

# ADC-12U SERIES ANALOG TO DIGITAL CONVERTER

TECHNICAL REFERENCE



Click for more info: [www.eeci.com/adc-12up.htm](http://www.eeci.com/adc-12up.htm)

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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 (500 samples per second typical)
Analog Inputs.....	12 single-ended inputs (8, 10 or 12 bit resolution) or 6 fully differential inputs (8, 10 or 12 bit resolution) ADC-12U8 (8 bit resolution will divide your measurement range into 256 different increments) ADC-12U10 (10 bit resolution will divide your measurement range into 1,024 different increments) ADC-12U12 (12 bit resolution will divide your measurement range into 4,096 different increments)
Analog Voltage Input Range.....	0 to 4.096 volt (default range - provides 16 mv divisions per increment with 8 bit, 4 mv divisions with 10 bit or 1 mv divisions with 12 bit) 0 to 3.3 volt or 0 to 5 volt external - low precision user supplied in the range of 1 volt to 5 volts (to terminal block) Contact EECl support for a high precision voltage reference pre-installed
Data Logger.....	twelve channel formatted, select by event, seconds or minutes, text, csv or delimited
Expansion Capability.....	expandable to control up to 144 relays/inputs (or combinations) using EX-8M, EXM-16 or EXM-32 Relay I/O Expansion Modules
Interface.....	USB (also available in WiFi version (ADC12-WIFI), Ethernet version (ADC12-ENET) RS-232 version (ADC12-RS232) or RS-485 version (ADC12-RS485))
Software Compatibility.....	Windows 11, Windows 10, Windows 8.1, 7, Vista, XP and Windows Server
Weight.....	1 ounce
Size.....	1.875 inches by 3.75 inches

## SET-UP AND TESTING

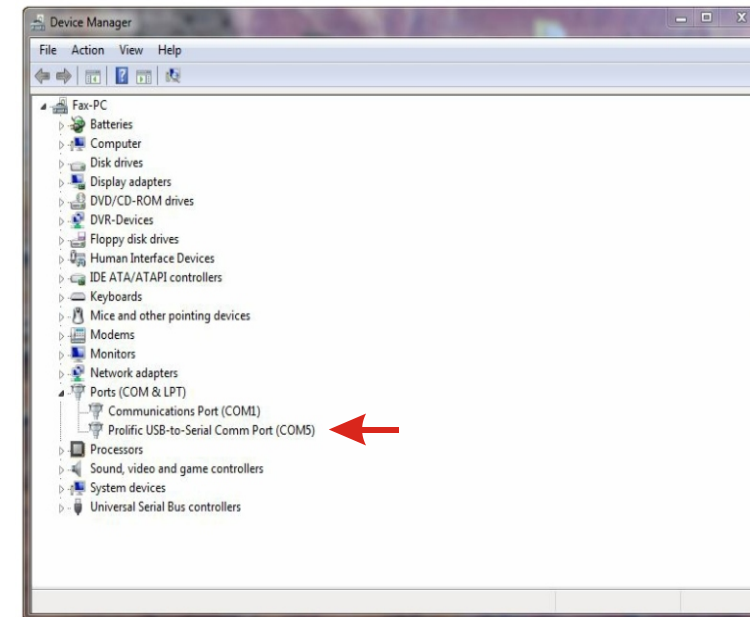
Upon receiving your ADC-12U, you should connect and test the operation of the hardware to verify proper operation. Please set-up and test the ADC-12U as follows (Windows 11, 10, 8.1, 7, Vista, XP\* or Windows Server) \*service pack 3

**(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-12U Analog to Digital Converter** to any available USB port on your computer using a CC-USB 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.



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.

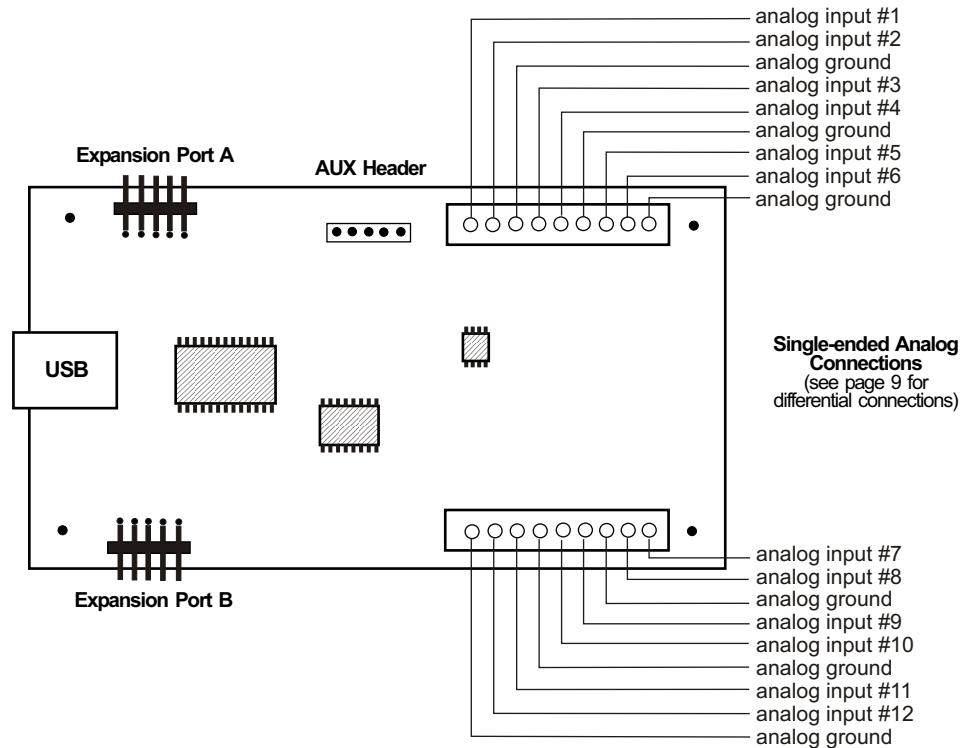
\*verify that this is the com port assigned to the ADC-12U by unplugging the ADC-12U from your USB port and watching the entry in device manager. The entry should disappear and then reappear when you plug the ADC-12U back in.

If you do not have an Internet connection or are having problems with the USB Com driver installation, disconnect the ADC-12U 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).

## CONNECTION DIAGRAM

### ADC-12U SERIES ANALOG TO DIGITAL CONVERTER



## DESCRIPTION

The ADC-12U series Analog to Digital converters connect to any available USB port on your Windows desktop or laptop PC (including some tablets and phones). Twelve analog inputs channels are provided for conversion to 8, 10 or 12 bit digital format. The converters may be set to six channel fully differential mode if required. Three optional expansion ports are available for connection of up to 144 relays, 144 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-12U

The ADC-12U series Analog to Digital Converters are warranted against factory defects for a period of 90 days from the date of purchase. The ADC-12U has proven to be extremely reliable in actual operation during field tests. We recommend that the ADC-12U 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.

**(Step 5) After you have verified** or installed the up to date USB Com driver, reconnect (if not already connected\*) your ADC-12U Analog to Digital Converter to the same USB port and install the ADC-12U device driver\*\* by clicking the "Install EECl 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-12U will be created. When installing the ADC-12U device driver on a Windows XP or Vista computer, double click on setup.exe in the XP-Vista folder. \*if you reconnect your ADC-12U 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-12U device driver is installed,** the ADC-12U com port should be detected and a pop-up will prompt you for the com port to be used with your ADC-12U A to D Converter (correct com port should be shown). You may edit the com port if incorrect. The ADC-12U User Interface will now open and the label just under the COM port indicator should show that Com port open. Please Note: When the ADC-12U inputs are floating (no connection) the inputs may show random or changing values from noise picked up by the high impedance inputs. Click the "Install Help Files" button to install important trouble-shooting and reference information before you close the installer.

**(Step 7) Test each analog input** by connecting each input (one at a time) to one of the GND (reference -) terminals. Your screen should show a "0" for that input. After this is completed, connect each input (one at a time) with 4 volts DC supplied between one of the GND (-) terminals and the analog input terminal (+). Your screen should show a "255" for 8 bit inputs, "1023" for 10 bit inputs or "4095" for 12 bit inputs for each input. If additional testing is desired, connect a 10k ohm 10 or 20 turn potentiometer to each input (one at a time) as shown below. The input shown on the screen should increment from 0 to 255 (8 bit), 0 to 1023 (10 bit) or 0 to 4095 (12 bit). The number shown for each input should increment by one (in 256 increments for 8 bit inputs), (in 1024 increments for 10 bit inputs) or (in 4096 increments for 12 bit inputs) as the potentiometer is slowly adjusted from 0 to 20 turns. Differential inputs will display 8 bit as (-128 to +127), 10 bit as (-512 to +511) and 12 bit as (-2048 to +2047).

If operation of the analog inputs are normal, then testing is now complete and your ADC-12U may be placed in service. If problems are encountered during testing, proceed to the trouble-shooting procedures shown on page 5.

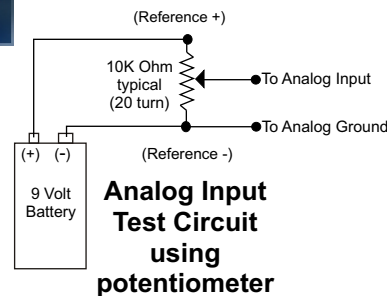
After testing is complete, you may label your analog inputs, set scale and offsets, set precision and add a suffix (such as °, PSI, mA, etc) by going to the setup window in the ADC-12U User Interface and clicking the Analog Setup button. The ADC-12U Data Logger may be started by checking the Enable box. 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 12 icon in your system tray by the clock (bottom right of screen as shown below).



Click the blue 12 icon to re-open the ADC-12U User Interface. Click the "Unload Device Driver" to remove and unload the ADC-12U device driver.

Please note that by default, the ADC-12U device driver is only loaded on demand to conserve system resources. To re-start the ADC-12U device driver, double click the red and blue ADC-12U desktop icon. You may install the ADC-12U device driver permanently by checking the "Driver Only" check box under Setup in the ADC-12U User Interface. Please see page 6.



## HOW TO OPEN DEVICE MANAGER

**Windows 8, 8.1, 10 and Windows 11:** Move your mouse cursor to the lower right side of your screen and click on Settings (or use search). Click on Control Panel near the top and click on the Device Manager icon.

**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.

## TROUBLE-SHOOTING THE ADC-12U

(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-12U to partially function and/or with erratic operation.

(2) Verify that the Prolific USB to Serial Com Port entry is the com port used by your ADC-12U. You may do this by watching the entry in Device Manager and unplugging your ADC-12U from your computer USB port. The entry should disappear and then re-appear when you plug the ADC-12U 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-12U device driver is correctly installed and loaded. Click the blue 12 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-12U USB cable from your computer, wait 5 seconds and plug back in. Open the ADC-12U User Interface by clicking on the blue icon in your system tray and double click on the blue EECl 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.

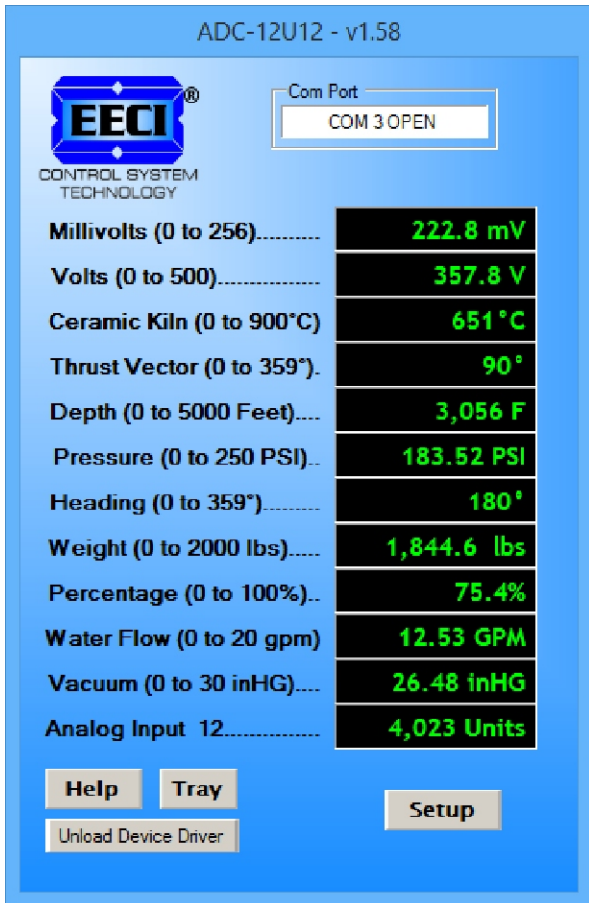
(6) If erratic operation is experienced, check for loose connections at the terminal block (tug on each wire going into the terminal block), check for short circuits caused by metal contact to the ADC circuit areas or other connected hardware.

(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.

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

## EXPANSION PORTS

The ADC-12U provides three expansion ports for additional I/O operations using the same USB port. The expansion ports may be 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 EECl 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. 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 EECl web site.



## THE ADC-12U USER INTERFACE

The ADC-12U User Interface allows you to set all of the basic operating characteristics of the hardware and permits the ADC-12U to send and receive data from other Windows applications or programs that you create.

When the ADC-12 device driver is first installed, you are prompted for the com port that is to be used. This com port number is saved in the settings file "adc12u-set.ini" which is created in the folder c:\eec\adc-12u. 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 analog inputs for each of the 12 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-12U (display will change to six 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 eleven channel mode since the channel 12 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-12U.

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-12U User Interface may be set to start 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 adc12u-set.ini file so that if the user interface is shut down, it will restart with all the new settings. Click the Tray button (driver only mode) to close the window after the ADC-12U is set-up for your application. A blue 12 icon will appear in your system tray (click to re-open the user interface). The ADC-12U User Interface may be left open when used as a stand alone data logger or if an external application is not used. The ADC-12U User Interface may be completely shut down (and driver unloaded) by clicking the Unload button. Once shut down, you will need to double click the ADC-12U desktop icon to re-start the ADC-12U Device Driver (or clicking the ADC-12U icon under All Programs in the EECI folder). The Help button will provide additional assistance if you installed the Help files from the ADC-12U installation CD.

### AUTO START-UP FOR THE ADC-12U

By default, the ADC-12U device driver is only loaded on demand to conserve system resources. You may install the ADC-12U device driver permanently by checking the "Driver Only" check box under Setup in the ADC-12U User

Interface if you intend to always have the ADC-12U connected to a USB port. You will then always see the ADC-12U system icon in your system tray\* along with the other system devices (such as your speaker, printer or display adapter). Click the blue 12 icon in your system tray to open the ADC-12U User Interface. If the ADC-12U device driver is not installed permanently, you will need to double click the ADC-12U desktop icon to load the ADC-12U 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-12U DATA LOGGER

The ADC-12U 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 by clicking the Analog Setup button. The ADC-12U 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. The data log interval may be set to seconds or minutes by clicking the button to the right of the setting. A suffix may be added to the logged value (such as PSI, Volts, °, etc.). Extended ASCII characters may be added by holding down the alt key and entering the ASCII code on your keyboard keypad. Example: to display a degree symbol, hold down the alt key and enter 248 on your keypad. The precision setting allows you to log your data in integer only, tenth, hundredth, thousandth or auto select.

### 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 (12) labels and a timer control to your form. Insert the following code into the timer sub. The (12) ADC-8U analog inputs are displayed in labels 1 through 12.

```
Private Sub Timer1_Tick(sender As Object, e As EventArgs) Handles Timer1.Tick
    readInputs() 'collect analog inputs
```

```
For W = 1 To 12
    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 < 13; i++)
    {
        MyLabelArray[i].Text = inputBytes[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-12U allows for several different reference voltage configurations. The reference voltage determines the voltage input range for all (12) analog input channels ((6) channels in differential mode). The following configurations are selectable from Setup in the ADC-12U user interface. When the ADC-12U is configured for a user provided reference input, the ADC-12U becomes an (11) channel converter since the channel twelve terminal is used for the reference input. The ADC-12U may also be configured to provide the internal reference as an output if required. The reference output voltage will be provided at the channel twelve input terminal (and becoming an (11) channel converter). Using the default internal reference setting will provide the greatest input noise rejection. Option 1 is the default setting. Filter caps must be installed (next to select header) with external reference.

- Option 1: 4.096 volt internal - allows a (0 to 4.1) volt input range with no reference output ((12) channel single ended) allows a (-2 to +2) volt input range with no reference output ((6) channel differential) - high precision
- 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 (12) channel single ended or (6) channel fully differential - uses low precision 5V digital power
- 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 (11) channel single ended\*\* reference output provided on channel 12 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 (11) channel single ended reference voltage from AUX header\*\* is applied to the channel 12 analog input (also providing access to the reference voltage) shunt connects ch 12 - low precision.
- Option 4: 5 volt - allows a (0 to 5) volt input range or (-2.5 to +2.5) volts in differential mode\* with reference (11) channel single ended reference voltage from AUX header\*\* is applied to the channel 12 analog input (also providing access to the reference voltage) shunt connects ch 12 - low precision.
- 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 (11) channel single ended\*\* reference voltage from user is applied to the channel 12 analog input (providing access to the reference voltage). Example: 2 volts applied to the channel 12 analog input provides a (0 to 2) volt input range single ended or (-1 to +1) volts for differential inputs\*. Contact EECl support for High Precision References.

\*(6) channel fully differential (-) side of the channel 6 input is connected to GND.

\*\***IMPORTANT:** header shunt must be removed unless Option 4 or 5 is selected under Setup (may damage ch 12)

## SINGLE ENDED ANALOG VOLTAGE INPUTS

Voltages up to hundreds of volts may be divided down to the 5 volt range by using a simple resistance divider as shown on the following page (the signal source must be capable of driving a 1 ma load). To determine the value transmitted by the ADC for a specific voltage applied to the divider circuit use the following formula: (VI divided by DF) times 51 = TV (where TV = transmitted value sent by the ADC, VI = voltage input to divider, DF = divider factor) DF = full scale voltage divided by 5 volts. EXAMPLE: 100 volts full scale divided by 5 = 20 = DF. A 60 volt input to the divider divided by 20 multiplied by 51 = 153 = TV, the value transmitted by the ADC (8 bit).

The voltage input source may be located up to several hundred feet from the ADC. The wire which connects the ADC to the signal source should be a twisted pair to reduce possible input noise (22 or 24 gauge communication cable or CAT5 typical). Shielded cable may be used to further protect against EMI or lightning noise (the shield should be left disconnected at the source and connected to an earth ground/equipment ground at the ADC).

Lower millivolt signal levels (such as the output signals from a watt transducer, pressure transducer, load cell, etc.) with typical full scale voltages of only 20 to 100 millivolts will require the addition of the VA-1, VA-2, VA-4 or VA-8 instrumentation amplifier. The VA-1 connects to any of the analog inputs and will convert a millivolt signal input to a 0 to 5 volt output for input into the ADC. Signal levels this low will may require shielded cable to reduce noise. An adjustment on the VA-1 will set the input scale. The shield should be left disconnected at the source and grounded to an earth ground at the VA-1. Applications requiring isolated analog inputs require the VI-8I linear opto isolated amplifier.

**NOTE:** When the analog inputs are left floating, (no connection) the ADC will transmit fluctuating numbers as a result of noise present at the inputs. We recommend that any unused inputs be connected to GND (reference (-)) to prevent possible errors on other channels.

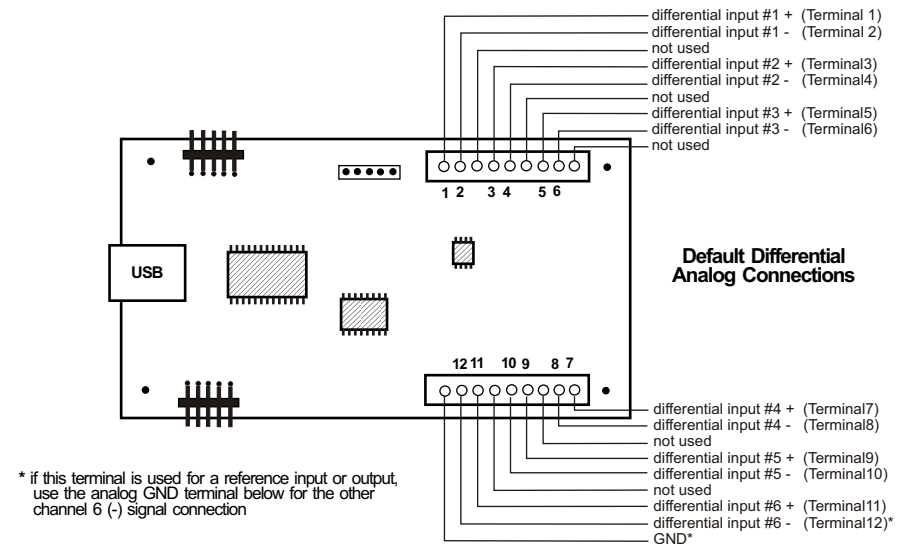
**FILTERING INPUT NOISE:** A .1 uf filter capacitor is installed on the ADC card (one for each channel) which significantly reduces errors and fluctuation as a result of input noise. A 2.7 mf or 10 mf tantalum capacitor may added for additional filtering (input response time will be slower).

Shown on the following pages in figures A, B & C are methods for reading contact closure, potentiometer movement & light levels.

## DIFFERENTIAL ANALOG INPUTS

The ADC-12U may be set to accept (6) fully differential inputs in place of the (12) single ended inputs. The differential voltage input range is determined by the reference setting and/or reference input as shown on the previous page. The differential input signals connect to the terminals as shown below . The GND terminal connection is not used unless the analog input terminal 12 is used for a reference input or output. The GND terminal is then used in place of terminal 12 for the channel 6 differential input-.

### DIFFERENTIAL ANALOG INPUT TERMINAL BLOCK CONNECTIONS



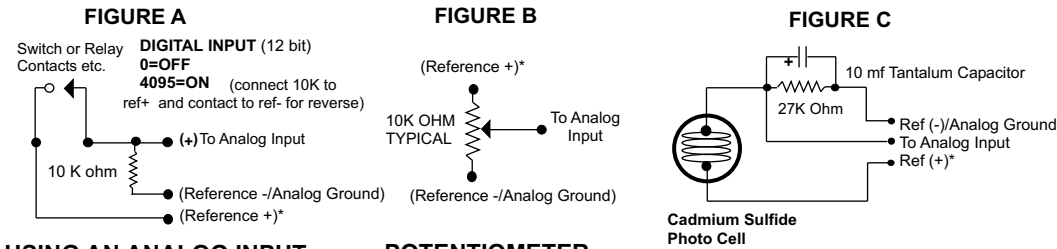
## VOLTAGE INPUT AMPLIFICATION AND SIGNAL CONDITIONING

The ADC-12U defaults to a 0 to 4 volt input range (installation of a voltage reference will allow input ranges as low as 0 to 1 volt). When the input voltage range is required to be lower, (such as with a watt transducer or load cell) an external instrumentation amplifier must be used to amplify the input signal to the 0 to 4 volt input range of the ADC.

Several general purpose instrumentation amplifiers are available to amplify lower signal levels to the 0 to 4 volt range required by the ADC (for use with 8, 10 and 12 bit inputs). The VA-1 is a single channel amplifier for connection to the ADC-4U, ADC-8U or ADC-12U. The VA-2, VA-4 and VA-8 amplifiers are two, four and eight channel versions of the VA-1. The VA-1, VA-2, VA-4 and VA-8 all provide 15 turn potentiometer(s) for gain adjustment (amplification level). The amplification level is adjusted for a 0 to 100 millivolt input at the factory. The amplification level may adjusted for signal inputs as low as 0 to 5 millivolts or as high as 0 to 5 volts. Lower signal levels (such as the output signal from a watt transducer, pressure transducer, load cell, etc.) with typical full scale voltages of only 20 to 100 millivolts will require the addition of the VA-1 instrumentation amplifier when connecting to the ADC. Signal levels this low may

require shielded twisted pair wire. The shield should be left disconnected at the source and grounded to an earth electrical ground at the VA-1.

**CONNECTION OF DIFFERENTIAL SIGNALS TO THE VA-1:** If low level differential inputs are required, the VA-1 may be used to convert a differential signal into a 0 to 5 volt signal for connection to the ADC. The VA series amplifiers have a reference input (for connection to the ADC reference) which is used to generate a 2.5 volt offset (adjustable). The gain adjustment on the VA series amplifiers may be adjusted to allow for differential signals as low as (+) and (-) 5 millivolts or as high as (+) and (-) 5 volts. Using the VA-1 will allow the use of all 12 single ended inputs on the ADC-12U since the low level differential input to the VA-1 is converted to a single ended signal for connection to the ADC-12U.



**FIGURE A**  
DIGITAL INPUT (12 bit)  
Switch or Relay Contacts etc.  
0=OFF  
4095=ON (connect 10K to ref+ and contact to ref- for reverse)

**FIGURE B**  
(Reference +)\*  
10K OHM TYPICAL  
To Analog Input  
(Reference -/Analog Ground)

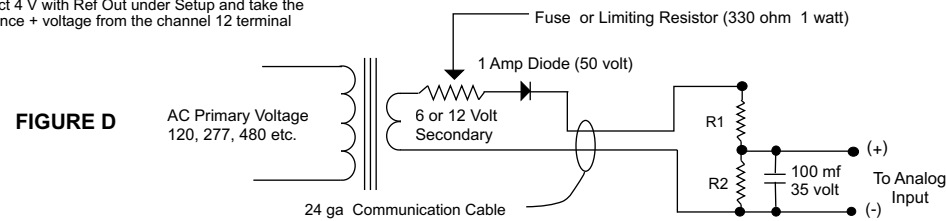
**FIGURE C**  
10 mf Tantalum Capacitor  
27K Ohm  
Ref (-)/Analog Ground  
To Analog Input  
Ref (+)\*  
Cadmium Sulfide Photo Cell

**USING AN ANALOG INPUT FOR ON/OFF STATUS**

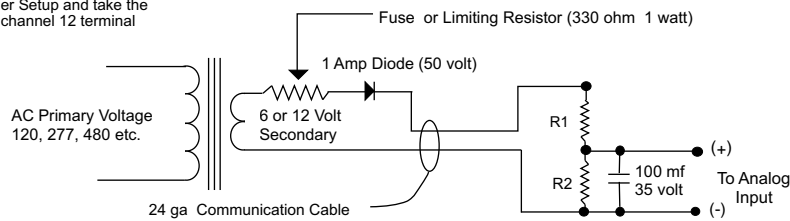
**POTENTIOMETER MOVEMENT SENSING**

**MEASURING LIGHT LEVELS**

\* select 4 V with Ref Out under Setup and take the reference + voltage from the channel 12 terminal



**FIGURE D**



**FIGURE E**

**HIGH VOLTAGE INTERFACING**

**CAUTION:** When working with high voltages, the potential for fire, explosion, electrocution, eye injury or blindness and life threatening injuries or death exists. If you are not familiar with the precautions needed when working with high voltages, do not attempt to connect high voltage up to these circuits. To prevent the danger of a high voltage feeding back to the ADC and the fire/injury/electrocution hazard caused by an open or short circuit, 10 volt 2 watt zener diodes and a 1/4 amp fuse should be connected as shown in figure E. Wire used to interconnect a high voltage input must be rated for use with the higher voltage. When connecting the ADC to high voltage AC equipment the method shown in figure D above is recommended.

The following method is used to divide a high voltage down to the 5 volt range needed for input into the ADC. This method involves the use of two resistors (R1 and R2) which together add up to Rt (total resistance). The total

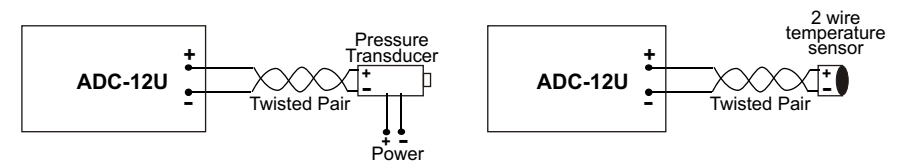
resistance is determined by using the Ohms Law to compute the resistance needed for a 1 milliamp current flow through the resistors. **EXAMPLE:** If your full scale voltage is 100 volts ( $R = E$  divided by  $I$ ) 100 volts divided by .001 amp = 100,000 ohms (100K ohm). To determine the proper ratio, divide 5 volts by the full scale voltage. 5 divided by 100 volts = .05. Multiple this ratio by the total resistance to determine the value of R2. R1 is then equal to the difference between the total resistance and R2. **EXAMPLE:** ratio .05 times total resistance 100,000 ohms = 5,000 ohms (the value of R2). Total resistance 100,000 ohms less R2 5,000 ohms = 95,000 ohms (the value of R1). To determine the power rating needed for the resistor, use the following formula:  $P = I$  squared times  $R$ . **EXAMPLE:** .001 squared = .000001 times R1 95,000 ohms = .095 watts. A 1/8 or 1/4 watt resistor would be sufficient.

**IMPORTANT:** The full scale voltage used should be the highest possible voltage that could be present at the high voltage input.

AC voltages may be applied to the high voltage input if a diode is connected in series and a filter capacitor (100 mf, 35 volt typical) is connected between the ADC analog input and the ADC reference (-). AC voltages over 24 volts or great enough to create an electrical shock hazard or fire should be connected to the ADC analog input using a step-down transformer to reduce the high voltage down to the 5 volt range as shown in figure D. A diode and filter capacitor must be connected on the secondary side of the transformer (a common low current power transformer may be used).

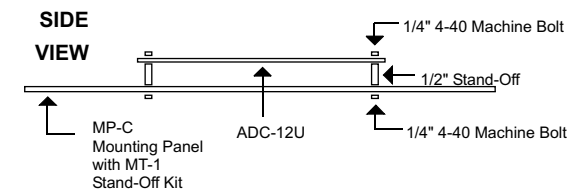
**CONNECTING SENSORS TO THE ADC-12U**

A large variety of sensors, transducers, load cells and other devices that provide an analog output may be connected to the ADC-12U. Most types of sensors may be located up to 1,000 feet from the ADC-12U. Pull up resistors may be installed on the underside of the ADC-12U for 2 wire sensors that receive power from the USB port. The cable used to connect sensors to the ADC-12U 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.



**MOUNTING**

The ADC-12U Analog to Digital card may be mounted in an enclosure (part # EN-C or EN-D) or on a metal mounting panel using the MT-1 stand-off mounting hardware as shown below. The ADC-12U will attach to the 4 stand-off spacers using 4-40 machine screws (4 mounting holes are provided on the ADC-12U). Contact technical support for more information on mounting panels and various mounting layouts.



## RAW ANALOG DATA

The ADC-12U will present the raw analog data in single ended mode as a number between:  
 0 to 255 (8 bit)  
 0 to 1023 (10 bit)  
 0 to 4095 (12 bit)

and in differential mode as a number between:  
 -128 to +127 (8 bit)  
 -512 to +511 (10 bit)  
 -2048 to +2047 (12 bit)

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 the logged data.

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

Driver Auto Loads on System Start\*

## 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.

Rate at which Analog Inputs are Updated\*\*  
 Load Driver Only and show Tray Icon when Driver Loads

\*\*the default sample rate is 250ms (4 times per second). This is the rate at which all analog inputs are updated. A setting of 100ms will update all 12 analog inputs 10 times per second, yielding an effective sample rate of 120 samples per second.

**Channel 12 detail:** The channel 12 analog terminal has three possible configurations. The default 4.096 V Internal option is used to select a standard analog input with a 4.096 volt reference (1 mv increments in 12 bit). When the Supplied External option is selected (shown above under Voltage Reference), the channel 12 analog terminal becomes an input and is used to input the reference voltage. When the 4 V with Ref Out option is selected, the channel 12 analog terminal becomes an output and is used to provide the 4.096 internal reference voltage for use with your hardware. When the default 4.096 V Internal option is not selected, the ADC-12U will disconnect the standard channel 12 analog input and will only allow the input of 11 standard analog levels (channels 1 to 11).

**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 adc12u.ini file.

To completely automate the ADC-12U, check Start Minimized, Driver Only and Allow External Commands. In this mode of operation, your program has complete control of the ADC-4U and the User Interface does not open. \*do not check unless the ADC-12U is always connected to a USB port.

## SAMPLE RATE OF ANALOG INPUTS

All twelve analog inputs are updated at the same rate which you set under Setup in the ADC-4U User Interface. The default setting is every 250ms with an effective sample rate of 48 samples per second (or each channel sampled four times per second). A setting of 1000 will sample all twelve inputs once per second or a setting of 2500 every 2.5 seconds, etc. Use caution when making changes to this setting as a time setting too low will waste processor resources. A setting below 10ms will degrade system performance and will not allow for any change of the analog level due to the filter cap and decoupling resistor on the analog input (which average the signal level to reduce noise).

## INPUT SCALING AND OFFSETS

Analog inputs may be scaled and offsets added by opening the user interface and clicking Setup and then Analog Setup. This allows you to directly display temperature, pressure, position, etc. by adjusting the raw analog data coming from the sensor to the actual units (such as degrees, PSI, mm, GPM, RPM, etc.). The Precision setting allows the units to be displayed in integer, tenth, hundreds, etc. Use the Suffix box to change the display from the default Units to the required specifier. You may check the "Raw" checkbox to disable all formatting.

	Analog In Labels	Scale	Offset	Suffix	Precision
1	Temperature	.18	-459	.	1
2	Pressure	1	0	PSI	3
3	Analog Input 3	1	0	Units	0
4	Analog Input 4	1	0	Units	0
5	Analog Input 5	1	0	Units	0
6	Analog Input 6	1	0	Units	0
7	Analog Input 7	1	0	Units	0
8	Analog Input 8	1	0	Units	1



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