# ACQ-7700 Signal Conditioners

**DSI**™

**DSI/Ponemah Life Science products are <u>not</u> "medical devices" intended to be used for the purposes of diagnosis of disease or other conditions, or in the cure, mitigation, treatment, or prevention of disease, or used as a life support device.  Use of DSI/Ponemah products are solely for the purposes of conducting life science research.**

# Contents

# Carrier 48

# Safety

This general safety information is for both user and service personnel. Specific **WARNINGS** and **CAUTIONS** will be found throughout the manual where applicable. Please refer to the Sécurité section for the French translation of this safety section.

**TERMS AND SYMBOLS IN THIS MANUAL AND ON THE EQUIPMENT**

ATTENTION, this symbol indicates paragraphs providing cautionary and detailed information about a specific part of the instrument. That part of the equipment is also marked with this symbol (See references to this symbol in the manual).

WARNING, risk of electric shock

AC, Alternating current

Type B Applied Part – Common connected to Earth
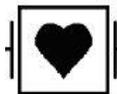
Type CF Equipment Defibrillation proof

Equipotentiality / Chassis ground

STANDBY (Power is on, instrument off in standby mode)

OFF (connection to AC mains)

ON (connection to AC mains)

**DSI/Ponemah Life Science products are <u>not</u> "medical devices" intended to be used for the purposes of diagnosis of disease or other conditions, or in the cure, mitigation, treatment, or prevention of disease, or used as a life support device. Use of DSI/Ponemah products are solely for the purposes of conducting life science research.**

**WARNING**
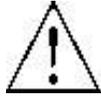


**IF THIS INSTRUMENT IS OPERATED OR USED IN A MANNER NOT SPECIFIED, THE PROTECTION PROVIDED BY THE SYSTEM MAY BE IMPAIRED.  DO NOT USE IN THE PRESENCE OF FLAMMABLE ANESTHETICS.**

## POWER SOURCE

This instrument is intended to operate indoors from a power source that does not apply more than 250 volts RMS between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is required. If the unit is mounted in a permanent installation (i.e. rack-mounted), then the user MUST provide access to the plug OR connect the instrument to a circuit with a user accessible breaker or power switch. The detachable power cord is the means by which the mains are disconnected.

## PROPERLY GROUND THE INSTRUMENT

This instrument is grounded through the power cord. It is a Class 1 Device. Grounding reliability can only be achieved when the equipment is connected to a hospital grade receptacle. Use only the power cord and connector specified for your instrument. Use only a power cord that is in good condition.

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) may render an electric shock.

## USE PROPER TEST LEADS AND CABLES

Test leads and/or interconnect cables may carry **HAZARDOUS** live voltages. They must be examined regularly for wear. Worn leads or cables should be replaced.

The amplifier has been designed and tested for protection against the effects of the discharge of a cardiac defibrillator. For safe operation, use the only the cables provided with the amplifier.

## ECG ELECTRODE PLACEMENT

The user should assure that any electrodes used, including the neutral electrode, do not contact any conductive parts, including earth.

Whenever a defibrillator is used, assure that the leads are placed on the appropriate places on the subject. Leads should never be placed on grounded surfaces. Verify that defibrillator leads are NOT placed directly on the ECG electrodes.

## DO NOT USE WITH HF SURGICAL EQUIPMENT

It is imperative that the ECG electrodes be removed from the subject before using any HF surgical equipment. This equipment DOES NOT provide protective means against burns when used with HF surgical equipment.

## SUMMATION OF RISK CURRENT

The amplifier has been designed and tested to meet safe leakage current specifications when attached to the subject. Any additional equipment added to the subject may increase leakage. The operator should be aware of the possible summation of additional leakage currents when additional equipment is connected to the subject.

## USE WITH PACEMAKERS

The operator should be aware of any possible interactions or safety hazards when the amplifier is used in conjunction with cardiac pacemakers and other stimulant devices. The manufacturer of these devices should be consulted for additional information.

**EMI/RFI**

The amplifier has been tested to meet EMI/RFI susceptibility and radiation standards. However, the user should be aware of possible electromagnetic interactions between this device and other devices in the same area and correct the situation as needed. Any type of conductive sheet connected to an electrical ground and placed between the source and equipment will help to reduce EMI.

***WARNINGS* FOR AUTHORIZED SERVICE PERSONNEL**

Dangerous voltages exist at several points in this instrument. To avoid personal injury, do not touch exposed connections or components while power is on. There are no user serviceable components in the signal conditioners. Return the unit to DSI for calibration and service.

**USE THE PROPER FUSE**

To avoid fire hazard, use only a fuse of the correct type, voltage rating, and current rating as specified in the parts list for your instrument.

**DO NOT OPERATE WITHOUT COVERS AND PANELS INSTALLED**

To avoid personal injury and equipment damage, the user should disconnect power before removing covers, panels or any grounding straps. Reinstall covers, panels, and any grounding straps *before* reconnecting power.

**WARNING: NO MODIFICATION TO THIS EQUIPMENT IS ALLOWED**

# System Overview

## Introduction

This manual describes the installation, operation, and specifications for the DSI/Ponemah ACQ-7700 based signal conditioners that operate with the Ponemah Physiology Platform.

Each ACQ-7700 signal conditioner has common user interface elements that are described in a common section of this manual. For specific details of a particular signal conditioner, refer to that section of the manual.

All ACQ-7700 signal conditioners are user-installable and are compatible with the ACQ-7700. For more information on where and how these signal conditioners can be used, contact your local DSI/Ponemah representative.

## ACQ-7700 Signal Conditioning System

The DSI/Ponemah ACQ-7700 series of signal conditioners are fully programmable. Integrated with the Ponemah acquisition and analysis software, they create a powerful yet easy to use data recording system. The Ponemah software was created to optimize the real-time monitoring, acquisition, review, and analysis of physiological signals. It is designed for the Microsoft® Windows™ Operating System environment, delivering very efficient utilization of computer resources.

Signal conditioner setup is performed using an intuitive graphic user interface. All parameters can be programmed directly in your test parameter units, greatly reducing potential data conversion errors. All setup parameters can be saved as a logical test name for later recall, saving valuable protocol set up time.

## System Configuration

The ACQ-7700 signal conditioner occupies a single slot of the ACQ-7700 case. The input signals from the signal conditioners are conditioned, digitized, and routed, via the ACQ-7700 "Broadcast" backplane, to the recording system. The Ponemah software controls the viewing and acquisition of this data.

Within the Ponemah software, an integrated software module handles all control and communication with the ACQ-7700 signal conditioners. You do not have to load any additional software or configure any software systems. When the system is started, the Ponemah software will automatically query the system and identify the ACQ-7700 signal conditioners and their slot placement.

For detailed information on the Ponemah software, please refer to the Ponemah Installation and Reference Manual.

Contact your local DSI/Ponemah sales representative to discuss your signal conditioner requirements and to obtain a complete listing of available signal conditioners and their specific capabilities.

# Environmental Specifications

The following list of specifications is valid for the DSI products listed in this manual.

## Temperature

These temperatures reflect the local ambient of the host unit:

10°C to 40°C Operating

-20°C to 80°C Storage

## Humidity

30 to 75% Relative Humidity non-condensing Operating

5 to 95% Relative Humidity non-condensing Storage

## Altitude

2000 meters maximum

# Configuring the System

## System Description

The ACQ-7700 signal conditioners use a single slot of the ACQ-7700. It includes three sections: the analog conditioning front end, an analog to digital conversion section and a bus communication and data interface section. There are no controls or internal jumpers or settings on any of the ACQ-7700 signal conditioners; all control is performed by software. Depending on the chassis the ACQ-7700 accepts various number of ACQ-7700 signal conditioners. Signal conditioners are inserted into guided slots and secured by the positive threaded latching screws on the signal conditioner.

Power, data, and communication connections are via a board-mounted connector on the rear of the ACQ-7700. The only user connections are the individual input signals.

## Initial Inspection

Prior to attempting any electrical connections or operation, visually examine the unit for any damage.

## Installing ACQ-7700 Signal Conditioners

Turn OFF the power to the ACQ-7700. Remove the line cord. Remove all input measuring circuit terminals from ALL signal conditioners.

Slide the signal conditioner into the next available open slot. Slots must be filled contiguously starting with slot A.. Slot A must be occupied. The metal side plate fits into plastic guides that align the signal conditioner with the backplane mating connectors. Turn the latching screw knobs clockwise to secure the signal conditioner in its slot. Tightening the latching screws secures the mating connectors located on the rear of the signal conditioner into the backplane connector of the ACQ-7700. Be careful not to over tighten these screws. Assure all blank slots are filled with blank panels for proper airflow.

When connecting the signal conditioner's input cables, care should be taken to avoid contact with hazardous external voltages. **Always install the connection to the signal conditioner input connector BEFORE applying the source voltage to the cable**.

Reconnect the power cord and restore power to the system.

# Removing ACQ-7700 Signal Conditioners

Turn OFF the power to the ACQ-7700. (The signal conditioners **may be damaged** if inserted or removed under power). The power switch is located either on the front or rear of the ACQ-7700.

Remove all source voltages/signals being monitored.

Disconnect the signal conditioner's input cables.

With an appropriate screwdriver, use a Phillips screwdriver and turn the screws in a counter-clockwise direction until the outer ring of the latch mechanism is free turning. Now turn the latch mechanism counter-clockwise and pull the signal conditioner from the slot.

Slide the signal conditioner out of the ACQ-7700.

Insert a blank panel into the exposed slot. These panels perform more than simply an aesthetic function. They are required for proper system cooling and RFI/EMI shielding.

# ACQ-7700 Chassis

An ACQ-7700 is used in a number of DSI/Ponemah recording instruments. This assembly is designed to house ACQ-7700 signal conditioners and supply all power, communications, and data transfer to and from the host instrument.

# Getting Started

## Introduction

Please reference the ACQ-7700 Installation Manual (MU00225) for a detailed description of the ACQ-7700 installation.

Before turning on the acquisition Interface power, be sure the line voltage is within the power supply specifications.

The power switch for the ACQ-7700 is located on the front of the unit.  A green light located on the **ACQ-7700** front panel illuminates when power is ON.

Connect the ACQ-7700 to the USB port selected during installation using a standard USB cable.  If you have not already installed the Ponemah software on your system, please refer to the **Ponemah Physiology Platform** reference manual for installation instructions.

Once the inputs are connected, power up the acquisition interface, and start the Ponemah application.  You are now ready to begin recording data.

The screen captures in this manual are taken from the current Ponemah software.  Older versions of Ponemah are similar.

## ACQ-7700 Signal Conditioner User Interface

The signal conditioner main menu may be accessed by selecting the menu item **Hardware**, **7700 Amplifier Setup** from the Ponemah application as displayed here:
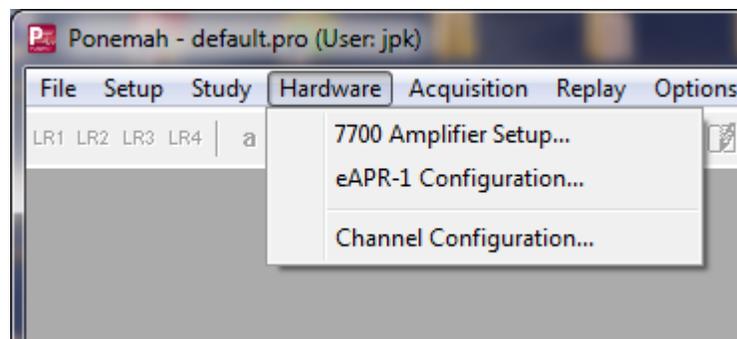


*7700 Amplifier Setup*

The signal conditioner main menu displays an overview of the signal conditioners installed within your recording system.  If more than one type of signal conditioner is installed, each type will display an associated setup configuration menu, which is

accessed by selecting the appropriate tab in the main menu. In the example in Figure *Signal Conditioner Configuration Dialog*, three types of signal conditioner are installed: ABDC-32, UniversalXE, and Carrier. You can select any signal conditioner for setup by clicking on the tab associated with that signal conditioner.
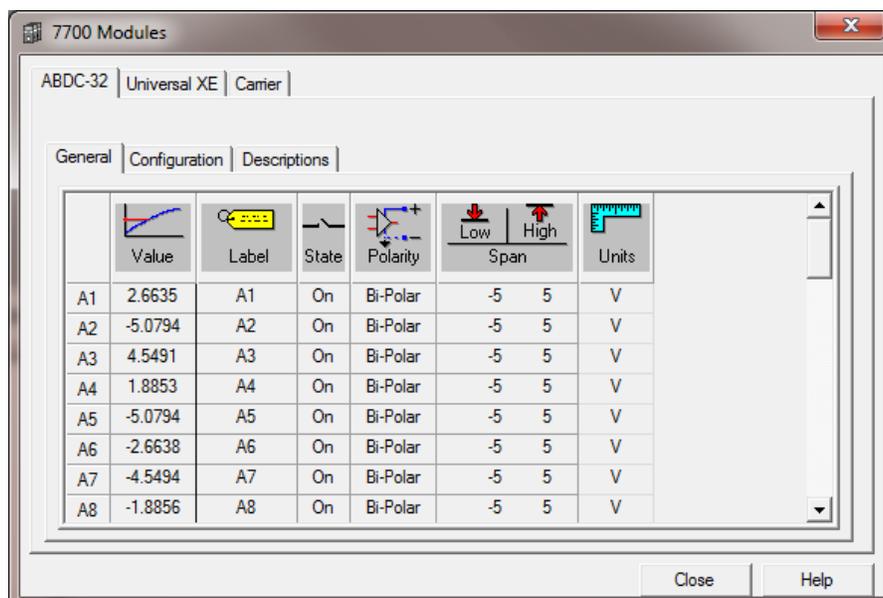


*Signal Conditioner Configuration Dialog*

The General tab displays the setup status of the signal conditioner. The slots in the ACQ-7700 are labeled **A** through M (dependent upon the type of ACQ 7700 being used), from left to right. The first slot is **A**. Since the ABDC-32 signal conditioner has 32 input channels, there will be 32 set up rows displayed. In this example, A1 through A8 are displayed since the signal conditioner is inserted in the first slot. For each input, all parameters are displayed in the Units selected for that input. Using the vertical scroll bar at the right allows access to inputs A9 to A32.

The Configuration tab displays other options that can be configured. These are signal conditioner specific.

The Descriptions tab allows you to enter text to further describe the parameters being recorded. It is not directly used as part of the signal conditioner configuration but is available for review whenever desired.

The Features tab displays other options that can be configures. These are specific to the Multi-Lead ECG POD (ECG12).

Channel specific parameters may be entered in two ways. Text entry can be performed by selecting a particular cell, clicking your mouse pointer on it, and entering the new value, or double clicking on a particular cell, then a graphic element will appear which prompts you for your input. These are displayed, along with a description of the function, which is below it.

If you click on the icon of a setup function, such as **Label** or **Span**, all channels in that setup column will be selected. A graphic element or dialog box will appear and all channels may be changed, globally, with one entry.

For functions that use a graphical toggle switch, the function is enabled by double clicking your mouse pointer in the desired cell. Once selected, a graphical representation of a toggle switch will briefly appear, the switch position will change, and the selection panel will close. To disable the function, simply follow the same

procedure, double clicking your mouse pointer in the desired cell. The switch position will change and the panel will close.

If the mouse cursor is placed over one of the span readings, a tool tip will appear equating the inputted voltage to the outputted user units (Span).
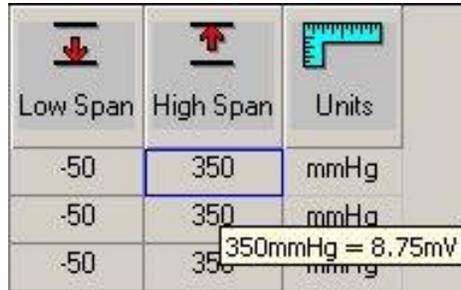
| ↓ | ↑ | 📏 |
|---|---|---|
| Low Span | High Span | Units |
| -50 | 350 | mmHg |
| -50 | 350 | mmHg |
| -50 | 35~~0~~ 350mmHg = 8.75mV | ~~mmHg~~ |

*Span Tool tip*

# ABDC-4 / ABDC-32

## Introduction

This section describes the operation and specifications for the Advanced Basic DC (ABDC-4) with either 4 channel capability, model number 13-7715-04 or (ABDC-32) 32 channel capability, model number 13-7715-02.

The ACQ-7700 ABDC-4 signal conditioner has 4 single ended inputs and the ABDC-32 has 32 single ended inputs. Any input can configured in unipolar or bipolar polarity.

## Analog Input Connections

The ABDC-4 signal conditioner uses four standard grounded BNC connectors while the ABDC-32 signal conditioner has a 37-pin "D" shell type male input connector. The inputs are single ended. The input common is therefore referenced to the chassis.



**MAXIMUM VOLTAGE ABOVE EARTH POTENTIAL TO ANY INPUT CONNECTION IS ±50VDC OR PEAK AC.**

The inputs for the ABDC-32 37-pin "D" connector are defined in the table below.

| PIN | DESCRIPTION | PIN | DESCRIPTION |
|-----|-------------|-----|-------------|
| 1 | Input Ch 9 | 20 | Input Ch 1 |
| 2 | Input Ch 10 | 21 | Input Ch 2 |
| 3 | Input Ch 11 | 22 | Input Ch 3 |
| 4 | Input Ch 12 | 23 | Input Ch 4 |
| 5 | Input Ch 13 | 24 | Input Ch 5 |
| 6 | Input Ch 14 | 25 | Input Ch 6 |
| 7 | Input Ch 15 | 26 | Input Ch 7 |
| 8 | Input Ch 16 | 27 | Input Ch 8 |
| 9 | Input Ch 25 | 28 | Input Ch 17 |
| 10 | Input Ch 26 | 29 | Input Ch 18 |
| 11 | Input Ch 27 | 30 | Input Ch 19 |
| 12 | Input Ch 28 | 31 | Input Ch 20 |
| 13 | Input Ch 29 | 32 | Input Ch 21 |
| 14 | Input Ch 30 | 33 | Input Ch 22 |
| 15 | Input Ch 31 | 34 | Input Ch 23 |
| 16 | Input Ch 32 | 35 | Input Ch 24 |
| 17 | Ground | 36 | Ground |
| 18 | Ground | 37 | Ground |
| 19 | Ground | | |

*ABDC-32 Input Connections*

# Configuring the ABDC-4 or ABDC-32

The only difference in the following menus is that the ABDC-4 will only display 4 input channels while the ABDC-32 will display 32 input channels in the dialogs.

In the figures below, the ABDC-4 signal conditioner has been selected. When a signal conditioner is selected, its tab is brought to the foreground and a group of set up menus specific to that signal conditioner will be displayed. This will include General, Configuration, and Descriptions tabs.

## General Tab

The General Tab allows the user to set up channel specific signal conditioner parameters. They include the channel Label, State, Polarity, and Span.
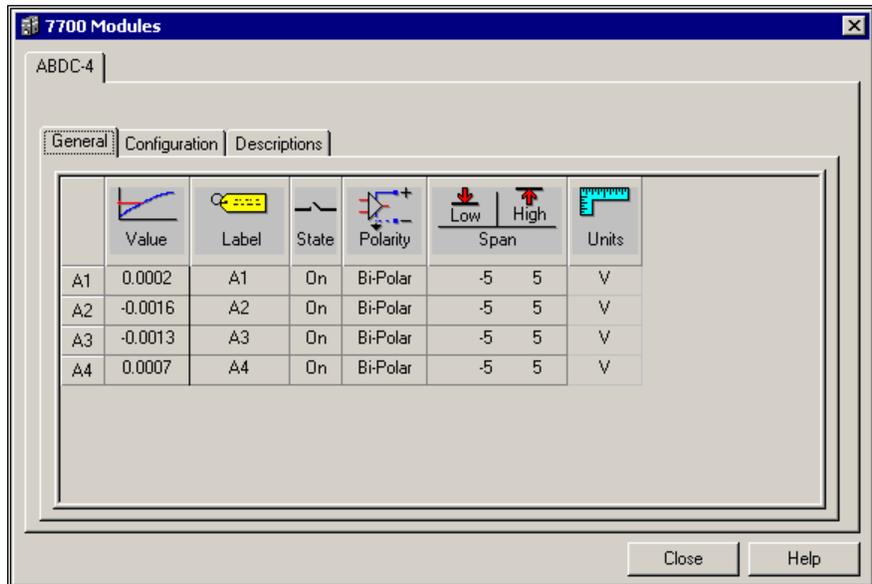


*ABDC-4 General Tab*

### *Value*
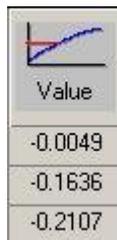


This column continuously displays the current value that is on the input of the signal conditioner. This column is updated by the system once every second and cannot be updated by the user.

This column is useful in troubleshooting the signal conditioner input connection.

### *Label*



Label allows you to type in a logical name of up to 10 additional characters for a particular input channel. The chosen name will be saved and used to identify the input data throughout the system, such as in the dialog that displays input channel information.

### *State*



The State function will turn the sampling on or off for that channel, but the last value will continue to be displayed. It is recommended that this selection should always be left in the ON condition. To turn any channel on or off, set the analysis to DIS in the P3 Setup dialog. The default setting is **On**.

### *Polarity*
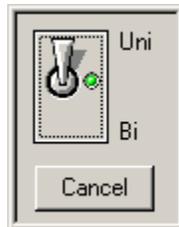


The Polarity function allows you to select the polarity of the signal to be displayed either in Bi-Polar or Uni-Polar mode. This is accomplished by a simple toggle switch function. The ABDC signal conditioner is designed such that the inputs may be either Bi-Polar (zero centered) or Uni-Polar (zero at the edge). Double clicking on any one channel will change the polarity. All channels can be changed at once by clicking on the Polarity icon. In Bi-Polar mode the Span settings automatically scale to a plus and minus value. In Uni-Polar mode the Span settings automatically scale from 0 to a plus value. The default setting is **Bi-Polar**.

### *Span - Bi-Polar Mode*
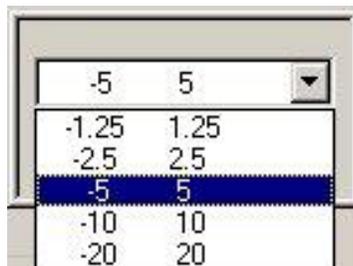
There is one span control that sets the maximum input of the signal conditioner. The Bi-Polar High/Low Span is symmetrical. Ranges available are ±1.25V, ±2.5V, ±5V, ±10V, and ±20V. The Span defines the sensitivity or scale for each channel. This function sets the maximum and minimum values in user units that will be recorded. The default setting is ±5.

**NOTE:** Span should be set AFTER High/Low Cal and High/Low Unit values are set in the Configuration Menu.

The Span may be chosen to be any of the five selections within the valid range for that input. When Span is selected, a dialog box appears. Simply select the range desired. The actual value you enter may be considerably different since it will usually be in the units corresponding to your application. This will be defined by the calibration and unit set up in the Configuration tab. Refer to High/Low Cal and High/Low Unit setup for a sample setup.

### *Span - Uni-Polar Mode*
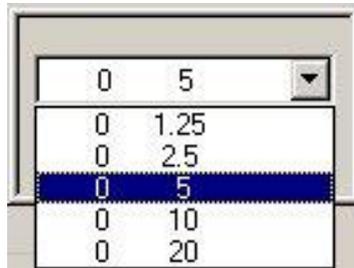


There is one span control that sets the maximum input of the signal conditioner. The Uni-Polar High/Low Span is scaled 0V to +1.25V, 2.5V, 5V, 10V, and 20V. The Span defines the sensitivity or scale for each channel. This function sets the maximum and minimum values in user units that will be recorded. The default setting is 0 to 5.

**NOTE:** Span should be set AFTER High/Low Cal and High/Low Unit values are set in the Configuration Menu.

The Span may be chosen to be any of the five selections within the valid range for that input. When Span is selected, a dialog box appears. Simply select the range desired. The actual value you enter may be considerably different since it will usually be in the units corresponding to your application. This will be defined by the calibration and unit set up in the Configuration tab. Refer to High/Low Cal and High/Low Unit setup for a sample setup.

### *Units*



This column displays the units that have been set in the **Configuration** tab and cannot be changed in this tab. The Units have no effect on the channel and it is for documenting the Input units.

## Configuration Tab

To set up the actual signal input configuration, select the Configuration tab in the signal conditioner setup panel. The Configuration set up screen as shown below, *ABDC-4 Configuration Tab*, will be displayed.
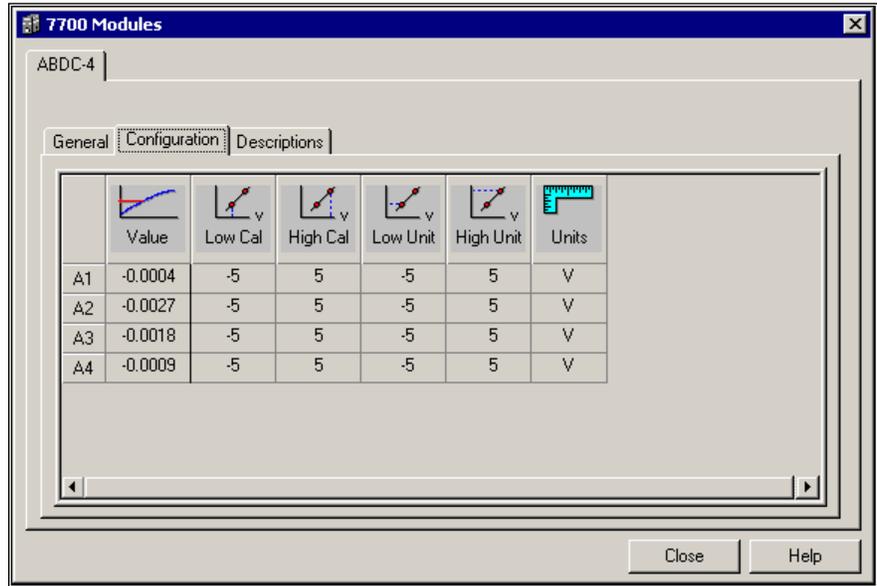


*ABDC-4 Configuration Tab*
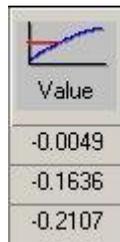
### *Value*



This column continuously displays the current value that is on the input of the signal conditioner. This column is updated by the system once every second and cannot be updated by the user.

This column is useful in troubleshooting the signal conditioner input connection.

### Low Cal & High Cal

| -1.000 | Measure |
|---|---|

**Measure Settings**
- ○ Current
- ○ Maximum
- ○ Minimum
- ◉ Average

Time: 1 second(s)

| OK | Cancel |
|---|---|

If you have available an input calibration signal (voltage), it can be used to calibrate the inputs. Double clicking on either the Low Cal or High Cal cell associated with the channel will open a dialog box as shown. This function allows a specific value to be entered that will be assigned to either the Low or High Cal. See Measure section for more information on this function and the use of the feature.

Additional setup information is needed to correctly scale the particular signal input. Since the input can be from a vast number of different sources, the specific input Units, High Unit, and Low Unit of measure should be set up. This calibrates the channel to the actual user units and scaling. The system will now display, record, and perform analysis directly in your units of measure. System defaults are: -5 Low Cal = -5 Low Unit and +5 High Cal = +5 High Unit. Low and High Cal entries are actual voltage values. The same defaults are present in the High Cal function. Also see Low and High Units and Measure section.

The calibration values entered are in the base units of the signal conditioner (Volts).

### Measure
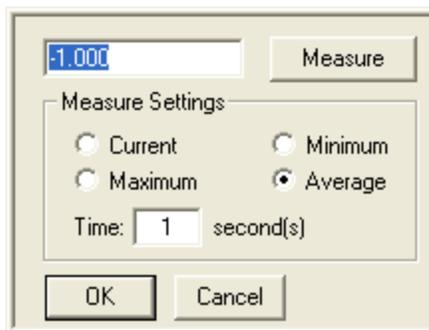
| -1.000 | Measure |
|---|---|

**Measure Settings**
- ○ Current
- ○ Maximum
- ○ Minimum
- ◉ Average

Time: 1 second(s)

| OK | Cancel |
|---|---|

In instances where there is offset on the input signal, the Measure function can compensate for this offset. The software can Measure a Low or High Cal value, and set that value to equal the entry in the Low or High Units cells.

If you have available an input calibration signal (voltage), it can be used to calibrate the inputs. Double clicking on either the Low Cal or High Cal cell associated with the channel will open a Measure dialog box as shown here. This function allows you to manually enter a specific value that will be assigned to either the Low or High Cal, or, by clicking the Measure button accept an external voltage that will set the calibration of the signal conditioner channel to correspond to the external calibration signal. Measure will enter any value that is being read at that time.

**Measure Settings:** provides user control over how data is sampled and recorded for the Low and High Cal values.

- Current – Will record the value at the end of the interval specified in the Time column. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine the end point for calibration and will record the last data point when the time interval is completed.

- Maximum - Will record the maximum value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Minimum - Will record the minimum value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Average - Will record the average value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Time - Number of seconds used to define the interval over which the calibration value for the Maximum, Minimum, or Average will be sampled.

**NOTE:** The Average selection with a Time of one second is the default setting for the Universal, Bridge, Transducer, ABDC and Carrier signal conditioners. The previous method utilized to determine Low and High Cal values was to take the value at the time that the Measure button was selected.

## Low Units & High Units

The user can select the units he wishes to display. Combined with Low Cal and High Cal, the user can set "x" value in Cal to equal "y" number of units. Example: If 2.500mV is entered in the High Cal and 100 was entered in High Units, then 2.500 mV = 100 units. Also see Measure Function.
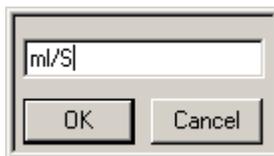
## Units

Units allow you to enter the actual engineering units being measured. The default is Volts (V), but this may be changed to any engineering units. The User Unit input field is limited to 9 characters.

Example: Suppose channel 4 is connected to a flow meter that outputs a voltage proportional to the blood flow. To record this, input A4 will be configured in Voltage Mode. Double clicking on the A4 Units cell will display a text box, allowing you to enter "ml/S".

# Descriptions Tab

The Descriptions tab allows the user to enter a text description for each input.

The Descriptions Menu allows you to enter text to further describe the parameters being recorded.  This may include additional user information or test setup information.  This information is stored in a text file.  It is not directly used as part of the signal conditioner configuration but is available for review whenever desired. Double click on the Text area, type in the information, then click on the OK button. Below is a typical Description tab.
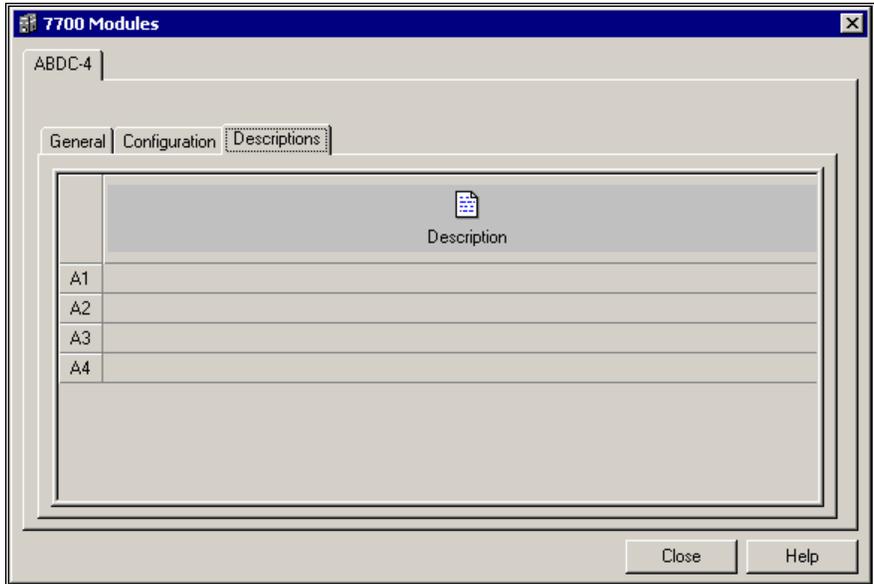


*ABDC-4 Descriptions Tab*

# Voltage View and Resetting

The ABDC-4 signal conditioner has the capability of viewing its values for debugging purposes and also resetting each channel if a problem has occurred during setup.

## Voltage View

This view allows the user to see the raw voltage that is being inputted into the channels. Right click on one of the channels (anywhere except for the Input Identifier or Value columns) and select **Voltage View**. Below is an example of the right click menu that will appear.



*Voltage View Menu*

Once voltage view has been selected the values listed for **Value**, **Low Span**, and **High Span** are listed in volts. Those columns values will change from black numbering to green numbering to notify the user that they are running in voltage view. Also, the **Units** column entry will change from black lettering to gray lettering. When voltage view has been set, the units of the values shown are in V. Shown below is an example of the **7700 Modules** dialog with voltage view set.
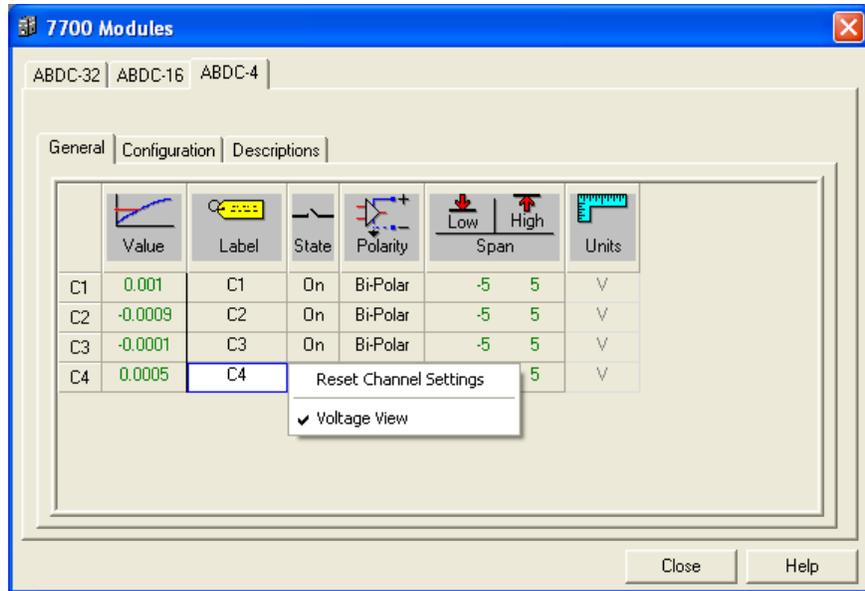
*Voltage View*

To return back to normal view, select **Voltage View** again.

## Reset

This selection allows the user to reset the settings of the channel selected. When selected, the channel will reset all columns dependent on which mode is currently selected. View the Mode section for default settings. When this selection is selected, a message box will appear asking if the channel should be reset. This allows the user to select **No** to cancel the resetting of the channel and **Yes** to reset the channel.

# Accessories

This section lists the available accessories that are available for the ABDC-32 signal conditioners:

BNC Input Module - J03380 (ABDC-32 only) (Includes cable for connection)

Cable set BNC-BNC – J02936

# Specifications - ABDC-4 and ABDC-32

## Input Specifications

Circuit:  Single ended

Impedance:  100kΩ to each input

Maximum input voltage:  ±50V without damage for 30 sec

Common Mode Rejection:  ≥-80 dB min

Input Range Bipolar:  ±1.25V, ±2.5V, ±5V, ±10V, and ±20V

Input Range Unipolar:  0 to 1.25V, 0 to 2.5V, 0 to 5V, 0 to 10V and 0 to 20V

## A/D Converter

Resolution:  16 bits

Conversion rate: 250k samples/sec aggregate

## Output

Accuracy:  ±0.5% of full scale typ., ±0.7% max

Bandwidth:  Flat to ±2% at 10kHz

Noise:  Less than 0.3% F.S. typ., 0.5% max

Offset:  ±0.3% F.S typ., ±0.5% max with input shorted

## Power Specifications

+5V @ <600mA

+12V @ <200mA

-12V @ <200mA

# Universal XE

## Introduction

This section describes the installation, operation and specifications for the DSI/Ponemah Universal XE signal conditioner, Model Number 13-7715-59. The Universal XE signal conditioner is a user installable signal conditioner compatible with the ACQ-7700 and compatible with Ponemah Physiology Platform software versions 4.40 and later (with the appropriate hardware DLL files) For more information on where and how this signal conditioner can be used, contact your local DSI/Ponemah representative.

The ACQ-7700 Universal XE signal conditioner is a four-channel signal conditioner. The four independent input connectors each have their own associated excitation source for use with transducers or strain gages. The signal conditioner occupies a single slot of the ACQ-7700. The four input signals are conditioned, digitized, and routed, via the ACQ-7700 "Broadcast" backplane, to the recording system. The system software controls the viewing and acquisition of this data.

The maximum acquisition sampling rate for the Universal XE signal conditioner is 100K samples per second/channel.

## Analog Inputs

Each of the signal conditioners front panel connectors is labeled with its channel number. See the *Input Signal Connections* section.



**MAXIMUM VOLTAGE ABOVE EARTH POTENTIAL TO EITHER INPUT TERMINAL IS 20VDC OR PEAK AC. EXCEEDING THIS VALUE CAN CAUSE DAMAGE. NORMAL CONTINUOUS INPUT VOLTAGE MAXIMUMS WITHOUT DAMAGE ARE ±5.0VDC OR 5V PEAK.**



Type B Applied Part – Common connected to Earth

## Input Signal Connections

The Universal XE signal input connection is made with a 14-pin ODU connector, one per channel. The Universal XE Connector Table describes the pin designations for this connector. The maximum input voltage is ±5.0VDC or 5V peak. It is recommended that a shielded cable be used for low-level measurements.

| Pin | Function | Pin | Function |
|---|---|---|---|
| 1 | +12V Module Power | 8 | Channel Negative Input |
| 2 | 12V Common | 9 | Channel Positive Input |
| 3 | -12V Module Power | 10 | Channel Common |
| 4 | +5V Common | 11 | Chassis Ground |
| 5 | +5V Module Power | 12 | Channel Probe AC/DC Select |
| 6 | Channel Excitation Out Negative | 13 | Channel Excitation Out Position |
| 7 | External Reset | 14 | Channel Excitation Return |

**DESCRIPTION OF FUNCTIONS:**

| Pin | Description |
|---|---|
| 1 | Provides +12 power to an external preamp |
| 2 | Provides 12 volt common to an external preamp |
| 3 | Provides -12 power to an external preamp |
| 4 | Provides 5 volt common to an external preamp |
| 5 | Provides +5 power to an external preamp |
| 6 | Negative excitation voltage |
| 7 | External Reset |
| 8 | Negative input signal |
| 9 | Positive input signal |
| 10 | Common for input signal |
| 11 | Connect to Earth ground |
| 12 | Allows selection of AC or DC coupling in the preamp |
| 13 | Positive excitation voltage |
| 14 | Excitation return signal |

Cable Plug Rear View
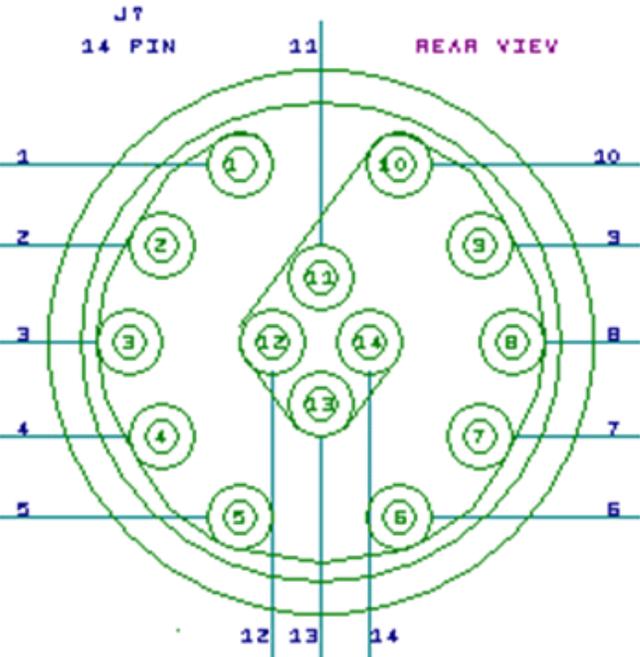
# Configuring the Universal XE Signal Conditioner

Note:  Screen captures in this section show an ACQ-7700 with multiple signal conditioners.  The Universal XE signal conditioner has been selected.

In the figure below, *Universal XE General Tab*, the Universal XE signal conditioner has been selected.  When a signal conditioner type is selected, its tab is brought to the foreground and a group of set up menus specific to that signal conditioner will be displayed.  This will include General, Configuration, and Descriptions tabs, which are accessed by their own tabs.

## General Tab

The General tab, as seen in the Universal XE signal conditioner, allows the user to set up channel specific signal conditioner parameters.  This includes the Label, Mode, High and Low Pass Filters, and Low Span and High Span.
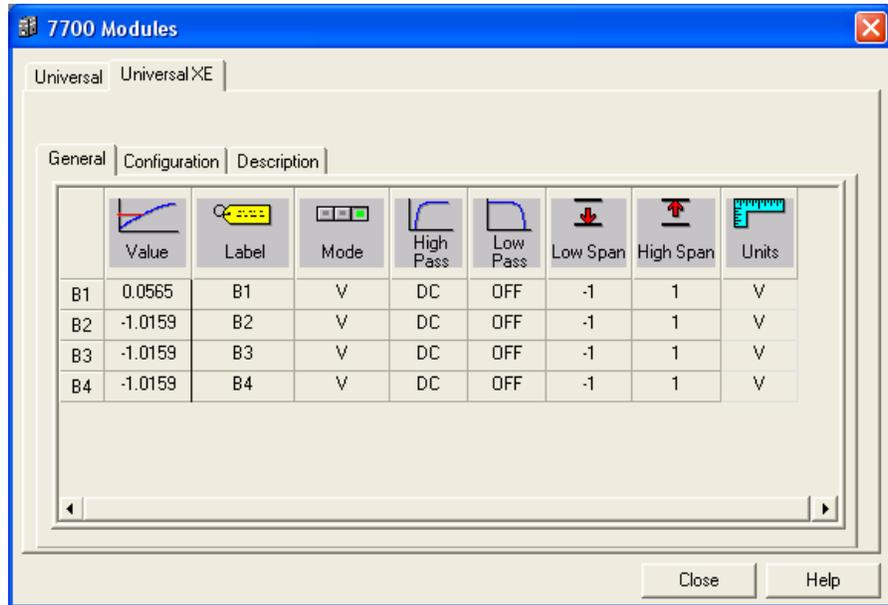


*Universal XE General Tab*

### *Value*



This column continuously displays the current value that is on the input of the signal conditioner.  This column is updated by the system once every second and cannot be updated by the user.

This column is useful in troubleshooting the signal conditioner input connection.
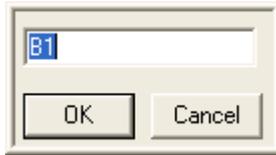
### *Label*



Label allows you to type in a logical name of up to 10 additional characters for a particular input channel.  The chosen name will be saved and used to identify the input data throughout the system, such as in the dialog that displays input channel information.
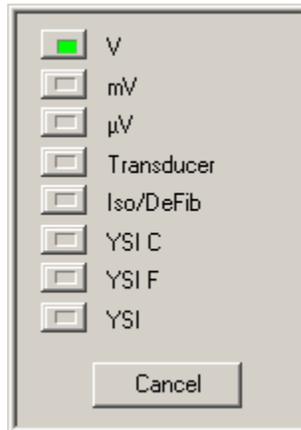
*Mode*



This selection allows you to choose the mode of operation for a particular channel. As with all signal conditioner functions, double clicking the mouse pointer in the mode cell of a particular channel allows you to set that channel. Double clicking on the Mode symbol allows you to set all channels, globally, to the same mode of operation. In both instances, a graphic selection panel will appear with the operating modes described below.

The default settings when V is the selected mode are **Low Span** = **-1**, **High Span** = **1**, **Low Cal** = **-1.000**, **High Cal** = **1.000**, **Low Unit** = **-1**, **High Unit** = **1**, and **Units** = **V**.

The default settings when mV is the selected mode are **Low Span** = **-500**, **High Span** = **500**, **Low Cal** = **-1.000**, **High Cal** = **1.000**, **Low Unit** = **-1**, **High Unit** = **1**, and **Units** = **mV**.

The default settings when μV is the selected mode are **Low Span** = **-500**, **High Span** = **500**, **Low Cal** = **-1.000**, **High Cal** = **1.000**, **Low Unit** = **-1**, **High Unit** = **1**, and **Units** = **μV**.

The default settings when Transducer is set are **Low Pass** = **100 Hz**, **Low Span** = **-50**, **High Span** = **350**, **Excitation** = **5V**, **Low Cal** = **0**, **High Cal** = **2.500**, **Low Unit** = **0**, **High Unit** = **100**, and **Units** = **mmHg**.

The default settings when Iso/DeFib is set are **Low Span** = -500, **High Span** = 500, **Low Cal** = -1.000 **High Cal** = 1.000 **Low Unit** = -1 **High Unit** = 1 and **Units** = **mV**.

The default settings when YSI C is set are **Low Pass** =10 **Hz**, **Low Span** =30(°C), **High Span** =50(°C), **Excitation** =2.5V, **Low Cal** = 971.468(mV), **High Cal** =1114.948(mV), **Low Unit** = 35(°C), **High Unit** = 45(°C), and **Units** = **deg C**.

The default settings when YSI F is set are **Low Pass** =10 **Hz**, **Low Span** =90(°F), **High Span** =120(°F), **Excitation** =2.5V, **Low Cal** = 971.468(mV), **High Cal** =1114.948(mV), **Low Unit** = 95(°F), **High Unit** = 113(°F), and **Units** = deg F.

The default settings when YSI is set are **Low Pass** =10**Hz**, **Low Span** =900(mV), **High Span** =1200(mV), **Excitation** =2.5V, **Low Cal** = -1.000(mV), **High Cal** = 1.000(mV), **Low Unit** = -1, **High Unit** = 1, and **Units** = **mV**.

## Iso/Defib Probe

See the 7700 Isolated Defibrillation Protected Probe section if using the Iso/DeFib Probe.

## YSI Probes

The YSI selections allow the user to connect a YSI probe. See the YSI Calibration section for the calibration of the YSI probes:

## Transducer

This mode is used when connecting to a strain gage based transducer, such as a blood pressure transducer. The transducer must have a complete 4-arm circuit. In Transducer mode, the signal conditioner supplies excitation to the transducer strain gage circuit and measures the resultant output voltage. When Transducer is selected, the signal conditioner will use the direct input from the transducer to calibrate the input channel in user units (see Unit/Cal setup in the Configuration tab section). Units default to mmHg in Transducer Mode.

## Voltage

This mode sets the channel to operate as a general purpose DC input signal conditioner with selections of microvolts, millivolts, or volts. In Voltage Mode, additional information is needed to correctly set up the particular signal input. Since the input can be from a vast number of different sources, the specific input Units, High Unit and Low Unit of measure may be changed manually. This calibrates the channel to the actual user units and scaling. The system will now display, record, and perform analysis directly in your units of measure. Unit defaults match the mode selection, i.e. mV defaults to mV in the Units cell.

### *High Pass*
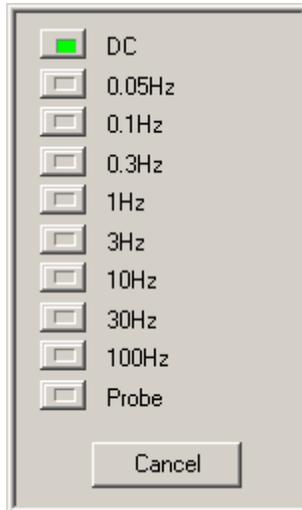


This function allows you to add a high pass filter to your input signal.

Typically a High Pass filter is needed when using a high sensitivity on the signal conditioner with the input measuring a bio-potential.

High Pass Selection is not available in Transducer Mode or any of the YSI modes.

### *Low Pass*
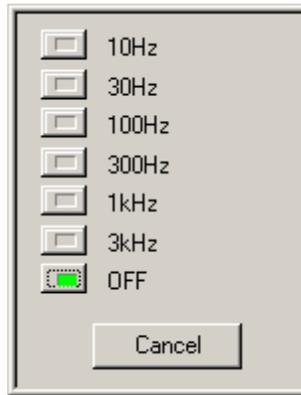


This function allows you to add a low pass filter to your input signal.

Since the Universal XE signal conditioner has a large input bandwidth, certain signals require that the signal be bandwidth limited. This performs as an anti-aliasing filter for the signal conditioner. Selecting OFF sets the Low Pass Filter to maximum bandpass of the signal conditioner, approximately 5kHz at -3dB.

### *Low Span*
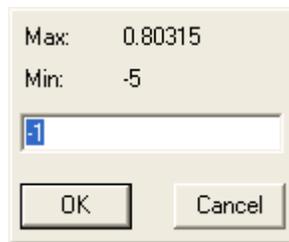


The span defines the sensitivity or scale for each channel. The Low Span sets the minimum value, in user units that will be recorded. When setting up channel parameters, SPAN should be set last. Assure the setting is appropriate for the anticipated readings. If offset is anticipated, the low span should be a number that will allow the trace to remain on the display.

The span is dependent upon the mode of operation selected. The Low Span may be chosen to be any value within the valid range for that input. The valid range is shown above the data entry box. When Low Span is selected, a dialog box appears. Simply type in the value desired. If the value entered is outside of the acceptable range for this input, an **INVALID** message will flash in the Low Span window. The actual value you enter may be considerably different since it will usually be in the units corresponding to your application.

Under certain conditions, the Spans will display the minimum or maximum allowed value in scientific notation.

### *High Span*
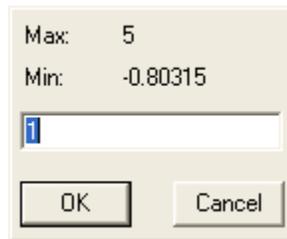
Max:    5

Min:    -0.80315

1

    OK        Cancel

The span defines the sensitivity or scale for each channel. The High Span sets the maximum value, in user units that will be recorded. When setting up channel parameters, SPAN should be set last. Assure the setting is appropriate for the anticipated readings. Assure to set the high span for a number that will allow the trace to remain on the display.

The span is dependent upon the mode of operation selected. The High Span may be chosen to be any value within the valid range for that input. The valid range is shown above the data entry box. When High Span is selected, a dialog box appears. Simply type in the value desired. If the value entered is outside of the acceptable range for this input, an **INVALID** message will flash in the High Span window. The actual value you enter may be considerably different since it will usually be in the units corresponding to your application.

### *Units*
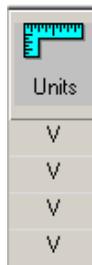
Units

V

V

V

V

This column displays the units that have been set in the **Configuration** tab and cannot be changed in this tab. The Units have no effect on the channel and it is for documenting the Input units.

## Configuration Tab

To set up the actual signal input configuration, select the Configuration tab in the signal conditioner setup panel.  The Configuration set up screen, as shown in *Universal XE Configuration Tab*, will be displayed.
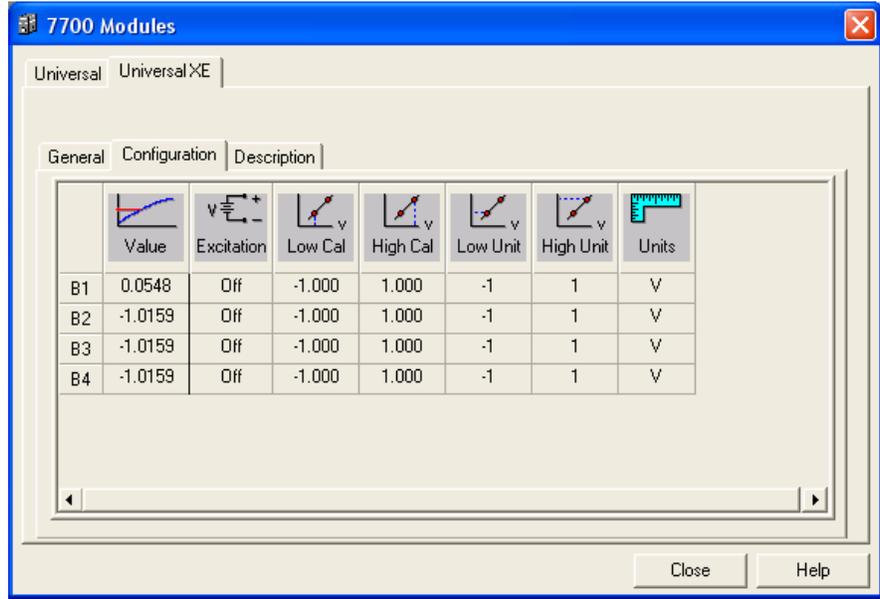


*Universal XE Configuration Tab*

### *Excitation*
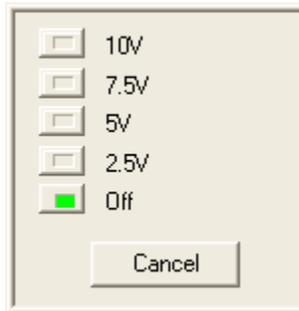


This function displays a text box that allows you to set the excitation voltage that will be applied to the transducer or strain gage.  Although this is commonly set to 5VDC, it may be beneficial to change this setting.  The output of a transducer is directly proportional to the input excitation.  Therefore, by doubling the excitation voltage, you can double the output of the transducer.

**NOTE:**  You should be careful not to exceed the rated operational range of your transducer.  Also, adding excitation will increase the current and the heat that must be dissipated by the transducer.  In some cases, this additional heat may cause the transducer signal to drift unacceptably.

**Caution:  Excitation current is limited to 20mA.  Exceeding this limit will lead to measurement errors!**

**Excitation maximum = $(20 * 10^{-3})$ \*($R_{bridge}$)**

### Low Cal & High Cal
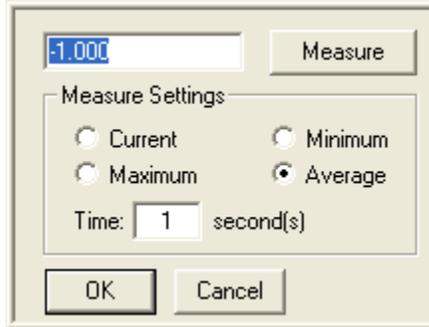


If you have an available input calibration signal (voltage), it can be used to calibrate the inputs.  Double clicking on either the Low Cal or High Cal cell associated with the channel will open a dialog box as shown.  This function allows a specific value to be entered that will be assigned to either the Low or High Cal.  See Measure section for more information on this function and the use of the feature.

Additional setup information is needed to correctly scale the particular Low and High signal inputs.  Since the input can be from a vast number of different sources, the specific input Units, High Unit and Low Unit of measure should be set up.  This calibrates the channel to the actual user units and scaling.  The system will now display, record, and perform analysis directly in the units of measure.  System defaults are:  -1.00 Low Cal = -1 Low Unit when in Voltage Mode.  Low and High Cal entries are actual voltage values.  The same defaults are present in the High Cal function.  Also see Low and High Units and Measure section.

The calibration values entered are in the base units of the signal conditioner (Volts for a mode setting of V, millivolts for modes settings of mV, Transducer, and microvolts for a mode setting of μV).

### Measure



In instances where there is offset on the input signal, the Measure function can compensate for this offset.  The software can Measure a Low or High Cal value, and set that value to equal the entry in the Low or High Units cells.

If you have available an input calibration signal (voltage), it can be used to calibrate the inputs.  Double clicking on either the Low Cal or High Cal cell associated with the channel will open a Measure dialog box as shown here.  This function allows you to manually enter a specific value that will be assigned to either the Low or High

Cal, or, by clicking the Measure button accept an external voltage that will set the calibration of the channel to correspond to the external calibration signal. Measure will enter any value that is being read at that time.

**Measure Settings:** provides user control over how data is sampled and recorded for the Low and High Cal values.

- Current - Will record the value at the end of the interval specified in the Time column. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine the end point for calibration and will record the last data point when the time interval is completed.

- Maximum - Will record the maximum value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Minimum - Will record the minimum value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Average - Will record the average value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Time - Number of seconds used to define the interval over which the calibration value for the Maximum, Minimum, or Average will be sampled.

**NOTE:** The Average selection with a Time of one second is the default setting for the Universal, Universal XE, Bridge, Transducer, ABDC and Carrier signal conditioners. The previous method utilized to determine Low and High Cal values was to take the value at the time that the Measure button was selected.

### *Low Units & High Units*

The user can select the units to be displayed. Combined with Low Cal and High Cal, the user can set "x" value in Cal to equal "y" number of units. Example: If 2.500mV is entered in the High Cal and 100 was entered in High Units, then 2.500mV = 100 units. Also see Measure Function.

### *Units*

Units allow you to enter the actual engineering units being measured.  The default is dependent on the Mode selected but this may be changed to any engineering units. The User Unit input field is limited to 9 characters.

## Descriptions Tab

The Descriptions tab allows the user to enter a text description for each input and to further describe the parameters being recorded.  This may include additional user information or test setup information.  This information is stored with the test set up in a text file.  It is not directly used as part of the signal conditioner configuration but is available for review whenever desired.  Double Click on the text area, type in the information, and then click on the **OK** button.  Below is a typical Description tab.
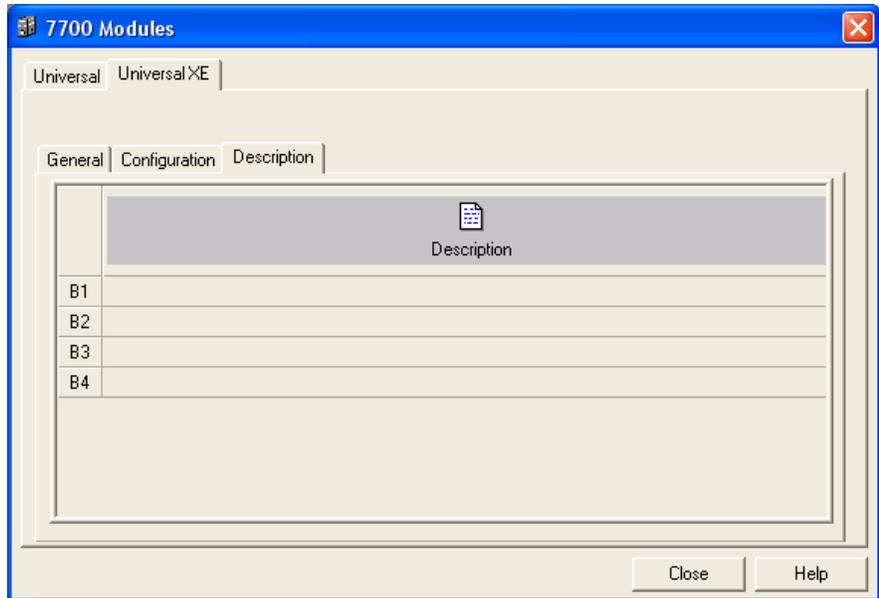
*Universal XE Descriptions Tab*

# YSI Calibration

The following procedures are used to measure temperatures using a 700A series YSI probe with a Universal XE Signal conditioner.

## YSI PROBE:  PRESET CALIBRATION

A standard YSI probe connected to the 7700 Universal XE signal conditioner using two required adapter cables (J03445-1 & J03586) can be used without calibration.

Select YSI-C from the Mode Box in the Universal XE Signal conditioner General Tab.  The probe will display results in degrees Celsius within approximately ±1°C.

Select YSI-F from the Mode Box in the Universal XE Signal conditioner General Tab.  The probe will display results in degrees Fahrenheit within approximately ±2°F.

## YSI PROBE:  PHYSICAL CALIBRATION

The probe can be calibrated to two known temperature sources.

Select YSI from the Mode Box, in the Universal XE Signal conditioner General Tab.

When selecting the YSI probe, default values are populated. This places the probe in a voltage-measuring mode and will display an associated voltage for temperatures between 30°C (86°F) and 50°C (122°F).

Lower the temperature of the probe.  Once the temperature has stabilized, record the probe voltage measured (Vmin) and also the temperature of the probe (Tmin).

Raise the temperature of the probe.  Once the temperature has stabilized, record the probe voltage measured (Vmax) and also the temperature of the probe (Tmax).

Set the following boxes:

Low Cal: = Vmin value

High Cal: = Vmax value

Low Unit: = Tmin value

High Unit: = Tmax value

Set the "Units" field to the same unit of measurement that the temperature measurements were taken above (degC or DegF).

Set the "Low Span" and "High Span" settings to measure the range of temperatures of interest.

Note that the YSI probe is intended for use over a small temperature range, and calibrating the probe over a small temperature range allows the highest measurement accuracy (to within ±0.05°C, ±0.1°F in the 30 to 50°C range).  The YSI probe output is not completely linear, and calibrating to two extremes (freezing and boiling) may generate results similar to using the device in the un-calibrated mode ±1°C, ±2°F. Calibrating the device between two close temperatures of interest should provide an accurate measurement limited to the theoretic non-linearity of the probe and the accuracy of the calibration fixture.

# Voltage View and Resetting

The Universal XE signal conditioner has the capability of viewing its values for debugging purposes and also resetting each channel if a problem has occurred during setup.

## Voltage View

This view allows the user to see the raw voltage that is being inputted into the channels. Right click on one of the channels (anywhere except for the Input Identifier or Value columns) and select **Voltage View**. Below is an example of the right click menu that will appear.



*Voltage View Menu*

Once voltage view has been selected the values listed for **Value**, **Low Span**, and **High Span** are listed in volts. Those columns values will change from black numbering to green numbering to notify the user that they are running in voltage view. Also, the **Units** column entry will change from black lettering to gray lettering. When voltage view has been set, the units of the values shown are dependent on the mode selected. If in V mode the units are Volts, if in mV mode the units are mV, if in µV mode the units are µV, and if in Transducer mode the units are in mV. Shown below is an example of the **7700 Modules** dialog with voltage view set.
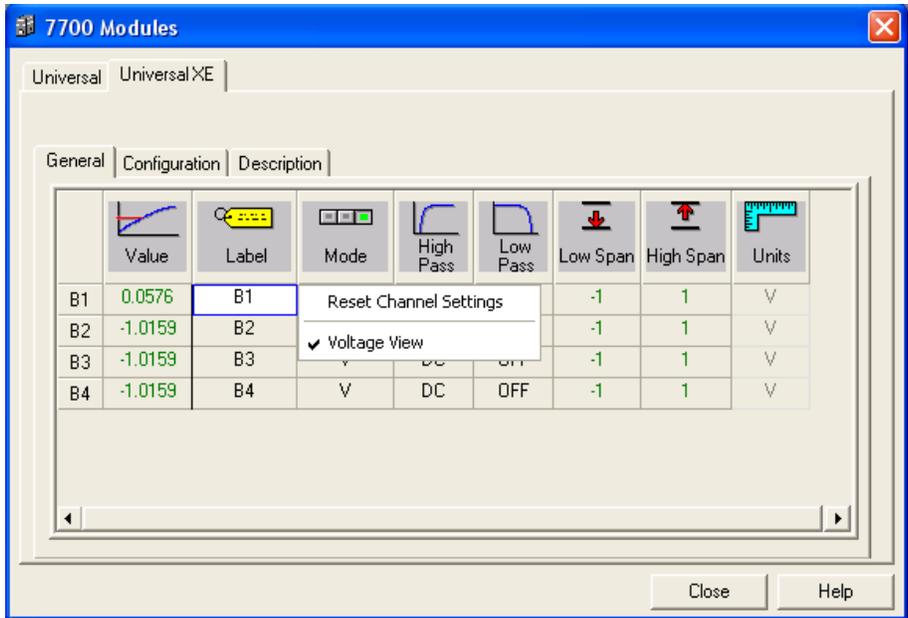
*Voltage View*

To return back to normal view, select **Voltage View** again.

## Reset

This selection allows the user to reset the settings of the channel selected. When selected, the channel will reset all columns dependent on which mode is currently selected. View the Mode section for default settings. When this selection is selected, a message box will appear asking if the channel should be reset. This allows the user to select **No** to cancel the resetting of the channel and **Yes** to reset the channel.

# Typical Transducer Setup

## Selection of Mode
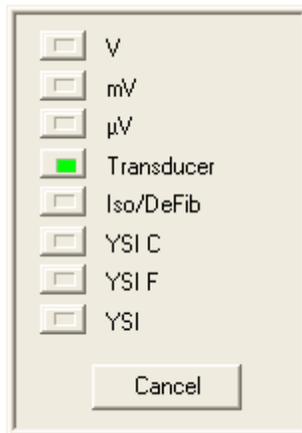


In this example, the first channel on the Universal XE signal conditioner will be set to Transducer Mode. First, select the **General** tab. Highlight and change channel one to Transducer in the Mode column as shown above. Channel one will now be in the default Transducer Mode. Shown below are the General and Configuration tabs in the transducer default mode with only channel one being selected. In the Configuration tab, the default is 5V excitation, and Low Cal and Low Unit and High Cal and High Unit default as follows:  0mVDC = 0mmHg and 2.500mVDC = 100mmHg. Many transducers are typically 50μV/V/cmHg (or 5μV/V/mmHg). Thus the calibration factor and output is as follows: 50μV per V (5V Excitation) = 250μV x 10(cm) = 2.5mV.

## Defaults

The following dialogs display the defaults in Transducer mode.
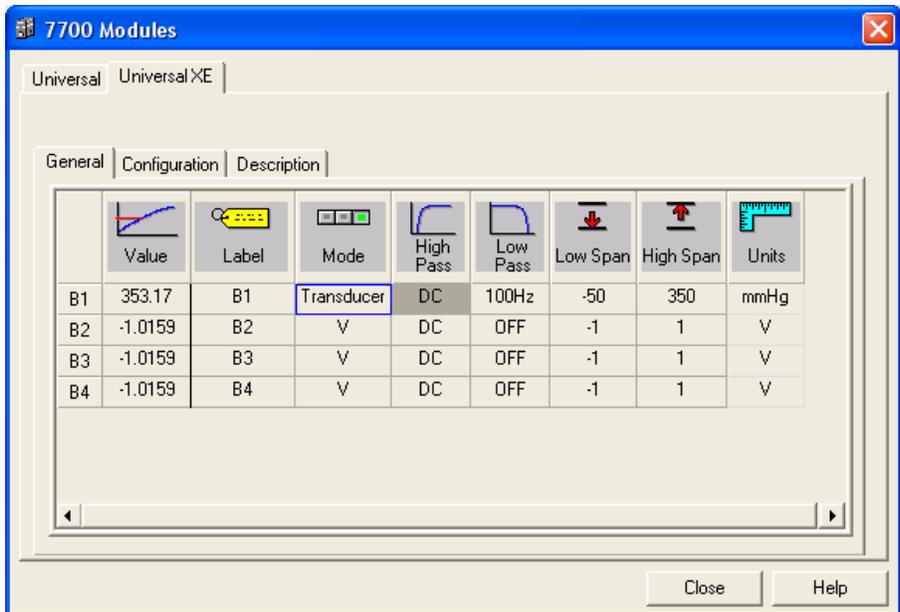
*General tab Transducer defaults*
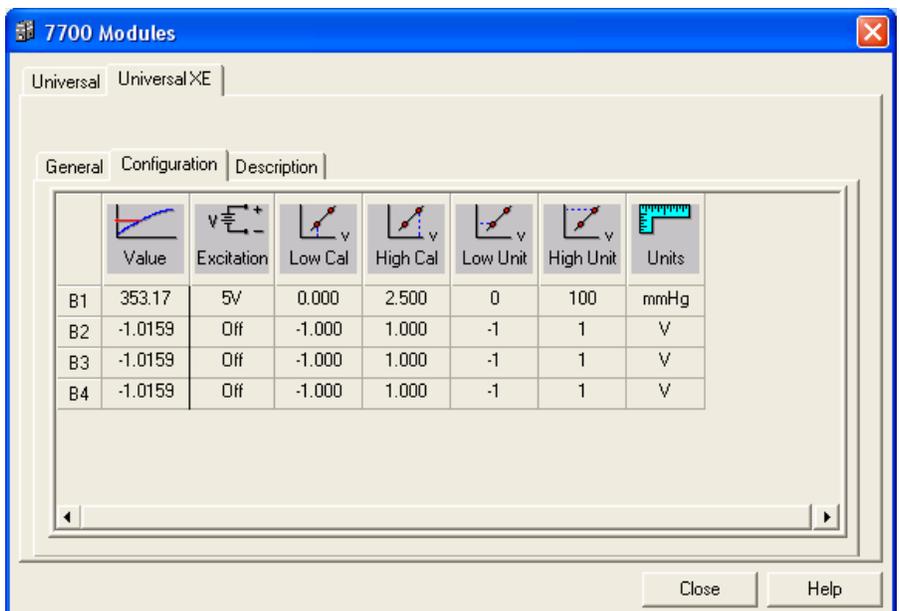


*Configuration tab Transducer defaults*

## Transducer Calibration

Most transducers are not EXACTLY 50μV/V/cmHg (or 5μV/V/mmHg) so the signal conditioner must be calibrated for a particular transducer.

First a zero baseline must be established, and this is typically with no pressure being applied to the transducer. Dependent on the position of the transducer at rest, there is usually some offset due to gravity or any other forces acting on the transducer causing a small amount of zero shift or offset.
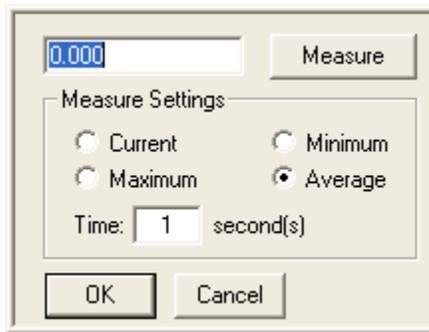
Double click on the Low Cal cell for channel one. This opens a dialog box that enables the user to either enter the offset value in mV (if known), or "Measure" the value. By clicking on the **Measure** button, the software will accept an external voltage that will set the zero calibration of the channel to correspond to the value read. With the transducer at rest and open to air, click on the **Measure** button. The offset value will be read and automatically inserted in the Low Cal cell. The example below indicates that there is 0.059mV offset with the transducer at rest.
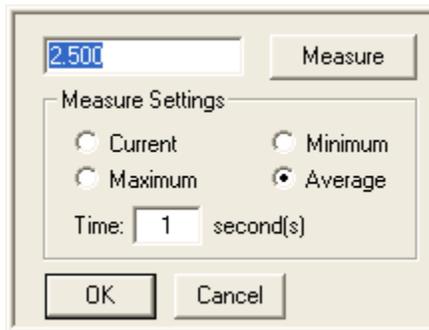
Next, a gain value must be entered in High Cal. If you have an input calibration source available, it can be used to input a value to set the gain. Double click on the High Cal cell for channel one. This opens a dialog box that enables the user to either enter the gain value in mV (if known), or "Measure" the value. By clicking on the **Measure** button, the software will accept an external voltage that will set the gain calibration of the channel to correspond to the value read. Apply 100mmHg pressure to the transducer and, click on the **Measure** button. The gain value will be read and automatically inserted in the High Cal menu. The example below indicates that the gain calibration value is 2.483mV. This indicates that this transducer is not exactly 50μV/V/cmHg (or 5μV/V/mmHg). If so, that value would be read as 2.500mV.

**Measure Settings:** provides user control over how data is sampled and recorded for the Low and High Cal values.

- Current - Will record the value at the end of the interval specified in the Time column. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine the end point for calibration and will record the last data point when the time interval is completed.

- Maximum - Will record the maximum value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Minimum - Will record the minimum value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Average - Will record the average value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Time - Number of seconds used to define the interval over which the calibration value for the Maximum, Minimum, or Average will be sampled.

**NOTE:** The Average selection with a Time of one second is the default setting for the Universal, Universal XE, Bridge, Transducer, ABDC and Carrier signal conditioners. The previous method utilized to determine Low and High Cal values was to take the value at the time that the Measure button was selected.

If you have the calibration factor for the transducer, you may enter its value directly. Many manufacturers supply that value with the transducer. Typically, the 50µV/V/cmHg (or 5µV/V/mmHg) sensitivity may vary. Inserting that value into the equation: "__"µV per "__"V (excitation value) x 10 (10cm=100mm) = __mV. The values are typically between 2.300 and 2.600mV for 5V excitation.

Now set up the spans for the channel. Setting the spans sets the lower and upper units for the anticipated data range. If values fall outside the span, signals will remain clipped until they fall back with the range. Spans should be modified last and set to allow a cushion for anticipated data above normal. Calibration is now completed. 0mm pressure will now read 0mmHg and when 100mmHg is applied the reading will be 100mmHg. Shown below is the Configuration tab after completion of the transducer calibration.

**7700 Modules**

Universal | Universal XE

General | Configuration | Description

| | Value | Excitation | Low Cal | High Cal | Low Unit | High Unit | Units |
|----|-------|-----------|---------|----------|----------|-----------|-------|
| B1 | 100.25 | 5V | 0.059 | 2.483 | 0 | 100 | mmHg |
| B2 | -1.0159 | Off | -1.000 | 1.000 | -1 | 1 | V |
| B3 | -1.0159 | Off | -1.000 | 1.000 | -1 | 1 | V |
| B4 | -1.0159 | Off | -1.000 | 1.000 | -1 | 1 | V |

Close | Help
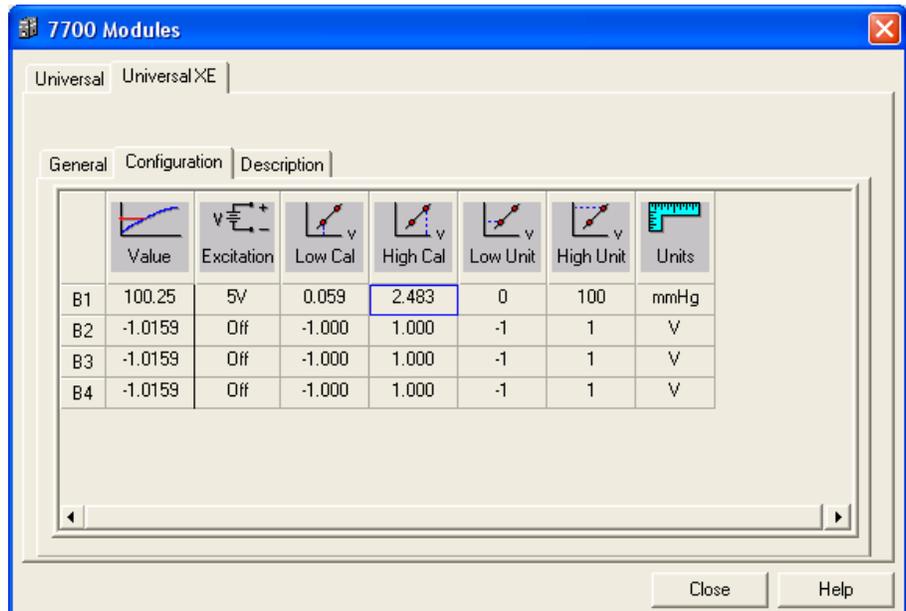
*Transducer Calibrated*

# Accessories

This section lists the available accessories that are available for the Universal XE signal conditioner.

| Part Number | Description |
| --- | --- |
| J03590 | Input Cable to BNC 10FT |
| J03587 | Input Cable to 3 Lead ECG 10FT |
| 13-7759-IDP | Isolated/Defibrillation protected ECG Probe |
| 13-7759-GPP | Isolated/Defibrillation protected General Purpose Probe |
| J03589 | Input Cable to ISO POD 2.5FT |
| J03125 | Xdcr BD P23XL Blood Pressure Transducer |
| P02041 | Xdcr BD DT682018 Blood Pressure Transducer/No cable (10 pack) |
| J03588 | Input Cable to BD Transducer / Blood Pressure 12FT |
| J03591 | Buxco TRD5700 Pressure Transducer |
| J03345* | Xdcr Force for FT-302 |
| J03482-40* | Hugo Sachs Stratham Transducer |
| J03446* | Differential Head Stage Amplifier |
| P02302-701* | YSI Temperature Probe |
| J03445-1* | Adaptor Cable for YSI Temperature Probe |
| J03586 | Adaptor Cable 18" |

* Requires J03586 (Adaptor Cable 18") Consult the factory for additional input accessories and cables.

# Specifications

The 13-7715-59 Universal XE signal conditioner is a four-channel signal conditioner designed specifically to work with signals from low level input voltage and transducers with sensitivities from 50µV to 5V full scale.  All channels are identical, but can be independently configured.  Each channel has its own programmable voltage excitation supply as well.  Programmable eight-pole low pass filters for each channel are available for both noise and anti-alias filtering.  The total functionality of each channel is controlled through the Ponemah software.

## Input Circuit (typical of each channel)

Differential non-isolated balanced to ground

10MΩ each input to common

Input Type: DC Input Impedance, AC Input Impedance

Greater than 100kΩ at 1kHz

Maximum input ±20VDC or peak AC

## Measurement Range

| | |
|---|---|
| Linear Range: | Bipolar: ±25µV to ±5V full scale |
| | Unipolar: 0-50µV to 0-5V full scale |

## Transducer Excitation

| | |
|---|---|
| Type: | Bipolar/Unipolar |
| Voltage: | Off, 2.5, 5.0,7,5 ±1%, and 10VDC, ±5% |
| Resolution: | 12 BIT |
| Maximum current: | 15mA |

## Signal Conditioner Output

| | |
|---|---|
| A/D Converter: | 16 BITS |
| Sample Rate: | 100kHz per channel maximum |

## Accuracies

**DC Mode Gain Accuracy:**

±0.5% FS in mV ranges

**DC Mode Zero Error:**
<±0.4% of FS in the mV ranges

**FILTERS:**

Low pass eight-pole DSP Bessel with seven selectable settings of:
      10, 30, 100, 300, 1000, 3000Hz and OFF (OFF= > 5kHz)

High pass single-pole Bessel with nine selectable settings of:
      DC, 0.05, 0.1, 0.3, 1.0, 3.0, 10, 30, and 100Hz, ±10%

**COMMON MODE:**

-60dB minimum with 1kΩ unbalance @ 60Hz

**CROSSTALK:**

-90dB minimum between adjacent channels on ±500mV range

**NOISE:**

| | |
|---|---|
| DC to 1kHz: | Less than 10µVP-P typical at max gain |
| DC to 5kHz: | Less than 20µV P-P at max gain |

**ZERO SUPPRESSION:**

| Voltage Range | Max Suppression |
|---|---|
| ±5V to ±200mV | ±5V |
| ±200mV to ±0.2mV | ±0.5V |
| Less than 0.2mV | ±0.05V |

Resolution:                      16 bits

# Transducer Mode

Measurement Range:          50µV to 5.0V full scale

Frequency Response:  Uses Low Pass eight-pole DSP Bessel filter with seven selectable settings of:
        10, 30, 100, 300, 1000, 3000Hz, and OFF (OFF = > 5kHz)

Accuracy @ -3dB:           ±5% of indicated frequency

High Pass Filter:             DC coupled only

# Carrier

## Introduction

This section describes the installation, operation, and specifications for the ACQ-7700 Carrier signal conditioner, model number 13-7715-35.  This signal conditioner is designed specifically to stimulate and measure up to four variable reluctance pressure transducers, such as the Validyne DP-45 and DP-250.  The system software controls signal gain, offset, and data acquisition parameters.

## Analog Inputs

Transducers can be supplied by DSI/Ponemah with the proper 7 pin Lemo connector to plug directly into the front plate of the signal conditioner.

This signal conditioner is not intended to be used as a general analog voltage input device.



**NOTE:**  Input connectors are sensitive to static discharge, observe precautions when handling.

# Input Signal Connections

The 7 pin Lemo signal input connections are shown below.

**View From Front of Signal Conditioner**



EXCITATION VOLTAGE -

GROUND

EXCITATION
VOLTAGE +

- INPUT
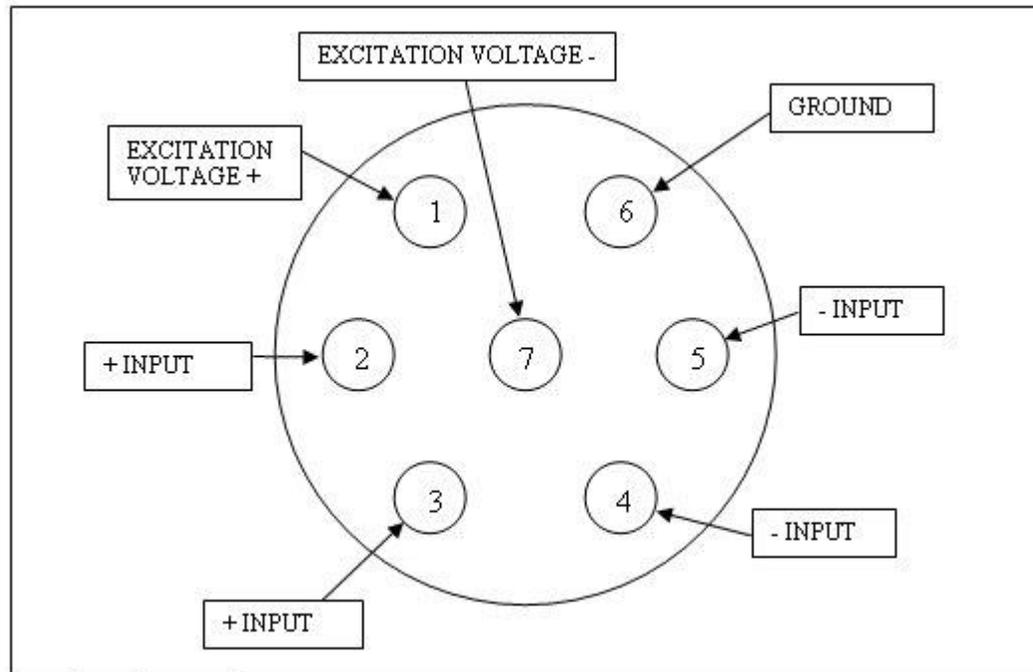
+ INPUT

- INPUT

+ INPUT

*Lemo Input Connector Assignment*

| Pin | Carrier 13-7715-35 |
|-----|--------------------|
| 1 | Excitation Voltage + |
| 2 | + Input |
| 3 | + Input |
| 4 | - Input |
| 5 | - Input |
| 6 | Ground |
| 7 | Excitation Voltage - |

# Configuring the Carrier Signal Conditioner

From the **Ponemah** software **Calibration** menu, select **7700 Amplifier Setup**.

In the figure below, **Carrier General Tab**, the Carrier signal conditioner has been selected. When a signal conditioner type is selected, a tab is brought to the foreground and a group of parameters specific to that signal conditioner are displayed. The tabs are titled: General, Configuration, and Description.

## General Tab

The General tab allows the user to set up channel specific signal conditioner parameters. The General tab includes: Label, Low Pass setting, Low Span, High Span, and Units.
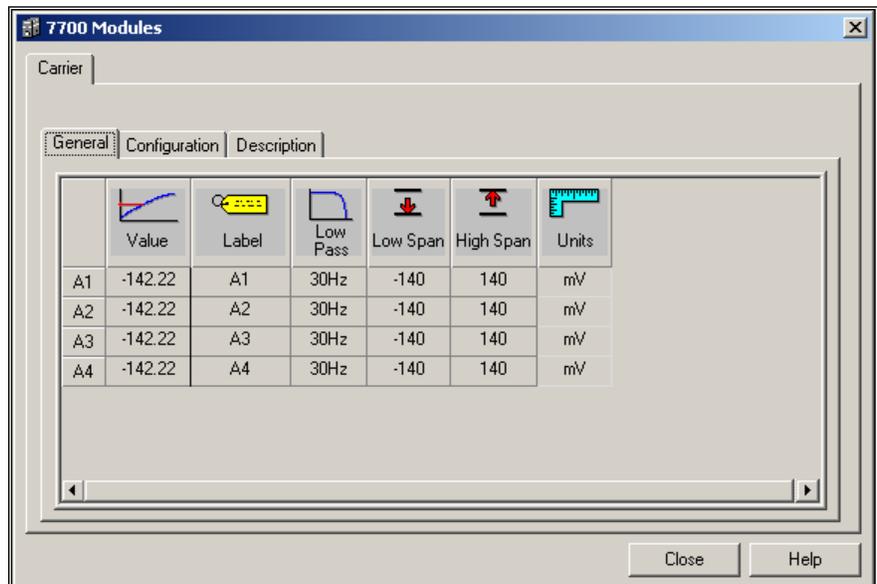


*Carrier General Tab*

### *Value*



This column continuously displays the current value of the input signal in user units. This column is updated by the system once every second.

This column is useful in troubleshooting the signal conditioner input connection.

The Value column can also be set to display the input Voltage in millivolts (see the **Voltage View** section below).

## *Label*



Label allows the user to type in a logical name of up to 10 characters for a particular input channel. The chosen name will be saved and used to identify the input data throughout the system, such as in the dialog that displays input channel information.

## *Low Pass*
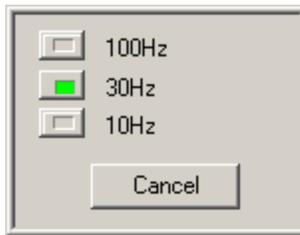


This function sets the corner frequency of filtering to the input signal.

A detailed description of the filter settings is listed in the **Specifications** section of this manual under the **Filter Settings** heading.

## *Low Span*

The Low Span sets the minimum value, in user units, that will be recorded.
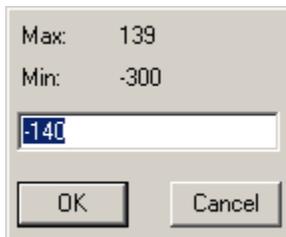


The Low Span minimum and maximum limits are calculated through an internal formula that takes into account the physical limits of the hardware and the user calibration set-points. The Low Span value can be set by double clicking on the Low Span cell for a particular channel in the General Tab dialog box.

The following conditions will cause the Low Span to display **Invalid** and revert to the last valid Low Span setting:

- Attempting to set the Low Span to the same value as High Span

- Attempting to set the Low Span out of the range of the **Min** and **Max** limits

The system may automatically change the Low Span setting if changes to the High Cal, Low Cal, High Unit, or Low Unit would cause the Low Span to be set outside of the physical limits of the amplifier.

## High Span
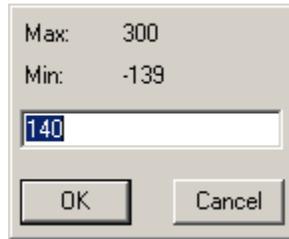


The High Span sets the maximum value, in user units, that will be recorded.

The High Span minimum and maximum limits are calculated through an internal formula that takes into account the physical limits of the hardware and the user calibration set-points.  The High Span value can be set by double clicking on the High Span cell for a particular channel in the General Tab dialog box.

The following conditions will cause the High Span to display **Invalid** and revert to the last valid High Span setting:

- Attempting to set the High Span to the same value as Low Span

- Attempting to set the High Span out of the range of the **Min** and **Max** limits

The system may automatically change the High Span setting if changes to the High Cal, Low Cal, High Unit, or Low Unit would cause the High Span to be set outside of the physical limits of the amplifier.

## Units



The Units box displays the user units as entered in the Configuration Tab.

# Configuration Tab

The Configuration Tab allows the user to generate an internal conversion factor between the millivolt output of the actual transducer and a meaningful unit of measure (user units). This tab also enables the user to calibrate the transducer.
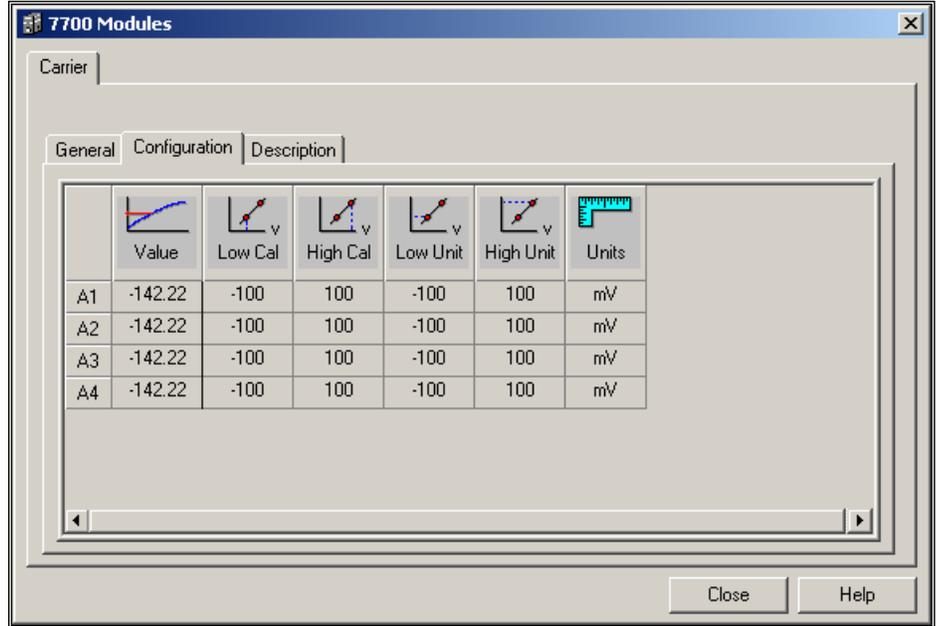


*Carrier Configuration Tab*
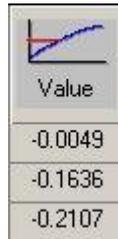
## *Value*



This column continuously displays the current value of the input signal in user units. This column is updated by the system once every second.

The Value column can also be set to display the input Voltage in millivolts (see the **Voltage View** section below).

### *Low Cal*
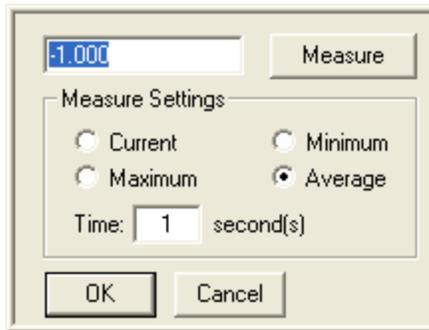


The Low Cal value sets the millivolt value that corresponds to the Low Unit user value. A voltage input that is equal to the Low Cal setting will display the value of the Low Unit setting in the Value column in user measurements.

The **Measure** button takes the millivolt value at the input of the signal conditioner, based on the Measure Settings, as the Low Cal set-point at the time the measure button is pressed.

**Measure Settings:** provides user control over how data is sampled and recorded for the Low and High Cal values.

- Current – Will record the value at the end of the interval specified in the Time column. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine the end point for calibration and will record the last data point when the time interval is completed.

- Maximum - Will record the maximum value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Minimum - Will record the minimum value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Average - Will record the average value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Time - Number of seconds used to define the interval over which the calibration value for the Maximum, Minimum, or Average will be sampled.

**NOTE:** The Average selection with a Time of one second is the default setting for the Universal, Bridge, Transducer, ABDC and Carrier signal conditioners. The previous method utilized to determine Low and High Cal values was to take the value at the time that the Measure button was selected.

If the gage factor (sensitivity) value is known, that value can be typed in and used. If this is the case, a measure does not need to be performed, but performing a measure is recommended.

Changing this field should not interact with any other field (**Low Span** or **High Span**) if the field is currently in range.

The calibration values entered are in the base units of the signal conditioner (millivolts).

## *High Cal*
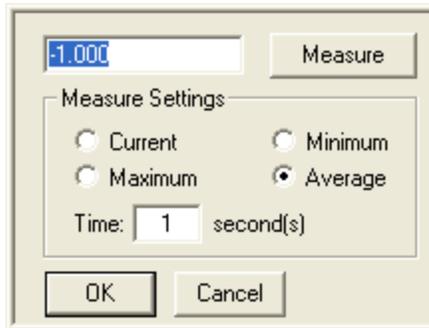


The High Cal value sets the millivolt value that corresponds to the High Unit user value.   A voltage input that is equal to the High Cal setting will display the value of the High Unit setting in the Value column in user measurements.

The **Measure** button takes the millivolt value at the input of the signal conditioner, based on the Measure Settings, as the High Cal set-point at the time the measure button is pressed.

**Measure Settings:** provides user control over how data is sampled and recorded for the Low and High Cal values.

- Current – Will record the value at the end of the interval specified in the Time column.  After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine the end point for calibration and will record the last data point when the time interval is completed.

- Maximum - Will record the maximum value over the interval specified in the Time field.  After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Minimum - Will record the minimum value over the interval specified in the Time field.  After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Average - Will record the average value over the interval specified in the Time field.  After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Time - Number of seconds used to define the interval over which the calibration value for the Maximum, Minimum, or Average will be sampled.

**NOTE:** The Average selection with a Time of one second is the default setting for the Universal, Bridge, Transducer, ABDC and Carrier signal conditioners.  The previous method utilized to determine Low and High Cal values was to take the value at the time that the Measure button was selected.

If the gage factor (sensitivity) value is known, that value can be typed in and used.  If this is the case, a measure does not need to be performed, but performing a measure is recommended.

Changing this field should not interact with any other field (**Low Span** or **High Span**) if the field is currently in range.

The calibration values entered are in the base units of the signal conditioner (millivolts).

### *Low Unit*

The Low Unit value sets the user value that corresponds to the Low Cal voltage measurement. The value in this box is displayed in the Value cell and in user measurements when the input voltage is equal to the Low Cal value.

Changing this field should not interact with any other field (**Low Span** or **High Span**) if the field is currently in range.

### *High Unit*
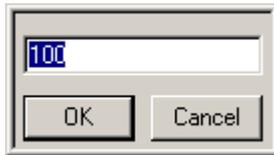
The High Unit value sets the user value that corresponds to the High Cal voltage measurement. The value in this box is displayed in the Value cell and in user measurements when the input voltage is equal to the High Cal value.

Changing this field should not interact with any other field (**Low Span** or **High Span**) if the field is currently in range.

### *Units*
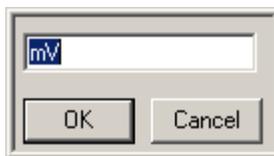
Units allow the user to enter the actual engineering unit of measure. The Units default is millivolts (mV), but may be changed to any engineering units. The User Unit input field is limited to 9 characters.

Typical User Units could be:  mmHg, inH$_2$O, L/Min, mL/Sec

## Descriptions Tab

The Descriptions tab allows the user to enter a text description for each input and to further describe the parameters being recorded, including additional user information or test setup information. Description Tab information is stored with the calibration information in a log file. Double click on the text area, type in the information, and then click on the **OK** button. Below is a typical Description Tab.
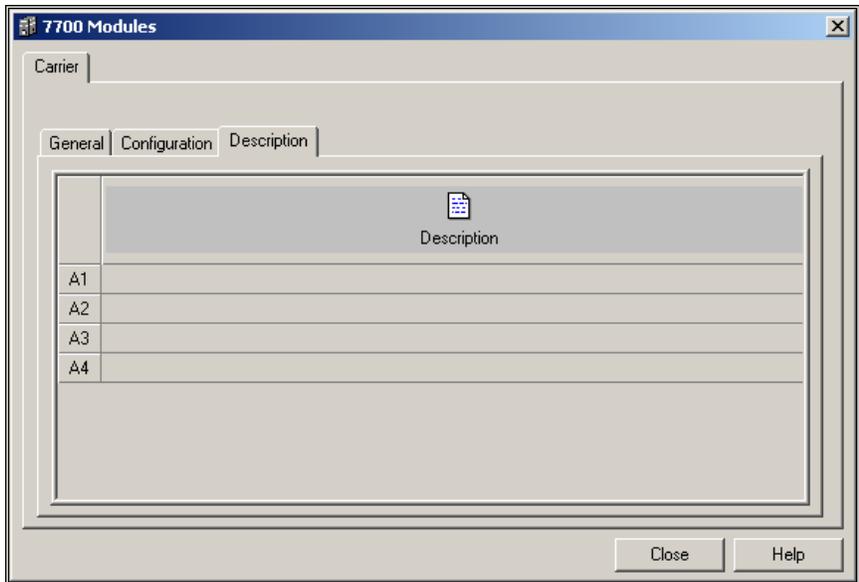
*Carrier Description Tab*

# Voltage View and Resetting

The Carrier signal conditioner has the capability of viewing its values for debugging purposes and also resetting each channel if a problem has occurred during setup.

## Voltage View

The Low Span, High Span, and Value cells normally indicate parameters in User Units. The Voltage View mode allows these parameters to be displayed in millivolts.

In any of the cells that accept user input, a right click opens up the Reset Channel Settings/Voltage View menu. By left clicking on **Voltage View**, a check is placed next to the text and the Voltage View mode is entered. The Low Span, High Span, and Value columns are then displayed in green with millivolt values substituting the user values, and the Units column is displayed in gray.
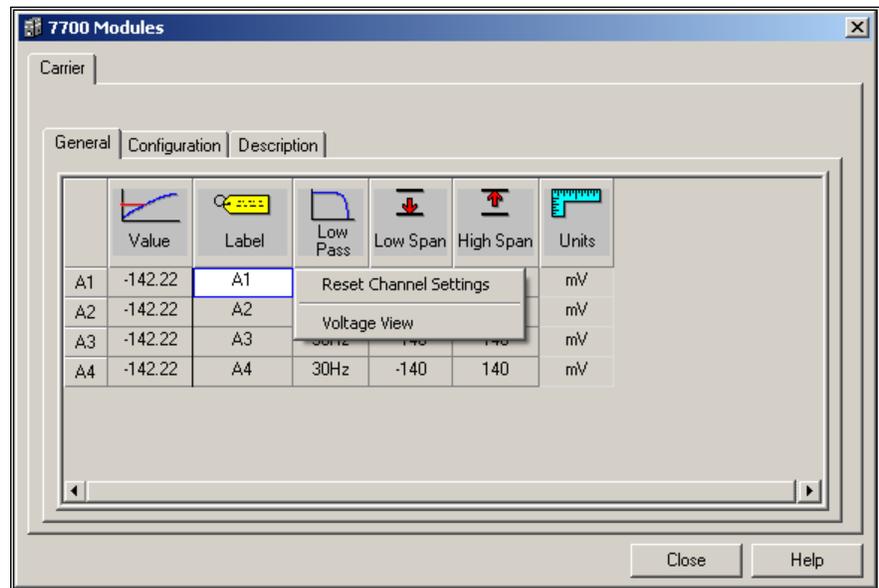


*Voltage View Menu*

The signal conditioner has a minimum and maximum input voltage range that can be resolved, and sometimes when applying user units the amplifier must change span ranges so that these minimum and maximum conditions are not violated. The Voltage View mode allows the user to check the current amplifier settings against the limits of the amplifier as listed in the amplifiers specifications.
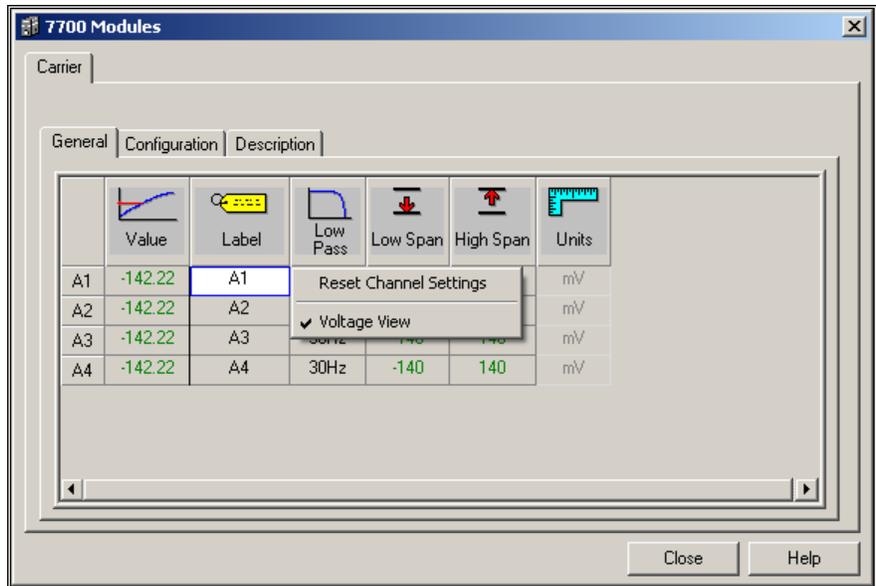
*Voltage View*

To return back to normal view, select **Voltage View** again.

# Reset Channel Settings

The Reset Channel Settings selection allows a channel to be quickly reset to default conditions. In any cell that accepts user input, a right click opens up the Reset Channel Settings/Voltage View menu. By performing a left click on the **Reset Channel Settings** selection, the Reset procedure is started. The user is asked for confirmation before setting the channel to these defined settings:

Label:              The signal Conditioner Slot and the Channel number

Low Pass:        30Hz

Low Span:        -140 (mV)

High Span:       140 (mV)

Low Cal:          -100 (mV)

High Cal:         100 (mV)

Low Unit:        -100

High Unit:       100

Units:              mV

---

# Calibration Procedure

## Calibration Overview

The Low/High Cal settings and the Low/High Unit settings are used by the system to convert the transducer output (in millivolts) to a meaningful unit of measure (user units). The system software internally generates a conversion graph with the millivolt input on the X axis, and user units on the Y axis. The slope of the line is determined internally from six user entered values (High Span, Low Span, High Cal, Low Cal, High Unit, and Low Unit). The Low Span, High Span, Low Unit, and High Unit settings set the four points on the Y axis. The Low Cal and High Cal settings set two points on the X axis. The system internally calculates the two remaining points on the X axis by projecting a straight line from the user entered points. The system will automatically change the High Span and/or Low Span if the internally generated span exceeds the physical capabilities of the signal conditioner. The system will always maintain a straight line between the four points on the graph and prevent the physical capabilities of the signal conditioner from being exceeded.
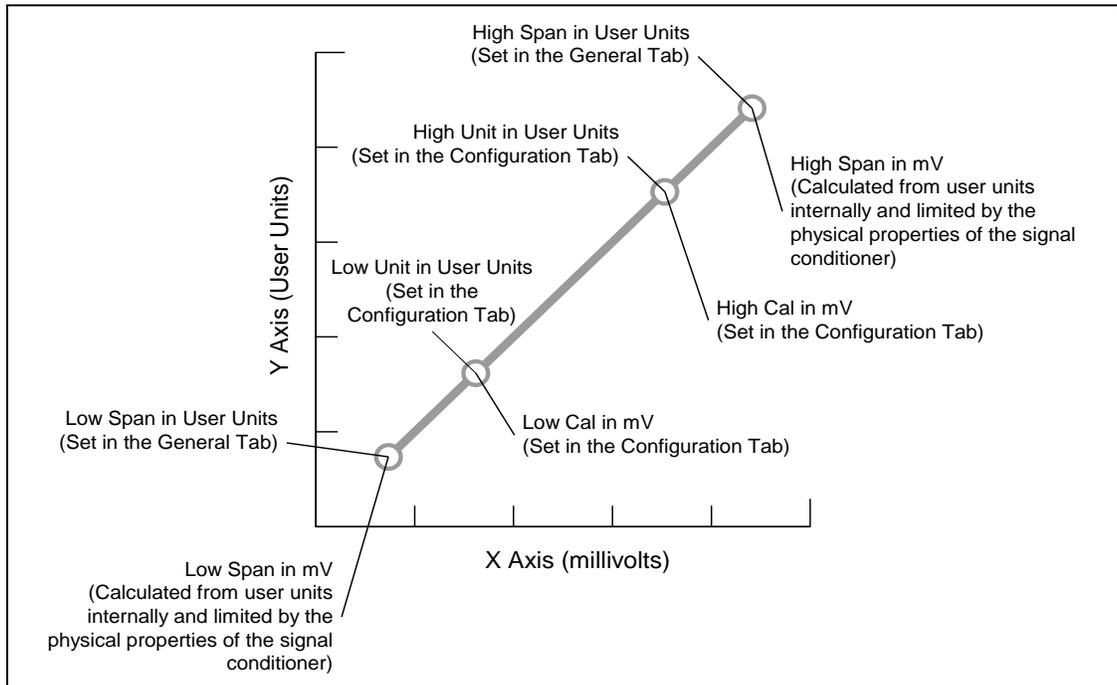


*Calibration Graph*

## Connecting Fittings

The fittings on the Validyne pressure transducers (DP-45s) have straight NPT fittings and may require some type of thread seal tape (like Teflon® tape). It is not recommended to use pipe dope because some types of pipe dope contain hazardous chemicals and they may react with compounds in the user's studies.

# Typical Calibration Procedures

A Validyne pressure transducer connected to a Pneumotachograph or Laminar Flow Element will read a flow rate.

The procedure for setting up the channel requires that the user knows the final maximum and minimum flow rates, and can generate a known flow to set the calibration points and conversion units.

## *Bias Flow Calibration*

This section will run through the calibration of a transducer using a bias flow.

A.  Verify that the two known flow rates are within the current span of the transducer, by setting the channel to a default state.

   The channel input can be returned to a default span with the following:

   In any cell that accepts user input, a right click opens up the Reset Channel Settings/Voltage View menu.  By performing a left click on the **Reset Channel Settings** selection, the Reset procedure is started.  Select the **Yes** option to reset the channel.

   The default span has now been set to resolve the full Validyne transducer range.

B.  Set the user units for the transducer in the **Units** column (for example mL/S).

C.  Determine the two points that will be used for the low calibration and high calibration points.  It is recommended to use as wide of a range as possible for the calibration points.

D.  Set the low flow rate as determined in step C.) in the transducer.

E.  Open the measure dialog for the **Low Cal** on the channel that is being calibrated.  Click on the **Measure** button to measure the existing value (select the appropriate Measure Settings).

F.  Set the **Low Unit** value equal to the **Low Cal** value.  This is a temporary step required to make sure that the software does not change the span range of the amplifier, which would prohibit the user from making the **High Cal** measurement.

G.  Set the high flow rate as determined in step C.) into the transducer.

H.  Open the measure dialog for the **High Cal** on the channel that is being calibrated.  Click on the **Measure** button to measure the existing value (select the appropriate Measure Settings).

I.  Enter the low calibration point in user units in the **Low Unit** cell, as determined in step C.).

J.  Enter the high calibration point in user units in the **High Unit** cell, as determined in step C.).

**NOTE:**  At no time can the **Low Unit** and **High Unit** values be the same, the software will display an **Invalid** condition if this is attempted.

K.  Select the **General** tab and set the **Low Span** (the lowest flow rate to measure) in user units.

---

L.  Set the **High Span** (the highest flow rate to measure) in user units.

## *Non Bias Flow Calibration*

This section will run through the calibration of a transducer using a non bias flow.

A.  Verify that the known flow rate is within the current span of the transducer, by setting the channel to a default state.

The channel input can be returned to a default span with the following:

In any cell that accepts user input, a right click opens up the Reset Channel Settings/Voltage View menu.  By performing a left click on the **Reset Channel Settings** selection, the Reset procedure is started. Select the **Yes** option to reset the channel.

The default span has now been set to resolve the full Validyne transducer range.

B.  Set the user units for the transducer in the **Units** column (for example mL/S).

C.  Determine the calibration point.  Typically the calibration point is approximately 90% of full scale.

D.  Open the transducer to air.

E.  Open the measure dialog for the **Low Cal** on the channel that is being calibrated.  Click on the **Measure** button to measure the existing value (select the appropriate Measure Settings).

F.  Set the **Low Unit** value equal to the **Low Cal** value.  This is a temporary step required to make sure that the software does not change the span range of the amplifier, which would prohibit the user from making the **High Cal** measurement.

G.  Set the high flow rate as determined in step C.) in the transducer.

H.  Open the measure dialog for the **High Cal** on the channel that is being calibrated.  Click on the **Measure** button to measure the existing value (select the appropriate Measure Settings).

I.  Set the **Low Unit** value to **0**, as determined in step C.

J.  Enter the high calibration point in user units in the **High Unit** cell, as determined in step C.).

**NOTE:**  At no time can the **Low Unit** and **High Unit** values be the same, the software will display an **Invalid** condition if this is attempted.

K.  Select the **General** tab and set the **Low Span** (the lowest flow rate to measure) in user units.

L.  Set the **High Span** (the highest flow rate to measure) in user units.

## *Intrapleural, Esophageal, or Thoracic Pressure Calibration*

The calibration for pressure is the same procedure used in the **Non Bias Flow Calibration** Section (above), except that units will be a pressure (for example "In/Hg"), and the term "pressure" replaces the term "flow rate".

# Calibration Verification and Minor Adjustments

Once the transducer has been calibrated using the above procedures, minor changes can be made to the **High Cal** and **Low Cal** values without requiring changes to the **Low Unit** and **High Unit** values, and without changes being made to the **Low Span** and **High Span** values by the software.

The reason this would be done is if the same transducer and Carrier signal conditioner are being used after a long idle time.

Prior to performing changes to either **High Cal** or **Low Cal**, make sure that the number in the **Value** column falls within the **Low Span** and **High Span** setting prior to pressing the **Measure** button. For the **Measure** button to work properly, the transducer must be generating a signal that is inside of the user span. If the calibration points cannot be measured properly, the user must return to the basic calibration procedure.

# Pneumotachograph Sizing (Validyne)

Size the pneumotachograph as required for the application (typical values):

0-3L/min - Mouse

0-5L/min - Guinea Pig and Rat

0-10L/min - Rabbit

0-35L/Min - Small Canine

0-100L/Min - Medium Canine

0-160L/Min - Large Canine

The pneumotachograph converts the flow into a differential pressure as the air flow passes through a controlled restriction in the pneumotachograph. The Validyne pressure transducer is connected to these differential pressure ports. The "+" side of the transducer is connected to the pressure port on the inlet side (animal side) of the pneumotachograph and the "-" side of the transducer is connected to the pressure port on the outlet side of the pneumotachograph.

To determine the amount of differential pressure generated by a particular flow rate, the pneumotachograph is supplied with a "calibration factor" (typically listed on the data sheet, or on the actual pneumotachograph). Make sure the flow units match the units listed in the calibration factor before determining the differential pressure (for example, if the calibration factor is in $(mmH_2O)/(L/Min)$, the flow rate must be expressed in L/Min).

$$Flow\_Rate\,\frac{L}{Min} = \frac{60Sec}{Min} \bullet Flow\_Rate\,\frac{L}{Sec}$$

**Figure A: Convert flow rate in Liters per Second to Liters per Minute**

$$Flow\_Rate\,\frac{L}{Min} = \frac{60Sec}{Min} \bullet \frac{L}{1000mL} \bullet Flow\_Rate\,\frac{mL}{Sec}$$

**Figure B: Convert flow rate in milliliters per Second to Liters per Minute**

$$Diffpress = Cal\_Factor \bullet Flow\_Rate$$

**Figure C:  Differential Pressure Calculation**

In the above equation, **Cal_Factor** represents the calibration factor published by the manufacturer of the pneumotachograph and **Flow_Rate** is the actual flow rate through the pneumotachograph.  The Differential pressure **Diffpress** is in units expressed in the calibration factor:  for example, if the calibration factor is in $(mmH_2O)/(L/Min)$, the pressure will be expressed as $mmH_2O$.

The Validyne transducers are listed with the maximum amount of pressure the transducer can resolve in $cmH_2O$ for a given diaphragm (The diaphragm type is supplied as part of the transducer part number).  To convert units of pressure, the following typical equations can be used.

$$Diffpress_{cmH2O} = \frac{cm}{10mm} \bullet Diffpress_{mmH2O}$$

**Figure D:  Convert pressure in mmH₂O to cmH₂O**

$$Diffpress_{cmH2O} = \frac{2.54cm}{inch} \bullet Diffpress_{inchesH2O}$$

**Figure E:  Convert pressure in inches of H₂O to cmH₂O**

To determine the amount of deflection the transducer will have for a various flow rate, use the pressure calculated in Figure C and convert it to units in $cmH_2O$.  The measured pressure can then be compared against the maximum pressure that the transducer can resolve.

$$Output\% = \frac{Diffpress}{Maxpress} \bullet 100$$

**Figure F:  Determining Deflection %**

In the above equation, **Diffpress** is the actual differential pressure as calculated in Figure C and converted to units in $cmH_2O$.  **Maxpress** is the maximum pressure that the transducer can resolve, also in $cmH_2O$.  **Output%** is the percentage of full scale that the transducer is generating.

To determine if a given pneumotachograph and transducer combination will work in a given application, calculate the **Output%** figure for minimum flow rates and maximum flow rates.  Verify that neither of these figures exceed 100%, and that the subtraction of these two figures are not less than 0.8%.

Note that typically the Validyne transducer generates 25mV/V of excitation, the Carrier Signal Conditioner provides 5V of excitation, and can measure as little as 1mV of span.  These factors set the lower limit of a full-scale reading to 0.8%.  The upper limit of 100% is determined by the physical properties of the transducer.  Applying a pressure of more than 100% to a transducer can cause the measurement plate to bend and introduce unexpected offsets and inaccurate gains in future measurements.

## Synchronous Operation of Excitation Voltages

Many older transducer amplifiers suffered from various issues that involved the excitation from one transducer being coupled to another transducer.  One of the more annoying issues was a "heterodyne" effect, in which two carrier frequencies

oscillating at slightly different frequencies would beat against each other causing an offset that would slowly rise and fall over time. The Carrier signal conditioner is tightly synchronized to the master clock of the ACQ-7700 acquisition system, so all carrier waveforms are tightly synchronized eliminating the "heterodyne" effect.

## Positioning of Transducers

Several issues can effect the operation of a transducer, causing offsets to measurements:

- **Gravity** - The transducers include a thin stainless steel plate that is moved by small pressure variations. The plate is so delicate that it can sag slightly under its own weight when positioned horizontally, causing a small offset voltage reading. The transducer should be mounted in a vertical position (the mounting bar should be horizontal for DP-45 installations, and the DP-250 should be mounted to a horizontal surface) to minimize the effects of gravity on the transducer.

- **Vibration** - The transducer plate has a finite mass and is highly susceptible to vibration, which can cause random or periodic noise on the measured voltage. The transducers should be mounted to a stable mass not subject to vibration.

- **Magnetic Coupling** - The magnetic flux generated by a transducer can induce a small offset on other transducers that are located extremely close together. Each transducer should be mounted at least 2" away from other transducers.

- **Capacitive Coupling** - The transducer generates a voltage across two coils, by introducing stray sources of capacitance, the resonant properties of the coil can change generating an offset. Cables contain a small amount of internal capacitance and can be the source of offset. Care should be taken to prevent any conductive material from coming into contact with the transducer body that could cause capacitive coupling. The human body also acts as a capacitive source, and by touching the exposed case of the transducer can generate small amounts of offset.

# Accessories

This section lists the accessories that are available for the Carrier signal conditioner.

Validyne transducer (DP45)- J03399-14($\pm$2.25cmH$_2$O), J03399-24($\pm$22.5cmH$_2$O)

Validyne transducer (DP250) - J03423-14($\pm$2.25cmH$_2$O), J03423-24($\pm$22.5cmH$_2$O)

Validyne transducer adapter cable (Cannon to Lemo) - J03397

# Specifications

The 13-7715-35 Carrier signal conditioner is a four-channel signal conditioner designed specifically to work with signals from a Validyne transducer. All channels are identical, but can be independently configured. The total functionality of each channel is controlled through the Ponemah software.

## Excitation Voltage

5VRMS @ 5kHz up to 200mA. Short circuit protected.

Output waveform is synchronized channel to channel, amplifier to amplifier. Accuracy is determined by the system clock accurate to $\pm$50ppm.

## A/D Converter

16 bit

## Sample Rate

5kHz, synchronous conversion to excitation voltage (sideband decoding)

## Input

$\pm$500$\mu$V full scale to $\pm$300mV full scale (0.2mV/V to 120mV/V), continuously variable gain over range

## Input Impedance

>10M$\Omega$

## Zero Suppression

$\pm$250mV continuously variable

## Zero Suppression Error

< $\pm$0.5%

## Filter Settings

100Hz, $10^{th}$ order Butterworth digital IIR filter with 100Hz (±5%) low pass 2 pole Sallen-Key Bessel filter (hardware implemented).

30Hz, $6^{th}$ order Butterworth digital IIR filter.

10Hz, $5^{th}$ order Butterworth digital IIR filter.

## Noise

< 0.02% all scale settings, all filter settings

## Input Offset Voltage

< ±2.5mV (0.1% of Excitation Voltage)

## Gain Error

< ±0.5% of full scale input

## Linearity

< ±0.1% of full scale input

# DCOM & BIO12 Pod

## Introduction

This section describes the installation, operation and specifications for the DSI/Ponemah DCOM module, Model Number 13-7715-70 and the 12 channel isolated bio-potential, Model Number13-7770-BIO12. The DCOM module is a user installable module compatible with the ACQ-7700. For more information on where and how this module and associated pod can be used, contact your local DSI/Ponemah representative.

The ACQ-7700 DCOM module is a digital communication module that works with assorted pods. The DCOM occupies a single slot of the ACQ-7700 chassis, controls and reads data from a pod and formats data from the pod to be interpreted by the recording system. The system software controls the viewing and acquisition of this data.

The 12 Channel Isolated Bio-potential pod can accept a wide range of A/C bio-potentials such as EMG, ECG and ENG. The inputs of the pod have galvanic isolation from the ACQ-7700 chassis.

## DCOM Connections

The DCOM module is connected to the BIO12 Pod through an eight conductor serial link cable. There are no user available inputs or outputs on the DCOM.

## BIO12 Signal Connections

Input to the BIO12 Pod is through 1.5mm pin jack connectors which are common to many types of commercially available electrodes. Inputs are referenced to the ISO GND connection and isolated from the 7700 Chassis.



**MAXIMUM VOLTAGE ABOVE ISO GND TO EITHER INPUT TERMINAL IS +/-30VDC. EXCEEDING THIS VALUE CAN CAUSE DAMAGE.**

# Configuring the DCOM for BIO12 Pod

In the figure below, *BIO12 General Tab*, the DCOM module automatically detects and presents information for the BIO12 Pod, when connected. When a signal conditioner type is selected, its tab is brought to the foreground and a group of set up menus specific to that signal conditioner is displayed. General, Configuration, and Descriptions tabs can be displayed, each of which are accessed by clicking on the tab heading.

## General Tab

The General tab, as seen in the DCOM module, allows the user to set up channel specific connected Pod parameters, including the Label, Low Pass Filters, and Low/High Span.
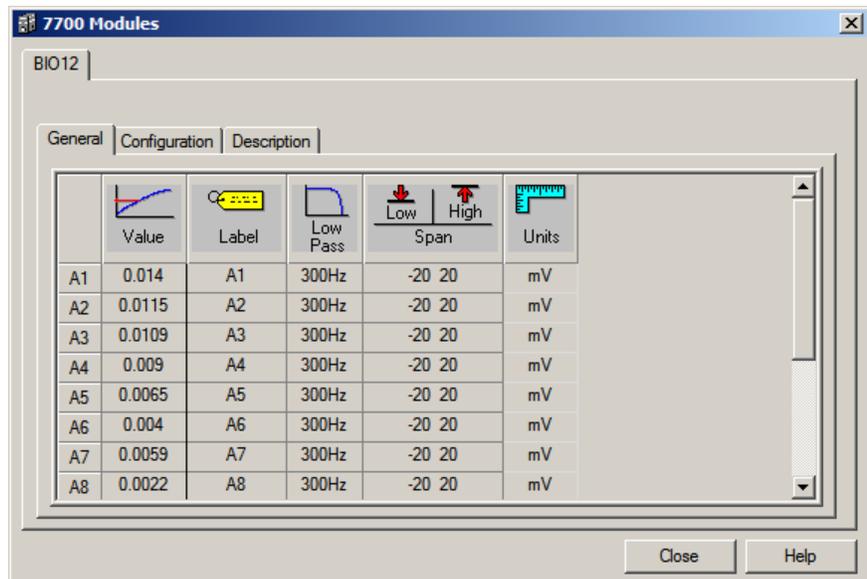


*BIO12 General Tab*

### *Value*
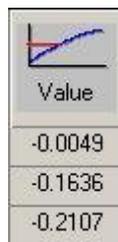


This column continuously displays the current value that is on the input of the signal conditioner. This column is updated by the system once every second and cannot be updated by the user.

This column is useful in troubleshooting the signal conditioner input connection.

### *Label*

Label allows you to type in a logical name of up to 10 additional characters for a particular input channel.  The chosen name will be saved and used to identify the input data throughout the system, such as in the dialog that displays input channel information.
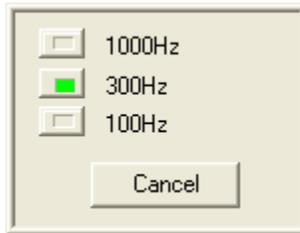
### *Low Pass*

Adjust the Low Pass Filter settings as required.  For most applications, the default setting of 300Hz is adequate.

### *Low/High Span*

The span defines the sensitivity or scale for each channel.  When setting up channel parameters, SPAN should be set last.  Span should be set slightly higher than the largest anticipated input signal.

The Span can be set to any of the following millivolt ranges:

| Low Span | High Span |
|:---:|:---:|
| -20 | 20 |
| -10 | 10 |
| -5 | 5 |
| -1 | 1 |
| -.5 | .5 |
| -.2 | .2 |
| -.1 | .1 |
| -.05 | .05 |
| -.02 | .02 |

### *Units*

This column displays the units that have been set in the **Configuration** tab and cannot be changed in this tab.  The Units have no effect on the channel and are used for documenting the Input units.

# Configuration Tab

The Configuration Tab allows the user to generate an internal conversion factor between the millivolt input to the BIO12 and a meaningful unit of measure (user units) or to calibrate the input signal to a known reference.
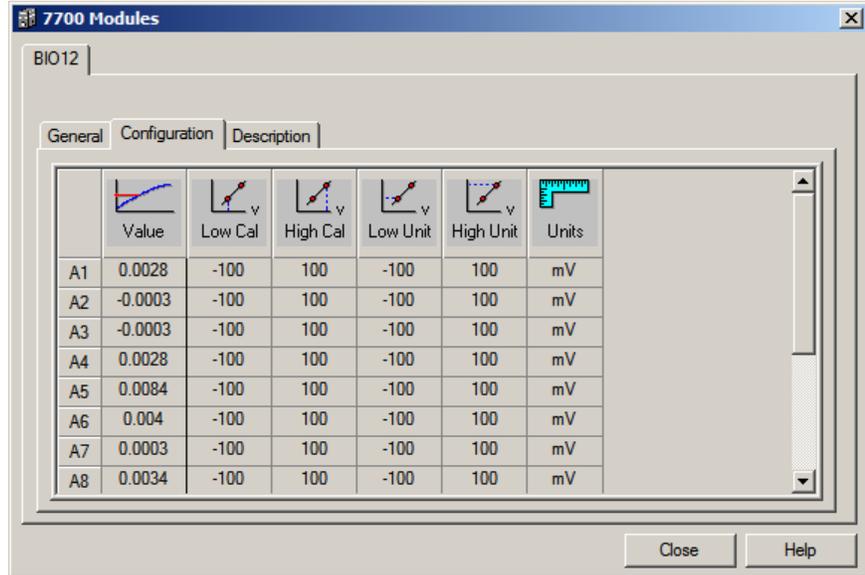


*BIO12 Configuration Tab*
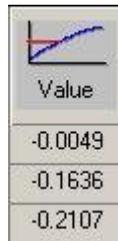
## *Value*



This column continuously displays the current value that is on the input of the signal conditioner. This column is updated by the system once every second and cannot be updated by the user.

## *Low Cal & High Cal*

The Low Cal and High Cal settings are used in conjunction with the Low Unit and High Unit settings to allow the user to convert an input voltage to a user defined scale.

The Low Cal value sets the millivolt value that corresponds to the Low Unit user value. A voltage input equal to the Low Cal value will display the Low Unit value (in the Value column). Likewise, the High Cal value sets the millivolt value that corresponds to the High Unit user value. A voltage input equal to the High Cal value will display the High Unit value.
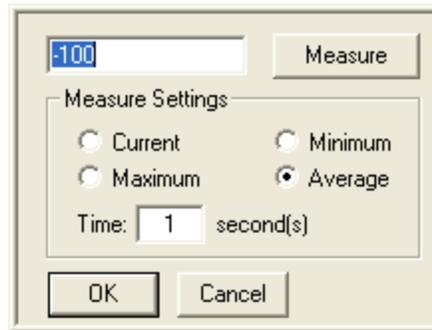
### *Measure*



Double clicking on a Low Cal or High Cal box will open an associated "Measure" dialog box.

The input to the BIO12 is AC coupled which prevents calibration from a DC source voltage. An AC calibration source (that is capable of millivolt/microvolt output) can be used to calibrate the input to a known AC voltage by performing a "Minimum" measure in the Low Cal dialog, a "Maximum" measure in the High Cal dialog, setting the Low Unit to the negative peak of the AC calibrator output and the High Unit to the positive peak of AC calibrator output.

Note that since the inputs are AC coupled, DC offsets from the signal source are automatically removed.

**Measure Settings:** provides user control over how data is sampled and recorded for the Low and High Cal values.

- Current – Will record the value at the end of the interval specified in the Time column. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine the end point for calibration and will record the last data point when the time interval is completed. Note that since the inputs are AC coupled, unexpected results may occur when attempting to measure with this setting.

- Maximum - Will record the maximum value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Minimum - Will record the minimum value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Average - Will record the average value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Time - Number of seconds used to define the interval over which the calibration value for the Maximum, Minimum, or Average will be sampled.

### *Low Units & High Units*



The user can select the units to be displayed.  Combined with Low Cal and High Cal, the user can set "x" value in Cal to equal "y" number of units.  Example:  If 2.500mV is entered in the High Cal and 100 was entered in High Units, then 2.500mV = 100 units.  Also see Measure Function.

Changing this field does not interact with any other field (**Low Span** or **High Span**).

### *Units*



Units allow you to enter the actual engineering units being measured.  The default is mV but this may be changed to any engineering unit.  The User Unit input field is limited to 9 characters.

# Descriptions Tab

The Descriptions tab allows the user to enter a text description for each input and to further describe the parameters being recorded. This may include additional user information or test setup information. This information is stored with the test set up in a text file. It is not directly used as part of the signal conditioner configuration but is available for review whenever desired. Double Click on the text area, type in the information, and then click on the **OK** button. Below is a typical Description tab.



*BIO12 Descriptions Tab*

# Voltage View and Resetting

The BIO12 has the capability of viewing input voltage instead of the input in user units for debugging purposes and also the ability of resetting each channel if a problem has occurred during setup.

## Voltage View

By performing a right click on a channel (anywhere except for the Input Identifier or Value columns) and selecting **Voltage View**, raw voltages are displayed in place of user units in the Value cell. Below is an example of the right click menu that will appear.



*Voltage View Menu*

Once voltage view has been selected, the values listed for **Value**, **Low Span**, and **High Span** are listed in millivolts  Those column values will change from black to green to notify the user that the values are in  Voltage View mode.  Also, the **Units** column entry will change from black lettering to gray lettering.  Shown below is an example of the **7700 Modules** dialog with voltage view set.

*Voltage View*

To return back to normal view, select **Voltage View** again.

## Reset

This selection allows the user to reset the settings of the channel selected.  When selected, the channel will reset all columns dependent on which mode is currently selected.  View the Mode section for default settings.  When this selection is selected, a message box will appear asking if the channel should be reset.  This allows the user to select **No** to cancel the resetting of the channel and **Yes** to reset the channel.

# Accessories

This section lists the available accessories that are available for the 12 Bio-potential Pod.

| Part Number | Description |
| --- | --- |
| J03557-20 | SERIAL LINK CABLE, 20FT, 7700 ISO POD TO DCOM |
| P02407-0 | LEAD 36", 1.5MM PLUG TO UN-TERMINATED, BLK |
| P02407-2 | LEAD 36", 1.5MM PLUG TO UN-TERMINATED, RED |
| P02407-5 | LEAD 36", 1.5MM PLUG TO UN-TERMINATED, GRN |
| P02409-0 | ADAPTER, TOUCH PROOF, 1.5MM TO 2MM, BLK |
| P02409-2 | ADAPTER, TOUCH PROOF, 1.5MM TO 2MM, RED |
| P02409-5 | ADAPTER, TOUCH PROOF, 1.5MM TO 2MM, GRN |

Consult the factory for additional input accessories and cables.

# Specifications

The 13-7715-70 DCOM module and BIO12 Pod are designed specifically to work with signals from low level input voltages with sensitivities from $40\mu V$ to 40mV full scale. All channels are identical, but can be independently configured. Each channel has a programmable eight-pole low pass filter. The total functionality of each channel is controlled through the Ponemah software.

## Input Circuit (typical of each channel)

Differential isolated balanced to ground

Greater than $10M\Omega$ each input to common at DC. Impedance can be approximated with a $10M\Omega$ resistor in parallel with a 1.6nF capacitor.

Maximum input $\pm30VDC$

Leakage < 10uA at 265 VRMS

## Measurement Range

Linear Range: $40\mu V$ to 40mV full scale

## Signal Conditioner Output

A/D Converter: 16 BITS

Sample Rate: 20kHz per channel maximum

## 12 Bio-potential Pod Accuracies

**FILTERS:**

Selectable: 100Hz, 300Hz or 1000Hz Low pass.

Eight-pole DSP based Bessel settings of: 100Hz, and 300Hz ±3% in conjunction with a hardware implemented five-pole Bessel filter at 1000Hz ±15%.

Non-selectable: .05Hz ±20% High Pass (hardware implemented).

**COMMON MODE:**

Less than -90dB

**CROSSTALK:**

Less than -60dB (measured at 36mVpk-pk 10 Hz with all channels set to same gain range)

**LINEARITY:**

±0.5% of full scale

**NOISE:**

Less than 20 uV pk-pk

**Gain Error:**

Less than ±0.5% full scale

**Zero Drift typ:**

0.01% of full scale per degree C

# DCOM & Multi-Lead ECG Pod (ECG12)

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## Introduction

This section describes the installation, operation and specifications for the DSI/Ponemah DCOM module, Model Number 13-7715-70 and the Multi-Lead ECG Pod, Model Number13-7770-ECG12.  The DCOM module is a user installable module compatible with the ACQ-7700.  For more information on where and how this module and associated pod can be used, contact your local DSI/Ponemah representative.

The ACQ-7700 DCOM module is a digital communication module that works with assorted pods.  The DCOM occupies a single slot of the ACQ-7700 chassis, controls and reads data from a pod and formats data from the pod to be interpreted by the recording system.  The system software controls the viewing and acquisition of this data.

The Multi-Lead ECG Pod uses the standard 10 lead input connections and derives by Einthovens triangle the standard and augmented leads:  I, II, III, aVF, aVL, and aVR.  V1 through V6 are generated using Wilsons Central Terminal.  Other V leads may be substituted for any of the V leads, 1 through 6.

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## DCOM Connections

The DCOM module is connected to the Multi-Lead ECG Pod through an eight conductor serial link cable.  There is one available BNC connector used as a TTL output.

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## Multi-Lead ECG Signal Connections

### ECG Lead Connections

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The ECG input is a type "CF" input and is isolated and protected from the effects of defibrillation. In order for the Multi-Lead ECG Pod to work correctly, the ECG leads must be connected to the subject using the supplied input harness (274-7000-001) and patient cable set. Each input lead is labeled with **RL**, **LL**, **RA**, **LA**, and **V1** through **V6**.

The other end of the input harness is connected to the side panel 15-pin connector labeled ECG Input.

This 15 pin D-SUB connector provides the connection to the ECG input cable.
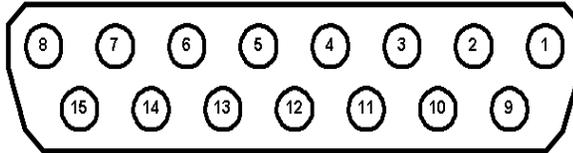


| Pin | Signal | Pin | Signal |
|-----|--------|-----|--------|
| 1 | Chest Lead 2 | 9 | Right Arm |
| 2 | Chest Lead 3 | 10 | Left Arm |
| 3 | Chest Lead 4 | 11 | Left Leg |
| 4 | Chest Lead 5 | 12 | Chest Lead 1 |
| 5 | Chest Lead 6 | 13 | No Connection |
| 6 | Shield | 14 | Right Leg |
| 7 | No Connection | 15 | No Connection |
| 8 | No Connection | | |

Table 1, ECG input connector pin descriptions

# Configuring the DCOM for Multi-Lead ECG Pod (ECG12)

In the figure below, *ECG12 General Tab*, the DCOM module automatically detects and presents information for the Multi-Lead ECG Pod, when connected. When a signal conditioner type is selected, its tab is brought to the foreground and a group of set up menus specific to that signal conditioner is displayed. General, Configuration, Description, and Features tabs can be displayed, each of which are accessed by clicking on the tab heading.

## General Tab

The General tab, as seen in the DCOM module, allows the user to set up channel specific connected Pod parameters, including the Label, Low Pass Filters, and Low/High Span.
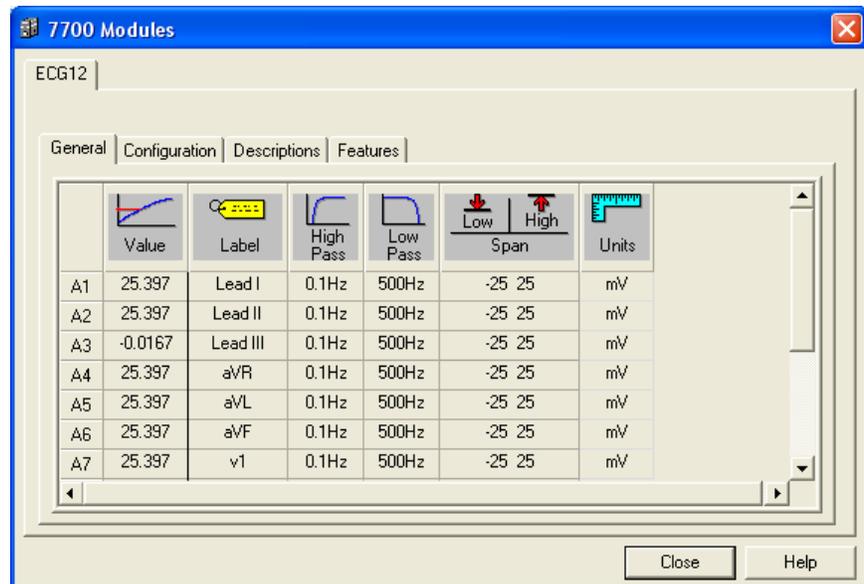


*ECG12 General Tab*

### *Value*



This column continuously displays the current value that is on the input of the signal conditioner. This column is updated by the system once every second and cannot be updated by the user.

This column is useful in troubleshooting the signal conditioner input connection.

### Label

Label allows you to type in a logical name of up to 10 additional characters for a particular input channel.  The chosen name will be saved and used to identify the input data throughout the system, such as in the dialog that displays input channel information. The label column is automatically populated with the appropriate Lead type.

### Low/High Pass

Adjust the Low Pass Filter settings as required.  The default setting for the low pass filter is 500Hz while the default setting for the high pass filter is 0.1Hz. NOTE: changing the filter settings on one channel will automatically change the filter on all channels.
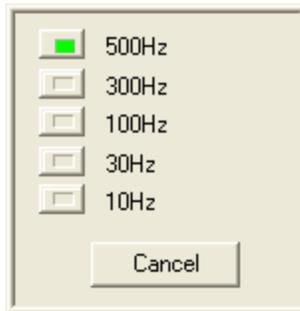
Low Pass Filter
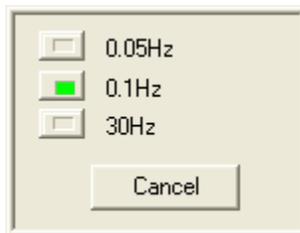
High Pass Filter

### Low/High Span

*The span defines the sensitivity or scale for the channels.  When setting up channel parameters, SPAN should be set last.  Span should be set slightly higher than the largest anticipated input signal.* NOTE: changing the span settings on one channel will automatically change the span on all channels.

The Span can be set to any of the following ranges:

| Low Span | High Span |
|----------|-----------|
| -25mV | 25mV |
| -10mV | 10mV |
| -5mV | 5mV |
| -2.5mV | 2,5mV |
| -1mV | 1mV |
| -500uV | 500uV |
| -250uV | 250uV |

## *Units*

This column displays the units that have been set in the **Configuration** tab and cannot be changed in this tab.  The Units have no effect on the channel and are used for documenting the Input units. The default units are in mV.

# Configuration Tab

The Configuration Tab allows the user to generate an internal conversion factor between the millivolt input to the Multi-Lead ECG Pod and a meaningful unit of measure (user units) or to calibrate the input signal to a known reference (if desired).
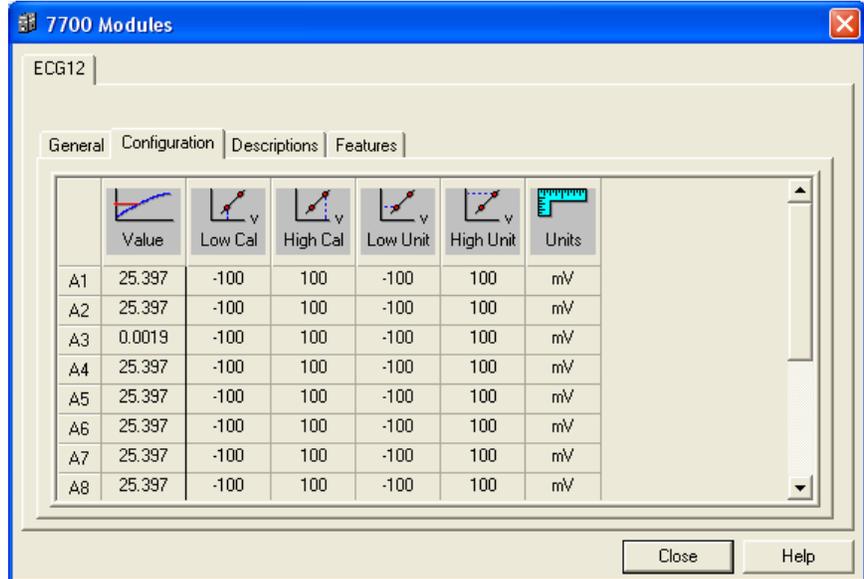


*ECG12 Configuration Tab*
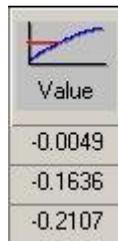
### Value



This column continuously displays the current value that is on the input of the signal conditioner. This column is updated by the system once every second and cannot be updated by the user.

### Low Cal & High Cal

There is no need to calibrate the Multi-Lead ECG Pod. Default values shown in the configuration tab (± 100) provide a 1-to-1 relationship between the input voltage and the user unit.

The Low Cal and High Cal settings are used in conjunction with the Low Unit and High Unit settings to allow the user to convert an input voltage to a user defined scale.

The Low Cal value sets the value that corresponds to the Low Unit user value. A voltage input equal to the Low Cal value will display the Low Unit value (in the Value column). Likewise, the High Cal value sets the value that corresponds to the High Unit user value. A voltage input equal to the High Cal value will display the High Unit value.
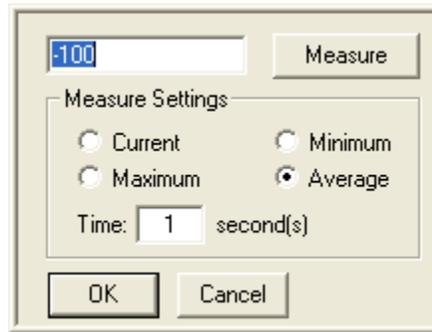
## *Measure*



Double clicking on a Low Cal or High Cal box will open an associated "Measure" dialog box.

If desired, a calibration source can be used to calibrate the input to a known voltage by performing a "Minimum" measure in the Low Cal dialog, a "Maximum" measure in the High Cal dialog, setting the Low Unit to the negative peak of the calibrator output and the High Unit to the positive peak of calibrator output.

**Measure Settings:** provides user control over how data is sampled and recorded for the Low and High Cal values.

- Current – Will record the value at the end of the interval specified in the Time column. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine the end point for calibration and will record the last data point when the time interval is completed. Note that since the inputs are AC coupled, unexpected results may occur when attempting to measure with this setting.

- Maximum - Will record the maximum value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Minimum - Will record the minimum value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Average - Will record the average value over the interval specified in the Time field. After selecting the Measure button, the software will utilize the following number of seconds entered in the Time column to determine this value.

- Time - Number of seconds used to define the interval over which the calibration value for the Maximum, Minimum, or Average will be sampled.

### *Low Units & High Units*

```
┌─────────────────────────┐
│ ┌─────────────────────┐ │
│ │100                  │ │
│ └─────────────────────┘ │
│  ┌──────┐   ┌────────┐  │
│  │  OK  │   │ Cancel │  │
│  └──────┘   └────────┘  │
└─────────────────────────┘
```

The user can select the units to be displayed.  Combined with Low Cal and High Cal, the user can set "x" value in Cal to equal "y" number of units.  Example:  If 1.000mV is entered in the High Cal and 1 was entered in High Units, then 1.000mV = 1 unit.  Also see Measure Function.

Changing this field does not interact with any other field (**Low Span** or **High Span**).

### *Units*

```
┌─────────────────────────┐
│ ┌─────────────────────┐ │
│ │mV                   │ │
│ └─────────────────────┘ │
│  ┌──────┐   ┌────────┐  │
│  │  OK  │   │ Cancel │  │
│  └──────┘   └────────┘  │
└─────────────────────────┘
```

Units allow you to enter the actual engineering units being measured.  The default is mV but this may be changed to any engineering unit.  The User Unit input field is limited to 9 characters.

## Descriptions Tab

The Descriptions tab allows the user to enter a text description for each input and to further describe the parameters being recorded.  This may include additional user information or test setup information.  This information is stored with the test set up in a text file.  It is not directly used as part of the signal conditioner configuration but is available for review whenever desired.  Double Click on the text area, type in the information, and then click on the **OK** button.  Below is a typical Description tab.



*ECG12 Descriptions Tab*

## Features Tab (for Multi-Lead ECG Pod only)

The Features tab allows the user to select criteria for the QRS Detection and Baseline Reset features. Below is a typical Features tab.
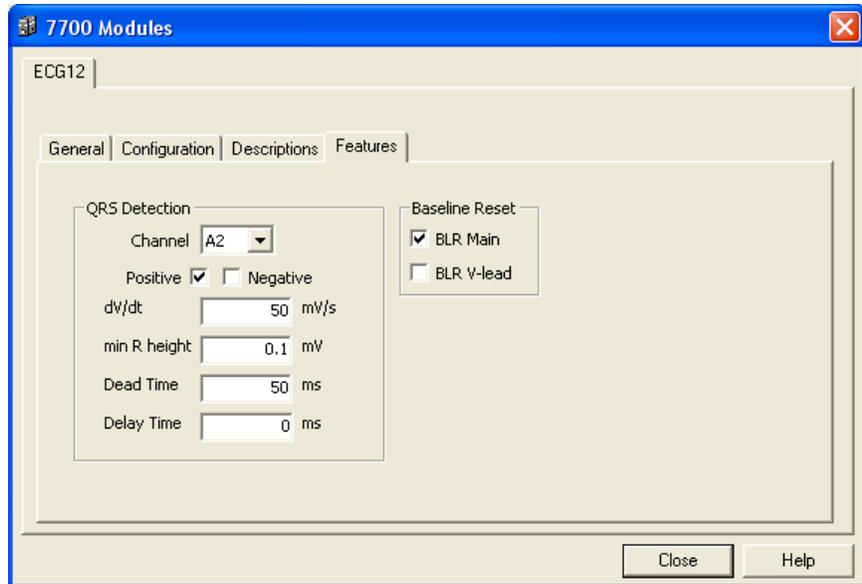
*ECG12Features Tab*

### QRS Detection

The system is able to detect a QRS complex and generate a TTL(transistor-transistor logic) output to trigger external equipment via the BNC connector on the front of the DCOM module. The following parameters are used to detect the pulse and are set by the user.

**Channel** - The ECG channel that will be monitored. Can be set to any of the 12 leads. User can select the direction of the QRS pulse based on the ECG channel selected (Positive, Negative, or both).

**dV/dT Threshold** - Settable 0 to 65535.

**Dead Time** - Time from pulse detection where a new pulse will not be generated. Settable 0 to 3.0 seconds.

**Delay Time** - Time from QRS detection to TTL output pulse. Settable 0 to 3.0 seconds.

### Baseline Reset

When selected, the low pass filter will reset when the signal saturates the selected span range. The signal will be reset to a baseline condition, allowing the user to see the ECG signal. The reset function can be disabled by the end user for both the Main leads and V-leads.

## Lead-Off Detection

Input leads on the graph page will display a square wave when one or more patient cables affecting that input is not properly connected to the animal.  It is recommended that one graph page be created to display all leads being collected. This will allow the user to quickly notice if any leads have fallen off the animal via the lead-off detector feature.
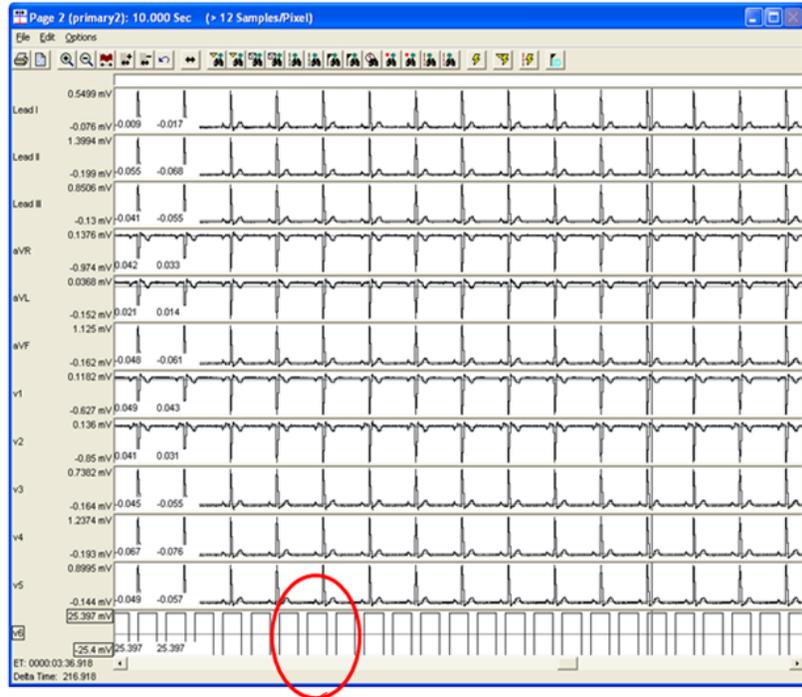
Lead-Off Detection Square Wave

| Lead | Animal Input Connections |
|------|--------------------------|
| I | Left Arm – Right Arm |
| II | Left Leg – Right Arm |
| III | Left Leg – Left Arm |
| aVR | Right Arm – ((Left Leg +Left Arm)/2) |
| aVL | Left Arm – ((Right Arm +Left Leg)/2) |
| aVF | Left Leg – ((Right Arm +Left Arm)/2) |
| V1 | V1 – ((Right Arm + Left Arm + Left Leg)/3) |
| V2 | V2 – ((Right Arm + Left Arm + Left Leg)/3) |
| V3 | V3 – ((Right Arm + Left Arm + Left Leg)/3) |
| V4 | V4 – ((Right Arm + Left Arm + Left Leg)/3) |
| V5 | V5 – ((Right Arm + Left Arm + Left Leg)/3) |
| V6 | V6 – ((Right Arm + Left Arm + Left Leg)/3) |

# Zero/Cal Buttons

The side panel has a Zero and Cal button. The following describes function of the buttons.

- **Zero** - when the button is pressed, the pod zeros all outputs. The zero voltage will be enabled as long as the Zero button is pressed. This can be used for the low calibration value in the Ponemah system. This is also useful to set the zero baseline value on a conventional chart recorder.

- **Cal** - when the pressed, the pod will apply a calibration signal. The calibration voltage will be enabled as long as the Cal button is pressed. This can be used for the high calibration value in the Ponemah system. This is also useful for setting the span on a conventional chart recorder. The calibration signal will be present on all channels and is determined by the amplifier full scale span.

| Low Span | High Span | Cal Voltage |
|----------|-----------|-------------|
| -25mV | 25mV | 1mV |
| -10mV | 10mV | 1mV |
| -5mV | 5mV | 1mV |
| -2.5mV | 2,5mV | 5mV |
| -1mV | 1mV | 100uV |
| -500uV | 500uV | 100uV |
| -250uV | 250uV | 100uV |

**NOTE:** When the **Zero** or **Cal**, buttons is pressed, the high pass filters are discharged, which will remove any saturation condition on the outputs due to a disconnected input lead or a defib pulse.

# Voltage View and Resetting

The Multi-Lead ECG pod has the capability of viewing input voltage instead of the input in user units for debugging purposes and also the ability of resetting each channel if a problem has occurred during setup.

## Voltage View

By performing a right click on a channel (anywhere except for the Input Identifier or Value columns) and selecting **Voltage View**, raw voltages are displayed in place of user units in the Value cell. Below is an example of the right click menu that will appear.



*Voltage View Menu*

Once voltage view has been selected, the values listed for **Value**, **Low Span**, and **High Span** are listed in millivolts Those column values will change from black to green to notify the user that the values are in Voltage View mode. Also, the **Units** column entry will change from black lettering to gray lettering. Shown below is an example of the **7700 Modules** dialog with voltage view set.

To return back to normal view, select **Voltage View** again.

## Reset

This selection allows the user to reset the settings of the channel selected. When selected, the channel will reset all columns dependent on which mode is currently selected. View the Mode section for default settings. When this selection is selected, a message box will appear asking if the channel should be reset. This allows the user to select **No** to cancel the resetting of the channel and **Yes** to reset the channel.
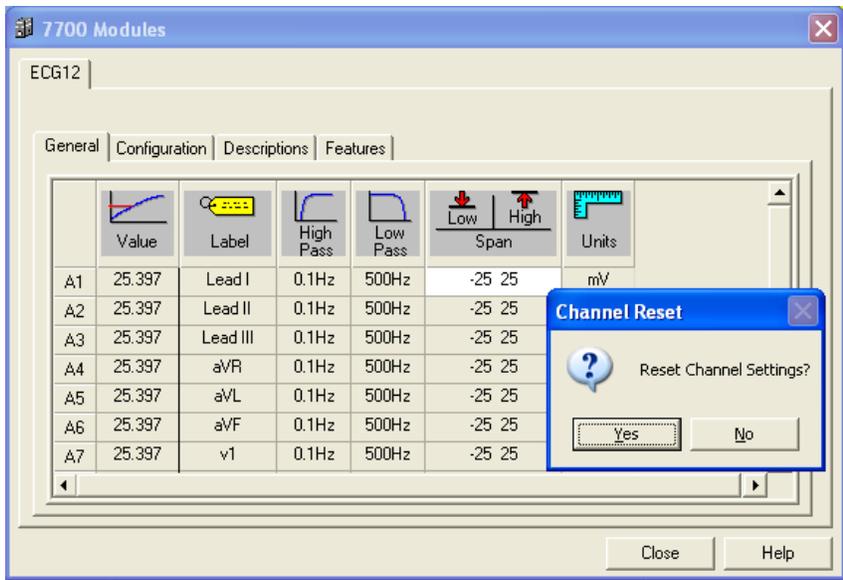
# Accessories/Replacement Parts

This section lists the available accessories that are available for the Multi-Lead ECG Pod.

| Part Number | Description |
| --- | --- |
| J03557-20 | SERIAL LINK CABLE, 20FT, 7700 ISO POD TO DCOM |
| 274-7000-001 | 10 Lead Input Harness, 6ft/1.8m, for Multi-Lead ECG POD (13-7770-ECG12) |
| 274-7001-001 | 10 Lead Patient Cable Set (Grabber), 29in/74cm, for Multi-Lead ECG POD (13-7770-ECG12) |
| 274-7002-001 | 10 Lead Patient Cable Set (Banana), 29in/74cm, for Multi-Lead ECG POD (13-7770-ECG12) |
| 274-7004-001 | Subdermal Needle Electrodes 27 GA, 6MM, 6ft/1.8m, Sterile (quantity 25) |

Consult the factory for additional input accessories and cables.

# User Maintenance

User maintenance is generally limited to cleaning only. Disconnect the pod. Loose dust and dirt may be removed with a soft cloth or brush. Any dirt remaining behind can be removed with a soft cloth dampened with a mild detergent and water solution. Do not allow liquid to enter the interior of the pod as electrical leakage characteristics may change. Never use abrasive cleaners. Do not autoclave the pod.

The ECG cables may be cleaned by wiping them with a cloth dampened with a solution of warm water and a mild detergent or USP soap tincture. Do not submerge the cables. To disinfect the cables, wipe them with a sodium hypochlorite (bleach) solution 10% in water. Do not use organic solvents. Ethylene oxide may be used to sterilize the ECG cables. After cleaning, the cables should be cleaned with water and dried with a clean cloth. Do not autoclave the cables. For further information on cleaning the specific ECG cables, refer to literature from the manufacturer that accompanies the cable.

# Troubleshooting

The table below lists certain conditions that can occur and the corrective action to take to resolve the problem. If the following actions do not solve the problem, consult the factory prior to returning the unit for service.

| Problem | Solution |
| --- | --- |
| No Output Signal | 1. Verify that the power switch to the ACQ 7000 is turned on.<br>2. Bad connection to subject.. |
| Noise on ECG Signal | 1. Verify that all subject connections |

| Response Incorrect | are correct. |
| | 2. Inspect cabling for breaks in shielding. |

# Re-Certification of Performance

For continued safe operation and verification of specifications, it is recommended that the pod, including the supplied input harness and leads, be recertified (calibrated) annually by the factory. For further information please contact Technical Support at 800-262-9687 (option 2) or e-mail support@datasci.com.

# Specifications

The ECG inputs are available on the side panel via a captive 15 pin female, D-sub connector.

## Signal Input

| | |
|---|---|
| Input Leads: | RA, LA, LL, RL, and V1-V6 |
| Resolution | 16 Bits |
| Sample rate | 10 kHz, 12 channels MUX at 120 kHz |
| Input Impedance | ≥ 10M Ohms |
| Input Voltage | ±250uV to ±25mV full scale |
| Defibrillator Protection | 360 Joules delivered at 5000V |
| Isolation chassis | > 1500V rms for 1 minute, isolated circuits to |
| Leakage | 10uA at 265 VRMS |

## Accuracy Specifications

**FILTERS:**

Selectable: 0.05Hz, 0.10Hz or 30.0Hz High pass (hardware implemented).

Selectable Low Pass Anti-Alias DSP filter settings of: 10Hz, 30Hz, 100Hz, and 300Hz ±3% in conjunction with a hardware implemented five-pole Bessel filter at 500Hz ±15%.

**COMMON MODE:**

Less than -90dB

**CROSSTALK:**

Less than -60dB (measured at 90% full scale input signal 10 Hz input with all channels set to same gain range)

**LINEARITY:**

Less than ±0.5% of full scale

**NOISE:**

Less than 15 uV pk-pk or 0.1% of Full Scale (whichever is greater)

**Gain Error:**

Less than ±0.5% full scale

**Classification:**

The Multi-Lead ECG pod is classified as IP40.

# Declaration Electromagnetic Emissions/Immunity

## Electromagnetic Emissions/Immunity Tables

| Guidance and manufacturer's declaration – electromagnetic emissions | | |
|---|---|---|
| The equipment is intended for use in the electromagnetic environment specified below.  The customer or the user of the equipment should assure that it is used in such an environment. | | |
| **Emissions Test** | **Compliance** | **Electromagnetic environment - guidance** |
| RF emissions<br><br>EN 55011 | Group 1 | The equipment uses RF energy only for its internal function.  Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment. |
| RF emissions<br><br>EN 55011 | Class A | |
| Harmonic emissions<br><br>EN 61000-3-2 | Class A | |
| Voltage fluctuations / flicker emissions<br><br>EN 61000-3-3 | Complies | The equipment is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes. |

**Guidance and manufacturer's declaration - electromagnetic immunity**

The equipment is intended for use in the electromagnetic environment specified below. The customer or the user of the equipment should assure that it is used in such an environment.

| Immunity test | IEC 60601 test level | Compliance level | Electromagnetic environment - guidance |
|---|---|---|---|
| Electrostatic discharge (ESD)<br><br>EN 61000-4-2 | ±6kV contact<br>±8kV air | Complies | Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%. |
| Electrical fast transient/burst<br><br>EN 61000-4-4 | ±2kV for power supply lines<br>±1kV for input / output lines | Complies | Mains power quality should be that of a typical commercial or hospital environment. |
| Surge<br><br>EN 61000-4-5 | ±1kV differential mode<br>±2kV common mode | Complies | Mains power quality should be that of a typical commercial or hospital environment. |
| Voltage dips, short interruptions and voltage variations on power supply input lines<br><br>EN 61000-4-11 | <5% $Ut$ (>95% dip in $Ut$) for 0,5 cycle<br><br>40% $Ut$ (60% dip in $Ut$) for 5 cycles<br><br>70% $Ut$ (30% dip in $Ut$) for 25 cycles<br><br><5% $Ut$ (>95% dip in $Ut$) for 5 sec | Complies | Mains power quality should be that of a typical commercial or hospital environment. If the user of the equipment requires continued operation during power mains interruptions, it is recommended that the equipment be powered from an uninterruptible power supply or a battery. |
| EN-61000-4-8 | 3A/m | 3A/m | Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment. |

NOTE: $Ut$ is the a.c. mains voltage prior to application of the test level.

**Guidance and manufacturer's declaration - electromagnetic immunity**

The equipment is intended for use in the electromagnetic environment specified below.  The customer or the user of the equipment should assure that it is used in such an environment.

| Immunity test | IEC 60601 test level | Compliance level | Electromagnetic environment - guidance |
|---|---|---|---|
| | | | Portable and mobile RF communications equipment should be used no closer to any part of the equipment, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** |
| Conducted RF  EN 61000-4-6 | 3Vrms  150kHz to 80MHz | 3Vrms | $d = [\frac{3,5}{10}]\sqrt{P}$ |
| Radiated RF  EN 61000-4-3 | 3V/m  80MHz to 2,5GHz | 3V/m | $d = [\frac{3,5}{10}]\sqrt{P}$ 80MHz to 800MHz  $d = [\frac{7}{10}]\sqrt{P}$ 800MHz to 2,5GHz  Where $P$ is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and $d$ is the distance in meters (m).  Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should be less than the compliance level in each frequency range.  Interference may occur in the vicinity of equipment marked with the following symbol: |

NOTE 1:  At 80MHz and 800MHz, the higher frequency range applies.

NOTE 2:  These guidelines may not apply in all situations.  Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

Field strengths from fixed transmitters, such as base stations for radio (cellular / cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy.  To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered.  If the measured field strength in the location in which the equipment is used exceeds the applicable RF compliance level above, the equipment should be observed to verify normal operation.  If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the equipment.

Over the frequency range 150kHz to 80MHz, field strengths should be less than 10V/m.

# Sécurité

Cette information générale de sécurité est pour l'utilisateur et le personnel de service. Des AVERTISSEMENTS et les ATTENTIONS spécifiques seront trouvés dans tout le manuel là où il est applicable.

**LIMITES ET SYMBOLES DE CE MANUEL ET SUR L'ÉQUIPEMENT**

ATTENTION, ce symbole indique des paragraphes fournissant des informations d'avertissement et détaillées au sujet d'une pièce spécifique de l'instrument. Qu'une partie de l'équipement est également identifiée par ce symbole (voir les références à ce symbole dans le manuel).

AVERTISSEMENT, risque de décharge électrique

C.A., courant alternative

Dactylographiez la partie appliquée par B – Commun relié à la terre

L'Équipement de classe CF Defibrillation preuve

La terre d'Equipotentiality/chassis

EN ATTENTE (le courant passe, instrument eteint en mode 'attente')

OUTRE DE (raccordement aux forces à C.A.)

EN MARCHE (raccordement aux forces à C.A.)

**Les produits de DSI/Ponemah ne sont pas "les dispositifs médicaux" prévus pour être employés pour les buts du diagnostic de la maladie ou d'autres conditions, ou dans le traitement, la réduction, ou la**

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**prévention de la maladie, ou pour être employés comme dispositif de soutien de la vie. L'utilisation des produits de DSI/Ponemah sont seulement pour les buts de conduire la recherche de la science de vie.**

**AVERTISSEMENT**

**SI CET INSTRUMENT EST ACTIONNÉ OU UTILISÉ de quelque sorte NON INDIQUÉ, LA PROTECTION FOURNIE PAR LE SYSTÈME PEUT ÊTRE ALTÉRÉE. N'EMPLOYEZ PAS EN PRÉSENCE DES ANESTHÉSIQUES INFLAMMABLES.**

## SOURCE D'ÉNERGIE

Cet instrument est prévu pour fonctionner à l'intérieur à partir d'une source d'énergie qui n'applique pas plus de 250 volts de RMS entre les conducteurs d'approvisionnement ou entre l'un ou l'autre conducteur d'approvisionnement et la terre. Une prise de terre protectrice par le conducteur de terre dans le cable électrique est exigée. Si l'unité est montée dans une installation permanente (c.-à-d. monté sur crémaillère), l'utilisateur DOIT permettre d'accéder à la prise OU relier l'instrument à un circuit avec un commutateur ou un disjoncteur accessibles à l'utilisateur. Le cable électrique détachable est le moyen par lequel les forces sont débranchées.

## CORRECTEMENT RECTIFIER L'INSTRUMENT

Cet instrument est fondu par le cordon du secteur. C'est un dispositif de la classe 1. Fondre la fiabilité peut seulement être réalisé quand l'équipement est relié à un réceptacle de catégorie d'hôpital. Utilisez seulement le cordon et le connecteur de secteur indiqués pour votre instrument. Employez seulement un cordon de secteur qui est en bon état.

Après la perte du raccordement du protecteur-terre, toutes les pièces conductrices accessibles (y compris des boutons et des contrôles qui peuvent sembler être isolés) peuvent rendre une décharge électrique.

## EMPLOYEZ LES FILS TEST ET LES CÂBLES APPROPRIÉS

Les fils test et/ou les câbles d'interconnexion peuvent porter des tensions de phase DANGEREUSES. Ils doivent être examinés régulièrement pour l'usage. Des fils ou les câbles usés devraient être remplacés.

L'amplificateur a été conçu et examiné pour la protection contre les effets de la décharge d'un défibrillateur cardiaque. Pour l'exploitation sûre, n'employez que les câbles équipés d'amplificateur.

## PLACEMENT DE L'ÉLECTRODE ECG

L'utilisateur devrait s'assurer que toutes les électrodes employées, y compris l'électrode neutre, n'entrent en contact avec aucune partie conductrice, y compris la terre.

Chaque fois qu'un défibrillateur est utilisé, assurez que les fils sont placés sur les endroits appropriés sur le sujet. Les fils ne devraient jamais être placés sur les surfaces au sol. Vérifiez que les fils du défibrillateur ne sont pas placés directement sur les électrodes ECG.

## N'EMPLOYEZ PAS AVEC L'ÉQUIPEMENT CHIRURGICAL DE HAUTE FRÉQUENCE

Il est impératif que les électrodes d'ECG soient enlevées du sujet avant d'utiliser n'importe quel équipement chirurgical de haute fréquence. Cet équipement ne fournit pas des moyens protecteurs contre des brûlures quand l'équipement est utilisé avec l'équipement chirurgical de haute fréquence.

## ADDITION DU COURANT DE RISQUE

L'amplificateur a été conçu et examiné pour répondre à des spécifications de fuite courantes une fois attaché au sujet. N'importe quel matériel supplémentaire ajouté au sujet peut augmenter la fuite. L'opérateur devrait se rendre compte de l'addition possible des courants additionnels de fuite quand le matériel supplémentaire est relié au sujet.

## UTILISATION AVEC DES STIMULATEURS

L'opérateur devrait se rendre compte de tous les interactions ou risques en matière de sécurité possibles quand l'amplificateur est utilisé en même temps que les stimulateurs cardiaques et d'autres dispositifs de stimulant. Le fabricant de ces dispositifs devrait être consulté pour toute information supplémentaire.

**EMI/RFI**

L'amplificateur a été examiné pour répondre à des normes de susceptibilité et de rayonnement d'EMI/RFI. Cependant, l'utilisateur devrait se rendre compte des interactions électromagnétiques possibles entre ce dispositif et d'autres dispositifs dans le même secteur et corriger la situation si nécessaire. N'importe quel type de feuille conductrice mis à une terre électrique et placé entre la source et l'équipement aidera à réduire l'IEM.

**AVERTISSEMENTS POUR LE PERSONNEL DE SERVICE AUTORISÉ**

Les tensions dangereuses existent à plusieurs points dans cet instrument. Pour éviter des blessures, ne touchez pas les raccordements ou les composants exposés tandis que le courant passe. Il n'y a aucun élément disponible d'utilisateur dans les conditionneurs de signal. Renvoyez l'unité à DSI pour le calibrage et service.

**UTILISEZ LE FUSIBLE APPROPRIÉ**

Pour éviter le risque d'incendie, utilisez seulement un fusible du type correcte, de l'estimation de tension, et de l'estimation courante comme indiqué dans la liste des pièces pour votre instrument.

**N'UTILISEZ PAS SANS COUVERTURES ET PANNEAUX INSTALLÉS**

Pour éviter des blessures et des dommages aux équipments, l'utilisateur devrait débrancher l'appareil avant d'enlever les couvertures, les panneaux ou les attaches. Réinstallez les couvertures, les panneaux, et les attaches avant de rebrancher l'appareil.

**AVERTISSEMENT: ON NE PERMET AUCUNE MODIFICATION À CET ÉQUIPEMENT**

# Product Issue Report

## Product Issue Report Form

Sales Person:

Customer Name:

Company:

Address:



Phone Number:

Email Address:



Ponemah Version (including Service Pack):

Serial Number:

Priority:

Date:

Hardware:



Status of issue (check one)

        [] Unreproduced  [] Reproduced

        [] Needs repair    [] As intended



Computer hardware/software

Brand/Model:

CPU Speed:

RAM:

Operating System (including Service Pack):



Networked

        [] Yes    [] No

Issue:

Steps to Repeat

# Feature Request

## Feature Request Form

Sales Person: _____
Customer Name: _____
Company: _____
Address: _____
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Phone Number: _____
Email Address: _____
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Ponemah Version (including Service Pack): _____
Serial Number: _____
Priority: _____
Date: _____
Hardware: _____

Feature (check one)
    [] Unevaluated    [] Pending
    [] Implement    [] Already Exists

Description: _____
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