

DAC-8U SERIES DIGITAL TO ANALOG CONVERTER

TECHNICAL REFERENCE



Click for more info: www.eeci.com/dac-8up.htm

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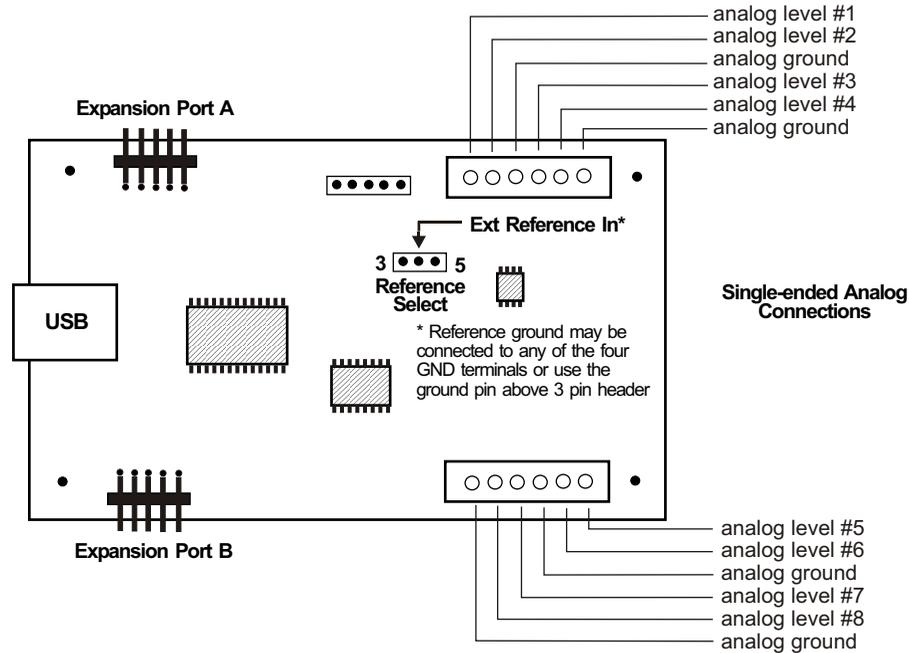
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* the DAC-8U may be ordered with a predetermined high precision voltage reference installed (1.024V, 2.048V, 2.5V, 3V or 4.096V). These provide a precise voltage output per increment. Please contact EECI support for more info.

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 Update Rate.....	100 updates per second or better
Analog Outputs.....	8 analog output channels (8, 10, 12 or 16 bit resolution)
DAC-8U8	(8 bit resolution will divide your analog output level into 256 different increments)
DAC-8U10	(10 bit resolution will divide your analog output level into 1,024 different increments)
DAC-8U12	(12 bit resolution will divide your analog output level into 4,096 different increments)
DAC-8U16	(16 bit resolution will divide your analog output level into 65,536 different increments)
Analog Voltage Output Range	0 to 5 volt (default range using USB power as reference - low precision) 0 to 3.3 volt (using digital power as reference - low precision or with user supplied reference* (provides output levels in the range of 0 to .01 volts up to 0 to 5 volts)
Data Logger.....	eight 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 (DAC8-WIFI), Ethernet version (DAC8-ENET) RS-232 version (DAC8-RS232) or RS-485 version (DAC8-RS485))
Software Compatibility.....	Windows 11, Windows 10, Windows 8.1, 7, Vista, XP and Windows Server
Weight.....	.75 ounce
Size.....	1.875 inches by 3.125 inches

CONNECTION DIAGRAM
DAC-8U SERIES DIGITAL TO
ANALOG CONVERTER



DESCRIPTION

The DAC-8U series Digital to Analog converters connect to any available USB port on your desktop or laptop PC (including some tablets and phones). Eight analog outputs channels are provided for conversion from 8, 10, 12 or 16 bit digital format. 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 DAC-8U

The DAC-8U series Digital to Analog Converters are warranted against factory defects for a period of 90 days from the date of purchase. The DAC-8U has proven to be extremely reliable in actual operation during field tests. We recommend that the DAC-8U 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

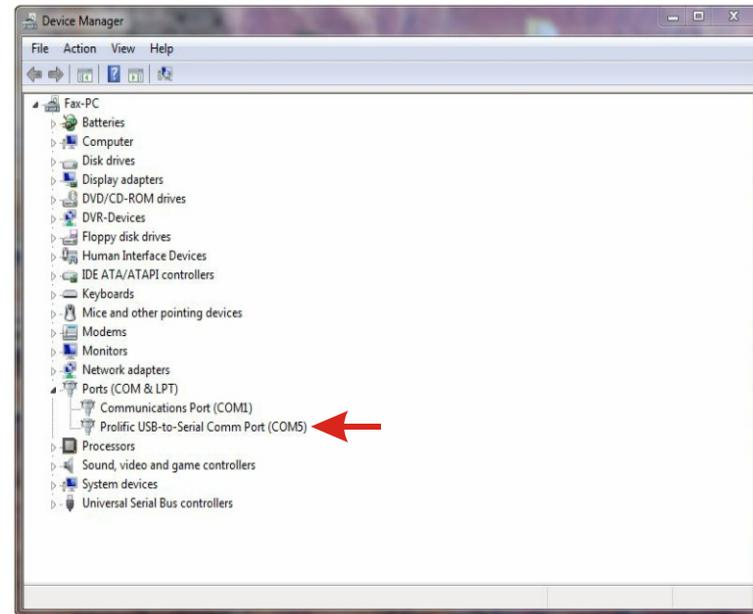
Upon receiving your DAC-8U, you should connect and test the operation of the hardware to verify proper operation. Please set-up and test the DAC-8U as follows: (Windows XP*, Vista, Windows Server, Windows 7, 8.1, Windows 10 or Windows 11) *service pack 3

(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 (please note that if you are not connected to the Internet, the installer will delay for about 30 seconds while attempting to connect).

(Step 2) Connect your DAC-8U Digital to Analog 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 4 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 DAC-8U by unplugging the DAC-8U (not hub) from your USB port and watching the entry in device manager. The entry should disappear and then reappear with the DAC-8U reconnected.

If you do not have an Internet connection or are having problems with the USB Com driver installation, disconnect the DAC-8U 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).

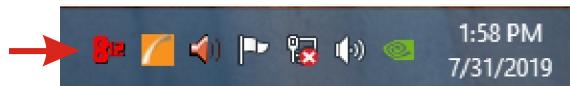
(Step 5) After you have verified or installed the up to date USB Com driver, reconnect (if not already connected*) your DAC-8U Digital to Analog Converter to the same USB port and install the DAC-8U device driver** by clicking the "Install EECI Device Driver" button from the installer dialog window (if you have auto start disabled, you may browse to the Windows Driver folder and double click on setup.exe). A desktop icon for the DAC-8U will be created. When installing the DAC-8U device driver on a Windows XP or Vista computer, double click on setup.exe in the XP-Vista folder. *if you reconnect your DAC-8U 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 DAC-8U device driver is installed, the DAC-8U com port should be detected and a pop-up will prompt you for the com port to be used with your DAC-8U D to A Converter (correct com port should be shown). You may edit the com port if incorrect. The DAC-8U User Interface will now open and the label just under the COM port indicator should show that Com port open. Click the "Install Help Files" button to install important trouble-shooting and reference information before you close the installer.

Your screen should show a row of eight channels with eight analog level input boxes along with the set buttons. The default reference voltage is set to 5 volts (0 to 5 volt analog output range)

(Step 7) Test each analog output by entering a number (0 to 255 for 8 bit), (0 to 1023 for 10 bit), (0 to 4095 for 12 bit) or (0 to 65535 for 16 bit) in the text box for the channel. Press the S button to set the analog output level to this number. The analog voltage output should increment from 0 to 5 volts, (256 increments for 8 bit), (1,024 increments for 10 bit) or (in 4,096 increments for 12 bit), (in 65,536 increments for 16 bit) as you increase the number. For example... to set the analog output level to mid range (2.5 volts) enter: (128 for 8 bit converters), (512 for 10 bit converters) or (2048 for 12 bit converters) or (32768 for 16 bit converters). If operation of the analog outputs are normal, then testing is now complete and your DAC-8U may be placed in service. Analog output levels may be labeled and scaled as shown on page 6 if desired. Scale, Offset and Suffix entries are provided to allow the input value in the user interface to adjust the analog output level as required. If problems are encountered during testing, proceed to the trouble-shooting procedures shown on page 5.



Click the "Tray" button to place the User Interface in "driver only" mode. You will see a red 8/12 icon in your system tray by the clock (bottom right of screen as shown below).

Click the red 8/12 icon to re-open the DAC-8U User Interface.

Click "Unload Device Driver" to unload the DAC-8U device driver. Please note that by default, the DAC-8U device driver is only loaded on demand to conserve system resources. To re-start the DAC-8U device driver, double click the red and blue DAC-8U desktop icon or (if your DAC is always connected), you may check the "Driver Only" box in setup to permanently install the device driver.

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.

TROUBLE-SHOOTING THE DAC-8U

(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 DAC-8U 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 DAC-8U. You may do this by watching the entry in Device Manager and unplugging your DAC-8U from your computer USB port. The entry should disappear and then re-appear when you plug the DAC-8U back in to your computer USB port.

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

(4) Verify that the DAC-8U Driver is correctly installed and running. Click the red 8 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 DAC-8U USB cable from your computer, wait 5 seconds and plug back in. Open the DAC-8U User Interface by clicking on the red 8 icon in your system tray and double click on the blue EECI logo to reset the DAC-8U. 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 DAC circuit areas or other connected hardware. Check for shorts on all analog output channels.

(7) When an external reference is used, the reference voltage must not exceed 5 volts or go below 1 volt and must not be allowed to go negative.

(8) Check the current drain on all your analog outputs. Your connected device must not pull over 25ma (for best accuracy the analog output current should be less than 10ma) for each channel.

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

EXPANSION PORTS

The DAC-8U provides two expansion ports for additional I/O operations. 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. A third expansion port is provided that will permit an additional 128 relays/outputs/inputs to be added using the EXM-16 or EXM-32 Relay I/O Expansion Modules. The relay output ports on the EX-8M and EXM-16 expansion modules are similar to those on the AR-16, EX-16 and EX-32 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 cards/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 and EXM-16 expansion modules, please refer to the Technical Reference available on the EECI web site.

THE DAC-8U SIMULATOR

The DAC-8U Simulator is a great tool to use when you are testing your code since you will not need to measure voltage on the outputs when testing. You may run the simulator with (or without) the DAC-8U connected and you will be able to see the levels of all the DAC channels. The simulator is in a folder on your installation CD, just double click setup.exe to install.



THE DAC-8U USER INTERFACE

The DAC-8U User Interface allows you to set all of the basic operating characteristics of the hardware and permits the DAC-8U to send and receive data from other Windows applications or programs that you create. A password protected version of this User Interface is available (contact EECl support for info).

When the DAC-8U device driver is started for the first time, you are prompted for the com port that is to be used with the DAC-8U. This com port number is saved in the settings file "dac8u-set.ini" which is created in the folder c:\eecl\dac-8u. The driver 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. To manually set the analog output levels, enter the desired output level and click the S button to set the analog output voltage for that channel. Enter (0 to 255 for 8 bit), (0 to 1023 for 10 bit), (0 to 4095 for 12 bit) or (0 to 65535 for 16 bit).

Clicking the Setup button allows you to label the analog outputs for each of the 8 channels. The com port, baud rate and sampling rate settings are changed below. Un-checking the

Allow External Commands box will prevent other Windows applications from sending or receiving data from the DAC-8U. The data logger may be enabled by checking the box in the data logger section and entering the file type information. The logger will log an event each time an analog output level is updated.

The DAC-8U User Interface may be started in driver only mode by checking the Start Minimized box if the DAC-8U12 will always be connected. 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 dac8u-set.ini file so that if the device driver is unloaded, it will restart with the new settings. Click the Tray button (driver only mode) to close the window after the DAC-8U User Interface is set-up for your application. A red 8 icon will appear in your system tray (click to re-open the user interface). The DAC-8U User Interface may be left open if an external application is not used. The DAC-8U User Interface may be completely shut down (and driver unloaded) by clicking the "Unload Device Driver" button. Once shut down, you will need to double click the DAC-8U desktop icon to re-start the DAC-8U Driver (or clicking the DAC-8U icon under All Programs in the EECl folder). The Help button will provide additional assistance if you installed the Help files from the DAC-8U installation CD.

AUTO START-UP FOR THE DAC-8U DRIVER

By default, the DAC-8U12 device driver is only loaded on demand to conserve system resources. You may install the DAC-8U12 device driver permanently by checking the "Driver Only" check box under Setup in the DAC-8U12 User Interface. The "Driver Only" check box should not be checked unless the DAC-8U12 is connected at all times. You will then always see the DAC-8U12 system icon in your system tray* along with the other system devices (such as your speaker, printer or display adapter). Click the red 8 icon in your system tray to open the DAC-8U12 User Interface. If the DAC-8U12 device driver is not installed permanently, you will need to double click the DAC-8U12 desktop icon to load the DAC-8U12 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 DAC-8U ANALOG OUTPUTS

The DAC-8U outputs are intended to just provide a voltage for a controller to read (that typically pull only about 1 or 2ma). The DAC-8U outputs may be able to sink up to 25ma but you probably should not go over about 10ma as this will effect accuracy. You may add a precision (high current output) Op Amp if you need to drive a load with accurate output voltage. The DAC-8U will normally power up with all outputs at 0v. If the DAC-8U still has values in memory, the outputs may return to previous levels upon the next update. Your code should update the outputs to the desired level at startup. A 10 ohm resistor and .01mf cap are installed on the outputs to decouple and help protect the outputs (these may be removed if needed).

THE DAC-8U DATA LOGGER

The DAC-8U User Interface provides a data logger function that will save the analog output levels to a file each time an analog output level is updated (or time based). Channel labels, Scale and Offset may be edited by clicking the D to A Setup button under setup. The DAC-8U 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. 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. Click the Data Interval button to log the data by event or time (may be set to seconds or minutes). When the logger is set to log by time enter the time interval in the box above the Data Interval button (seconds or minutes).

PROGRAMMING EXAMPLES

VISUAL BASIC EXAMPLE (Microsoft Visual Studio)

*To use this example, copy the code module (supplied on your CD) to a sub called setOutputs(). From the toolbox, drag (8) textboxes and a timer control to your form. Insert the following code into the timer sub. The (8) DAC-8U analog outputs levels are entered using textboxes 1 through 8. If you wish to update the analog outputs 4 times per second (for example), set the timer interval to: Timer1.Interval = 250 (example shown is with a 4.096 reference)

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

```
setOutputs() 'set analog output levels for all channels to your array*
```

```
End Sub
```

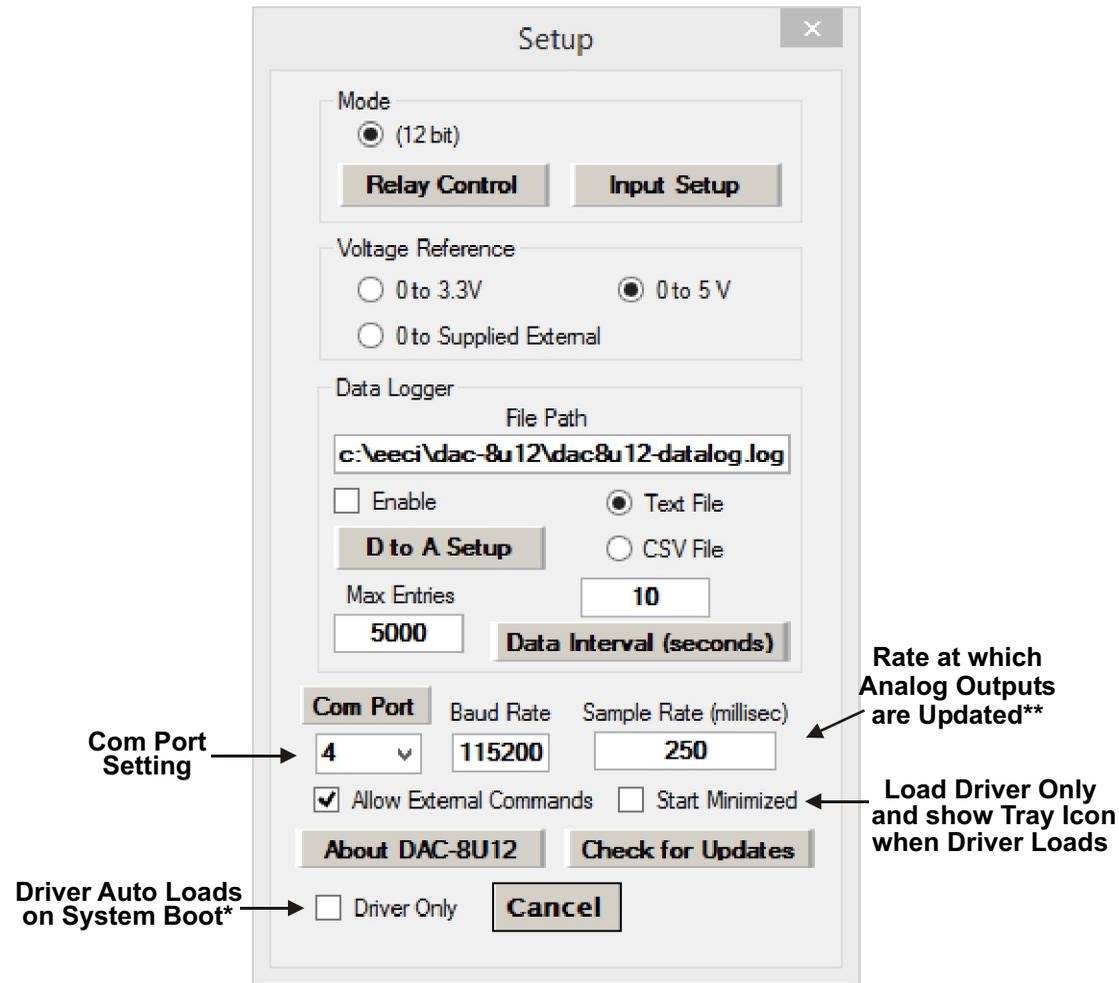
*You may also set channels individually (such as setOutputs(4,2000) which sets the output to 2 volts on channel 4

VISUAL C# EXAMPLE (Microsoft Visual Studio)

```
private void timer1_Tick(object sender, EventArgs e)
{
    SetOutputs(); //set analog output levels for all channels to your array*
}
```

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#, C++ and ASP .Net. Additional source code examples are available in several other variations which may be more suitable for alternate programming languages. DLL's and LabVIEW examples are also provided. Please contact EECl technical support for more information.

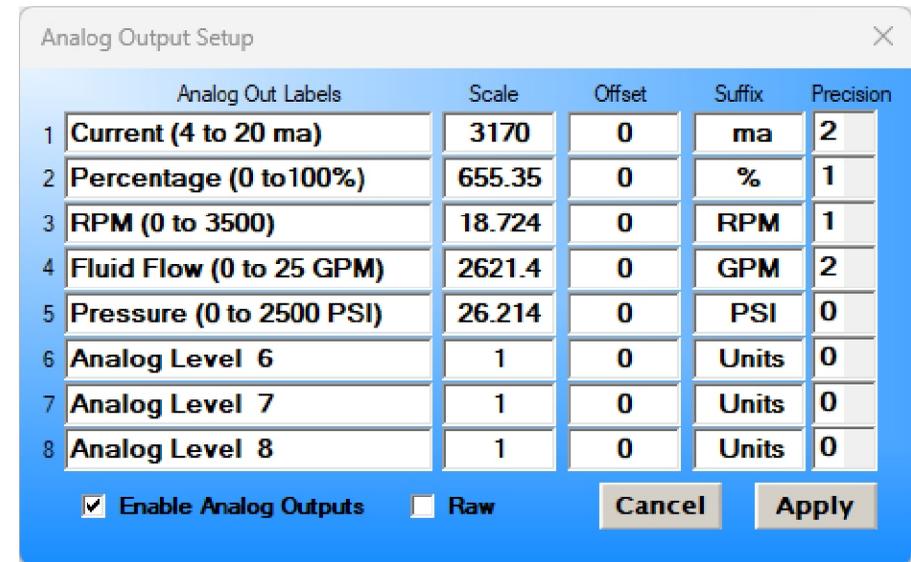


Click the Com Port Button to update the detected com ports in the pull-down. Click the Data Interval Button to toggle between minutes and seconds.

To completely automate the DAC-8U, check Start Minimized, Driver Only and Allow External Commands. In this mode of operation, your program has complete control of the DAC-8U and the User Interface does not open.

*do not check unless the DAC-8U 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 outputs are updated.



NOTE: You must uncheck "Raw" and click the "Apply" button for any changes to take effect. Checking the Raw checkbox will disable all formatting.

The DAC-8U User Interface may be used stand alone to manually control the analog output levels and/or to log events without the need to develop your own software. The above setup is for a 16 bit D to A converter.

Click the D to A Setup button to open Analog Output Setup (shown above) to scale and label your analog outputs. You may also double click the Analog Output label (on the primary User Interface) to open Analog Output Setup.

Enter the Scale factor to adjust the analog output voltage for the corresponding input. The scale value will multiply the entered number to provide the desired output voltage. Below are examples to scale the output by percentage:

- 8 BIT:** A scale factor of 2.55 will provide 100% output voltage with a percentage input of 100
- 10 BIT:** A scale factor of 10.23 will provide 100% output voltage with a percentage input of 100
- 12 BIT:** A scale factor of 40.95 will provide 100% output voltage with a percentage input of 100
- 16 BIT:** A scale factor of 655.35 will provide 100% output voltage with a percentage input of 100

Shown in the above setup are several other examples for use with a 16 bit outputs (4-20ma, RPM, Fluid Flow and Pressure). Enter the desired suffix in the Suffix field to add to the displayed output and logged event. Label the outputs as desired by entering the text in the Analog Out Labels field. Special characters may be added by holding down the alt key and entering the ASCII code on your keyboard keypad (extended ASCII). Example: to display a degree symbol, hold down the alt key and enter 248 on your keypad. Four digit unicode symbols or foreign language may be added using the same method but adding + to the unicode input (example: alt +0169 will display ©). You may also just use copy and paste (copy and paste this degree symbol: °).

The Offset field may be used to add or subtract from the analog output voltage (this value may be positive or negative). This function may be used for calibration or to adjust for needed offset adjustment (such as when you may need a 0 volt output with a 1 to 5 volt input).

VOLTAGE REFERENCE INPUT

The DAC-8U allows for several different reference voltage configurations. The reference voltage determines the voltage output range for all (8) analog output channels. The following configurations are selectable. Option 1 is the default setting.

- Option 1: 5 volt - allows a (0 to 5) volt output range ((8) channel single ended - low precision) (default setting)
- Option 2: 3.3 volt - allows a (0 to 3.3) volt output range ((8) channel single ended - low precision)
external reference voltage selected with circuit board shunt.
- Option 3: User supplied* - must be in the range of 1 volt to 5 volts and should have an output impedance of 500 ohms or less reference voltage from user is applied to the 2 position AUX header.
Example: 2 volts applied to the AUX header provides a (0 to 2) volt output range (single ended)

* the DAC-8U may be ordered with a predetermined high precision voltage reference installed. Please contact EECI support for assistance.

CONNECTING DEVICES TO THE DAC-8U ANALOG OUTPUTS

A large variety of devices (variable flow air dampers, temperature controllers, adjustable speed AC drive controllers, VFD motors, adjustable flow valves, lighting controllers, audio level controllers) and other devices that require an analog input may be connected to the DAC-8U. The cable used to connect devices to the DAC-8U analog outputs should be twisted pair or shielded twisted pair to suppress environmental noise. Low cost CAT 5 cable (or shielded CAT 5) works well when multiple devices are in the same location. The DAC-8U may be used to control the current in a 4-20mA loop by adding the CO-420T transmitter. The CO-420T4 may be used to convert four of the DAC-8U outputs to four 4-20mA transmitters.

MOUNTING

The DAC-8U 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 DAC-8U will attach to the 4 stand-off spacers using 4-40 machine screws (4 mounting holes are provided on the DAC-8U). Contact technical support for more information on mounting panels and various mounting layouts.

