

Sensor Controller Overview:

The PowerWise inDAC is a microcontroller designed for data acquisition and control of a wide of building systems. This data acquisition hardware features Modbus RTU communication protocol for connection to Modbus enabled gateway devices allowing for local or cloud storage. The inDAC's feature two serial connection types: RS-232 and RS-485 enabling expansion of inputs and outputs. The hardware accommodates both analog and digital sensor inputs allowing for integration to a wide variety of sensors. Each device features the following inputs and outputs:

- 6 Analog Input (0-5 VDC, 12 bit resolution)
- 4 Pulse Inputs (1 kHz max, sinking, 24 VDC max)
- 4 Digital Inputs (sinking, 24 VDC max)
- 4 Digital Outputs (sinking, 24 VDC max)
- 20 1-Wire Sensor ID's

The following is a guide on how to connect the inDAC to a gateway device and wire a variety of building monitoring sensors.

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2. inDAC Dimensions/ Mounting

inDAC Connection:

Powering Up & Communication Connection:

The inDAC needs to be powered by a 9-16 VDC power supply rated to a minimum of 1 amp. The system comes standard with a +12 VDC 18 Watt wall transformer with the neutral connected to ground. There is a connector located on the left hand side of the enclosure. A DIN rail mountable industrial power supply can be supplied/used, which allows for multiple inDAC's to be powered by one source. **Figure 1** shows the communication connection diagram for the inDAC and eMonitor Gateway.

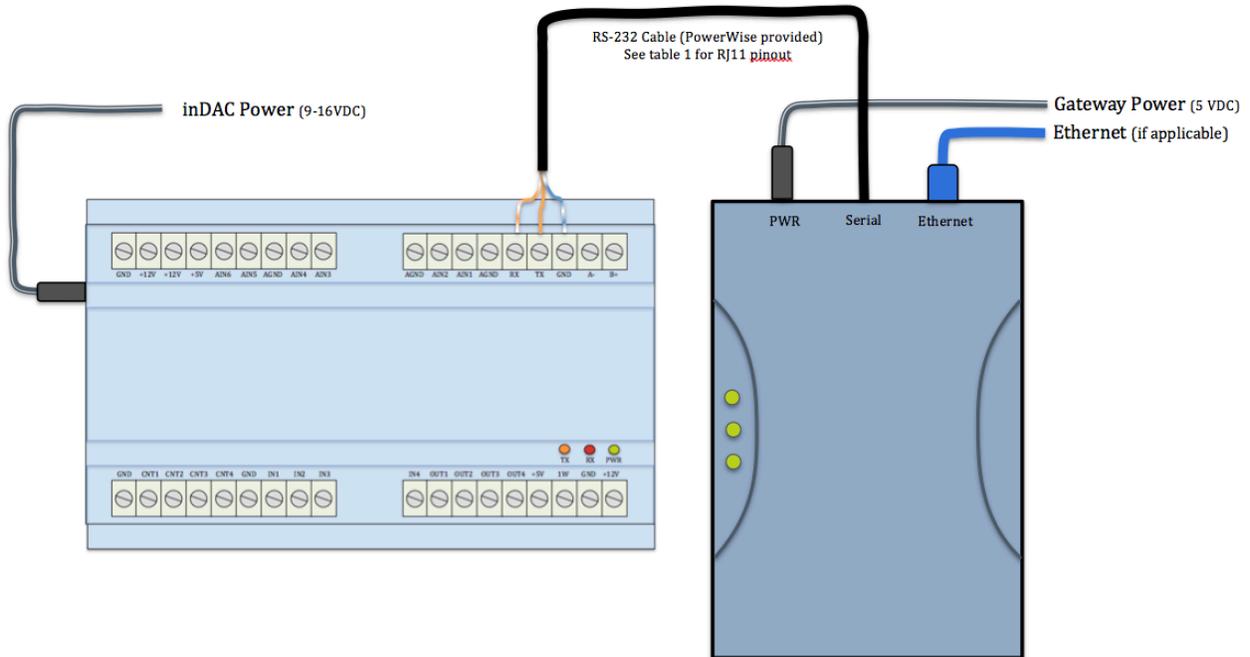


Figure 1. inDAC communication connection diagram.

A single inDAC should be connected via the RS-232 Serial port on the eMonitor gateway. If Powerwise has provided you with a RS-232 cable the connection should be made like that shown in **Table 1**. All custom made cables should follow this pin out but do not have to use the same color code/convention.

inDAC	Cable	eMonitor Gateway (RJ11)
GND	Blue -White	GND (6)
TX	Orange	RX (5)
RX	Orange White	TX (4)

Table 1. RS-232 Connection

The eMonitor gateway supports up to 5 inDAC's per connected eMonitor connected in parallel via RS-485. **Figure 2** shows connection of two inDAC's to an eMonitor gateway.

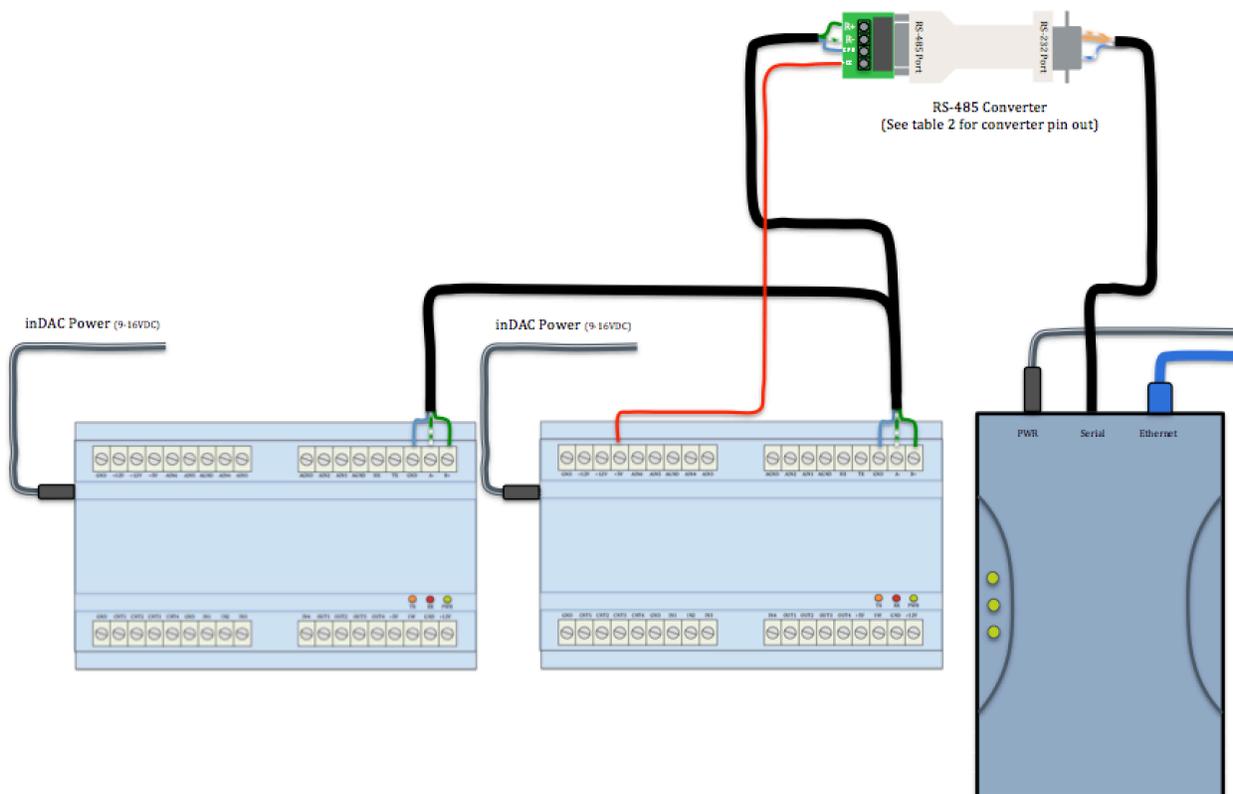


Figure 2. inDAC RS-485 connection diagram.

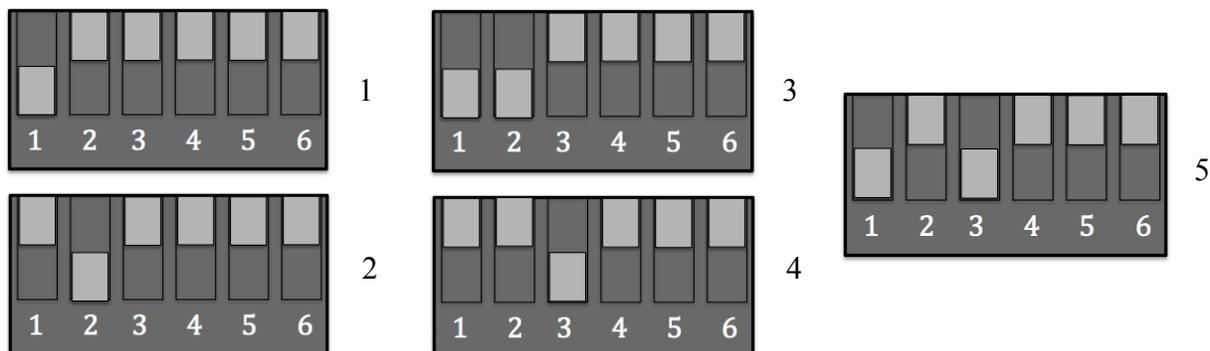
The following **Table 2** shows the connection of RS-485 to the inDAC when daisy chaining up to 5 devices together.

inDAC	Cable	RS485-RS232 Converter		Cable	eMonitor Gateway (RJ11)
		RS-485	RS-232		
GND	Blue	GND	GND	Blue-White	GND (6)
B+	Green	R+	Pin 2	Orange-White	RX (4)
A-	Green-White	R-	Pin 3	Orange	TX (5)
+5V	Red	Vcc	Pin 5	-	-

Table 2. RS-485 Connection

inDAC Unique Address Selection:

The inDAC(s) need to have a unique address set via the DIP switch on the right hand side of the case. **Figure 3** shows how the DIP switches should be arranged to acquire the correct address.



Each inDAC needs a unique address set unlike that of another inDAC on a single eMonitor Gateway. This address will be indicated on the embedded server explained below.

Once the proper connections have been made as stated above, power up the inDAC(s) and eMonitor gateway. The power light (PWR) on the inDAC(s) should blink green and the power light on the eMonitor gateway should be solid green. Next connect the ethernet cable (if hardwired version, blinks red lights upon power up) or provision the wireless network (if wifi version, blinks green on power up (page 22 eMonitor manual)).

Connection can be verified on eMonitor gateway by solid green/linking yellow LINK light. Indicator lights on each inDAC can confirm connection and communication to the eMonitor gateway as well. The Rx (receive) and Tx (transmit) lights should blink in succession every second indicating proper RS-232 connection.

RS-485 communication will be indicated by a blinking power and Rx light every second and the Tx light will blink three times for one inDAC and move on to the next inDAC blinking three times until it cycles back to the original inDAC. Next connect to the embedded server.

Embedded Server Connection:

The eMonitor Gateway has an embedded server that can be accessed (when connected to the local network) to help during setup and commissioning of the product. Data uploaded to the server is averaged over one minute intervals whereas data seen on the embedded server is updated every 3-5 seconds. Connection to the embedded server is obtained by connecting to the gateways unique IP address. This can be found on your routers DHCP/connected devices list or found on your eMonitor dashboard by clicking the “STATUS” link the in the upper left hand corner.

Once the correct address has been obtained enter it in your browser window like that shown in **Figure 3**.

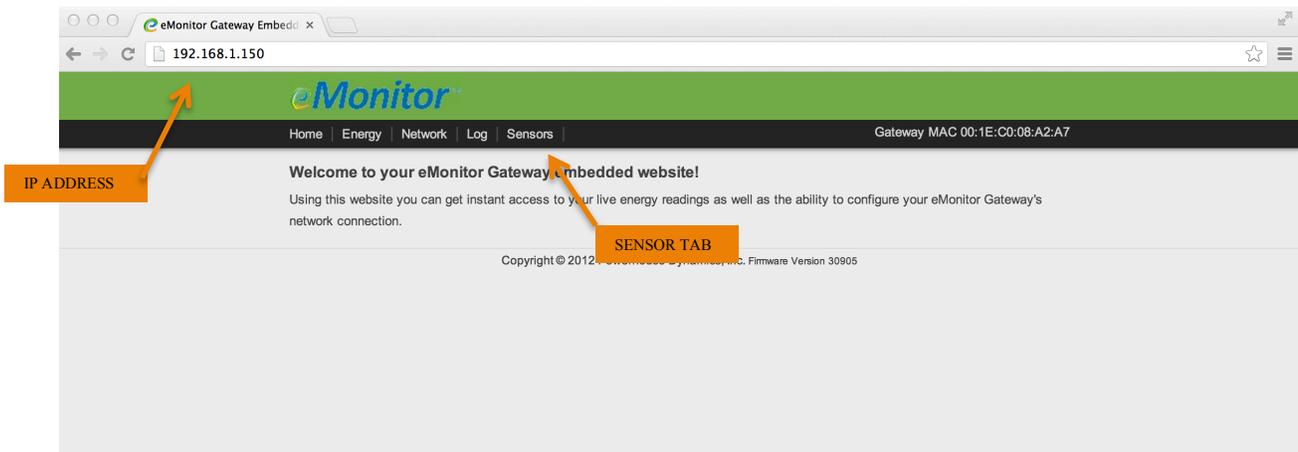


Figure 3. Gateway Embedded Server

Some browsers respond better to the embedded server (Chrome, Firefox) than others (Internet Explorer). Once connection has been made to the embedded server select the Sensors tab to view all sensor data shown in **Figure 4**.

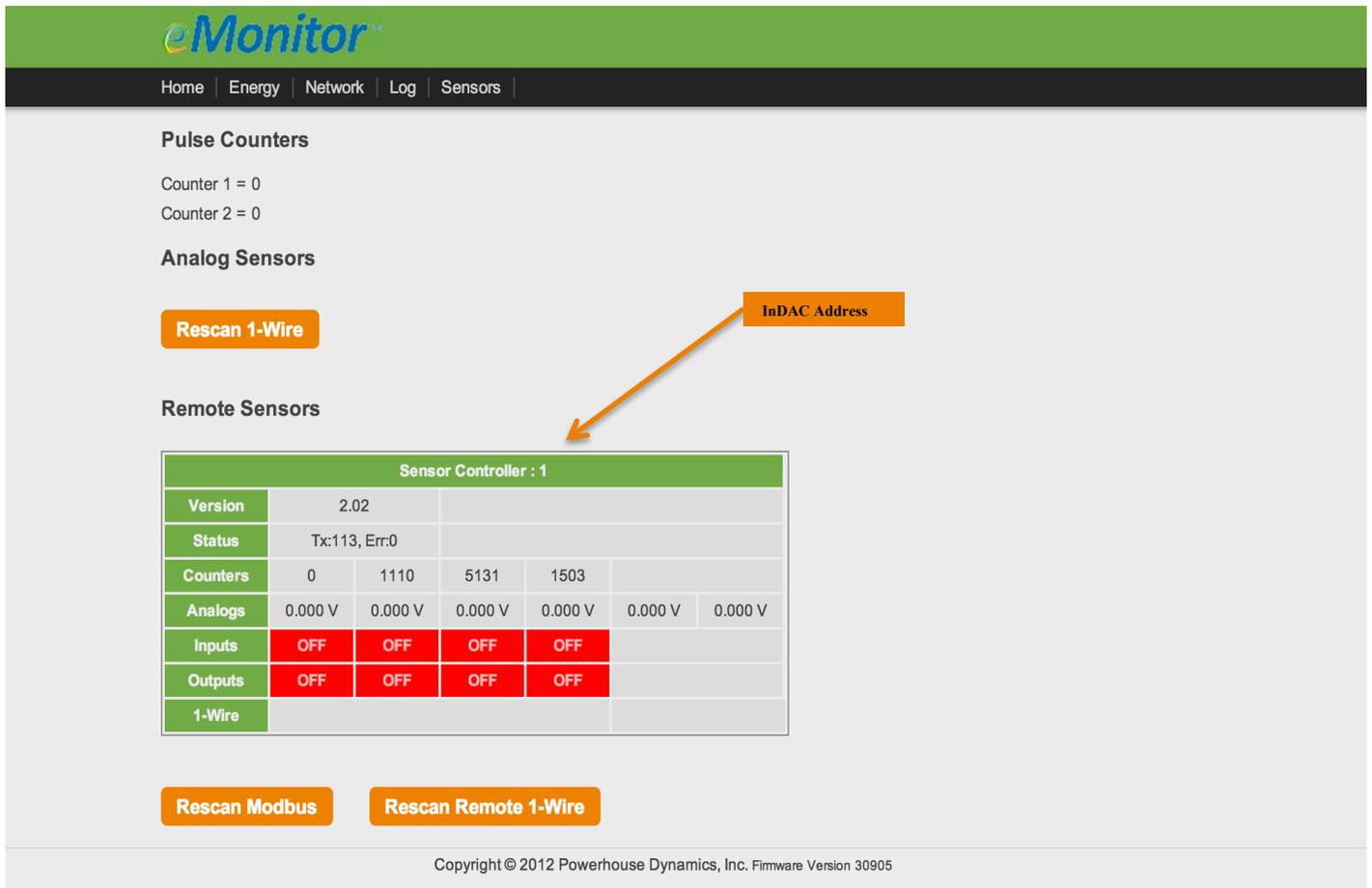


Figure 4. Gateway Embedded Server with inDAC support.

The inDAC will show up under “Remote Sensors” on the embedded server. The first inDAC will automatically be found. To add additional inDAC’s the “Rescan Modbus” button needs to be pressed. Make sure to wait up too 30 seconds for the inDAC to show up under “Remote Sensors”.

Once all inDAC’s have been found all data points can be verified from the table. The following heading denotes the values and ranges that can be expected for each data type.

InDAC Unique Address: Each inDAC should be setup to have a unique address compared to the other inDAC’s on a single Gateway. This value is set using the DIP switch and explained in the **inDAC Unique Address Selection** above.

Version: The firmware version present on the specific inDAC. The firmware version is only needed for troubleshooting if a problem should arise.

Status: The inDAC communicates with the Gateway via serial communication. **Tx** indicates the number of successful transmits to the Gateway. **Error** indicates the number of attempted but failed communications with the Gateway. Under normal conditions the **Tx** should count up every couple of seconds and the error should remain static. If the **Error** is counting regularly make sure to check connections.

Counters: There are four (4) counter inputs per inDAC that are cumulative. Once the maximum value (65535) is reached this will reset and start again. Channels 1 through 4 go from left to right, respectively.

Analogs: There are six (6) analog inputs per inDAC with an input range from 0 to 4.999 volts. Channels 1 through 6 go from left to right, respectively.

Inputs: The inDAC has four (4) digital inputs. When connected to ground the indicator will change from red “OFF” to green “ON”.

Outputs: The inDAC has four (4) digital outputs. When triggered the indicator will change from red “OFF” to green “ON” pulling the channel to ground.

1-Wire: 20 unique 1-Wire devices can show up in this window. The “Rescan Remote 1-Wire” button should be toggled if new sensors are to be added to an existing set.

InDAC Terminal Layout

In **Figure 5** below is the layout of the inDAC depicting all points of connection for analog, digital, and serial communication.

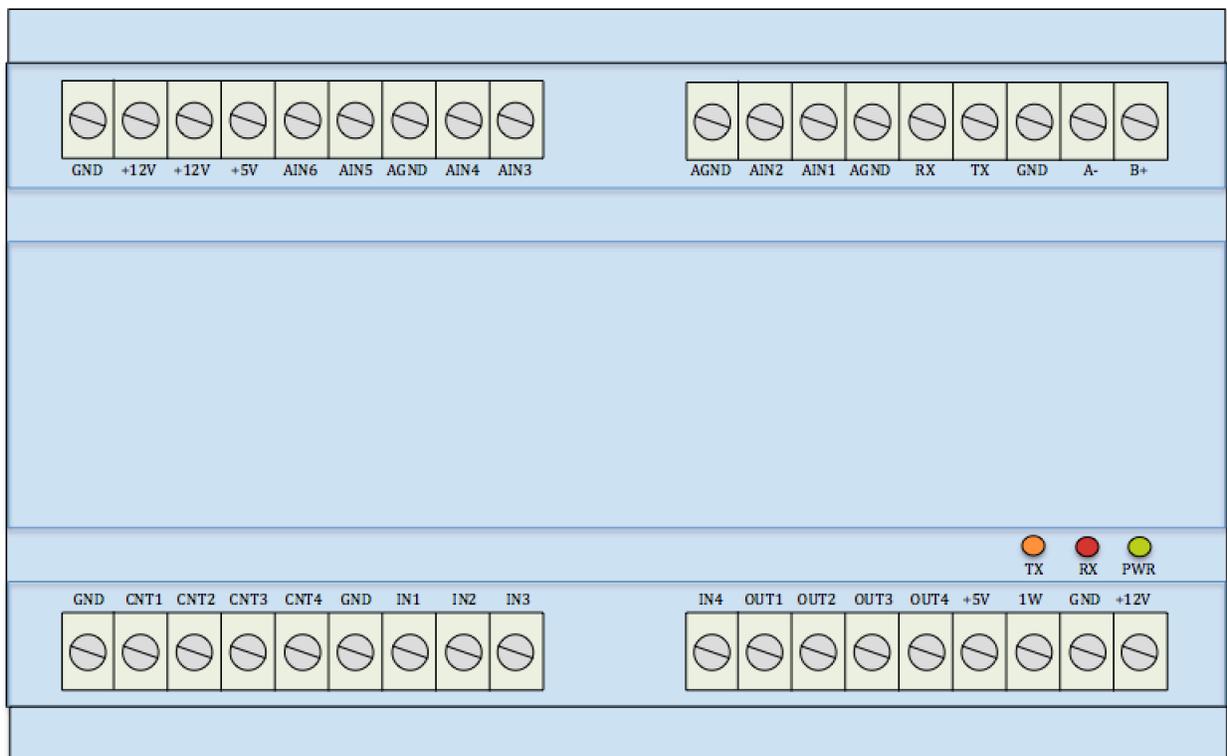


Figure 5. inDAC Terminal Layout.

The board is equipped with a regulated +5V DC power supply to be used for excitation voltages. There is also unregulated +12V DC power available, which is passed through from the power supply powering the inDAC.

Counter Inputs/Connections:

The inDAC has four (4) counter cumulative inputs labeled CT1 –CT4 rated to a maximum switching frequency of 1000 samples per second (1 kHz) and protected to 24 VDC input. These inputs need to be setup with sinking logic and will register a pulse/switch when connected to ground. Common sensors include hall-effect flow meters, reed switch flow meters, speed sensors, and contact closures. **Figure 6** shows the typical connection diagram for sensors.

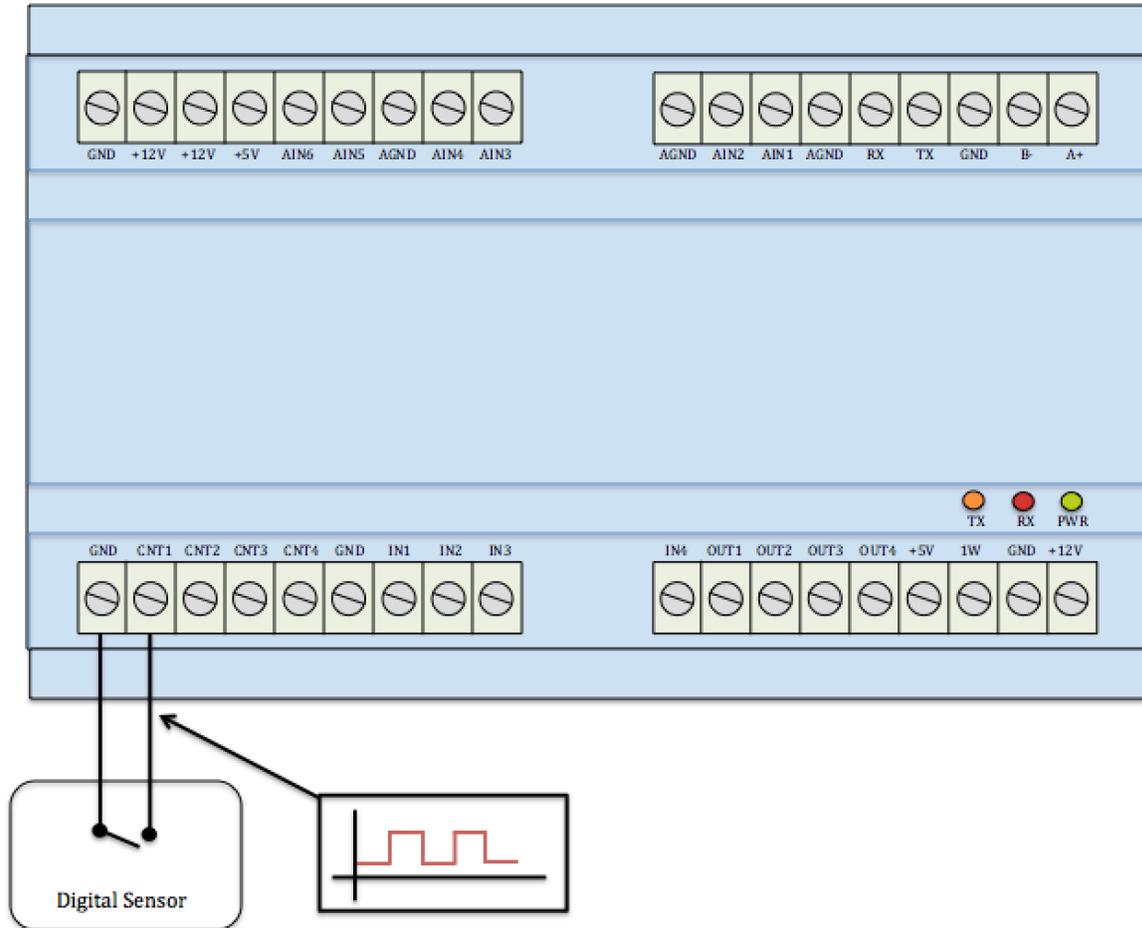


Figure 6. Counter Connection Diagram

For additional sensor specific wiring diagrams please visit the **PowerWise Technical Documents** page located at www.Powerwisesystems.com.

Analog Input Connection

The inDAC has six (6) inputs labeled AIN1 – AIN6 with an input range of 0 – 5 VDC with 12 bit resolution. The ports are optically isolated with overvoltage protection up to 24 VDC. Although the inDAC records only raw data locally scaling factors are applied on the PowerWise website under the settings page. **Figure 7** is the typical connection to the analog input port.

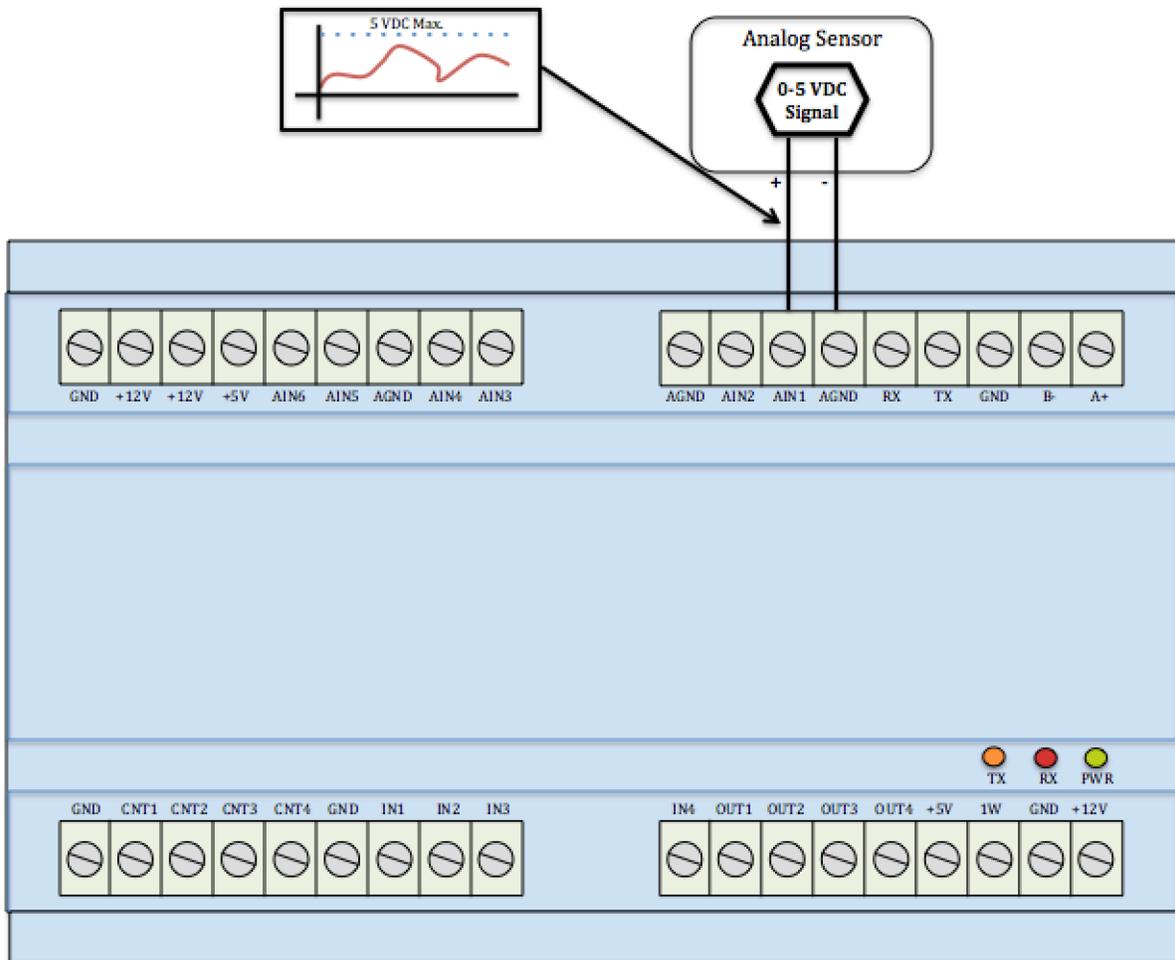


Figure 7. Analog Input Connection Diagram

Analog sensors such as level sensors, HVAC equipment control set points, etc. will integrate into these channels. Integration into 4 – 20 mA output devices can be accomplished by installing a 250 ohm resistor between the signal and ground of the port. For additional sensor specific wiring diagrams please visit the **PowerWise Technical Documents** page located at www.Powerwisesystems.com.

Digital Input Connection:

Four (4) digital input channels are found at connections IN1 – IN4 of the PowerWise inDAC. The digital inputs should be used to tell whether a sensor is “On” or “OFF”. These inputs are triggered when connected to ground indicating “ON”. The ports are optically isolated with overvoltage protection up to 24 VDC. **Figure 8** shows the common connection for a digital 2-wire input.

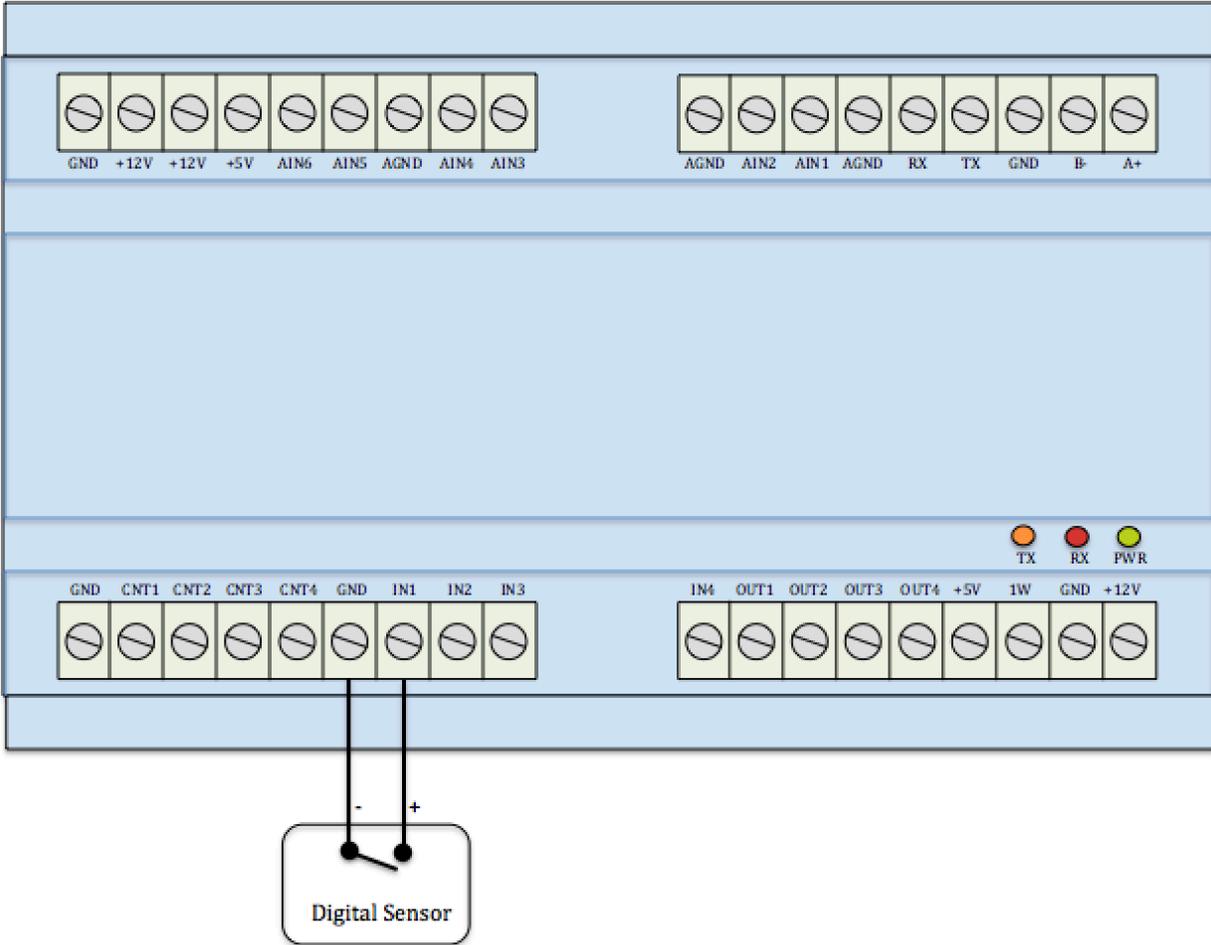


Figure 8. Digital Input Connection Diagram

These inputs will work with a variety of building sensors such as AC switches, DC switches, optical sensors, flame detectors, etc. For additional sensor specific wiring diagrams please visit the **PowerWise Technical Documents** page located at www.Powerwisesystems.com.

Digital Output Connection:

Digital outputs are located on channels labeled OUT1 – OUT4 on the sensor controller. Each of the four channels are rated to 100 mA maximum and isolated to 24VDC max. These channels are designed to offer basic control of various building systems. **Figure 9** shows the basic connection for any digital output sensor or device.

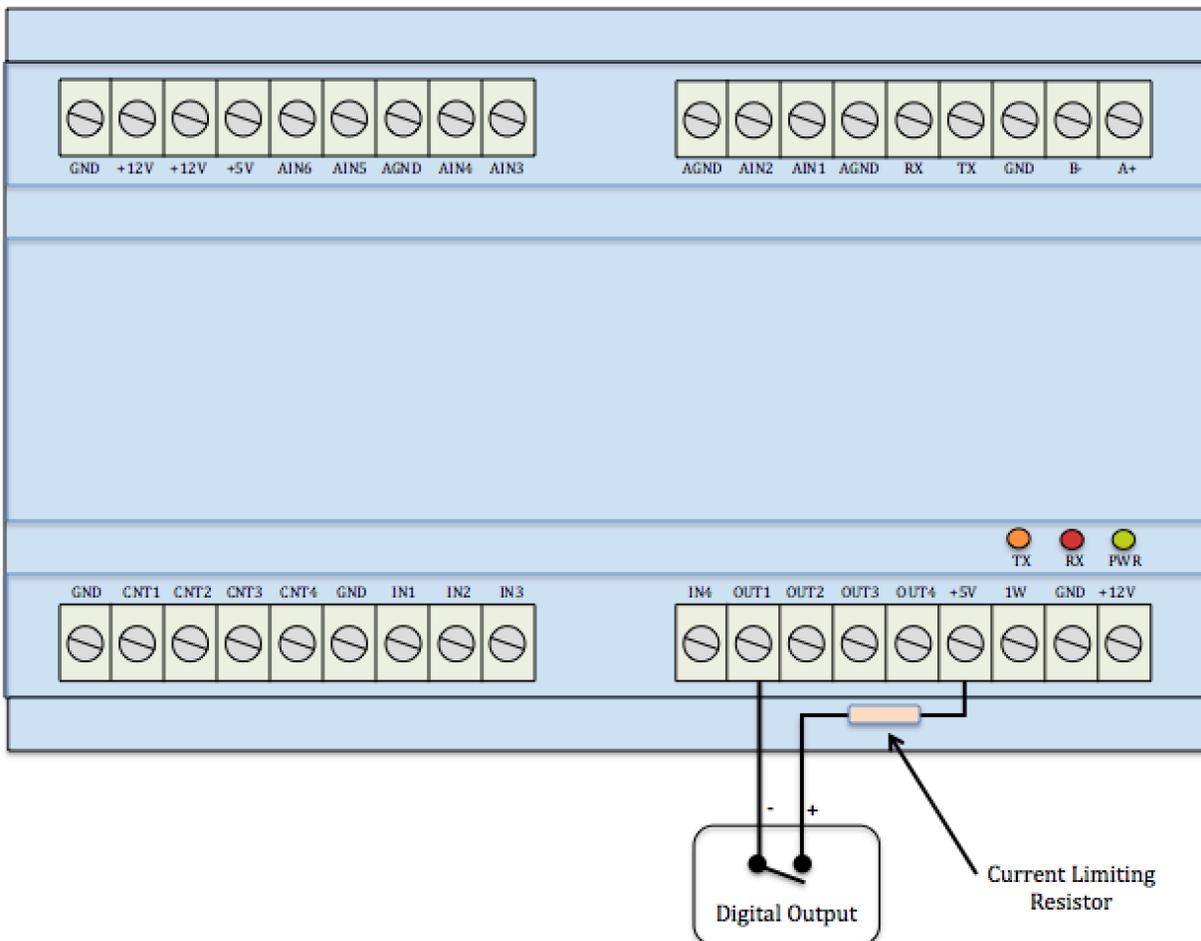


Figure 9. Digital Output Connection Diagram

The output can also be connected to a 12VDC or 24VDC power source as long as the current is limited to 100mA. This connection should only be used to power very low consumption devices and is designed primarily to trigger relays, HVAC equipment controls, indicators, etc. For additional sensor specific wiring diagrams please visit the **PowerWise Technical Documents** page located at www.Powerwisesystems.com.

1-Wire Connection:

1-Wire devices are digital sensors that communicate through the 1-Wire communication protocol. Each individual sensor is hard coded with a 64 bit unique id that should be recorded before installation. Each 1 Wire device can be connected in parallel with a maximum of 20 unique id's. **Figure 10** below shows typical connection of 1-Wire devices.

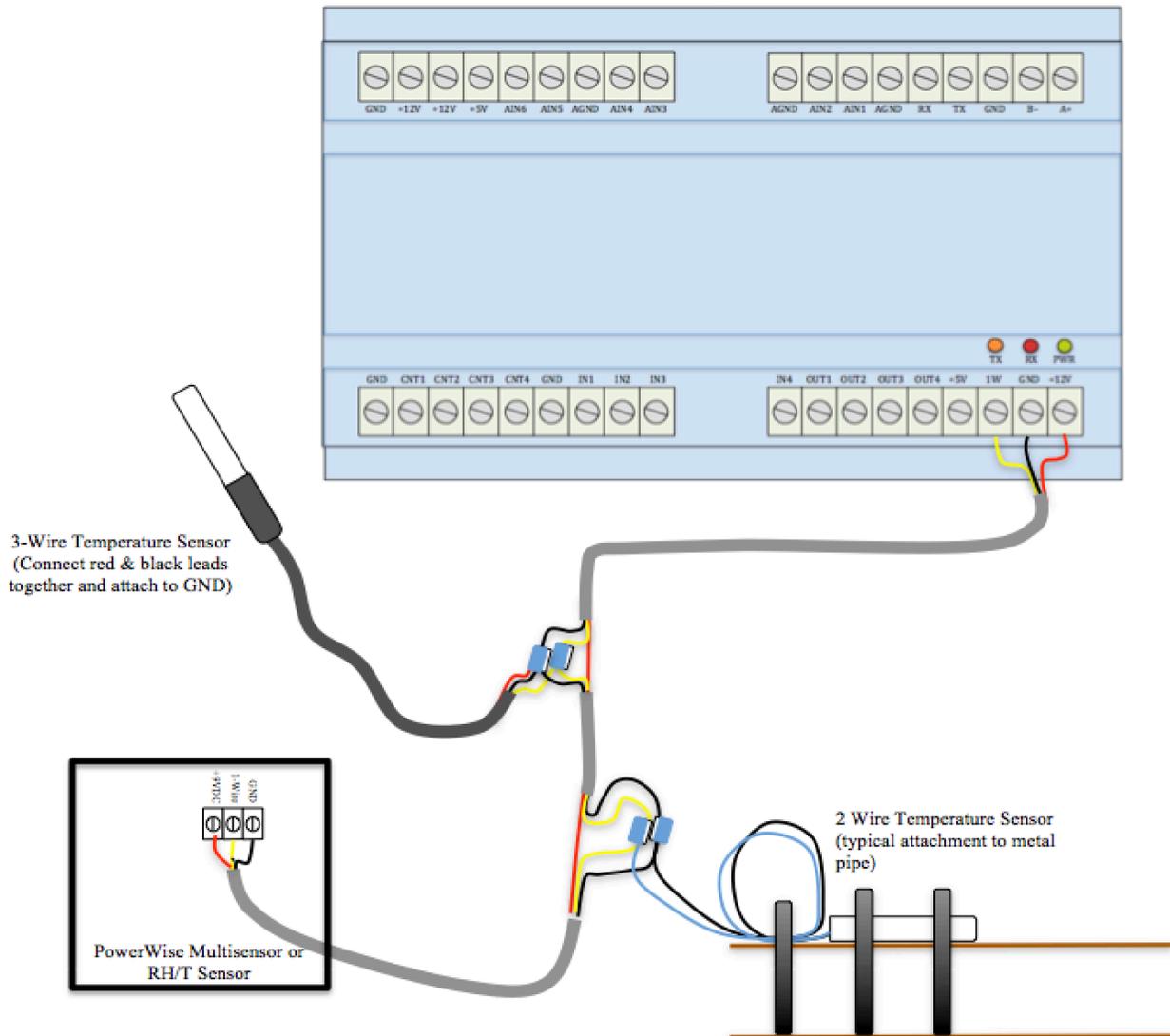


Figure 10. 1-Wire Connection Diagram

PowerWise Systems offers a range of custom devices to record building conditions. Temperature sensors come in a small stainless steel barrel and are used to measure ambient temperature, flow media in pipes, and surface temperatures. PowerWise also offers a relative humidity/temperature (RH/T) combined device as well as a Multisensor, which reports volatile organic compound (VOC) or carbon dioxide (CO₂). The RH/T and Multisensor require external power supplied by the +12V DC port shown in **Figure 10**. The number of unique ID's per 1-Wire device is shown in **Table 3** below.

Device	Unique ID(s)
Temperature Sensor	1 (28)
Relative Humidity & Temperature Sensor	2 (28 & 26)
Multisensor (CO ₂ & VOC)	2 (28 & 26)

Table 3. 1-Wire ID(s) (Note: A "1WT" is added to each sensor label on dashboards.)

NOTE: Each inDAC can have a maximum of 5x (26 ID's) and 15x (28 ID's)

inDAC Dimensions/ Mounting

The PowerWise inDAC is packaged for installation on either 35mm DIN rail or mall mounted. **Figure 11** shows the overall dimensions and mounting options.

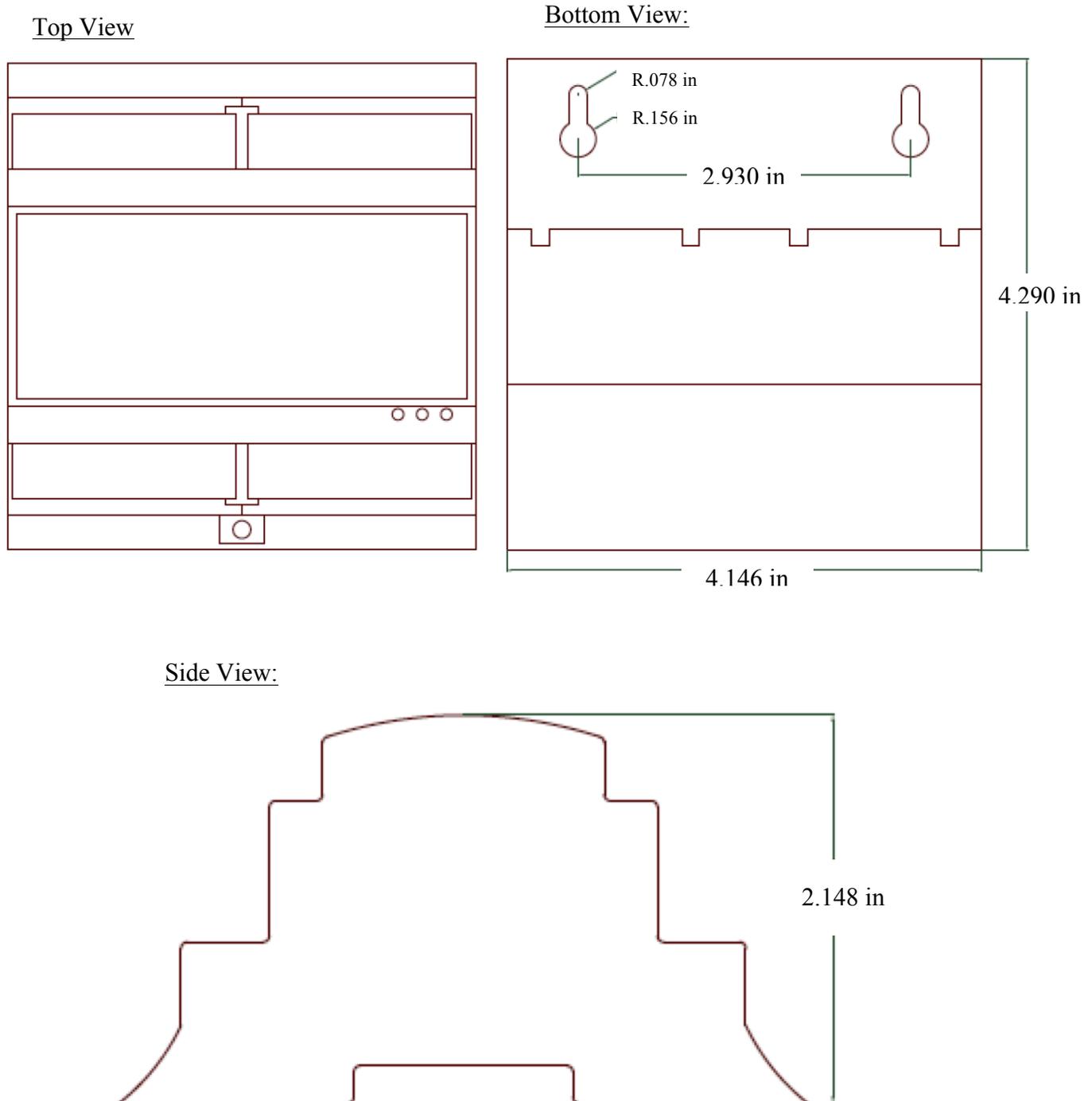


Figure 11. inDAC Drawing