ADC-T SERIES TEMPERATURE INTERFACE
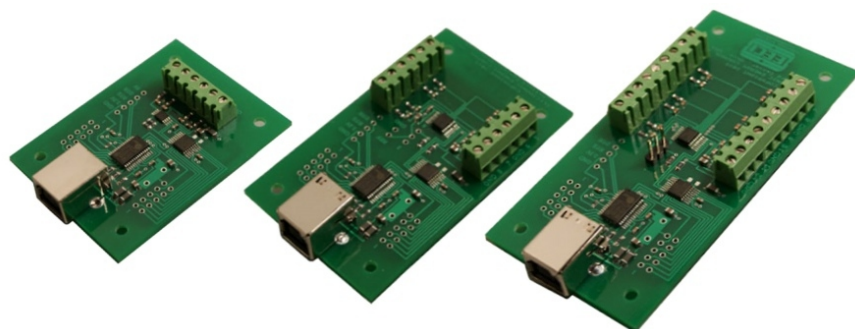
TECHNICAL REFERENCE

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

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)

Sensor Accuracy................... 1 degree initial accuracy* (when using the standard sensors)
*greater accuracy is achieved with software calibration

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............ expandable to control up to 144 relays/inputs (or combinations) using
EX-8M, EXM-8, EXM-16 or EXM-32 Relay I/O Expansion Modules

Interface.............................. USB (also available in WiFi version (ADCT-WIFI), Ethernet version
(ADCT-ENET) RS-232 version (ADCT-RS232) or
RS-485 version (ADCT-RS485))

Software Compatibility......... Windows XP, Vista, Windows Server, Windows 7, 8.1, 10 and Windows 11

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

CONNECTION DIAGRAM

A D C - T   S E R I E S
T E M P E R A T U R E   I N T E R F A C E

Expansion Port A

AUX Header

USB

+temperature input #1
+temperature input #2
sensor (-) ground
+temperature input #3
+temperature input #4
sensor (-) ground

Expansion Port B
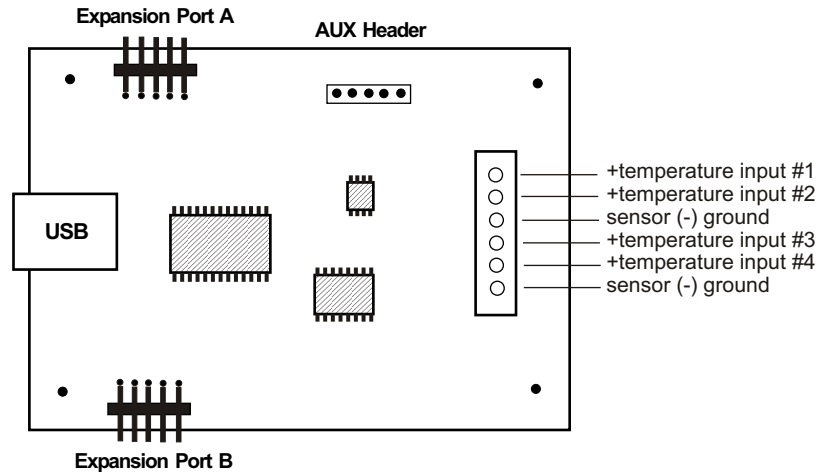
USE CAUTION WHEN CONNECTING SENSORS - REVERSED POLARITY MAY CAUSE DAMAGE

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.
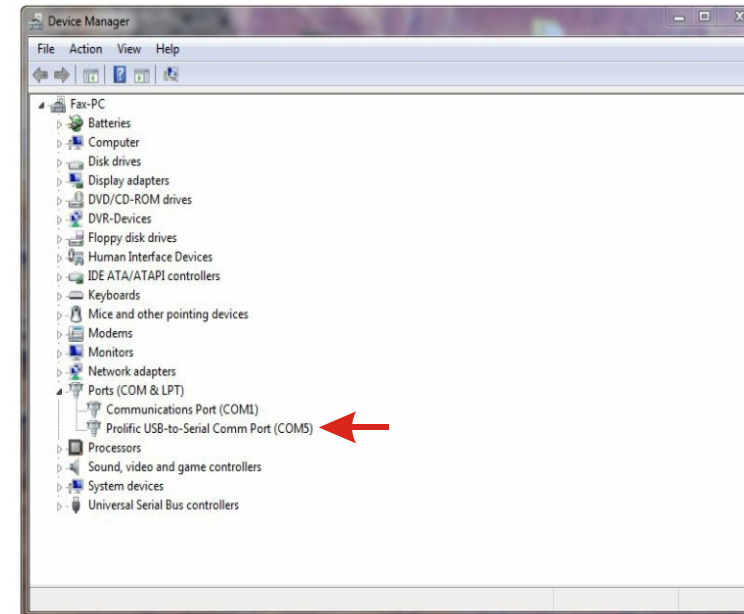
SET-UP AND TESTING

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, Windows 7, 8.1 or later) *service pack 3

(Step 1) Connect to the Internet. This permits any security or software updates to occur during installation. If you do not have an Internet connection, you may skip this step.

(Step 2) Connect your ADC-T Analog to Digital Converter to any available USB port on your computer using a CC-USBB cable (1 to 15 foot). A high percentage of systems will be up to date and you will not see any activity or a pop-up message (allow up to 30 seconds for any system message). If your USB Com driver is out of date, you may receive a message that your system is being updated or a new driver is being installed. Allow the update to occur before you move to the next step. If you do not see activity or receive a system message, proceed to step 3.

(Step 3) Insert the installation CD or USB flash drive and wait for the security message (with a USB flash drive, you may need to browse to the drive icon from your My Computer link). OK or click the startup.exe file to start the installer dialog.

(Step 4) Check your USB Com driver by clicking on the "Open Device Manager" button in the installer dialog window and expanding the "Ports (COM & LPT)" category (expand the category by clicking on the + or arrow, see Device Manager on page 5 or go directly to Device Manager from Control Panel). If you see a "Prolific USB-to-Serial Comm Port" entry, this is your USB Com driver* and the com port assigned is to the right of the entry. Right click on the entry and select "Properties"and click 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 not up to date, right click on the entry and select "Update Driver Software". If your USB Com driver is up to date then please note the Com port number assigned and jump to step 5.

*verify that this is the com port assigned to the ADC-T by unplugging the ADC-T from your USB port and watching the entry in device manager. The entry should disappear and then reappear when you plug the ADC-T back in.

If you do not have an Internet connection or are having problems with the USB Com driver installation, disconnect the ADC-T USB cable from your computer and install the USB Com driver from your CD by clicking on the "Install USB Com Driver" button. Please note that you may have to remove any out of date Prolific Com drivers on your system before the current driver will install correctly. It is important that you use the remove feature on your CD (not the remove feature in Device Manager). The remove feature is shown after clicking the "Install USB Com Driver" button from the installer dialog window (allow up to 30 seconds for the installer to load and appear).

(Step 5) After you have verified or installed the up to date USB Com driver, reconnect (if not already connected*) your ADC-T Analog to Digital Converter to the same USB port and install the ADC-T device driver** by clicking the "Install EECI Device Driver" button from the installer dialog window (if you have auto start disabled, you may browse to the Windows Driver folder and double click on setup.exe). A desktop icon for the ADC-T will be created. When installing the ADC-T device driver on a Windows XP or Vista computer, double click on setup.exe in the XP-Vista folder. *if you reconnect your ADC-T to a different USB port, a different com port may be assigned.

**Please note that the Microsoft .Net Framework must be installed on your system. The .Net Framework is already installed if you have Windows 7 or higher. If the .Net Framework is not installed on your computer, the installation program will attempt to download and install the .Net Framework from the Microsoft Update website 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". *for XP, Service Pack 3 must be installed.

(Step 6) After the ADC-T device driver is installed, the **ADC-T** com port should be detected and a pop-up will prompt you for the com port to be used with your **ADC-T** A to D Converter (correct com port should be shown).You may edit the com port if incorrect. The ADC-T User Interface will now open and the label just under the COM port indicator should show that Com port open. When the sensors are left unconnected your screen should show a row of 4, 8 or 12 blank boxes. Click the "Install Help Files" button to install important trouble-shooting and reference information before you close the installer.

(Step 7) 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.

If operation of the temperature inputs are normal, you may label your temperature inputs and calibrate 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.

The ADC-T Data Logger may be started by checking the Enable box. The data log entry interval may be set to minutes or seconds (click the M or S button) and entering the desired time interval. The settings will not go into effect until the Apply button is clicked.

Click the "Tray" button to place the User Interface in "driver only" mode. You will see a blue 4 icon in your system tray by the clock (bottom right of screen as shown below).

Click the blue 4 icon to re-open the ADC-T User Interface. Click "Unload Device Driver" to unload the ADC-T device driver.

Please note that by default, the ADC-T device driver is only loaded on demand to conserve system resources. To re-start the ADC-T device driver, double click the red and blue ADC-T desktop icon or under Applications.

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 8.1, 10, 11 and Windows Server

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 or search Device Manager.

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 device driver 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.
.
(5) Remove the ADC-T USB cable from your computer, wait 5 seconds and plug back in. Open the ADC-T User 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 three expansion ports for additional I/O operations using the same COM port. The expansion ports may used to connect up to 144 relays (8 per expansion port) or to connect up to 144 inputs (or combinations of relays and inputs) using EX-8M and/or EXM-16 expansion modules. The relay output ports on the EX-8M and EXM-16 are identical to those used on all EECI products and accept the same relay cards and other accessories. A variety of relay cards with various contact configurations are available for connection to the expansion modules. A partial list 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. A Digital to Analog expansion module may be used to output a 0 to 5 volt or user supplied 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.
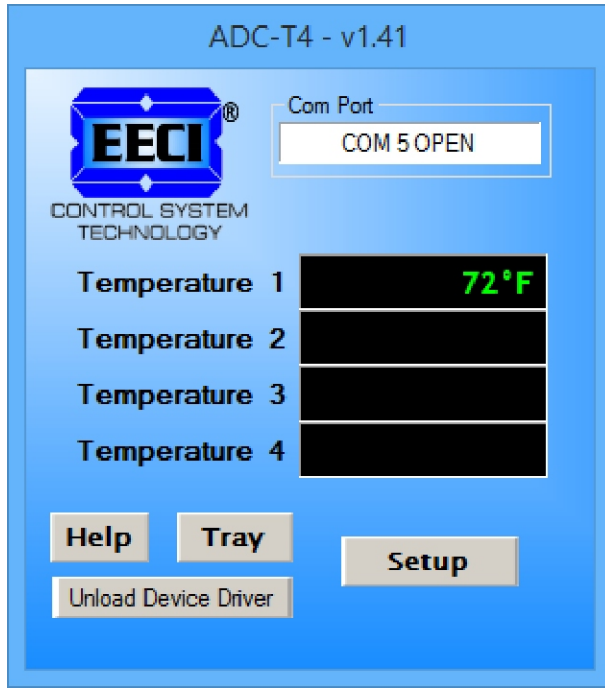
THE ADC-T USER INTERFACE

The ADC-T User 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. The screen shot to the left is showing only one sensor connected. A blank reading will be shown until the sensor is connected.

When the user interface is opened 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:\eeci\adc-t. The user interface will then open 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 User Interface may be started in driver only mode 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 device driver is unloaded, it will restart with all the new settings. Click the Tray button (driver only mode) to close the after the ADC-T User Interface is set-up for your application. A blue 4 icon will appear in your system tray (click to re-open the user interface). The ADC-T User Interface may be left open when used as a stand alone data logger or if an external application is not used. The ADC-T User Interface may be completely shut down (and driver unloaded) by clicking "Unload Device Driver" at the bottom. Once shut down, you will need to double click the ADC-T desktop icon to re-start the ADC-T device driver/User Interface (or click the ADC-T icon under All Programs in the EECI folder).The Help button will provide additional assistance if you installed the Help files from the ADC-T installation CD.

AUTO START-UP FOR THE ADC-T

By default, the ADC-T device driver is only loaded on demand to conserve system resources. You may install the ADC-T device driver permanently by checking the "Driver Only" check box under Setup in the ADC-T User Interface. You will then always see the ADC-T system icon in your system tray* along with the other system devices (such as your speaker, printer or display adapter). Click the blue 4 icon in your system tray to open the ADC-T User Interface. If the ADC-T device driver is not installed permanently, you will need to double click the ADC-T desktop icon to load the ADC-T device driver each time your system starts.
*you may need to expand the arrow in your system tray to see all the icons (the tray is the row of icons on the lower right of your screen, next to your clock).

THE ADC-T DATA LOGGER

The ADC-T User 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 (2/4/6 channels in differential mode). The following configurations are selectable from the setup dialog of the ADC-T. When the ADC-T4 is configured for a user provided reference input, the ADC-T4 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 (ADC-T4) or channel 12 (ADC-T12) 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 internal - allows a (0 to 4.096) volt input range - no reference output ((4) channel single ended)
allows a (-2.048 to +2.048) volt input range with no reference output ((2) channel differential)

Option 2: 5 volt internal - 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 resister

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). Low precision/digital power**

Option 5: 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). Low precision/digital power**

Option 6: 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*.

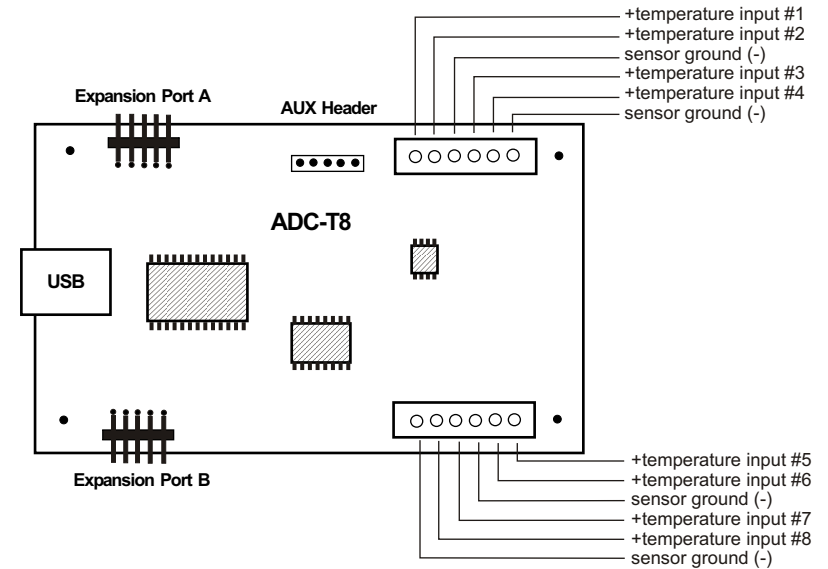*(2) channel fully differential (-) side of the channel 2 input is connected to GND.
** the ADC-T may be ordered with a high precision voltage reference installed. Please contact EECI support.

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.
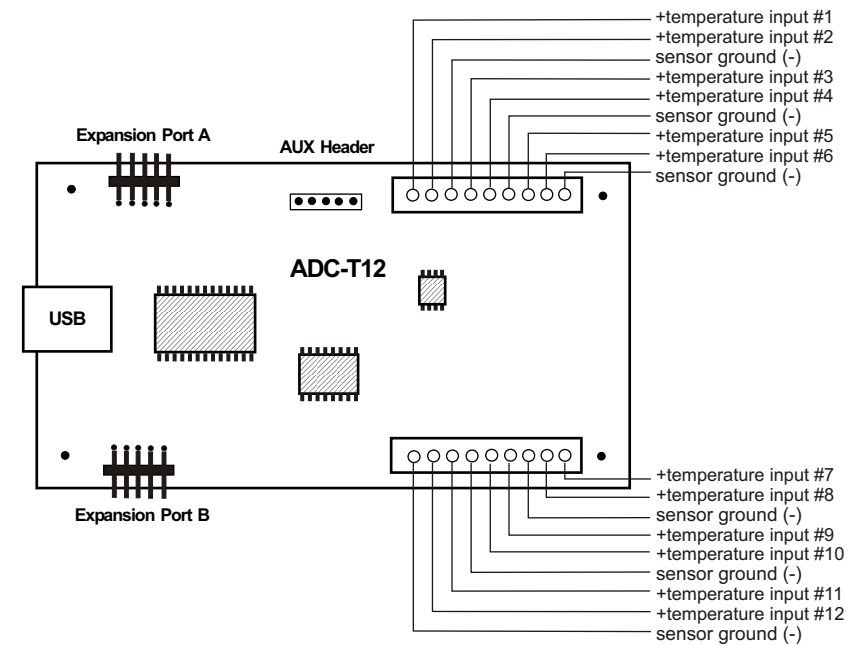
TEMPERATURE SENSOR PIN-OUT (TO-92 package)

Clip off adjust lead (not used)

ADJ
(+)
(-)
Bottom View

(+)
(-)
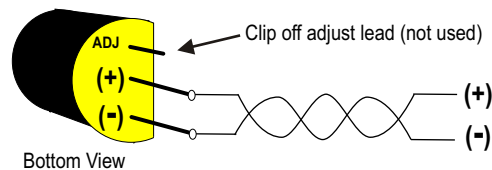
Twisted pair to ADC-T terminal block (up to 1,000 feet) CAT5 may be used. Shielded CAT5 will add protection from lightning induced sensor damage

ADC-T8

Expansion Port A
AUX Header
+temperature input #1
+temperature input #2
sensor ground (-)
+temperature input #3
+temperature input #4
sensor ground (-)
USB
Expansion Port B
+temperature input #5
+temperature input #6
sensor ground (-)
+temperature input #7
+temperature input #8
sensor ground (-)

USE CAUTION WHEN CONNECTING SENSORS - REVERSED POLARITY MAY CAUSE DAMAGE

ADC-T12

Expansion Port A
AUX Header
+temperature input #1
+temperature input #2
sensor ground (-)
+temperature input #3
+temperature input #4
sensor ground (-)
+temperature input #5
+temperature input #6
sensor ground (-)
USB
Expansion Port B
+temperature input #7
+temperature input #8
sensor ground (-)
+temperature input #9
+temperature input #10
sensor ground (-)
+temperature input #11
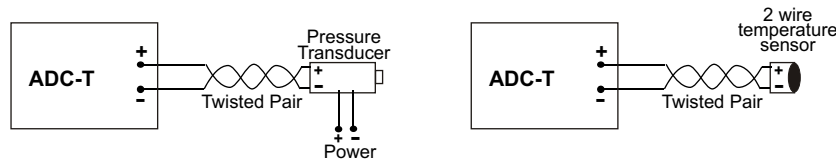+temperature input #12
sensor ground (-)

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 (for greater accuracy) 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-T 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 then degrees F (or 273 degrees less then 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.
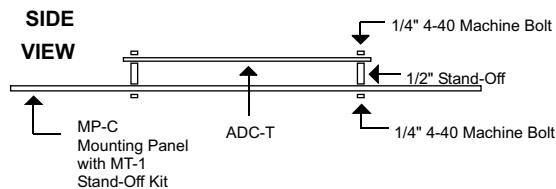
RAW ANALOG DATA

The ADC-T will present the raw analog data as a number between:
0 to 255 (8 bit)
0 to 1023 (10 bit)
o to 4095 (12 bit)
when in single ended mode and a number between:
-128 to +127 (8 bit)
-512 to +511 (10 bit)
-2048 to +2047 (12 bit)
when in differential mode.

Relay and Input labels may be changed by clicking the Relay Control or Input Setup buttons. Click the Analog Setup button to make changes to the analog labels, suffix, scale, offset or precision. These also apply to logged data.

SETUP FUNCTIONS

Start the data logger by checking the Enable box. The logger will roll-over or stop based on the setting in the Max Entries box. The Data Interval may be set to minutes or seconds and will log the data based on the setting in the box.

Click to Refresh Com Ports (use the pull-down to select, then Apply to set)

Rate at which Analog Inputs are Updated**

Load Driver Only and show Tray Icon when Driver Loads

Driver Auto Loads on System Start*

NOTE: Once a change is made, the Apply Button will appear. Changes will not be applied until you click the Apply button. The changes are saved to the adct.ini file.

To completely automate the ADC-T, check Start Minimized, Driver Only and Allow External Commands. In this mode of operation, your program has complete control of the ADC-T and the User Interface does not open. *do not check unless the ADC-T is always connected to a USB port.

**the default sample rate is 250ms (4 times per second). This is the rate at which all analog inputs are updated.

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