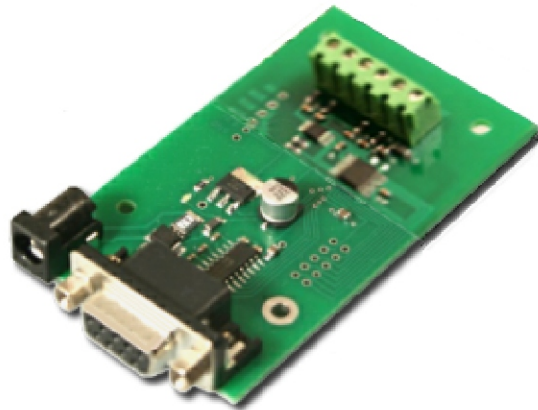


# DAC2-16RS232 DIGITAL TO ANALOG CONVERTER

TECHNICAL REFERENCE



Click for more info: [www.eeci.com/dac2-rs232p.htm](http://www.eeci.com/dac2-rs232p.htm)

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

[www.eeci.com](http://www.eeci.com)  
*Click for Website*

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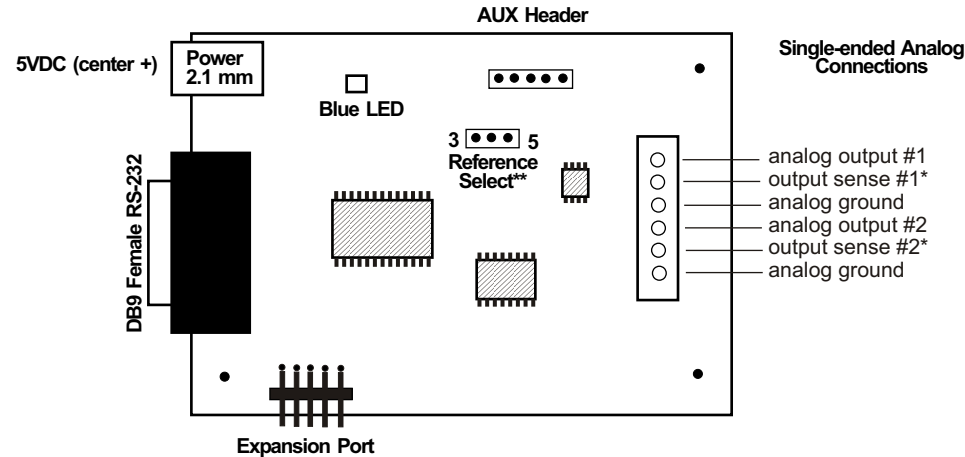
## SPECIFICATIONS

Power Supply.....	5 volts DC, 50ma
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/Sampling Rate.....	100 samples per second or better
Analog Outputs.....	1 or 2 analog output channels (16 bit resolution) (16 bit resolution will divide your analog output level into 65,536 different increments)
DAC1-16RS232	1 analog output channel (16 bit resolution)
DAC2-16RS232	2 analog output channels (16 bit resolution)
Analog Voltage Output Range	0 to 5 volt (default range using power supply 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)
* the DAC-2U 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.	
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.....	RS-232 (also available in WiFi version (DAC2-WIFI), Ethernet version (DAC2-ENET) USB version (DAC-2U16) or RS-485 version (DAC2-RS485))
Software Compatibility.....	Windows XP, Vista, Windows Server, Windows 7, Windows 8.1 and Windows 10
Weight.....	.75 ounce
Size.....	1.875 inches by 2.5 inches

## SET-UP AND TESTING

### CONNECTION DIAGRAM

#### DAC2-16RS232 SERIES DIGITAL TO ANALOG CONVERTER



\* the output sense terminal for each channel may be connected directly to your device input to provide the most accurate output voltage. If output sense is not used, a jumper must be installed from the output sense to the analog output terminal.

\*\* the default output range is 0 to 5 volts (low precision) using your USB 5 volt power as a reference. You may select a 0 to 3.3 volt output range by moving the shunt to the 3 position. The 3.3 volt setting uses the 3.3 volt digital power as a reference. The DAC-2U may be ordered with a predetermined high precision voltage reference installed. Please contact EECI support for more info

### DESCRIPTION

The DAC2 series Digital to Analog converters connect to any available USB port on your desktop or laptop PC (including some tablets and phones). Two analog outputs channels are provided for conversion from 16 bit digital format. The DAC1-16RS232 is the single channel version. Two optional expansion ports are available for connection of up to 136 relays, 136 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 DAC2

The DAC2 series Digital to Analog Converters are warranted against factory defects for a period of 90 days from the date of purchase. The DAC2 has proven to be extremely reliable in actual operation during field tests. We recommend that the DAC2 and associated hardware be installed in a suitable enclosure (4 mounting holes are provided on the circuit board) and that reasonable precautions be taken to protect the circuit from static discharge.

Upon receiving your DAC2-16RS232, you should connect and test the operation of the hardware to verify proper operation. Please set-up and test the DAC2 as follows (Windows XP\*, Vista, Windows Server, Windows 7, 8.1 or Windows 10) \*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 DAC2-16RS232 Digital to Analog converter** to your computer RS-232 port using a CC-DB9SP cable (1 to 50 foot). The RS-232 cable used should be a 9 pin female to a 9 pin male. The pins should be wired pin to pin. Only three pins need to be wired: pin 2 to pin 2, pin 3 to pin 3 and pin 5 to pin 5.

**(Step 3) Connect your 5 volt DC power adapter** (part # PS-5VDC-1000)\* A blue LED on the circuit will light to indicate a ready state.

**\*IMPORTANT NOTE ABOUT POWERING THE DAC2-16RS232 DIGITAL TO ANALOG CONVERTER:** The DAC2-16RS232 is powered with a 5 volt DC power source (center pin +, reversed polarity will cause damage). The PS-5VDC-1000 power adapter should be used to power the DAC2-16RS232. If an alternate power source is used, it should be completely isolated (not powering other devices and must not be connected to an equipment or earth ground). The alternate power source should have low noise output, should also be regulated (minimum voltage of 4.8 volts and a maximum of 5.0 volts) and able to provide 300ma of current. We also recommend the power source or adapter be plugged into a surge protector or protected UPS. These power input requirements must be followed to prevent error free analog data and to prevent damage to the DAC2-16RS232.

**(Step 4) Insert your DAC2-16RS232 installation CD** and close the drive door to start the CD setup process and display the installation window. You may receive a security message pop-up if your operating system is Windows 8 or higher (click the pop-up and then click "run startup.exe").

**(Step 5) Check your Com port** by clicking on the "Open Device Manager" button on your installation window (OK security message if shown in taskbar) and expanding the "Ports (COM & LPT)" category. You should see a Communications Port entry, if this is the Com port that you have connected to, the Com port assigned is to the right of the entry. If you are using a USB to RS-232 adapter, please follow the instructions provided with the adapter (part # CO-USB)

**(Step 6) Install the DAC2-16RS232 Device Driver\*** by clicking the "Install Device Driver" button on your CD installation dialog (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 DAC2-16RS232 will be created.

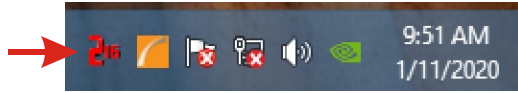
\*Please note that the Microsoft .Net Framework must be installed on your system. The .Net Framework is already installed if you have Windows 7 or higher. If the .Net Framework is not installed on your computer, the installation program will attempt to download and install the .Net Framework from the Microsoft 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 7) After the DAC2-16RS232 device driver is installed,** the DAC2 com port should be detected and a pop-up will prompt you for the com port to be used with your DAC2 D to A Converter (correct com port should be shown). You may edit the com port if incorrect. The DAC2 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 now show a row of two channels with two 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) using the low precision adapter voltage.

**(Step 8) Test each analog output** by entering a number (0 to 65,535 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, (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: (32767 for 16 bit converters). If operation of the analog outputs are normal, then testing is now complete and your DAC2 may be placed in service. If problems are encountered during testing, proceed to the troubleshooting procedures shown on page 5.

Click the "Tray" button to place the User Interface in "driver only" mode. You will see a red 2 icon in your system tray by the clock (bottom right of screen as shown below).



Click the red 2/16 icon to re-open the DAC2-16RS232 User Interface. Click the "Unload Device Driver" to unload the DAC2 device driver. Please note that by default, the DAC2 device driver is only loaded on demand to conserve system resources. To re-start the DAC2 device driver, double click the red and blue DAC2-16RS232 desktop icon or under Applications.

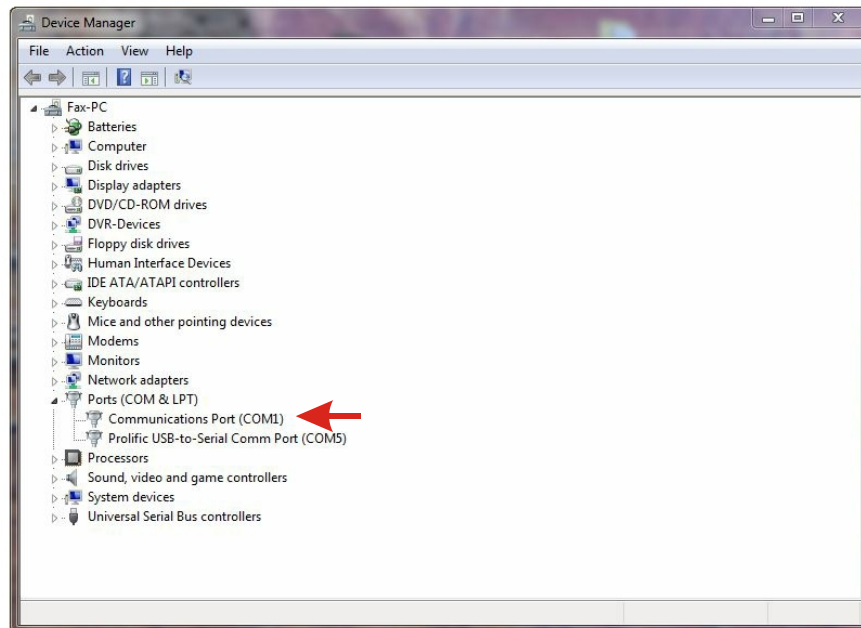
### HOW TO OPEN DEVICE MANAGER

#### 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, 8.1, 10 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 DAC2-16RS232

(1) Verify that 5 volt DC power is supplied to your DAC2-16RS232 (the blue ready LED should light). Measure the voltage using a multi meter (center pin +, reversed polarity may cause damage). The PS-5VDC-1000 power adapter should be used to power the DAC2-16RS232. If an alternate power source is used, it should be completely isolated (not powering other devices and must not be connected to an equipment or earth ground). The alternate power source should have low noise output, should also be regulated (minimum voltage of 4.8 volts and a maximum of 5.0 volts) and able to provide 300ma of current. We also recommend the power source or adapter be plugged into a surge protector or protected UPS. These power input requirements must be followed to prevent error free analog data and to prevent damage to the DAC2-16RS232.

(2) Verify that the DAC2-16RS232 is connected to the same com port that you have set in the DAC2-16RS232 User Interface (check in Device Manager)

(3) Try replacing the RS-232 cable and/or using a different RS-232 port. The RS-232 cable should be pin to pin (pin 2 to pin 2, pin 3 to pin 3 and pin 5 to pin 5).

(4) Verify that the DAC2-16RS232 Device Driver is correctly installed and loaded. Click the red 2 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) Reset the DAC2-16RS232 Device Driver by clicking on the red 2 icon in your system tray and double click on the blue EECl logo to reset. 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.

(7) The input reference voltage must not exceed 5 volts (nor should the reference voltage go negative) when an external reference is used.

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

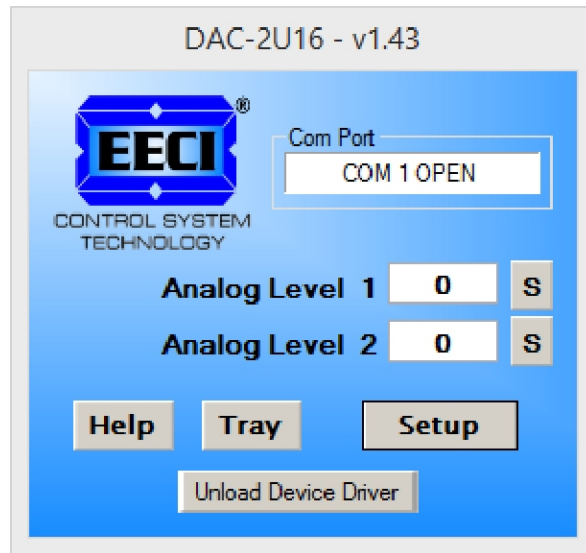
### EXPANSION PORTS

The DAC2 provides two expansion ports for additional I/O operations. The first expansion port may be used to connect up to 8 relays or to connect up to 8 inputs (or combinations of relays and inputs) using an EX-8M expansion card. The second expansion port 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, RG-8, RH-8, RI-8, RJ-8, RL-8, RN-8, 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. For additional information on the EX-8M and EXM-16 expansion modules, please refer to the Technical Reference available on the EECl web site.

### THE DAC2-16RS232 SIMULATOR

The DAC2-16RS232 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 DAC2-16RS232 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 DAC2-16RS232 USER INTERFACE



The DAC2 User Interface allows you to set all of the basic operating characteristics of the hardware and permits the DAC2 to send and receive data from other Windows applications or programs that you create.

When the user interface is opened for the first time you are prompted for the com port that is to be used with the DAC2. This com port number is saved in the settings file "dac2-set.ini" which is created in the folder c:\eecid\dac2-16rs232. The driver will then load 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 65535 for 16 bit).

Clicking the Setup button allows you to label the analog outputs for each of the 2 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 DAC2. 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 DAC2 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 dac2u-set.ini file so that when the user interface is shut down, it will restart with the new settings. Click the Tray button (driver only mode) to close the window after the DAC2 User Interface is set-up for your application. A red 2 icon will appear in your system tray (click to re-open the user interface). The DAC2 User Interface may be left open if an external application is not used. The DAC2 User Interface may be completely shut down (and driver unloaded) by clicking the Unload Driver button. Once shut down, you will need to double click the DAC2 desktop icon to re-start the DAC2 Driver (or clicking the DAC2 icon under All Programs in the EECI folder). The Help button will provide additional assistance if you installed the Help files from the DAC2 installation CD.

### AUTO START-UP FOR THE DAC2 DRIVER

By default, the DAC2-16RS232 device driver is loaded only on demand to conserve system resources. You may install the DAC2 device driver permanently by checking the "Driver Only" check box under Setup in the DAC2 User Interface. You will then always see the DAC2 system icon in your system tray\* along with the other system devices (such as your speaker, printer or display adapter). Click the red 2 icon in your system tray to open the DAC2 User Interface. If the DAC2 device driver is not installed permanently, you will need to double click the DAC2 desktop icon to load the DAC2 device driver each time your system starts. You should not check the "Driver Only" box unless you intend to have the DAC2 permanently connected to an RS-232 port on your system.

\*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 DAC2-16RS232 ANALOG OUTPUTS

The DAC2 outputs are intended to just provide a voltage for a controller to read (that typically pull only about 1 or 2ma). The DAC2 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 DAC2 will normally power up with all outputs at 0v. If the DAC2 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 is installed on the outputs to decouple and help protect the outputs (these may be removed if needed).

### THE DAC2 DATA LOGGER

The DAC2 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 may be edited by clicking the Analog Setup button under setup. The DAC2 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 these example, copy the code module (supplied on your CD) to a sub called setOutputs(). From the toolbox, drag (2) textboxes and a timer control to your form. Insert the following code into the timer sub. The (2) DAC2 analog outputs levels are entered using textboxes 1 and 2. If you wish to update the analog outputs 4 times per second (for example), set the timer interval to: Timer1.Interval = 250

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

```
setOutputs() 'set analog outputs
```

```
End Sub
```

#### VISUAL C# EXAMPLE (Microsoft Visual Studio)

```
private void timer1_Tick(object sender, EventArgs e)
{
    SetOutputs();
}
```

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 EECI 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 DAC2-16RS232, check Auto Connect, Start Minimized, Driver Only and Allow External Commands. In this mode of operation, your program has complete control of the DAC-2U and the User Interface does not open. \*do not check unless the DAC2-16RS232 is always connected to RS-232

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

**VOLTAGE REFERENCE INPUT**

The DAC2 allows for several different reference voltage configurations. The reference voltage determines the voltage output range for all the analog output channels. The following configurations are selectable. Option 1 is the default setting.

- Option 1: 5 volt - provides a low precision (0 to 5) volt output range ((2) channels single ended) (default setting)
- Option 2: 3.3 volt - provides a low precision (0 to 3.3) volt output range ((2) channels single ended) external reference voltage selected with circuit board shunt.
- Option 3: User supplied\* - must be in the range of .01 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)

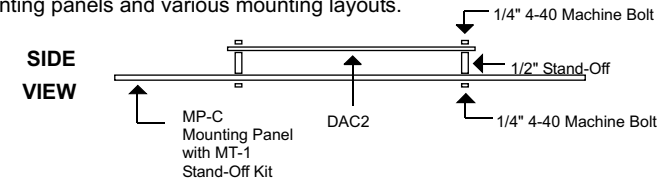
\* the DAC2 may be ordered with a predetermined high precision voltage reference installed (1.024V, 2.048V, 2.5V, 3V or 4.096V). These provide a precise voltage output per increment. Please contact EECI support for more info.

**CONNECTING DEVICES TO THE DAC2 ANALOG OUTPUTS**

A large variety of devices (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 DAC2. The cable used to connect devices to the DAC2 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 DAC2 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 DAC2 outputs to four 4-20mA transmitters.

**MOUNTING**

The DAC2 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 DAC2 will attach to the 4 stand-off spacers using 4-40 machine screws (4 mounting holes are provided on the DAC2). Contact technical support for more information on mounting panels and various mounting layouts.



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