OFF.
2. Set the gain to x 1k.
3. Set the generator to 50 Hz at 7Vrms.
4. Connect the generator to the + and – inputs simultaneously.
5. Connect the ac volt meter to the preamplifier output. Reading should be <45mVrms.
6. Set the generator to 50 kHz. AC volt meter should read <1.6Vrms.

3.6 DISTORTION CHECK

1. Set the preamplifier to a cut off frequency of 100 kHz in the low-pass mode with 0dB of gain.
2. 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.
3. The reading should be <0.005%.
4. Disconnect oscillator and distortion analyzer.

3.7 AC/DC COUPLING CHECK

1. Apply a 1Vdc signal to the + INPUT of the preamplifier.
2. Ground the – input of the preamplifier.
3. Set the gain to 0dB.
4. Set the FILTER to the off position.
5. Set COUPLING to DC.
   The OUTPUT of the preamplifier should be approximately 1Vdc and 0Vdc in the AC COUPLED mode.

End of Test.

SECTION 4
USB-COM OPTION
(for Remote Programming)

4.1 INTRODUCTION

The Model 7008 has the ability to be remotely controlled by installing the USB-COM option. With the USB-COM option, the Model 7008 can be remotely controlled via the USB connection from your computer. It gives the user full control of all parameters over the USB Bus. The following information will give suggested steps to get quickly started connecting, configuring and using the 7008 on a USB connection directly to your PC.

4.2 USB-COM OPTION

The USB-COM option is a USB bus powered remote programming option, which uses drivers supplied by Future Technology Devices International Ltd (FTDI), making it possible to remotely control the Model 7008 by sending specific commands.

The FTDI USB drivers can be operated in one of two general modes: Virtual COM port (VCP) or D2XX. Once the VCP drivers are loaded, all that is required of the host app is to open what appears to be an RS232 port (it shows up in Device Manager as a COM port), set the baud rate to 38,400 and start to send and receive data using the exact same methods and source code as those used with the original DB9 ports.

The downside to using the VCP drivers is the same issue that has always plagued legacy developers using DB9 ports is how do you determine which COM port your hardware is connected to? The options are limited to either assuming your hardware is on a particular COM port (dangerous), or the host app has to open every available port and send out a ping then wait for the correct reply (which is both tedious and time consuming).

The second option is to use the D2XX drivers. In this mode, the host app can tell how many FTDI USB devices are connected to the PC and what each device's name or serial number is with the FT ListDevices() function call. The port can then be opened to a specific FTDI USB device using either its name or serial number (both are programmed into the USB interface chip) using the FT_OpenEx() function call. The hardware can be plugged into any available USB port and later changed to a different port on the host PC or connected hub without restriction or any need to relearn the location of the device. The downside to using the D2XX drivers is the use of the library. Either the .lib library file must be included in the source code project, or the functions in the DLL must be loaded at run time.

The D2XX Programmer's Guide lists the functions available in the FTD2XX.DLL. It can be downloaded at:

http://www.ftdichip.com/Support/Documents/ProgramGuides.htm

Programming examples using the D2XX drivers and DLL can be found in the Projects section of the FTDI site.

The default EEPROM setting is set to install the VCP driver. An example is provided that shows how to program the 7008 using a Windows™ terminal program is in Paragraph 4.2.2, page 20.

Directions for the supplied Windows™ program FT Prog, (also on Krohn-Hite.com), which allows changing the EEPROM to use the DLL programming driver is found in Paragraph 4.2, page 18.

4.2.1 INSTALLING THE DRIVERS

The Windows™ combined driver model (CDM), which may be installed on Windows 2000™, XP™, VISTA™ or Windows 7™, allows applications to access FTDI devices through either the D2XX DLL or a COM port without having to change driver type. However, it should be noted that an application can only communicate through one of these interfaces at a time and cannot send commands to the D2XX DLL and the associated COM port at the same time.

The CDM driver comes in two parts. The first part is the bus layer that provides D2XX style functionality and is always installed. The second part is the serial COM port layer and the CDM driver will determine whether a COM port should be exposed by reading the EEPROM built into the device. The drivers will install if needed when you plug in the supplied USB cable into the computer.

4.2.2 DRIVER INSTALLATION SEQUENCE ON A WINDOW XP™ S

Click “Next” to start.

Figure 4.1 - Hardware Wizard

Figure 4.2 - Hardware Wizard Searching

Click “Finish” and the last driver should install.

Figure 4.3 - Completing Hardware Wizard

Click “Next” to start.

Figure 4.4 - Hardware Found

Click “Finish” to exit the Wizard.

Figure 4.5 - Finishing Hardware Wizard

4.2.2 HOW TO SET-UP AND RUN WINDOWS™ HYPER-TERMINAL ON A WINDOWS XP™ SYSTEM

Windows™ HyperTerminal can be used to program the Krohn-Hite Model 7008 using the USB connection.
First install the USB drivers by connecting the computer to the 7008 and follow the prompts.
Start Windows™ HyperTerminal by doing the following:

Click START, then ALL PROGRAMS, then ACCESSORIES, then COMMUNICATIONS and finally HYPER TERMINAL.

The Hyper Terminal program now opens.
Open a new connection if needed and enter a name in the Name box: (example: 7008), pick an Icon (optional), and then click on the "OK" button.

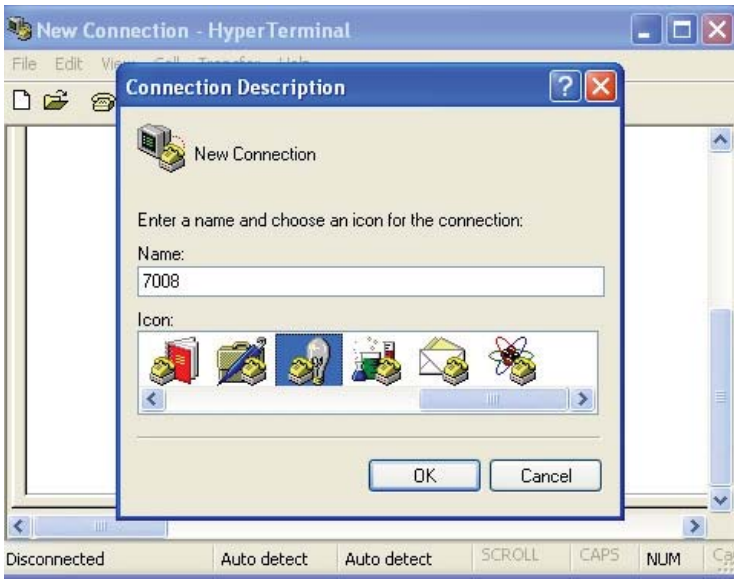


Figure 4.6 - HyperTerminal Connection

Next the “Connect to” window appears.

Select the correct com port from the “Connect Using” drop down box.

Click the “OK” button when done.

Figure 4.7 - HyperTerminal Connect to Screen

If you need to find the port #, look in device manager “Ports (COM & LPT)” to find the “USB Serial Port” number. Windows™ short cut key; press both the Windows™ Start & Break key to open the System section of control panel, then click on the Hardware tab. Click the Device Manger button to open it , then click the “+” beside Ports (COM & LPT) to list all ports for the computer.

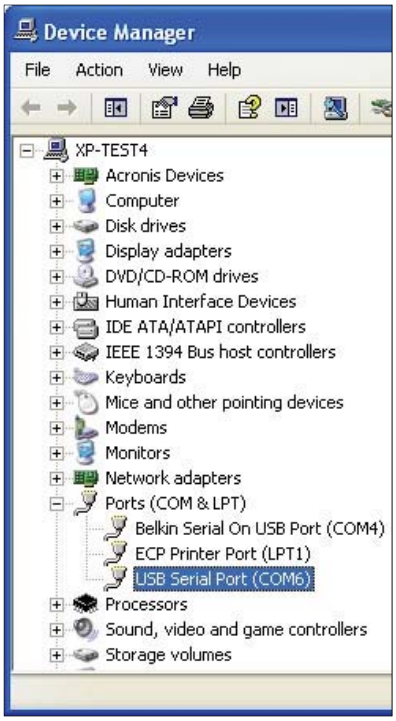
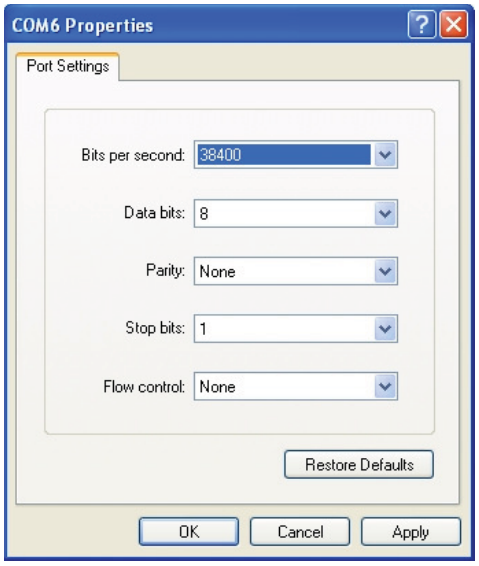


Figure 4.8 - System Properties and Device Manager Screens

Close the Device manger & Control Panel when finished.

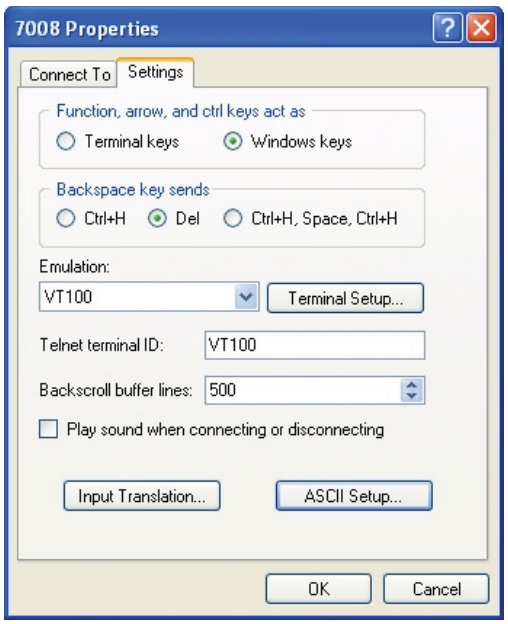
Next open the properties settings by clicking the “File” menu item and selecting “properties” from the list.



Set the Port Settings to the following.
Bits per second to 38400.
Data bits to 8.
Parity to None.
Stop bits to 1.
Flow control to None.
Click the “OK” button when done.

Figure 4.9 -Comm Properties Screen

Next open the properties settings by clicking the “File” menu item and selecting “properties” from the list. Click on “Settings” tab and select the items to match the following Figure.



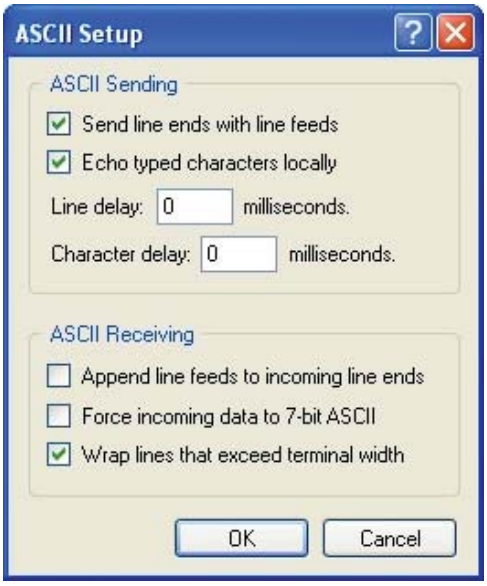
Click on “Windows keys” under Function, arrow and ctrl keys act as.

Click on “Del” under Backspace key sends.

Click on the Emulation arrow and select "VT100".

Click on “ASCII Setup” and select the items to match the following Figure.

Figure 4.10 - 7008 Properties Screen



Select "Send line ends with line feeds".

Select "Echo typed character locally".

Click "OK" to close the ASCII setup box.

Figure 4.11 - ASCII Setup Screen

Click "OK" to close the Properties Box window.

Communications should now be available, HyperTerminal screen bottom left should display “Connected” as in the Figure below.

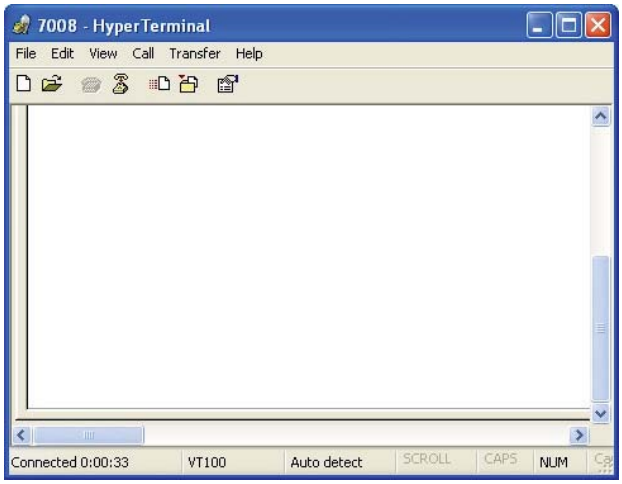


Figure 4.12 - 7008 HyperTerminal Connection

Now verify that the communications is established by typing in “CH1,S” and press enter.
If there is communication, the Model 7008 will return the Setup string for the channel entered. In this example: CH1;G2;CP1;BW1;IC1;SR1

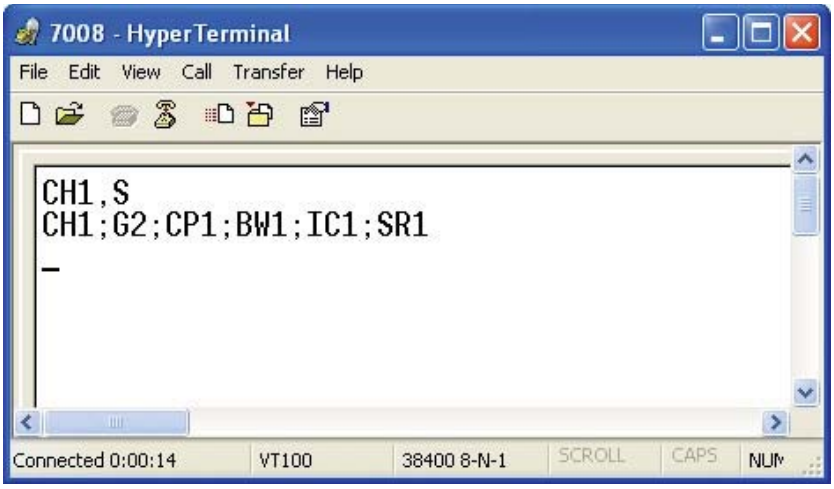


Figure 4.13 - 7008 HyperTerminal Commands Example

4.2.3 AN ALTERNATE TO HYPER-TERMINAL OPERATION

For Windows™ systems that do not have MS HyperTerminal support (i.e. Windows 7™ or later) or an alternate to HyperTerminal , an open source terminal program called Tera Terminal can be used.

The latest version for Tera Terminal can be downloaded from:

http://en.sourceforge.jp/projects/ttssh2/releases/

Once installed, just run the Tera Terminal EXE from the Tera Terminal folder under “all Programs”, which is off of the start menu.
Click “New Connection” from the file menu. You should see a screen similar to the one below.

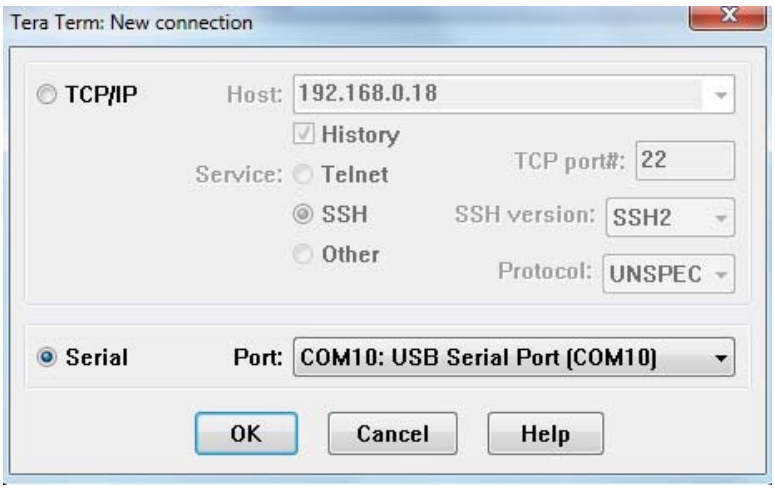


Figure 4.14 - Tera Terminal New Connection Screen

Select “Serial” and the correct port number (Comm10 in this case) and click “OK”.
Click “Terminal” from the Setup menu above. The following screen appears.

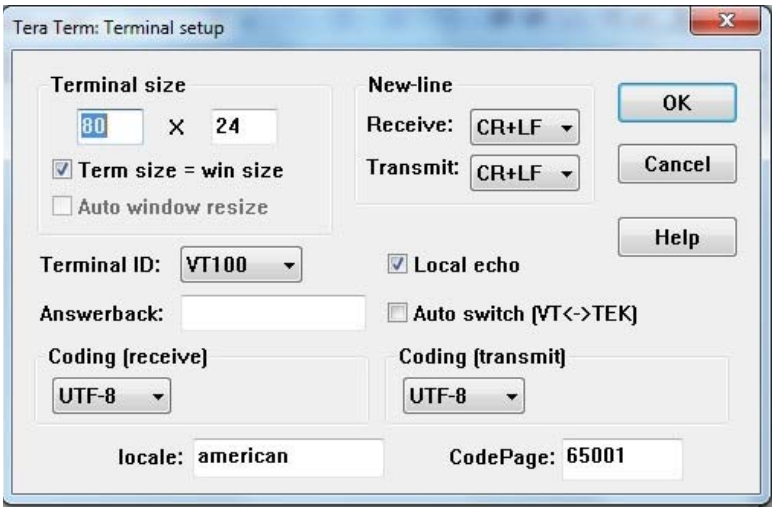


Figure 4.15 - Tera Terminal Setup Scrren

If needed, adjust the settings to match the Figure above. Click “OK”.
Click “Serial Port” from the Setup menu. The following screen appears.

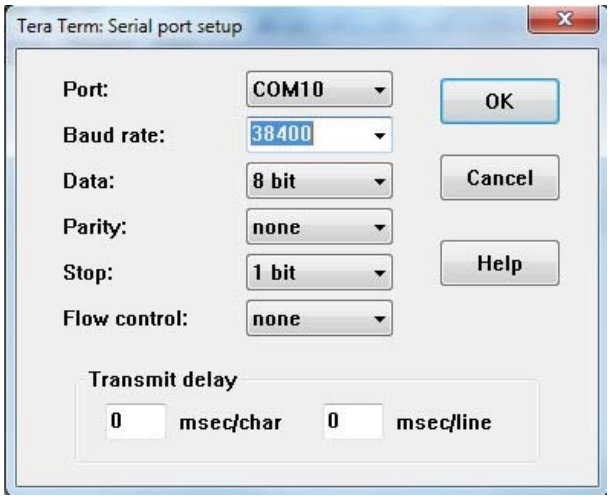


Figure 4.16 - Tera Terminal Serial Port Setup Screen

Set the “port:” to the port number used in the first Figure (Com10 in this example).
Set the “Baud rate:” to 38400, “Data:” to 8 bit, “Parity:” to none, “Stop:” to 1 bit.
Set the “Flow control:” to none and click “OK”.

Now you can send remote commands and you should receive a reply back.

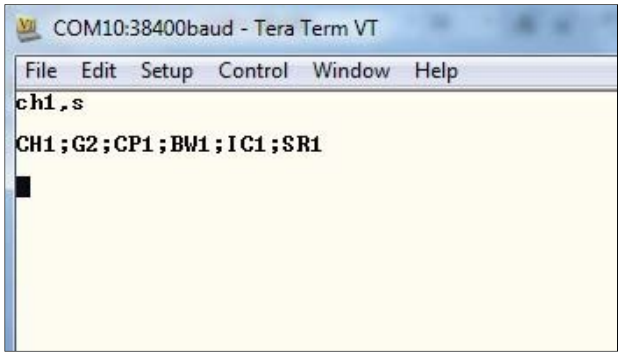


Figure 4.17 - Tera Terminal VT Screen

Here is an example of a query (“s” command) of channel 1, along with the reply.

4.3 MODEL 7008 PROGRAMMING COMMANDS

The following information describes the command syntax needed to program the 7008. All commands can be upper or lower case. They also can be combined as long as each command is followed by a delimiter. Valid delimiters are the colon (;) and the comma (,). A carriage return and line feed is also needed at the end of the command string to inform the 7008 of the end of the string.

The data string is sent with the channel number first followed by the delimiter then any or all of the commands for that channel. The commands can be sent in any order. Valid channel numbers are ch1 through ch8 or AL for setting all channels.

4.3.1 TABLE OF COMMANDS

Command	Description
G1	Gain set to 1
G2	Gain set to 10
G3	Gain set to 100
G4	Gain set to 1000
IC1	Input Coupling set to OFF (both grounded)
IC2	Input Coupling set to SE + (- grounded)
IC3	Input Coupling set to SE - (+ grounded)
IC4	Input Coupling set to Diff (both on)
SR1	Shunt Resistor set to Open
SR2	Shunt Resistor set to 50 Ohms
SR3	Shunt Resistor set to 500 Ohms
SR4	Shunt Resistor set to 5k Ohms
SR5	Shunt Resistor set to 50k Ohms
CP1	Coupling set to AC
CP2	Coupling set to DC
BW1	Bandwidth Filter OFF
BW2	Bandwidth Filter ON 100kHz
S	Setup Query current settings

4.3.2 COMMAND STRING EXAMPLES

Example1: ch2,g2,ic2,sr1,cp1,bw1(CRLF)
This sets channel 2 to a gain of 10, + input BNC on, no shunt resistor connected, input set to AC coupling, and full bandwidth (no low pass filter).

Example 2:AL;G4(CRLF)
This sets all channels to a gain of 1000.

Example 3:CH4;S(CRLF)
This query channel 4 to see the current setting. Reply example: CH4;G4;CP2;BW1;IC1;SR2

4.3.3 REPSONSE TO A COMMAND STRING

After receiving a string, the Model 7008 will send a response code back.

The responses are:

7008 Response	Description of Response
*A	Data Ok, No errors
*B	Data Error
*C	Syntax Error
*D	7008 in Local Mode

A data error is caused by sending incorrect data, such as “G7” for a Gain setting. If you get a syntax error, check that the delimiter is either a comma “,” or a colon “;”. The “7008 in Local Mode” error informs you that you need to press the “Local/Remote” key to place the 7008 in remote mode.

SECTION 5
LAN-COM OPTION
(for Remote Programming)

5.1 INTRODUCTION

The Model 7008 has the ability to be remotely controlled by installing the LAN-COM option. With the LAN-COM option, the Model 7008 can be remotely controlled via the LAN connection from your computer. It gives the user full control of all parameters over the LAN Bus. The following information will give suggested steps to get quickly started connecting, configuring and using the 7008 on a LAN connection directly to your PC.

5.1.1 SITE LANs AND PRIVATE LANs

The LAN-COM option is a local area network (LAN) in which LAN-enabled instruments and Windows PCs are connected through a site LAN (workgroup LAN, Intranet, or Enterprise LAN) via a router, hub, or switch. A Private LAN is a local area network in which LAN-enabled instruments and Windows PCs are NOT connected to a site LAN.

5.1.2 CONNECTING THROUGH A NETWORK

To use the Model 7008 through a network, the LAN-COM option must be installed and a straight through CAT5e cable must be used to connect the 7008 to the network. The remote control setting of the 7008 must also be set to LAN from the Port Selection Menu. The default setting for the IP address is set to obtain the address via DHCP. Connect the 7008 to the network and turn it on. After a moment, your DHCP (Dynamic Host Configuration Protocol) server should assign a valid address automatically. Start HyperTerminal and configure it if needed.

5.1.3 CONNECTING DIRECTLY TO THE MODEL 7008 (no network)

To use the Model 7008 directly connected to a computer and not through a network, a crossover CAT5e cable must be used to connect the 7008 to the network card of the computer. Connect the 7008 directly to the network first and then power it on. After a moment, your computer should assign an IP address to the Model 7008, if it is set to obtain IP addresses automatically (default setting). Use the supplied LANScan program if needed to find the IP address of the local computer or the Model 7008. See Section 4.2.2 for using Hyper Terminal to communicate with the 7008.

> NOTE: The remote control setting of the 7008 must also be set to LAN from the Port Selection Menu (see Section 4.2.).

5.1.4 HOW TO FIND THE CURRENT IP ADDRESS

Connect the correct network cable to the Model 7008 before turning the 7008 on. For a direct connection setup, use a CAT5e Crossover Cable. Otherwise use a Standard Cat5e Straight Cable.

Run the Krohn-Hite supplied LANScan program. This program will scan your local network to find the current IP Address of all the 7008's. This is a stand-alone program that will run from a flash drive or the Krohn-Hite Manual CD that was packed with the 7008.

Upon starting the program, the following window displays in the figure below. Click Run. The program displays its main window.

Figure 5.1 - Security Warning Screen

The window shown in Figure 4.19 is the opening window for the LANScan program.

Figure 5.2 - Xport Scan Screen

In this example, the computer running the LANScan program has an IP address of 192.168.1.103. Click the Search button near the bottom of the window to start scanning. The figure below shows the results of the scan.

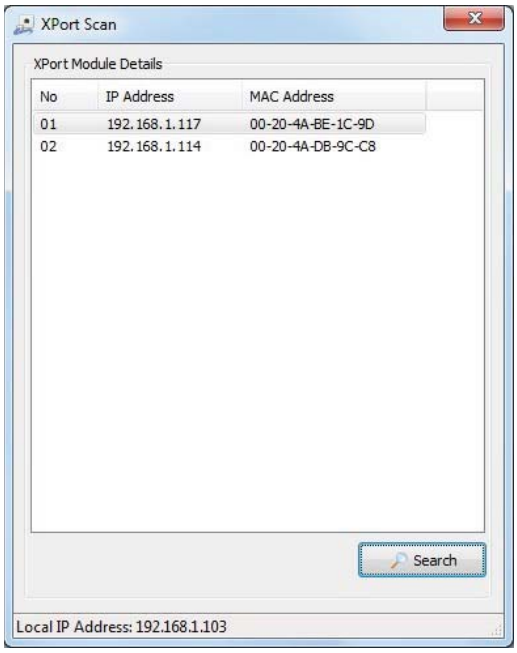


Figure 5.3 - Xport Scan Results Screen

In this example, there is one 7008 with an IP Address of 192.168.1.117. If more than one 7008 is on the network, you can use the MAC Address to identify the calibrator of interest.

5.1.5 SETTING A FIXED IP ADDRESS

First, connect the correct network cable to the model 7008 before turning the 7008 on. For a direct connection setup, use a CAT5e Crossover Cable, otherwise use a standard CAT5e Straight-Through Cable.
Run the LANScan program to find the current IP address of the 7008.

NOTE: LANScan is provided on the CD that came with the 7008, or it can be found on our web site home page www.krohn-hite.com located under Software.

Once the IP address is found, using a browser like Internet Explorer, type in the 7008 address in the address bar.

A dialog box will appear prompting for a User name and Password (see Figure 5.4). If no password has been defined (default) then leave both fields blank and click "OK". If a password has been defined, leave the username blank, type in the password, and click "OK".

Figure 5.4 - Tera Terminal New Connection Screen

After the Security box information has been entered, the Device Server Configuration Manager will display.

Figure 5.5 - Device Server Configuration Manager Screen

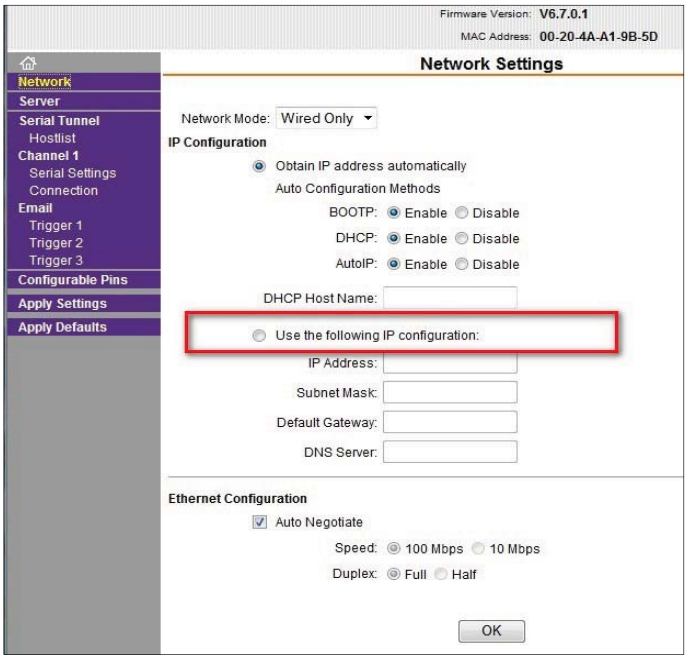


Figure 5.6 - Network Settings Screen

On the main menu in the left side of the window, click Network (highlighted in red above) and the following page will display.

Click on the Use the following IP configuration radio button (highlighted in the red above).

Enter the IP address, Subnet mask and Default gateway (the gateway parameter is optional) you want to assign to the 7008. Typical subnet for most local networks would be (255.255.255.0). Then click "OK" (highlighted in red below) at the bottom of the window.

Assign address 192.168.1.147 with a subnet Mask of 255.255.255.0.

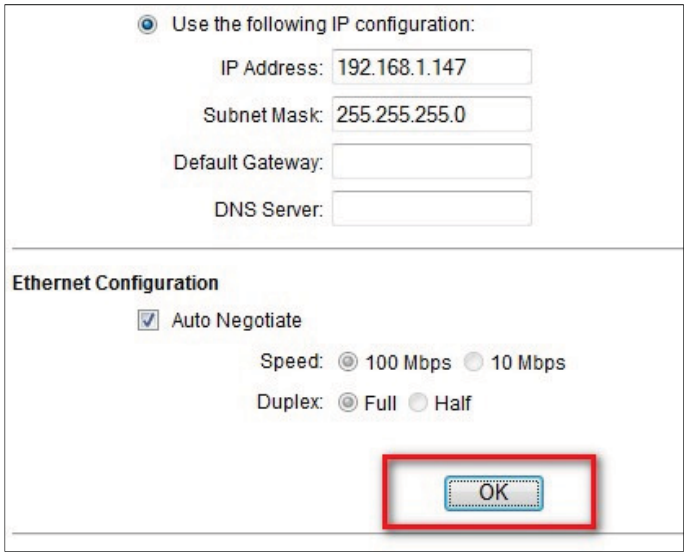


Figure 5.7 - Network Settings Screen

On the main menu in the left side, click Apply Settings (highlighted red below). After about five seconds the window will inform you that the 526 LAN is rebooting in order to apply the settings.

Figure 5.8 - IP Configuration Screen

Close the browser when done.

5.1.6 LAN and HyperTerminal Setup

When connecting the 7008 to a network or computer directly, check the communication port setting of the 7008. Change the setting for LAN operation.

In order to use the Krohn-Hite Model 7008 with LAN, you must decide if the connection is made through a network or direct. A CAT5e Straight-Through Cable must be used for a network connection and a CAT5e Crossover Cable if connecting directly to the Model 7008.

5.1.7 How to Set-Up and Run Windows™ HyperTerminal

Windows™ HyperTerminal can be used to program the Krohn-Hite Model 7008 using the LAN connection. Once you have made the LAN connection via a network or directly to the 7008, do the following:

Click on
START then,
ALL PROGRAMS then,
ACCESSORIES then,
COMMUNICATIONS then,
HYPER-TERMINAL.

This will execute the HyperTerminal Program.

Enter 7008 in the Name box (not 526), then click on "OK".

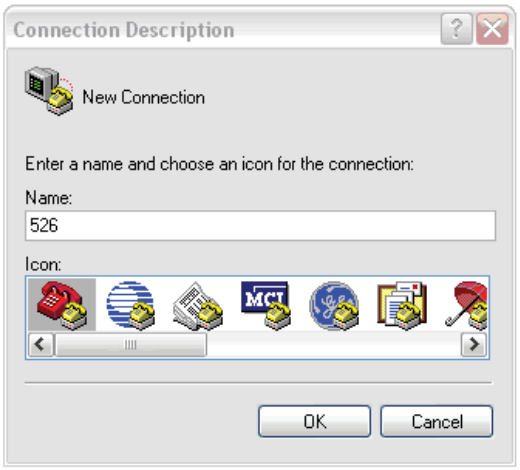


Figure 5.9 - Connection Screen

Now in the Connect Using box, change the COM1 to TCP/IP.

Figure 5.10 - Connect To Screen

The window will change.

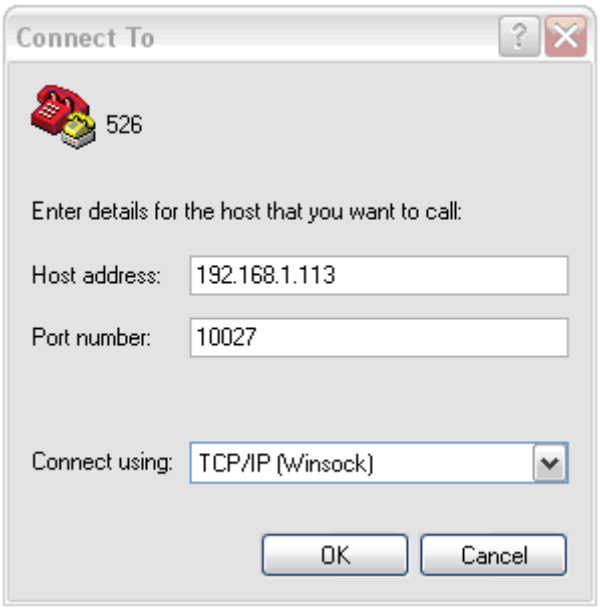


Figure 5.11 - New Connect To Screen

Enter the Host Address (address of the Model 7008).
Enter the Port Number 10027 (7008 default port).
Click "OK".

Hyper-Terminal will now open.

Click on "File", then "Properties".
Click on “Settings” tab.
Click on “Windows keys” under Function, arrow and ctrl keys act as.
Click on the Emulation arrow and select "VT100".
Click on “ASCII Setup”.
Select "Send line ends with line feeds".
Select "Echo typed character locally".
Click "OK" to close the ASCII setup box.
Click "OK" to close the Properties Box window.

Communications should now be available.

Now verify that the communications is established by typing in “*IDN?” and press enter. If there is communication, the Model 7008 will return the installed firmware version string, similar to the example below:

KROHN-HITE 7008, VER 1.2

SECTION 6
REMOVING AND INSTALLING PREAMPLIFIER CARDS

6.1 INTRODUCTION

The information following will describe how to remove and install a 700 Amplifier Card into the chassis of the 7008. Precautions should be taken when the covers are removed.

If the Model 7008 is not working properly, has failed or needs calibration, call the Krohn-Hite Service Department at 508-580-1660 for an RMA (Return Material Authorization) number. Affix a label to the outside of the box with the following information:

Krohn-Hite Corporation
Attn: Service Department RMA ####
15 Jonathan Drive, Unit 4
Brockton, MA 02301-5566

Costs for repair and calibration can be found on our web site www.krohn-hite.com, or you can call the Service Department for the information directly.

6.2 REMOVING A MODEL 700 PREAMPLIFIER CARD

To remove a Model 700 card from the 7008 chassis, you need to first detach the power cord from the unit. Now remove the top cover by removing the top cover screws. Once the cover is removed, you will have exposed the Model 700 Preamplifer cards, USB or LAN card, Power Supply card and Display card.

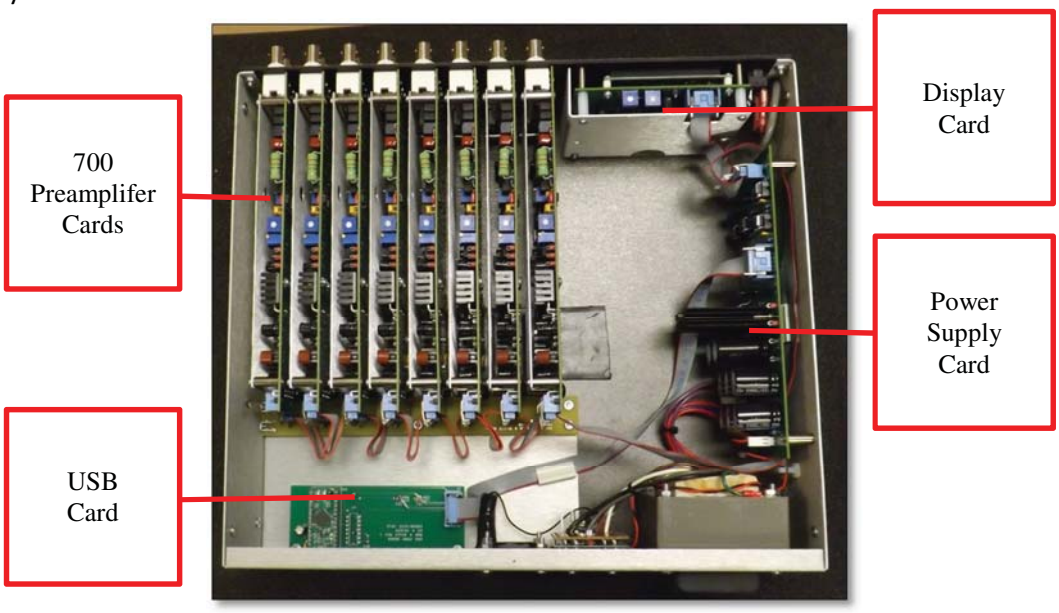


Figure 6.1 – 7008 with Top Cover Removed

WARNING

Before removing any preamplifier cards from the chassis, be aware that they have been set with an address at the factory indicating the slot position in the chassis. Do not mix up the order in which the cards are installed, or the cards will not communicate with the firmware resulting in the card indicating NO CHANNEL.

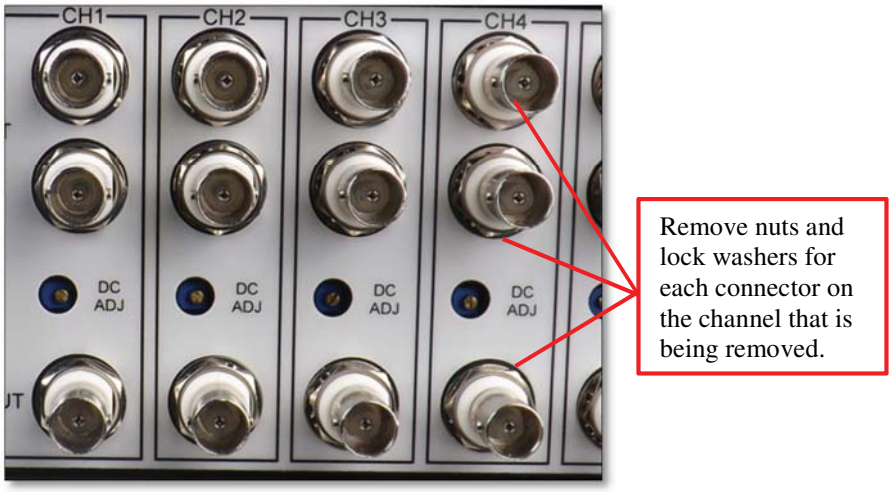


Figure 6.2 – Input/Output BNC Connections

Now looking at the front panel, remove the three BNC nuts and washers from the both the input and output connectors from the channel being removed. Be careful not to scratch the panel when doing this.

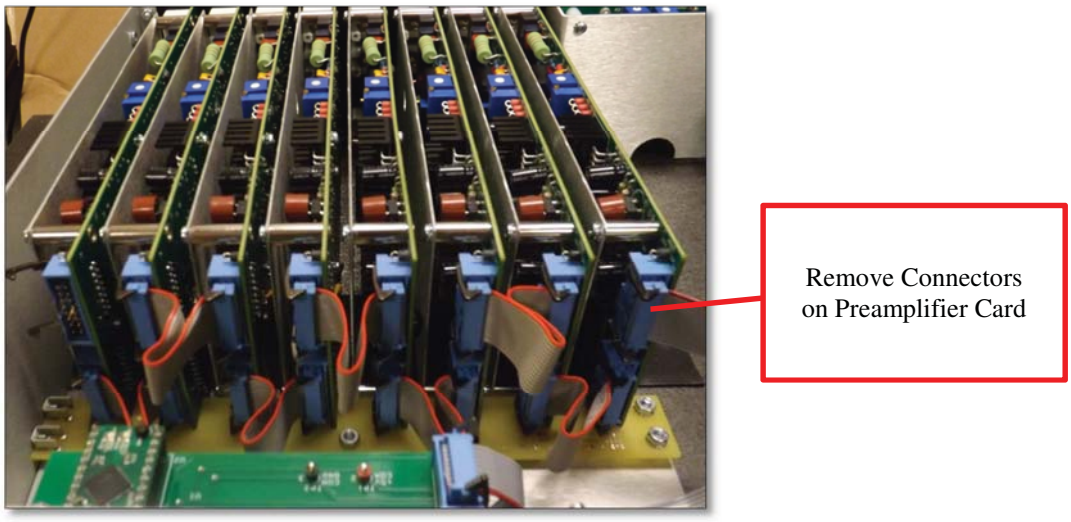


Figure 6.3 – Rear View of Preamplifier Cards

Now remove the connectors at the rear of the card of the channel being removed. Gently lift the card up at the rear, pull back towards the rear panel to clear the Card Guide that holds the preamplifier cards in place, and lift the card out, clearing the front panel BNC holes.

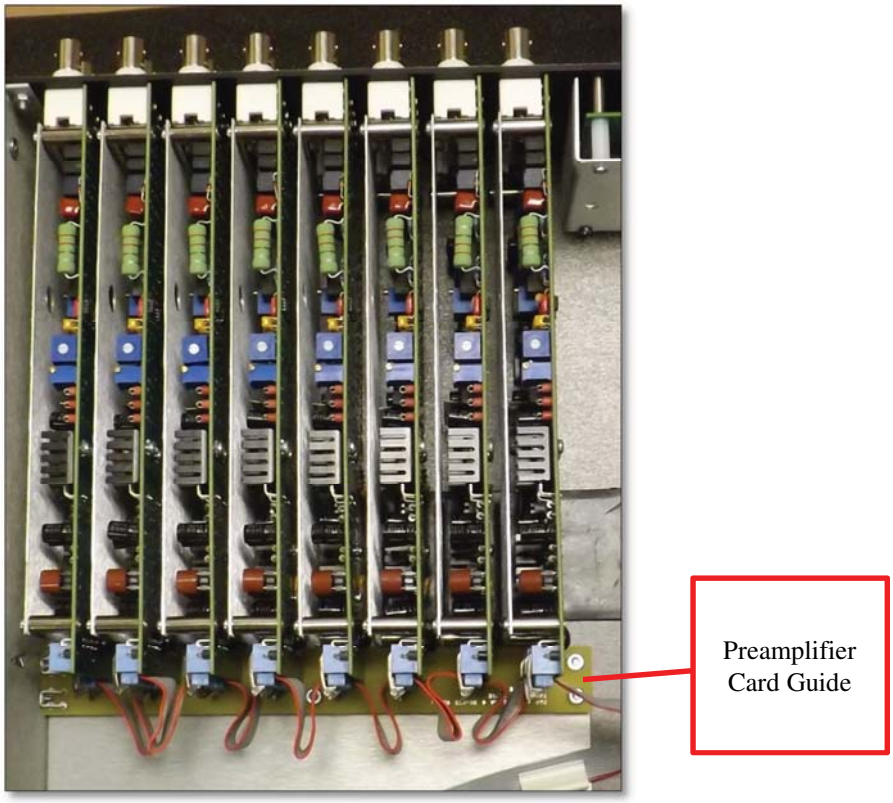


Figure 6.4 – Preamplifier Cards

6.3 INSTALLING THE MODEL 700 PREAMPLIFIER CARD

Installing the Model 700 Preamplifier Card can be simply done by reversing the order of Paragraph 6.2.

KROHN-HITE CORPORATION