Model 482C54/04

4-channel ICP® Sensor Signal Conditioner

Installation and Operating Manual

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

Toll-free: 800-828-8840
24-hour SensorLine: 716-684-0001
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Web: www.pcb.com





Repair and Maintenance

PCB guarantees Total Customer Satisfaction through its "Lifetime Warranty Plus" on all Platinum Stock Products sold by PCB and through its limited warranties on all other PCB Stock, Standard and Special products. Due to the sophisticated nature of our sensors and associated instrumentation, **field servicing and repair is not recommended and, if attempted, will void the factory warranty**.

Beyond routine calibration and battery replacements where applicable, our products require no user maintenance. Clean electrical connectors, housings, and mounting surfaces with solutions and techniques that will not harm the material of construction. Observe caution when using liquids near devices that are not hermetically sealed. Such devices should only be wiped with a dampened cloth—never saturated or submerged.

In the event that equipment becomes damaged or ceases to operate, our Application Engineers are here to support your troubleshooting efforts 24 hours a day, 7 days a week. Call or email with model and serial number as well as a brief description of the problem.

Calibration

Routine calibration of sensors and associated instrumentation is necessary to maintain measurement accuracy. We recommend calibrating on an annual basis, after exposure to any extreme environmental influence, or prior to any critical test.

PCB Piezotronics is an ISO-9001 certified company whose calibration services are accredited by A2LA to ISO/IEC 17025, with full traceability to SI through N.I.S.T. In addition to our standard calibration services, we also offer specialized tests, including: sensitivity at elevated or cryogenic temperatures, phase response, extended high or low frequency response, extended range, leak testing, hydrostatic pressure testing, and others. For more information, contact your local PCB Piezotronics distributor, sales representative, or factory customer service representative.

Returning Equipment

If factory repair is required, our representatives will provide you with a Return Material Authorization (RMA) number, which we use to reference any information you have already provided and expedite the repair process. This number should be clearly marked on the outside of all returned package(s) and on any packing list(s) accompanying the shipment.

Contact Information

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For a complete list of distributors, global offices and sales representatives, visit our website, www.pcb.com.

Safety Considerations

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the precautions required to avoid injury. While our equipment is designed with user safety in mind, the protection provided by the equipment may be impaired if equipment is used in a manner not specified by this manual.

Discontinue use and contact our 24-Hour Sensorline if:

- Assistance is needed to safely operate equipment
- Damage is visible or suspected
- Equipment fails or malfunctions

For complete equipment ratings, refer to the enclosed specification sheet for your product.

Definition of Terms and Symbols

The following symbols may be used in this manual:



DANGER
Indicates an immediate hazardous situation, which, if not avoided, may result in death or serious injury.



CAUTION
Refers to hazards that could damage the instrument.



NOTE
Indicates tips, recommendations and important information. The notes simplify processes and contain additional information on particular operating steps.

The following symbols may be found on the equipment described in this 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 on the unit indicates that the user should refer to the operating instructions located in the manual.



This symbol indicates safety, earth ground.

PCB工业监视和测量设备 - 中国RoHS2公布表

PCB Industrial Monitoring and Measuring Equipment - China RoHS 2 Disclosure Table

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
住房	O	O	O	O	O	O
PCB板	X	O	O	O	O	O
电气连接器	O	O	O	O	O	O
压电晶体	X	O	O	O	O	O
环氧	O	O	O	O	O	O
铁氟龙	O	O	O	O	O	O
电子	O	O	O	O	O	O
厚膜基板	O	O	X	O	O	O
电线	O	O	O	O	O	O
电缆	X	O	O	O	O	O
塑料	O	O	O	O	O	O
焊接	X	O	O	O	O	O
铜合金/黄铜	X	O	O	O	O	O

本表格依据 SJ/T 11364 的规定编制。

O： 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

X： 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

铅是欧洲RoHS指令2011/65/ EU附件三和附件四目前由于允许的豁免。

CHINA RoHS COMPLIANCE

Component Name	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Chromium VI Compounds (Cr(VI))	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
Housing	O	O	O	O	O	O
PCB Board	X	O	O	O	O	O
Electrical Connectors	O	O	O	O	O	O
Piezoelectric Crystals	X	O	O	O	O	O
Epoxy	O	O	O	O	O	O
Teflon	O	O	O	O	O	O
Electronics	O	O	O	O	O	O
Thick Film Substrate	O	O	X	O	O	O
Wires	O	O	O	O	O	O
Cables	X	O	O	O	O	O
Plastic	O	O	O	O	O	O
Solder	X	O	O	O	O	O
Copper Alloy/Brass	X	O	O	O	O	O

This table is prepared in accordance with the provisions of SJ/T 11364.

O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

X: Indicates that said hazardous substance contained in at least one of the homogeneous materials for this part is above the limit requirement of GB/T 26572.
Lead is present due to allowed exemption in Annex III or Annex IV of the European RoHS Directive 2011/65/EU.

SIGNAL CONDITIONER

Model 482C54
Model 482C64

GENERAL OPERATION MANUAL

For powering ICP® and charge sensors and remote charge convertors, these signal conditioners provide 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.

This manual describes the functions and features of models 482C54 and 482C64.

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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, Models 482C54 & 482C64, 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.

482C54 and 482C64 require 10-15 VDC with 500 mA to operate. In turn, they supply up to 20 mA and 24 VDC to connected ICP® sensors or in-line charge converters. The units receive power from a supplied 12 VDC universal AC power adaptor.

1-2. System Description

Models 482C54 and 482C64 are four-channel, bench top signal conditioner designed to interface measurement signals to readout or recording devices. The units provide up to 20 mA of constant current excitation to power ICP® sensors and in-line charge converters. The models can also accept a direct charge input. A calibration input is included on each model that is connected to a 1,000 pF capacitor. Other features include incremental gain, a front panel keypad and display, BNC jack inputs and outputs and an RS-232 port for computer control. Model 482C64 includes an Ethernet port as an additional option for computer control (the only difference between the two models).

List of 482C54 and 482C64 features:

- ICP®, Voltage and Charge sensor input
- Incremental gain, x0.1 – x200 (step of .1)
- Front panel keypad and display
- 10 kHz low pass output filter (fourth order)
- External calibration input (1,000 pF capacitor)
- RS-232 interface for computer control with supplied MCSC software
- 12-bit accuracy signal conditioning
- Input fault and overload LED
- Variable ICP® source current, up to 20 mA per channel
- Illuminator lights and a power button on the front panel
- Rear panel BNC jack input/output connectors
- Non-Volatile Memory

1-2.1 Input/Output Mode

482C54 and 482C64 contain 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

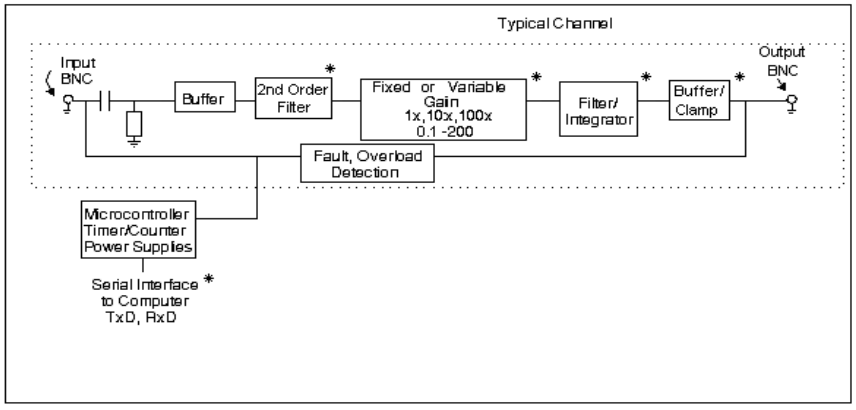


Figure 1 Generic block diagram of model series 482C signal conditioners (* = option)

1-4. Installation

482C54 and 482C64 come 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.

1-4.1 Grounding Techniques

Integrating models 482C54 and 482C64 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 both models have their signal ground line tied together internally at the power supply.

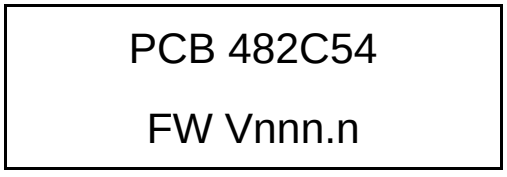
2. Insure that the sensor does not pick up line noise from the body under test. The case of the sensor should be isolated from the body under test (ground) using an isolation pad. The isolation pad breaks the loop formed by the signal path of the sensor to the signal conditioners and the return (ground) from conditioners 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 models when initially powered on.





▼ 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 input 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 models include three input modes – ICP®, voltage and charge. The factory default for all channels is ICP®. To change the mode select the INPT option from the main menu use the down ↓ arrow button to scroll down and the left / right ←→ button until the cursor is over INPT and the hit ENTER.

Gain	Sens	INPT
FSOT	FSIN	FLTi

A 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 Input Type 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® or voltage 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.

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

Scroll and select INPT 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 Voltage.

Chan	Input Type
2	VOLTAGE

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.

NOTE: In ICP® mode, the OPEN LED stays lit until a properly functioning ICP® sensor is attached.

NOTE: Three different charge sensitivities are available for Charge Input Mode: 0.1 mv/pC, 1.0 mV/pC and 10 mV/pC. The front panel OPEN LED goes out for channels set to charge mode to signify the internal charge amplifier is functioning properly. The bias measurement submenu (see section 2-4, #12) will display the actual bias voltage of the internal charge amplifier.

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	INPT
FSOT	FSIN	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, perform the following steps:

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.

Channel	Gain
2	001.0

To change the gain, use the up ↑ and down ↓ arrow keys to scroll through the values. The models have incremental gain selectable from .1 to 200.0 (step of .1). Use 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.

Channel	Gain
2	010.0

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 any 100 - 240 VAC 47 - 63 Hz power source, attach the supplied ferrite clamp on the AC cord to ensure CE conformance. The ferrite clamp should be placed as close to the signal conditioner as possible. Press the "ON/OFF" button to turn the unit on.

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

1-6. Maintenance and Repair

It is not recommended that repair of these models be attempted in the field. Should trouble occur, contact the factory for assistance. If the units become dusty and dirty, they may be wiped off with a soft cloth.

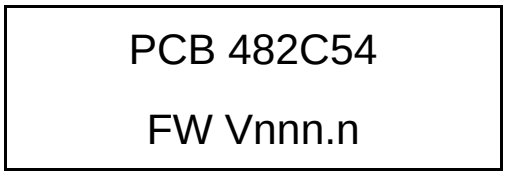
2-0. FRONT PANEL MODULE CONTROL

2-1. Introduction

Both models are 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:



The unit is initialized, with the factory default settings.
The factory defaults are:

- Gain = 1.0
- Gain Type = Gain
- Sensitivity = 10.0
- Full Scale input = 1000.0
- Full Scale output = 10.0
- Input Mode = ICP®
- Input Filter = Disabled (if equipped)
- Current excitation = 4.0 mA
- Output Filter = Disabled (if equipped)
- Coupling = AC
- Clamp = OFF

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	INPT
FSOT	FSIN	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 ↓ or up ↑ arrow key. This action scrolls vertically to the subsequent lines on the menu. The additional menu lines that can be selected from are shown below.

EXCi	EXCv	FLTo
ACDC	ZERO	ARNG
SWOT	CLMP	Bias
CHRD	Cal	LEDS
Ver?	Unit	Reset
Disp	Savs	Res

2-4. Submenu Format and Command Selections

1) Gain Functionality – Includes five menu selections

The following menu options all pertain to how the gain functionality operates in the 482C54 and 482C64.

Gain Type (GType on front panel): Allows the user to choose how the gain of each channel can be set. The selections in the submenu are Gain and Normalize (Gain is the factory default setting). Pressing ENTER brings up the submenu shown below. The up ↑ and down ↓ arrow key can be used toggle between the two options.

Gain Set Option
Gain

Both options return control to the main menu after a selection is made. If Gain is selected then only the **GAIN** menu item can be used to set the gain of a channel. If Normalize is selected then the **GAIN** menu item is disabled and **SENS**, **FSOT** and **FSIN** will be used to set the gain using this equation: **Gain in ICP® mode = (FSOT * 1000) / (FSIN * SENS). Gain in charge mode = (FSOT * 1000) / (Charge Sensor SENS * FSIN * Charge Convertor SENS).**

If the user attempts to use a menu selection (SENS, FSOT, FSIN, GAIN) that conflicts with the GType setting the message 'Invalid Item for Gain Entry Type' will be displayed.

Gain (GAIN on front panel): Directly sets the gain value of each channel. The gain range is from .1 to 200.0 (step of .1). GType must be set to the Gain selection. See section 1-4.2c for instructions on setting the gain directly.

Sensitivity (SENS on front panel): The sensor sensitivity is entered here using the ←→ and ↑↓ arrow keys and then hitting Enter. GType must be set to the Normalize selection.

Full Scale Input (FSIN on front panel): The estimated full scale mechanical input (ex – engineering units, g's, psi, bar, etc.) is entered here using the ←→ and ↑↓ arrow keys and then hitting Enter. GType must be set to the Normalize selection.

Full Scale Output (FSOT on front panel): The desired full scale output voltage is entered here using the ←→ and ↑↓ arrow keys and then hitting Enter. GType must be set to the Normalize selection.

The submenus for SENS, FSIN and FSOT appear like this:

Chan	Sensitivity
2	00100.000

Chan	FS In
2	01000.000

Chan	FSOT
2	0010.0

The 482C54 and 482C64 have the ability to automatically normalize the output sensitivity of each channel based on the sensitivity of the sensor (SENS), the full scale value of the input (FSIN) in engineering units (g's for example) and the full scale output (FSOT) of the amplifier expressed in volts (this is the output that a signal at an FSIN level will produce). As stated previously, the gain equations are:

Gain in ICP® mode = (FSOT * 1000) / (FSIN * SENS)

Gain in charge mode = (FSOT * 1000) / (Charge Sensor SENS * FSIN * Charge Convertor SENS)

Normalized Output Example: A full scale output of 5 volts is desired and a full scale input of 380 engineering units is expected. The sensor sensitivity is 9.96 mV/g. These values should be entered into FSOT, FSIN and SENS respectively. The gain will be automatically set to 1.3 to give a 5 volt full scale output based on the expected input and sensor sensitivity.

Gain = (5 * 1000) / (380 * 9.96) = 1.3

Normalization is useful when standardizing the output of channels with sensors of different sensitivities. Consider the following example where 1V/unit standardization on each channel is desired:

Channel	Sensor Sensitivity	Gain Setting	Actual Gain Needed
1	10.10 $^{mV}/_{unit}$	99.0	99.01
2	101.32 $^{mV}/_{unit}$	9.9	9.869
3	22.30 $^{mV}/_{unit}$	44.8	44.84

2) Sensor Input Mode (INPT on front panel):
See section 1-4.2b.

3) Input Filter (FLTi on front panel):
A screen stating 'This Option is Not Installed' will appear. These models do not come standard with an input filter, but the option is available. Contact the factory for more information.

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.

GAIN	SENS	INPT
FSOT	FSIN	FLTi

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.

Chan	INP Filter
2	Off

4) Output Filter (FLTo on front panel):
482C54 and 482C64 come standard with a 10 kHz output filter.

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.

EXCi	EXCv	FLTo
ACDC	ZERO	ARNG

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-nn.nk' or 'Off', once you have the desired setting selected hit ENTER to apply it.

NOTE: The ON setting also indicates the filter corner, in kHz, implemented by the filter for the channel.

Chan	Out Filter
2	ON-10.0k

5) ICP® Current Adjustment (EXCi on front panel):
The current excitation value can be set from 0 – 20 mA, where 0 = Off. To set the current excitation value, move the cursor to the 'EXCi' location, as shown below.

EXCi	EXCv	FLTo
ACDC	ZERO	ARNG

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.

Chan	ICP Current
4	02 mA

The 482C54 and 482C64 will turn off the current excitation signal if the unit is not in ICP® input mode and will not allow it to be set unless it is in ICP® mode. If a channel is selected from the EXCi menu that is inappropriate then **NA** will appear as shown below in place of the ICP® current settings. Also, because of this limitation, the 'ALL' channel selection is not allowed for this setting.

Chan	ICP Current
2	NA

NOTE: The factory default setting for the ICP® current is 4 mA.

6) Voltage Excitation (EXCv on the front panel):
Voltage excitation is not applicable to the 482C54 or 482C64. The 'Option Not Installed' message will appear if it is activated.

EXCi	EXCv	FLTo
ACDC	ZERO	ARNG

7) Input Coupling (ACDC on front panel):
Input coupling is not applicable to the 482C54 or 482C64. The models are AC coupled only. The 'Option Not Installed' message will appear if it is activated.

EXCi	EXCv	FLTo
ACDC	ZERO	ARNG

8) Auto Zero/ Auto Balance (ZERO on front panel):
Auto zero/Auto balance is not applicable to the 482C54 or 482C64. The 'Option Not Installed' message will appear if it is activated.

EXCi	EXCv	FLTo
ACDC	ZERO	ARNG

9) Auto Range (ARNG on front panel):
The auto range (also referred to as auto scale) feature on the models provides an automatic scaling of the output signal. Please refer to section 3-6.1 for further description. With this command, the programmable gain is implemented to give 0.8 of the full scale output. The signals are checked internally using the onboard A/D. To use this feature, place the cursor over the word "ARNG" on the display and press the enter key, the following submenu will appear.

EXCi	EXCv	FLTo
ACDC	ZERO	ARNG

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.

Chan	Autoscale
2	Off

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.

10) Switched Output (SWOT on front panel):
Switched Output is not applicable to the 482C54 or 482C64. The 'This Option is Not Installed' message will appear if it is activated.

SWOT	CLMP	Bias
CHRD	Cal	LEDS

11) Clamp (CLMP on the front panel):
The clamping function is not applicable to the 482C54 or 482C64. The 'This Option is Not Installed' message will appear if it is activated.

SWOT	CLMP	Bias
CHRD	Cal	LEDS

12) Bias Measurement (Bias on the front panel):
The models are capable of measuring the bias voltage present on each channel. By moving the cursor upon the "Bias" location, the display appears as follows:

SWOT	CLMP	Bias
CHRD	Cal	LEDS

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.

Chan	Bias
2	0023.7

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.

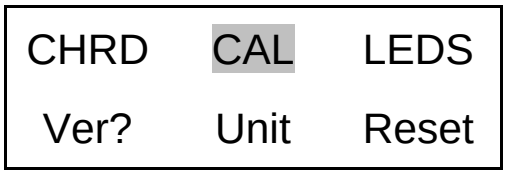
13) Channel Output Measurement (CHRD on front panel):
The models are capable of digitizing the channel output and displaying it on the front panel. By moving the cursor upon the "CHRD" location, the display appears as follows:

SWOT	CLMP	Bias
CHRD	CAL	LEDS

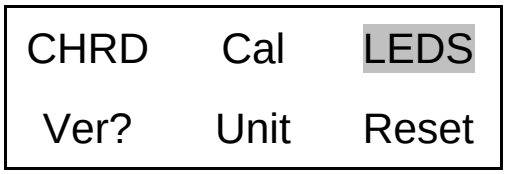
Using the ENTER button, the submenu appears as shown in the following diagram. Choose the channel you wish to change by using the up ↑ and down ↓ arrow keys. The output reading for the channel will be displayed automatically when the channel is selected.

Chan	Output
1	005.3

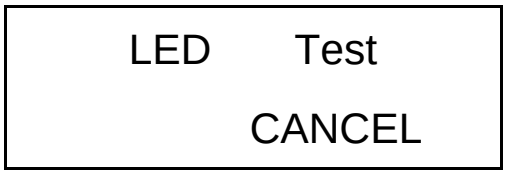
14) Calibration (CAL on front panel):
The Cal option is not applicable to the 482C54 or 482C64. The 'This Option is Not Installed' message will appear if it is activated.



15) LED Test (LEDS on front panel):
The testing of the front panel LEDs allows you to check whether or not they are functioning properly. To test them, place the cursor over the word "LEDS" on the display and press enter.

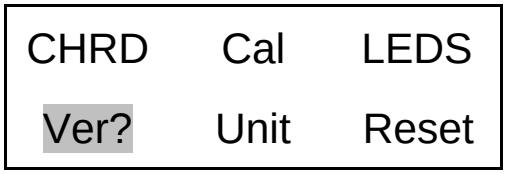


The screen shown below will be displayed:

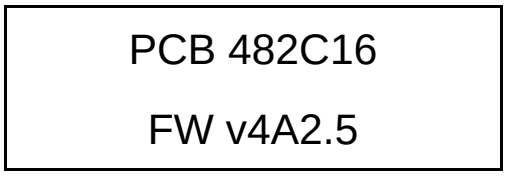


Use the up or down arrow key to select 'Execute' or 'Cancel'. Both options return control to the main menu. If 'Execute' is selected then the LED's will blink 3 times if 'Cancel' is selected then no action is taken.

16) Firmware Version (Ver? on front panel):
To determine the firmware version of the unit select the 'Ver?' menu option and hit enter.



A screen similar to the one shown below will be displayed:



17) Unit Identity (Unit on front panel):
The Unit ID may be changed by pressing the ENTER key on the front panel when the cursor is located on the Unit option.

CHRD	Cal	LEDS
Ver?	Unit	Reset

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. Both models include an RS-232 port. 482C64 also includes an Ethernet port.

18) Reset to Factory Default Settings (Reset on front panel):
The 482C54 and 482C64 reset capability 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.

CHRD	Cal	LEDS
Ver?	Unit	Reset

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.

Factory Defaults
Execute

19) Display Content Options (Disp on front panel):
The display option allows the user to choose from 3 selections of front panel content. To enter this mode, place the cursor over the Disp option and hit enter.

Ver?	Unit	Reset
Disp	Savs	Res

Pressing the ENTER brings up a submenu that allows the operator to continue by selecting either 'Gain', 'Bias' or 'Output'. 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. If the gain is greater than two significant digits then it is displayed in terms of thousands (i.e. 100 = 0.1k, 200 = 0.2k). Additionally, directly above the gain on the 1st line of the display will be up to 3 characters representing the channels input mode; 'I' for 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.

Display Opts
Gain

Following is what the screen will look like if the display was set to show 'Gain' and channel 1 has a gain of 100 and is in ICP® mode with the input filter 'On' with no output filter option installed. Similarly, channel 2 has a gain of 200 and is in ICP® mode with the input filter off; channel 3 has a gain of 1 and is in voltage mode with an input filter enabled and channel 4 has a gain of 10 and is in voltage mode with the input filter off.

I*-	I -	V*-	V -
0.1k	0.2k	1	10

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'.

I*-	I -	V*-	V -
B14	B14	B24	B24

The 'Output" display option is the same as the bias option except the channels output is digitized and displayed. As with the bias reading it will be refreshed periodically.

Following is what the screen will look like if the display was set to show 'Output'.

I*-	I -	V*-	V -
+0.0	9.9	+5.0	+1.0

NOTE: Due to the limited screen size values less than or equal to -9.9 are displayed as -9.9 and values greater than or equal 9.9 are displayed as 9.9.

20) Save current settings (Savs on front panel):
Activation of 'Savs' on the models causes the current settings to be saved as the default settings and used when the unit is powered up again. This command is useful for units without an on/off power button. For units with a power button the settings are automatically saved when the unit is powered down using the button.

Ver?	Unit	Reset
Disp	Savs	Res

21) Options that are not included and/or installed
For any selected option not actually included in models 482C54 and 482C64, an 'option not installed' message is shown on the display. When the ENTER button is pressed, the following is shown:

Option not installed

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. The sensor is powered by a +24 VDC power supply having a typical constant current of 2 to 20 mA (current can be fixed or variable depending on the signal conditioner model).

Sensor excitation occurs as the constant current of all channels are set. Model 482C54 and 482C64 allow the constant current to be adjusted up to 20 mA to provide the required excitation for most applications. Special situations, such as driving extra-long cables (more than 1,000 ft) with high frequency or fast rise time pulses, may require increasing the drive current to 12 mA or higher.

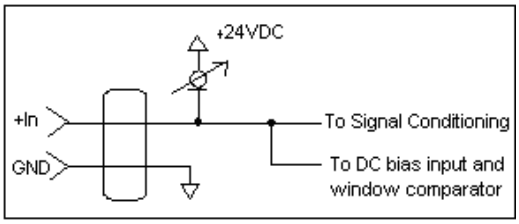


Figure 2 ICP® Sensor Excitation

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 model 401B04 sensor simulator, 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 482C54 and 482C64 monitor 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.

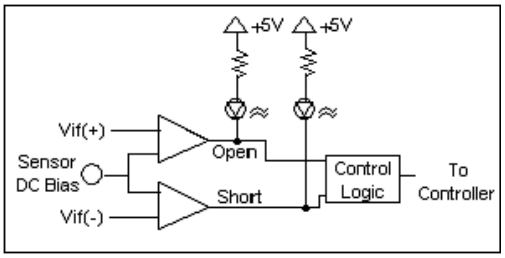


Figure 3 Input Fault Window Comparator with LED Indicator

3-4. Input Interface

The input signal conditioning for each channel provides a unity gain buffer with high-input impedance amplifiers. Both models are AC coupled. The DC bias is eliminated from signal.

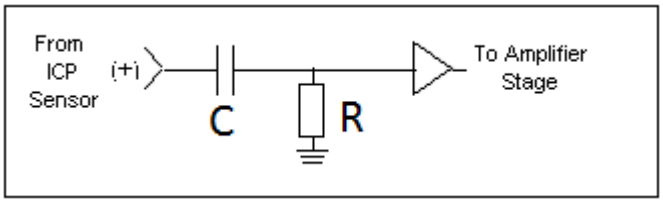


Figure 4 Input Amplifier Configuration

3-5. 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:

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

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.

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

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 482C54 and 482C64 have the capability to provide signal conditioning for charge mode sensors in addition to the standard ICP® type. The sensitivity (mV/pC) of the charge conversion will allow the charge mode sensors (pC/unit) to be normalized.

3-6. Auto scaling and Overload Detection

3-6.1 Auto scaling

To avoid overload, models 482C54 and 482C64 feature auto scaling 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 auto scale 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 auto scale feature is as follows:

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

3-6.2 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 6) 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.

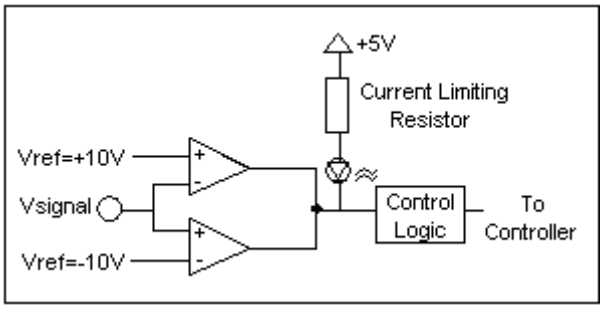


Figure 5 Auto scale/Overload Window Comparator

3-7. Connector Configuration

482C54 and 482C64 provide BNC inputs and outputs for ICP® and charge mode sensors.

Input/ Output Connector Definitions:
The BNC connectors are used to accept ICP®, charge 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. In all input modes, the signal must be AC type signals, unless the DC coupling option is turned on.

3-8. RS-232 Interface

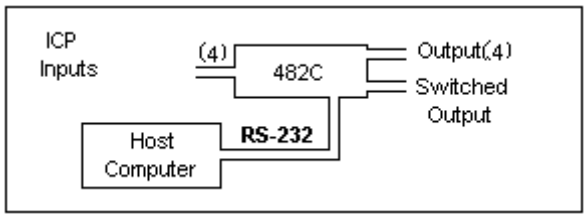


Figure 6 RS-232 Configuration

The RS-232 Interface provides serial control of 482C54 and 482C64. 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.

3-9. 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, input mode) 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.

4-0. COMPUTER INTERFACE PROGRAMMING GUIDE

4-1. Introduction

Individual commands are subject to feature availability on the particular unit. The RS-232 Interface enables the 482C16 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

482C54 and 482C64 include an RS-232 port. 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 Pin out 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

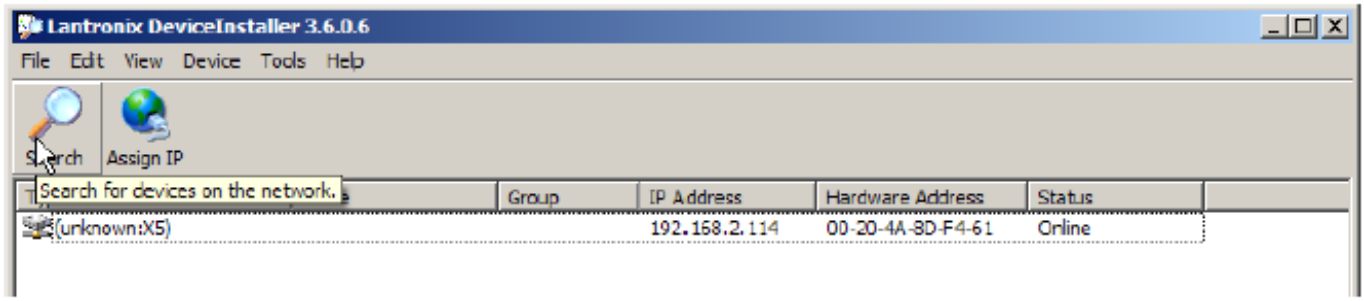
4-5. Ethernet Communication (482C64 ONLY)

The 482C64 is equipped with an Ethernet port for computer control. An IP address for this model must be setup before any remote communication can commence. The steps to set the IP address are as follows.

Connect directly with a crossover CAT5 cable or through a hub to a single signal conditioner. The conditioner is presumed to have a unit ID set to 1.

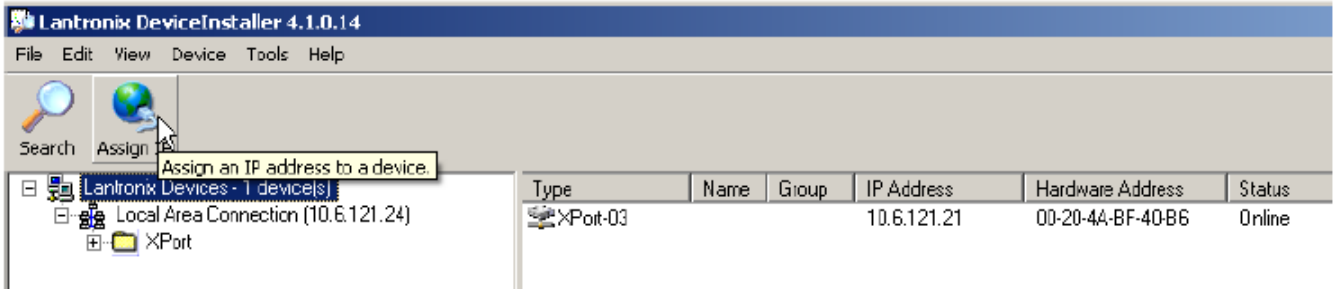
The IP address is set using an independent utility from Lantronix called DeviceInstaller™. This utility is provided on the PCB MCSC application software CD and is also available for download at the Lantronix website. DeviceInstaller™ can be accessed from the MCSC software 'Help │Configure Ethernet Devices' menu item.

Run DeviceInstaller™ and Screen Shot 1 will appear. Click on the search icon and the program will search for the Ethernet device internal to the signal conditioner. When the conditioner is found, details about the unit show in the list. You can verify it is the correct unit by comparing the hardware (MAC) address displayed to the one listed on the side of the signal conditioner.



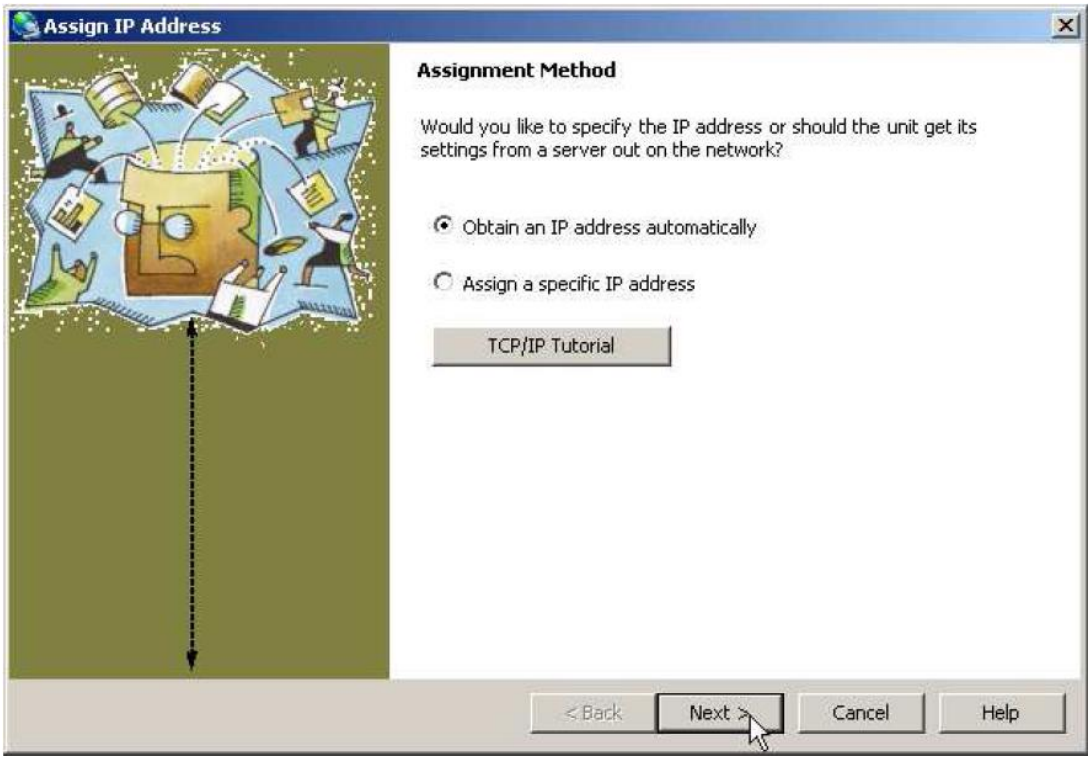
Screen Shot 1

Selecting an item from the list shown in Screen Shot 2 highlights the item and enables more icons.



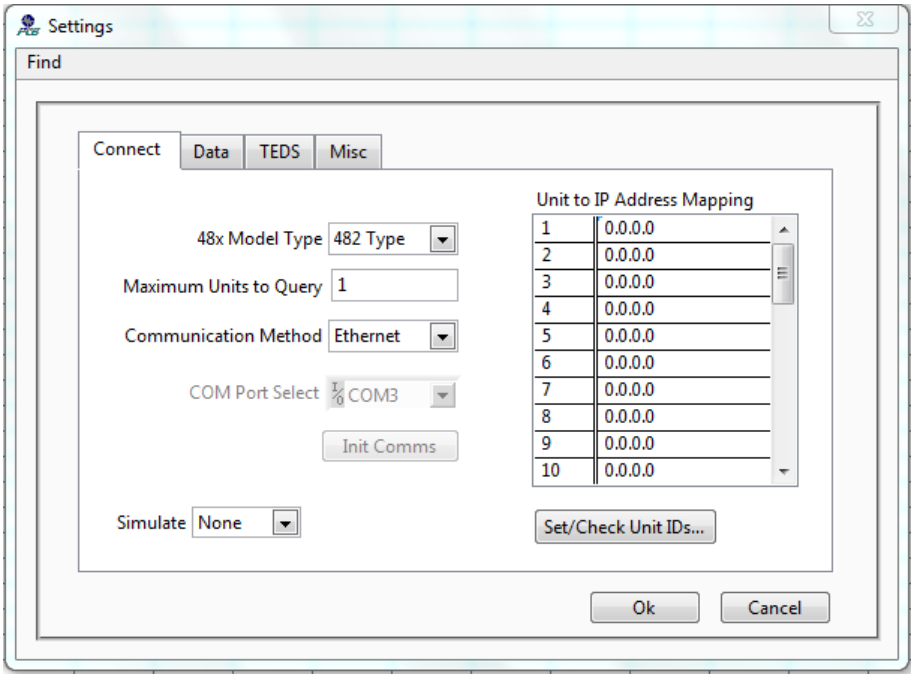
Screen Shot 2

Select Assign IP and Screen Shot 3 will appear. Select 'Obtain an IP address automatically' to have it assigned from a network server. Select 'Assign a specific IP address' to assign a static address that is appropriate for network the signal conditioner is connected to.



Screen Shot 3

Now the assigned IP address can be used to communicate with the signal conditioner. The IP address needs to be entered into the MCSC software before the signal conditioner can be discovered. Select 'Settings' menu under the Settings drop down selection. The Settings input table will appear (Screen Shot 4).



Screen Shot 4

The following selections should be made:

48x Model Type: 482/483 Type
Maximum Units to Query: Enter the amount for the number of units that are trying to be discovered
Communication Method: Ethernet

All signal conditioners are preset (factory default) to a Unit ID of 1. If only one conditioner is being communicated with, enter the IP address next to number 1 in the *Unit to IP Address Mapping* box shown in Screen Shot 4. If more than one conditioner is being communicated with, use the front panel keypad and display to set each conditioner with a unique Unit ID. Map the IP addresses to the appropriate Unit ID in the *Unit to IP Address Mapping* box. The *Settings* box can be closed when mapping is complete. The *Discovery* button can now be pressed on the main screen and the signal conditioners will be found.

4-6. 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. Unit Initialization Procedure

1) To begin, plug 9-pin female DSUB connector of given cable into RS-232 port of the models. Plug the other end of the cable into the COM port of the computer.
2) Turn on power to the unit. The display or power indicator should light up to indicate the power is on.
3) With a computer that is set up to transmit data, according to the host set-up discussed in Section 4-3, 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 command set. The 482C series is highly differentiated and some commands may not be valid in all units. The 482C 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	Channel	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
CALB	R/W	Channel	Select Internal or External Cal setting
SWOT	R/W	Unit	Switched output (4 to 1 mux)
RTED	R	Channel	Read binary TEDS data from a sensor
WTED	W	Channel	Write binary TEDS data to a sensor
ALLC	R	Channel	Read most 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
CHRD	R	Unit	Read Channel output (returns all channels)
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 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. Commands

GAIN

SET GAIN: This command sets the programmable gain of a channel. The gain may be set to any setting within the 0.1 to 200 range for the incremental option included on the models.

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 Sens Query: 1:0:SENS?
Global Sens 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
- ¼ Bridge 10
- ½ Bridge 11
- Full Bridge 12
- Referenced Single Ended 13

NOTE: Not all input options are valid for all 482C models. Check the model specification for applicable input modes.

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. If the channel was in Voltage mode and this value gets set > 0, then the channel's input mode will switch 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 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:2=4;.

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

CPLG

The CPLG command sets the channel coupling to AC or DC mode.
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.

The coupling value is sent as an integer value: 0 –AC, 1-DC.

Setting:
1:1:CPLG= 1\r\n (unit 1, channel 1, DC Coupled)
Setting Response: 1: CPLG:ok

Query:
The CPLG query returns the channels coupling setting.

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

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

AZZR

The AZZR command is used to Auto Zero (input shorted) or Auto Balance (input connected) a channel that is DC coupled. This command invokes a function and therefore has no query capability. The function parameters are: 1=Auto Zero, 2=Auto Balance. (Auto Balance is only valid if the channel has a bridge input type selected).

Setting:

2:1:AZZR= 1\r\n (unit 2, channel 1, Auto Zero)

Setting Response: 2:AZZR:ok

Query:
N/A

VEXC

The VEXC command sets the voltage excitation level for bridge and differential mode inputs.
The voltage excitation value is sent as a floating point number from 0.0 (off) to ±12.0 Volts. If the value is sent as a negative number then the minus (-) Bridge Excitation will track the plus (+) Bridge Excitation setting. If it is sent as a Positive value then the minus (-) Bridge Excitation will be set to 0.

Setting:

1:1:VEXC= -10.0 \r\n *(unit 1, channel 1, sets* minus (-) Bridge Excitation and plus (+)Bridge Excitation to 10.0 volts – Bi-Polar*)*

1:1:VEXC= 10.0 \r\n *(unit 1, channel 1, sets* minus (-) Bridge Excitation to 0 and plus (+)Bridge Excitation to 10.0 volts – Uni-Polar*)*

Setting Response: 1:VEXC:ok

Query:
The VEXC query returns the voltage excitation value.

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

Global Query: 1:0: VEXC?
Global Response: 1:VEXC:1=-10.0;2=10.0;3=0.0;4=0.0;

CALB

The Calibration mode (CALB) command selects the calibration setting. For the bridge input on the 482C27 the options are OFF, Internal Shunt +, or Internal Shunt -. For other models that support calibration signal output, Internal Cal using internally generated 100 Hz or 1 kHz sine wave signals and External Cal are available.

The CALB value is sent as an integer value of either 0 –Disable, 1-1000 Hz Enable, 2-100 Hz Enable, 3-External Cal, 4 -Internal Shunt +, or 5 – Internal Shunt -.

Setting:

1:1: CALB= 4\r\n (unit 1, channel 1, Internal Shunt Cal +)

Setting Response: 1:CALB:ok

Query:
The CALB query returns the channels calibration setting.

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <0|1>;
Query: 1:1: CALB?
Response: 1: CALB:1=4;
Global Query: 1:0:CALB?
Global Response: 1:CALB:1=4;2=0;3=0;4=0;

RTED

The RTED query returns the TEDS information that is stored in the EEPROM of a memory chip in the sensor or other, TEDS capable, in-line module attached to a specific channel. Following is a list of recognized TEDS chips that can be read with the RTED command;

DS2430A	FC= 0x14	1 page	Plus an 8 byte Application register
DS2431	FC= 0x2D	4 Pages	
DS2433	FC= 0x23	16 Pages	
DS28EC20	FC= 0x43	80 Pages	

This command will also read the Application Register Status of a DS2430A chip, if one is encountered, 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.

The RTED command requires a page number parameter for chips larger than 128 bytes (e.g.DS2433 & DS28EC20). The page numbers must be expressed as two decimal characters starting at 00 and be appended to the end of the command after the '?'. However, in order to be backwards compatible, the page number is only used if the chip is DS2433 or DS28EC20, it is not necessary for DS2430A or DS2431 chips.

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. Additionally, for the larger capacity chips that do not have an application register the 1st byte should contain the CS of that page.
No attempt is made to validate or interpret TEDS data with this command.

Setting:
N/A – Command is Read only (the WTED command writes TEDS data)

Query:
The RTED command query returns the TEDS data associated with the specified channel. This command must be directed to a specific channel. The RTED response varies depending on the chip encountered:
DS2430A: The 1st byte of the response will return an indicator (0 or 1) that specifies if the DS2430A Application register has been used to store the basic TEDS data (1) and up to 40 bytes in ASCII Hex format (8 bytes of Application register content if it contained data and 32 bytes of the EEPROM content).
DS2431: The response will return the Family code 45(decimal) followed by 128 bytes of EEPROM data (4 pages of 32 bytes each) in 2 character hex notation.
DS2433 or **DS28EC20**: The response will return the appropriate family code followed by the specified page of EEPROM data – 32 bytes in in 2 character hex notation.

Query Format: Unit#:Ch#:CMD?<Page>
Response format: <Unit#>**:**RTED**:**<Ch#>= <APP Reg Status or Family code in decimal>:<APP Reg Contents (8 hex bytes if APP Reg Status=1)><DS2430A EEPROM Contents (32 hex bytes)>

Where: APP Reg Status for a DS2430 chip=1 if the APP Register had data or 0 if it did not. For all other chips this value is the Family Code of the chip which should be used to read the appropriate number of pages from the chip. (If value=0 or 1 then assume FC =0x14).

Query example 1: 1:2:RTED?00 ;read teds on channel 2 starting at the 1st page (0))
Response: (for a DS2430A TEDS chip on channel 2 with valid app register data)
1:RTED:2=**1**:168010a0097500008e64d059e6a427204aa7394a0a73215aa06d01903f97e6b7dcf9bc02
40000000

Query example 2: 1:1:RTED?00
Response example 2: Teds read on a sensor with a DS2431 chip (Family code 45 (0x2D) is the 1st item after the '=' in the response separated from the memory contents with a ':'. It will return all 4 pages of a DS2431 chip with 1 read command
1:RTED:1=**45**:12174053a059580900648019d89ae8e112801f1100e02e5aa068c187c76433da4e372c1
e93cb6610159d9e83d2735018449cca68b3180000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000\r\n

WTED

The WTED command writes a string of bytes to the EEPROM memory of a TEDS capable chip, contained in a sensor or inline module, attached to the specified channel. The command can transfer up to 1 page, 32 bytes, and the contents of an application register, 8 bytes, if one exists (DS2430A only if it is not locked). Following is a list of Maxim TEDS chips that can be written to with the WTED command;

DS2430A	FC= 0x14	1 Page	Plus an 8 byte Application Register
DS2431	FC= 0x2D	4 Pages	
DS2433	FC= 0x23	16 Pages	
DS28EC20	FC= 0x43	80 Pages	

The WTED command requires a page number parameter, for all chips, to identify which page will receive the data. Page numbering starts at 0.

NOTE: **No attempt is made to validate or interpret TEDS data with this command, it just writes bytes.**

Setting:
1:1:WTED=36:0:0:43:23:64:83:160:89:88:9:0:100:128:25:216:154:232:225:18:128:31:17:0:224:46:90:160:104:161:142:199:100:51:218:36

Command interpretation:
<Unit Id>**:**<Channel Id>**:** WTED=<TEDS data to write> with the following format.
Note: all values are decimal.
B0 – Message Length - Total bytes in message including this byte.
B1 - 1st 8 bytes go in Application Register? 0=FALSE | 1=TRUE
B2 – Page Number (0 for DS2430A | 0-3 for DS2431 | 0-15 for DS2433 | 0-79 for DS28EC20
B3 - Bn-1 TEDS page content (up to 40 bytes - 8 app register bytes plus 32 EEPROM bytes)
Bn – Checksum (Simple checksum of all bytes – least significant byte of 16 bit summation)
In the example above, the summation of 36...218 = 3364 = 0xD24; LSB=0x24=36 decimal

Setting Response: 1:WTED:ok

Query:
Use the RTED command to query TEDS data

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>; CPLG:< CPLG value>; CLMP:< CLMP value>; CALB:< CALB value>; VEXC:< VEXC value>; SWOT < SWOT value>

Query: 1:1:ALLC?
Response:1:ALLC:1=GAIN 1.0; SENS:10.0; FSCI:1000.0; FSCO:10.0; INPT:2.0; FLTR:0; IEXC:4; OFLT:0; CPLG:0; CLMP:0;CALB:0; VEXC: 0.0; SWOT:0;

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;

CHRD

The CHRD command is used to read all channels output levels.

Setting:
N/A – Command is Read only

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

Query Format: Unit#:Ch#:CHRD?
Response format: Unit#:Cmd:Ch#:=CH1 A/D;… CHn#:=CHn A/D;
Query: 1:0:CHRD?
Query Response 1:CHRD:1= 4.049;2=5.338;3=2.137;4=10.373;

SWOT

The Switched Output (SWOT) command selects which channel is switched to the switched output BNC for monitoring purposes as well as its normal analog output. This is a unit command so the channel designation in the command protocol is ignored

The switched output value is sent as an integer value: 0-OFF; or 1-MAX Channels to designate which channel is switched.

Setting:

1:0:SWOT= 4\r\n ***(unit 1, channel NA, Channel 4 is switched to the switched output BNC)***

Setting Response: 1: SWOT:ok

Query:

The SWOT query returns all channels coupling setting.

Query Format: Unit#:Ch#:CMD?
Response format: Unit#:Cmd:Ch#:= <channel # or 0=OFF>;
Query: 1:1:SWOT?
Response: 1:SWOT:1=4;

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

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:482C24 :FW v4A2.5 :1234:12-17-2015 :1:4:1:16,4,0,207,2:0.00000:0.00000:0.00000:0.00000:0.00000:0.00000:0.00000:0.00000: \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	Programmable LP Elliptical filter
OPT_FILTER_PGMBTR	0x10	Programmable 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
Miscellaneous 2 Options		
OPT_MISC2_IM33893	0x01	Old ISO Board installed
OPT_MISC2_A2D	0x02	A/D installed
OPT_MISC2_MULTIBDwDSP	0x04	Multi-board with display
OPT_MISC2_NOPWRBTN	0x80	ignore soft power button operation

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 (if equipped)
- Current excitation = 4.0mA
- Output Filter = Disabled (if equipped)
- 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: NA

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.

<Unit>:<Cmd String>:-10<CR> <LF>

legacy error from bad power supply problem w/482M179 */
<Unit>:<Cmd String>:-11<CR> <LF>
Bridge DC Offset ERR - Illegal Setting
<Unit>:<Cmd String>:-12<CR> <LF>
Bridge DC Offset ERR - Too Many iterations
<Unit>:<Cmd String>:-13<CR> <LF>
ICP DC Offset ERR - Bad RDG
<Unit>:<Cmd String>:-14<CR> <LF>
ICP DC Offset ERR - Too Many iterations
<Unit>:<Cmd String>:-15<CR> <LF>
Balance Request, channel not in Bridge mode - Illegal Setting
<Unit>:<Cmd String>:-16<CR> <LF>
Zero Request, channel not in Bridge mode or ICP/volt - Illegal Setting
<Unit>:<Cmd String>:-17<CR> <LF>
iEXc request while channel in Bridge/Diff mode,- Illegal Setting
<Unit>:<Cmd String>:-18<CR> <LF>
vEXc request while channel in ICP/Volt mode,- Illegal Setting
<Unit>:<Cmd String>:-19<CR> <LF>
TEDS read request when Channel is not in ICP or Voltage Mode
<Unit>:<Cmd String>:-20<CR> <LF>
TEDS Chip Search algorithm Failed
<Unit>:<Cmd String>:-21<CR> <LF>
TEDS Write Buffer too Big
<Unit>:<Cmd String>:-22<CR> <LF>
TEDS Write Buffer CS Failure

Model Number	4-CHANNEL ICP® SENSOR SIGNAL CONDITIONER	Revision: E
482C54		ECN #: 40512

Performance	**ENGLISH**	**SI**	
Channels	4	4	
Sensor Input Type(s)	ICP®, Voltage, Charge	ICP®, Voltage, Charge	
Voltage Gain	x0 to x200	x0 to x200	
Voltage Gain Increment	0.1	0.1	
Accuracy(Gain, x0.1 to x0.4)	± 5 %	± 5 %	
Accuracy(Gain, x0.5 to x200)	± 1 %	± 1 %	
Sensitivity(± 1 %)(Charge Input @ 100 Hz)	0.1 / 1.0 / 10.0 mV/pC	0.1 / 1.0 / 10.0 mV/pC	
Insulation Resistance at Input(Minimum Required)(0.1 mV/pC)	10 kohm	10 kohm	
Insulation Resistance at Input(1.0 mV/pC)	100 kohm	100 kohm	
Insulation Resistance at Input(10.0 mV/pC)	1 MOhm	1 MOhm	
Input Range(Charge Input, Nominal)	± 100,000 pC	± 100,000 pC	
Output Range(Minimum)	± 10 Vpk	± 10 Vpk	
Frequency Range(-5 %)(x0.1 to x99.9 Gain)	0.05 to 100,000 Hz	0.05 to 100,000 Hz	
Frequency Range(-5 %)(x100 to x200 Gain)	0.05 to 75,000 Hz	0.05 to 75,000 Hz	
Low Frequency Response(-5 %)(Charge Input)	0.5 Hz	0.5 Hz	[3]
Filter Type(Fourth-order Butterworth)	Low Pass	Low Pass	
Electrical Filter Roll-off	24 dB/octave	24 dB/octave	
Electrical Filter Corner Frequency(-3 dB)	10 kHz	10 kHz	[4][5]
Electrical Filter Roll-off	80 dB/decade	80 dB/decade	
Electrical Filter Pass Band Amplitude Accuracy	1 %	1 %	
Electrical Filter Stop Band Attenuation(Minimum)	96 dB	96 dB	
Phase Response(at 1 kHz)	± 1 °	± 1 °	
Non-Linearity(Charge Input)	≤ 1 % FS	≤ 1 % FS	
Cross Talk(maximum)	-72 dB	-72 dB	
TEDS Sensor Support	Yes	Yes	
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	
Power Required(direct input to unit)	DC power	DC power	
AC Power(50 to 60 Hz)	100 to 240 VAC	100 to 240 VAC	
AC Power	≤ 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	
DC Power	≤ 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]
Spectral Noise(10 Hz)(Gain x1)	1.5 µV/√Hz	1.5 µV/√Hz	[2]
Spectral Noise(100 Hz)(Gain x1)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
Spectral Noise(1 kHz)(Gain x1)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
Spectral Noise(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]
Spectral Noise(10 Hz)(Gain x10)	1.5 µV/√Hz	1.5 µV/√Hz	[2]
Spectral Noise(100 Hz)(Gain x10)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
Spectral Noise(1 kHz)(Gain x10)	1.0 µV/√Hz	1.0 µV/√Hz	[2]
Spectral Noise(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]
Spectral Noise(10 Hz)(Gain x100)	10.0 µV/√Hz	10.0 µV/√Hz	[2]
Spectral Noise(100 Hz)(Gain x100)	8.0 µV/√Hz	8.0 µV/√Hz	[2]
Spectral Noise(1 kHz)(Gain x100)	6.0 µV/√Hz	6.0 µV/√Hz	[2]
Spectral Noise(10 kHz)(Gain x100)	6.0 µV/√Hz	6.0 µV/√Hz	[2]
Broadband Electrical Noise(1 to 10,000 Hz)(0.1 mV/pC & Gain x1)	52.0 µV/rms	52.0 µV/rms	[2]
Spectral Noise(1 Hz)(0.1 mV/pC & Gain x1)	10.0 µV/√Hz	10.0 µV/√Hz	[2]
Spectral Noise(10 Hz)(0.1 mV/pC & Gain x1)	1.5 µV/√Hz	1.5 µV/√Hz	[2]
Spectral Noise(100 Hz)(0.1 mV/pC & Gain x1)	0.6 µV/√Hz	0.6 µV/√Hz	[2]
Spectral Noise(1000 Hz)(0.1 mV/pC & Gain x1)	0.6 µV/√Hz	0.6 µV/√Hz	[2]
Spectral Noise(10,000 Hz)(0.1 mV/pC & Gain x1)	0.6 µV/√Hz	0.6 µV/√Hz	[2]
Broadband Electrical Noise(1 to 10,000 Hz)(1.0 mV/pC & Gain x1)	52.0 µV rms	52.0 µV rms	[2]
Spectral Noise(1 Hz)(1.0 mV/pC & Gain x1)	14.0 µV/√Hz	14.0 µV/√Hz	[2]
Spectral Noise(10 Hz)(1.0 mV/pC & Gain x1)	2.0 µV/√Hz	2.0 µV/√Hz	[2]
Spectral Noise(100 Hz)(1.0 mV/pC & Gain x1)	0.7 µV/√Hz	0.7 µV/√Hz	[2]
Spectral Noise(1000 Hz)(1.0 mV/pC & Gain x1)	0.7 µV/√Hz	0.7 µV/√Hz	[2]
Spectral Noise(10,000 Hz)(1.0 mV/pC & Gain x1)	0.7 µV/√Hz	0.7 µV/√Hz	[2]
Broadband Electrical Noise(1 to 10,000 Hz)(10.0 mV/pC & Gain x1)	56.0 µV rms	56.0 µV rms	[2]
Spectral Noise(1 Hz)(10.0 mV/pC & Gain x1)	15.0 µV/√Hz	15.0 µV/√Hz	[2]
Spectral Noise(10 Hz)(10.0 mV/pC & Gain x1)	2.0 µV/√Hz	2.0 µV/√Hz	[2]
Spectral Noise(100 Hz)(10.0 mV/pC & Gain x1)	0.6 µV/√Hz	0.6 µV/√Hz	[2]
Spectral Noise(1000 Hz)(10.0 mV/pC & Gain x1)	0.6 µV/√Hz	0.6 µV/√Hz	[2]
Spectral Noise(10,000 Hz)(10.0 mV/pC & Gain x1)	0.6 µV/√Hz	0.6 µV/√Hz	[2]
Calibration Input(± 1 %)	± 1000 pC/V	± 1000 pC/V	
Physical			
Electrical Connector(ICP® Sensor Input)	BNC Jack	BNC Jack	
Electrical Connector(Charge Sensor Input)	BNC Jack	BNC Jack	
Electrical Connector(Output)	BNC Jack	BNC Jack	
Electrical Connector(DC Power Input)	6-socket mini DIN (female)	6-socket mini DIN (female)	
Electrical Connector(Charge Calibration Input)	BNC Jack	BNC Jack	
Electrical Connector(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	2.40 lb	1089 gm	

CE[6]

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.
ICP® is a registered trademark of PCB Group, Inc.

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]The low frequency tolerance is accurate within ±20% of the specified frequency.
[4]Frequency tolerance is within ± 5% of the specified value.
[5]Contact factory for other available frequencies.
[6]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)

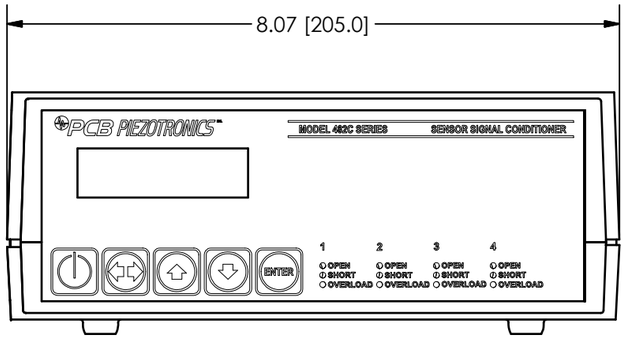
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Date: 2/5/2013	Date: 2/5/2013	Date:	Date: 2/5/2013	**35064**

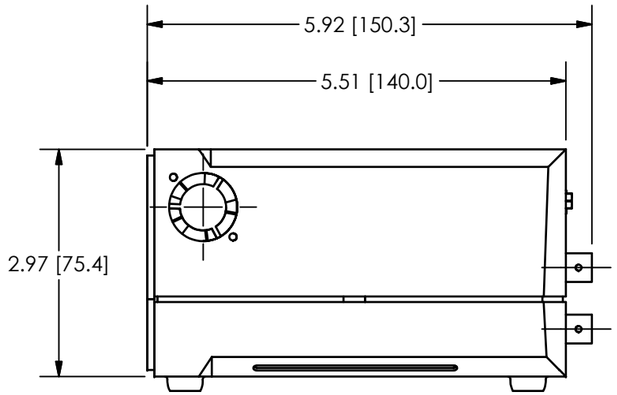
PCB PIEZOTRONICS
3425 Walden Avenue, Depew, NY 14043
Phone: 716-684-0001
Fax: 716-684-0987
E-Mail: info@pcb.com

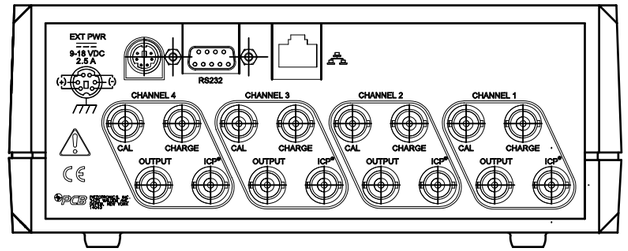
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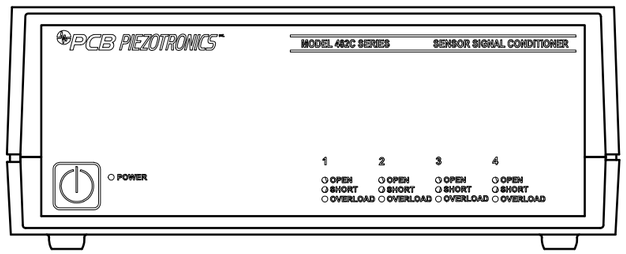
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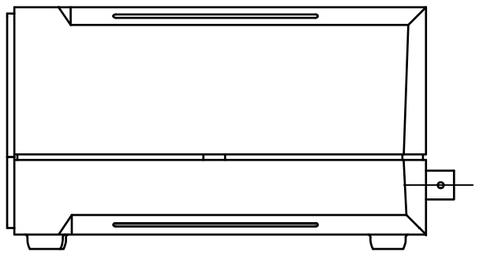
REVISIONS		
REV	DESCRIPTION	DIN
E	UPDATED ARTWORK	37737

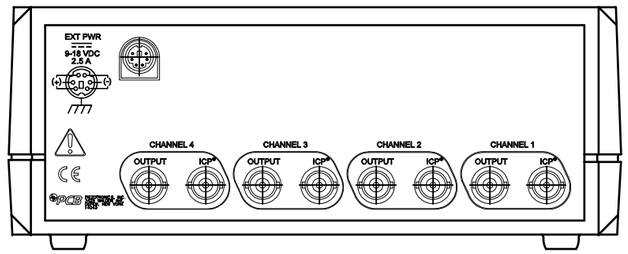


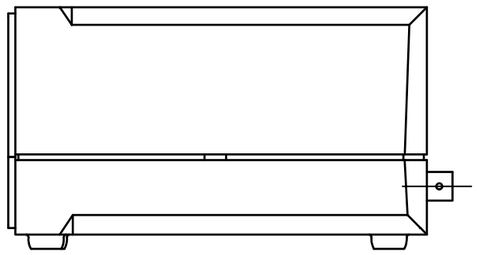


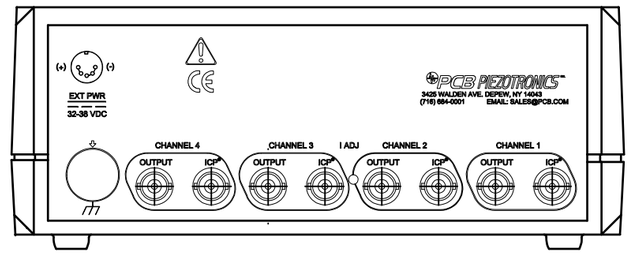












UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:		DRAWN		CHECKED		ENGINEER	
DIMENSIONS IN INCHES DECIMALS XX ±.03 XXX ±.010 ANGLES ± 2 DEGREES	DIMENSIONS IN MILLIMETERS [IN BRACKETS] DECIMALS X ± 0.8 XX ± 0.25 ANGLES ± 2 DEGREES	SMB	12/16/11	ECB	12/16/11	KEN L	12/16/11
FILLETS AND RADII .003 - .005	FILLETS AND RADII 0.07 - 0.13	TITLE: OUTLINE DRAWING MODEL 482C SERIES 4 CHANNEL SIGNAL CONDITIONER					

PCB PIEZOTRONICS
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(716) 684-0001 E-MAIL: sales@pcb.com

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