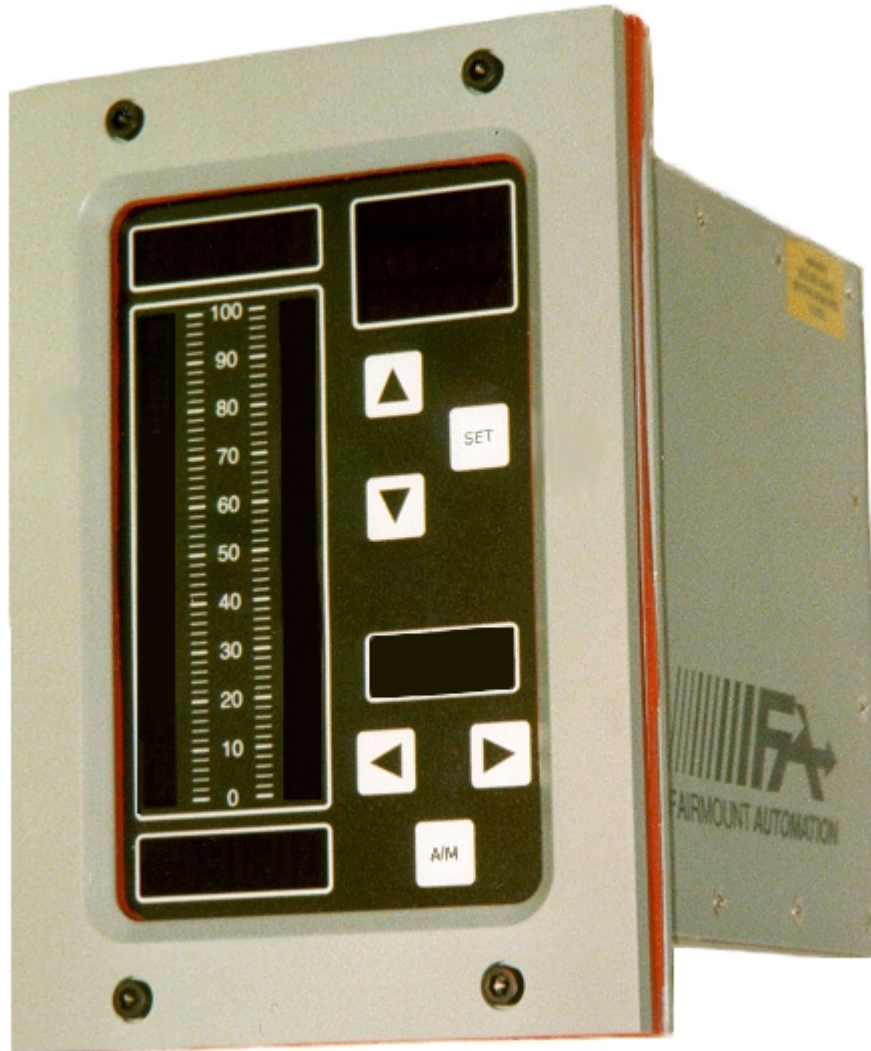




FAC-2000 Hardware Reference Guide

Includes a manual for the FAC-2000 controller's mechanical and electrical systems



Fairmount Automation Controller Series, Model 2000

Version 1.5
September 1999

Technical Bulletin 9110-0001

WARNING

Do not install, maintain or operate this equipment without reading, understanding and following the proper Fairmount Automation instructions and manuals, otherwise injury or damage may result.

Before performing maintenance on the FAC-2000 controller, be sure to disconnect all power sources (including main power and power signals from analog, digital, communications, and relay connections) and secure the process/system being controlled. Adjusting or removing this product while it is in the system may upset the process being controlled. This process upset may cause injury and/or damage.

This device should be installed, serviced, and maintained by qualified personnel only. Always remove all power sources before installing the device or opening any access panels on the FAC-2000. Failure to do so may result in injury and/or damage.

Ensure all environmental, mechanical, and electrical limits are not exceeded during operation, storage, and transportation of the controller. Failure to do so may result in damage or reduced lifetime of the device.

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1. INTRODUCTION

The Fairmount Automation Controller Series, Model 2000 (*FAC-2000*) is a general-purpose, highly configurable, multi-loop process controller. Its aluminum-steel construction makes the controller extremely rugged—it is specifically designed for operation in environments susceptible to extreme temperature, humidity, shock, and/or vibration.

The *FAC-2000* digital process controller is equipped with a large array of I/O capabilities. It combines the analog functionality of a standard process controller, with the digital functionality normally associated with Programmable Logic Controllers (PLC). In its standard configuration, the *FAC-2000* has three analog inputs, two analog outputs, two universal digital inputs, eight standard digital inputs, two digital outputs, and four form-C relays.

The digital technology used to build the *FAC-2000*, in combination with Fairmount Automation's *Design Pad for Windows*[®] software package, makes the *FAC-2000* extremely easy to program and very versatile. Programming the device entails “drawing” a desired control scheme using a vast array of operator functions. These operator functions are wired together to indicate the signal flows from device inputs to device outputs. After the design is done, *Design Pad* offers the ability to simulate the control scheme and model a process, graph any signal in the circuit, and interact with a computer-generated *FAC-2000* front panel.

This instruction bulletin provides detailed descriptions and illustrative examples on how to operate and install the *FAC-2000* controller. For information on how to program the *FAC-2000*, see the *Design Pad for Windows*[®] instructional bulletin (Fairmount Automation Technical Bulletin 9110-0002).

[®] Windows is a registered trademark of Microsoft Corporation

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2. SAFETY CONSIDERATIONS

Before performing maintenance on the *FAC-2000* controller, be sure to disconnect all power sources (including main power and power signals from analog, digital, communications, and relay connections).

While operating, the *FAC-2000* unit must have its case connected to a safety ground. Touching an ungrounded case may result in an electrical shock. Also, be aware that instrumentation connected to AC or DC power sources may still have power even though the unit is not on.

This unit, depending on its configuration, contains up to four fuses. Remove all power sources before inspecting or changing the fuses.

Ensure all environmental, mechanical, and electrical limits are not exceeded during operation, storage, and transportation of the controller. Failure to do so may result in damage or reduced lifetime of the device.

This device should be installed and serviced by qualified personnel only. Always remove all power sources before installing the device or opening any access panels on the *FAC-2000*. Failure to do so may result in serious injury and/or equipment damage.

Care should be taken when touching the controller's all-metal enclosure in high temperature environments. Be aware that the enclosure temperature may be in excess of 85° Celsius.

The *FAC-2000* is constructed with circuit boards containing static-sensitive electrical components. All maintenance on these boards must be performed using standard static-electricity practices. Always use a grounded wrist strap when manipulating these parts and only place the boards on static-free surfaces. Always use static-free bags if transporting these circuit boards (while not in the *FAC-2000*).

3. GENERAL DESCRIPTION

The *FAC-2000* has a variety of Input / Output (I/O) features, including three analog inputs, two analog outputs, ten digital inputs (two universal and eight standard), two digital outputs, form C-relays, form A-relays, DC and AC solid state relays, and a user-interface on the front panel. These, and other features, are described in this section (see the *Product Specifications* section of this bulletin for an overview of all the *FAC-2000* characteristics).

3.1 The User Interface

This part of the bulletin describes the features of the *FAC-2000* controller used to interface with a plant operator. It does not describe the software tools that the control engineer uses to program and maintain the device—see the *Design Pad* instruction bulletin (Fairmount Automation Technical Bulletin 9110-0002) for more information.

3.1.1 The Front Panel

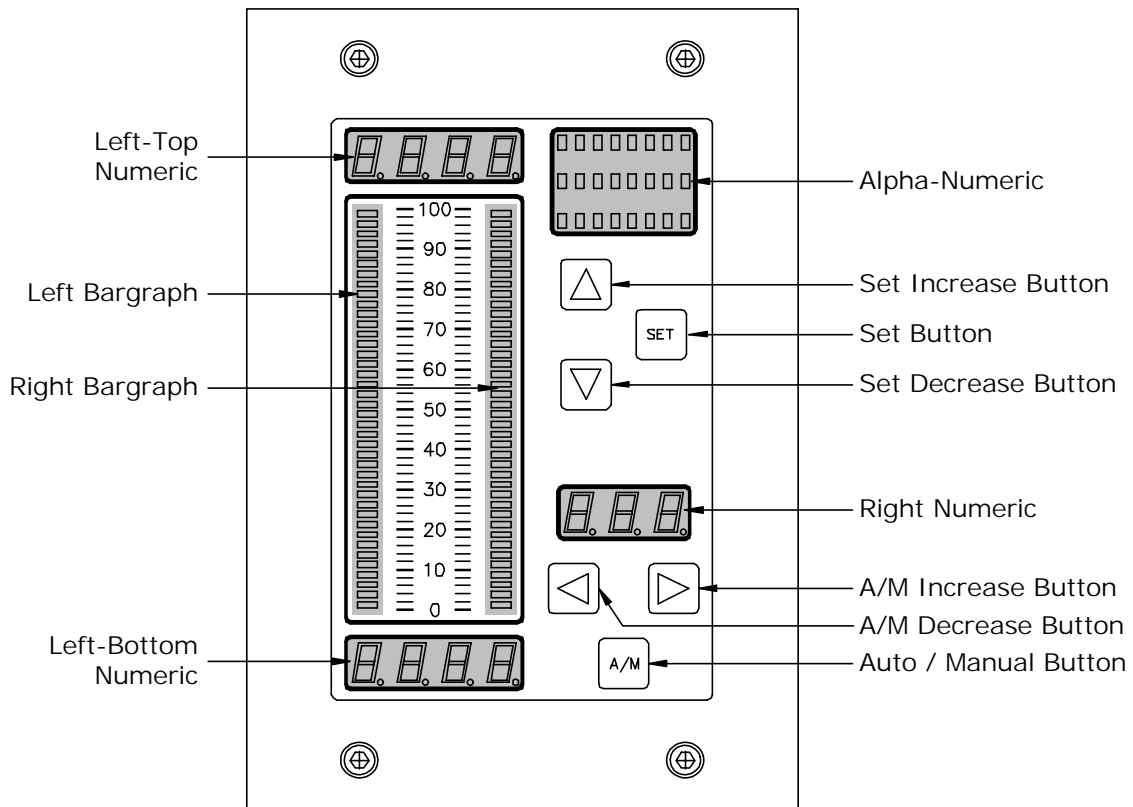


Figure 1 - The *FAC-2000*'s front panel

Figure 1 shows the front panel of the *FAC-2000* and its user interface components. The panel contains three types of displays (numeric, alphanumeric and bargraph displays) and six membrane-switch keys.

3.1.2 Display Elements

The *FAC-2000* controller contains three numeric displays to indicate signal values (*e.g.*, the process variable, set point, output, *etc.*) These displays are labeled left-top numeric (four-digit), left-bottom numeric (four-digit), and right numeric (three-digit) in Figure 1. The four-digit elements display values in the range of -999 to 9999, and the three-digit elements display values in the range of -99 to 999. When the number to be shown is above the range, each numeric element will display an ‘H’ character (indicating a *HIGH* reading). When the number is below the range, each element will display an ‘L’ character (indicating a *LOW* reading). The decimal point position of a numeric display can be fixed to a specified digit position (for display consistency) or can be floating (to maximize the display range). When the decimal point position is fixed, the numeric display range is reduced. For example, if the decimal point is fixed at the second digit of a four-digit display element, the values shown will range from -99.9 to 999.9.

Signal values may also be indicated on the *FAC-2000* bargraph displays (labeled left bargraph and right bargraph in Figure 1). Each bargraph contains 40 LED elements. Typically, the number of elements illuminated is proportional to the signal value. Alternatively, each bargraph can be programmed to illuminate a variable-height band of LEDs above, below, or centered about the signal value of interest.

Each numeric and bargraph display can be configured to flash on and off when a user-specified event occurs (*e.g.*, a digital input channel is *high*). This feature can be useful to indicate dangerous operating conditions. It can also be used to indicate manual mode operation.

The *FAC-2000* controller also provides three eight-character alphanumeric display elements to convey text-based information to plant personnel. ASCII text messages (limited to 256 characters in length) can be scrolled across any of the three-display target lines. These messages can be presented in various ways—they can flash across the display, scroll at variable rates, and repeat a specified number of times. In addition, multiple messages can be assigned to the same target line simultaneously (each target-line maintains a 3-level priority queue of messages to display).

3.1.3 Set Menu System

Plant operators may adjust control scheme parameters (*e.g.*, the process set point, controller gains) via the *FAC-2000 Set Menu* system. The Set Menu is accessed with the SET button and parameter values are adjusted with the UP and DOWN arrow buttons (see Figure 1). The adjustment of control scheme parameters with the set menu system is equivalent to the circuit shown in Figure 2. It consists of a signal generator with a single adjustable output level. It is that output level that is adjusted from the set menu. Note that the generator may be an analog generator (which has many output states) or a digital generator (with exactly two output states).

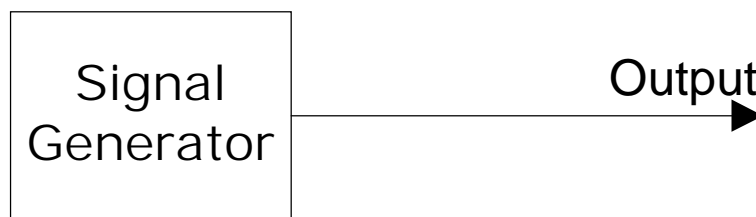


Figure 2 - Typical 'Set' menu object

The set menu system works as follows:

- 1) Press the SET button to enter the set menu (note: the amount of time the button must be held before the set menu appears is adjustable in software.)
- 2) If there is only one adjustable signal generator in the controller's program, then go to step 5.
- 3) The top two lines¹ of the alphanumeric display present the user with a list of parameter names (such as 'PID gain' or 'set point'). Use the UP and DOWN arrow buttons to scroll through this list.
- 4) If you wish to adjust a parameter, press the SET button again—the current parameter value will then be displayed—and go to step 5. Otherwise, if you wish to exit the set menu, scroll down the list until the 'Press SET to exit set menu' message is displayed. Press the SET button and the device will exit the SET menu.
- 5) Press the UP arrow button to increase the parameter value; press the DOWN arrow button to decrease the parameter value. If an arrow button is held, the parameter value will begin to change at a rapid rate (note: the repeat rate for a held key is adjustable in software.)

¹ All user-defined alphanumeric text messages on the top two display lines are paused while the controller is in the set menu system.

- 6) When the desired value has been reached, press the SET button to record the change. If there is only one adjustable signal generator, the controller will exit the SET menu. Otherwise, the controller will remain in set menu mode and will again display the list of adjustable parameters. That is, the controller will return to step 3.

3.1.4 Set Menu System with Password Protected Engineering Level Parameters

It is sometimes desirable to hide and protect certain plant parameters from operator level users (such as controller gains, critical values, etc.) In these cases, the control engineer should tag such variables as 'Engineer Level' and restrict access to them using a 6-character alphanumeric password. During normal operation of the controller the engineering level parameters will not be visible within the SET menu.

To access these engineering level parameters from the front panel of the controller, press both the UP and DOWN arrows simultaneously while in the SET menu system (note: if the control scheme includes only engineering level parameters, the password entry screen is presented as soon as the SET button is pressed.) The controller will prompt you for the password. The password is entered a single character at a time by using the UP or DOWN arrow to scroll through the character set at each position. When the desired character is displayed, press the SET key to enter it and move to the next position. Repeat this process until all six characters have been entered. After pressing SET to enter the last character, the controller will compare the password with the one in its schema file. If the password is accepted, the list of settable parameters (as described in section 3.1.3) will be appended with the engineering level parameters. These parameters will remain accessible via the SET menu (even after the SET menu is exited) until the UP and DOWN arrows are simultaneously pressed while in the SET menu system.

3.1.5 Auto/Manual (A/M) Menu System

A typical process controller may operate in automatic mode (where the device computes a controller output) or in manual mode (where a plant operator specifies the controller output). The *FAC-2000* unit is a versatile multi-loop controller that provides this functionality and more. It can be configured to operate in a partially-manual, partially-automatic mode called *mixed* mode. While in mixed mode, a subset (*e.g.*, an individual loop) of the control scheme executed by the device may operate in automatic mode, while another subset operates in manual mode, while yet another subset operates in automatic mode. (For instance, in a three-loop control scheme, the plant operator may maintain two loops in automatic modes and the third in manual mode.)

The *FAC-2000* contains an *A/M Menu* system that presents a plant operator with a list of all control signals that may be toggled between automatic and manual modes. The menu system also allows the operator to set the controller output signal value when in manual mode. A control signal object in the *A/M Menu* system is equivalent to the circuit shown in Figure 3. The figure shows an input signal and an adjustable signal generator connected to a switch. The output of the switch is attached to the output of the circuit. When the switch connects the input signal to the output signal, the switch is said to be in the *automatic* position. The switch is in the *manual* position when the signal generator is connected to the output of the switch. If the switch is in the manual position, adjusting the level of the signal generator can set the output. The *FAC-2000* provides the control engineer with both stand-alone A/M circuits and A/M circuits built into controller blocks (e.g., PID, PD, and PI operators). See the *Operator Reference* section of the *Design Pad* instructional bulletin (Fairmount Automation Technical Bulletin 9110-0002) for more information.

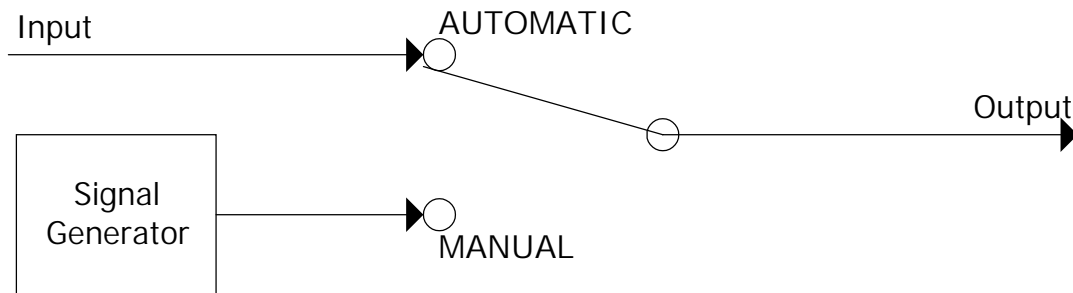


Figure 3 - Typical 'A/M' menu object

Notice that in order to adjust a typical A/M menu object, the user must be able to change both the switch position and the signal generator output level.

The A/M Menu system is accessed via the A/M button on the *FAC-2000's* front panel; manual signal adjustments are made with the LEFT and RIGHT arrow buttons (see Figure 1). The flow chart of Figure 4 describes how these buttons are used to operate the *A/M Menu* system. When a control program contains a single A/M circuit (the usual configuration) adjustments are made as follows:

- 1) Press the A/M button to enter the *Auto-Manual Menu* system. The single A/M circuit will be switched into manual mode.
- 2) Edit the manual output by pressing the LEFT and RIGHT arrow buttons. If an arrow button is held down, the output value will begin to change at a rapid rate (note: the repeat rate for a held key is adjustable in software.)
- 3) To return the system to automatic mode, press the A/M button again.

When the SET menu is active, the status and adjustment value for the A/M Menu system are indicated on the bottom alphanumeric display line. Otherwise they are indicated on the top two alphanumeric display lines.

When a control program contains multiple A/M circuits, adjustments are made as follows:

- 1) Press the A/M button to enter the *Auto-Manual Menu* system.
- 2) The top two lines² of the alphanumeric display present a list of A/M circuit names (such as 'water level' or 'temperature') that can be adjusted. Use the LEFT and RIGHT arrow buttons to scroll through the list until the desired name to be changed is displayed.
- 3) If you wish to exit the *A/M Menu* system, scroll through the list until the 'Press A/M to exit A/M menu' message is displayed and press the A/M button.
- 4)
 - To switch a selected A/M circuit from automatic mode to manual mode, press the A/M button and go to step 5.
 - To switch a selected A/M circuit from manual mode to automatic mode, press and hold the A/M button for more than two seconds and go to step 2.
 - To adjust the generator signal of a selected A/M circuit that is already in manual mode, press and hold the A/M button for less than two seconds and go to step 5.
- 5) Adjust the manual output by pressing the LEFT and RIGHT arrow buttons. If an arrow button is held down, the parameter value will begin to change at a rapid rate (note: the repeat rate for a held key is adjustable in software.)
- 6) When the desired value has been reached, press the A/M button to record the change. Note that the A/M circuit will remain in manual mode. Go to step 3.

If the control schema has multiple A/M circuits, you may not enter both the SET and A/M menus simultaneously. Exit out of one menu before attempting to enter the other.

² All user-defined alphanumeric text messages on the top two display lines are paused while the controller is in the auto-manual menu system.

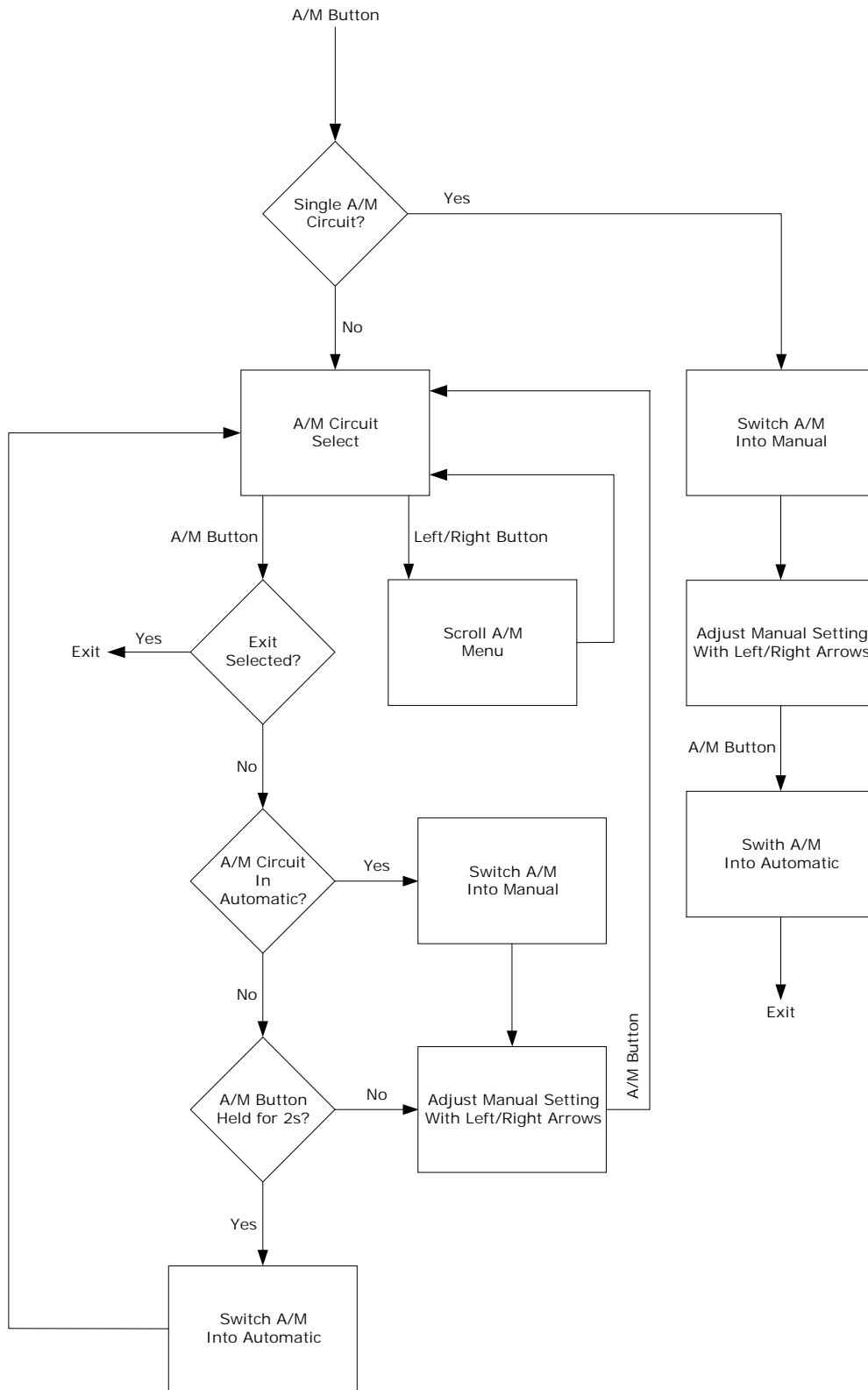


Figure 4 - A/M menu system flow chart

3.2 The Electrical Interface

The following section describes all of the electrical connection points on the *FAC-2000* process controller. See the *Installation* section of this bulletin for additional information and some pictorial examples on how to configure these electrical systems.

3.2.1 Providing Power to the Controller

Two different power supply options are available for the *FAC-2000* series controller. DC models accept an unregulated DC input source from 18 to 36 volts. AC models accept an AC source with a voltage range of 90 to 132 volts or 180 to 250 volts. The AC sources can have a line frequency of 47 to 63 hertz³.

Each source must be able to provide a maximum 25 watts of power for the controller. This does not include the power provided to devices external from the *FAC-2000*'s auxiliary power output (see the section below).

3.2.2 Powering External Devices from the FAC-2000

FAC-2000 controllers can be ordered with an isolated auxiliary power output to supply the *FAC-2000*'s I/O circuitry and external devices with energy (see Figure 5). This 25-watt voltage source has a nominal output of 28 volts DC, but can be adjusted at the factory to provide any voltage from 14 to 30 volts DC.

Depending on the design of the control system, some electrical inputs and outputs on the *FAC-2000* require an external voltage source (such as the analog output for example) to operate correctly. For this reason, it is highly recommended that *FAC-2000* controllers be ordered with the isolated auxiliary power output. This power output is accessible from the back panel of the controller via miniature cylindrical or terminal strip connectors.

For systems that can provide a *regulated* 28-volt DC power source for use by the *FAC-2000*'s electrical I/O, the designer can consider choosing a DC model that does not include the auxiliary power output. (Note: all *FAC-2000-DC-00* model controllers have the input power signals fed through to the auxiliary power output connections on the back of the *FAC-2000*—see Figure 6.) This method should be used with care, as it may not provide an isolated source and may result in higher electrical noise in the system.

³ Contact Fairmount Automation for AC input models with a frequency range from 47 to 440 hertz.

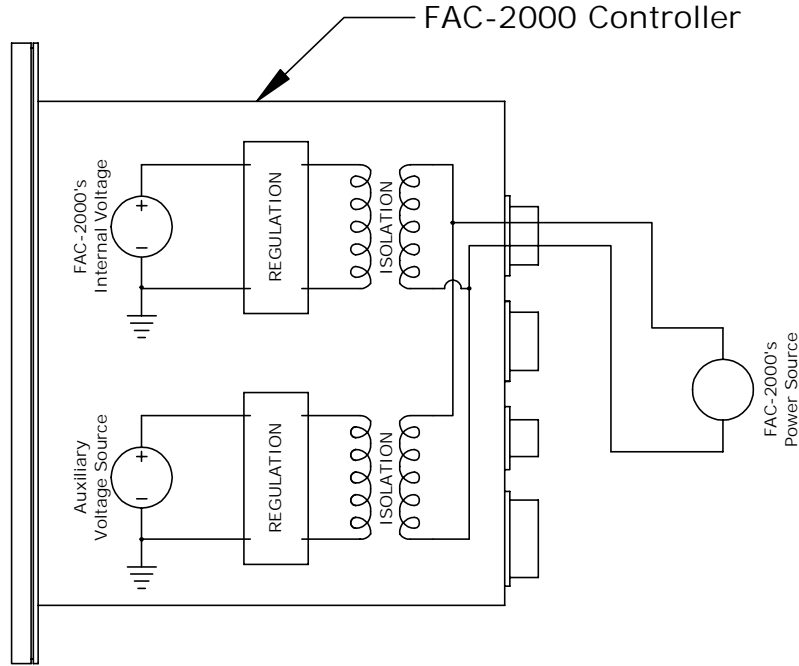


Figure 5 - FAC-2000 models with the isolated auxiliary power output

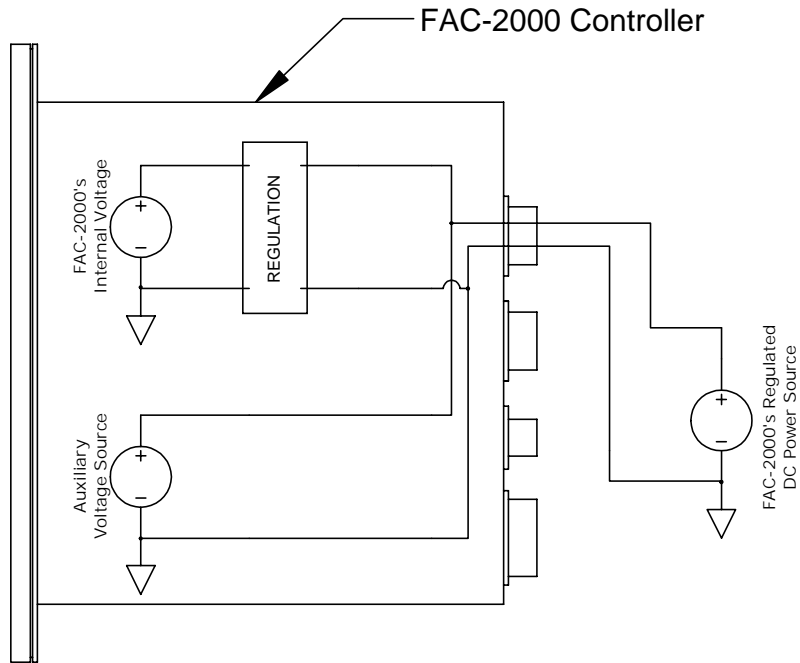
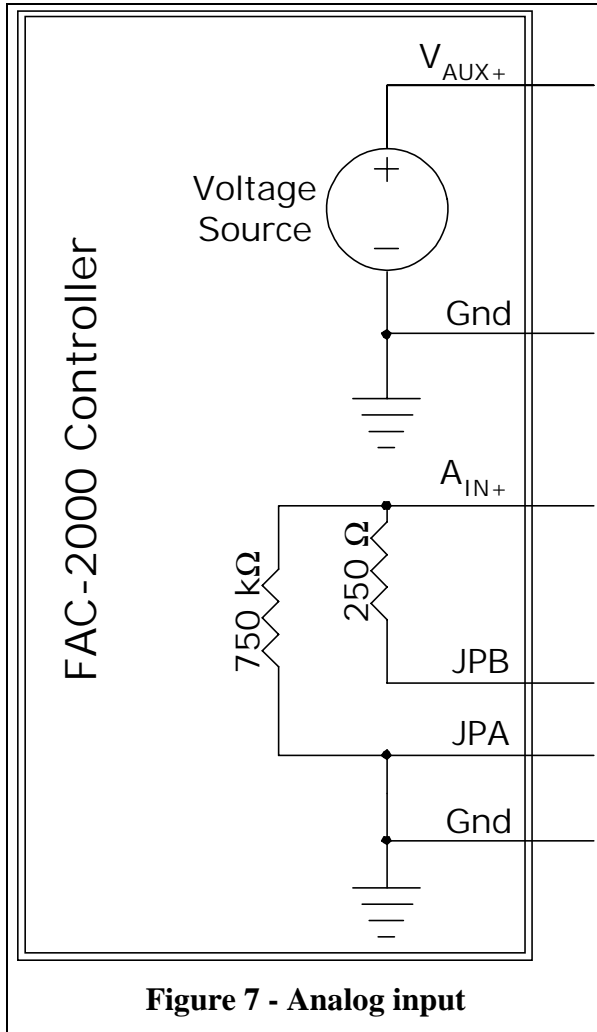


Figure 6 - DC powered FAC-2000 (base model number FAC-2000-DC-00) with no isolated auxiliary output

3.2.3 Analog Inputs



The *FAC-2000* contains three analog inputs capable of reading an analog current signal (from 3 to 20.8 mA DC) or an analog voltage signal (from 0.75 to 5.2 V DC) with connections similar to that shown in Figure 7. The figure shows the auxiliary output voltage source and an analog input with a jumper-selectable 750 k Ω or 250 Ω input impedance (measured from A_{IN+} to Gnd).

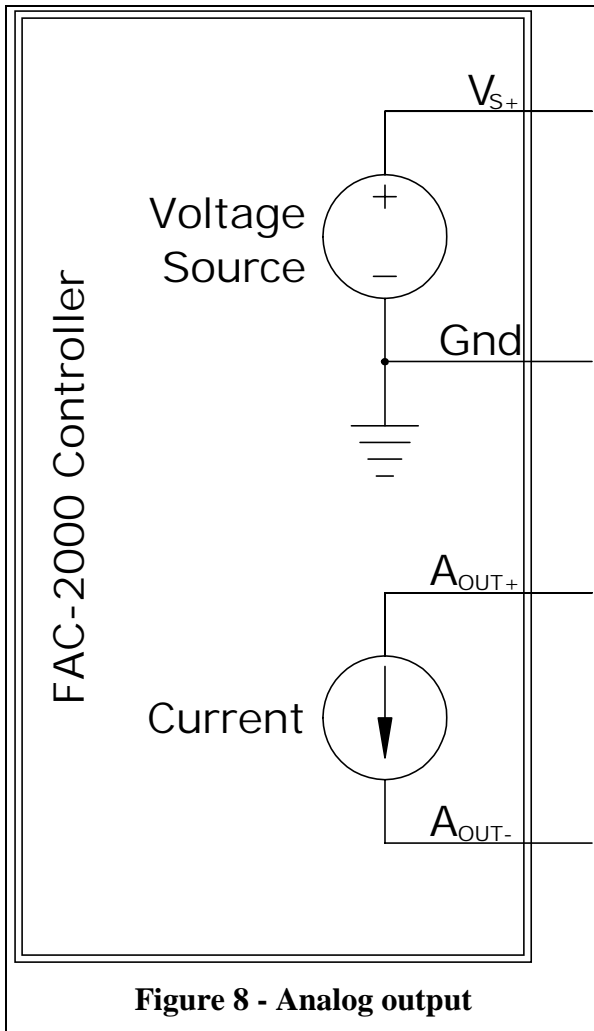
Input signals are attached to the A_{IN+} and Gnd (ground) pins. If the signal is a current source, pins JPA and JPB should be shorted together—this will result in a 250 Ω input impedance. If the signal is a voltage source, pins JPA and JPB should *not* be connected—this will result in an input impedance of 750 k Ω .

When used in conjunction with the auxiliary power output, the 250 Ω current input impedance is well suited for loop powered devices that communicate using protocols such as the HART[®] (Highway Addressable Remote Transducer) protocol.

WARNING: The analog inputs are protected by a voltage limiting device capable of shorting out voltages above 5.5 volts or below 0 volts at a maximum power of 1 watt. If the offending power source exceeds 1 watt, the voltage limiting device may fail closed to protect the analog input circuitry. This permanent failure must be repaired by Fairmount Automation before the input will function properly. **Care should be taken when wiring the device to ensure that this type of error does not occur.**

[®] HART is a registered trademark of the HART Communications Foundation.

3.2.4 Analog Outputs



The *FAC-2000* has two analog current outputs capable of providing 0 to 20.5 mA. With a 28 V source, these outputs can sink a load from 0 to 1200 Ω or alternatively, source a load from 0 to 250 Ω . Figure 9 and Figure 10 show the complete range of acceptable load resistance values for varying voltage sources. Make sure the load on the analog output is within the corresponding range for the voltage source being used.

Two common questions arise when using the analog outputs. First, what is the difference between wiring the output as a current source versus a current sink? The difference between the two is the position of the load relative to the A_{OUT+} and A_{OUT-} pins. In a current sink scheme, the load is attached to the A_{OUT+} pin. In a current source scheme, the load is attached to the A_{OUT-} pin. See Figure 30 and Figure 31 for examples of each. More importantly, as shown in Figure 30 and Figure 31, the position of the grounding point is different. Notice that if a current source is used, the load is attached directly to the circuit ground.

This is important if you wish to transmit an analog signal, for example, from a sending controller to multiple receiving controllers. By attaching the load (in this case the load is the analog inputs of the receiving controllers) to ground, the entire circuit can have a common ground reference point. This common ground can become important if a single source is providing power to all the controllers, sensors, and actuators in the system.

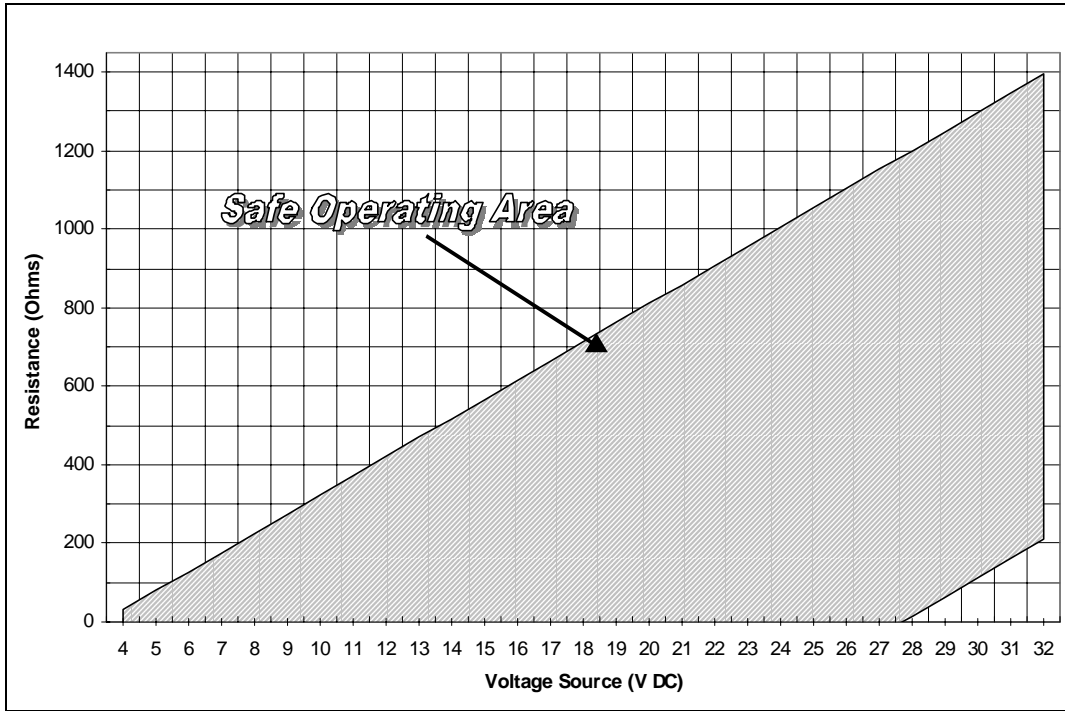


Figure 9 - Load resistance range for the analog outputs when sinking current

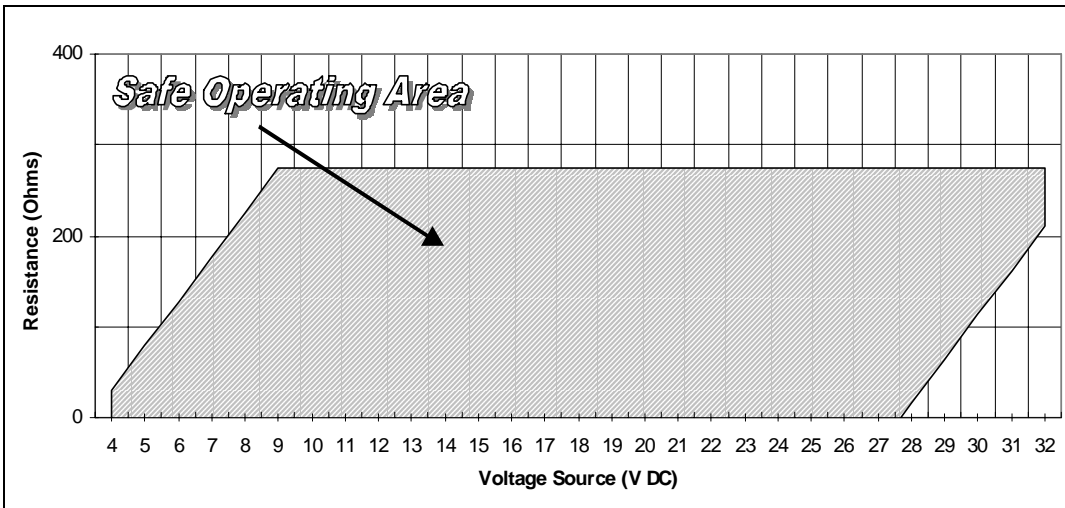


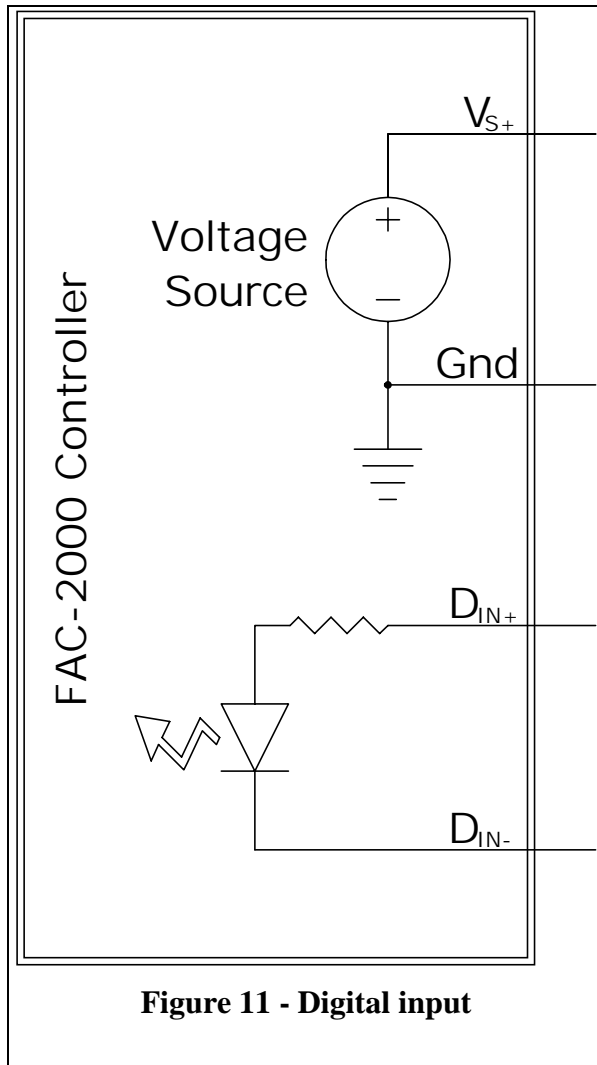
Figure 10 - Load resistance range for the analog outputs when sourcing current

The second common question is when should the circuit be wired as a current source rather than a current sink? In general, wire the circuit using the current sink configuration. If you need to transmit an analog signal between controllers, use the current source configuration. The main reason for this preference is that the analog output circuitry in the controller will sink current over a wider range of load conditions in comparison to a current source configuration.

Note that a voltage source from 4 to 32 V DC is required for the analog outputs to work correctly (see the *Installation* section of this bulletin for additional information). Care must be taken when selecting the source to ensure that grounding loops or unwanted grounding shorts do not occur. Also, the voltage for this analog output source cannot exceed the auxiliary output source. In general, it is recommended that the *FAC-2000's* auxiliary output source be used to power the analog outputs.

WARNING: The analog outputs are protected by a voltage limiting device capable of shorting out voltages above 35 volts or below 0 volts at a maximum power of 1-watt. If the offending power source exceeds 1 watt, the voltage limiting device may fail closed to protect the analog output circuitry. This permanent failure must be repaired by Fairmount Automation before the output will function properly. Care should be taken when wiring the device to ensure that this type of error does not occur.

3.2.5 Digital Inputs



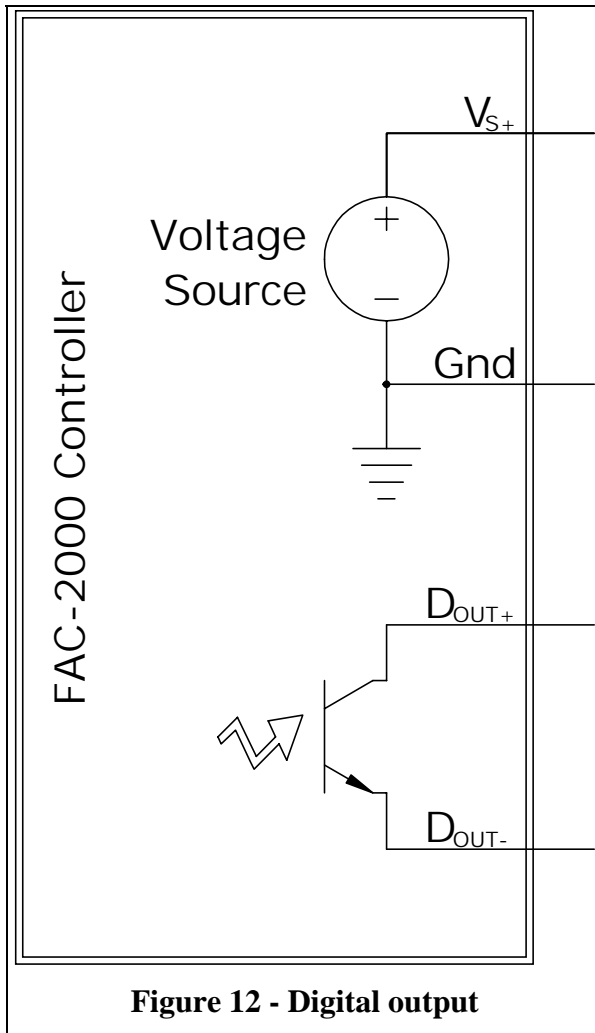
The *FAC-2000* contains ten optically isolated digital inputs. Eight of those inputs are classified as standard inputs and the remaining two as universal inputs. The main difference between the two types is the input voltage range. Figure 11 shows the equivalent circuit for these inputs. Notice that each input drives an isolating infrared light emitting diode (LED). When current is supplied to the LED, the digital input is said to be in a logic high state. When current is removed from the LED, the digital input is in a logic low state. Table 1 shows the signal range associated with each logic state for each digital input type.

Both the universal and standard digital inputs, when used with a voltage source (such as the *FAC-2000's* auxiliary output), can be used to indicate a switch or contact closure. Use the universal digital input to interface with transistor-transistor logic (TTL) or CMOS logic circuits. Use the standard digital input to interface with sources above 30 V DC.

Table 1 - Voltage ranges for the digital inputs

Type	Low Logic Level Input Range (DC)	High Logic Level Input Range (DC)
Standard	0 to 1.5 V / 0 to 0.096 mA	9.1 to 120 V / 1.5 to 25.0 mA
Universal	0 to 0.8 V	4.5 to 30 V / 0.5 to 5 mA

3.2.6 Digital Outputs



Each *FAC-2000* has two open collector digital outputs. The outputs are optically isolated and can drive a load from a maximum 30 volt source with 20 mA (typical).

Figure 12 - Digital output

3.2.7 Mechanical Relay Outputs

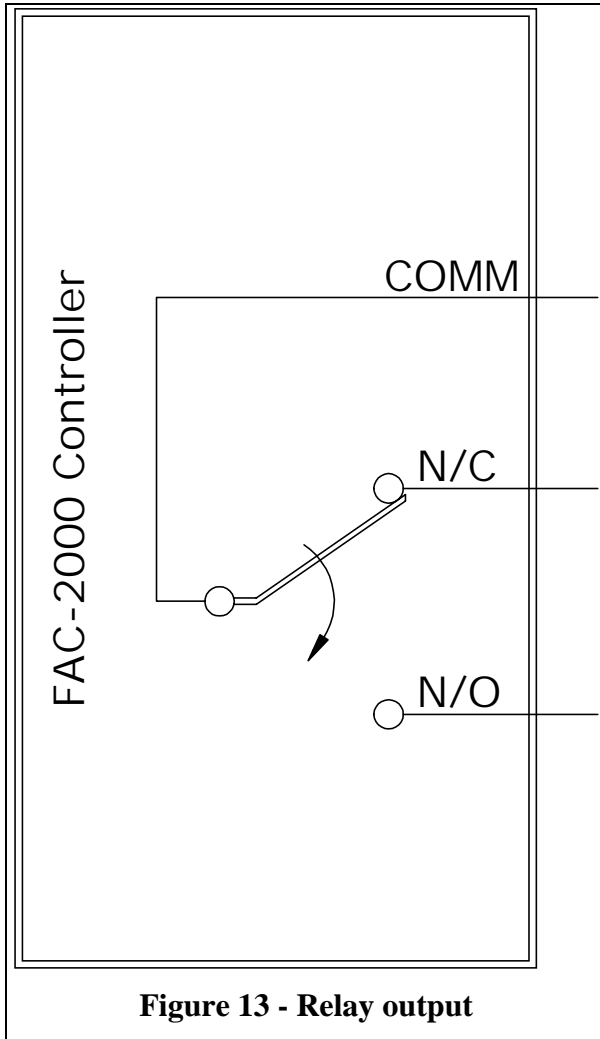


Figure 13 - Relay output

The standard *FAC-2000* provides four form-C outputs (see Figure 13). Each relay is capable of switching 4 A (resistive) at 24V DC or 2 A (resistive) at 240 V AC.

The *FAC-2000* can be ordered with an enhanced relay board. This enhanced board contains two mechanical form C relays and can contain up to a maximum of three additional 0.5 A (resistive) 100 VDC / 120 VAC mechanical form A.

On *FAC-2000* units equipped with miniature cylindrical connectors, some relay outputs may have additional current carrying limitations imposed by the connector pin. See section 5.2.2 on page 51 for more information.

3.2.8 Solid State Relay Outputs

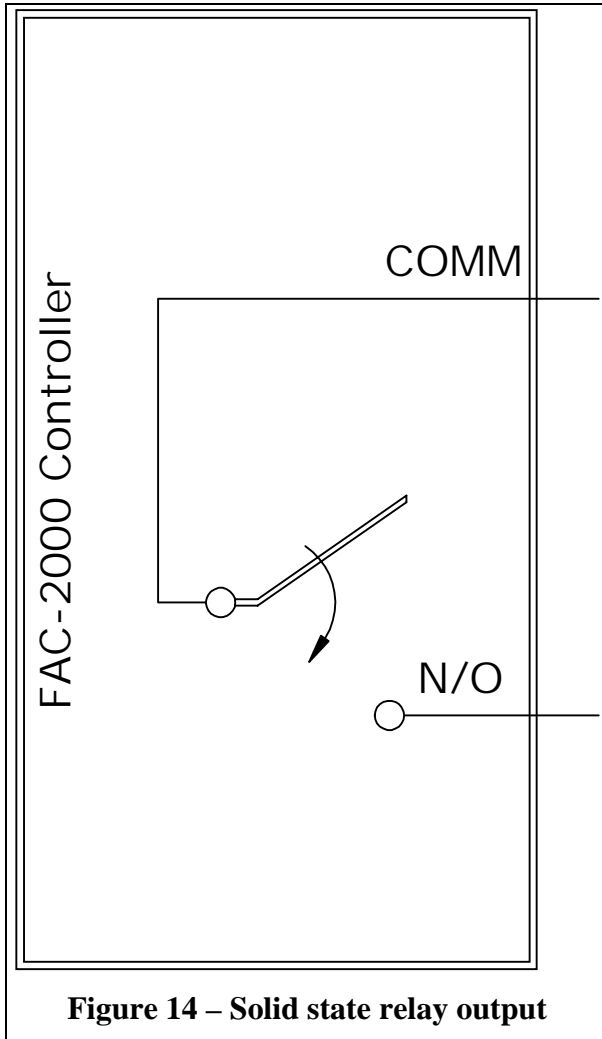


Figure 14 – Solid state relay output

until the input waveform crosses zero volts. This translates to a maximum switching delay of approximately half the AC line frequency.

On *FAC-2000* units equipped with miniature cylindrical connectors, some relay outputs may have additional current carrying limitations imposed by the connector pin. See section 5.2.2 on page 51 for more information.

The *FAC-2000* can be special ordered with an enhanced relay board that can include up to three DC or AC solid-state form A relays (see Figure 14.) Each solid-state relay is capable of switching 3 amp resistive or inductive loads at 60V DC or 140 V AC.

Each solid-state relay must be individually specified as AC or DC when ordered. You may not use the AC type to switch DC signals and visa-versa.

Do not use the solid-state modules to switch low currents as they typically have a 4-mA leakage current in the off state. If it is necessary to switch low current, please use a mechanical relay.

Keep in mind that DC solid-state relays have defined polarities – the terminals labeled common (COMM) are positive and those labeled normally open (N/O) are negative.

Also, please note that the AC solid-state modules are zero crossing turn-on. This means that the modules will not energize

3.2.9 Networking

The standard *FAC-2000* provides hardware support for networks compatible with RS-232 and RS-485 voltage levels.

RS-232 point-to-point serial networks in the *FAC-2000* are used to provide an interface between a maximum of two devices (typically between a personal computer and a *FAC-2000* controller). Programming the controller is normally accomplished through this interface. This network can be used to transmit data at a maximum of 38,400 bits per second over a maximum distance of about 49 feet.

RS-485 multi-drop serial networks can connect up to 32 devices via a three-wire link (note: more than 32 devices can be connected by using a RS-485 network repeater/isolator – contact Fairmount Automation for more information.) The network contains one master that initiates all communications. Each remaining slave device on the link will respond only when the master device attempts communication with it. This network can be used to transmit information at a maximum 115,000 bits per second over a maximum distance of 4000 feet (the network distance can be increase by using a RS-485 network repeater/isolator.)

Care should be taken when selecting the wire type to be used for the transmission channel. For short distances (typically under 10 feet), standard 22 to 24 AWG twisted pair telephone cable can be utilized. If the network extends over larger distances, higher quality wire should be used (such as Datalene (type 8162) wire from Belden Wire and Cable Company).

RS-485 networks should be terminated at the two ends with resistors that match the characteristic impedance of the transmission line. Typically, they are in the range of 100 to 120 ohms. Check the manufacturer's data sheet on the cable you are using in your system.

The controller also can be configured at the factory to accept RS-422 voltage levels. Please contact Fairmount Automation for more information.

See Table 6 for common networking accessories including COM 2 miniature cylindrical connector termination shells and various cables.

4. PRODUCT SPECIFICATIONS

Degree of Protection (pending)

Facial	NEMA 4
Housing	NEMA 4 (models with terminal boards are excluded)

Environmental Limits

Operating Ambient Temperature Limits	-20°C to 65°C
Storage/Transport Ambient Temperature Limits	-40°C to 85°C
High Impact Shock	MIL-STD-901D
Mechanical Vibrations	MIL-STD-167B

AC Power Models

Voltage Range	90 to 132 VAC or 180 to 250 VAC
Frequency Range	47 to 63 ⁴ Hz
Maximum Power Consumption	25 Watts (not including Aux. DC Output)

DC Power Models

Voltage Range	18 to 36 VDC
Maximum Power Consumption	25 Watts (not including Aux. DC Output)

Auxiliary DC Voltage Output (for models ordered with the auxiliary output source)

Voltage Range	28 VDC (factory adjustable from 14 to 30 VDC)
Maximum Output Power	25 Watts

Analog Inputs 1, 2, and 3

Rated Signal Range (for each input)	3 to 20.8 mA or 0.75 to 5.2 VDC
Input Impedance	250 or 750k ohms (user selectable)
Resolution	12 bits minimum

Digital Inputs 1-8

Signal Low Voltage	0 to 1.5 VDC
Signal High Voltage	9.1 to 128 VDC

Universal Digital Inputs 1 and 2

Signal Low Voltage	0 to 0.8 VDC
Signal High Voltage	4.5 to 30 VDC

Analog Outputs 1 and 2

⁴ Contact Fairmount Automation for AC input models with a frequency range from 47 to 440 hertz.

Rated Signal Range	0 to 20.5 mA
Voltage Range	4 to 32 VDC ⁵
Load Range	0 to 1400 ohms ⁵
Resolution	12 bits

Digital Outputs 1 and 2

Type	Opto-Isolated Transistor
Rated Signal Range (current)	25 mA typical
Rated Signal Range (voltage)	30 VDC

Mechanical Relay Outputs (4 on standard relay board and 2 on enhanced relay board)

Type	Form C (N.O., COMM, N.C.)
Maximum Rated Signal Range	4 A (resistive) @24 VDC or 120 VAC, 2 A(resistive) @240 VAC ⁶

Mechanical Relay Outputs (maximum of 3 on enhanced relay board only)

Type	Form A (N.O., COMM)
Maximum Rated Signal Range	0.5 A (resistive) @100 VDC or 120 VAC ⁶

Solid State Outputs (maximum of 3 on enhanced relay board only)

Type	Form A (N.O., COMM)
Maximum Rated Signal Range	3 A (resistive and inductive) @60 VDC or 140 VAC ⁷

Displays

Element Type	Yellow, green, and red LEDs
Digital Readouts	Two 4 digit, 7 segment digital readouts One 3 digit, 7 segment digital readout Colors are user-specified 0.4" in height 0.3" in width
Analog Bar Graphs	Two columns of 40 LEDs (colors are user-specified) 4" in height 0.2" in width 0 to 100% range 2.5% bargraph operation resolution
Alpha-numeric Displays	Three rows with 8 characters (7x5 pixel resolution) each.
Keypad	Six positive tactile-feel keys

⁵ See Figure 9 and Figure 10 on page 13.

⁶ See Section 5.2.2 on page 51 and Section 3.2.7 on page 17 for more information.

⁷ See Section 5.2.2 on page 51 and Section 3.2.8 on page 18 for more information.

Network Support

Point-to-Point

RS-232 (maximum of 2 devices)

Multi-drop

RS-485

Turn-on Time

Less than 15 seconds

Programming Method

Design Pad graphical programming environment on a PC using Windows 95 or better —
Compiled programs are typically transferred from a PC's COMM port to the controller
via RS-232 serial link

Local Adjustments

Outputs and user-specified properties are adjusted using a six-button keypad

Dimensions

Front: 5.5 x 8"

Depth (w/o cylindrical connector shells): 7.75"

Weight

Approximately 7 pounds

Microprocessor

386SX 33 MHz

2 MB DRAM

2 MB Non-volatile FLASH RAM

Watchdog Timer

5. INSTALLATION

The following section provides a general guideline on how to install the *FAC-2000*.

Before installing the controller, inspect it fully for any damage that may have occurred during shipping. Do not install the controller if it appears to be damaged and contact Fairmount Automation for a return materials authorization (RMA) number.

This device must be installed in a manner that ensures no mechanical or electrical limits (as stated in the product specification) are exceeded. Permanent damage to the device may result.

Only qualified personnel should install the FAC-2000 controller. *Always remove all power sources before installing the device—failure to do so may result in serious injury and/or equipment damage.*

Do not open any covers to the controller while it is located in corrosive or high humidity environments. This may cause damage to the internal circuits.

Cover all unused miniature connector receptacles with receptacle caps.

5.1 Mechanical Installation

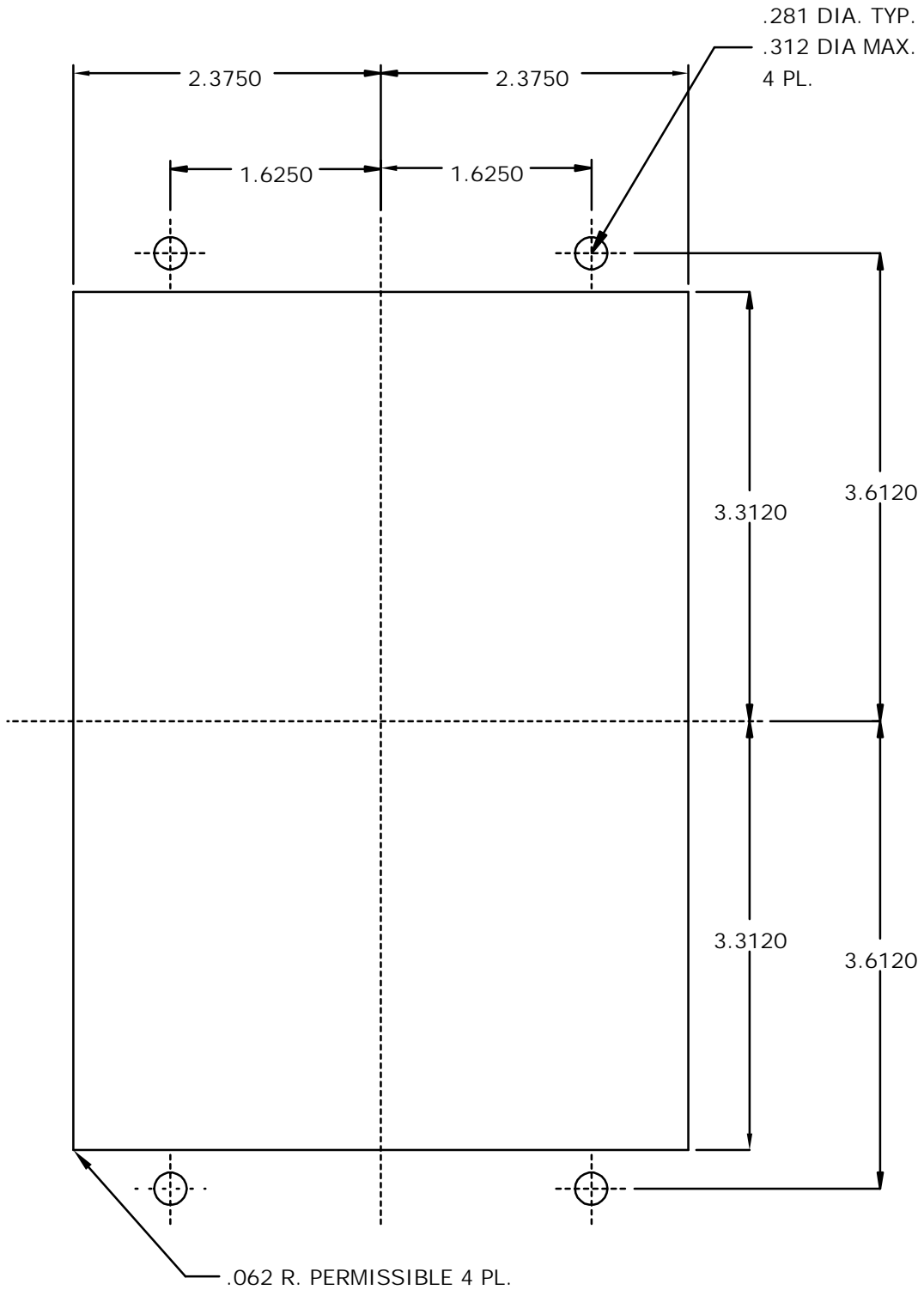
The *FAC-2000* is designed for installation in a panel or console between 1/16 and 1/2 inch thick. Figure 15 shows the required panel cutout dimensions.

IMPORTANT NOTE: The mounting holes must not exceed 0.312" in diameter (the recommended mounting hole diameter is 0.281".)

After cutting out the pattern shown in Figure 15, place the mounting assembly on the mounting plate in the following order (refer to Figure 20):

- 1) Silicone flange gasket (see Figure 17)
- 2) *FAC-2000* controller body
- 3) Silicone bezel gasket (see Figure 16)
- 4) Four mounting spacers
- 5) Steel bezel (see Figure 19)

From the rear of the mounting plate, slide the locking clamp (see Figure 18) over body of the controller with the PEM nuts facing *away* from the mounting plate. While holding the locking clamp, insert the four 10-32 hex socket head cap screws into each hole of the bezel and tighten with a 5/32 hex head wrench. The recommended seating torque for the 10-32 hex socket head screws is 76 in-lbs.



MATERIAL: .062 TO .500 THICK

Note: All dimensions are in inches

Figure 15 - Cutout required to install the controller

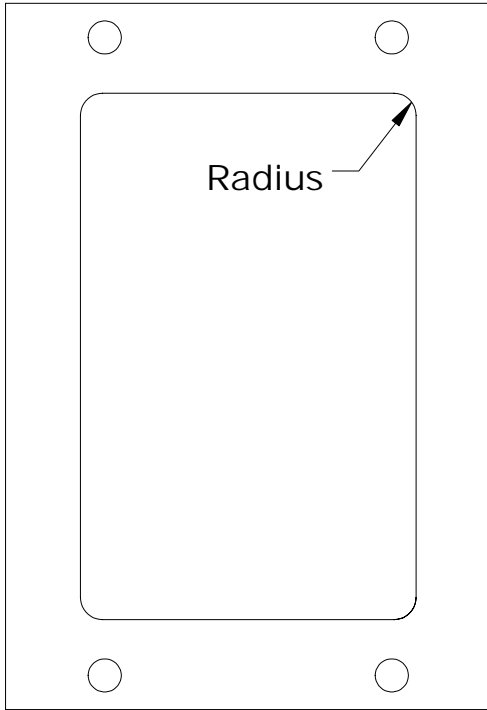


Figure 16 - The silicone bezel gasket

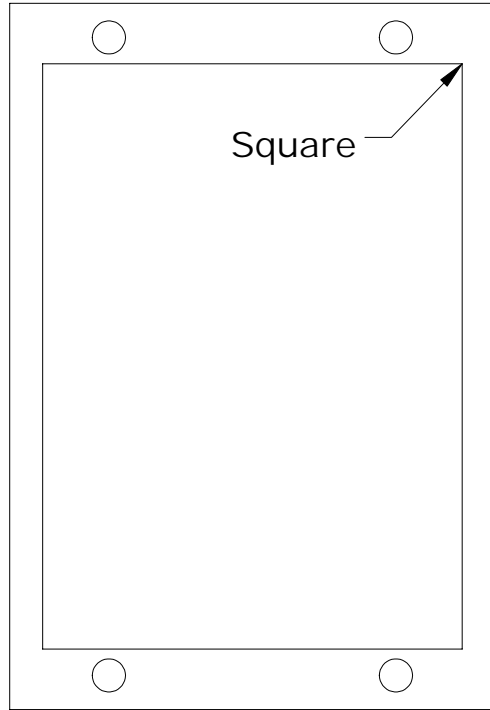


Figure 17 - The silicone flange gasket

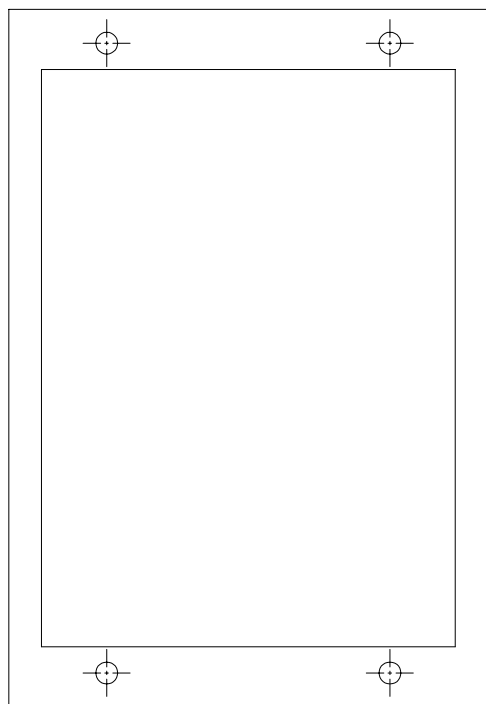
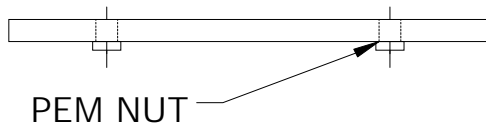


Figure 18 - The locking clamp

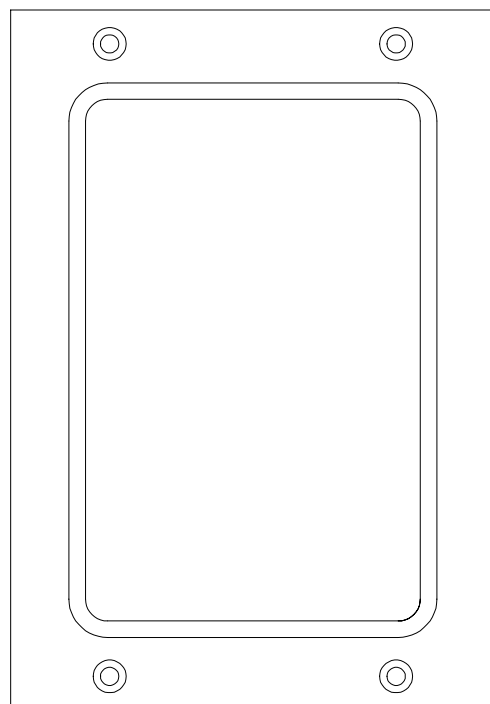
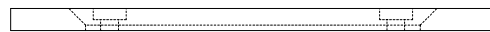


Figure 19 - The bezel

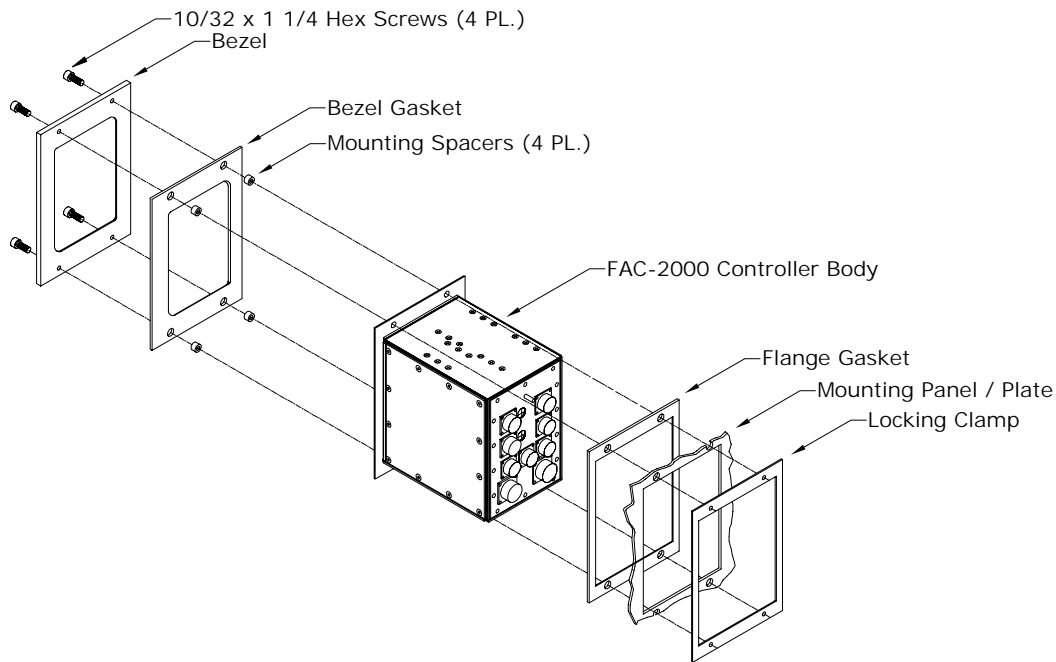


Figure 20 - Mounting configuration

If the *FAC-2000* contains miniature cylindrical connectors, the mounting depth of the controller behind the mounting panel/plate (measured from the front face of the mounting panel/plate to the ends of the miniature cylindrical connector receptacles and fuse holder(s)) is 7.2 inches. When strain-relieving plugs are attached to the connector receptacles (not including the depth associated with wire exiting the plugs), the mounting depth required is 8.5 inches.

If the *FAC-2000* is constructed with terminal board connectors, the mounting depth of the controller behind the mounting panel/plate (measured from the front face of the mounting panel / plate to the ends of the fuse holder(s)) is 7.2 inches.

The controller will extend 0.56 inches in front of the mounting plate (measured from the front face of the mounting panel/plate to the heads on the four 10/32 x 1/4 mounting bolts).

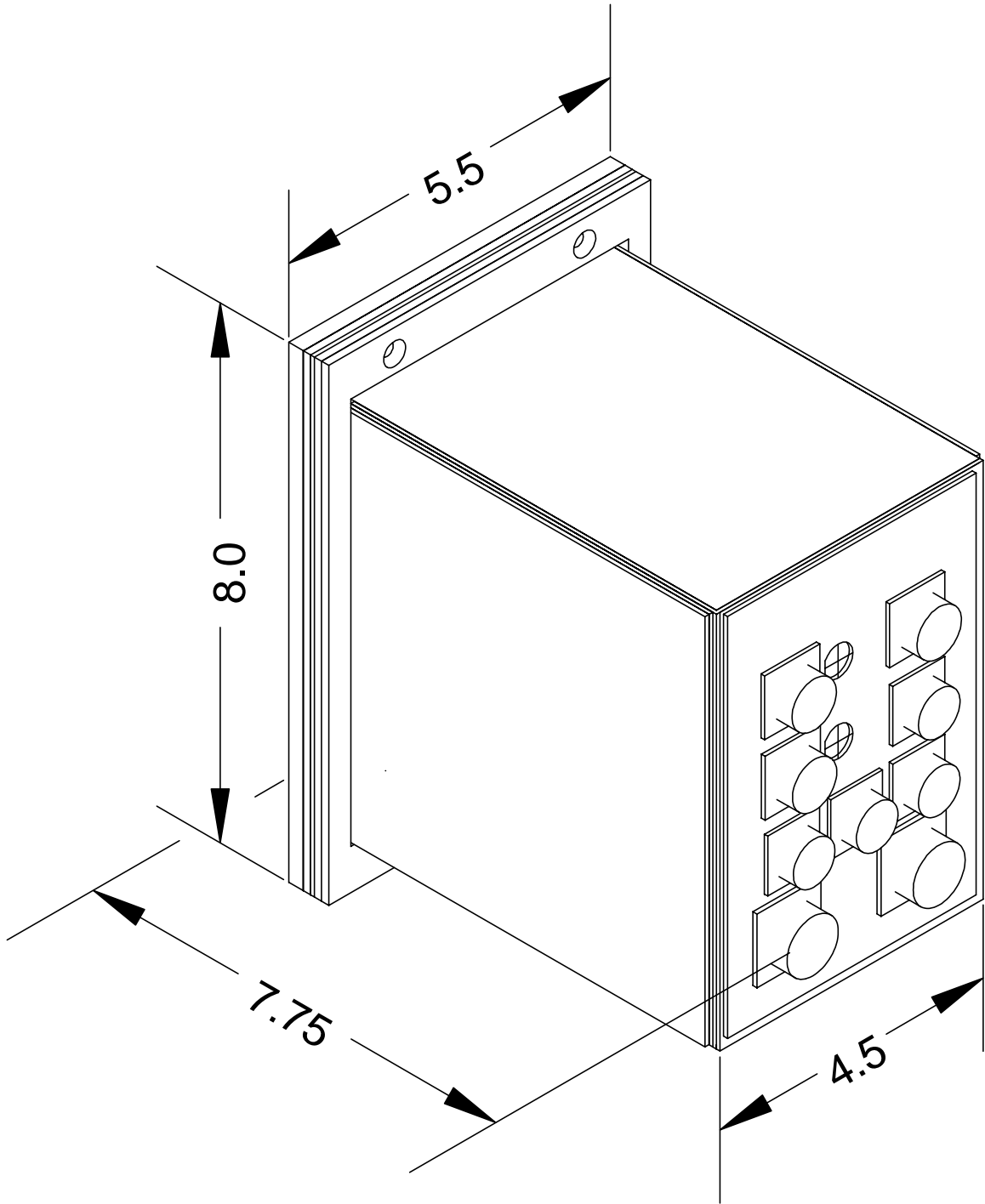


Figure 21 - Case size

5.2 Electrical Installation

As with all electrical devices, it is important to keep in mind the layout of the *grounds* when wiring a control circuit. There are three types of grounds to keep track of (see Figure 22):

1. Earth / Case Ground,
2. Isolated ground for the controller, and
3. External power supply ground or a non-isolated ground for the controller (see Figure 6).

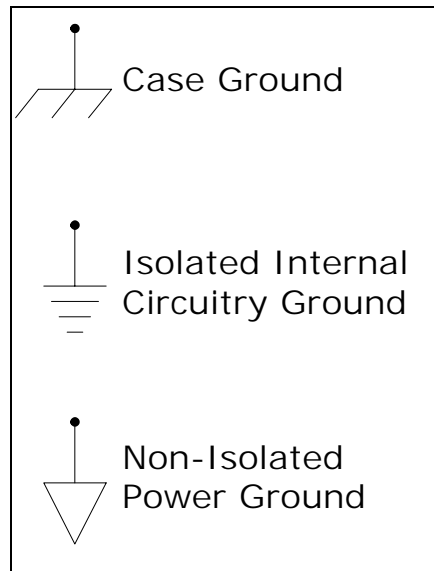


Figure 22 - Ground symbols and their associated labels

The ground symbols shown in Figure 22 are used throughout the installation figures in this section. Like symbols in each of the figures represent the same circuit point. Make sure that joining these common grounds to different voltage potential levels does not create unwanted shorts.

The circuitry ground and the auxiliary output ground are both isolated from the input power source, and as a result, are isolated from the external world. Thus, the designer only needs to be concerned with not mixing grounds within the same controller.

IMPORTANT NOTE: The *FAC-2000-DC-00* model does not have an isolated auxiliary output so the ground may or may not be isolated depending on the external voltage source that is used.

Connections to the analog inputs, analog outputs, and communications circuitry are all referenced to the same isolated internal circuitry ground. The relay, digital inputs, and

digital outputs are optically or magnetically isolated and therefore pose no ground-mixing risk.

Consider the example connection diagram shown in Figure 23, where both analog inputs are connected to the same signal. In the figure, a loop-powered transmitter is connected in series to both analog input 1 and analog input 2 of the same controller. Inside the *FAC-2000* silhouette, the equivalent circuit of each analog input is shown. Notice that the negative analog input terminal is connected to the internal circuitry ground symbol. This is true for all analog inputs.

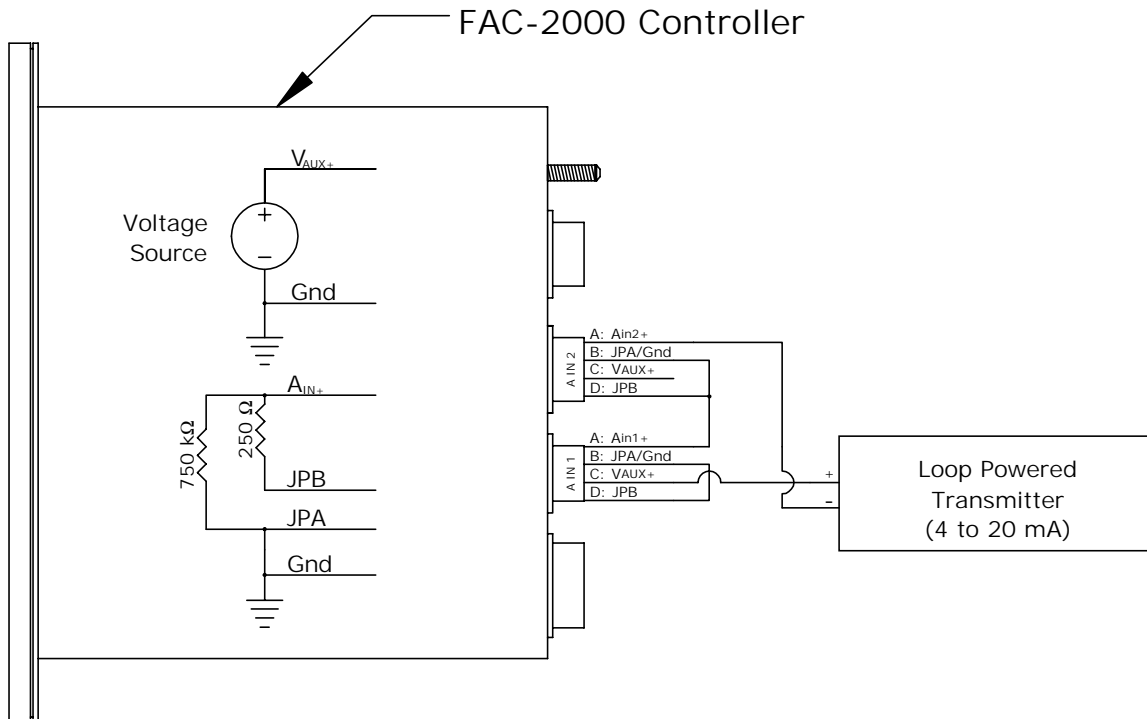


Figure 23 - Incorrect grounding scheme example

Since the ground (Gnd) terminal of each analog input is at the same ground potential, the wiring diagram of Figure 23 is equivalent to the diagram shown in Figure 24. Notice that in the equivalent circuit, the analog input 1 leads are shorted together, thereby totally bypassing the input. This problem can be resolved by wiring analog input 2 as a voltage input and wiring it in parallel to analog input 1 (see Figure 29).

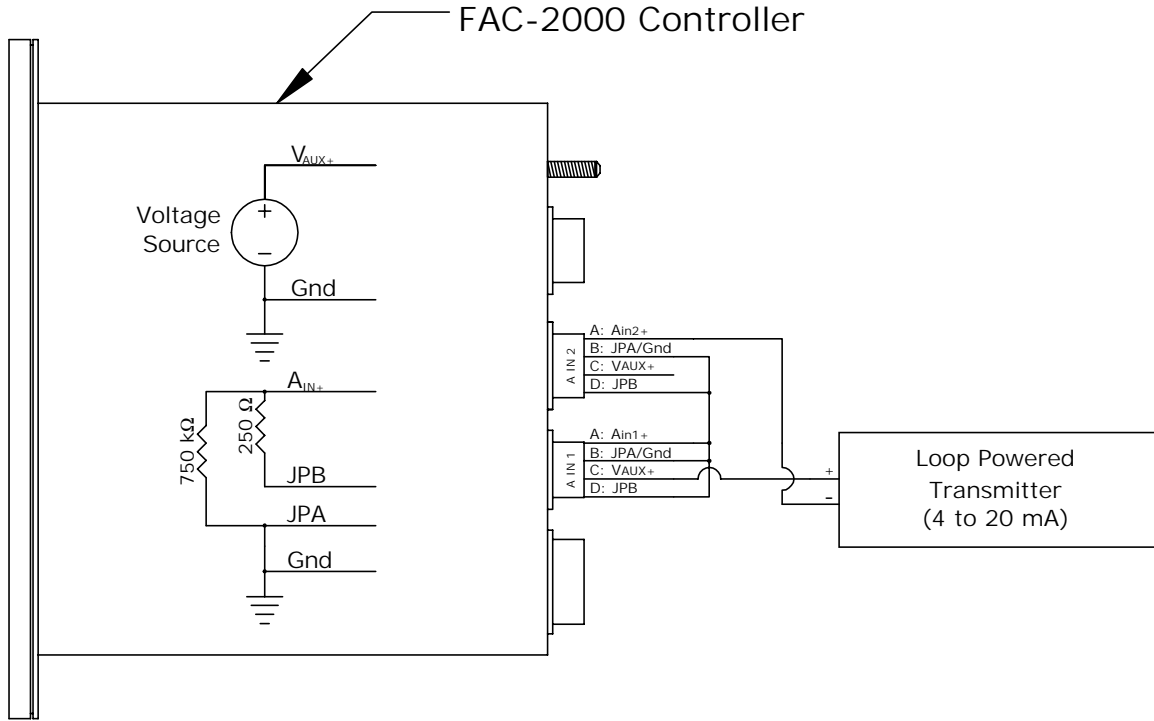


Figure 24 - Equivalent wiring diagram for the example in Figure 20

The following wiring diagrams shown in Figure 25 through Figure 37 illustrate how the FAC-2000 should be wired under different conditions.

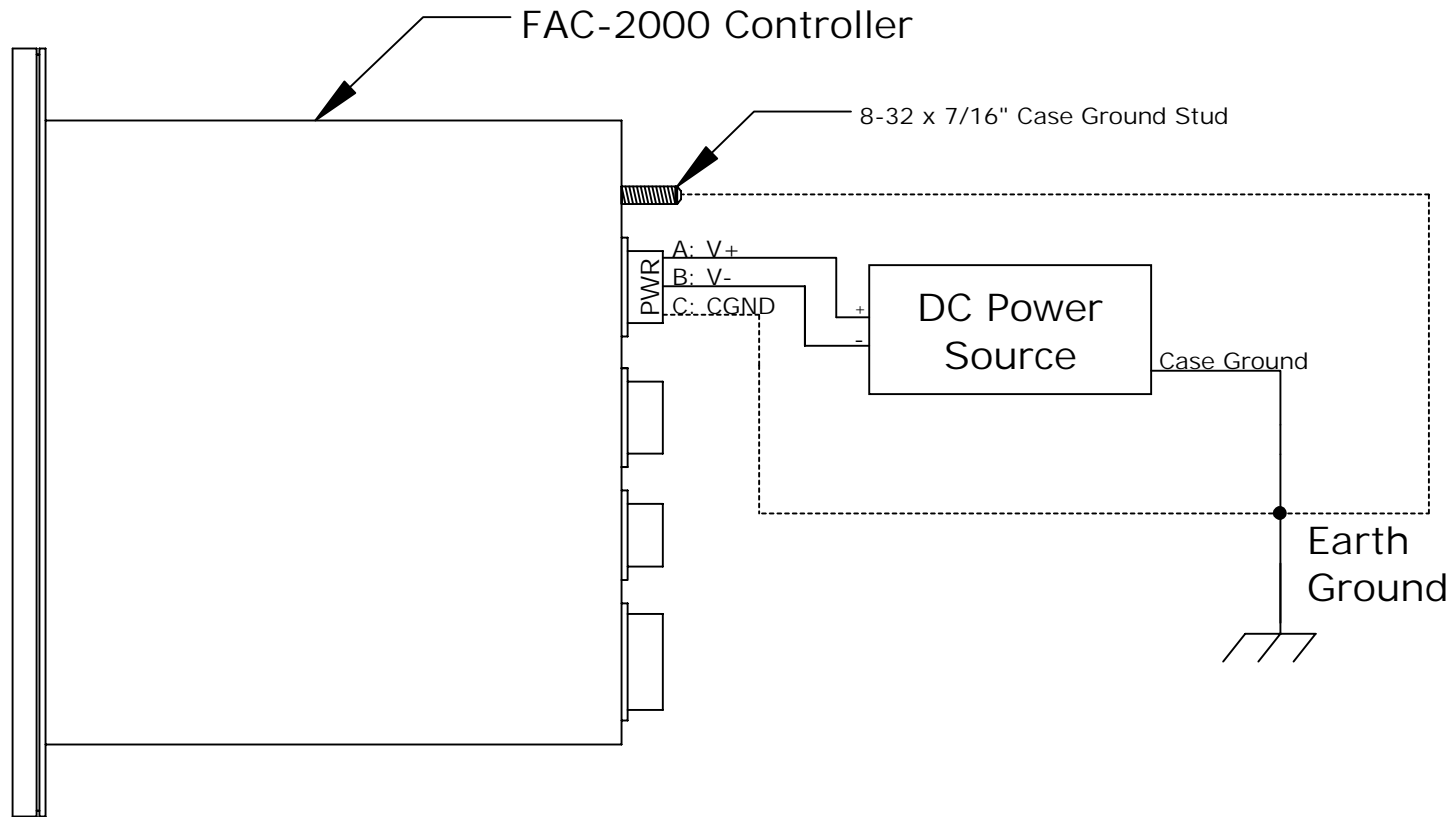


Figure 25 - DC power wiring

Notes: The dashed lines represent the ground wires. Connect either the dashed line going to the miniature cylindrical connector or the 8-32 stud.

Warning: An improperly grounded case could result in electrical shock or incorrect operation of the controller.

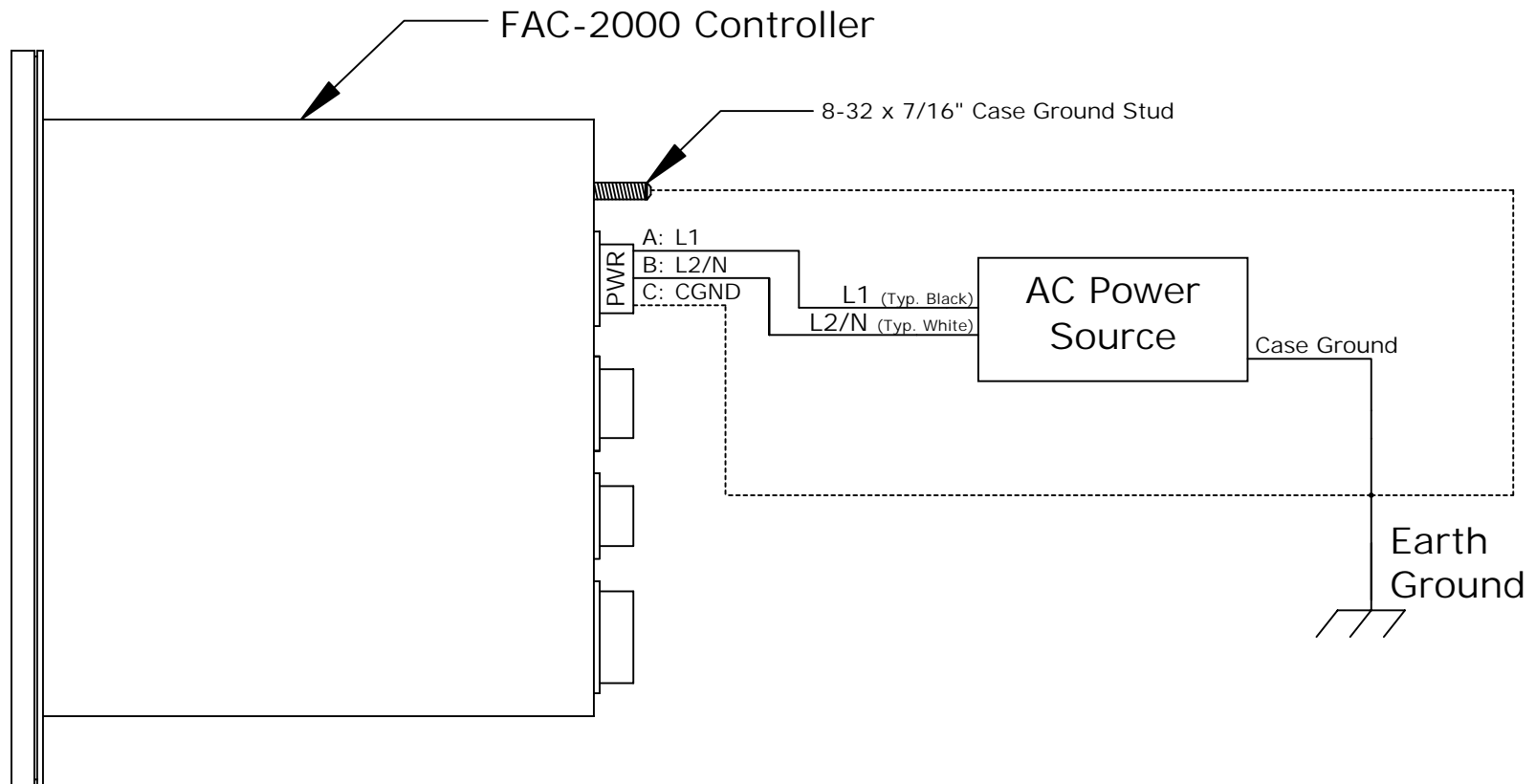


Figure 26 - AC power wiring

Notes: The dashed lines represent the ground wires. Connect either the dashed line going to the miniature cylindrical connector or the 8-32 stud.

Warning: An improperly grounded case could result in electrical shock or incorrect operation of the controller.

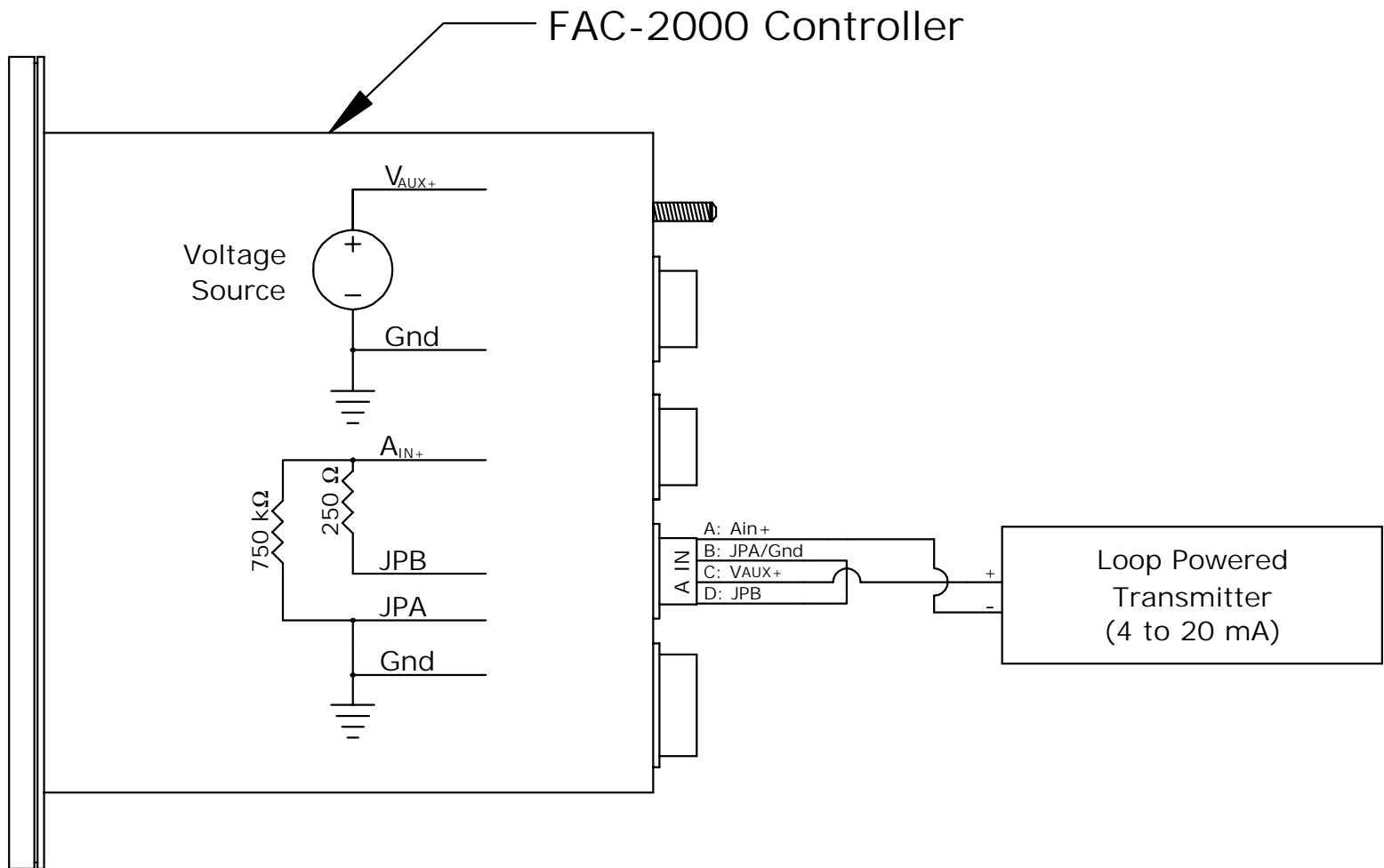


Figure 27 - Suggested analog input wiring with a loop powered transmitter

Note: With JPA and JPB shorted together the $750\text{ k}\Omega$ resistor can be neglected resulting in an input impedance of approximately $250\ \Omega$.

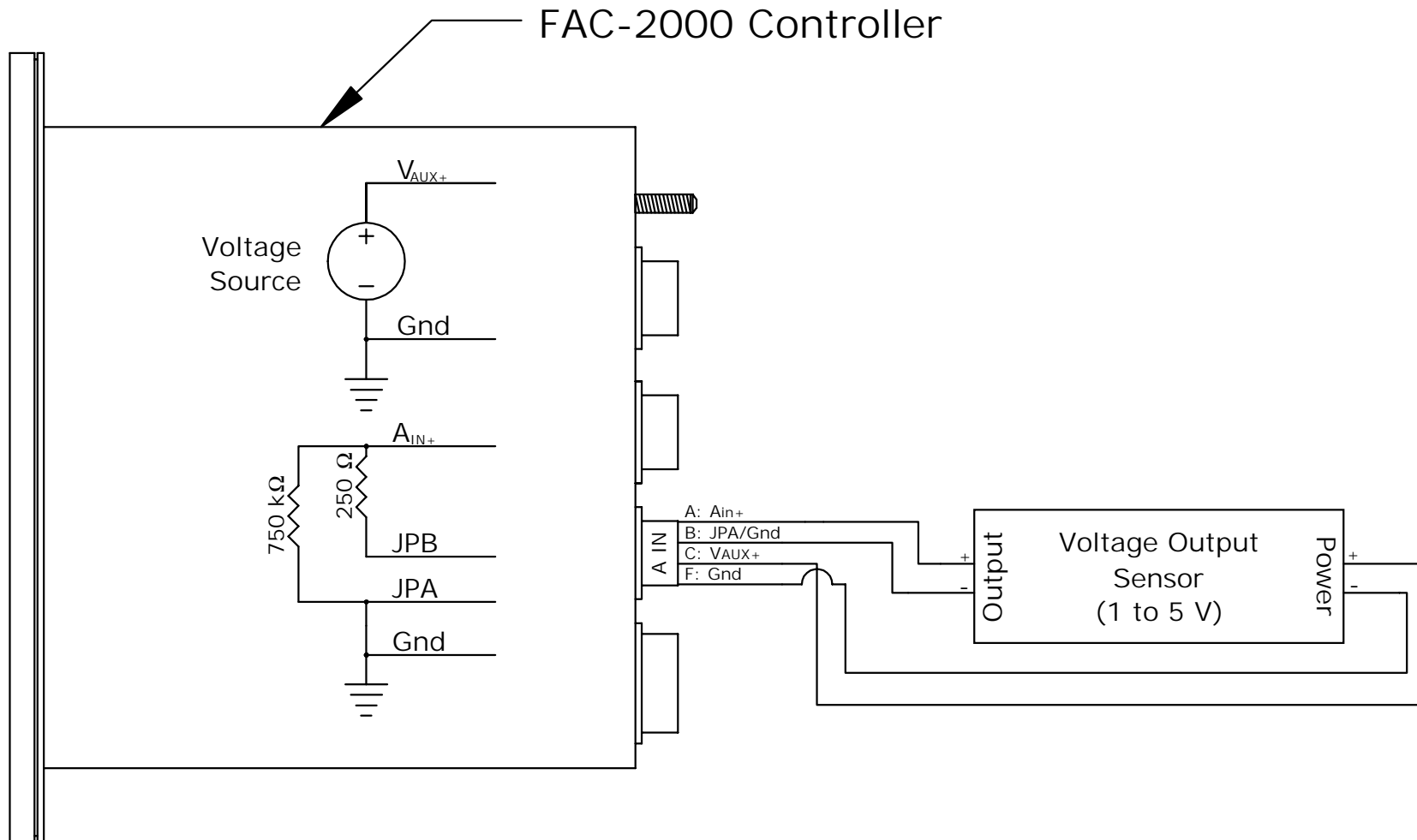


Figure 28 - Suggested analog input wiring to a sensor with a voltage output

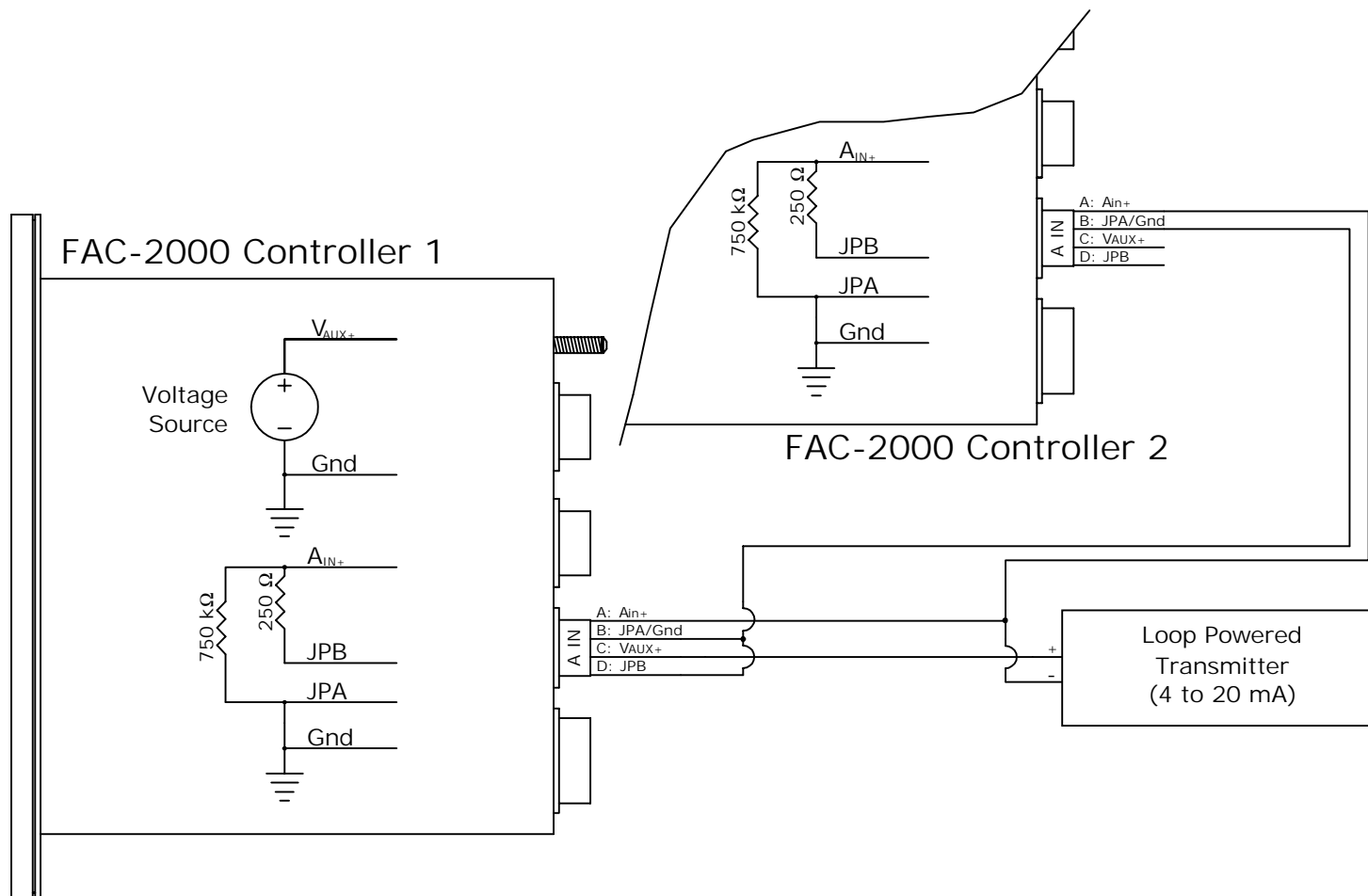


Figure 29 - Suggested analog input wiring for two controllers reading the same output from a loop powered transmitter

Note: In the above configuration controller 1 is wired as a current input (4 to 20 mA). A current input has advantages for noise immunity (when compared to a voltage input) and supplies the 250 Ω impedance required for communication with most loop powered transmitters. Controller 2 is wired as a voltage input in parallel to controller 1; it has a signal range from 1 to 5 volts.

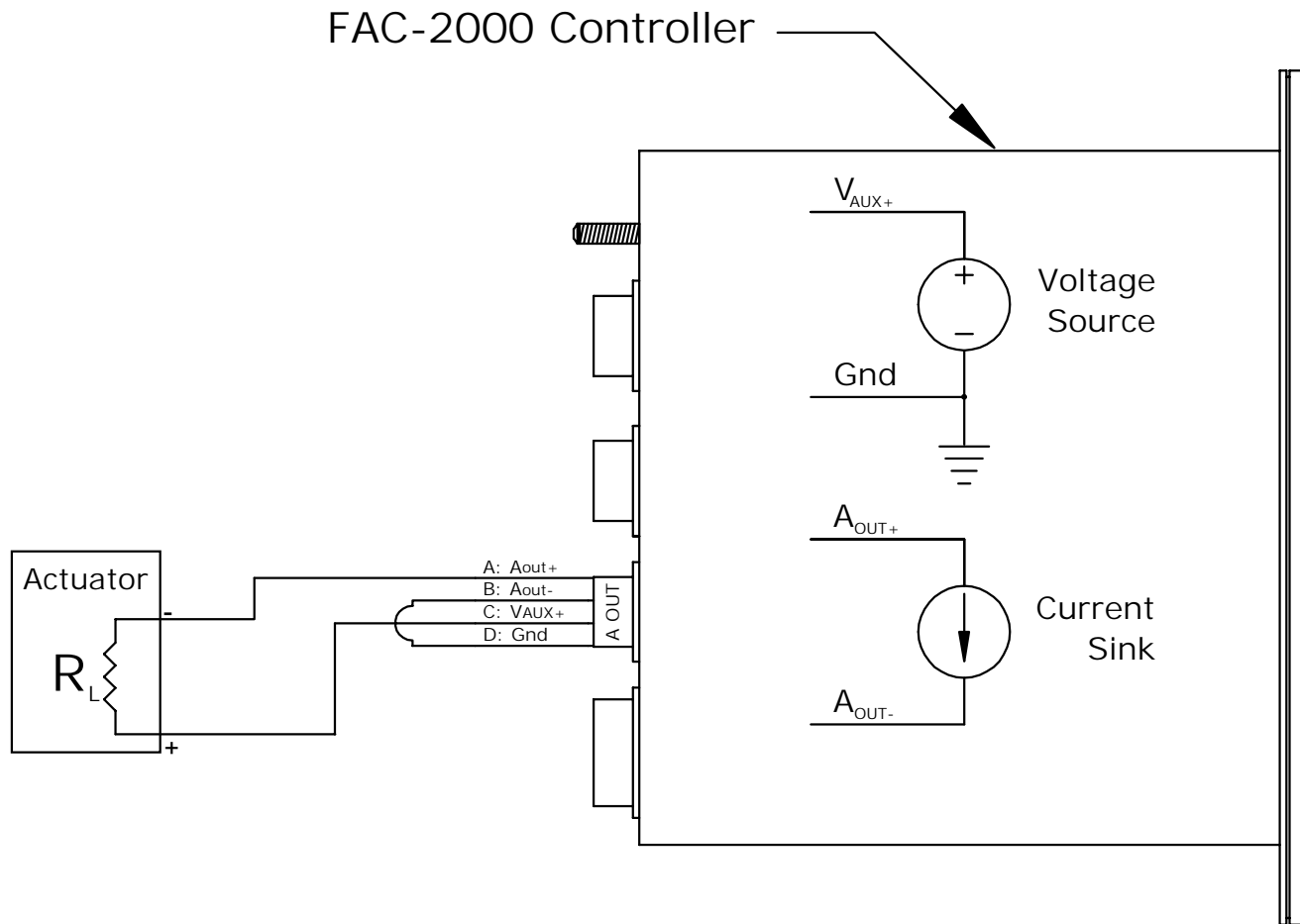


Figure 30 - Suggested analog output wiring with the controller configured as a current sink

Notes: See the graph in Figure 9 on page 13 for allowable load resistance (R_L) values.

A voltage source is required for the current sink circuitry to operate correctly.

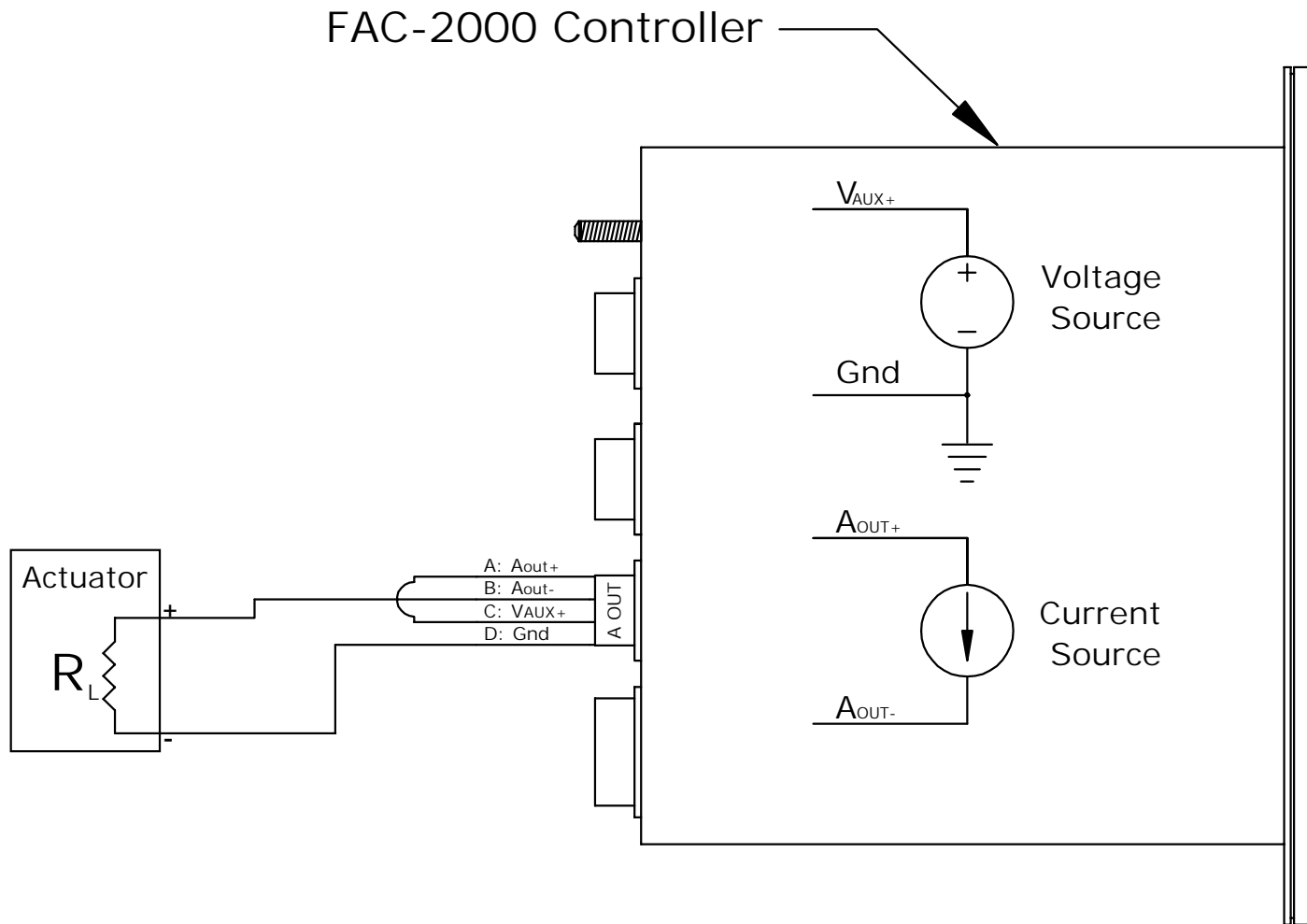


Figure 31 - Suggested analog output wiring with the controller configured as a current source

Notes: See the graph in Figure 10 on page 13 for allowable load resistance (R_L) values.
 A voltage source is required for the current source circuitry to operate correctly.

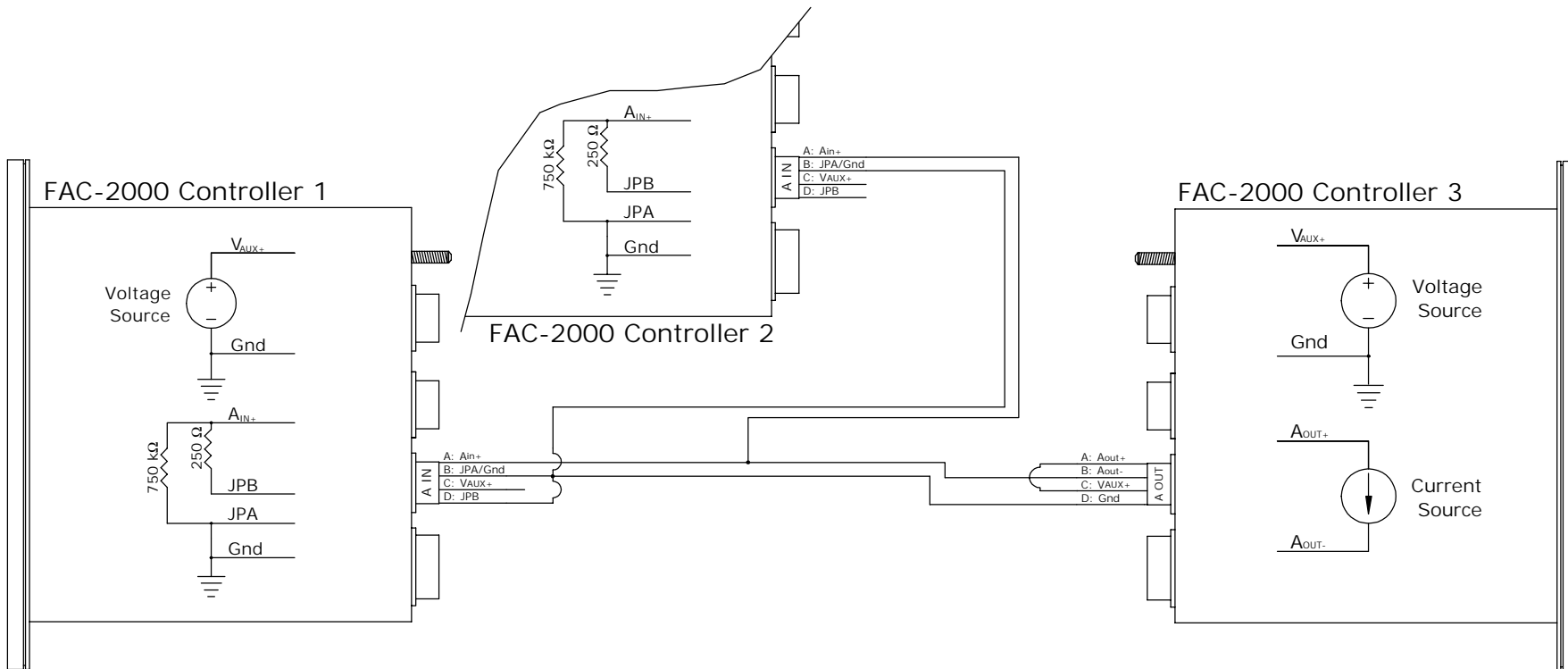


Figure 32 - Suggested wiring to transmit an analog signal from controller 3 to controllers 1 and 2

Notes: Notice that controller 1 is wired as a current input, and as such, provides the necessary load resistance for the analog output of controller 3. In addition, this example shows a second controller (wired as a voltage input in parallel to the current input of controller 2) reading the analog output of controller 3.

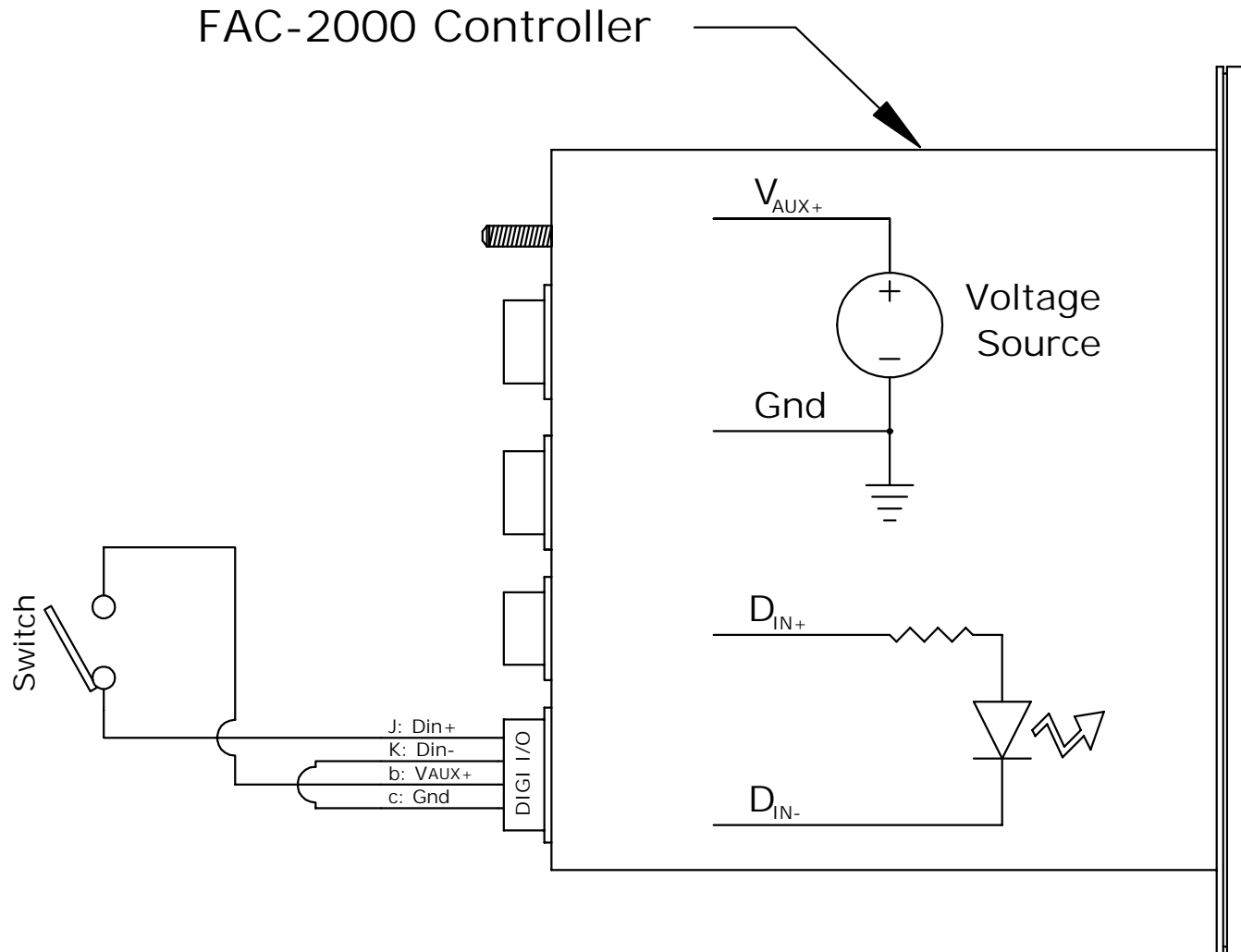


Figure 33 - Suggested digital input wiring to a mechanical switch

Notes: The suggested wiring above uses digital input 1. Any digital input could be wired in a similar configuration.

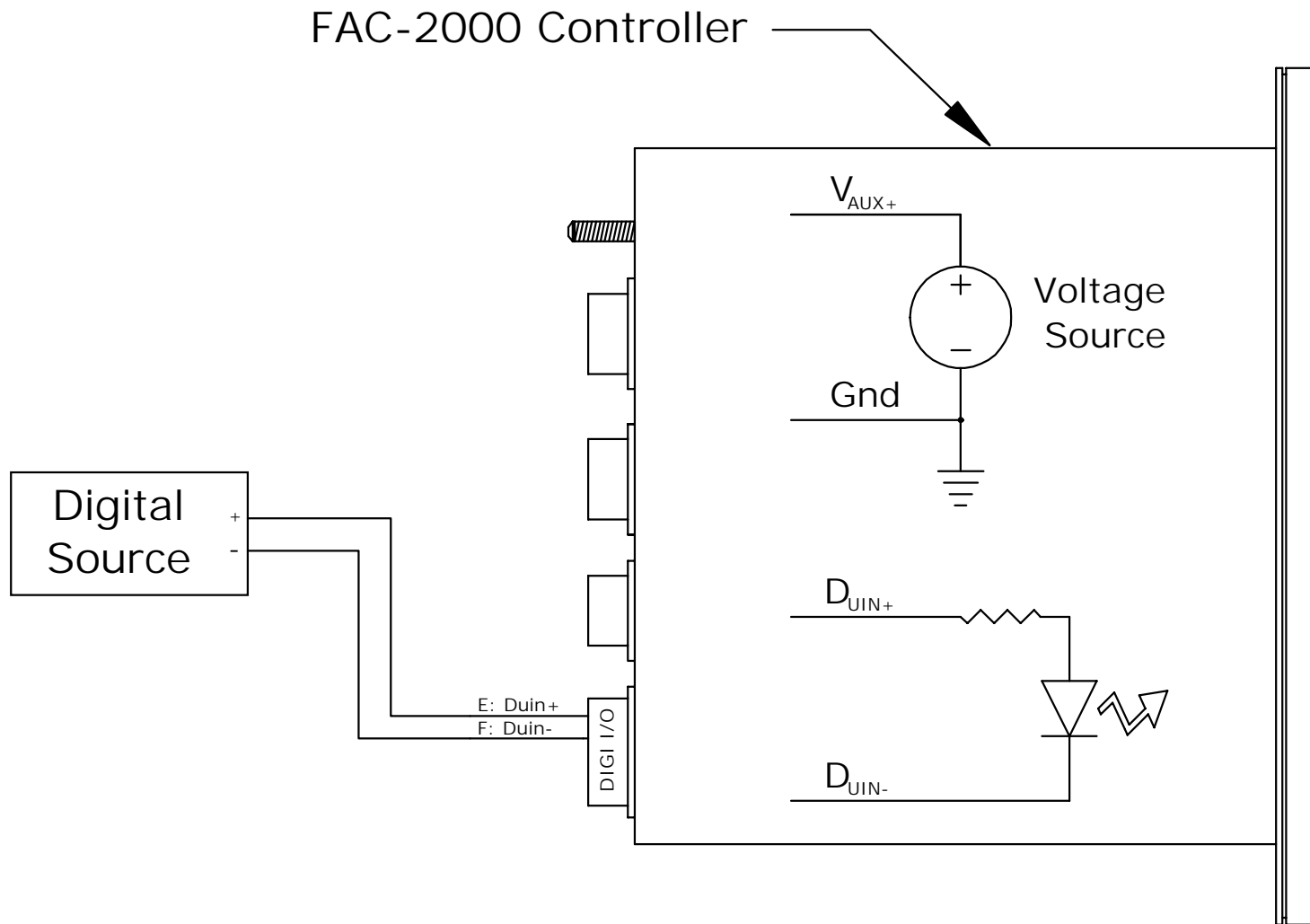


Figure 34 - Suggested universal digital input from a 5V digital source

Notes: The suggested wiring above uses universal digital input 1. Universal digital input 2 could be wired in a similar configuration.

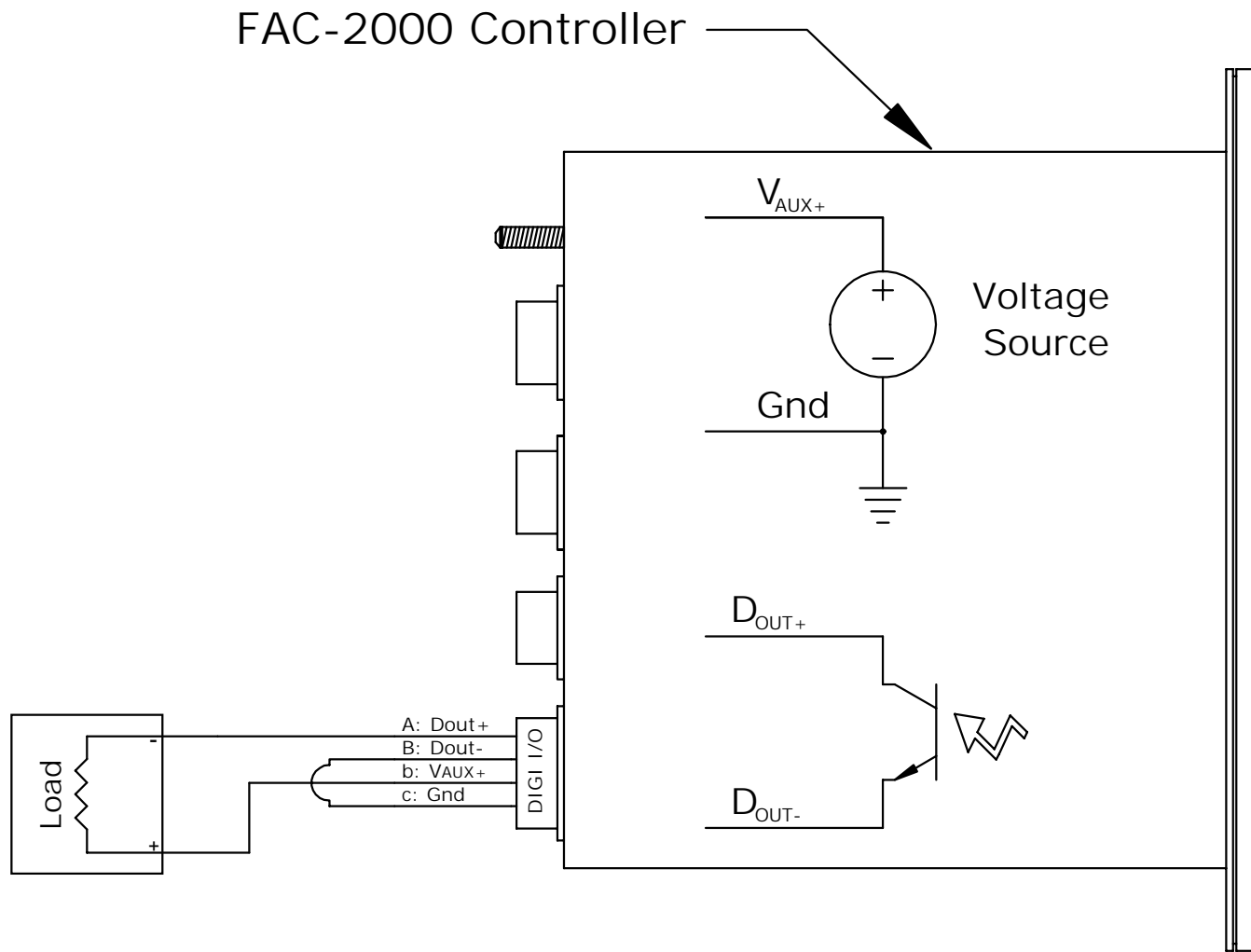


Figure 35 - Suggested digital output wiring

Notes: The suggested wiring above uses digital output 1. Digital output 2 could be wired in a similar configuration.

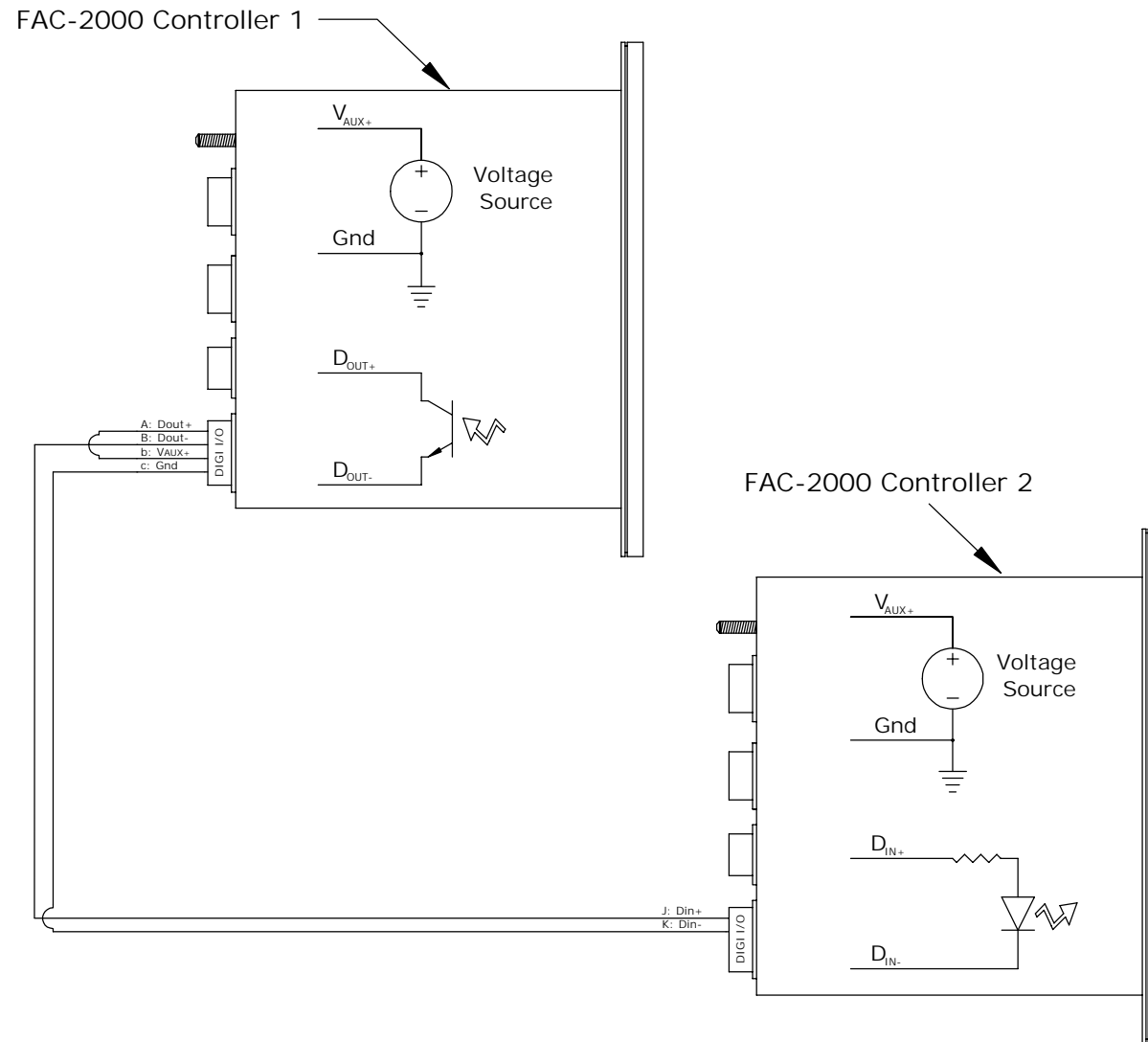


Figure 36 - Suggested wiring to transmit a digital signal from controller 1 to controller 2

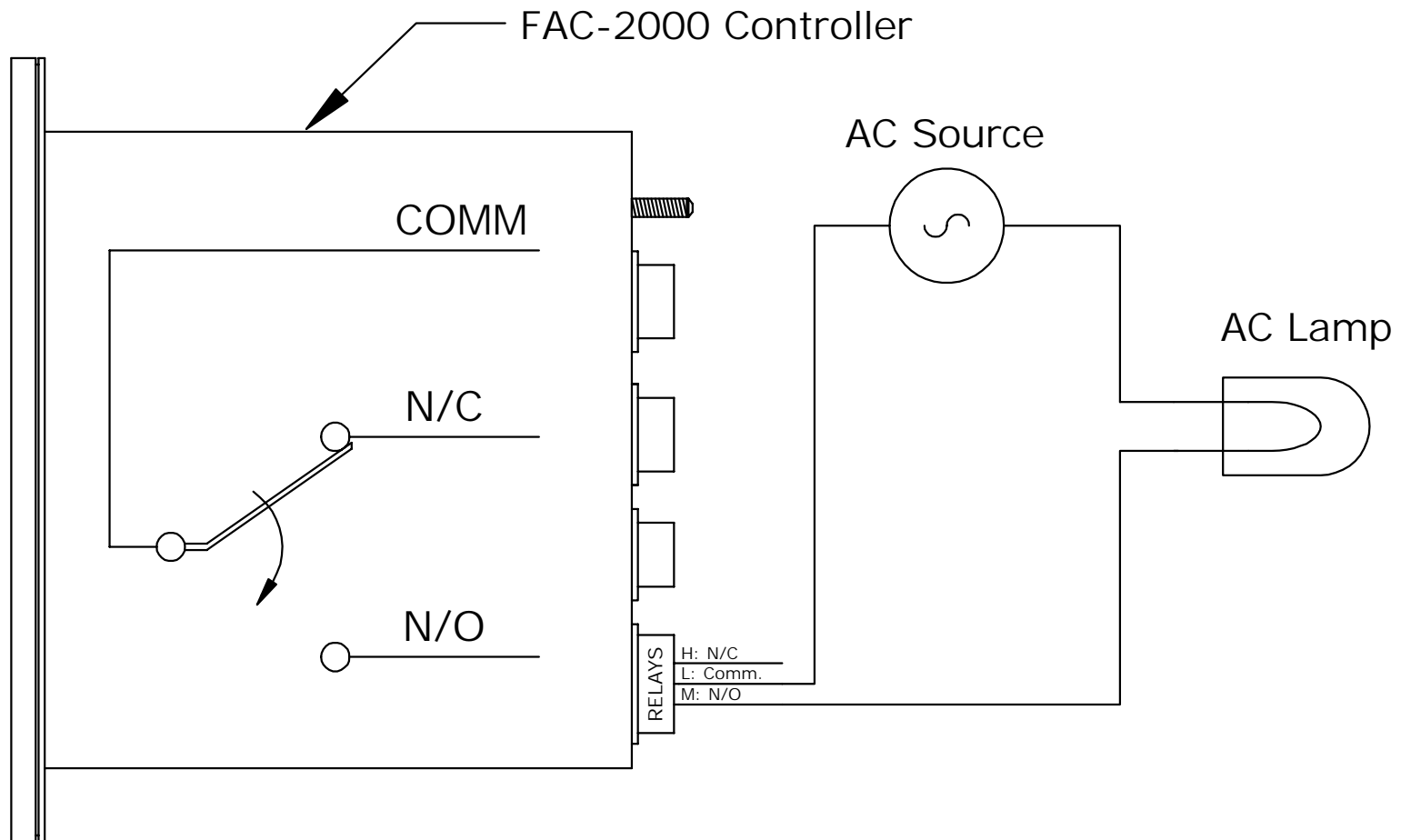


Figure 37 - Typical relay output wiring for a non-inductive load using the standard relay board

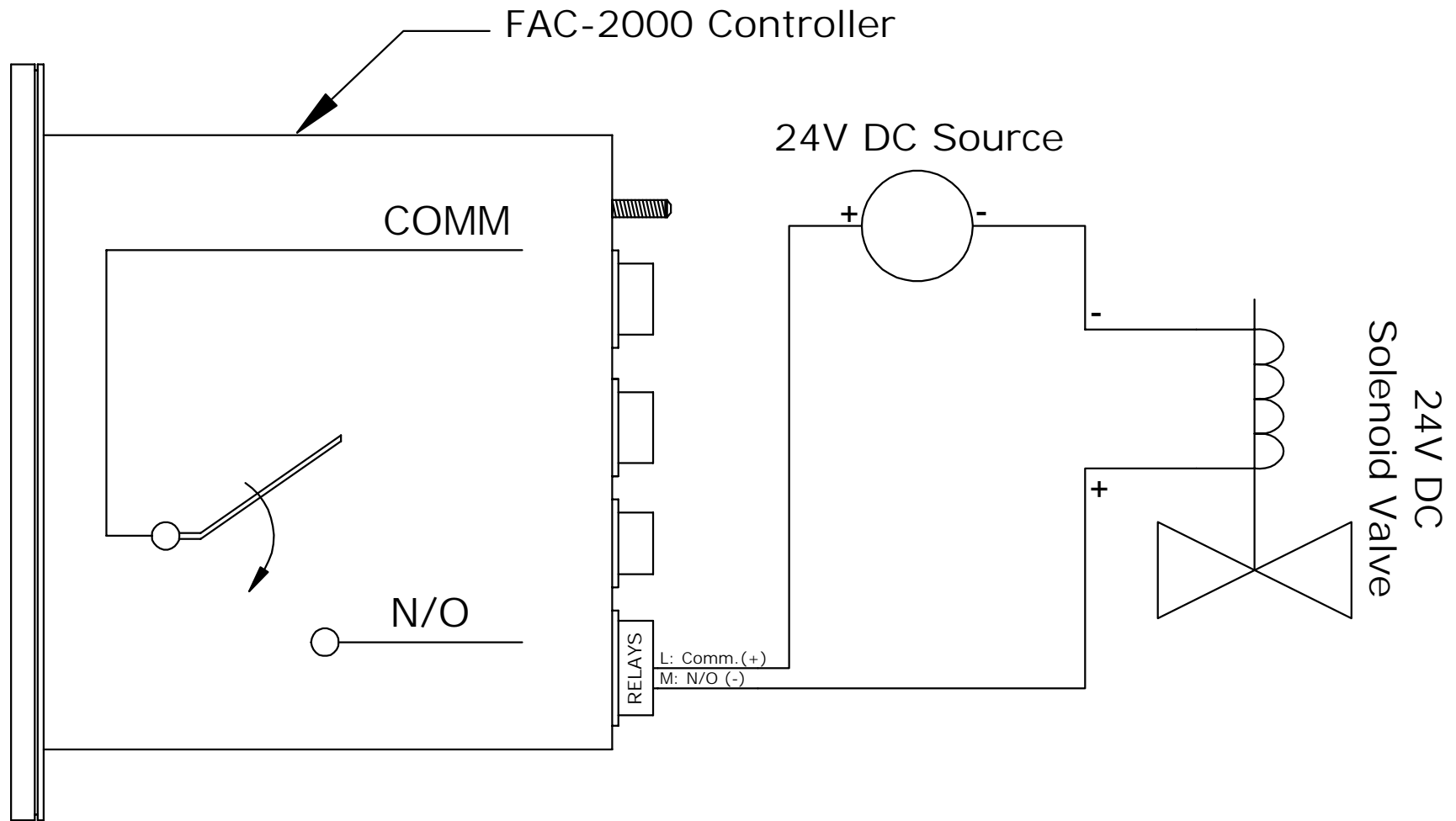


Figure 38 - Typical relay output wiring for a 24 volt DC inductive load using the enhanced relay board and a DC solid-state relay

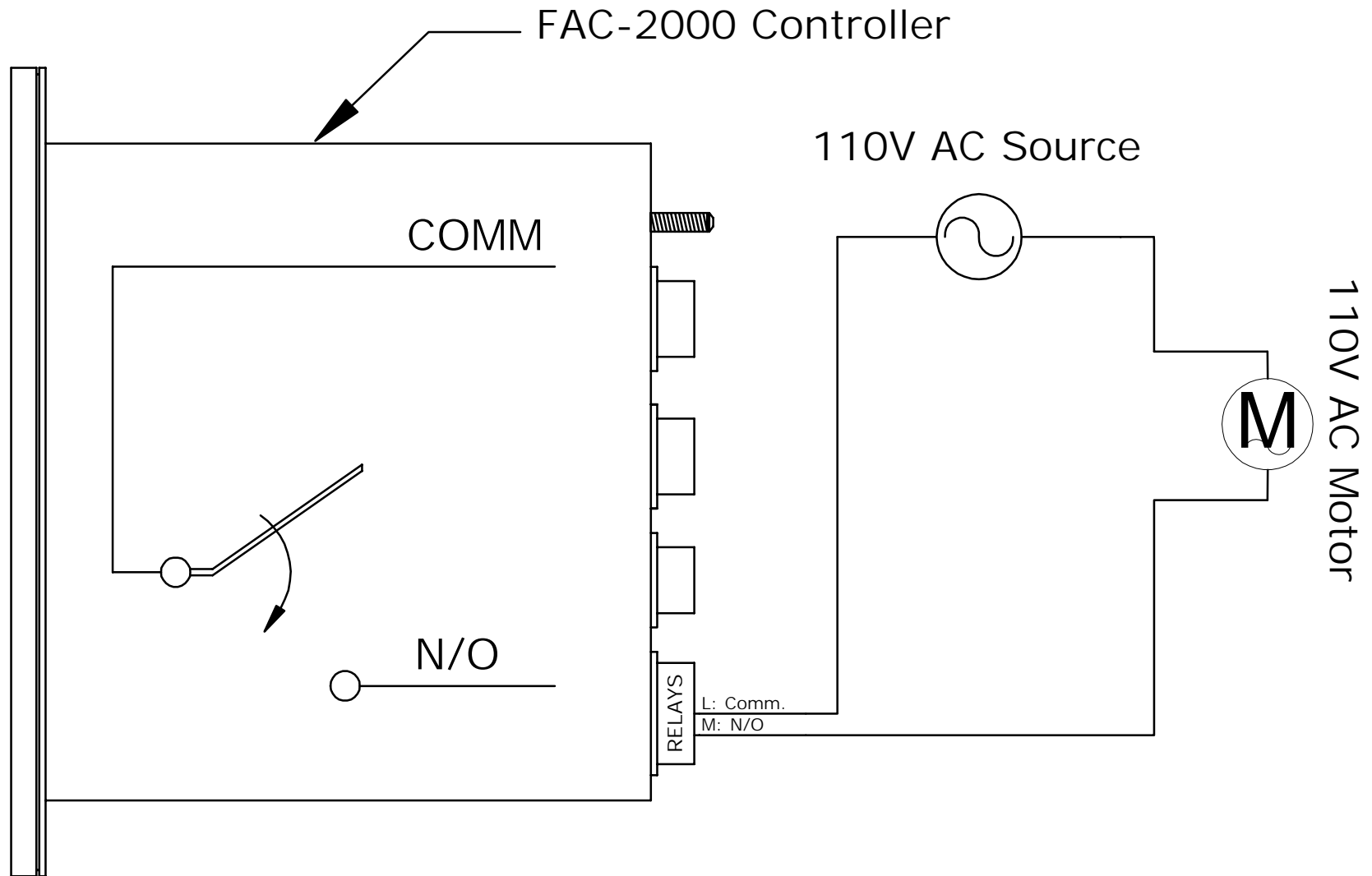


Figure 39 - Typical relay output wiring for an AC inductive load using the enhanced relay board and an AC solid-state relay

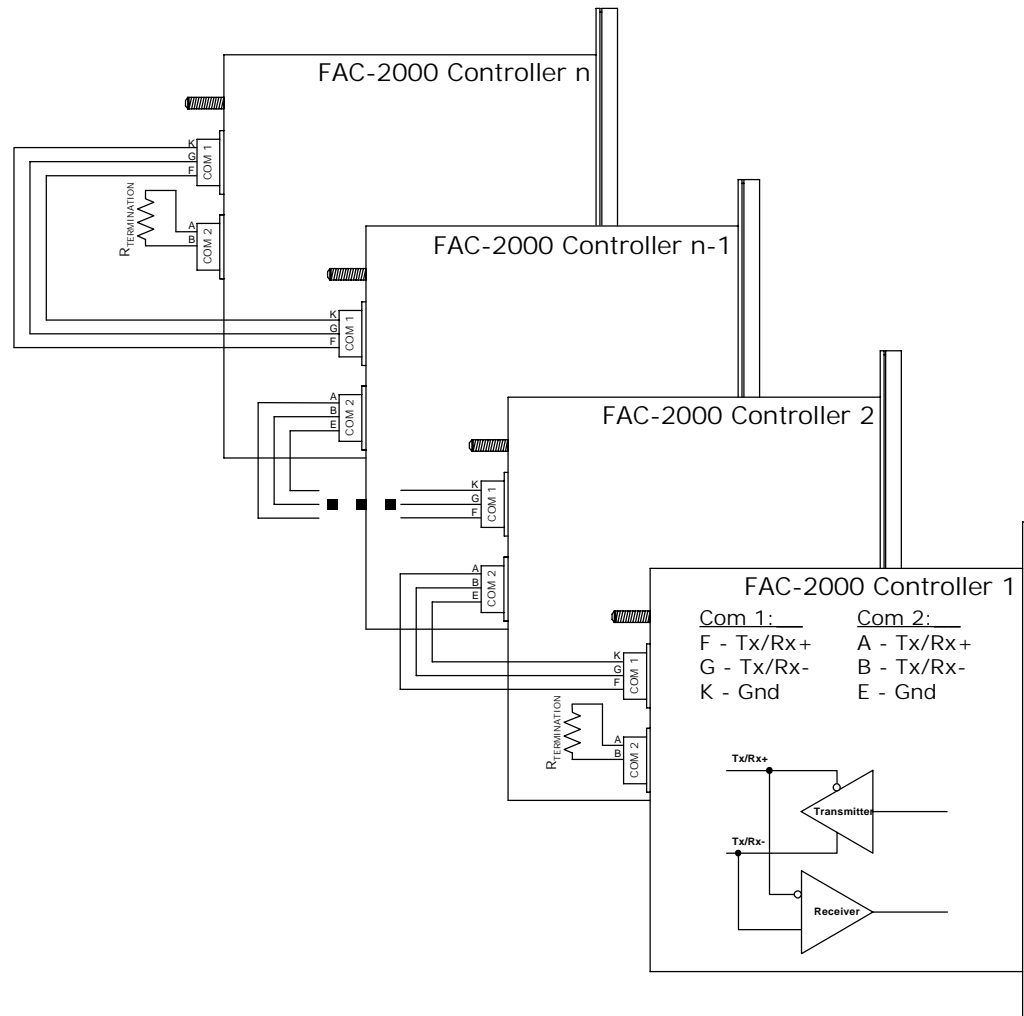


Figure 40 - Example RS-485 two-wire multi-drop FAC-2000 network

Note: $R_{\text{TERMINATION}}$ is typically between 100 and 120 ohms. See the section titled 'Networking' on page 19 for more information.

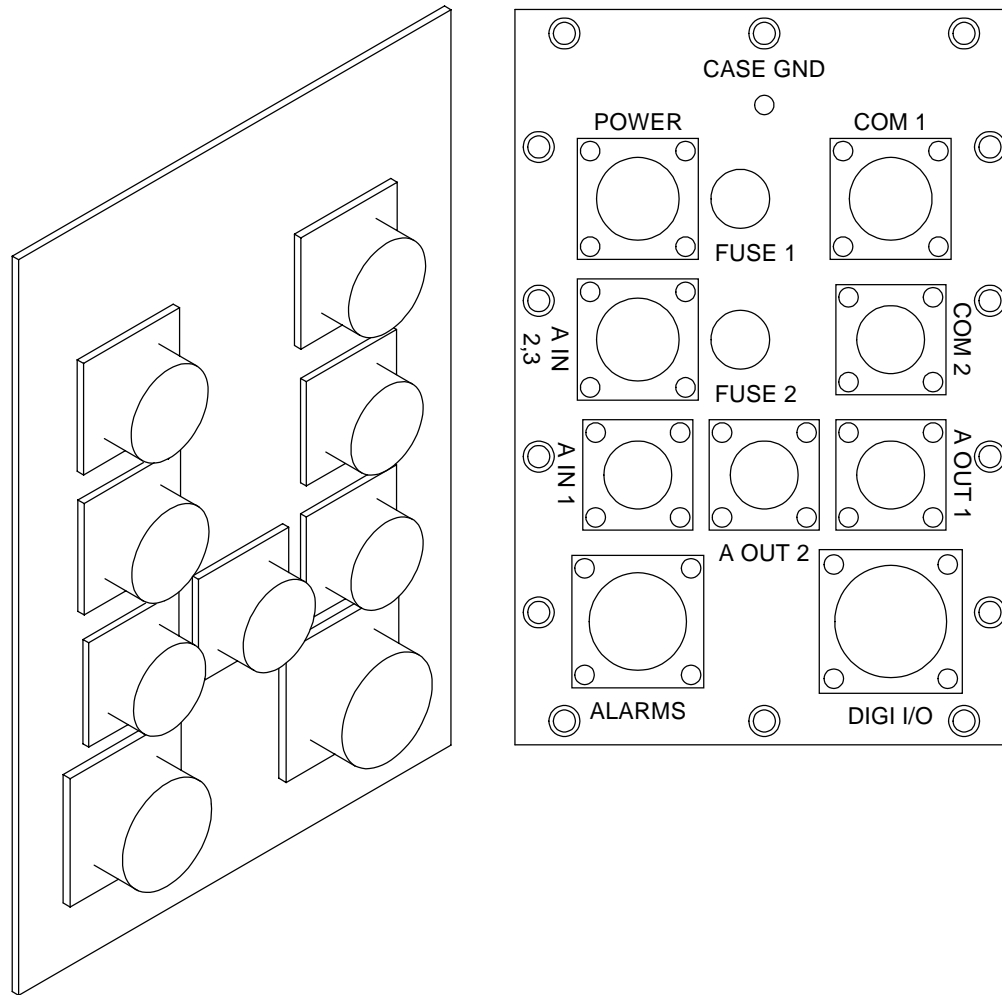


Figure 41 - Miniature cylindrical connector layout

Note: DC Model *FAC-2000* controllers contain only 1 fuse holder; AC models contain two.

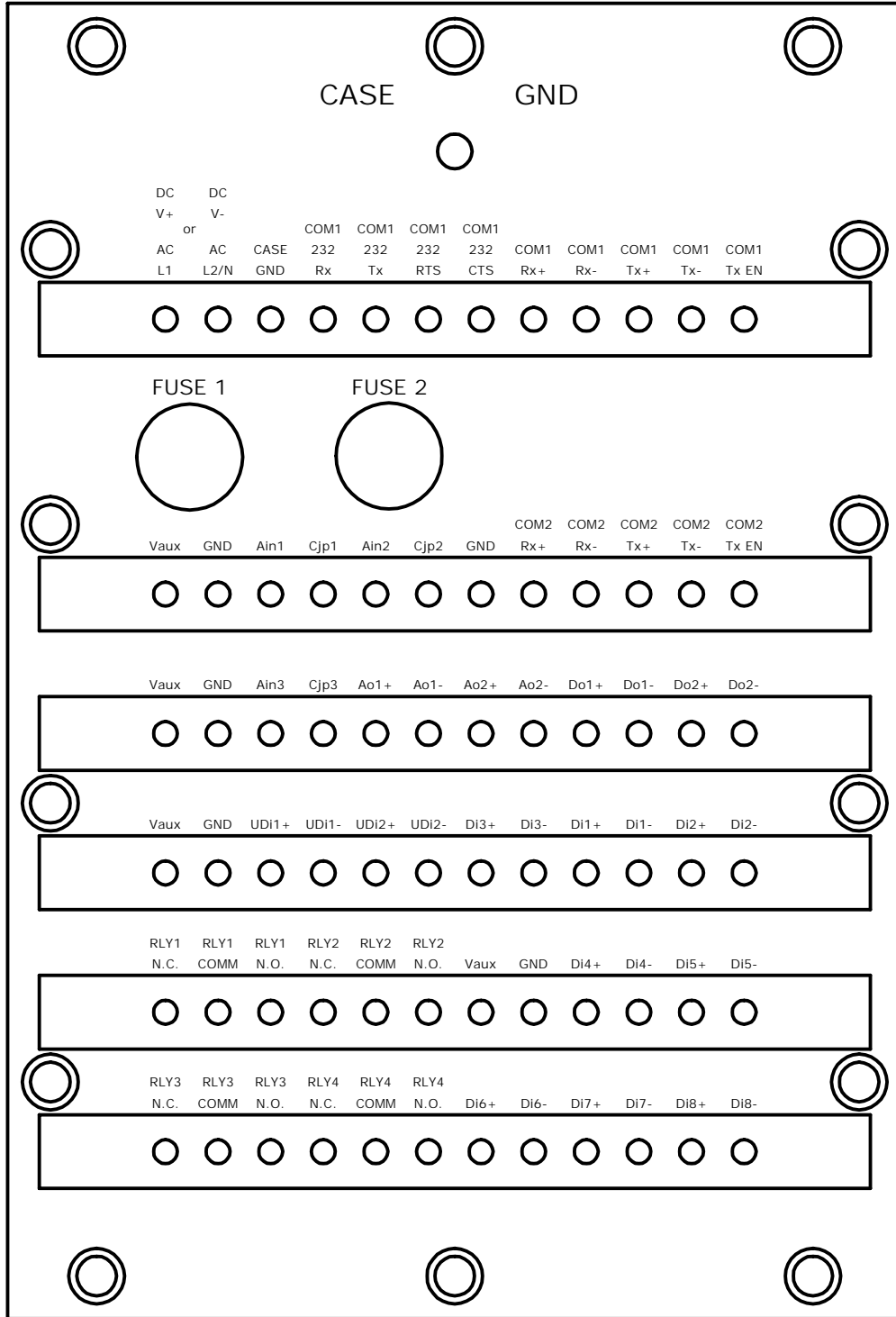


Figure 42 - Terminal board connector layout

Notes: All terminal board screws are size #2.

DC Model *FAC-2000* controllers contain only 1 fuse holder; AC models contain two.

5.2.1 Controller Accessories

The following miniature cylindrical connector shells should be used to mate with the FAC-2000's miniature cylindrical box mount connector receptacles:

Table 2 - Miniature cylindrical connector shell part numbers (crimp type)

Description	Fairmount Automation #	Amphenol #	MIL-C-26482, Series 1 #
DC Power Connector	30090-000	PT 06 SE 12-3 S SR	MS3126F123S
AC Power Connector	30090-001	PT 06 SE 12-3 S Y SR	MS3126F123SY
COM1 Connector	30090-002	PT 06 SE 12-10 P SR	MS3126F1210P
COM2 Connector	30090-003	PT 06 SE 10-6 S W SR	MS3126F106SW
Analog Input 1 Connector	30090-004	PT 06 SE 10-6 S SR	MS3126F106S
Analog Input 2-3 Connector	30090-005	PT 06 SE 12-8 S SR	MS3126F128S
Analog Output 1 Connector	30090-006	PT 06 SE 10-6 P W SR	MS3126F106PW
Analog Output 2 Connector	30090-007	PT 06 SE 10-6 P SR	MS3126F106P
Digital I/O Connector	30090-008	PT 06 SE 16-26 S SR	MS3126F1626S
Alarms Connector	30090-009	PT 06 SE 14-12 S SR	MS3126F1412S

Table 3 - Miniature cylindrical connector shell part numbers (solder type)

Description	Fairmount Automation #	Amphenol #	MIL-C-26482, Series 1 #
DC Power Connector	30090-020	PT 06 E 12-3 S SR	MS3116F123S
AC Power Connector	30090-021	PT 06 E 12-3 S Y SR	MS3116F123SY
COM1 Connector	30090-022	PT 06 E 12-10 P SR	MS3116F1210P
COM2 Connector	30090-023	PT 06 E 10-6 S W SR	MS3116F106SW
Analog Input 1 Connector	30090-024	PT 06 E 10-6 S SR	MS3116F106S
Analog Input 2-3 Connector	30090-025	PT 06 E 12-8 S SR	MS3116F128S
Analog Output 1 Connector	30090-026	PT 06 E 10-6 P W SR	MS3116F106PW
Analog Output 2 Connector	30090-027	PT 06 E 10-6 P SR	MS3116F106P
Digital I/O Connector	30090-028	PT 06 E 16-26 S SR	MS3116F1626S
Alarms Connector	30090-029	PT 06 E 14-12 S SR	MS3116F1412S

Use the following receptacle caps to cover all unused box mount connectors:

Table 4 - Miniature cylindrical connector receptacle cap part numbers

Description	Fairmount Automation #	Amphenol #	Base MS #
Shell Size 10 Protection Cap (ANALOG IN 1, ANALOG OUT 1, ANALOG OUT 2, COM 2)	30093-001	10-101960-10	MS3181-10
Shell Size 12 Protection Cap (DC POWER, AC POWER, COM1, ANALOG IN 2-3)	30093-002	10-101960-12	MS3181-12
Shell Size 14 Protection Cap (ALARMS)	30093-003	10-101960-14	MS3181-14
Shell Size 16 Protection Cap (DIGITAL I/O)	30093-004	10-101960-16	MS3181-16

Use the following sealing plugs for unused pins in the miniature cylindrical connector shells:

Table 5 - Miniature cylindrical connector sealing plug part numbers

Description	F.A. #	Amphenol #	MS #
Contact Size 16 Sealing Plug	30093-101	10-405996-16	MS27488-16
Contact Size 20 Sealing Plug	30093-102	10-405996-20	MS27488-20

Table 6 contains common parts used for RS-485 and RS-232 networking. Use the COM 1 to 9 and 25 pin D cable to export programs from a PC to the controller.

Table 6 – Networking Accessories

Description	Fairmount Automation #
COM 1 to 9 and 25 pin D RS-232 Serial Cable (5 ft.)	01004-000
RS-485 COM 1 to COM 2 Serial Cable (User Specified Length)	01005-000
RS-485 COM 2 Miniature Cylindrical Connector Termination Plug (110 Ω)	01006-000
RS-485 Isolator / Repeater	01011-000
RS-485 Network Biasing Terminator (110 Ω)	01012-000

5.2.2 Miniature Cylindrical Connector Pinout

Refer to Figure 41 for the miniature cylindrical connector layout on the back of the *FAC-2000*.

Power

A = DC V+ / AC Line 1

B = DC V- / AC Line 2

C = CASE GND

$A_{IN\ 1}$

A = A_{IN1+}

E = Ground

B = $A_{IN\ 1}$ Read Current JPA / Ground

F = Ground

C = V_{AUX+}

D = $A_{IN\ 1}$ Read Current JPB

$A_{IN\ 2,3}$

A = A_{IN2+}

E = A_{IN3+}

B = $A_{IN\ 2}$ Read Current JPA / Ground

F = $A_{IN\ 3}$ Read Current JPA / Ground

C = V_{AUX+}

G = V_{AUX+}

D = $A_{IN\ 2}$ Read Current JPB

H = $A_{IN\ 3}$ Read Current JPB

$A_{OUT\ 1}$

A = A_{OUT1+}

B = A_{OUT1-}

C = V_{AUX+}

D = Ground

$A_{OUT\ 2}$

A = A_{OUT2+}

B = A_{OUT2-}

C = V_{AUX+}

D = Ground

Digital I/O	A = D _{O1+}	J = D _{I1+}	T = D _{I5+}	b = V _{AUX+}
	B = D _{O1-}	K = D _{I1-}	U = D _{I5-}	c = Ground
	C = D _{O2+}	L = D _{I2+}	V = D _{I6+}	
	D = D _{O2-}	M = D _{I2-}	W = D _{I6-}	
	E = D _{UI1+}	N = D _{I3+}	X = D _{I7+}	
	F = D _{UI1-}	P = D _{I3-}	Y = D _{I7-}	
	G = D _{UI2+}	R = D _{I4+}	Z = D _{I8+}	
	H = D _{UI2-}	S = D _{I4-}	a = D _{I8-}	

Relays: (standard relay board only)	J = 1 N.C.*	A = 3 N.C.
	K = 1 COMM*	B = 3 COMM
	G = 1 N.O.	C = 3 N.O.
	H = 2 N.C.	D = 4 N.C.
	L = 2 COMM*	E = 4 COMM
	M = 2 N.O.*	F = 4 N.O.

*Denotes connector pins with a 4 amp carrying capacity; remaining pins are 1.5 amp.

Relays: (enhanced relay board only)	J = 3 COMM (+ DC)*	A = 1 N.C.
	K = 3 N.O. (- DC)*	B = 1 COMM
	G = 2 COMM (+ DC)	C = 1 N.O.
	H = 2 N.O. (- D.C.)	D = 4 N.C.
	L = 5 COMM (+ D.C.)*	E = 4 COMM
	M = 5 N.O. (-D.C.)*	F = 4 N.O.

*Denotes connector pins with a 3 amp carrying capacity; remaining pins can carry 1.5 amps. The current limit for the circuit may be smaller depending on the type of relays ordered. See sections 3.2.7 and 3.2.8 for more information.

Com1	A = 232 Rx	F = 485 Tx/Rx + or 422 Tx+
	B = 232 Tx	G = 485 Tx/Rx - or 422 Tx-
	C = 232 RTS	H = 422 Rx +
	D = 232 CTS	J = 422 Rx -
	E = Ground	K = Ground

Com2	A = 485 Tx/Rx + or 422 Tx+
	B = 485 Tx/Rx - or 422 Tx-
	C = 422 Rx +
	D = 422 Rx -
	E = Ground

6. PARTS LIST

See Figure 43 for an isometric exploded view of the controller and its components. Descriptions and part numbers of all the components referenced in the figure are shown below.

Table 7 - FAC-2000 parts list

Drawing Reference	Description	Fairmount Automation Part #
1	10-32 x 1 1/4" Socket Head Cap Screw SS	50010-007
2	Bezel	21001-000
3	Bezel Gasket	01001-007
4	Mounting Spacer	21011-000
5	Keypad	30070-000
6	8-32 x 3/8" Flat Undercut M/S SS	50010-004
7	Enclosure Front Plate	21002-000
8	7/16" 8-32 M-F Shock Mounts	50060-001
9	8-32 x 3/8" Phil MS SS	50010-001
10	User-Interface PC Board	11003-500
11	User-Interface Shock-Mount Bracket	21006-000
12	8-32 Kep Nut	50020-001
13	Enclosure Back Plate	21002-000
14	Connector Plate Gasket	01001-010
15	Connector Plate	21004-000
16	Miniature Cylindrical Connector Receptacles	See Table 8
17	Fuse Holders	30130-002**
18	Flange Gasket	01001-008
19	Console/Mounting Panel	
20	Locking Clamp	21005-000
21	6-32 X 1/4" Flat Undercut M/S SS	50010-006
22	Side Access Panel	21003-000
23	Side Access Panel Gasket	01001-009
24	Enclosure Access Panel Plate	21002-000
25	Standard Relay PC Board / Enhanced Relay PC Board	11002-500 / 11011-500
26	Enclosure Bottom Plate	21002-000
28	Enclosure Side Plate	21002-000
29	Input / Output PC Board	11004-500
30	Microprocessor PC Board	11005-500
31	Power Board 3/8" Flat Undercut M/S SS	50010-002
32	Enclosure Top Plate	21002-000
33	DC-DC Converter Thermal Pad	*
34	AC-DC Converter Thermal Pad	*
35	5V DC-DC Converter	*
36	Auxiliary Output DC-DC Converter	*
37	AC-DC Converter	*
38	Converter Mounting Brace	*
39	Power PC Board	*
40	DC-DC Converter Cross-Strap	*
41	AC-DC Converter Cross-Strap	*
42	4-40 x 15/32" Socket Head Cap Screw SS	*
43	Power Board Sealing Washers	50040-002
44	Relay and I/O Board Sealing Washers	50040-003

*See Table 12 for complete power board assemblies.

**See Table 11 for a listing of replacement fuses.

Table 8 - Miniature cylindrical connector box mount receptacle part numbers (solder type)

Description	F.A. #	Amphenol #	MIL-C-26482, Series 1#
DC Power Connector	30090-100	PT 02 E 12-3 P	MS3112E123P
AC Power Connector	30090-101	PT 02 E 12-3 P Y	MS3112E123PY
COM1 Connector	30090-102	PT 02 E 12-10 S	MS3112E1210S
COM2 Connector	30090-103	PT 02 E 10-6 P W	MS3112E106PW
Analog Input 1 Connector	30090-104	PT 02 E 10-6 P	MS3112E106P
Analog Input 2-3 Connector	30090-105	PT 02 E 12-8 P	MS3112E128P
Analog Output 1 Connector	30090-106	PT 02 E 10-6 S W	MS3112E106SW
Analog Output 2 Connector	30090-107	PT 02 E 10-6 S	MS3112E106S
Digital I/O Connector	30090-108	PT 02 E 16-26 P	MS3112E1626P
Alarms Connector	30090-109	PT 02 E 14-12 P	MS3112E1412P

Table 9 - Miniature cylindrical connector box mount receptacle part numbers (crimp type)

Description	F.A. #	Amphenol #	MIL-C-26482, Series 1#
DC Power Connector	30090-120	PT 02 SE 12-3 P	MS3122E123P
AC Power Connector	30090-121	PT 02 SE 12-3 P Y	MS3122E123PY
COM1 Connector	30090-122	PT 02 SE 12-10 S	MS3122E1210S
COM2 Connector	30090-123	PT 02 SE 10-6 P W	MS3122E106PW
Analog Input 1 Connector	30090-124	PT 02 SE 10-6 P	MS3122E106P
Analog Input 2-3 Connector	30090-125	PT 02 SE 12-8 P	MS3122E128P
Analog Output 1 Connector	30090-126	PT 02 SE 10-6 S W	MS3122E106SW
Analog Output 2 Connector	30090-127	PT 02 SE 10-6 S	MS3122E106S
Digital I/O Connector	30090-128	PT 02 SE 16-26 P	MS3122E1626P
Alarms Connector	30090-129	PT 02 SE 14-12 P	MS3122E1412P

Table 10 - Miniature cylindrical connector box mount gasket part numbers

Description	Fairmount Automation #	Amphenol #
Shell Size 10 Gasket (ANALOG IN 1, ANALOG OUT 1, ANALOG OUT 2, COM 2)	30093-201	10-101949-10
Shell Size 12 Gasket (DC POWER, AC POWER, COM1, ANALOG IN 2-3)	30093-202	10-101949-12
Shell Size 14 Gasket (ALARMS)	30093-203	10-101949-14
Shell Size 16 Gasket (DIGITAL I/O)	30093-204	10-101949-16

Table 11 - Replacement Fuses

Description	Fairmount Automation Part #
DC Powered Model fuses (1 required): 3 Amp, 250V, ¼ x 1¼", time-delay	30130-001
AC Powered Model fuses (2 required): ½ Amp, 250V, ¼ x 1¼", time-delay	30130-000

Table 12 - Complete power PC board assembly part numbers (with mounting hardware)

Controller Model	Description	Fairmount Automation Part Number
FAC-2000-AC-28	AC Input w/28V Output	11001-501
FAC-2000-DC-28	DC Input w/28V Output	11001-502
FAC-2000-DC-00	DC Input w/o 28V Output	11001-504

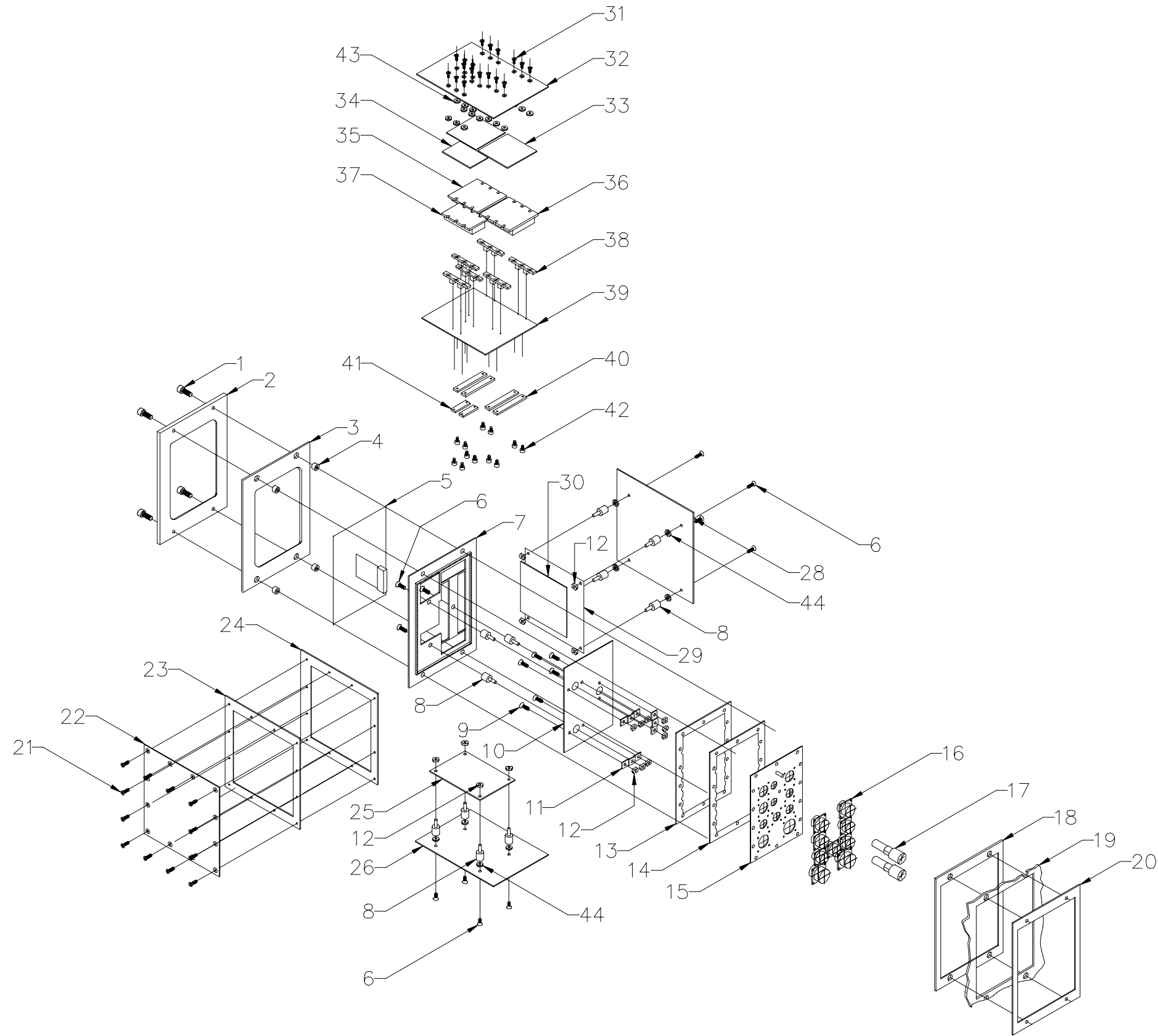


Figure 43 - FAC-2000 exploded isometric view

7.2 Enhanced Relay Board Special Feature Ordering Codes

MODEL FAC2000	Digital Process Controller					
⋮	CODE	Power Source and Auxiliary Output				
⋮	DC28	DC Power Input, 28V Auxiliary Power Output				
⋮	DC00	DC Power Input				
⋮	AC28	AC Power Input, 28V Auxiliary Power Output				
⋮	⋮	CODE	Connector Type			
⋮	⋮	C	Miniature Cylindrical Connectors			
⋮	⋮	T	Terminal Connectors			
⋮	⋮	⋮	⋮			
⋮	⋮	CODE	Other Special Feature			
⋮	⋮		No Special Feature			
⋮	⋮	R	Enhanced Relay Board			
⋮	⋮	D	Custom Display Board Color Combination			
⋮	⋮	X	With Other Special Feature – Specify			
⋮	⋮	⋮	⋮			
FAC2000	-		R			
⋮	⋮	⋮	⋮			
⋮	⋮	CODE	Relay #2 Type			
⋮	⋮	A	AC Solid State Relay			
⋮	⋮	D	DC Solid State Relay			
⋮	⋮	M	Mechanical Relay (Form A)			
⋮	⋮	⋮	⋮			
⋮	⋮	CODE	Relay #3 Type			
⋮	⋮	A	AC Solid State Relay			
⋮	⋮	D	DC Solid State Relay			
⋮	⋮	M	Mechanical Relay (Form A)			
⋮	⋮	⋮	⋮			
⋮	⋮	CODE	Relay #5 Type			
⋮	⋮	A	AC Solid State Relay			
⋮	⋮	D	DC Solid State Relay			
⋮	⋮	M	Mechanical Relay (Form A)			
⋮	⋮	⋮	⋮			
FAC2000-DC28-C	-	R	A	A	A	Enhanced relay board special feature example order

MODEL FAC2000	Digital Process Controller	
CODE	Power Source and Auxiliary Output	
DC28	DC Power Input, 28V Auxiliary Power Output	
DC00	DC Power Input	
AC28	AC Power Input, 28V Auxiliary Power Output	
CODE	Connector Type	
C	Miniature Cylindrical Connectors	
T	Terminal Connectors	
CODE	Other Special Feature	
	No Special Feature	
R	Enhanced Relay Board	
D	Custom Display Board Color Combination	
X	With Other Special Feature – Specify	

FAC2000 - - D

CODE	Alphanumeric Display Color	
Y	Yellow	
R	Red	
G	Green	
CODE	Left Bargraph Display Color	
G	Green	
Y	Yellow	
R	Red	
CODE	Right Bargraph Display Color	
R	Red	
G	Green	
Y	Yellow	
CODE	Top and Right Numeric Display Colors	
RY	Top Red, Right Yellow	
RR	Top Red, Right Red	
YR	Top Yellow, Right Red	
YY	Top Yellow, Right Yellow	
GG	Top Green, Right Green	
CODE	Bottom Numeric Display Color	
G	Green	
Y	Yellow	
R	Red	

FAC2000-DC28-C D Y G R RY G

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