Model 482C16

Four Channel, ICP® Sensor Signal Conditioner

Installation and Operating Manual

**For assistance with the operation of this product,
contact PCB Piezotronics, Inc.**

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PCB PIEZOTRONICS INC.
A PCB GROUP COMPANY

Warranty, Service, Repair, and Return Policies and Instructions

The information contained in this document supersedes all similar information that may be found elsewhere in this manual.

Total Customer Satisfaction – PCB Piezotronics guarantees Total Customer Satisfaction. If, at any time, for any reason, you are not completely satisfied with any PCB product, PCB will repair, replace, or exchange it at no charge. You may also choose to have your purchase price refunded in lieu of the repair, replacement, or exchange of the product.

Service – Due to the sophisticated nature of the sensors and associated instrumentation provided by PCB Piezotronics, user servicing or repair is not recommended and, if attempted, may void the factory warranty. Routine maintenance, such as the cleaning of electrical connectors, housings, and mounting surfaces with solutions and techniques that will not harm the physical material of construction, is acceptable. Caution should be observed to insure that liquids are not permitted to migrate into devices that are not hermetically sealed. Such devices should only be wiped with a dampened cloth and never submerged or have liquids poured upon them.

Repair – In the event that equipment becomes damaged or ceases to operate, arrangements should be made to return the equipment to PCB Piezotronics for repair. User servicing or repair is not recommended and, if attempted, may void the factory warranty.

Calibration – Routine calibration of sensors and associated instrumentation is recommended as this helps build confidence in measurement accuracy and acquired data. Equipment calibration cycles are typically established by the users own quality regimen. When in doubt about a calibration cycle, a good "rule of thumb" is to recalibrate on an annual basis. It is also good practice to recalibrate after exposure to any severe temperature extreme, shock, load, or other environmental influence, or prior to any critical test.

PCB Piezotronics maintains an ISO-9001 certified metrology laboratory and offers calibration services, which are accredited by A2LA to ISO/IEC 17025, with full traceablility to N.I.S.T. In addition to the normally supplied calibration, special testing is also available, such as: sensitivity at elevated or cryogenic temperatures, phase response, extended high or low frequency response, extended range, leak testing, hydrostatic pressure testing, and others. For information on standard recalibration services or special testing, contact your local PCB Piezotronics distributor, sales representative, or factory customer service representative.

Returning Equipment – *Following these procedures will insure that your returned materials are handled in the most expedient manner.* Before returning any equipment to PCB Piezotronics, contact your local distributor, sales representative, or factory customer service representative to obtain a Return

Materials Authorization (RMA) Number. This RMA number should be clearly marked on the outside of all package(s) and on the packing list(s) accompanying the shipment. A detailed account of the nature of the problem(s) being experienced with the equipment should also be included inside the package(s) containing any returned materials.

A Purchase Order, included with the returned materials, will expedite the turn-around of serviced equipment. It is recommended to include authorization on the Purchase Order for PCB to proceed with any repairs, as long as they do not exceed 50% of the replacement cost of the returned item(s). PCB will provide a price quotation or replacement recommendation for any item whose repair costs would exceed 50% of replacement cost, or any item that is not economically feasible to repair. For routine calibration services, the Purchase Order should include authorization to proceed and return at current pricing, which can be obtained from a factory customer service representative.

Warranty – All equipment and repair services provided by PCB Piezotronics, Inc. are covered by a limited warranty against defective material and workmanship for a period of one year from date of original purchase. Contact PCB for a complete statement of our warranty. Expendable items, such as batteries and mounting hardware, are not covered by warranty. Mechanical damage to equipment due to improper use is not covered by warranty. Electronic circuitry failure caused by the introduction of unregulated or improper excitation power or electrostatic discharge is not covered by warranty.

Contact Information – International customers should direct all inquiries to their local distributor or sales office. A complete list of distributors and offices can be found at www.pcb.com. Customers within the United States may contact their local sales representative or a factory customer service representative. A complete list of sales representatives can be found at www.pcb.com. Toll-free telephone numbers for a factory customer service representative, in the division responsible for this product, can be found on the title page at the front of this manual. Our ship to address and general contact numbers are:

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ECN: 17900

SIGNAL CONDITIONER

Model 482C

GENERAL OPERATION MANUAL

For powering ICP® , and charge sensors, this signal conditioner provides an effective method for managing small numbers of sensor channels. A simple command set, entered through industry standard interface, allows the user to generate powerful application-specific programs to automate system testing.

The 482C is available with many different options from PCB. This manual describes the most basic functions, as well as all of the options that are available. Please note at the beginning of the section if the function being described is standard, or an option.

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1-0. INTRODUCTION AND SPECIFICATIONS

1-1. Introduction: Safety Considerations

WARNING SYMBOLS AND TERMS

The following symbols and terms may be found on the equipment described in this manual.

This symbol on the unit indicates that the user should refer to the operating instructions located in the manual.

This symbol on the unit indicates that high voltage may be present. Use standard safety precautions to avoid personal contact with this voltage.

This symbol indicates that the test fixture, Model 482C, must be connected to earth ground via the power cord.

The **WARNING** heading used in this manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **Caution** heading used in this manual explains hazards that could damage the instrument.

WARNING 1: *The power supply/signal conditioner should not be opened by anyone other than qualified service personnel.* This product is intended for service by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid injury.

WARNING 2: This equipment is designed with user safety in mind; however, the protection provided by the equipment may be impaired if the equipment is used in a manner not specified by PCB Piezotronics, Inc.

Caution 1: *Cables can kill your equipment.* High voltage ElectroStatic Discharge (ESD) can damage electrical devices. Similar to a capacitor, a cable can hold a charge caused by triboelectric transfer, such as that which occurs in the following:

- Laying on and moving across a rug.
- Any movement through air.
- The action of rolling out a cable.
- Contact to a non-grounded person

The solution for product safety: 1) Connect the cables only with the AC power off. 2) Temporarily "short" the end of the cable before attaching it to any signal input or output.

Caution 2: *ESD considerations should be made prior to performing any internal adjustments on the equipment.* Any piece of electronic equipment is vulnerable to ESD when opened for adjustments. Internal adjustments should therefore be done ONLY at an ESD-safe work area. Many products have ESD protection, but the level of protection may be exceeded by extremely high voltage that is typically present in normal situations.

EQUIPMENT RATINGS

For complete specifications, please refer to the enclosed Specification Sheet. This equipment operates optimally at +32 to +120°F (0 to +50°C), in an environment having <85% relative humidity. Its line power frequency range is 50/60 Hz.

The Model 482C requires 10-15 VDC with 500 mA to operate. In turn, it supplies 24 VDC, 2 to 20 mA excitation voltage to connected ICP® or in-line charge converters sensors. The unit gets its power via AC power adaptor, 12 VDC battery pack, 28 VDC or a car adapter which plugs into the receptacle on the rear panel.

1-2. Model 482C System Description, Basic Configuration

The Model 482C is a basic one or four channel signal conditioning system designed to interface measurement signals to readout or recording devices. The unit also serves to provide excitation power for ICP® and in-line charge converters type sensors.

The following are features that come standard on every 482C:

- 12-bit accuracy signal conditioning
- Unity gain
- Input fault and overload LED
- Variable ICP® source current, 0 to 20 mA
- Illuminator lights and a power button on the front panel
- Rear panel BNC input/output connectors
- Non-Volatile Memory

Model 482C is also fully configurable from the factory with the following options:

- RS-232 Interface
- Adjustable Gain: x1 x10 x100 or Incremental .1 – 200
- Normalized Output (requires incremental gain)
- AC, DC or Switchable input coupling
- Voltage sensor input
- Fixed low pass fourth-order filter at output, with a variety of cutoff frequencies available
- Selectable ICP® or charge mode sensor input, 0.1 mV/pC or,
- Selectable ICP® or charge mode sensor input, 1.0 mV/pC or,
- Selectable ICP® or charge mode sensor input, 10 mV/pC
- Clamped Output
- Capable of reading TEDS
- Front panel keypad control/display
- Fixed low pass 2nd order filter at input

1-2.1 Model 482C ICP® Input/Output Mode, All Models

The Model 482C contains a regulated 24 VDC power supply that provides constant current for up to 4 individual channels. Both the output and input connections utilize BNC connectors and are brought out through the rear panel.

1-3. Block Diagram

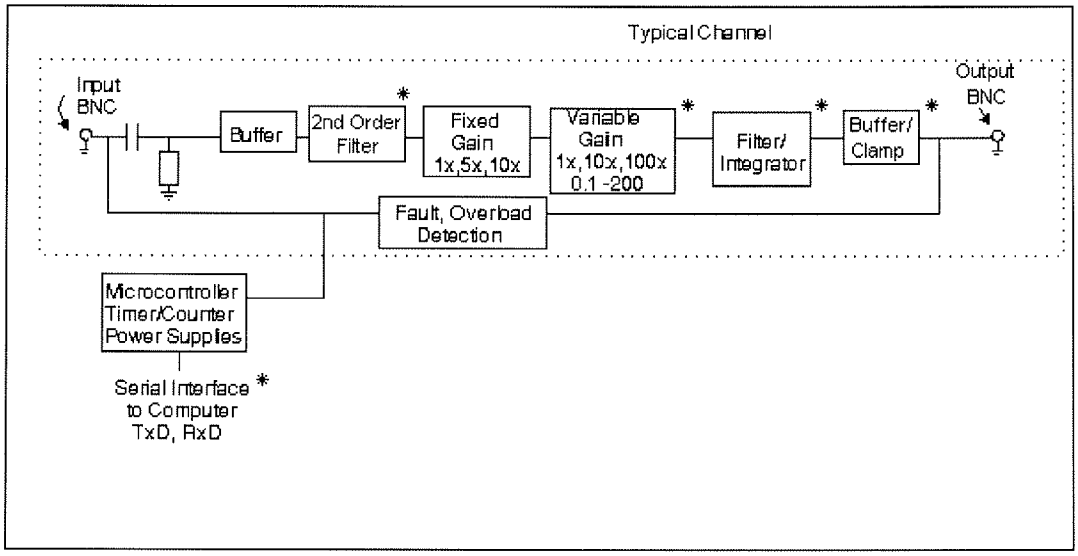


Figure 1 Typical Block Diagram of Model 482C (*=option)

1-4 Installation

Model 482C comes in the form of a standard box. The box should be located in such a way as to allow convenient access to the power outlet for disconnect purposes. Since these units have low power consumption, they can be located in confined environments.

NOTE: Specific installation is available; contact PCB

1-4.1. Grounding Techniques

Integrating the Model 482C unit into an application that links the outputs to other test equipment powered by line voltages may lead to errors or loss of signal-to-noise ratio due to ground loops. The evidence of ground loops is easily seen whenever the fundamental frequency (50 or 60 Hz) or a multiple of the fundamental frequency is present in the system when the sensors are "at rest." In order to maintain the operating specification of noise and reduce the effects of line interference, proper grounding techniques should be used. The following procedure may be helpful:

1. Make sure the signal ground lines of all equipment are tied together. The signal grounds of the channels are typically tied together via the case of the input and output BNC connectors. The individual channels of the Model 482C have their signal ground line tied together internally at the power supply.

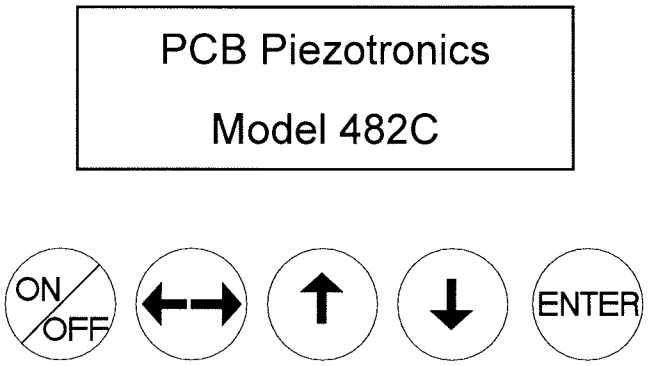
2. Insure that the sensor does not pick up line noise from the body under test. The case of the sensor should be isolated from the body under (ground) using an isolation pad. The isolation pad breaks the loop formed by the signal path of the sensor to the Model 482C and the return (ground) from the Model 482C back to the sensor.

3. Make sure that all equipment signal grounds of the test system are tied to the Earth ground at a single point and the connections linking the equipment ground are made using a wire that can provide a very low impedance connection.

1-4.2 Quick Set-up Instructions

1-4.2a Front Panel Introduction

The following illustration shows the front panel module as it appears on the Model 482C.



▼ This button is used to scroll DOWN through the options in the menus. In the submenus, this button can be used to change the channel and increments.

▲ This button is used to scroll UP through the options in the menus. In the submenus, this button can be used to change the channel and increments.

◄ ► This button moves you in the left / right direction through the menus and submenus.

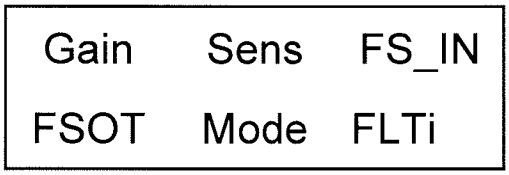
ENTER: This button applies the setting of the option just set, while exiting the user out of the submenu.

NOTE: Please refer to section 1-4.1b and 1-4.2c for instructions on how to set the mode and gain options. The settings for these options should be considered before unit is used to collect data

NOTE: In the Submenus a flashing cursor represents a menu that will accept user input. A non- flashing cursor represents a status menu, no input needed.

1-4.2b Mode Option

The mode option lets the user switch between ICP®, voltage or charge modes. The factory default for all channels is ICP®. To change the mode select the Mode option from the main menu use the down ↓ arrow button to scroll down and the left / right ←→ button until the cursor is over the Mode option, and the hit ENTER.



The submenu will appear. Choose the channel you wish to change by using the up ↑ or down ↓ arrows. Once that is done use the left / right ←→ button to move the cursor over to the Mode column. To change the Mode, use either the up ↑ or down ↓ arrow to scroll through the options. You can set the channel to be in either ICP®, voltage or charge mode. Once you have it set, you can either scroll back to the channel column; to change the mode on another channel; or hit ENTER to save the changes.

Ex: If you want to change channel 2 to be in Charge mode you would perform the following steps:

Scroll and select Mode from the main menu, and hit enter. Once in the submenu, the flashing cursor will be in the channel column, hit the up ↑ arrow button until the channel column reads 2

Chan	Input Type
2	ICP

Hit the left / right ←→ arrow key once so that the cursor is over the Mode column. Use the up ↑ or down ↓ arrow keys until the mode says charge.

Chan	Input Type
2	CHARGE

Once you have hit enter, your changes will be saved.

NOTE: To make a global change (set all the channels to the same mode) set the channel to ALL.

1-4.2c Programmable Gain Option

To enter the submenu for the variable gain option, place the cursor over the word "Gain" in the main menu. This is shown as:

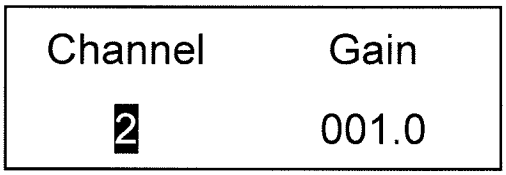
Gain	Sens	FS_IN
FSOT	Mode	FLTi

By pressing the ENTER button, the submenu for changing the gain of any channel appears on the display. The submenu pertaining to the "Gain" selection appears as:

Channel	Gain
1	001.0

Example: To set the gain of Channel 2 to x10

The flashing cursor appears over the channel selection. Choose the channel you wish to change by using the up↑ or ↓ arrows. Once you have selected the channel, use the left/right ←→ arrow key to move the flashing cursor over to the gain column.



To change the gain, use the up ↑ and down ↓ arrow keys to scroll through the options. If your unit has decimal gain you may choose between x1, x10 or x100. If your unit has incremental gain you can choose between .1 and 200.0 by using the left/right ←→ arrow key to move the flashing cursor over any digit in the gain column to select an appropriate value In this example, a gain of 10 is selected; (see example below). As with all setting changes, the actual gain internal to the unit is changed when the 'ENTER' button is pushed.

To set the next channel, press the left right ←→ arrow key to resume channel control, then press the up↑ or down ↓ arrow keys to select a different channel. Continue making selections with the directional keys until all desired channels are set, then press the ENTER key to return to the option menu.

NOTE: To make a global change (set all the channels to the same gain) set the channel to ALL.

1-5. Operation: Standard AC Line

Plug the adapter into a 120V/60 Hz or 230V/50 Hz power source and press the "ON/OFF" button.

1-5.1 Using the Power Adapter

When using a power adapter to power the unit, make sure to observe the correct pinout, as indicated on the rear panel of the unit.

CAUTION: Refer to the rear panel for proper input voltage and currents.

1-6. Maintenance and Repair

It is not recommended that the customer attempt repair of the Model 482C in the field. Should trouble occur, contact the factory for assistance. If the unit becomes dusty and dirty, it may be wiped off with a soft cloth.

2-0. FRONT PANEL MODULE CONTROL

2-1. Introduction

The Model 482C is equipped with the capability of controlling functions through the front panel module. This module consists of a display and five (5) push buttons. The display shows various menus in which all of the available options are given. The user may scroll through the menu, and choose any option to change the settings.

2-2. Unit Initialization

Upon pressing the ON/OFF button, the unit will turn on and display the following:

PCB 482C
FW Ver n.n

The unit is initialized, with the factory default settings.

NOTE: Reference Section 4-10 for memory default settings.

2-3. Main Menu Format

Initially, pressing any button will cause the first two menu lines to be displayed and the cursor will blink on the 'Gain' option.

Gain	Sens	FS_IN
FSOT	Mode	FLTi

The cursor may be moved around the main menu by using the arrow keys. To show the other selections of the main menu, press the down ↓ arrow key. This action scrolls vertically to the subsequent lines on the menu. Theses lines are shown below.

ICP?	Auto	FLTo
Coupl	Clmp	Bias
Oscl	Unit	Reset
Disp	LEDS	Ver?

Pressing the down ↓ arrow key button once again shows:

2-4. Submenu Format and Command Selections

Please review the options that your unit has and refer to the proper sections.

1) Gain Options:

If the Incremental Gain Option is installed then the 482C has the ability to automatically adjust the gain of each channel based on three or four other values. These values are; the Sensitivity of the sensor, the Full Scale value of the input (FSI) in engineering units (g's for instance), The Full Scale Output (FSO) of the amplifier expressed in Volts (this is the output that a signal at an FSI level will produce). The fourth value, Charge Converter Sensitivity, is required if the unit has the Multiple Charge Sensitivity Input Mode options installed, and one of the Charge options is selected. The amplifier will always force the gain equation to be true by adjusting either the gain, if one of the FSI, FSO, SENS or Charge Mode inputs changes, or FSI if the Gain is set directly. The Gain equation is as follows:

Gain=(FSO *1000)/(FSI*SENS*Charge SENS (if applicable)).

If the Incremental Gain Option is installed then the SENS, FS_IN and FSOT settings described below are applicable, If the variable gain option (x1, x10, x100) or a fixed gain option is installed then these settings do not apply.

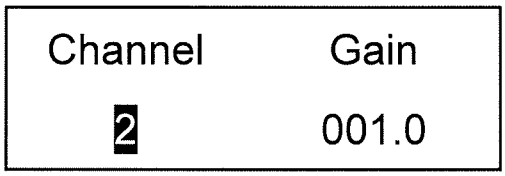
Setting the Gain:
To enter the submenu for the variable gain option, place the cursor over the word "Gain" in the main menu. This is shown as:

Gain	Sens	FS_IN
FSOT	Mode	FLTi

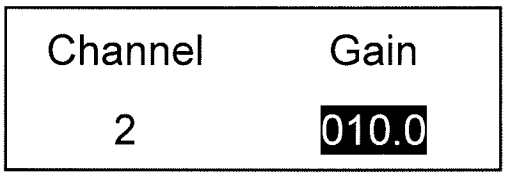
By pressing the ENTER button, the submenu for changing the gain of any channel appears on the display. The submenu pertaining to the "Gain" selection appears as:

Channel	Gain
1	001.0

Example: To set the gain of Channel 2 to x10
The flashing cursor appears over the channel selection. Choose the channel you wish to change by using the up↑ or ↓ arrows. Once you have selected the channel, use the left/right ←→ arrow key to move the flashing cursor over to the gain column.



To change the gain, use the up ↑ and down ↓ arrow keys to scroll through the options. If your unit has decimal gain you may choose between x1, x10 or x100. If your unit has incremental gain you can choose between .1 and 200.0 by using the left/right ←→ arrow key to move the flashing cursor over any digit in the gain column to select an appropriate value In this example, a gain of 10 is selected; (see example below). As with all setting changes, the actual gain internal to the unit is changed when the 'ENTER' button is pushed.

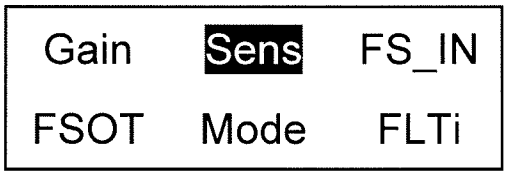


To set the next channel, press the left arrow key to resume channel control, then press the up ↑ or down ↓ arrow keys to select a different channel. Continue making selections with the directional keys until all desired channels are set, then press the ENTER key to return to the option menu.

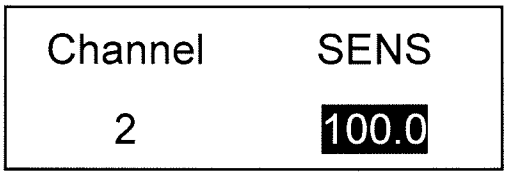
NOTE: To do a global change (set all the channels to the same gain) set the channel to ALL.

2) Sensitivity Value (Valid only if the Incremental Gain (0.1 –200.0 is also installed):

Entering a Sensitivity value will cause the gain of the unit to be changed based on the equation shown above. Sensitivity is set in the same way that the incremental Gain value is set, using the left/right ←→ arrow key to move the flashing cursor over any digit in the SENS column to select an appropriate value As with all setting changes, the actual gain internal to the unit is changed when the 'ENTER' button is pushed.



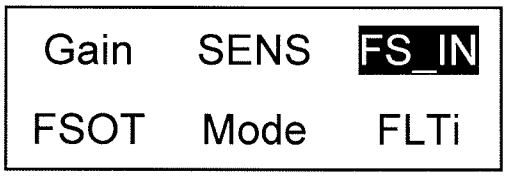
The sub-menu of the "SENS" selection shows the current value for sensor sensitivity (assumed to be mV/EU):



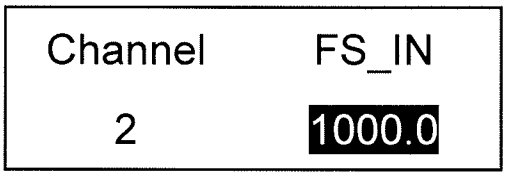
3) Full Scale Input Value (Valid only if the Incremental Gain (0.1 –200.0 is also installed):

Entering a Full Scale Input value will cause the gain of the unit to be changed based on the equation shown above. The FSI value is set in the same way that the incremental Gain value is set, using the left/right ←→ arrow key to move the

flashing cursor over any digit in the FS_IN column to select an appropriate value As with all setting changes, the actual gain internal to the unit is changed when the 'ENTER' button is pushed.

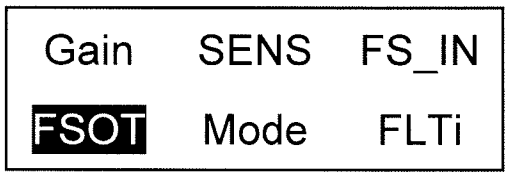


The sub-menu of the "FS_IN" selection shows the current value for Full Scale Input (assumed to be EU):

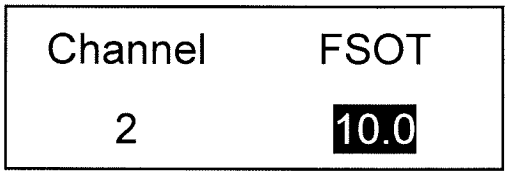


4) Full Scale Output Value (Valid only if the Incremental Gain (0.1 –200.0 is also installed):

Entering a Full Scale Output value will cause the gain of the unit to be changed based on the equation shown above. The FS0 value is set in the same way that the incremental Gain value is set, using the left/right ←→ arrow key to move the flashing cursor over any digit in the FSOT column to select an appropriate value As with all setting changes, the actual gain internal to the unit is changed when the 'ENTER' button is pushed.

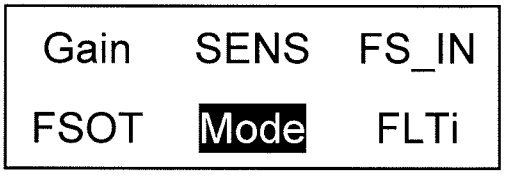


The sub-menu of the "FSOT" selection shows the current value for Full Scale Output in Volts. The range is 0.5 to 10.0

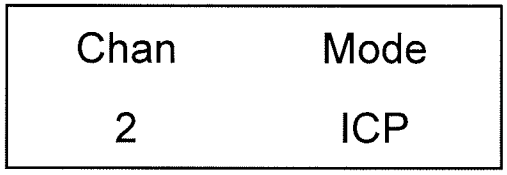


5) Mode:

Many Input Mode options are available for the 482C unit. The most common mode option allows the user to switch between ICP®, voltage or charge modes. The factory default for all channels is ICP®. To change the mode select the Mode option from the main menu using the left / right ←→ arrow keys until the cursor is over the Mode option, and then press the Enter button.



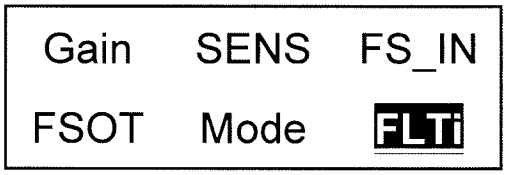
The following submenu will appear. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. Next, use the left / right ←→ arrow key to move the flashing cursor over to the Mode column. To change the Mode, use either the up ↑ or down ↓ arrow key to scroll through the options, once you have the desired setting selected hit ENTER to apply it.



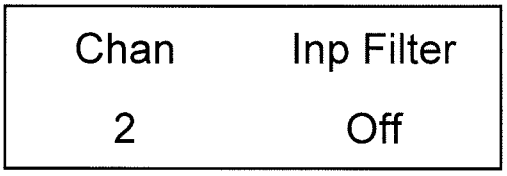
NOTE: Setting a channel to Voltage Mode will cause the ICP current source to be turned off to all channels and will force all other channels in ICP mode to Voltage mode. This is the result of the ICP current source being a unit level setting and, as such, cannot be set individually for each channel. Conversely, If ICP is set for any channel, all Voltage Mode channels will also be set to ICP mode.

6) Input Filter option:

Each channel's Input filter setting can be set independently of the other channels. To change the Input Filter setting from the main menu, use the left / right ←→ arrow keys until the cursor is over the FLTi option, and then press the Enter button.

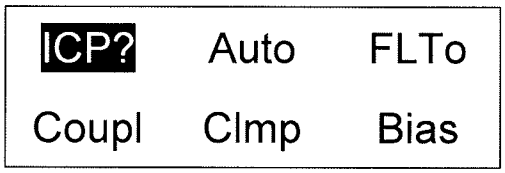


The following submenu will appear. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. Next, use the left / right ←→ arrow key to move the flashing cursor over to the INP Filter column. To change the Filter setting, use either the up ↑ or down ↓ arrow key to select either 'On' or 'Off', once you have the desired setting selected hit ENTER to apply it.

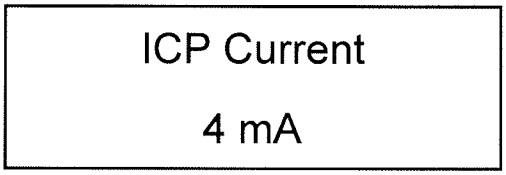


7) ICP® Current Adjustment:

This is a UNIT level command, meaning the selected ICP® current level is supplied to all of the channels in ICP input mode. This value can be set from 0 – 20 mA. Where 0 = Off. To set the current excitation value, move the cursor to the 'ICP?' location, as shown below.



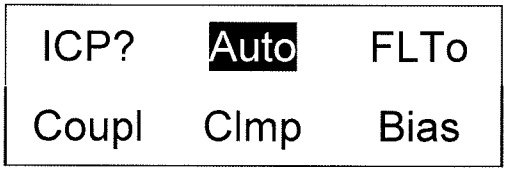
Pressing the ENTER button, will cause the following submenu to appear. The ICP® current may be altered by using the up ↑ or down ↓ arrow keys.



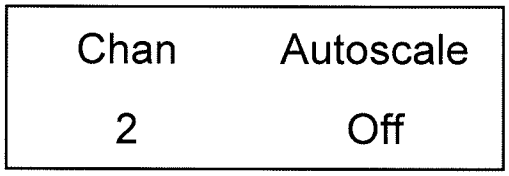
NOTE- The factory default setting for the ICP® current is 4 mA. Please refer to the reference section for optional settings. Also a ICP current setting of 0 automatically puts the input mode for any channels with ICP mode selected to Voltage Mode. Conversely, if a value greater than 0 is selected, any channels in Voltage Mode will be switched to ICP mode.

8) Autoscale Option (Valid only if the Incremental Gain (0.1 –200.0 is also installed):

The auto-scaling feature provides an automatic scaling of the output signal. Please refer to section 3-7.1 for further description. With this command, the programmable gain is implemented to give the largest signal amplitude output. The signals are checked internally; if there is an overload, the signal is stepped down and checked again. This procedure is followed for the indicated channel. To use this feature, place the cursor over the word "Auto" on the display.



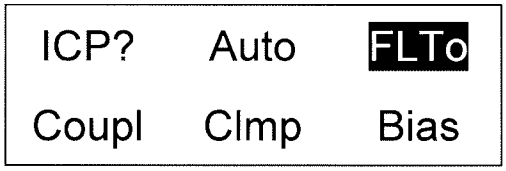
Hit the enter key, and the following submenu will appear. use the up ↑ or down ↓ arrow keys to toggle between the 'OFF', 'ON' or 'IMED' options. Once you have set the Auto-scale option, hit the ENTER key to return to the main menu. ON turns the auto scale function ON and it will continue scaling the gain until it is manually turned off. The 'IMED' option runs through the auto-scale algorithm once and then turns it off automatically.



NOTE- Auto-scale option should NOT be left on while measurements are being taken. It is strictly to be used during the setting of the gain, and then the option should be turned off.

9) Output Filter option:

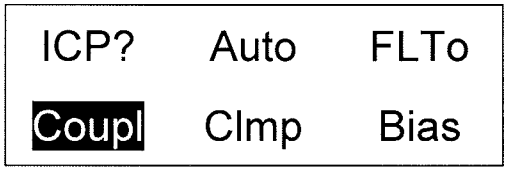
Each channel's Output filter setting can also be set independently of the other channels. To change the Output Filter setting from the main menu, use the left / right ←→ arrow keys until the cursor is over the FLTo option, and then press the Enter button.



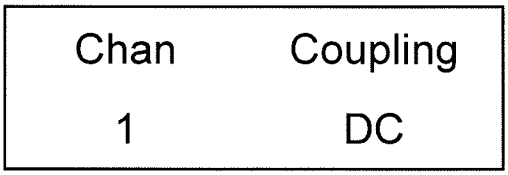
The following submenu will appear. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. Next, use the left / right ←→ arrow key to move the flashing cursor over to the Out Filter column. To change the Filter setting, use either the up ↑ or down ↓ arrow key to select either 'On' or 'Off', once you have the desired setting selected hit ENTER to apply it.

10) Input Coupling:

The Model 482C provides an option for AC or DC coupling. The AC coupled mode passes the signal through a DC blocking capacitor or high pass filter to remove the sensor bias voltage. By moving the cursor on the "COUPL" location, the display shows:



When the ENTER button is pressed, the submenu for the coupling options will include; **AC, DC, DC ADJ+, DC ADJ-, DC Exit**. The selection can be changed by using the up ↑ or down ↓ buttons.



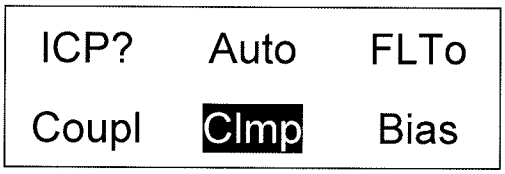
DC Coupling

The DC coupling option will attempt to remove a DC offset from the input signal by reading the bias and using an internal DAC to zero it. This function will be performed when the setting is changed from AC to DC. If the unit was in DC then the previous value will be used. Additionally, a user can further refine the zero process by manually adjusting the DAC either up or down using the DC ADJ+ or DC ADJ- options. For this operation only the adjustment takes place

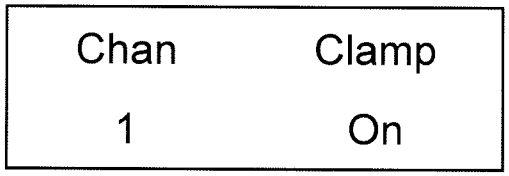
when the ENTER button is pressed while the DC ADJ+ or DC ADJ- is selected but the menu will not transition to another screen. To exit the adjustment process, use the up ↑ or down ↓ buttons to select DC Exit. If DC Exit is selected the channel is set to DC mode and the front panel.
NOTE: The value that is used to zero a channel will be saved in non-volatile memory when the unit is powered down and be reinstated upon power-up.

11) Clamped

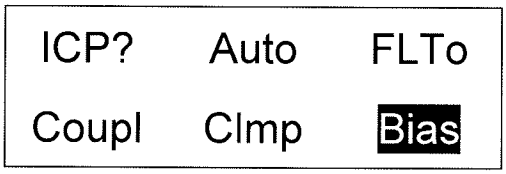
The user may select the Clamp function by pressing the ENTER key on the front panel when the cursor is located on the CLMP option.



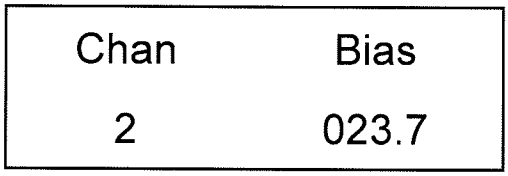
The following submenu will appear. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. Next, use the left / right ←→ arrow key to move the flashing cursor over to the Out Filter column. To change the Filter setting, use either the up ↑ or down ↓ arrow key to select either 'On' or 'Off', once you have the desired setting selected hit ENTER to apply it.



12) Bias Measurement:
The 482C is capable of measuring the bias voltage present on each of its channels. By moving the cursor upon the "Bias" location, the display appears as follows:



Using the ENTER button, the submenu appears as shown in the following diagram. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. The bias reading for the channel will be displayed automatically when the channel is selected.



If unit had a short circuit, the bias voltage would be <2.0V. Proper bias voltage is between 2.0V and 22V. Anything over 22V would indicate an open circuit.

13) Internal Reference Oscillator. (This option is available only on units with the Isolation option)

The user may select the Oscillator setting by pressing the ENTER key on the front panel when the cursor is located on the OSCL option.

Oscl	Unit	Reset
Disp	LEDS	Ver?

The following submenu will appear. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. Next, use the left / right ←→ arrow key to move the flashing cursor over to the Oscillator column. To change the Oscillator setting, use either the up ↑ or down ↓ arrow key to select either 'Off', '1kHz', '100Hz', once you have the desired setting selected hit ENTER to apply it.

Chan	Oscillator
1	1kHz

14) Unit Id.

The user may change the Unit Id setting by pressing the ENTER key on the front panel when the cursor is located on the Unit option.

Oscl	Unit	Reset
Disp	LEDS	Ver?

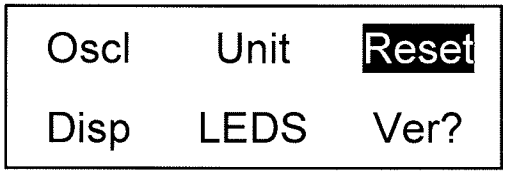
The following submenu will appear. Use the up ↑ or down ↓ arrow key to change the Unit Id setting to a new value. Once you have the desired setting selected hit ENTER to apply it.

Current Unit #
1

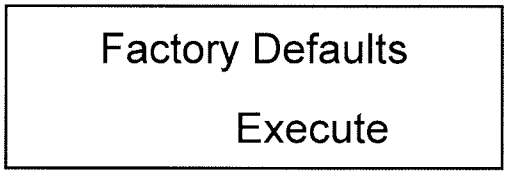
Note: Changing the Unit Id is only necessary if you have the Ethernet or RS-232 communication option installed and you are communicating with more than one unit. If this is the case then all units in the network MUST have a unique Id.

15) Reset to Factory Default Settings:

The reset option provides a mechanism to reset the unit to its factory default settings. To do this select the reset option from the menu by placing the cursor over the Reset option and hitting enter.

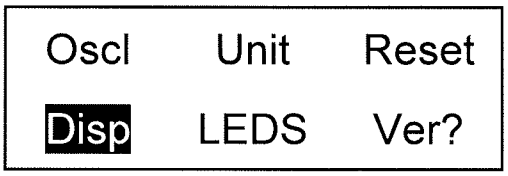


Pressing the ENTER brings up a submenu that allows the operator to continue by selecting 'Execute' or cancel the function by selecting 'Cancel'. Both options return control to the main menu. If 'Execute' is selected then the defaults are restored.



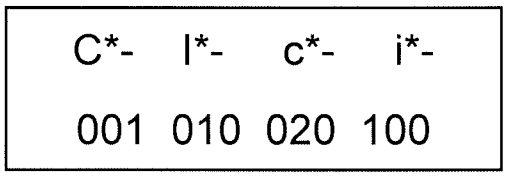
16) Display Content Options:

The Display option allows the user to choose from 3 selections of front panel content. To enter this mode, select the 'DISP' option from the menu by placing the cursor over the Reset option and hitting enter.



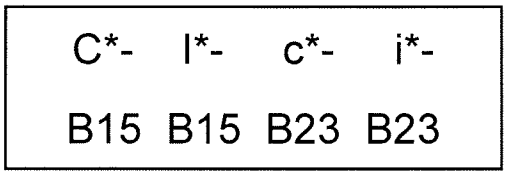
Pressing the ENTER brings up a submenu that allows the operator to continue by selecting either 'Gain', 'Bias' or 'Msg'. If 'Gain' is selected then each channel's current Gain setting will be displayed on the 2nd line of the front panel display to the nearest integer. Additionally, directly above the Gain on the 1st line of the display will be up to 3 characters representing the channels input mode ;'C' for Charge, 'c' for Isolated Charge, 'I' for ICP, 'i' for Isolated ICP, or 'V' for Voltage. Next to the Input mode indicator is the Input Filter setting; '*' for On, blank for Off and '-' if the option is not installed. Next to the Input Filter indicator is the Output Filter setting indication which has the same markings as the input filter.

Following is what the screen will look like if the Display was set to show 'Gain' and channel 1 has a gain of 1 and is in Charge mode with the input filter 'On' with no Output Filter option installed. Similarly, channel 2 has a gain of 10 and is in ICP mode; channel 3 has a gain of 20 and is in isolated charge mode and channel 4 has a gain of 100 and is in isolated ICP mode.

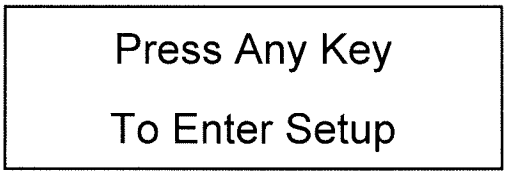


The 'Bias' display option is the same as the Gain option except the channels bias reading replaces the Gain setting. Also the Bias reading will be refreshed periodically.

Following is what the screen will look like if the Display was set to show 'Bias'.

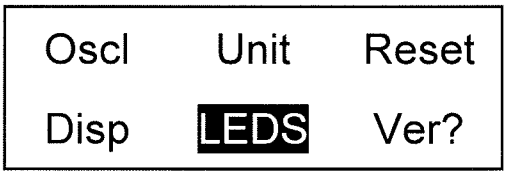


The 'Msg' display option simply displays the following message.

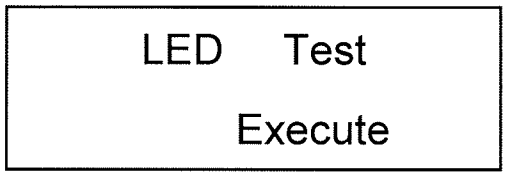


17) LED Test:

The testing of the front panel LEDs indicates whether or not they are functioning properly. To test them, place the cursor over the word "Leds" on the display.

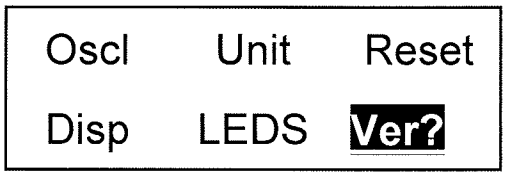


Pressing the ENTER brings up a submenu that allows the operator to continue the test by selecting 'Execute' or cancel the function by selecting 'Cancel'. Both options return control to the main menu. If 'Execute' is selected then all LEDs on the front panel will flash three times.

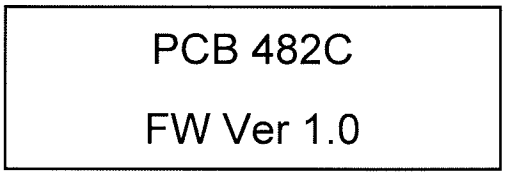


18) Firmware Version:

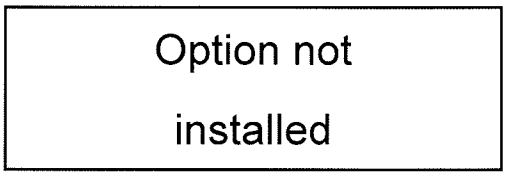
To determine the firmware version of the unit select the 'Ver?' menu option.



A screen similar to the one shown below will be displayed



For any selected option not actually included in a particular unit, a message is shown on the display. This occurs on the main menu. The cursor is placed over a selected option not included in the model purchased. When the ENTER button is pressed, the following is shown:



Reference

3-0. THEORY OF OPERATION

3-1. Sensor Excitation

ICP® refers to a low output impedance voltage mode sensor combining an integrated circuit and a piezoelectric sensing element in a single housing to provide a voltage output. This sensor is powered by a +24 VDC power supply having a constant current, variable from 2 to 20 mA.

Sensor excitation occurs as the constant current of all channels are set. Model 482C allows the constant current to be adjusted between 2 and 20 mA to provide the required excitation for most applications. Special situations, such as driving extra-long cables (more than 1000 ft) with high frequency or fast rise time pulses, may require increasing the drive current to 12 mA or higher. See Figure 3-1.1.

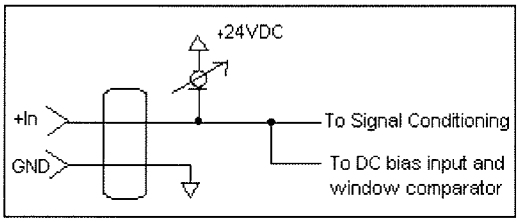


Figure 2 ICP® Sensor Excitation

When driving fast rise time pulses over long lines, system performances can be optimized by "tuning" the drive current to the line; i.e. by finding the best current setting for the particular test of physical parameters. To determine the optimal current setting, experiment with your particular test set up. To insure optimal accuracy in constant-current adjustment, make sure all channels have sensors or simulated loads, similar to the one provided by the Model 401A04 Sensor Circuit, consisting of a voltage amplifier similar to those found in ICP® sensors.

3-2. Input Protection

The input section has protection to limit the amplitude of the incoming signal to within +24 volts to ground. Maximum allowable input voltage without distortion is ±10 volts, relative to the sensor bias voltage.

3-3. Input Fault Detection

Model 482C monitors two input fault conditions, "short" and "open," which indicate problems with sensor input and is displayed through the front panel LEDs. Either case implies that the sensor is NOT functioning properly. An input is **shorted** when it has a ground path for the sensor excitation and **open** when the sensor fails to draw the excitation.

Two voltage comparators consist of a window comparator that has two reference voltages (V_{ref}) representing thresholds for "short" and "open." When the sensor's bias voltage (V_{bias}) exceeds the comparator range, the front panel input fault LED lights.

NOTE: Red LED implies input fault.

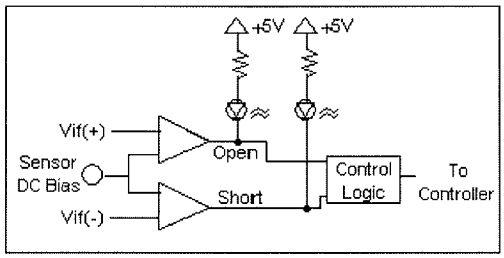


Figure 3 Input Fault Window Comparator with LED Indicator

3-4. Input Interface

The input signal conditioning for each channel provides a unity gain buffer with high-input impedance amplifiers. With the AC coupled option it also eliminates the DC bias from the input signal with a 10-second time constant.

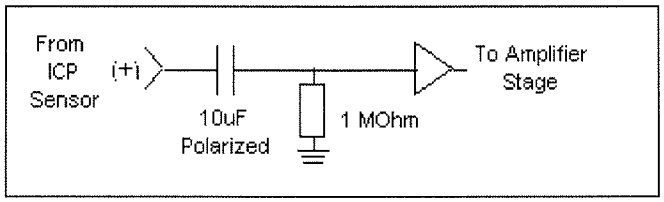


Figure 4 Input Amplifier Configuration

3-5. Gain

The Programmable Gain Amplification (PGA) block consists of a decimal gain amplifier. See Figure 3-5.1.

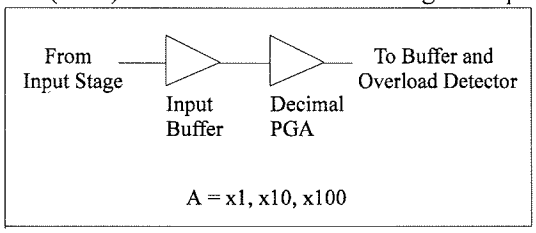


Figure 5 Selectable Gain Amplifier Configuration

3-5.1 Programmable Gain

With the two available programmable gain options, the user can adjust the gain as needed. Adjustable gain with three discrete settings (x1, x10, x100) or incremental gain (from 0.1 to 200) are available. The steps in the incremental gain option is 0.1. These options are particularly useful in the standardization of groups of sensors. Consider the following example, wherein the user desires to normalize sensitivities to 1 V/unit for each channel.

Channel	Sensor Sensitivity	Gain Setting of 482C	Actual Gain Needed
1st	10.10 $^{mV}/_{unit}$	99.00	99.01
2nd	101.32 $^{mV}/_{unit}$	9.9	9.869
3rd	22.30 $^{mV}/_{unit}$	44.8	44.84

These results may be accomplished by using either of two techniques. First, the user may set the gain via the computer interface command set (See the command strings in Section 4-9 in the Computer Interface Programming Guide.) or the user may set the gain by using the front panel control.

3-6. Normalized Output Sensitivity

The definition of normalized output sensitivity is the calculation of the individual channel's gain, depending on the sensitivity of the sensor attached and the desired output sensitivity. This is simply a function of the desired output sensitivity (in Volts/ unit) divided by the sensor's sensitivity.

$$\text{Gain} = {}^{1\ \text{Volt}} / {}_{\text{Sensitivity (mV/unit)}}$$

Additionally, a feature to improve flexibility allows changing the output level to a value of 5 Volts/ unit instead of normalized 1 Volt/ unit. Some users request the ability calculate the gain using a known input signal along with the sensor sensitivity, and desired output level. The result of the request impacts the formula:

$$\text{Gain} = {}^{1\ \text{Volt/}} / {}_{\text{[Sensitivity (mV/unit) * Full Scale Input (units)]}}$$

Adding some simple error checking to insure the limits of the sensor and gain limits of the signal conditioner are not exceeded completes the normalization process.

$$\text{Gain}_{\text{normalized}} = {}^{\text{FSOT (V)}} / {}_{\text{SENS * FSIN}}$$

Additional Considerations:
The storage of individual channel gains is stored in non-volatile memory locations. The new variables for each channel's sensitivity, Full Scale Output level, and Full Scale Input are stored in non-volatile memory locations when the unit is powered down.

The error checking should provide a flag if the desired normalized output level is not feasible due to gain limitations. The gain required may be too large given the sensor sensitivity defined, or too small which implies the sensor will not be capable measure the expected value. The typical sensor will output a signal up to ±5 Volts. The maximum swing may be used in the error checking.

The 482C has the capability to provide signal conditioning for charge mode sensors in addition to the standard ICP® type. The sensitivity (mV/ pC) of the in-line charge converters (422M) will be stored at final calibration to allow charge mode sensors (pC/ unit) to be normalized.

3.7 Overload Detection and Autoscaling

3-7.1 Autoscaling

To avoid overload, the Model 482C features autoscaling for gain adjustment. It first sets maximum gain on all channels, then decreases the gain setting of any channel on which an overload has occurred. The gain autoscale continues until there is no overload with respect to the preset overload threshold level (standard ±10 volts) and sensed signal of the channel. Final gain and overload status interrogation is possible through the command set. The correct procedure for using the autoscale feature is as follows:

1. Excite the structure under test.
2. Enable autoscale (Autoscale on).
3. Wait several seconds, until the unit is stabilized.
4. Disable autoscale (Autoscale off).
5. Read the gains of all channels.
6. Begin test run.

3-7.2 Overload

The overload feature uses the same window comparator principle previously discussed. The $+V_{ref}$ is equal to the default overload value of ±10 volts. When the input voltage (Vsignal of Figure 3-7.1) to the window comparator exceeds the reference voltage limits, overload has occurred, and the comparator's output, which is normally "high," becomes "low." This "low" state illuminates the overload LED and triggers the latch of overload detection circuitry. During regular measuring time, the latch holds the occurrence of overloads until the user reads its status through the computer interface.

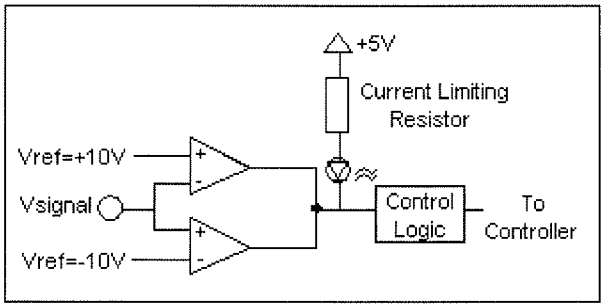


Figure 6 Autoscale/Overload Window Comparator

3-8. Filtering

The Model 482C can be ordered with low pass, or high pass filters installed in any or all channels for the removal of unwanted noise. The available filter modules are second and fourth-order Butterworth low pass (-24 dB/octave) filters. High pass filters are available upon request. The filters have a master enable/disable control. In models equipped with a

second and forth order filter, the second order filters may be disabled by individual channel. Typical cutoff frequencies include:

Option Number	Cutoff Frequency (-3 dB)
01	100 Hz
02	200 Hz
03	500 Hz
04	1 kHz
05	2 kHz
06	5 kHz
07	10 kHz
08	20 kHz
09	50 kHz
10	100 kHz

The user may also define a specific cutoff frequency that satisfies a specific need using the Filter Option. Contact the factory regarding individual requirements.

3-9. RMS - DC Conversion Every Channel

This option converts the input AC signal to an equivalent DC signal to provide a cost-efficient, approximate measure of diagnostic information. The effective voltage or current value, when combined with the circuit resistance, determines the average power for a cycle. For example, if the sensed sinusoidal signal is 2 volts peak-to-peak, 1 volt peak, the RMS value may be obtained by multiplying the peak value (1 volt) by 0.707. Maximum output V_{rms} is 5 volts, which corresponds to ±14.2 volts peak-to-peak, 7 volts peak for a sinusoidal signal.

3-10. Connector Configuration

The base model 482C provides BNC inputs and outputs for ICP®-type sensors. The remaining options deal with selectable ICP® or charge mode sensor input, and they differ only in terms of charge sensitivities.

3-10.1 Piezoelectric Charge Mode Sensor Input

This option allows the user to condition piezoelectric charge signal inputs with considerable temperature, filtering, and gain flexibility. The Model 482C configured for this type of input has BNC inputs to accept charge signals from charge mode sensors (e.g., PCB accelerometer Series 357).

The charge sensitivity can be selected as 0.1 mV/pC, 1.0 mV/pC, or 10 mV/pC. Each channel must be selected as either charge mode or ICP® mode via RS-232 communication or with the keypad (if so equipped). The front panel (red) OPEN LED goes out for the channel selected in the charge mode to signify that the internal charge amplifier is functioning properly. In units with front panel control, the bias menu will display the actual bias voltage for the internal charge amplifier. In the ICP® mode, the OPEN LED stays illuminated until a properly functioning ICP® sensor is attached.

3-10.2 ICP®, Voltage or Charge Input Per Channel

This option allows the user to select the input mode of each channel. The selection is made via RS-232 connection or through the keypad. The functionality of the 482C while in ICP® or voltage mode is very similar, the only difference being in the bias current, which does not flow in voltage mode. When voltage mode is selected, the unit will

automatically set the current to zero (0) mA for all channels. With no ICP® excitation present on the input connector, the channel is simply a voltage amplifier.

The factory default is ICP® input mode for all channels in the unit. The user must reconfigure the channels to accept a voltage input signal.

Input/ Output Connector Definitions:

The BNC connectors are used to accept ICP® and Voltage mode input signals. The ICP® excitation will be present on the input BNC only when the ICP® current is turned on. The voltage input mode allows bipolar, positive and negative (above and below ground) signals. The charge signals are directly input into an in-line charge converter with nominal selectable sensitivity of .1mV/ pC, 1.0mV/pC or 10mV/pC. In all input modes, the signal must be AC type signals, unless the DC coupling option is included in the unit.

3-11. RS-232

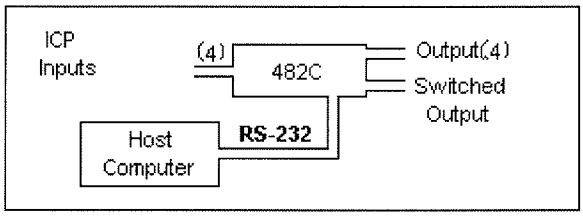


Figure 7 RS-232 Configuration

The RS-232 Interface provides serial control of the Model 482C. This may be accomplished through the use of a personal computer, dumb terminal, or handheld controller. The command format is based upon letter representations of the controllable options. This serial interface, set-up, and programming are described in Section 4.

3-12.1 Non-Volatile Memory

This feature keeps the programmed configurations stored when the unit is powered down. When the unit is turned on, all programmable features (e.g., gains, filter status, switched output settings, overload levels, integration level) active at last use are preserved. When the unit is powered down the non-volatile memory is updated with the current channel settings. The unit's non-volatile memory may be reset to the factory default settings by using the reset menu option.

3-13 Transducer Electronic Data Sheet (TEDS) Interface:

The TEDS sensors attach to the input connectors the same way a traditional ICP® sensor is attached to the 482C. The TEDS interface requires both the RS-232 or Ethernet computer interface option, and the input mode option. The digital control and input mode features automatically perform the TEDS read or write function. After the communication with the TEDS sensor is complete the input mode returns to the input mode (charge or ICP®) prior to the communication.

The current TEDS function will perform a read of the "raw" TEDS data and return the 32 bytes of TEDS sensor EEPROM data and the 8 byte Application register contents, if it was programmed, and returns the data in an ASCII Hex representation.

4-0. COMPUTER INTERFACE PROGRAMMING GUIDE (for RS-232 or Ethernet equipped units)

4-1. Introduction

Individual commands are subject to feature availability on the particular unit.
The RS-232 Interface enables the Model 482C to be fully controlled by a computer or handheld controller. With this interface, the unit is able to become part of a fully automated system.

4-2 RS-232

The RS-232 provides total control of the unit except for hardware RESET. The rest of the options described previously are computer-controllable.

4-3. RS-232 Host Set-Up

Before any serial interface is used to communicate with the host computer, a specific set-up must be followed. These parameters must be set for the host computer. The full list of parameters is shown below: (EOL = End of Line.)

Parameter	Setting
Transmission Rate	19,200 BPS (bits per second)
Parity	None
Number of data bits	8
Number of stop bits	1
Handshaking	None
Echo	None
Transmit EOL	Carriage Return and Line Feed, <CR><LF>
Receive EOL	Carriage Return and Line Feed, <CR><LF>

4-4. RS-232 Rear Panel Pinout Listing

Number of 9-Pin Connector	Function	Notes
1	N.C.	Not Connected
2	TXD	From 482C
3	RXD	To 482C
4	N.C.	Not Connected
5	Ground	Ground
6	N.C.	Not Connected
7	N.C.	Not Connected
8	N.C.	Not Connected
9	N.C.	Not Connected

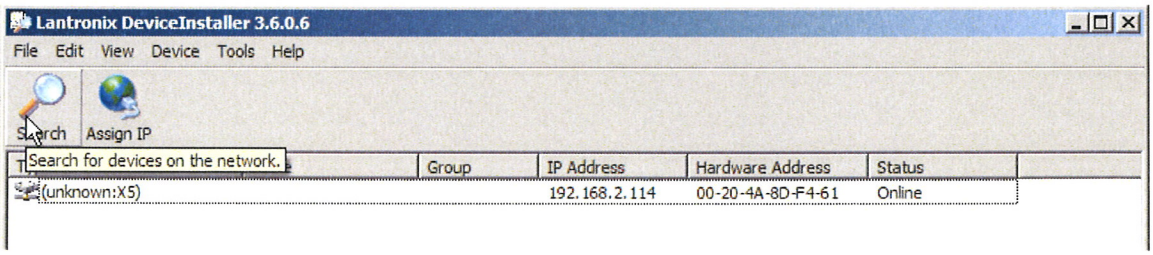
4-5. Ethernet Communication

If the 482 unit is equipped with the Ethernet option then the unit's IP address must be set up before any remote communication can commence.

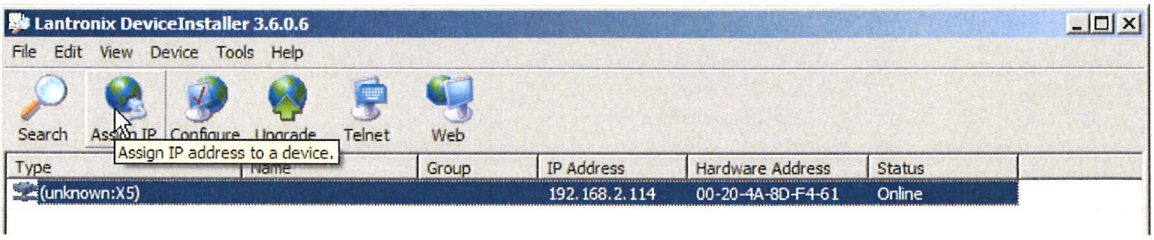
The steps to set the IP address of a 482 Unit are as follow:

- Connect, either directly with a crossover CAT5 cable or through a hub, to a single unit. This unit is presumed to have a Unit ID of 1,
- Set the IP address using an independent utility from Lantronix called DeviceInstaller™. To download the Lantronix DeviceInstaller™ application go to: http://www.lantronix.com/device-networking/utilities-tools/device-installer.html

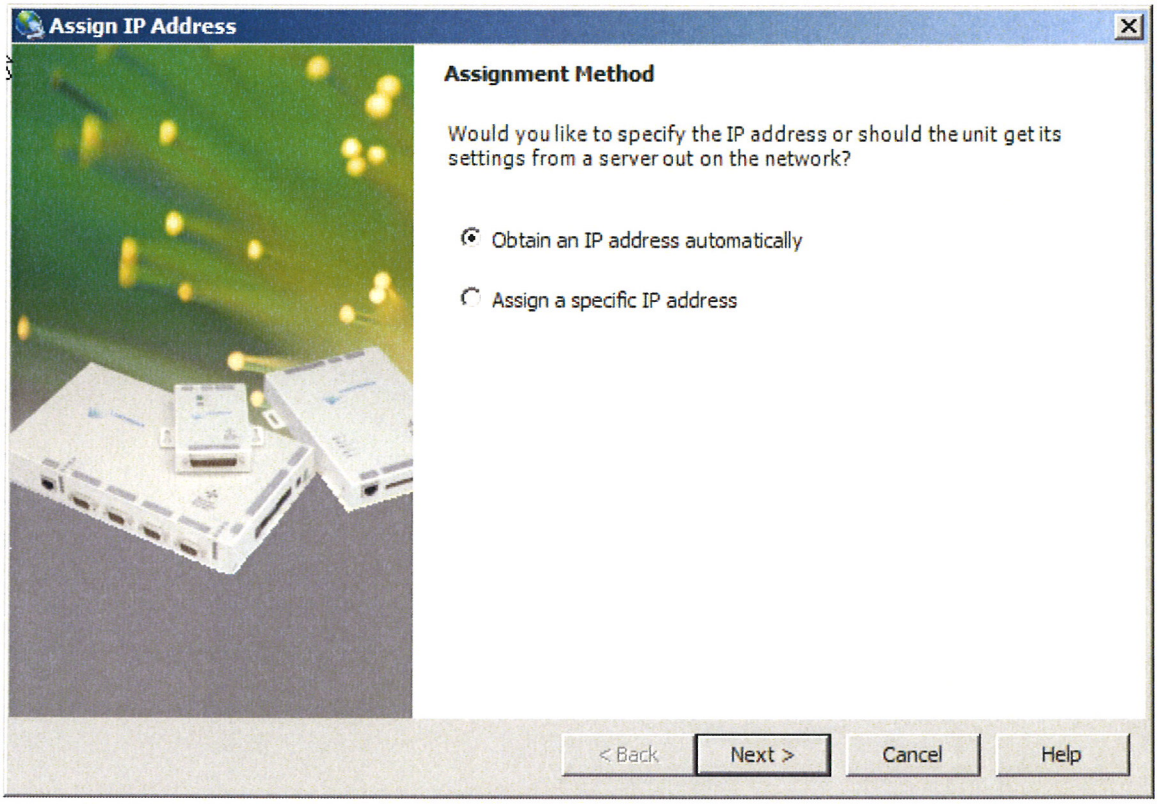
- After the DeviceInstaller™ application is installed, run it and the following screen will appear. Click on the Search icon and the program will search for the Ethernet device internal to the 482 unit. When found, as shown below, details about the device show in the list. You can verify it is the correct unit but comparing the Hardware (MAC) Address displayed to the one listed on the side of the 482 unit.



- Selecting an item from the list, shown below, highlights the item in the list and enables more icons.



- Select **Assign IP** and the following screen will appear. Select whether you want to assign a static IP address that is appropriate for your network or have it assigned from a network server. Subsequent steps are self-explanatory.



- Now you can use the assigned IP address to address the unit.

Important Note: The communication protocol requires a unit id as part of the command header. The unit id is not the IP address. To send commands to the unit Via Ethernet you must address the TCP-IP packets with the proper IP address and ensure the packet payload contains the correct Unit Id in the command header.

4-6. Model 482C Communication Guidelines

1) Data transfer from the host terminal to the unit must contain an ending delimiter of <CR><LF>.

Example: <CR><LF> -Carriage Return and Line feed. (In ASCII, <CR> is 13; <LF> is 10.)

2) The number of characters for any command string, from the first character to the <CR>, may not exceed 255.
3) Status request commands, i.e., commands ending with a "?", may only be sent within one transmission.
Example: 7:0:GAIN?<CR> <LF>
-Reads the gain setting of all channels.

4-7. Model 482C Unit Initialization Procedure

1) To begin, plug 9-pin female DSUB connector of given cable into RS-232 port of Model 482C. Plug the other end of the cable into the COM port of the terminal or computer.
2) Turn on power to Model 482C. The display or power indicator should light up to indicate the power is on.
3) With the terminal or computer that is set up to transmit data, according to the host set-up discussed in Section 3-3, send the command:

"1:0:LEDS=0" <CR><LF>

This command flashes the front panel LEDs three times.

4-8. Command Summary

The table below is a summary of the 482x command set. The 482 is highly configurable and, as such, Some commands may not be valid in all units. The 482x commands are sent and received from/to the host computer in ASCII text format.

Command	Type	Scope	Meaning
GAIN	R/W	Channel	Set or read gain
SENS	R/W	Channel	Sensor Sensitivity
FSCI	R/W	Channel	Expected Full Scale Input Value
FSCO	R/W	Channel	Full Scale Output
INPT	R/W	Channel	Input Signal Mode Selection
IEXC	R/W	Unit	Read/Adjust ICP® current setting
FLTR	R/W	Channel	Enable/disable input filters
OFLT	R/W	Channel	Enable/disable output filters
CLMP	R/W	Channel	Enable/disable Clamp
CPLG	R/W	Channel	Select AC or DC coupling
OSCL	R/W	Channel	Select Oscillator setting
RTED	R	Channel	Read TEDS data (DS2430A)
ALLC	R	Channel	Read majority of channel settings
RBIA	R	Unit	Measure Bias (returns all channels)
STUS	R	Unit	input fault / overload status, for all channels
UNIT	R	Unit	Read Unit Configuration information
UNID	R/W	Unit	Set Unit ID
LEDS	FCN	Unit	Front panel LED test function
RSET	FCN	Unit	Restores factory default channel settings
AUTR	FCN	Channel	Enable/disable auto-scaling function
SAVS	FCN	Unit	Saves the current settings to NVRAM

Command type definitions;

- R/W – the setting can be read from or written to the unit or channel.
- R – The information can only be read from the unit or channel.
- FCN – The command invokes a function in the unit.

4-9. Command Format

The 482x communication protocol incorporates the concept of 'Directed' and 'Global' commands at both the Unit and Channel level with the following characteristics;

- Unit or Channel numbers =0 are global commands that affect either all units or all channels of a particular unit or both.
- Directed commands that set a unit parameter are always acknowledged (ACK) with an ASCII message that indicates '<Unit#>:<CMD>:ok' if implemented with no errors or NAK with; <Unit#>:<CMD>:=<error#>' if an error was encountered.
- Directed commands that request a particular parameters setting (query) result in a query response being returned
- No response is ever given to a Global Unit command.

Command Format:

'Unit#:Ch#:Cmd[=|?]{<value1 >{,< value2 >}}{;Ch#:Cmd[=|?]{<value1>{,< value2>}}}\n\r

- Each message must be preceded by a Unit# & Channel# (both of which could be 0)
- Messages may contain multiple commands separated by a semicolon ';'.
- The second and subsequent commands in a message shall not contain a unit number but shall contain a channel number.
- Each command in a message will evoke a response message if one is warranted (not global)
- Query's ('?') can only be directed to one unit but if the channel=0 then each channel's setting will be returned in the order 0-MAXCHANNELS separated by a ':'

Command examples:

1:0:GAIN=100.2\r\n	unit 1,all channels gain set to 100.2
1:1:GAIN=100.2;2:GAIN=120.3\r\n	unit 1, channel 1 gain = 100.2; channel 2 gain = 120.3
1:3:GAIN=100.2;0:FLTR=1\r\n	unit 1, channel 3 gain = 100.2; all channel's filter = ON

General Query Response Format
Unit#:Cmd:Ch#=<value>{; Ch#=<value>}...>{; Ch#=<value>}...\r\n

Responses to a query with a channel number=0 will return the setting of each channel in a list separated by semicolons ';'.
If the target of the query is a unit setting (ex. current excitation) then the channel number returned is the 1st channel of the board that processed the command.

4-10 Multiple Board Models

Some 482x models (ex. 482M179) have multiple main boards installed which will appear as a contiguous set of channels, when in fact, physically, they are completely separate and operate somewhat independently. This presents some interesting communication challenges. For instance, a global channel command to set 8 channels on a 482M179 unit will be handled by each internal board simultaneously. However only the board with the channels designated as 1-4 will ACK the command, the other board will remain silent.
Likewise, a global Query command will be responded to by the channel 1-4 board but will be ignored by the channel 5-8 board. However, In order to facilitate efficient communications with the second board, the concept of a second unit address was introduced. A user's control application can direct global channel setting queries to the second board of a unit by addressing the query to the secondary unit address of the unit. This secondary unit address is defined to be the normal unit address ***plus 128*** (i.e. if a units address is 1 then the 2nd board's address would be 129)

4-11. Commands

GAIN

SET GAIN: This command sets the programmable gain of a channel. The gain may be set to x1, x10, or x100 for the variable gain option or to any setting within the 0.1 to 200 range for the incremental option.

Setting:
The amplifier gain can be set directly by sending a Gain command:

1:0:GAIN=100.2\r\n (unit 1,all channels gain set to 100.2)

When a channels gain is set directly the unit will adjust the FSI parameter of the gain equation using the following equation; FSI = (((FSO*1000)/Gain)/Sens) to ensure it remains valid.

Setting Response: 1:GAIN:ok

Query:
The Gain query returns all of the parameters used to determine it in a single response

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:=Gain:SENS:FSO:FSI;
Query: 1:5:GAIN?
Response: 1:GAIN:5= 5.0: 10.0: 10.0: 200.0;

Global Gain Query: 1:0:GAIN?
Global Gain Response: **1:GAIN:1**= 5.0: 10.0: 10.0: 200.0;**2**= 5.0: 10.0: 10.0: 200.0;**3**= 5.0: 10.0: 10.0: 200.0;**4**= 5.0: 10.0: 10.0: 200.0;

SENS

The SENS command provides a mechanism to have the transducer Sensitivity influence the Gain setting of the channel. Channel Gain is calculated using the equation;
Gain = FSO*1000/(FSI*SENS). If a Sensitivity is entered that caused the gain to exceed the amplifiers capability the FSI component will be adjusted to keep the equation valid.

Setting:
1:0:SENS=20.2\r\n ***(unit 1,all channels transducer sensitivity set to 20.2)***
Setting Response: 1:SENS:ok

Query:
The Sens query returns the channels transducer sensitivity

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= SENS;
Query: 1:1:SENS?
Response: 1:SENS:1= 6.0;

Global Gain Query: 1:0:SENS?
Global Gain Response: 1:SENS:**1**= 6.0;**2**= 10.0;**3**= 10.0;**4**= 10.0;

FSCI

The FSCI command provides a scaling mechanism to automatically set the gain based on a known input level (in EU) and what output level (in Volts) you would like that Full Scale input level to be represented by. For instance 1000g's = 10Volts. These 2 values along with the transducer sensitivity set the gain. Channel Gain is calculated using the equation: Gain = FSO*1000/(FSI*SENS).

Setting:
1:1:FSCI=1000.000\r\n ***(unit 1, channel 1 FSI set to 1000.0)***
Setting Response: 1:FSCI:ok

Query:
The FSCI query returns the channels Full Scale Input value in engineering units

Query Format: Unit#:Ch#:CMD?

Response format: Unit#:Cmd:Ch#:= <fsci>;
Query: 1:1: FSCI?
Response: 1:FSCI:1=1000.0;

Global FSCI Query: 1:0:FSCI?
Global FSCI Response: 1:FSCI:1=1000.0;2=1000.0;3=1000.0;4=1000.0;

FSCO

The FSCO command provides a scaling mechanism to automatically set the gain based on a known input level (in EU) and what output level (in Volts) you would like that Full Scale input level to be represented by. For instance 1000g's = 10Volts. These 2 values along with the transducer sensitivity set the gain. Channel Gain is calculated using the equation:
Gain = FSO*1000/(FSI*SENS).

Setting:

1:1:FSCO=10.000\r\n ***(unit 1, channel 1 FSI set to 10.0)***

Setting Response: 1:FSCO:ok

Query:

The FSCO query returns the channels Full Scale Output Value in volts

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <fsci>;
Query: 1:1: FSCO?
Response: 1:FSCO:1=10.0;

Global FSCO Query: 1:0:FSCO?
Global FSCO Response: 1:FSCO:1=10.0;2=10.0;3=10.0;4=10.0;

INPT

The INPT command sets the input mode for a given channel. The mode selection is sent as an integer value. The possible input modes and their associated values are:

- CHARGE 0
- VOLTAGE 1
- ICP 2
- Multi-Charge option of 10mV/pc sensitivity 3
- Multi-Charge option of 1.0mV/pc sensitivity 4
- Multi-Charge option of 0.1mV/pc sensitivity 5
- Isolated ICP 6
- Isolated Multi-Charge option of 10mV/pc sensitivity 7
- Isolated Multi-Charge option of 1.0mV/pc sensitivity 8
- Isolated Multi-Charge option of 0.1mV/pc sensitivity 9

NOTE: Not all input options are valid for all 482 models. Check your models specification for applicable input options

Setting:

1:1:INPT= 2\r\n (unit 1, channel 1 input mode set to ICP)

Setting Response: 1:INPT:ok

Query:

The INPT query returns the channels input mode selection

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <inpt>;
Query: 1:1:INPT?
Response: 1:INPT:1= 2;

Global INPT Query: 1:0:INPT?
Global INPT Response: 1:INPT:1= 2.0;2= 2.0;3= 2.0;4= 2.0;

IEXC

The IEXC command sets the current excitation level for ICP mode. This is a UNIT setting (i.e. all channels will get set to this value) as a result, if the channel was in Voltage mode and this value gets set > 0, then the channel's input mode will revert to ICP mode. Likewise if the channel is in ICP mode and current excitation is turned off (0) then the channel input mode changes to Voltage.
The current excitation value is sent as an integer value from 0 (off) to 20mA.

Setting:

1:1:IEXC= 4\r\n (unit 1, channel 1 but all channels are set to 4mA)

Setting Response: 1:IEXC:ok

Query:

The IEXC query returns the units excitation value.

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <IEXC>;
Query: 1:2:IEXC?
Response: 1:IEXC:1=4;

Note: Unit setting responses return the lowest channel number of the board that is responding. In the example above the query requested channel 2's setting but got channel 1 in response because all channels are the same.

Global IEXC Query: 1:0: IEXC?
Global IEXC Response: 1:IEXC:1=4;

FLTR

The FLTR command enables or disables the Input Filter .
The Input Filter value is sent as an integer value of either 0 -Disable or 1-Enable.

Setting:

2:1:FLTR= 1\r\n (unit 2, channel 1, Input Filter Enabled)

Setting Response: 2: FLTR:ok

Query:

The FLTR query returns the channels Input Filter selection

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <0|1>;
Query: 2:1: FLTR?
Response: 2:FLTR:1=1;

Global FLTR Query: 1:0: FLTR?

Global FLTR Response: 1:FLTR:1=1;2=0;3=0;4=0;

OFLT

The OFLT command enables or disables the Output Filter.
The Output Filter value is sent as an integer value of either 0 -Disable or 1-Enable.

Setting:
2:1:OFLT= 1\r\n (unit 2, channel 1, Output Filter Enabled)
Setting Response: 2: OFLT:ok

Query:
The FLTR query returns the channels Output Filter.
Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <0|1>;
Query: 2:1: OFLT?
Response: 2: OFLT:1=1;

Global OFLT Query: 1:0: OFLT?
Global OFLT Response: 1: OFLT:1=1;2=0;3=0;4=0;

CLMP

The CLMP command enables or disables the Clamp feature. When Clamp is disabled the channel is 'Buffered'
The Clamp value is sent as an integer value of either 0 –Disable (buffered) or 1-Enable.

Setting:
2:1:CLMP= 1\r\n (unit 2, channel 1, Clamp Enabled)
Setting Response: 2: CLMP:ok

Query:
The CLMP query returns the channels Clamp setting.
Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <0|1>;
Query: 1:1:CLMP?
Response: 1:CLMP:1=0;

Global OFLT Query: 1:0:CLMP?
Global OFLT Response: 1:CLMP:1=0;2=0;3=0;4=0;

CLPG

The CLPG command sets the channel coupling to AC or DC mode and allows further manual refinement if DC mode is selected. This feature is only available in units with a variable gain option (x1, x10, x100).

DC Coupling

The DC coupling option will attempt to remove a DC offset from the input signal by reading the bias and using an internal DAC to zero it. This function will be performed when the setting is changed from AC to DC. If the unit was in DC then the previous value will be used. Additionally, a user can further refine the zero process by manually adjusting the DAC either up or down using the DC ADJ+ or DC ADJ- options. To exit the adjustment process, send a DC Exit command. The DC Exit command sets the channel to DC mode.

NOTE: The value that is used to zero a channel will be saved in non-volatile memory when the unit is powered down and be reinstated upon power-up.

The coupling value is sent as an integer value: 0 –AC, 1-DC, 2-DC ADJ +, 3-DC ADJ -, 4-DC ADJ Exit.

Setting:

1:1:CLPG= 1\r\n (unit 1, channel 1, DC Coupled)

Setting Response: 2: CLPG:ok

Query:

The CLPG query returns the channels coupling setting.

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <0|1>;
Query: 1:1:CLPG?
Response: 1:CPLG:1=0;

Global Query: 1:0:CPLG?
Global Response: 1:CPLG:1=0;2=0;3=0;4=0;

OSCL

The OSCL command selects the Internal Reference Oscillator setting. When either the 100 or 1k Hz setting is selected the channel is forced into a charge mode, if it isn't set that way already, and an internal 100pC signal is generated. This signal is then converted to a voltage based on the selected charge sensitivity (1mV/pC if any ICP setting was selected) after which the channels gain is applied to provide an internal cal signal.
This feature is only available in units with an Isolation module.

The OSCL value is sent as an integer value of either 0 –Disable, 1-1000 Hz Enable, 2-100 Hz Enable

Setting:

1:1: OSCL= 1\r\n (unit 1, channel 1, Oscillator=1 kHz)

Setting Response: 1:OSCL:ok

Query:

The OSCL query returns the channels Internal Reference Oscillator setting.

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <0|1>;
Query: 1:1: OSCL?
Response: 1: OSCL:1=0;

Global OFLT Query: 1:0:OSCL?
Global OFLT Response: 1:OSCL:1=1;2=0;3=0;4=0;

RTED

The RTED query returns the TEDS information that is stored in the sensor or other, TEDS capable, in-line module attached to a specific channel. The 482x devices are 1451.4 compliant in that they will read the DS2430A Application Register Status to see if it indicates the 64 bit Application Register has data in it. If so it will read the Application register contents and return it followed by the contents of the TEDS EEPROM.

NOTE: The 1st byte of the DS2430A EEPROM data should contain the checksum of both the Application Register contents and the EEPROM contents if the TEDS is 1451.4 compliant. No attempt is made to validate or interpret the TEDS data.

Setting:
N/A – Command is Read only

Query:
The RTED query returns the TEDS data associated with the specified channel. This command must be directed to a specific channel. It will return an indicator that specifies if the DS2430A Application register has been used to store the basic TEDS data and up to 40 bytes in ASCII Hex format (8 bytes of Application register content if it was burned and 32 bytes of the EEPROM content).

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#= <APP Reg Status>:<APP Reg Contents (8 bytes if APP Reg Status=1)><DS2430A EEPROM Contents (32 bytes)>
Where: APP Reg Status=1 if the APP Register had data or 0 if it did not

Query: 1:1:RTED?
Response: (for TEDS chip on channel 1 with valid app register data)
1:RTED:1=1:**168010a009750000**12648016a88ae8e112801f2000f60ec4046dd18737f3206a380555e765390800

ALLC

The ALLC command is used to read several channel settings at once.

Setting:
N/A – Command is Read only

Query:
This command must be a directed command use of the global channel indicator is not allowed.

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= GAIN:<Gain value>; SENS:< SENS value>; FSCI:< FSCI value>; FSCO:< FSCO value>; INPT:< INPT value>; FLTR:< FLTR value>; IEXC:< IEXC value>; OFLT:< OFLT value>; CLMP:< CLMP value>; OSCL:< OSCL value>;
Query: 1:1:ALLC??
Response: 1:ALLC:1=GAIN: 10.0;SENS: 10.0;FSCI: 100.0;FSCO: 10.0;INPT: 2.0;FLTR:1;IEXC:4;OFLT:0;CPLG:2;CLMP:0;OSCL:1;

RBIA

The RBIA command is used to read all channels Bias Levels.

Setting:

N/A – Command is Read only

Query:
This command is a global command and will return all channel bias readings regardless of the channel id in the command.

Query Format: Unit#:Ch#:RBIA?
Response format: Unit#:Cmd:Ch#:=CH1 bias;... CHn#:=CHn bias;
Query: 1:1:RBIA?
Query Response: 1:RBIA:1= 25.5;2= 25.5;3= 25.5;4= 25.5;

STUS

The STUS command is used to read the unit and all channel status indicators.

Setting:
N/A – Command is Read only

Query:
This command is a global command and will return all channel bias readings regardless of the channel id in the command.

Query Format: Unit#:Ch#:STUS?
Response format: Unit#:Cmd:Ch#:<unit status bit map>;<CH1 status bit map>;...;<CHn status bit map>;
Query: 1:1:STUS?
Query Response: 1:STUS:1:0;1;5;5;5;

Where :
Unit Bit 0 = 1= BAD EEPROM read for channel settings on power up
Unit Bit 1 = 1= BAD EEPROM read for Unit options on power up
Unit Bit 2 = 1= BAD EEPROM read for cal factors on power up
For Unit bit map 0=no errors
Channel Bit 0= Short input fault (0=Fault; 1 = no fault)
Channel Bit 1= Open input fault (0=Fault; 1 = no fault)
Channel Bit 2= Overload condition (0=Overload; 1 = no Overload)
For channel bit map 7=no errors

UNIT

Query:
The UNIT query returns the unit configuration information which includes the installed options, unit number, Model id and starting channel number
Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Model string:Firmware Ver string: Serial Number:Cal Date:Filter Corner: Unit#:#channels:Starting Ch#: Gain Option byte, Input Option Byte, Filter option byte,Misc1 option byte,Misc2 option byte<cr><lf>
Query: 1:1:UNIT?

Response: 1:UNIT:482C\s\s\s\s\s\s\s\s\s\s\s\s:FW\sVer\s1.0:12345:09-27-2006:10.000:1:4:1:16,37,1,143,0\r\n

Model & Firmware version strings are self-explanatory. Following are:
Serial Number (U16): Cal Date (10 character string): Filter corner (kHz)
Unit Id: Number of Channels: Starting Channel Number
Followed by the option bytes:

Gain Options		
OPT_GAIN_x1	0x01	Fixed x1
OPT_GAIN_x5	0x02	Fixed x5
OPT_GAIN_x10	0x04	Fixed x10
OPT_GAIN_VAR	0x08	Variable Fixed (x1,x10,x100)
OPT_GAIN_INC	0x10	incremental .1-200
OPT_GAIN_FINE2h	0x20	Fine Gain .0025-200
OPT_GAIN_FINE1k	0x40	Fine Gain .0025-1000
Input Options		
OPT_INP_ALLCHG	0x01	All charge
OPT_INP_ICPVOLTCHG	0x02	ICP|VOLT|CHG
OPT_INP_ICPVOLT	0x04	ICP|VOLT
OPT_INP_INTCAL	0x08	Internal Cal
OPT_INP_EXTCAL	0x10	External Cal
OPT_INP_ISOLATION	0x20	Isolation
Filter Options		
OPT_FILTER_IN	0x01	Input filter (time constant)
OPT_FILTER_OUT	0x02	Output filter
OPT_FILTER_FIXLP	0x04	Fixed LP filter
OPT_FILTER_PGMELP	0x08	Prgm LP Elliptical filter
OPT_FILTER_PGMBTR	0x10	Prgm LP Butterworth filter
Miscellaneous Options		
OPT_MISC_COUPLING	0x01	AC/DC coupling
OPT_MISC_CLAMP	0x02	Clamp
OPT_MISC_TEDS	0x04	TEDS
OPT_MISC_IEXC	0x08	current excitation
OPT_MISC_SINTG	0x10	Single Integration
OPT_MISC_DINTG	0x20	Double Integration
OPT_MISC_MUX	0x40	Mux /Switch-out
OPT_MISC_DISPLAY	0x80	FP Display

Future Use
Currently undefined and available for expansion

UNID

The UNID command is used to set the units ID number. The Unit Id number is critical to remote communications since it indicates to the unit which commands it should accept and respond to. Units are typically shipped with a unit id of 1. If more than one unit is in the system and they will be communicated with remotely the user must set a unique id in each unit. This can be done through the front panel interface, if one exists, or by connecting to each unit individually and sending this command.

Setting:

1:1:UNID= 2\r\n (unit 1, channel 1, New ID=2)

Setting Response: 2:UNID:ok
NOTE: The new Unit Id becomes effective immediately

Query:
This command can be sent as a query but its usefulness is marginal being as it is a directed command and as such it is necessary to include the Unit Id in the command and the response will simply validate the commands unit id parameter.

Query Format: Unit#:Ch#:UNID?
Response format: Unit#:Cmd:Ch#:=unit id
Query: 2:1:UNID?
Query Response: 2:UNID:1=2;

LEDS

The LEDS command is used to test the LED functionality of the front panel. When sent as a command the LED's on the front panel will flash 3 times. This command invokes a function and therefore has no query capability.

Setting:
2:1:LEDS= 0\r\n (unit 2, channel 1, Any value)

Setting Response: 2:LEDS:ok

Query:
N/A

RSET

The RSET command is used to restore the factory default channel settings. This command invokes a function and therefore has no query capability.

Setting:
2:1:RSET = 0\r\n (unit 2, channel 1, Any value)

Setting Response: 2:RSET:ok

Query:
N/A

The factory Defaults are:

- Gain= 1.0
- Sensitivity=10.0
- Full Scale input= 1000.0
- Full Scale output= 10.0
- Input Mode = ICP
- Input Filter=Disabled
- Current excitation=4.0mA
- Output Filter=Disabled
- Coupling =AC
- Clamp=OFF
- Internal Reference Oscillator=OFF

AUTR

The AUTR command invokes the Auto-Scaling function. With this command, the programmable gain is adjusted to give the largest signal amplitude output without causing an overload condition. The signals are checked internally; if there is an overload, the signal is stepped down and checked again.
Possible settings are: **0=off,1-on,2=immediate**. The Immediate option causes the auto scale function to execute one time and then turns off the function automatically. When Auto scale is 'ON' the unit will continue to invoke the function until the function is turned OFF with a subsequent command.

Setting:

2:1:AUTR =1\r\n ***(unit 2, channel 1, Auto Scaling ON)***

Setting Response: 2:AUTR:ok

Query:

Query Format: Unit#:Ch#: AUTR?
Response format: Unit#:Cmd:Ch#:=current state (0=off,1-on,2=immediate)
Query: 2:1:AUTR?
Query Response: 2:AUTR:1=0;

SAVS

The SAVS command is used to store the current channel setting as the default settings that will be restored on power up. This command invokes a function and therefore has no query capability.

Setting:

2:1:SAVS = 0\r\n(unit 2, channel 1, Any value)

Setting Response: 2:SAVS:ok

Query:
N/A

Communication Responses

Typically the unit will return **<Unit>:<Cmd String>:OK** when the command is successful. Errors are indicated with negative numbers. The unit may return one of the following:

<Unit>:<Cmd String>:OK<CR> <LF>
Represents that the last command was entered in the correct format and was performed properly.

<Unit>:<Cmd String>:-1<CR> <LF>
Option Error. The unit is not equipped with the option necessary to implement the command sent

<Unit>:<Cmd String>:-2<CR> <LF>
Channel Error. The channel number in the command is invalid.

<Unit>:<Cmd String>:-3<CR> <LF>
Command Error. The command is not recognized.

<Unit>:<Cmd String>:-4<CR> <LF>
Unit Error. The unit number in the command is invalid.

<Unit>:<Cmd String>:-5<CR> <LF>

Unit Error. The function invoked by the command encountered an error or a query only command (ex. RBIA) was sent as a setting.

<Unit>:<Cmd String>:-6<CR> <LF>

Command Parameter Error. A channel setting parameter was found to be out of range.

SIGNAL CONDITIONER

Model 482C

GENERAL OPERATION MANUAL

For powering ICP® , and charge sensors, this signal conditioner provides an effective method for managing small numbers of sensor channels. A simple command set, entered through industry standard interface, allows the user to generate powerful application-specific programs to automate system testing.

The 482C is available with many different options from PCB. This manual describes the most basic functions, as well as all of the options that are available. Please note at the beginning of the section if the function being described is standard, or an option.

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1-0. INTRODUCTION AND SPECIFICATIONS

1-1. Introduction: Safety Considerations

WARNING SYMBOLS AND TERMS

The following symbols and terms may be found on the equipment described in this manual.

This symbol on the unit indicates that the user should refer to the operating instructions located in the manual.

This symbol on the unit indicates that high voltage may be present. Use standard safety precautions to avoid personal contact with this voltage.

This symbol indicates that the test fixture, Model 482C, must be connected to earth ground via the power cord.

The **WARNING** heading used in this manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **Caution** heading used in this manual explains hazards that could damage the instrument.

WARNING 1: *The power supply/signal conditioner should not be opened by anyone other than qualified service personnel.* This product is intended for service by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid injury.

WARNING 2: This equipment is designed with user safety in mind; however, the protection provided by the equipment may be impaired if the equipment is used in a manner not specified by PCB Piezotronics, Inc.

Caution 1: *Cables can kill your equipment.* High voltage ElectroStatic Discharge (ESD) can damage electrical devices. Similar to a capacitor, a cable can hold a charge caused by triboelectric transfer, such as that which occurs in the following:

- Laying on and moving across a rug.
- Any movement through air.
- The action of rolling out a cable.
- Contact to a non-grounded person

The solution for product safety: 1) Connect the cables only with the AC power off. 2) Temporarily "short" the end of the cable before attaching it to any signal input or output.

Caution 2: *ESD considerations should be made prior to performing any internal adjustments on the equipment.* Any piece of electronic equipment is vulnerable to ESD when opened for adjustments. Internal adjustments should therefore be done ONLY at an ESD-safe work area. Many products have ESD protection, but the level of protection may be exceeded by extremely high voltage that is typically present in normal situations.

EQUIPMENT RATINGS

For complete specifications, please refer to the enclosed Specification Sheet. This equipment operates optimally at +32 to +120°F (0 to +50°C), in an environment having <85% relative humidity. Its line power frequency range is 50/60 Hz.

The Model 482C requires 10-15 VDC with 500 mA to operate. In turn, it supplies 24 VDC, 2 to 20 mA excitation voltage to connected ICP® or in-line charge converters sensors. The unit gets its power via AC power adaptor, 12 VDC battery pack, 28 VDC or a car adapter which plugs into the receptacle on the rear panel.

1-2. Model 482C System Description, Basic Configuration

The Model 482C is a basic one or four channel signal conditioning system designed to interface measurement signals to readout or recording devices. The unit also serves to provide excitation power for ICP® and in-line charge converters type sensors.

The following are features that come standard on every 482C:

- 12-bit accuracy signal conditioning
- Unity gain
- Input fault and overload LED
- Variable ICP® source current, 0 to 20 mA
- Illuminator lights and a power button on the front panel
- Rear panel BNC input/output connectors
- Non-Volatile Memory

Model 482C is also fully configurable from the factory with the following options:

- RS-232 Interface
- Adjustable Gain: x1 x10 x100 or Incremental .1 – 200
- Normalized Output (requires incremental gain)
- AC, DC or Switchable input coupling
- Voltage sensor input
- Fixed low pass fourth-order filter at output, with a variety of cutoff frequencies available
- Selectable ICP® or charge mode sensor input, 0.1 mV/pC or,
- Selectable ICP® or charge mode sensor input, 1.0 mV/pC or,
- Selectable ICP® or charge mode sensor input, 10 mV/pC
- Clamped Output
- Capable of reading TEDS
- Front panel keypad control/display
- Fixed low pass 2nd order filter at input

1-2.1 Model 482C ICP® Input/Output Mode, All Models

The Model 482C contains a regulated 24 VDC power supply that provides constant current for up to 4 individual channels. Both the output and input connections utilize BNC connectors and are brought out through the rear panel.

1-3. Block Diagram

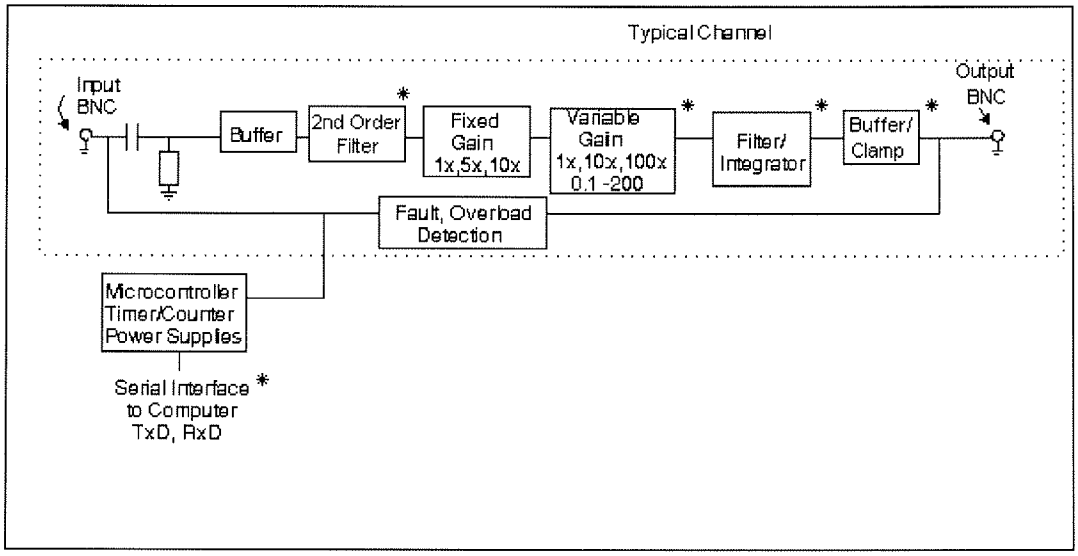


Figure 1 Typical Block Diagram of Model 482C (*=option)

1-4 Installation

Model 482C comes in the form of a standard box. The box should be located in such a way as to allow convenient access to the power outlet for disconnect purposes. Since these units have low power consumption, they can be located in confined environments.

NOTE: Specific installation is available; contact PCB

1-4.1. Grounding Techniques

Integrating the Model 482C unit into an application that links the outputs to other test equipment powered by line voltages may lead to errors or loss of signal-to-noise ratio due to ground loops. The evidence of ground loops is easily seen whenever the fundamental frequency (50 or 60 Hz) or a multiple of the fundamental frequency is present in the system when the sensors are "at rest." In order to maintain the operating specification of noise and reduce the effects of line interference, proper grounding techniques should be used. The following procedure may be helpful:

1. Make sure the signal ground lines of all equipment are tied together. The signal grounds of the channels are typically tied together via the case of the input and output BNC connectors. The individual channels of the Model 482C have their signal ground line tied together internally at the power supply.

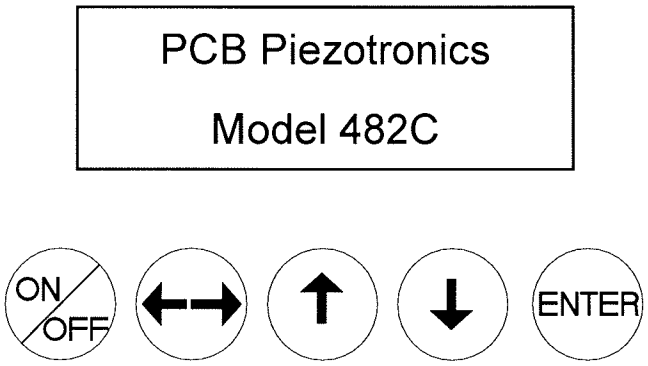
2. Insure that the sensor does not pick up line noise from the body under test. The case of the sensor should be isolated from the body under (ground) using an isolation pad. The isolation pad breaks the loop formed by the signal path of the sensor to the Model 482C and the return (ground) from the Model 482C back to the sensor.

3. Make sure that all equipment signal grounds of the test system are tied to the Earth ground at a single point and the connections linking the equipment ground are made using a wire that can provide a very low impedance connection.

1-4.2 Quick Set-up Instructions

1-4.2a Front Panel Introduction

The following illustration shows the front panel module as it appears on the Model 482C.



▼ This button is used to scroll DOWN through the options in the menus. In the submenus, this button can be used to change the channel and increments.

▲ This button is used to scroll UP through the options in the menus. In the submenus, this button can be used to change the channel and increments.

◄ ► This button moves you in the left / right direction through the menus and submenus.

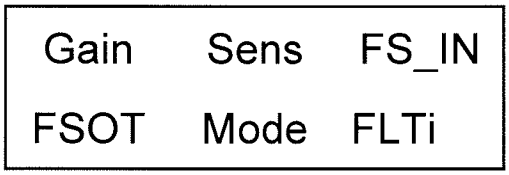
ENTER: This button applies the setting of the option just set, while exiting the user out of the submenu.

NOTE: Please refer to section 1-4.1b and 1-4.2c for instructions on how to set the mode and gain options. The settings for these options should be considered before unit is used to collect data

NOTE: In the Submenus a flashing cursor represents a menu that will accept user input. A non- flashing cursor represents a status menu, no input needed.

1-4.2b Mode Option

The mode option lets the user switch between ICP®, voltage or charge modes. The factory default for all channels is ICP®. To change the mode select the Mode option from the main menu use the down ↓ arrow button to scroll down and the left / right ←→ button until the cursor is over the Mode option, and the hit ENTER.



The submenu will appear. Choose the channel you wish to change by using the up ↑ or down ↓ arrows. Once that is done use the left / right ←→ button to move the cursor over to the Mode column. To change the Mode, use either the up ↑ or down ↓ arrow to scroll through the options. You can set the channel to be in either ICP®, voltage or charge mode. Once you have it set, you can either scroll back to the channel column; to change the mode on another channel; or hit ENTER to save the changes.

Ex: If you want to change channel 2 to be in Charge mode you would perform the following steps:

Scroll and select Mode from the main menu, and hit enter. Once in the submenu, the flashing cursor will be in the channel column, hit the up ↑ arrow button until the channel column reads 2

Chan	Input Type
2	ICP

Hit the left / right ←→ arrow key once so that the cursor is over the Mode column. Use the up ↑ or down ↓ arrow keys until the mode says charge.

Chan	Input Type
2	CHARGE

Once you have hit enter, your changes will be saved.

NOTE: To make a global change (set all the channels to the same mode) set the channel to ALL.

1-4.2c Programmable Gain Option

To enter the submenu for the variable gain option, place the cursor over the word "Gain" in the main menu. This is shown as:

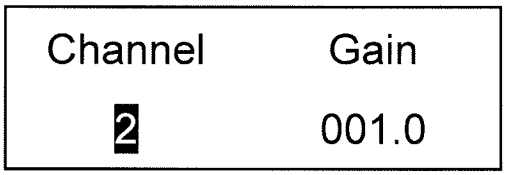
Gain	Sens	FS_IN
FSOT	Mode	FLTi

By pressing the ENTER button, the submenu for changing the gain of any channel appears on the display. The submenu pertaining to the "Gain" selection appears as:

Channel	Gain
1	001.0

Example: To set the gain of Channel 2 to x10

The flashing cursor appears over the channel selection. Choose the channel you wish to change by using the up↑ or ↓ arrows. Once you have selected the channel, use the left/right ←→ arrow key to move the flashing cursor over to the gain column.



To change the gain, use the up ↑ and down ↓ arrow keys to scroll through the options. If your unit has decimal gain you may choose between x1, x10 or x100. If your unit has incremental gain you can choose between .1 and 200.0 by using the left/right ←→ arrow key to move the flashing cursor over any digit in the gain column to select an appropriate value In this example, a gain of 10 is selected; (see example below). As with all setting changes, the actual gain internal to the unit is changed when the 'ENTER' button is pushed.

To set the next channel, press the left right ←→ arrow key to resume channel control, then press the up↑ or down ↓ arrow keys to select a different channel. Continue making selections with the directional keys until all desired channels are set, then press the ENTER key to return to the option menu.

NOTE: To make a global change (set all the channels to the same gain) set the channel to ALL.

1-5. Operation: Standard AC Line

Plug the adapter into a 120V/60 Hz or 230V/50 Hz power source and press the "ON/OFF" button.

1-5.1 Using the Power Adapter

When using a power adapter to power the unit, make sure to observe the correct pinout, as indicated on the rear panel of the unit.

CAUTION: Refer to the rear panel for proper input voltage and currents.

1-6. Maintenance and Repair

It is not recommended that the customer attempt repair of the Model 482C in the field. Should trouble occur, contact the factory for assistance. If the unit becomes dusty and dirty, it may be wiped off with a soft cloth.

2-0. FRONT PANEL MODULE CONTROL

2-1. Introduction

The Model 482C is equipped with the capability of controlling functions through the front panel module. This module consists of a display and five (5) push buttons. The display shows various menus in which all of the available options are given. The user may scroll through the menu, and choose any option to change the settings.

2-2. Unit Initialization

Upon pressing the ON/OFF button, the unit will turn on and display the following:

PCB 482C
FW Ver n.n

The unit is initialized, with the factory default settings.

NOTE: Reference Section 4-10 for memory default settings.

2-3. Main Menu Format

Initially, pressing any button will cause the first two menu lines to be displayed and the cursor will blink on the 'Gain' option.

Gain	Sens	FS_IN
FSOT	Mode	FLTi

The cursor may be moved around the main menu by using the arrow keys. To show the other selections of the main menu, press the down ↓ arrow key. This action scrolls vertically to the subsequent lines on the menu. Theses lines are shown below.

ICP?	Auto	FLTo
Coupl	Clmp	Bias
Oscl	Unit	Reset
Disp	LEDS	Ver?

Pressing the down ↓ arrow key button once again shows:

2-4. Submenu Format and Command Selections

Please review the options that your unit has and refer to the proper sections.

1) Gain Options:

If the Incremental Gain Option is installed then the 482C has the ability to automatically adjust the gain of each channel based on three or four other values. These values are; the Sensitivity of the sensor, the Full Scale value of the input (FSI) in engineering units (g's for instance), The Full Scale Output (FSO) of the amplifier expressed in Volts (this is the output that a signal at an FSI level will produce). The fourth value, Charge Converter Sensitivity, is required if the unit has the Multiple Charge Sensitivity Input Mode options installed, and one of the Charge options is selected. The amplifier will always force the gain equation to be true by adjusting either the gain, if one of the FSI, FSO, SENS or Charge Mode inputs changes, or FSI if the Gain is set directly. The Gain equation is as follows:

Gain=(FSO *1000)/(FSI*SENS*Charge SENS (if applicable)).

If the Incremental Gain Option is installed then the SENS, FS_IN and FSOT settings described below are applicable, If the variable gain option (x1, x10, x100) or a fixed gain option is installed then these settings do not apply.

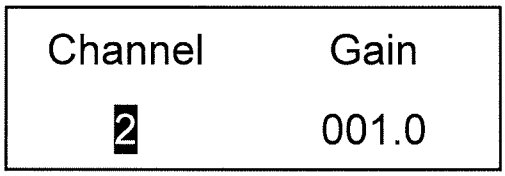
Setting the Gain:
To enter the submenu for the variable gain option, place the cursor over the word "Gain" in the main menu. This is shown as:

Gain	Sens	FS_IN
FSOT	Mode	FLTi

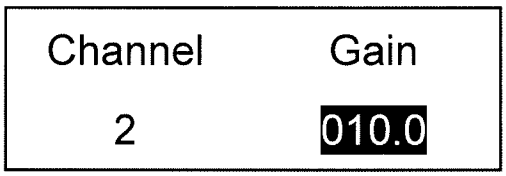
By pressing the ENTER button, the submenu for changing the gain of any channel appears on the display. The submenu pertaining to the "Gain" selection appears as:

Channel	Gain
1	001.0

Example: To set the gain of Channel 2 to x10
The flashing cursor appears over the channel selection. Choose the channel you wish to change by using the up↑ or ↓ arrows. Once you have selected the channel, use the left/right ←→ arrow key to move the flashing cursor over to the gain column.



To change the gain, use the up ↑ and down ↓ arrow keys to scroll through the options. If your unit has decimal gain you may choose between x1, x10 or x100. If your unit has incremental gain you can choose between .1 and 200.0 by using the left/right ←→ arrow key to move the flashing cursor over any digit in the gain column to select an appropriate value In this example, a gain of 10 is selected; (see example below). As with all setting changes, the actual gain internal to the unit is changed when the 'ENTER' button is pushed.

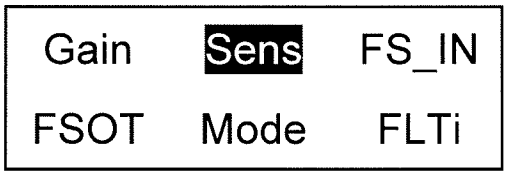


To set the next channel, press the left arrow key to resume channel control, then press the up ↑ or down ↓ arrow keys to select a different channel. Continue making selections with the directional keys until all desired channels are set, then press the ENTER key to return to the option menu.

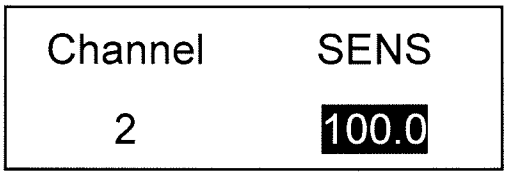
NOTE: To do a global change (set all the channels to the same gain) set the channel to ALL.

2) Sensitivity Value (Valid only if the Incremental Gain (0.1 –200.0 is also installed):

Entering a Sensitivity value will cause the gain of the unit to be changed based on the equation shown above. Sensitivity is set in the same way that the incremental Gain value is set, using the left/right ←→ arrow key to move the flashing cursor over any digit in the SENS column to select an appropriate value As with all setting changes, the actual gain internal to the unit is changed when the 'ENTER' button is pushed.



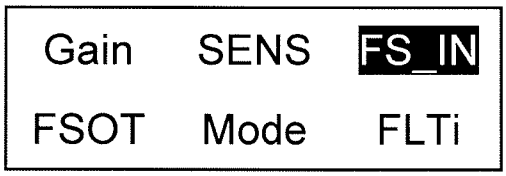
The sub-menu of the "SENS" selection shows the current value for sensor sensitivity (assumed to be mV/EU):



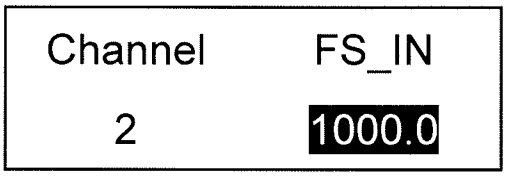
3) Full Scale Input Value (Valid only if the Incremental Gain (0.1 –200.0 is also installed):

Entering a Full Scale Input value will cause the gain of the unit to be changed based on the equation shown above. The FSI value is set in the same way that the incremental Gain value is set, using the left/right ←→ arrow key to move the

flashing cursor over any digit in the FS_IN column to select an appropriate value As with all setting changes, the actual gain internal to the unit is changed when the 'ENTER' button is pushed.

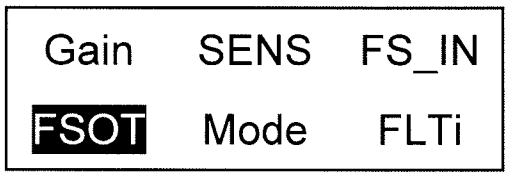


The sub-menu of the "FS_IN" selection shows the current value for Full Scale Input (assumed to be EU):

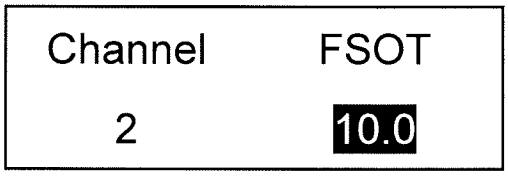


4) Full Scale Output Value (Valid only if the Incremental Gain (0.1 –200.0 is also installed):

Entering a Full Scale Output value will cause the gain of the unit to be changed based on the equation shown above. The FS0 value is set in the same way that the incremental Gain value is set, using the left/right ←→ arrow key to move the flashing cursor over any digit in the FSOT column to select an appropriate value As with all setting changes, the actual gain internal to the unit is changed when the 'ENTER' button is pushed.

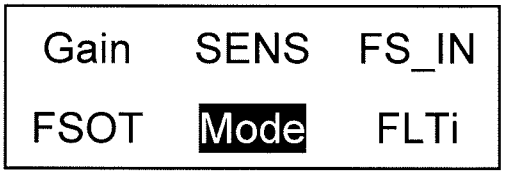


The sub-menu of the "FSOT" selection shows the current value for Full Scale Output in Volts. The range is 0.5 to 10.0

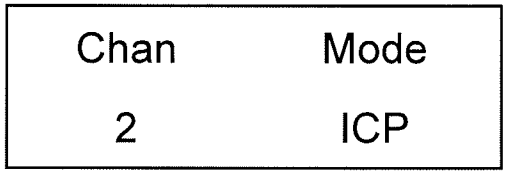


5) Mode:

Many Input Mode options are available for the 482C unit. The most common mode option allows the user to switch between ICP®, voltage or charge modes. The factory default for all channels is ICP®. To change the mode select the Mode option from the main menu using the left / right ←→ arrow keys until the cursor is over the Mode option, and then press the Enter button.



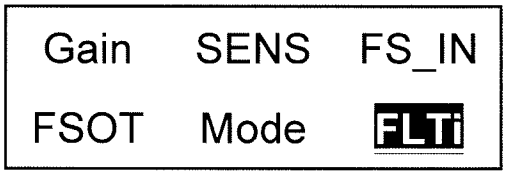
The following submenu will appear. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. Next, use the left / right ←→ arrow key to move the flashing cursor over to the Mode column. To change the Mode, use either the up ↑ or down ↓ arrow key to scroll through the options, once you have the desired setting selected hit ENTER to apply it.



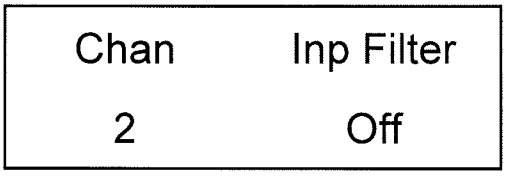
NOTE: Setting a channel to Voltage Mode will cause the ICP current source to be turned off to all channels and will force all other channels in ICP mode to Voltage mode. This is the result of the ICP current source being a unit level setting and, as such, cannot be set individually for each channel. Conversely, If ICP is set for any channel, all Voltage Mode channels will also be set to ICP mode.

6) Input Filter option:

Each channel's Input filter setting can be set independently of the other channels. To change the Input Filter setting from the main menu, use the left / right ←→ arrow keys until the cursor is over the FLTi option, and then press the Enter button.

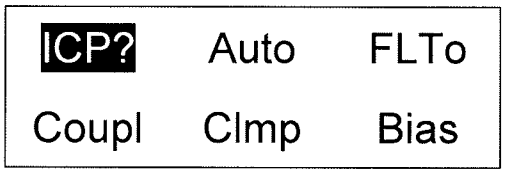


The following submenu will appear. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. Next, use the left / right ←→ arrow key to move the flashing cursor over to the INP Filter column. To change the Filter setting, use either the up ↑ or down ↓ arrow key to select either 'On' or 'Off', once you have the desired setting selected hit ENTER to apply it.

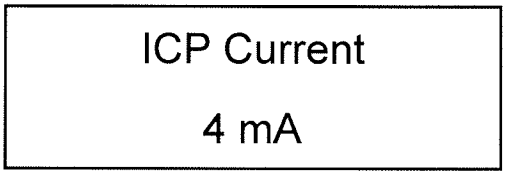


7) ICP® Current Adjustment:

This is a UNIT level command, meaning the selected ICP® current level is supplied to all of the channels in ICP input mode. This value can be set from 0 – 20 mA. Where 0 = Off. To set the current excitation value, move the cursor to the 'ICP?' location, as shown below.



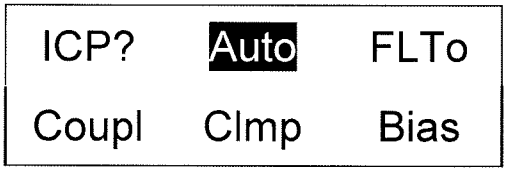
Pressing the ENTER button, will cause the following submenu to appear. The ICP® current may be altered by using the up ↑ or down ↓ arrow keys.



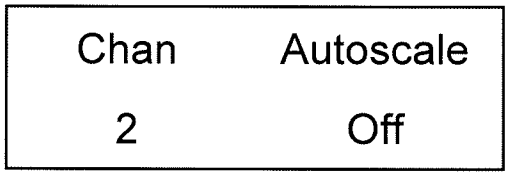
NOTE- The factory default setting for the ICP® current is 4 mA. Please refer to the reference section for optional settings. Also a ICP current setting of 0 automatically puts the input mode for any channels with ICP mode selected to Voltage Mode. Conversely, if a value greater than 0 is selected, any channels in Voltage Mode will be switched to ICP mode.

8) Autoscale Option (Valid only if the Incremental Gain (0.1 –200.0 is also installed):

The auto-scaling feature provides an automatic scaling of the output signal. Please refer to section 3-7.1 for further description. With this command, the programmable gain is implemented to give the largest signal amplitude output. The signals are checked internally; if there is an overload, the signal is stepped down and checked again. This procedure is followed for the indicated channel. To use this feature, place the cursor over the word "Auto" on the display.



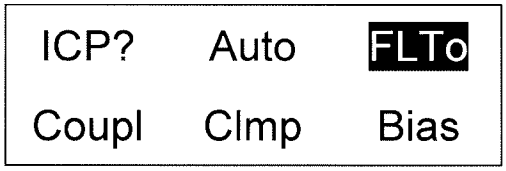
Hit the enter key, and the following submenu will appear. use the up ↑ or down ↓ arrow keys to toggle between the 'OFF', 'ON' or 'IMED' options. Once you have set the Auto-scale option, hit the ENTER key to return to the main menu. ON turns the auto scale function ON and it will continue scaling the gain until it is manually turned off. The 'IMED' option runs through the auto-scale algorithm once and then turns it off automatically.



NOTE- Auto-scale option should NOT be left on while measurements are being taken. It is strictly to be used during the setting of the gain, and then the option should be turned off.

9) Output Filter option:

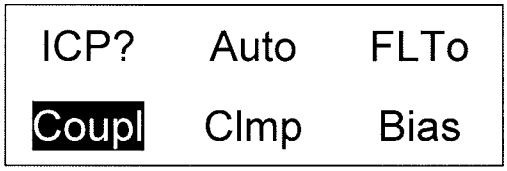
Each channel's Output filter setting can also be set independently of the other channels. To change the Output Filter setting from the main menu, use the left / right ←→ arrow keys until the cursor is over the FLTo option, and then press the Enter button.



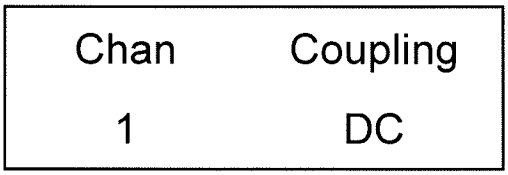
The following submenu will appear. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. Next, use the left / right ←→ arrow key to move the flashing cursor over to the Out Filter column. To change the Filter setting, use either the up ↑ or down ↓ arrow key to select either 'On' or 'Off', once you have the desired setting selected hit ENTER to apply it.

10) Input Coupling:

The Model 482C provides an option for AC or DC coupling. The AC coupled mode passes the signal through a DC blocking capacitor or high pass filter to remove the sensor bias voltage. By moving the cursor on the "COUPL" location, the display shows:



When the ENTER button is pressed, the submenu for the coupling options will include; **AC, DC, DC ADJ+, DC ADJ-, DC Exit**. The selection can be changed by using the up ↑ or down ↓ buttons.



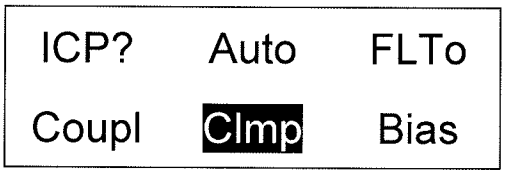
DC Coupling

The DC coupling option will attempt to remove a DC offset from the input signal by reading the bias and using an internal DAC to zero it. This function will be performed when the setting is changed from AC to DC. If the unit was in DC then the previous value will be used. Additionally, a user can further refine the zero process by manually adjusting the DAC either up or down using the DC ADJ+ or DC ADJ- options. For this operation only the adjustment takes place

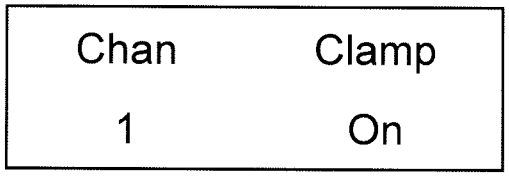
when the ENTER button is pressed while the DC ADJ+ or DC ADJ- is selected but the menu will not transition to another screen. To exit the adjustment process, use the up ↑ or down ↓ buttons to select DC Exit. If DC Exit is selected the channel is set to DC mode and the front panel.
NOTE: The value that is used to zero a channel will be saved in non-volatile memory when the unit is powered down and be reinstated upon power-up.

11) Clamped

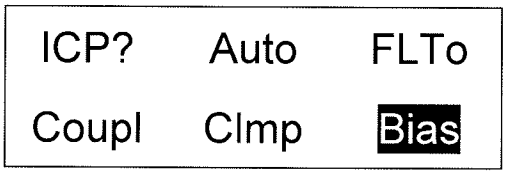
The user may select the Clamp function by pressing the ENTER key on the front panel when the cursor is located on the CLMP option.



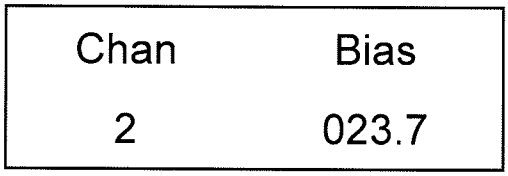
The following submenu will appear. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. Next, use the left / right ←→ arrow key to move the flashing cursor over to the Out Filter column. To change the Filter setting, use either the up ↑ or down ↓ arrow key to select either 'On' or 'Off', once you have the desired setting selected hit ENTER to apply it.



12) Bias Measurement:
The 482C is capable of measuring the bias voltage present on each of its channels. By moving the cursor upon the "Bias" location, the display appears as follows:



Using the ENTER button, the submenu appears as shown in the following diagram. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. The bias reading for the channel will be displayed automatically when the channel is selected.



If unit had a short circuit, the bias voltage would be <2.0V. Proper bias voltage is between 2.0V and 22V. Anything over 22V would indicate an open circuit.

13) Internal Reference Oscillator. (This option is available only on units with the Isolation option)

The user may select the Oscillator setting by pressing the ENTER key on the front panel when the cursor is located on the OSCL option.

Oscl	Unit	Reset
Disp	LEDS	Ver?

The following submenu will appear. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. Next, use the left / right ←→ arrow key to move the flashing cursor over to the Oscillator column. To change the Oscillator setting, use either the up ↑ or down ↓ arrow key to select either 'Off', '1kHz', '100Hz', once you have the desired setting selected hit ENTER to apply it.

Chan	Oscillator
1	1kHz

14) Unit Id.

The user may change the Unit Id setting by pressing the ENTER key on the front panel when the cursor is located on the Unit option.

Oscl	Unit	Reset
Disp	LEDS	Ver?

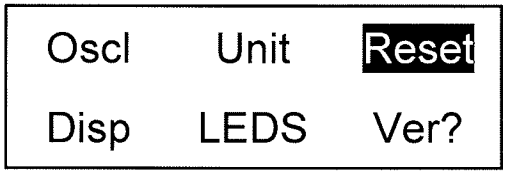
The following submenu will appear. Use the up ↑ or down ↓ arrow key to change the Unit Id setting to a new value. Once you have the desired setting selected hit ENTER to apply it.

Current Unit #
1

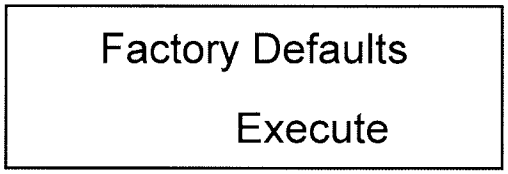
Note: Changing the Unit Id is only necessary if you have the Ethernet or RS-232 communication option installed and you are communicating with more than one unit. If this is the case then all units in the network MUST have a unique Id.

15) Reset to Factory Default Settings:

The reset option provides a mechanism to reset the unit to its factory default settings. To do this select the reset option from the menu by placing the cursor over the Reset option and hitting enter.

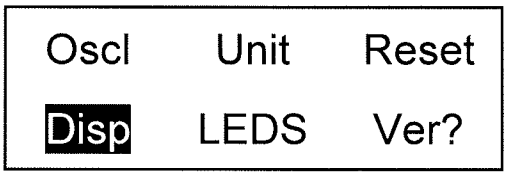


Pressing the ENTER brings up a submenu that allows the operator to continue by selecting 'Execute' or cancel the function by selecting 'Cancel'. Both options return control to the main menu. If 'Execute' is selected then the defaults are restored.



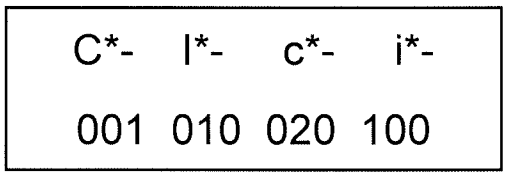
16) Display Content Options:

The Display option allows the user to choose from 3 selections of front panel content. To enter this mode, select the 'DISP' option from the menu by placing the cursor over the Reset option and hitting enter.



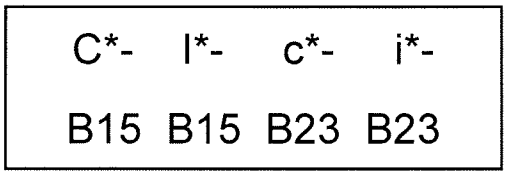
Pressing the ENTER brings up a submenu that allows the operator to continue by selecting either 'Gain', 'Bias' or 'Msg'. If 'Gain' is selected then each channel's current Gain setting will be displayed on the 2nd line of the front panel display to the nearest integer. Additionally, directly above the Gain on the 1st line of the display will be up to 3 characters representing the channels input mode ;'C' for Charge, 'c' for Isolated Charge, 'I' for ICP, 'i' for Isolated ICP, or 'V' for Voltage. Next to the Input mode indicator is the Input Filter setting; '*' for On, blank for Off and '-' if the option is not installed. Next to the Input Filter indicator is the Output Filter setting indication which has the same markings as the input filter.

Following is what the screen will look like if the Display was set to show 'Gain' and channel 1 has a gain of 1 and is in Charge mode with the input filter 'On' with no Output Filter option installed. Similarly, channel 2 has a gain of 10 and is in ICP mode; channel 3 has a gain of 20 and is in isolated charge mode and channel 4 has a gain of 100 and is in isolated ICP mode.

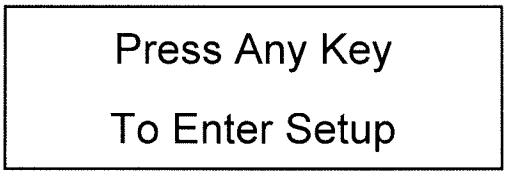


The 'Bias' display option is the same as the Gain option except the channels bias reading replaces the Gain setting. Also the Bias reading will be refreshed periodically.

Following is what the screen will look like if the Display was set to show 'Bias'.

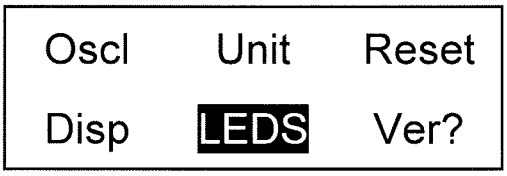


The 'Msg' display option simply displays the following message.

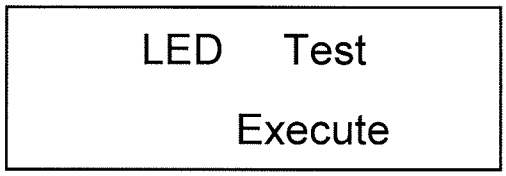


17) LED Test:

The testing of the front panel LEDs indicates whether or not they are functioning properly. To test them, place the cursor over the word "Leds" on the display.

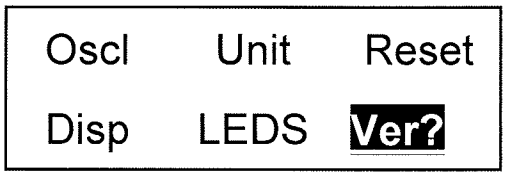


Pressing the ENTER brings up a submenu that allows the operator to continue the test by selecting 'Execute' or cancel the function by selecting 'Cancel'. Both options return control to the main menu. If 'Execute' is selected then all LEDs on the front panel will flash three times.

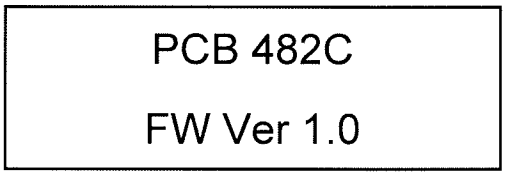


18) Firmware Version:

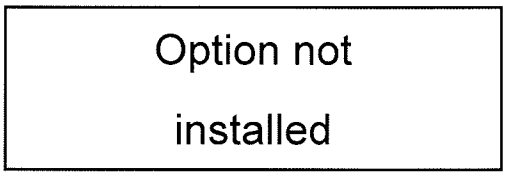
To determine the firmware version of the unit select the 'Ver?' menu option.



A screen similar to the one shown below will be displayed



For any selected option not actually included in a particular unit, a message is shown on the display. This occurs on the main menu. The cursor is placed over a selected option not included in the model purchased. When the ENTER button is pressed, the following is shown:



Reference

3-0. THEORY OF OPERATION

3-1. Sensor Excitation

ICP® refers to a low output impedance voltage mode sensor combining an integrated circuit and a piezoelectric sensing element in a single housing to provide a voltage output. This sensor is powered by a +24 VDC power supply having a constant current, variable from 2 to 20 mA.

Sensor excitation occurs as the constant current of all channels are set. Model 482C allows the constant current to be adjusted between 2 and 20 mA to provide the required excitation for most applications. Special situations, such as driving extra-long cables (more than 1000 ft) with high frequency or fast rise time pulses, may require increasing the drive current to 12 mA or higher. See Figure 3-1.1.

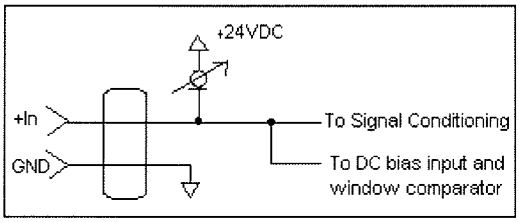


Figure 2 ICP® Sensor Excitation

When driving fast rise time pulses over long lines, system performances can be optimized by "tuning" the drive current to the line; i.e. by finding the best current setting for the particular test of physical parameters. To determine the optimal current setting, experiment with your particular test set up. To insure optimal accuracy in constant-current adjustment, make sure all channels have sensors or simulated loads, similar to the one provided by the Model 401A04 Sensor Circuit, consisting of a voltage amplifier similar to those found in ICP® sensors.

3-2. Input Protection

The input section has protection to limit the amplitude of the incoming signal to within +24 volts to ground. Maximum allowable input voltage without distortion is ±10 volts, relative to the sensor bias voltage.

3-3. Input Fault Detection

Model 482C monitors two input fault conditions, "short" and "open," which indicate problems with sensor input and is displayed through the front panel LEDs. Either case implies that the sensor is NOT functioning properly. An input is **shorted** when it has a ground path for the sensor excitation and **open** when the sensor fails to draw the excitation.

Two voltage comparators consist of a window comparator that has two reference voltages (V_{ref}) representing thresholds for "short" and "open." When the sensor's bias voltage (V_{bias}) exceeds the comparator range, the front panel input fault LED lights.

NOTE: Red LED implies input fault.

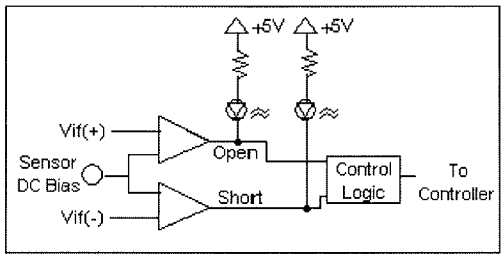


Figure 3 Input Fault Window Comparator with LED Indicator

3-4. Input Interface

The input signal conditioning for each channel provides a unity gain buffer with high-input impedance amplifiers. With the AC coupled option it also eliminates the DC bias from the input signal with a 10-second time constant.

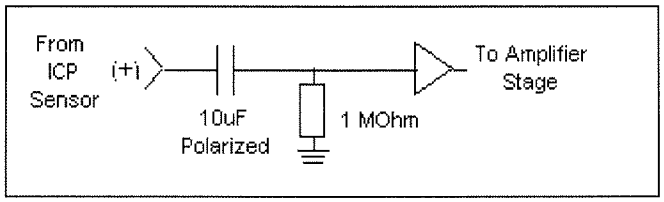


Figure 4 Input Amplifier Configuration

3-5. Gain

The Programmable Gain Amplification (PGA) block consists of a decimal gain amplifier. See Figure 3-5.1.

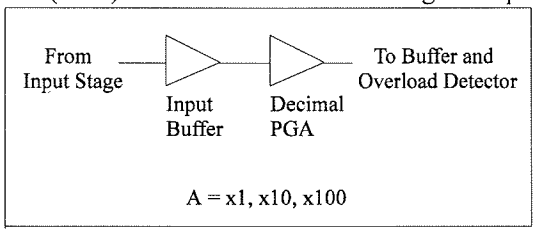


Figure 5 Selectable Gain Amplifier Configuration

3-5.1 Programmable Gain

With the two available programmable gain options, the user can adjust the gain as needed. Adjustable gain with three discrete settings (x1, x10, x100) or incremental gain (from 0.1 to 200) are available. The steps in the incremental gain option is 0.1. These options are particularly useful in the standardization of groups of sensors. Consider the following example, wherein the user desires to normalize sensitivities to 1 V/unit for each channel.

Channel	Sensor Sensitivity	Gain Setting of 482C	Actual Gain Needed
1st	10.10 $^{mV}/_{unit}$	99.00	99.01
2nd	101.32 $^{mV}/_{unit}$	9.9	9.869
3rd	22.30 $^{mV}/_{unit}$	44.8	44.84

These results may be accomplished by using either of two techniques. First, the user may set the gain via the computer interface command set (See the command strings in Section 4-9 in the Computer Interface Programming Guide.) or the user may set the gain by using the front panel control.

3-6. Normalized Output Sensitivity

The definition of normalized output sensitivity is the calculation of the individual channel's gain, depending on the sensitivity of the sensor attached and the desired output sensitivity. This is simply a function of the desired output sensitivity (in Volts/ unit) divided by the sensor's sensitivity.

$$\text{Gain} = {}^{1\ \text{Volt}} / {}_{\text{Sensitivity (mV/unit)}}$$

Additionally, a feature to improve flexibility allows changing the output level to a value of 5 Volts/ unit instead of normalized 1 Volt/ unit. Some users request the ability calculate the gain using a known input signal along with the sensor sensitivity, and desired output level. The result of the request impacts the formula:

$$\text{Gain} = {}^{1\ \text{Volt/}} / {}_{\text{[Sensitivity (mV/unit) * Full Scale Input (units)]}}$$

Adding some simple error checking to insure the limits of the sensor and gain limits of the signal conditioner are not exceeded completes the normalization process.

$$\text{Gain}_{\text{normalized}} = {}^{\text{FSOT (V)}} / {}_{\text{SENS * FSIN}}$$

Additional Considerations:
The storage of individual channel gains is stored in non-volatile memory locations. The new variables for each channel's sensitivity, Full Scale Output level, and Full Scale Input are stored in non-volatile memory locations when the unit is powered down.

The error checking should provide a flag if the desired normalized output level is not feasible due to gain limitations. The gain required may be too large given the sensor sensitivity defined, or too small which implies the sensor will not be capable measure the expected value. The typical sensor will output a signal up to ±5 Volts. The maximum swing may be used in the error checking.

The 482C has the capability to provide signal conditioning for charge mode sensors in addition to the standard ICP® type. The sensitivity (mV/ pC) of the in-line charge converters (422M) will be stored at final calibration to allow charge mode sensors (pC/ unit) to be normalized.

3.7 Overload Detection and Autoscaling

3-7.1 Autoscaling

To avoid overload, the Model 482C features autoscaling for gain adjustment. It first sets maximum gain on all channels, then decreases the gain setting of any channel on which an overload has occurred. The gain autoscale continues until there is no overload with respect to the preset overload threshold level (standard ±10 volts) and sensed signal of the channel. Final gain and overload status interrogation is possible through the command set. The correct procedure for using the autoscale feature is as follows:

1. Excite the structure under test.
2. Enable autoscale (Autoscale on).
3. Wait several seconds, until the unit is stabilized.
4. Disable autoscale (Autoscale off).
5. Read the gains of all channels.
6. Begin test run.

3-7.2 Overload

The overload feature uses the same window comparator principle previously discussed. The $+V_{ref}$ is equal to the default overload value of ±10 volts. When the input voltage (Vsignal of Figure 3-7.1) to the window comparator exceeds the reference voltage limits, overload has occurred, and the comparator's output, which is normally "high," becomes "low." This "low" state illuminates the overload LED and triggers the latch of overload detection circuitry. During regular measuring time, the latch holds the occurrence of overloads until the user reads its status through the computer interface.

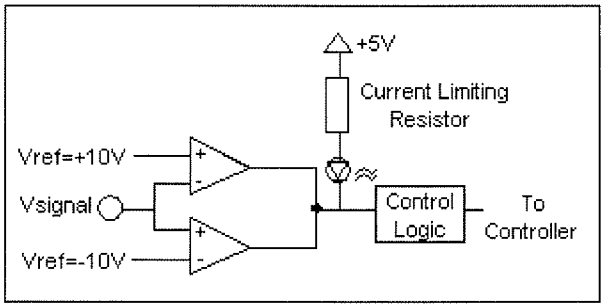


Figure 6 Autoscale/Overload Window Comparator

3-8. Filtering

The Model 482C can be ordered with low pass, or high pass filters installed in any or all channels for the removal of unwanted noise. The available filter modules are second and fourth-order Butterworth low pass (-24 dB/octave) filters. High pass filters are available upon request. The filters have a master enable/disable control. In models equipped with a

second and forth order filter, the second order filters may be disabled by individual channel. Typical cutoff frequencies include:

Option Number	Cutoff Frequency (-3 dB)
01	100 Hz
02	200 Hz
03	500 Hz
04	1 kHz
05	2 kHz
06	5 kHz
07	10 kHz
08	20 kHz
09	50 kHz
10	100 kHz

The user may also define a specific cutoff frequency that satisfies a specific need using the Filter Option. Contact the factory regarding individual requirements.

3-9. RMS - DC Conversion Every Channel

This option converts the input AC signal to an equivalent DC signal to provide a cost-efficient, approximate measure of diagnostic information. The effective voltage or current value, when combined with the circuit resistance, determines the average power for a cycle. For example, if the sensed sinusoidal signal is 2 volts peak-to-peak, 1 volt peak, the RMS value may be obtained by multiplying the peak value (1 volt) by 0.707. Maximum output V_{rms} is 5 volts, which corresponds to ±14.2 volts peak-to-peak, 7 volts peak for a sinusoidal signal.

3-10. Connector Configuration

The base model 482C provides BNC inputs and outputs for ICP®-type sensors. The remaining options deal with selectable ICP® or charge mode sensor input, and they differ only in terms of charge sensitivities.

3-10.1 Piezoelectric Charge Mode Sensor Input

This option allows the user to condition piezoelectric charge signal inputs with considerable temperature, filtering, and gain flexibility. The Model 482C configured for this type of input has BNC inputs to accept charge signals from charge mode sensors (e.g., PCB accelerometer Series 357).

The charge sensitivity can be selected as 0.1 mV/pC, 1.0 mV/pC, or 10 mV/pC. Each channel must be selected as either charge mode or ICP® mode via RS-232 communication or with the keypad (if so equipped). The front panel (red) OPEN LED goes out for the channel selected in the charge mode to signify that the internal charge amplifier is functioning properly. In units with front panel control, the bias menu will display the actual bias voltage for the internal charge amplifier. In the ICP® mode, the OPEN LED stays illuminated until a properly functioning ICP® sensor is attached.

3-10.2 ICP®, Voltage or Charge Input Per Channel

This option allows the user to select the input mode of each channel. The selection is made via RS-232 connection or through the keypad. The functionality of the 482C while in ICP® or voltage mode is very similar, the only difference being in the bias current, which does not flow in voltage mode. When voltage mode is selected, the unit will

automatically set the current to zero (0) mA for all channels. With no ICP® excitation present on the input connector, the channel is simply a voltage amplifier.

The factory default is ICP® input mode for all channels in the unit. The user must reconfigure the channels to accept a voltage input signal.

Input/ Output Connector Definitions:

The BNC connectors are used to accept ICP® and Voltage mode input signals. The ICP® excitation will be present on the input BNC only when the ICP® current is turned on. The voltage input mode allows bipolar, positive and negative (above and below ground) signals. The charge signals are directly input into an in-line charge converter with nominal selectable sensitivity of .1mV/ pC, 1.0mV/pC or 10mV/pC. In all input modes, the signal must be AC type signals, unless the DC coupling option is included in the unit.

3-11. RS-232

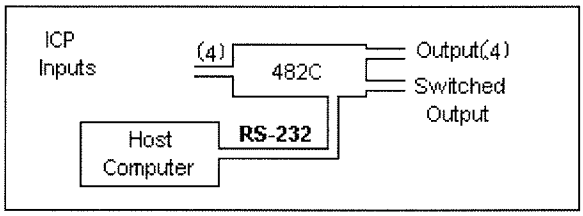


Figure 7 RS-232 Configuration

The RS-232 Interface provides serial control of the Model 482C. This may be accomplished through the use of a personal computer, dumb terminal, or handheld controller. The command format is based upon letter representations of the controllable options. This serial interface, set-up, and programming are described in Section 4.

3-12.1 Non-Volatile Memory

This feature keeps the programmed configurations stored when the unit is powered down. When the unit is turned on, all programmable features (e.g., gains, filter status, switched output settings, overload levels, integration level) active at last use are preserved. When the unit is powered down the non-volatile memory is updated with the current channel settings. The unit's non-volatile memory may be reset to the factory default settings by using the reset menu option.

3-13 Transducer Electronic Data Sheet (TEDS) Interface:

The TEDS sensors attach to the input connectors the same way a traditional ICP® sensor is attached to the 482C. The TEDS interface requires both the RS-232 or Ethernet computer interface option, and the input mode option. The digital control and input mode features automatically perform the TEDS read or write function. After the communication with the TEDS sensor is complete the input mode returns to the input mode (charge or ICP®) prior to the communication.

The current TEDS function will perform a read of the "raw" TEDS data and return the 32 bytes of TEDS sensor EEPROM data and the 8 byte Application register contents, if it was programmed, and returns the data in an ASCII Hex representation.

4-0. COMPUTER INTERFACE PROGRAMMING GUIDE (for RS-232 or Ethernet equipped units)

4-1. Introduction

Individual commands are subject to feature availability on the particular unit.
The RS-232 Interface enables the Model 482C to be fully controlled by a computer or handheld controller. With this interface, the unit is able to become part of a fully automated system.

4-2 RS-232

The RS-232 provides total control of the unit except for hardware RESET. The rest of the options described previously are computer-controllable.

4-3. RS-232 Host Set-Up

Before any serial interface is used to communicate with the host computer, a specific set-up must be followed. These parameters must be set for the host computer. The full list of parameters is shown below: (EOL = End of Line.)

Parameter	Setting
Transmission Rate	19,200 BPS (bits per second)
Parity	None
Number of data bits	8
Number of stop bits	1
Handshaking	None
Echo	None
Transmit EOL	Carriage Return and Line Feed, <CR><LF>
Receive EOL	Carriage Return and Line Feed, <CR><LF>

4-4. RS-232 Rear Panel Pinout Listing

Number of 9-Pin Connector	Function	Notes
1	N.C.	Not Connected
2	TXD	From 482C
3	RXD	To 482C
4	N.C.	Not Connected
5	Ground	Ground
6	N.C.	Not Connected
7	N.C.	Not Connected
8	N.C.	Not Connected
9	N.C.	Not Connected

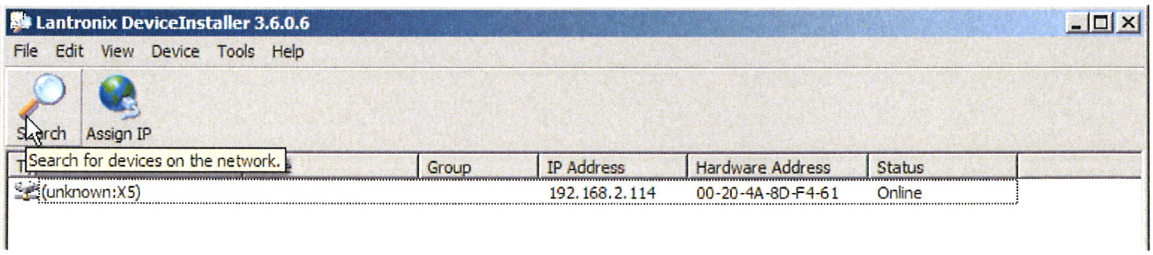
4-5. Ethernet Communication

If the 482 unit is equipped with the Ethernet option then the unit's IP address must be set up before any remote communication can commence.

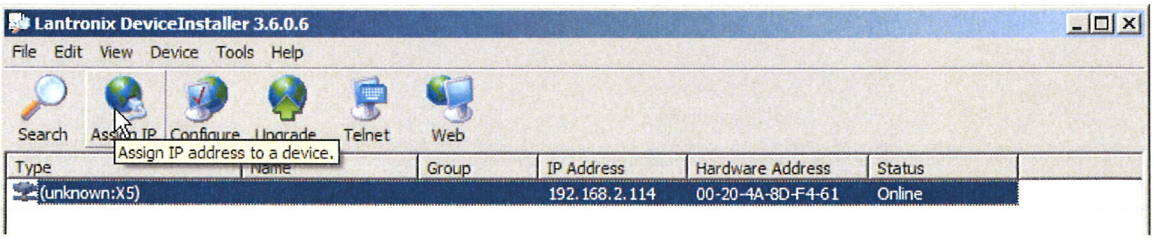
The steps to set the IP address of a 482 Unit are as follow:

- Connect, either directly with a crossover CAT5 cable or through a hub, to a single unit. This unit is presumed to have a Unit ID of 1,
- Set the IP address using an independent utility from Lantronix called DeviceInstaller™. To download the Lantronix DeviceInstaller™ application go to: http://www.lantronix.com/device-networking/utilities-tools/device-installer.html

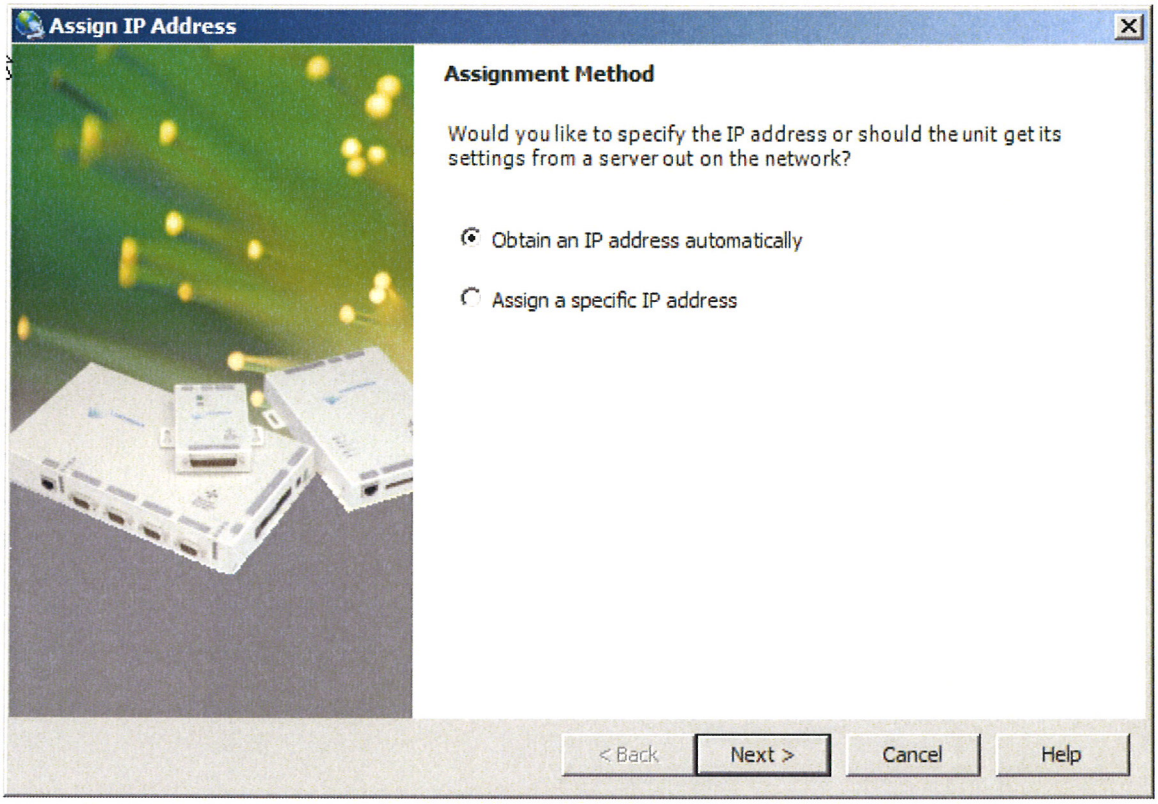
- After the DeviceInstaller™ application is installed, run it and the following screen will appear. Click on the Search icon and the program will search for the Ethernet device internal to the 482 unit. When found, as shown below, details about the device show in the list. You can verify it is the correct unit but comparing the Hardware (MAC) Address displayed to the one listed on the side of the 482 unit.



- Selecting an item from the list, shown below, highlights the item in the list and enables more icons.



- Select **Assign IP** and the following screen will appear. Select whether you want to assign a static IP address that is appropriate for your network or have it assigned from a network server. Subsequent steps are self-explanatory.



- Now you can use the assigned IP address to address the unit.

Important Note: The communication protocol requires a unit id as part of the command header. The unit id is not the IP address. To send commands to the unit Via Ethernet you must address the TCP-IP packets with the proper IP address and ensure the packet payload contains the correct Unit Id in the command header.

4-6. Model 482C Communication Guidelines

1) Data transfer from the host terminal to the unit must contain an ending delimiter of <CR><LF>.

Example: <CR><LF> -Carriage Return and Line feed. (In ASCII, <CR> is 13; <LF> is 10.)

2) The number of characters for any command string, from the first character to the <CR>, may not exceed 255.
3) Status request commands, i.e., commands ending with a "?", may only be sent within one transmission.
Example: 7:0:GAIN?<CR> <LF>
-Reads the gain setting of all channels.

4-7. Model 482C Unit Initialization Procedure

1) To begin, plug 9-pin female DSUB connector of given cable into RS-232 port of Model 482C. Plug the other end of the cable into the COM port of the terminal or computer.
2) Turn on power to Model 482C. The display or power indicator should light up to indicate the power is on.
3) With the terminal or computer that is set up to transmit data, according to the host set-up discussed in Section 3-3, send the command:

"1:0:LEDS=0" <CR><LF>

This command flashes the front panel LEDs three times.

4-8. Command Summary

The table below is a summary of the 482x command set. The 482 is highly configurable and, as such, Some commands may not be valid in all units. The 482x commands are sent and received from/to the host computer in ASCII text format.

Command	Type	Scope	Meaning
GAIN	R/W	Channel	Set or read gain
SENS	R/W	Channel	Sensor Sensitivity
FSCI	R/W	Channel	Expected Full Scale Input Value
FSCO	R/W	Channel	Full Scale Output
INPT	R/W	Channel	Input Signal Mode Selection
IEXC	R/W	Unit	Read/Adjust ICP® current setting
FLTR	R/W	Channel	Enable/disable input filters
OFLT	R/W	Channel	Enable/disable output filters
CLMP	R/W	Channel	Enable/disable Clamp
CPLG	R/W	Channel	Select AC or DC coupling
OSCL	R/W	Channel	Select Oscillator setting
RTED	R	Channel	Read TEDS data (DS2430A)
ALLC	R	Channel	Read majority of channel settings
RBIA	R	Unit	Measure Bias (returns all channels)
STUS	R	Unit	input fault / overload status, for all channels
UNIT	R	Unit	Read Unit Configuration information
UNID	R/W	Unit	Set Unit ID
LEDS	FCN	Unit	Front panel LED test function
RSET	FCN	Unit	Restores factory default channel settings
AUTR	FCN	Channel	Enable/disable auto-scaling function
SAVS	FCN	Unit	Saves the current settings to NVRAM

Command type definitions;

- R/W – the setting can be read from or written to the unit or channel.
- R – The information can only be read from the unit or channel.
- FCN – The command invokes a function in the unit.

4-9. Command Format

The 482x communication protocol incorporates the concept of 'Directed' and 'Global' commands at both the Unit and Channel level with the following characteristics;

- Unit or Channel numbers =0 are global commands that affect either all units or all channels of a particular unit or both.
- Directed commands that set a unit parameter are always acknowledged (ACK) with an ASCII message that indicates '<Unit#>:<CMD>:ok' if implemented with no errors or NAK with; <Unit#>:<CMD>:=<error#>' if an error was encountered.
- Directed commands that request a particular parameters setting (query) result in a query response being returned
- No response is ever given to a Global Unit command.

Command Format:

'Unit#:Ch#:Cmd[=|?]{<value1 >{,< value2 >}}{;Ch#:Cmd[=|?]{<value1>{,< value2>}}}\n\r

- Each message must be preceded by a Unit# & Channel# (both of which could be 0)
- Messages may contain multiple commands separated by a semicolon ';'.
- The second and subsequent commands in a message shall not contain a unit number but shall contain a channel number.
- Each command in a message will evoke a response message if one is warranted (not global)
- Query's ('?') can only be directed to one unit but if the channel=0 then each channel's setting will be returned in the order 0-MAXCHANNELS separated by a ':'

Command examples:

1:0:GAIN=100.2\r\n	unit 1,all channels gain set to 100.2
1:1:GAIN=100.2;2:GAIN=120.3\r\n	unit 1, channel 1 gain = 100.2; channel 2 gain = 120.3
1:3:GAIN=100.2;0:FLTR=1\r\n	unit 1, channel 3 gain = 100.2; all channel's filter = ON

General Query Response Format
Unit#:Cmd:Ch#=<value>{; Ch#=<value>}...>{; Ch#=<value>}...\r\n

Responses to a query with a channel number=0 will return the setting of each channel in a list separated by semicolons ';'.
If the target of the query is a unit setting (ex. current excitation) then the channel number returned is the 1st channel of the board that processed the command.

4-10 Multiple Board Models

Some 482x models (ex. 482M179) have multiple main boards installed which will appear as a contiguous set of channels, when in fact, physically, they are completely separate and operate somewhat independently. This presents some interesting communication challenges. For instance, a global channel command to set 8 channels on a 482M179 unit will be handled by each internal board simultaneously. However only the board with the channels designated as 1-4 will ACK the command, the other board will remain silent.
Likewise, a global Query command will be responded to by the channel 1-4 board but will be ignored by the channel 5-8 board. However, In order to facilitate efficient communications with the second board, the concept of a second unit address was introduced. A user's control application can direct global channel setting queries to the second board of a unit by addressing the query to the secondary unit address of the unit. This secondary unit address is defined to be the normal unit address ***plus 128*** (i.e. if a units address is 1 then the 2nd board's address would be 129)

4-11. Commands

GAIN

SET GAIN: This command sets the programmable gain of a channel. The gain may be set to x1, x10, or x100 for the variable gain option or to any setting within the 0.1 to 200 range for the incremental option.

Setting:
The amplifier gain can be set directly by sending a Gain command:

1:0:GAIN=100.2\r\n (unit 1,all channels gain set to 100.2)

When a channels gain is set directly the unit will adjust the FSI parameter of the gain equation using the following equation; FSI = (((FSO*1000)/Gain)/Sens) to ensure it remains valid.

Setting Response: 1:GAIN:ok

Query:
The Gain query returns all of the parameters used to determine it in a single response

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:=Gain:SENS:FSO:FSI;
Query: 1:5:GAIN?
Response: 1:GAIN:5= 5.0: 10.0: 10.0: 200.0;

Global Gain Query: 1:0:GAIN?
Global Gain Response: **1:GAIN:1**= 5.0: 10.0: 10.0: 200.0;**2**= 5.0: 10.0: 10.0: 200.0;**3**= 5.0: 10.0: 10.0: 200.0;**4**= 5.0: 10.0: 10.0: 200.0;

SENS

The SENS command provides a mechanism to have the transducer Sensitivity influence the Gain setting of the channel. Channel Gain is calculated using the equation;
Gain = FSO*1000/(FSI*SENS). If a Sensitivity is entered that caused the gain to exceed the amplifiers capability the FSI component will be adjusted to keep the equation valid.

Setting:
1:0:SENS=20.2\r\n ***(unit 1,all channels transducer sensitivity set to 20.2)***
Setting Response: 1:SENS:ok

Query:
The Sens query returns the channels transducer sensitivity

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= SENS;
Query: 1:1:SENS?
Response: 1:SENS:1= 6.0;

Global Gain Query: 1:0:SENS?
Global Gain Response: 1:SENS:**1**= 6.0;**2**= 10.0;**3**= 10.0;**4**= 10.0;

FSCI

The FSCI command provides a scaling mechanism to automatically set the gain based on a known input level (in EU) and what output level (in Volts) you would like that Full Scale input level to be represented by. For instance 1000g's = 10Volts. These 2 values along with the transducer sensitivity set the gain. Channel Gain is calculated using the equation: Gain = FSO*1000/(FSI*SENS).

Setting:
1:1:FSCI=1000.000\r\n ***(unit 1, channel 1 FSI set to 1000.0)***
Setting Response: 1:FSCI:ok

Query:
The FSCI query returns the channels Full Scale Input value in engineering units

Query Format: Unit#:Ch#:CMD?

Response format: Unit#:Cmd:Ch#:= <fsci>;
Query: 1:1: FSCI?
Response: 1:FSCI:1=1000.0;

Global FSCI Query: 1:0:FSCI?
Global FSCI Response: 1:FSCI:1=1000.0;2=1000.0;3=1000.0;4=1000.0;

FSCO

The FSCO command provides a scaling mechanism to automatically set the gain based on a known input level (in EU) and what output level (in Volts) you would like that Full Scale input level to be represented by. For instance 1000g's = 10Volts. These 2 values along with the transducer sensitivity set the gain. Channel Gain is calculated using the equation:
Gain = FSO*1000/(FSI*SENS).

Setting:

1:1:FSCO=10.000\r\n ***(unit 1, channel 1 FSI set to 10.0)***

Setting Response: 1:FSCO:ok

Query:

The FSCO query returns the channels Full Scale Output Value in volts

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <fsci>;
Query: 1:1: FSCO?
Response: 1:FSCO:1=10.0;

Global FSCO Query: 1:0:FSCO?
Global FSCO Response: 1:FSCO:1=10.0;2=10.0;3=10.0;4=10.0;

INPT

The INPT command sets the input mode for a given channel. The mode selection is sent as an integer value. The possible input modes and their associated values are:

- CHARGE 0
- VOLTAGE 1
- ICP 2
- Multi-Charge option of 10mV/pc sensitivity 3
- Multi-Charge option of 1.0mV/pc sensitivity 4
- Multi-Charge option of 0.1mV/pc sensitivity 5
- Isolated ICP 6
- Isolated Multi-Charge option of 10mV/pc sensitivity 7
- Isolated Multi-Charge option of 1.0mV/pc sensitivity 8
- Isolated Multi-Charge option of 0.1mV/pc sensitivity 9

NOTE: Not all input options are valid for all 482 models. Check your models specification for applicable input options

Setting:

1:1:INPT= 2\r\n (unit 1, channel 1 input mode set to ICP)

Setting Response: 1:INPT:ok

Query:

The INPT query returns the channels input mode selection

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <inpt>;
Query: 1:1:INPT?
Response: 1:INPT:1= 2;

Global INPT Query: 1:0:INPT?
Global INPT Response: 1:INPT:1= 2.0;2= 2.0;3= 2.0;4= 2.0;

IEXC

The IEXC command sets the current excitation level for ICP mode. This is a UNIT setting (i.e. all channels will get set to this value) as a result, if the channel was in Voltage mode and this value gets set > 0, then the channel's input mode will revert to ICP mode. Likewise if the channel is in ICP mode and current excitation is turned off (0) then the channel input mode changes to Voltage.
The current excitation value is sent as an integer value from 0 (off) to 20mA.

Setting:

1:1:IEXC= 4\r\n (unit 1, channel 1 but all channels are set to 4mA)

Setting Response: 1:IEXC:ok

Query:

The IEXC query returns the units excitation value.

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <IEXC>;
Query: 1:2:IEXC?
Response: 1:IEXC:1=4;

Note: Unit setting responses return the lowest channel number of the board that is responding. In the example above the query requested channel 2's setting but got channel 1 in response because all channels are the same.

Global IEXC Query: 1:0: IEXC?
Global IEXC Response: 1:IEXC:1=4;

FLTR

The FLTR command enables or disables the Input Filter .
The Input Filter value is sent as an integer value of either 0 -Disable or 1-Enable.

Setting:

2:1:FLTR= 1\r\n (unit 2, channel 1, Input Filter Enabled)

Setting Response: 2: FLTR:ok

Query:

The FLTR query returns the channels Input Filter selection

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <0|1>;
Query: 2:1: FLTR?
Response: 2:FLTR:1=1;

Global FLTR Query: 1:0: FLTR?

Global FLTR Response: 1:FLTR:1=1;2=0;3=0;4=0;

OFLT

The OFLT command enables or disables the Output Filter.
The Output Filter value is sent as an integer value of either 0 -Disable or 1-Enable.

Setting:
2:1:OFLT= 1\r\n (unit 2, channel 1, Output Filter Enabled)
Setting Response: 2: OFLT:ok

Query:
The FLTR query returns the channels Output Filter.
Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <0|1>;
Query: 2:1: OFLT?
Response: 2: OFLT:1=1;

Global OFLT Query: 1:0: OFLT?
Global OFLT Response: 1: OFLT:1=1;2=0;3=0;4=0;

CLMP

The CLMP command enables or disables the Clamp feature. When Clamp is disabled the channel is 'Buffered'
The Clamp value is sent as an integer value of either 0 –Disable (buffered) or 1-Enable.

Setting:
2:1:CLMP= 1\r\n (unit 2, channel 1, Clamp Enabled)
Setting Response: 2: CLMP:ok

Query:
The CLMP query returns the channels Clamp setting.
Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <0|1>;
Query: 1:1:CLMP?
Response: 1:CLMP:1=0;

Global OFLT Query: 1:0:CLMP?
Global OFLT Response: 1:CLMP:1=0;2=0;3=0;4=0;

CLPG

The CLPG command sets the channel coupling to AC or DC mode and allows further manual refinement if DC mode is selected. This feature is only available in units with a variable gain option (x1, x10, x100).

DC Coupling

The DC coupling option will attempt to remove a DC offset from the input signal by reading the bias and using an internal DAC to zero it. This function will be performed when the setting is changed from AC to DC. If the unit was in DC then the previous value will be used. Additionally, a user can further refine the zero process by manually adjusting the DAC either up or down using the DC ADJ+ or DC ADJ- options. To exit the adjustment process, send a DC Exit command. The DC Exit command sets the channel to DC mode.

NOTE: The value that is used to zero a channel will be saved in non-volatile memory when the unit is powered down and be reinstated upon power-up.

The coupling value is sent as an integer value: 0 –AC, 1-DC, 2-DC ADJ +, 3-DC ADJ -, 4-DC ADJ Exit.

Setting:

1:1:CLPG= 1\r\n (unit 1, channel 1, DC Coupled)

Setting Response: 2: CLPG:ok

Query:

The CLPG query returns the channels coupling setting.

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <0|1>;
Query: 1:1:CLPG?
Response: 1:CPLG:1=0;

Global Query: 1:0:CPLG?
Global Response: 1:CPLG:1=0;2=0;3=0;4=0;

OSCL

The OSCL command selects the Internal Reference Oscillator setting. When either the 100 or 1k Hz setting is selected the channel is forced into a charge mode, if it isn't set that way already, and an internal 100pC signal is generated. This signal is then converted to a voltage based on the selected charge sensitivity (1mV/pC if any ICP setting was selected) after which the channels gain is applied to provide an internal cal signal.
This feature is only available in units with an Isolation module.

The OSCL value is sent as an integer value of either 0 –Disable, 1-1000 Hz Enable, 2-100 Hz Enable

Setting:

1:1: OSCL= 1\r\n (unit 1, channel 1, Oscillator=1 kHz)

Setting Response: 1:OSCL:ok

Query:

The OSCL query returns the channels Internal Reference Oscillator setting.

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <0|1>;
Query: 1:1: OSCL?
Response: 1: OSCL:1=0;

Global OFLT Query: 1:0:OSCL?
Global OFLT Response: 1:OSCL:1=1;2=0;3=0;4=0;

RTED

The RTED query returns the TEDS information that is stored in the sensor or other, TEDS capable, in-line module attached to a specific channel. The 482x devices are 1451.4 compliant in that they will read the DS2430A Application Register Status to see if it indicates the 64 bit Application Register has data in it. If so it will read the Application register contents and return it followed by the contents of the TEDS EEPROM.

NOTE: The 1st byte of the DS2430A EEPROM data should contain the checksum of both the Application Register contents and the EEPROM contents if the TEDS is 1451.4 compliant. No attempt is made to validate or interpret the TEDS data.

Setting:
N/A – Command is Read only

Query:
The RTED query returns the TEDS data associated with the specified channel. This command must be directed to a specific channel. It will return an indicator that specifies if the DS2430A Application register has been used to store the basic TEDS data and up to 40 bytes in ASCII Hex format (8 bytes of Application register content if it was burned and 32 bytes of the EEPROM content).

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#= <APP Reg Status>:<APP Reg Contents (8 bytes if APP Reg Status=1)><DS2430A EEPROM Contents (32 bytes)>
Where: APP Reg Status=1 if the APP Register had data or 0 if it did not

Query: 1:1:RTED?
Response: (for TEDS chip on channel 1 with valid app register data)
1:RTED:1=1:**168010a009750000**12648016a88ae8e112801f2000f60ec4046dd18737f3206a380555e765390800

ALLC

The ALLC command is used to read several channel settings at once.

Setting:
N/A – Command is Read only

Query:
This command must be a directed command use of the global channel indicator is not allowed.

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= GAIN:<Gain value>; SENS:< SENS value>; FSCI:< FSCI value>; FSCO:< FSCO value>; INPT:< INPT value>; FLTR:< FLTR value>; IEXC:< IEXC value>; OFLT:< OFLT value>; CLMP:< CLMP value>; OSCL:< OSCL value>;
Query: 1:1:ALLC??
Response: 1:ALLC:1=GAIN: 10.0;SENS: 10.0;FSCI: 100.0;FSCO: 10.0;INPT: 2.0;FLTR:1;IEXC:4;OFLT:0;CPLG:2;CLMP:0;OSCL:1;

RBIA

The RBIA command is used to read all channels Bias Levels.

Setting:

N/A – Command is Read only

Query:
This command is a global command and will return all channel bias readings regardless of the channel id in the command.

Query Format: Unit#:Ch#:RBIA?
Response format: Unit#:Cmd:Ch#:=CH1 bias;... CHn#:=CHn bias;
Query: 1:1:RBIA?
Query Response: 1:RBIA:1= 25.5;2= 25.5;3= 25.5;4= 25.5;

STUS

The STUS command is used to read the unit and all channel status indicators.

Setting:
N/A – Command is Read only

Query:
This command is a global command and will return all channel bias readings regardless of the channel id in the command.

Query Format: Unit#:Ch#:STUS?
Response format: Unit#:Cmd:Ch#:<unit status bit map>;<CH1 status bit map>;...;<CHn status bit map>;
Query: 1:1:STUS?
Query Response: 1:STUS:1:0;1;5;5;5;

Where :
Unit Bit 0 = 1= BAD EEPROM read for channel settings on power up
Unit Bit 1 = 1= BAD EEPROM read for Unit options on power up
Unit Bit 2 = 1= BAD EEPROM read for cal factors on power up
For Unit bit map 0=no errors
Channel Bit 0= Short input fault (0=Fault; 1 = no fault)
Channel Bit 1= Open input fault (0=Fault; 1 = no fault)
Channel Bit 2= Overload condition (0=Overload; 1 = no Overload)
For channel bit map 7=no errors

UNIT

Query:
The UNIT query returns the unit configuration information which includes the installed options, unit number, Model id and starting channel number
Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Model string:Firmware Ver string: Serial Number:Cal Date:Filter Corner: Unit#:#channels:Starting Ch#: Gain Option byte, Input Option Byte, Filter option byte,Misc1 option byte,Misc2 option byte<cr><lf>
Query: 1:1:UNIT?

Response: 1:UNIT:482C\s\s\s\s\s\s\s\s\s\s\s\s:FW\sVer\s1.0:12345:09-27-2006:10.000:1:4:1:16,37,1,143,0\r\n

Model & Firmware version strings are self-explanatory. Following are:
Serial Number (U16): Cal Date (10 character string): Filter corner (kHz)
Unit Id: Number of Channels: Starting Channel Number
Followed by the option bytes:

Gain Options		
OPT_GAIN_x1	0x01	Fixed x1
OPT_GAIN_x5	0x02	Fixed x5
OPT_GAIN_x10	0x04	Fixed x10
OPT_GAIN_VAR	0x08	Variable Fixed (x1,x10,x100)
OPT_GAIN_INC	0x10	incremental .1-200
OPT_GAIN_FINE2h	0x20	Fine Gain .0025-200
OPT_GAIN_FINE1k	0x40	Fine Gain .0025-1000
Input Options		
OPT_INP_ALLCHG	0x01	All charge
OPT_INP_ICPVOLTCHG	0x02	ICP|VOLT|CHG
OPT_INP_ICPVOLT	0x04	ICP|VOLT
OPT_INP_INTCAL	0x08	Internal Cal
OPT_INP_EXTCAL	0x10	External Cal
OPT_INP_ISOLATION	0x20	Isolation
Filter Options		
OPT_FILTER_IN	0x01	Input filter (time constant)
OPT_FILTER_OUT	0x02	Output filter
OPT_FILTER_FIXLP	0x04	Fixed LP filter
OPT_FILTER_PGMELP	0x08	Prgm LP Elliptical filter
OPT_FILTER_PGMBTR	0x10	Prgm LP Butterworth filter
Miscellaneous Options		
OPT_MISC_COUPLING	0x01	AC/DC coupling
OPT_MISC_CLAMP	0x02	Clamp
OPT_MISC_TEDS	0x04	TEDS
OPT_MISC_IEXC	0x08	current excitation
OPT_MISC_SINTG	0x10	Single Integration
OPT_MISC_DINTG	0x20	Double Integration
OPT_MISC_MUX	0x40	Mux /Switch-out
OPT_MISC_DISPLAY	0x80	FP Display

Future Use
Currently undefined and available for expansion

UNID

The UNID command is used to set the units ID number. The Unit Id number is critical to remote communications since it indicates to the unit which commands it should accept and respond to. Units are typically shipped with a unit id of 1. If more than one unit is in the system and they will be communicated with remotely the user must set a unique id in each unit. This can be done through the front panel interface, if one exists, or by connecting to each unit individually and sending this command.

Setting:

1:1:UNID= 2\r\n (unit 1, channel 1, New ID=2)

Setting Response: 2:UNID:ok
NOTE: The new Unit Id becomes effective immediately

Query:
This command can be sent as a query but its usefulness is marginal being as it is a directed command and as such it is necessary to include the Unit Id in the command and the response will simply validate the commands unit id parameter.

Query Format: Unit#:Ch#:UNID?
Response format: Unit#:Cmd:Ch#:=unit id
Query: 2:1:UNID?
Query Response: 2:UNID:1=2;

LEDS

The LEDS command is used to test the LED functionality of the front panel. When sent as a command the LED's on the front panel will flash 3 times. This command invokes a function and therefore has no query capability.

Setting:
2:1:LEDS= 0\r\n (unit 2, channel 1, Any value)

Setting Response: 2:LEDS:ok

Query:
N/A

RSET

The RSET command is used to restore the factory default channel settings. This command invokes a function and therefore has no query capability.

Setting:
2:1:RSET = 0\r\n (unit 2, channel 1, Any value)

Setting Response: 2:RSET:ok

Query:
N/A

The factory Defaults are:

- Gain= 1.0
- Sensitivity=10.0
- Full Scale input= 1000.0
- Full Scale output= 10.0
- Input Mode = ICP
- Input Filter=Disabled
- Current excitation=4.0mA
- Output Filter=Disabled
- Coupling =AC
- Clamp=OFF
- Internal Reference Oscillator=OFF

AUTR

The AUTR command invokes the Auto-Scaling function. With this command, the programmable gain is adjusted to give the largest signal amplitude output without causing an overload condition. The signals are checked internally; if there is an overload, the signal is stepped down and checked again.
Possible settings are: **0=off,1-on,2=immediate**. The Immediate option causes the auto scale function to execute one time and then turns off the function automatically. When Auto scale is 'ON' the unit will continue to invoke the function until the function is turned OFF with a subsequent command.

Setting:

2:1:AUTR =1\r\n ***(unit 2, channel 1, Auto Scaling ON)***

Setting Response: 2:AUTR:ok

Query:

Query Format: Unit#:Ch#: AUTR?
Response format: Unit#:Cmd:Ch#:=current state (0=off,1-on,2=immediate)
Query: 2:1:AUTR?
Query Response: 2:AUTR:1=0;

SAVS

The SAVS command is used to store the current channel setting as the default settings that will be restored on power up. This command invokes a function and therefore has no query capability.

Setting:

2:1:SAVS = 0\r\n(unit 2, channel 1, Any value)

Setting Response: 2:SAVS:ok

Query:
N/A

Communication Responses

Typically the unit will return **<Unit>:<Cmd String>:OK** when the command is successful. Errors are indicated with negative numbers. The unit may return one of the following:

<Unit>:<Cmd String>:OK<CR> <LF>
Represents that the last command was entered in the correct format and was performed properly.

<Unit>:<Cmd String>:-1<CR> <LF>
Option Error. The unit is not equipped with the option necessary to implement the command sent

<Unit>:<Cmd String>:-2<CR> <LF>
Channel Error. The channel number in the command is invalid.

<Unit>:<Cmd String>:-3<CR> <LF>
Command Error. The command is not recognized.

<Unit>:<Cmd String>:-4<CR> <LF>
Unit Error. The unit number in the command is invalid.

<Unit>:<Cmd String>:-5<CR> <LF>

Unit Error. The function invoked by the command encountered an error or a query only command (ex. RBIA) was sent as a setting.

<Unit>:<Cmd String>:-6<CR> <LF>

Command Parameter Error. A channel setting parameter was found to be out of range.

Model Number	FOUR CHANNEL, ICP® SENSOR SIGNAL CONDITIONER	Revision: E
482C16		ECN #: 39050

Performance	ENGLISH	SI	
Channels	4	4	
Sensor Input Type(s)	ICP®, Voltage	ICP®, Voltage	
Accuracy(Gain, x0.1 to x0.4)	± 5 %	± 5 %	
(Gain, x0.5 to x200)	± 1 %	± 1 %	
Output Range(Minimum)	± 10 V	± 10 V	
Frequency Range(-5 %)(x0.1 to x99.9 Gain)	0.05 to 100,000 Hz	0.05 to 100,000 Hz	
(-5 %)(x100 to x200 Gain)	0.05 to 50,000 Hz	0.05 to 50,000 Hz	
Phase Response(at 1 kHz)	± 1 °	± 1 °	
Cross Talk(maximum)	-72 dB	-72 dB	
Fault/Bias Monitor/Meter(LED)	Open/Short/Overload	Open/Short/Overload	
Control Interface			
Human Interface	Keypad	Keypad	
Display	2 rows, 16 columns	2 rows, 16 columns	
Digital Control Interface	RS-232	RS-232	
Digital Control: Data Rate	19,200 bps	19,200 bps	
Digital Control: Start, Data, Stop, Parity	1, 8, 1, No	1, 8, 1, No	
Digital Control: Handshaking	RTS/CTS	RTS/CTS	
Digital Control: Cable Length(Maximum)	50 ft	15.2 m	
Environmental			
Temperature Range(Operating)	+32 to +120 °F	0 to +50 °C	
Electrical			
Power Required(for supplied AC power adaptor)	AC Power	AC Power	
(direct input to unit)	DC power	DC power	
AC Power(50 to 60 Hz)	100 to 240 VAC	100 to 240 VAC	
	≤ 1.6 amps	≤ 1.6 amps	
Excitation Voltage(To Sensor)	≥ +24 VDC	≥ +24 VDC	
DC Offset	≤ 50 mV	≤ 50 mV	
DC Power	+9 to +18 VDC	+9 to +18 VDC	
	≤ 2.5 amps	≤ 2.5 amps	
Constant Current Excitation(To Sensor)	0 to 20 mA	0 to 20 mA	[1]
Output Impedance	≤ 50 Ohm	≤ 50 Ohm	
Overload Threshold(± 0.2 Vpk)	+10 Vpk	+10 Vpk	
Broadband Electrical Noise(1 to 10,000 Hz)(Gain x1)	50 µV rms	50 µV rms	[2]
Spectral Noise(1 Hz)(Gain x1)	8.0 µV/√Hz	8.0 µV/√Hz	[2]
(10 Hz)(Gain x1)	1.5 µV/√Hz	1.5 µV/√Hz	[2]
(100 Hz)(Gain x1)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
(1 kHz)(Gain x1)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
(10 kHz)(Gain x1)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
Broadband Electrical Noise(1 to 10,000 Hz)(Gain x10)	75 µV rms	75 µV rms	[2]
Spectral Noise(1 Hz)(Gain x10)	20 µV/√Hz	20 µV/√Hz	[2]
(10 Hz)(Gain x10)	1.5 µV/√Hz	1.5 µV/√Hz	[2]
(100 Hz)(Gain x10)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
(1 kHz)(Gain x10)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
(10 kHz)(Gain x10)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
Broadband Electrical Noise(1 to 10,000 Hz)(Gain x100)	350 µV rms	350 µV rms	[2]
Spectral Noise(1 Hz)(Gain x100)	100.0 µV/√Hz	100.0 µV/√Hz	[2]
(10 Hz)(Gain x100)	10.0 µV/√Hz	10.0 µV/√Hz	[2]
(100 Hz)(Gain x100)	8.0 µV/√Hz	8.0 µV/√Hz	[2]
(1 kHz)(Gain x100)	6.0 µV/√Hz	6.0 µV/√Hz	[2]
(10 kHz)(Gain x100)	6.0 µV/√Hz	6.0 µV/√Hz	[2]
Physical			
Electrical Connector(ICP® Sensor Input)	BNC Jack	BNC Jack	
(Output)	BNC Jack	BNC Jack	
(DC Power Input)	6-socket mini DIN (female)	6-socket mini DIN (female)	
(RS-232 Digital Control)	DB-9 Connector	DB-9 Connector	
Size (Height x Width x Depth)	3.2 in x 8.0 in x 5.9 in	8.1 cm x 20 cm x 15 cm	
Weight	2.00 lb	907 gm	

CE [3]

All specifications are at room temperature unless otherwise specified.
In the interest of constant product improvement, we reserve the right to change specifications without notice.

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OPTIONAL VERSIONS

Optional versions have identical specifications and accessories as listed for the standard model except where noted below. More than one option may be used.

NOTES:

[1] User adjustable, factory set at 4 mA (± 1.0 mA). One control adjusts all channels.
[2] Typical.
[3] See PCB Declaration of Conformance PS024 for details.

SUPPLIED ACCESSORIES:

Model 017AXX Power Cord (1)
Model 100-7103-50 (02711) Multi-conductor cable, 6-ft, 9-pin female to 9-pin male. (1)
Model 488B14/NC POWER CONVERTOR (1)
Model EE75 PCB MCSC Control Software. (1)

Entered:	Engineer:	Sales:	Approved:	Spec Number:
Date: 4-23-12	Date: 4-11-12	Date: 4-13-12	Date: 4-17-12	35062

PCB PIEZOTRONICS
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Fax: 716-684-0987
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Model Number	FOUR CHANNEL, ICP® SENSOR SIGNAL CONDITIONER	Revision: E
482C16		ECN #: 39050

Performance	ENGLISH	SI	
Channels	4	4	
Sensor Input Type(s)	ICP®, Voltage	ICP®, Voltage	
Accuracy(Gain, x0.1 to x0.4)	± 5 %	± 5 %	
(Gain, x0.5 to x200)	± 1 %	± 1 %	
Output Range(Minimum)	± 10 V	± 10 V	
Frequency Range(-5 %)(x0.1 to x99.9 Gain)	0.05 to 100,000 Hz	0.05 to 100,000 Hz	
(-5 %)(x100 to x200 Gain)	0.05 to 50,000 Hz	0.05 to 50,000 Hz	
Phase Response(at 1 kHz)	± 1 °	± 1 °	
Cross Talk(maximum)	-72 dB	-72 dB	
Fault/Bias Monitor/Meter(LED)	Open/Short/Overload	Open/Short/Overload	
Control Interface			
Human Interface	Keypad	Keypad	
Display	2 rows, 16 columns	2 rows, 16 columns	
Digital Control Interface	RS-232	RS-232	
Digital Control: Data Rate	19,200 bps	19,200 bps	
Digital Control: Start, Data, Stop, Parity	1, 8, 1, No	1, 8, 1, No	
Digital Control: Handshaking	RTS/CTS	RTS/CTS	
Digital Control: Cable Length(Maximum)	50 ft	15.2 m	
Environmental			
Temperature Range(Operating)	+32 to +120 °F	0 to +50 °C	
Electrical			
Power Required(for supplied AC power adaptor)	AC Power	AC Power	
(direct input to unit)	DC power	DC power	
AC Power(50 to 60 Hz)	100 to 240 VAC	100 to 240 VAC	
	≤ 1.6 amps	≤ 1.6 amps	
Excitation Voltage(To Sensor)	≥ +24 VDC	≥ +24 VDC	
DC Offset	≤ 50 mV	≤ 50 mV	
DC Power	+9 to +18 VDC	+9 to +18 VDC	
	≤ 2.5 amps	≤ 2.5 amps	
Constant Current Excitation(To Sensor)	0 to 20 mA	0 to 20 mA	[1]
Output Impedance	≤ 50 Ohm	≤ 50 Ohm	
Overload Threshold(± 0.2 Vpk)	+10 Vpk	+10 Vpk	
Broadband Electrical Noise(1 to 10,000 Hz)(Gain x1)	50 µV rms	50 µV rms	[2]
Spectral Noise(1 Hz)(Gain x1)	8.0 µV/√Hz	8.0 µV/√Hz	[2]
(10 Hz)(Gain x1)	1.5 µV/√Hz	1.5 µV/√Hz	[2]
(100 Hz)(Gain x1)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
(1 kHz)(Gain x1)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
(10 kHz)(Gain x1)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
Broadband Electrical Noise(1 to 10,000 Hz)(Gain x10)	75 µV rms	75 µV rms	[2]
Spectral Noise(1 Hz)(Gain x10)	20 µV/√Hz	20 µV/√Hz	[2]
(10 Hz)(Gain x10)	1.5 µV/√Hz	1.5 µV/√Hz	[2]
(100 Hz)(Gain x10)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
(1 kHz)(Gain x10)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
(10 kHz)(Gain x10)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
Broadband Electrical Noise(1 to 10,000 Hz)(Gain x100)	350 µV rms	350 µV rms	[2]
Spectral Noise(1 Hz)(Gain x100)	100.0 µV/√Hz	100.0 µV/√Hz	[2]
(10 Hz)(Gain x100)	10.0 µV/√Hz	10.0 µV/√Hz	[2]
(100 Hz)(Gain x100)	8.0 µV/√Hz	8.0 µV/√Hz	[2]
(1 kHz)(Gain x100)	6.0 µV/√Hz	6.0 µV/√Hz	[2]
(10 kHz)(Gain x100)	6.0 µV/√Hz	6.0 µV/√Hz	[2]
Physical			
Electrical Connector(ICP® Sensor Input)	BNC Jack	BNC Jack	
(Output)	BNC Jack	BNC Jack	
(DC Power Input)	6-socket mini DIN (female)	6-socket mini DIN (female)	
(RS-232 Digital Control)	DB-9 Connector	DB-9 Connector	
Size (Height x Width x Depth)	3.2 in x 8.0 in x 5.9 in	8.1 cm x 20 cm x 15 cm	
Weight	2.00 lb	907 gm	

CE [3]

All specifications are at room temperature unless otherwise specified.
In the interest of constant product improvement, we reserve the right to change specifications without notice.

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OPTIONAL VERSIONS

Optional versions have identical specifications and accessories as listed for the standard model except where noted below. More than one option may be used.

NOTES:

[1] User adjustable, factory set at 4 mA (± 1.0 mA). One control adjusts all channels.
[2] Typical.
[3] See PCB Declaration of Conformance PS024 for details.

SUPPLIED ACCESSORIES:

Model 017AXX Power Cord (1)
Model 100-7103-50 (02711) Multi-conductor cable, 6-ft, 9-pin female to 9-pin male. (1)
Model 488B14/NC POWER CONVERTOR (1)
Model EE75 PCB MCSC Control Software. (1)

Entered:	Engineer:	Sales:	Approved:	Spec Number:
Date: 4-23-12	Date: 4-11-12	Date: 4-13-12	Date: 4-17-12	35062

PCB PIEZOTRONICS
3425 Walden Avenue, Depew, NY 14043
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E-Mail: info@pcb.com

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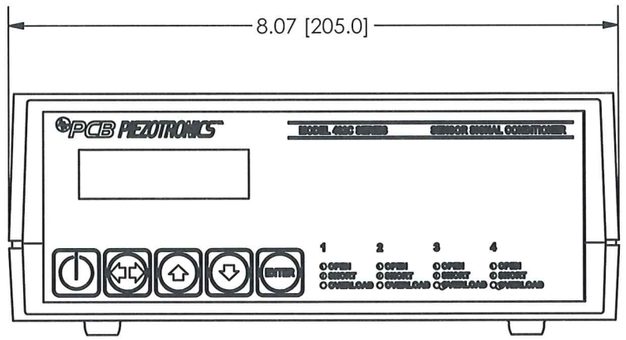
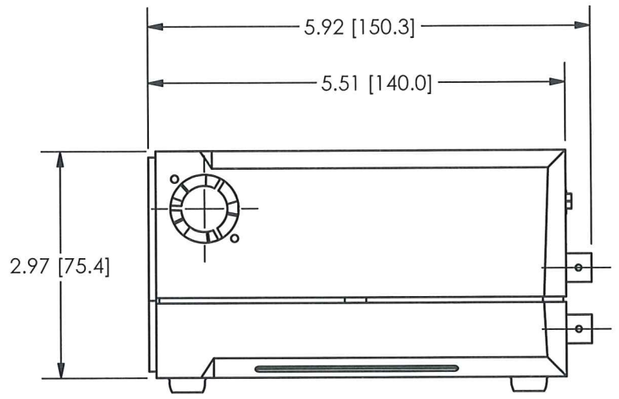
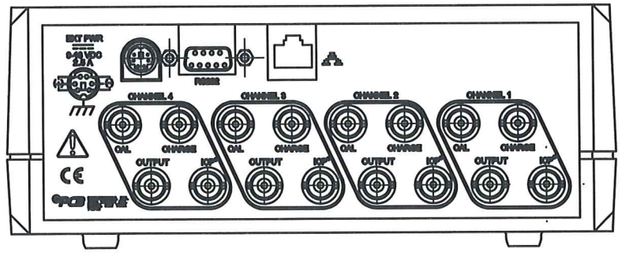
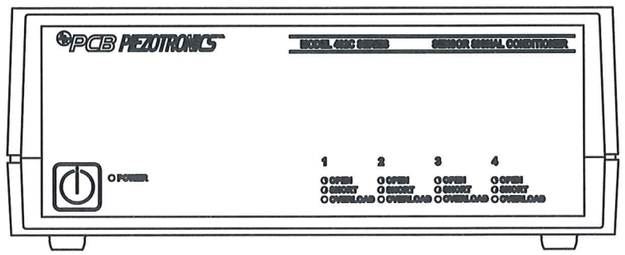
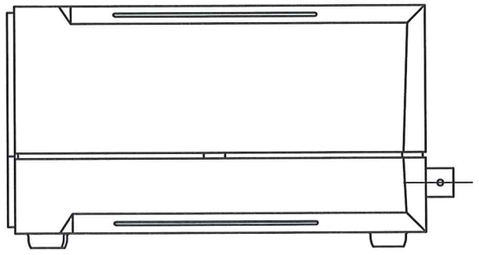
REVISIONS		
REV	DESCRIPTION	DIN
E	UPDATED ARTWORK	37737

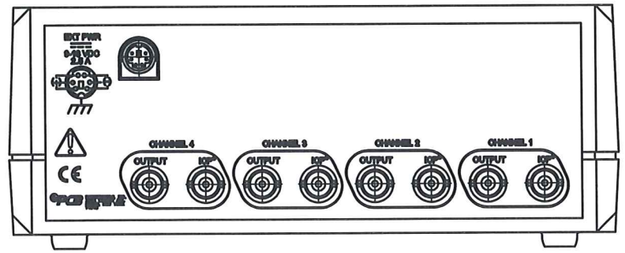


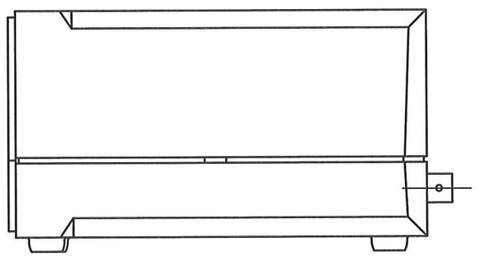


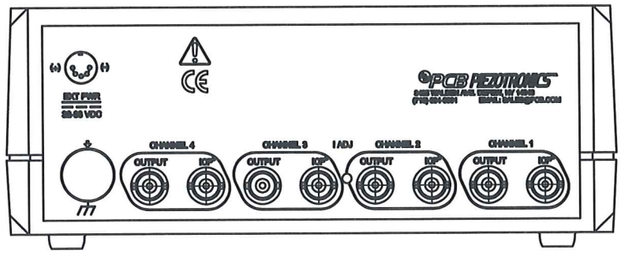












UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:	
DIMENSIONS IN INCHES DECIMALS XX ±.03 XXX ±.010 ANGLES ± 2 DEGREES	DIMENSIONS IN MILLIMETERS [IN BRACKETS] DECIMALS X ± 0.8 XX ± 0.25 ANGLES ± 2 DEGREES
FILLETS AND RADII .003 - .005	FILLETS AND RADII 0.07 - 0.13

DRAWN		CHECKED		ENGINEER	
SMB	12/16/11	ECB	12/16/11	KEN L	12/16/11

TITLE

OUTLINE DRAWING
MODEL 482C SERIES 4 CHANNEL
SIGNAL CONDITIONER

PCB PIEZOTRONICS INC.
3425 WALDEN AVE. DEPEW, NY 14043
(716) 684-0001 E-MAIL: sales@pcb.com

CODE IDENT. NO.	DWG. NO.	
52681	25495	
SCALE: .5X	SHEET 1 OF 1	

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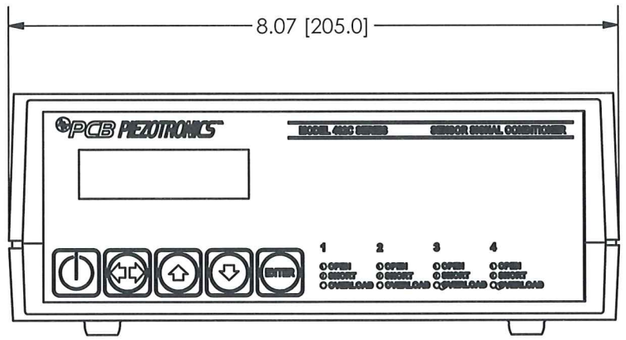

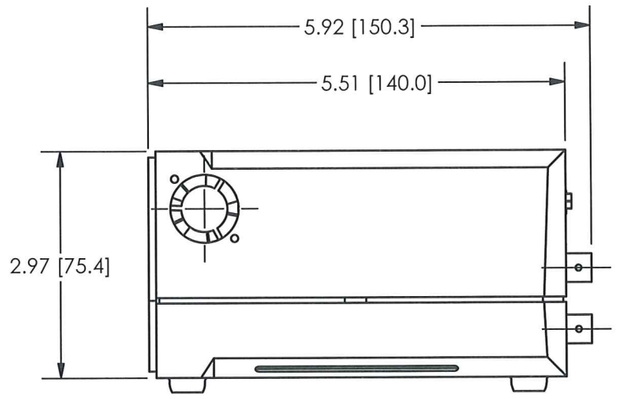

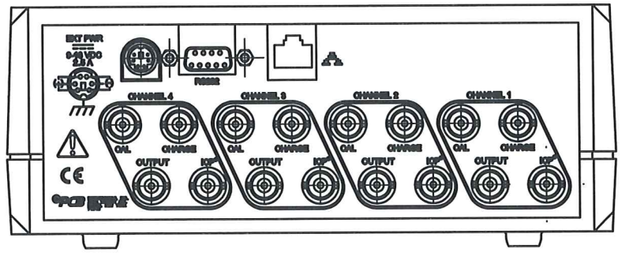

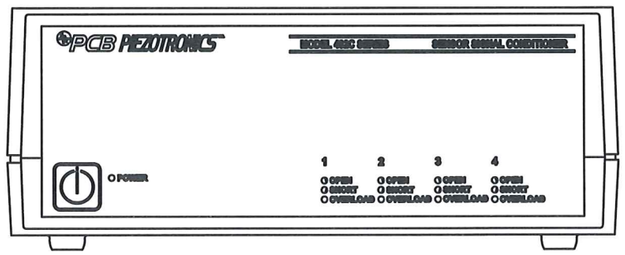

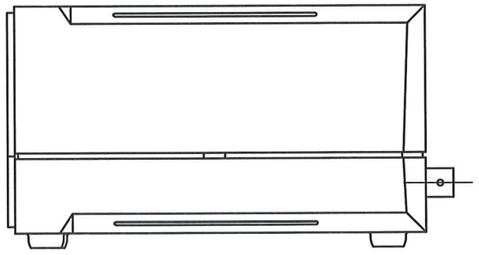

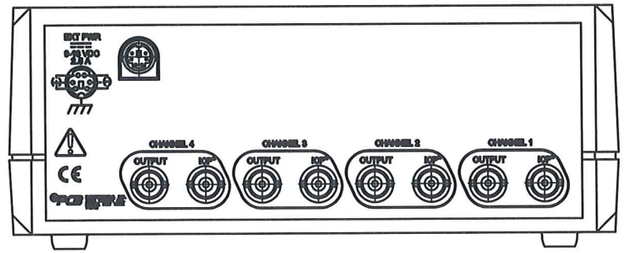

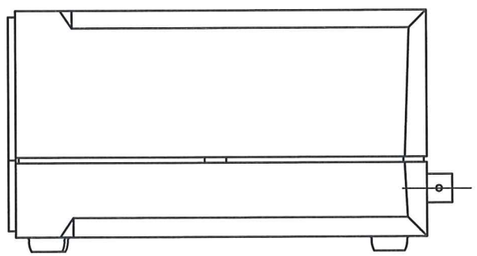

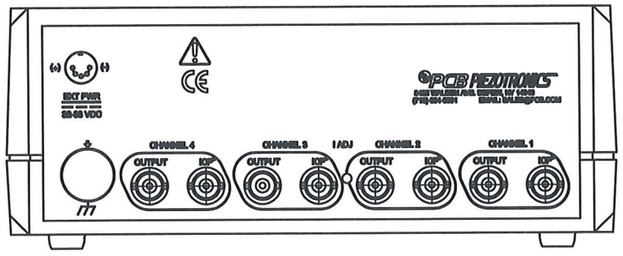

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