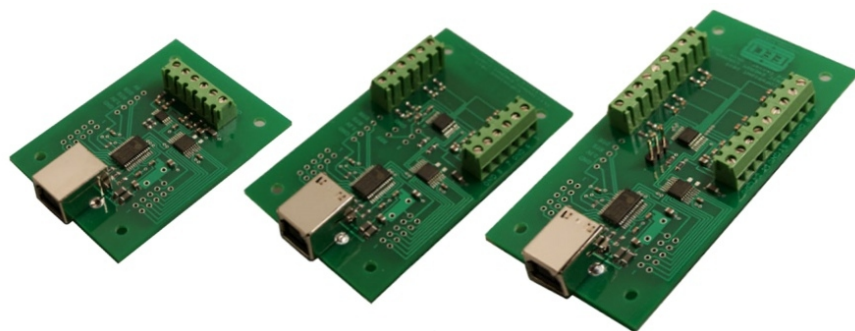


ADC-T SERIES TEMPERATURE INTERFACE

TECHNICAL REFERENCE



4, 8 and 12 channel

Click for more info: www.eeci.com/adc-tp.htm

PHONE..... (937) 349-6000
 ORDERS..... (800) 842-7714
 TECH SUPPORT... (937) 349-6000
 E-mail..... sales@eeci.com

www.eeci.com
Click for Website

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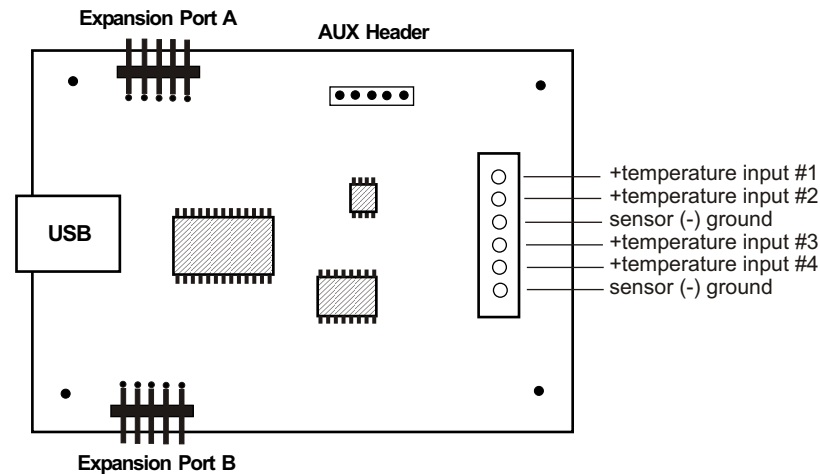
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SPECIFICATIONS

Power Supply.....	Powered from USB port (5 volts DC)
Operating Temp. Range.....	-40° C to +85° C
Serial Data Protocol.....	75 to 6,000,000 baud - auto detect (defaults to 115,200 baud) Full duplex operation (data bits, parity, stop bits will auto detect)
Maximum Sampling Rate.....	100 samples per second or better
Temperature Range.....	-40F to 212F (-40C to 100C) Optional extended range sensors -67F to 302F (-55C to 150C)
Resolution.....	1 degree (optional 1/4 degree resolution available)
Accuracy.....	1 degree (when using the standard sensors)
Temperature Inputs.....	Available in 4, 8 and 12 channel versions ADC-T4 4 channel (4 temperature sensors included - TO-92) ADC-T8 8 channel (8 temperature sensors included - TO-92) ADC-T12 12 channel (12 temperature sensors included - TO-92)
Expansion Capability.....	up to 16 relays (with up to (2) EX-8M expansion cards) or relay/input combinations up to 16 status inputs (with up to (2) EX-8M expansion cards)
Software Compatibility.....	Windows XP, Vista, Windows Server, Windows 7, Windows 8 and Windows 10 Windows 2000 and Windows ME using alternate software
Weight.....	.5 ounce
Size.....	1.875 inches by 2.5 inches ADC-T4 1.875 inches by 3.125 inches ADC-T8 1.875 inches by 3.75 inches ADC-T12

SET-UP AND TESTING

CONNECTION DIAGRAM ADC-T SERIES TEMPERATURE INTERFACE



USE CAUTION WHEN CONNECTING SENSORS - REVERSED POLARITY MAY CAUSE DAMAGE

PLEASE SEE PAGE 9 FOR THE ADC-T8 AND ADC-T12 CONNECTION DIAGRAMS

DESCRIPTION

The ADC-T series Temperature Interface connect to any available USB port on your desktop or laptop PC (including some tablets and phones). Four, eight and twelve temperature input channels are provided for conversion to digital format. Two optional expansion ports are available for connection of up to 16 relays, 16 status inputs or combinations of relays and inputs.

24 HOUR TECHNICAL SUPPORT

Technical support for our products is available by calling (937) 349-6000. If a technical adviser is not available, please leave your name, phone number and a time that you can be reached. Your call will be returned as soon as possible and within 8 hours. Calls received during normal business hours are usually returned within minutes.

WARRANTY AND CARE OF THE ADC-T

The ADC-T series Analog to Digital Converters are warranted against factory defects for a period of 90 days from the date of purchase. The ADC-T has proven to be extremely reliable in actual operation during field tests. We recommend that the ADC-T and associated hardware be installed in a suitable enclosure (4 mounting holes are provided on the circuit board) and that reasonable precautions be taken to protect the circuit from static discharge.

Upon receiving your ADC-T, you should connect and test the operation of the hardware to verify proper operation. Please set-up and test the ADC-T as follows (Windows XP*, Vista, Windows Server 2008, 2012, Windows 7, 8 or later) *service pack 3

(1) Connect your ADC-T Analog to Digital converter to your computer USB port using a CC-USBB cable (1 to 10 foot). A high percentage of systems will already have a USB Com driver installed and this is indicated by a pop up balloon in the lower right side of your screen. The balloon message may automatically assign a com port to your ADC-T and the com port assigned will be shown. If this occurs then make note of the com port for step 4 and go to step 2. The balloon message may also indicate that a driver has been located on your system and is being installed and after which a com port is assigned to the ADC-T. If this occurs then make note of the com port for step 4 and go to step 2.

The balloon message may request to search Windows Update for the correct driver. If you are connected to the Internet, you may click yes and allow the USB com driver to be installed and after which a com port is assigned to the ADC-T. If this occurs, then make note of the com port for step 4 and go to step 2.

With Windows XP, the "Found New Hardware Wizard" may pop up. If you have an Internet connection, allow the wizard to connect to Windows Update and install the USB com driver, then go to step 2.

If none of the above actions occur or if an error message is shown, you may install the USB Com driver* from the supplied CD by clicking the "Install USB Com Driver" button in the CD start window. After the USB com driver is installed, disconnect your ADC-T from the USB port, wait 5 seconds and plug back in. You may see a balloon message with the com port assigned to the ADC-T (if not, you will find the com port assigned in step 2).

*before installing a new USB com driver, go to Control Panel/Device Manager/Ports to check if a Prolific driver is shown (expand the category by clicking on the + or arrow). If you see a "Prolific USB to Serial Comm Port (COM-)" entry, the number to the right of COM is your com port. Right click on the entry, then properties, then the driver tab to check the version. If you have an out of date version and an Internet connection, click the "Update Driver" button to install the updated driver. Please note that it may be necessary to remove the outdated Prolific Com driver before the updated driver will correctly install (the supplied CD driver installation feature has a remove option - click Install Com Driver).

(2) Check your USB Com driver by going to Control Panel/Device Manager/Ports (see detail on the next page for your Windows version) or click the "Open Control Panel" button on the supplied CD start window. Click the small triangle (or +) to the left of Ports to expand the Ports category, right click the Prolific USB to Serial Comm Port, click properties and open the driver tab. Your USB Com driver must be Prolific version 3.4.62.293 or higher (dated 10/17/2013 or later). If your USB Com driver is up to date then please note the Com port number assigned and jump to step 3.

If your USB Com driver is not up to date, click the "Update Driver" button (under driver tab). If the driver does not update, disconnect the ADC-T USB cable from your computer and install the updated USB Com driver (located on your ADC-T CD from the start window, in the USB Com driver folder or from Windows Update). Please see detail*

(3) After you have verified or installed an up to date USB Com driver, reconnect your ADC-T Analog to Digital to any available USB port on your computer and insert the ADC-T CD. Install the ADC-T Software Interface* by clicking the "Install Software Interface" button in the CD start window (if you have auto-start disabled, you may browse to the Windows Test Program folder and double click on setup.exe). A desktop icon for the ADC-T will be created.

*Please note that the Microsoft .Net Framework must be installed on your system. If the .Net Framework is not installed on your computer, the installation program (ADC-T Software Interface) will attempt to download and install the .Net Framework from the Microsoft web site through your internet connection. This may take 5 minutes or longer. In order for the .Net Framework to install correctly, your computer must be up to date with Windows update. This is especially important with Windows XP and Vista. You may update your computer by clicking on the start button, All Programs, Windows Update and clicking on "Check for Updates".

After the installation is complete, a pop-up window will ask for the com port to be used with your ADC-T Temperature Interface. Enter the com port found during steps 1 or 2 and click OK. When all sensors are left unconnected your screen should show a row of 4, 8 or 12 blank boxes.

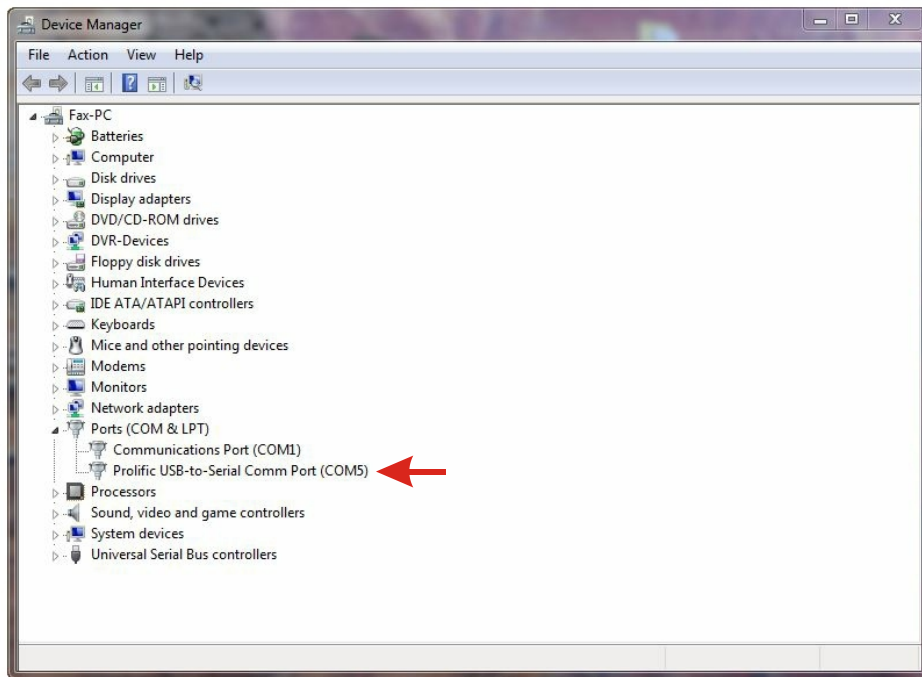
(4) Test each temperature input by connecting a sensor (one at a time) to each of the +temperature inputs and a GND (-) terminal. Use caution to observe the correct sensor polarity or damage could result. Your screen should show room temperature for that input. When you press the sensor between your forefinger and thumb, you should see the temperature increase. Please see page 8 for the temperature sensor TO-92 package pin connections.

(5) If operation of the temperature inputs are normal, you may calibrate the temperature inputs as described on page 10. Testing is now complete and your ADC-T may be placed in service. If problems are encountered during testing, proceed to the trouble-shooting procedures shown on page 5.

HOW TO OPEN DEVICE MANAGER

Windows XP, VISTA or Windows 7

Click the Start Button (lower left of screen), then Control Panel (right side). With the view set to classic view, small or large icons, click (or double click) the Device Manager icon. With Windows XP you will need to click the System icon (in Control Panel) then the Hardware Tab then the Device Manager button. You may also use the supplied CD to open Device Manager by clicking the "Open Device Manager" button when the CD auto starts.



Windows 8, 8.1, 10 and Windows Server 2012

Move your mouse cursor to the lower right side of your screen and click on Settings. Click on Control Panel near the top and click on the Device Manager icon.

TROUBLE-SHOOTING THE ADC-T

(1) Verify that your USB com driver is installed by going to Device Manager and checking for the Prolific USB to Serial Comm Port entry. Right click on the entry, then Properties, select the Driver tab and verify that the driver is dated 8/15/2014 or later. If the driver is out of date, connect to the Internet and click the Update Driver button. Please note that an out of date driver may allow the ADC-T to partially function and/or with erratic operation.

(2) Verify that the Prolific USB to Serial Comm Port entry is the com port used by your ADC-T. You may do this by watching the entry in Device Manager and unplugging your ADC-T from your computer USB port. The entry should disappear and then re-appear when you plug the ADC-T back in to your computer USB port.

(3) Try replacing the USB cable and/or using a different USB port.

(4) Verify that the ADC-T Software Interface is correctly installed and running. Click the blue icon in your system tray (bottom right) and check for the correct com port setting (should show the correct com port open). If the window below the COM indicator shows "COM Not Found!" then a com port issue is the problem (check for another program that may be using the com port). You may right click the taskbar at the bottom of your screen, then Task Manager to view running applications (select the processes tab).

(5) Remove the ADC-T USB cable from your computer, wait 5 seconds and plug back in. Open the ADC-T Software Interface by clicking on the blue icon in your system tray and double click on the blue EECI logo to reset the com port. You should see a reset message followed by a COM open indication. Click Setup and uncheck "Allow External Commands". If this corrects the issue that you are experiencing then an external application is the problem.

(6) If erratic operation is experienced, check for loose connections at the terminal block (tug on each wire going into the terminal block), check for short circuits caused by metal contact to the ADC circuit areas or other connected hardware.

(7) The input voltage to any of the analog inputs must not exceed the reference voltage (nor should the input go negative with respect to the reference when not in differential mode) or erratic data may be generated on one or more of the analog channels. When an external reference is used, the reference voltage must not exceed 5 volts.

(8) When a temperature input is left unconnected, the ADC-T temperature Interface will display a blank indication for that temperature input. When a temperature input is shorted, a very low negative temperature will be displayed.

Please contact EECI Support at (800) 842-7714 or (937) 349-6000 if you require additional assistance or have questions.

EXPANSION PORTS

The ADC-T provides two expansion ports for additional I/O operations using the same COM port. The expansion ports may used to connect up to 16 relays (8 per expansion port) or to connect up to 16 inputs (or combinations of relays and inputs) using EX-8M expansion cards. The relay output ports on the EX-8M are identical to those on the AR-16, EX-16 and EX-32 and accept the same relay cards and other accessories as the AR-16. A variety of relay cards includes the RD-8, RD-8M, RG-8, RH-8, RI-8, RJ-8, RL-8, RN-8, RN-8M, RP-8 and RJ-8. The RYD-8 relay driver card may be used to control larger power relays, contactors, solenoids, valves or other devices. The DA-1 Digital to Analog converter may be used to output a 0 to 5 volt or a 0 to 10 volt analog level. For additional information on the EX-8M Expansion card, please refer the the EX-8M Technical Reference available on the EECI web site.

USE OF THE ADC-T WITHOUT THE MICROSOFT .NET FRAMEWORK

The ADC-T may be used with older operating systems such as Windows 2000 and Windows ME. The Microsoft .Net Framework is not compatible with operating systems older than Windows XP so a different software interface is required for use with the ADC-T. Please contact EECI technical support for a download of the appropriate software interface.

THE ADC-T SOFTWARE INTERFACE



The ADC-T Software Interface allows you to set all of the basic operating characteristics of the hardware and permits the ADC-T to send and receive data from other Windows applications or programs that you create.

When the software interface is started for the first time you are prompted for the com port that is to be used with the ADC-T. This com port number is saved in the settings file "adct-set.ini" which is created in the folder c:\eecit\adc-t. The interface will then start using the com port assigned. The com port indicator should have a "COM Open" message as shown to the left with the correct com port shown. The com port may be changed by clicking the Setup button and changing the com number in the Com Port window and clicking Apply.

Clicking the Setup button allows you to label the temperature inputs for each of the channels. The com port, baud rate and sampling rate settings are changed below. Checking the box for differential input will allow differential inputs to be connected to the terminal block on the ADC-T (display will change to two channel mode). The boxes for reference input allow you to set the desired voltage input range (use of the external reference mode will change the

display to three channel mode since the channel 4 input is used for the external reference connection). Un-checking the Allow External Commands box will prevent other Windows applications from sending or receiving data from the ADC-T. The data logger may be enabled by checking the box in the data logger section and entering the desired time interval and file type information.

The ADC-T Software Interface may be started hidden by checking the Start Minimized box. Any changes made to Setup will not take effect until you click the Apply button. Clicking the Apply button saves the new settings to the adct-set.ini file so that if the software interface is shut down, it will restart with all the new settings. Click the Hide button to close the window after the ADC-T Software Interface is set-up for your application. A blue 4 icon will appear in your system tray (click to re-open the software interface). The ADC-T Software Interface may be left open when used as a stand alone data logger or if an external application is not used. The ADC-T Software Interface may be completely shut down by clicking the red X on the top right of the software interface. Once shut down, you will need to double click the ADC-T desktop icon to re-start the ADC-T Software Interface (or clicking the ADC-T icon under All Programs in the EECI folder). The Help button will provide additional assistance if you installed the Tech Reference from the ADC-T installation CD.

AUTO START-UP FOR THE ADC-T SOFTWARE INTERFACE

To automatically start the ADC-T software interface, copy your ADC-T desktop icon (right click) and paste in your computer Startup folder. In Windows XP up through Windows 7, the start-up folder is located by clicking your Start button and clicking on All Programs then scrolling down to the Startup folder. In Windows 8 and 8.1, move your cursor to the lower right of your screen and then click on Search. In Search, scroll all the way right and click "run" (under Windows System). Enter "shell:startup" (no quotes) and click OK. Your computer will start up normally with the ADC-T Software Interface running and shown in your system tray. You may also place your own application in the start-up folder to boot directly to your application (set the ADC-T Software Interface to start minimized).

THE ADC-T DATA LOGGER

The ADC-T Software Interface provides a data logger function that will save analog input readings to a file at preset time intervals. Scale and offset values may be factored into the recorded data event along with an input label by entering the desired values at the setup screen. The ADC-T data logger may be used stand alone if an external application is not used. The file output format may be set to plain text, CSV or text delimited formats and may be imported into database or spreadsheet applications if required.

PROGRAMMING EXAMPLES

VISUAL BASIC EXAMPLE (Microsoft Visual Studio)

To use these example, copy the code module (supplied on your CD) to a sub called readInputs(). From the toolbox, drag (4) labels and a timer control to your form. Insert the following code into the timer sub. The (4) ADC-T analog inputs are displayed in labels 1 through 4.

```
Private Sub Timer1_Tick(sender As Object, e As EventArgs) Handles Timer1.Tick
```

```
readInputs() 'collect analog inputs
```

```
For W = 1 To 4
```

```
MyLabelArray(W).Text = inputByte(W)  
Next W
```

```
End Sub
```

VISUAL C# EXAMPLE (Microsoft Visual Studio)

```
private void timer1_Tick(object sender, EventArgs e)  
{  
    ReadInputs();  
  
    for (int i = 1; i < 5; i++)  
    {  
        MyLabelArray[i].Text = inputByte[i].ToString();  
    }  
}
```

The entire source code program examples and the complete project code are provided on your installation CD along with additional source code examples in other programming languages. The programs are intended to demonstrate the fundamentals needed for development of your own software. The program examples may be copied to your program and used as a subroutine if desired.

These examples will run in all versions of Visual Studio including Visual Studio Express. The installation CD will have examples in all the programming languages used with Microsoft Visual Studio including Visual Basic, Visual C#, Visual C++ and ASP .Net. Additional source code examples are available in several other variations which may be more suitable for alternate programming languages. Please contact EECI technical support for more information.

VOLTAGE REFERENCE INPUT

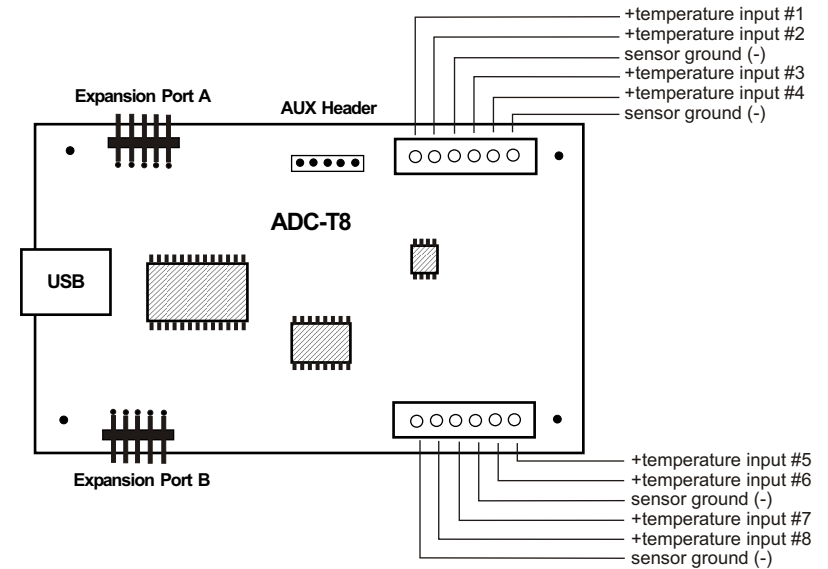
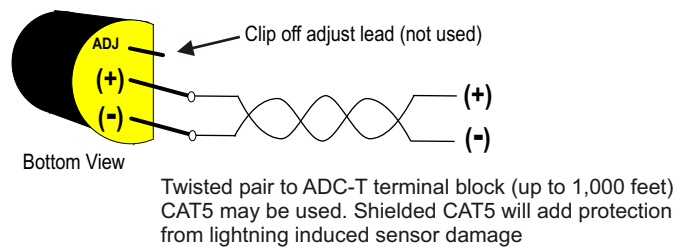
The ADC-T allows for several different reference voltage configurations that may be used if other types of sensors are connected. It may be necessary to remove (or adjust value) of the pull-up resistor that is installed on the underneath side of the ADC-T. The reference voltage determines the voltage input range for all of the input channels ((2) channels in differential mode). The following configurations are selectable from the setup page of the ADC-T. When the ADC-T is configured for a user provided reference input, the ADC-T becomes a (3) channel converter since channel four is used for the reference input. The ADC-T may also be configured to provide the internal reference as an output if required. The reference output voltage will be provided at the channel four or channel 12 input terminal (and becoming a (3) or (11) channel converter). The ADC-T8 has a separate reference input and allows use of all 8 input channels. Using the default reference setting will provide the greatest input noise rejection. Option 1 is the default setting.

- Option 1: 4.096 volt - allows a (0 to 4.1) volt input range with no reference output ((4) channel single ended) allows a (-2 to +2) volt input range with no reference output ((2) channel differential)
- Option 2: 5 volt - allows a (0 to 5) volt input range or (-2.5 to +2.5) in differential mode with no reference output (4) channel single ended or (2) channel fully differential
- Option 3: 4.096 volt - allows a (0 to 4.1) volt input range or (-2 to +2) in differential mode* with a reference output (3) channel single ended reference output provided on channel 4 analog input. The reference output voltage should be decoupled with a 2k series resistor
- Option 4: 3.3 volt - allows a (0 to 3.3) volt input range or (-1.65 to +1.65) volts in differential mode* with reference (3) channel single ended reference voltage from AUX header is applied to the channel 4 analog input (also providing access to the reference voltage).
- Option 4: 5 volt - allows a (0 to 5) volt input range or (-2.5 to +2.5) volts in differential mode* with reference (3) channel single ended reference voltage from AUX header is applied to the channel 4 analog input (also providing access to the reference voltage).
- Option 5: User supplied - must be in the range of 1 volt to 5 volts and should have an output impedance of 500 ohms or less (3) channel single ended reference voltage from user is applied to the channel 4 analog input (providing access to the reference voltage). Example: 2 volts applied to the channel 4 analog input provides a (0 to 2) volt input range single ended or (-1 to +1) volts for differential inputs*.

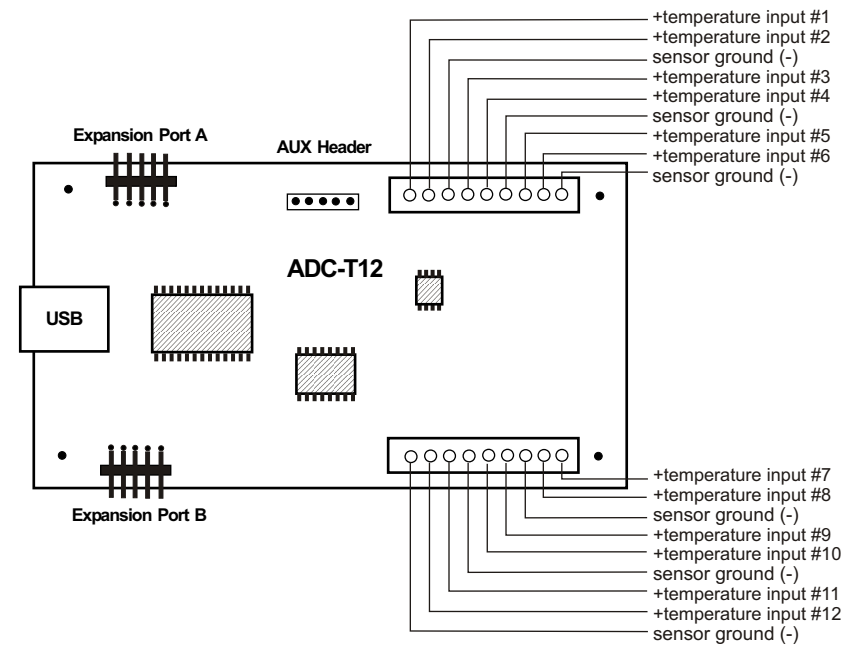
*(2) channel fully differential (-) side of the channel 2 input is connected to GND.

When other types of sensors (such as humidity, pressure, etc.) are connected to the ADC-T temperature inputs it may be necessary to remove or adjust the value of the pull-up resistor that is installed on the underside of the ADC-T. The displayed sensor read out on the ADC-T Software Interface and data logger will need to be adjusted for the 10 bit AD input by setting the scale, offset, precision and suffix parameters in the setup page.

TEMPERATURE SENSOR PIN-OUT (TO-92 package)



USE CAUTION WHEN CONNECTING SENSORS - REVERSED POLARITY MAY CAUSE DAMAGE

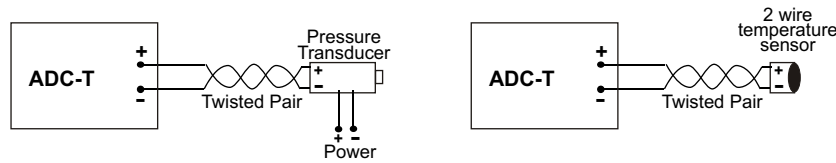


CONNECTING SENSORS TO THE ADC-T

Standard temperature sensors are included with the ADC-T Temperature Interface (4 with the ADC-T4, 8 with the ADC-T8 and 12 sensors with the ADC-T12). The standard sensor is provided in a TO-92 package. A variety of temperature sensor options are available. These include wall mount sensors, outdoor sensors and shields, extended range sensors, extended lead sensors, refrigerant and water line sensors, air duct sensors, TO-46 package and other types. Please contact EECI technical support for more information.

When a temperature input is left unconnected, the ADC-T temperature Interface will display a blank indication for that temperature input. When a temperature input is shorted, a very low negative temperature will be displayed.

A large variety of sensors, transducers, load cells and other devices that provide an analog output may be connected to the ADC-T. Most types of sensors may be located up to 1,000 feet from the ADC-T. Eight pull up resistors are pre-installed on the underside of the ADC-T for 2 wire temperature sensors that receive power from the USB port. The pull up resistor will normally have to be removed for transducers or sensors that receive power externally. The cable used to connect sensors to the ADC-T should be twisted pair or shielded twisted pair to suppress environmental noise. Low cost CAT 5 cable works well when multiple sensors are in the same location.



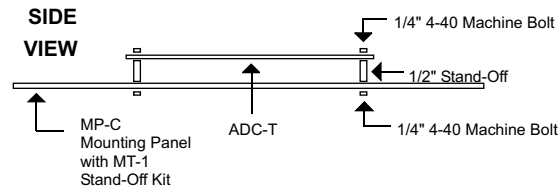
TEMPERATURE SENSOR CALIBRATION

After all your temperature sensors are connected and you have valid readings, the temperature inputs may be calibrated by placing a thermometer next to the temperature sensor and allowing the thermometer to stabilize to room temperature for about 5 to 10 minutes. Double click on that temperature sensor reading to bring up the calibration box and enter the temperature reading of the thermometer. Repeat for additional temperature sensors. Calibration effects only the offset setting for that temperature input and can be viewed by clicking the Analog Setup button.

The standard sensors that are provided with the ADC-T8 are precision temperature sensing ICs that provide a linear voltage increase of 10mv per degree C (or 5.555mv per degree F) with a theoretical output of 0 volts at 0 degree K. This is how the offset of -459 degrees is obtained since degrees K is 459 less than degrees F (or 273 degrees less than degrees C). The scale is determined by dividing the 4.096 volt reference by 1024 increments (10 bit, 4mv per increment). Dividing 4mv by the 5.555mv per degree F output of the sensor gives you a scale of .72.

MOUNTING

The ADC-T Analog to Digital card may be mounted in an enclosure or on a metal mounting panel using the MT-1 stand-off mounting hardware as shown below. The ADC-T will attach to the 4 stand-off spacers using 4-40 machine screws (4 mounting holes are provided on the ADC-T). Contact technical support for more information on mounting panels and various mounting layouts.



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