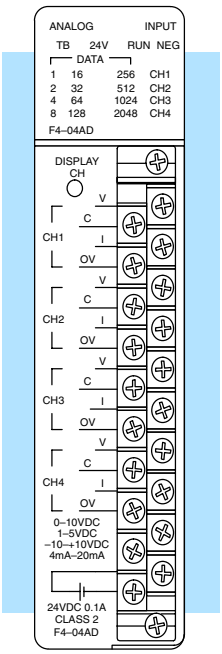
Module Specifications

The F4-04AD Analog Input module provides several features and benefits.

- It is a direct replacement for the popular D4-04AD module, when properly configured.
- It accepts four differential voltage or current inputs.
- Analog inputs are optically isolated from PLC logic components.
- The module has a removable terminal block, so the module can be easily removed or changed without disconnecting the wiring.
- All four analog inputs may be read in one CPU scan (DL440/450 CPUs only).
- Broken transmitter detection is provided for current inputs.





NOTE: If you are replacing a D4–04AD with a F4–04AD in an existing application, make sure to read the last section in this chapter, "Configuration Cross-Reference, D4–04AD to F4–04AD."

Analog Input Configuration Requirements

The F4–04AD Analog Input module requires either 16 or 32 discrete input points, depending on its operating mode (jumper selectable). The module can be installed in any slot of a DL405 system, including remote bases. The limitations on the number of analog modules are:

- For local and expansion systems, the available power budget and discrete I/O points are the limiting factors.
- For remote I/O systems, the available power budget and number of remote I/O points are the limiting factors.

Check the user manual for your particular model of CPU for more information regarding power budget and number of local or remote I/O points.

The following tables provide the specifications for the F4-04AD Analog Input Module. Review these specifications to ensure the module meets your application requirements.

Input Specifications

Number of Channels	4
Input Type	Single-ended or differential
Input Ranges	0–5, 1–5, 0–10, ±5, ±10 VDC, 0–20, 4–20 mA.
Resolution	12 bit (0 to 4095), unipolar 13 bit (±4095), bipolar
Input Impedance	20 MΩ minimum, voltage input 250 Ω, 1/2W, ±0.1%, 25 ppm/° C current input
Max. Continuous Overload	±50 VDC, voltage input, ±45 mA, current input
Recommended External Fuse	0.032A, Series 217 fast acting, current inputs
Common Mode Voltage Range	±10V maximum
Linearity	±0.025% of span (±1 count maximum, unipolar)
Input Stability	±1/2 count
Cross Talk	–80 dB, 1/2 count maximum
Full Scale Calibration Error	±12 counts maximum, voltage input ±16 counts maximum, at 20.000 mA current input
Offset Calibration Error	±1 count maximum, voltage input ±2 counts maximum, at 4.000 mA current input
Maximum Inaccuracy	0.4% maximum @ 25°C (77° F) 0.55% maximum @ 0 to 60°C (32 to 140° F)
Conversion Time	< 6 mS per selected channel
Noise Rejection Ratio	Normal mode: –3 dB @ 50 Hz, –6 dB / octave Common mode: –70 dB, DC to 12 kHz

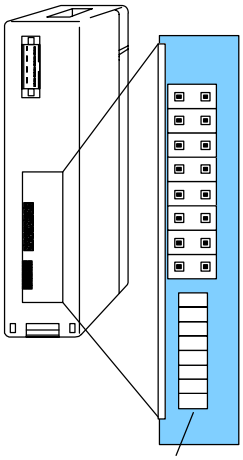
General Specifications

PLC Update Rate	4 channel per scan max.
Digital Input Points Required 16 or 32-bit mode	16 or 32 (X) input points 12 data bits, 4 bits optional for two's complement mode, 4 channel select bits, 12 bits unused in 32 bit mode
Power Budget Requirement	85 mA (power from base)
External Power Supply	24 VDC, ±10%, 100 mA, class 2
Operating Temperature	0 to 60°C (32° to 140° F)
Storage Temperature	–20 to 70°C (–4° to 158° F)
Relative Humidity	5 to 95% (non-condensing)
Environmental air	No corrosive gases permitted
Vibration	MIL STD 810C 514.2
Shock	MIL STD 810C 516.2
Insulation Resistance	10 MΩ, 500 VDC
Noise Immunity	NEMA ICS3-304

Setting the Module Jumpers

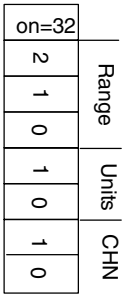
Jumper Locations

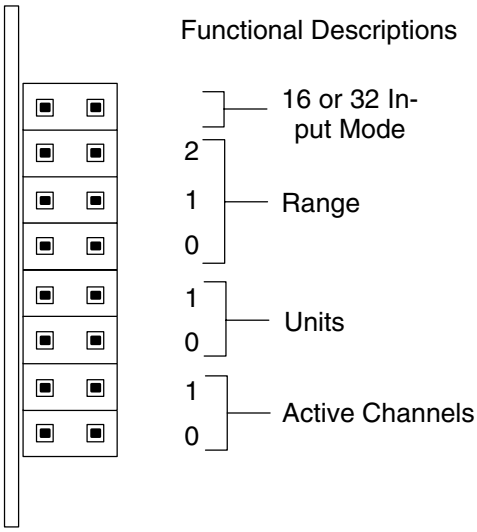
The module has several options that you can select by installing or removing jumpers. At the rear of the module is a bank of eight jumpers. They may be configured to select either 16 Input Mode or 32 Input Mode operation, input range selection, units of measurement selection and the number of channels enabled.



Jumper Descriptions

Jumper Descriptions (located below jumper on PC board)





NOTE: If you are replacing a D4–04AD module with the F4–04AD in an existing application, skip to the special section at the end of this chapter, “Configuration Cross-Reference, D4–04AD to F4–04AD”.

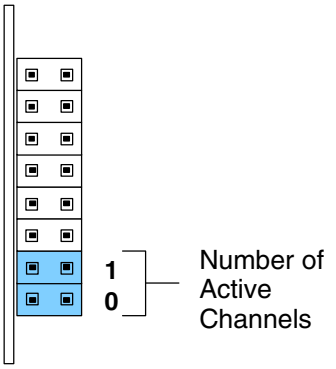
Factory Default Settings

By default, the module arrives from the factory with all jumpers installed. With all jumpers installed, the module has four active channels, is in 32 Input Mode, has 4 to 20 mA. input range, and the units of the data are 12-bit (0 to 4095) BCD numbers.

Selecting the Number of Active Channels

The F4-04AD module accepts from one to four analog inputs and converts the signal(s) to a desired format to send to the CPU. The bottom two jumpers (J7 and J8) select the number of channels enabled. The module only converts signals on channels that are enabled. If your application requires less than four signal inputs from this module, selecting fewer channels results in faster update times.

Use the following table to set jumpers.



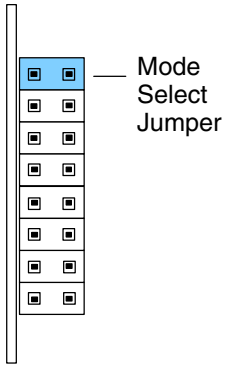
▪ ▪ = jumper removed

□□ = jumper installed

Channel(s) Selected	Jumper Settings
Channel 1	1 0
Channel 1, Channel 2	1 0
Channel 1, Channel 2, Channel 3	1 0
Channel 1, Channel 2, Channel 3, Channel 4	1 0

Selecting 16 Input or 32 Input Modes

The top jumper selects either 16 Input (remove jumper) or 32 Input (install jumper) operating modes. This is the number of X inputs the module requires in the PLC memory map. The module can interface to the CPU in two different ways, depending on the setting of this jumper. Use 32 Input mode if you want to maintain compatibility with PLC software written for the D4-04AD, or to use features not available in 16 Input mode, and to simplify supporting ladder logic. However, use 16 Input Mode if you must consume fewer X inputs. The feature chart on the next page can help you choose the mode for your application.



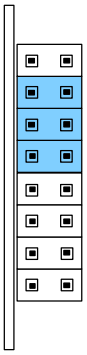
Mode	Jumper	I/O Points Consumed
16 Input	Remove	X0 – X17
32 Input	Install	X0 – X37

Features	16 Input Mode	32 Input Mode
Number of X Input Bits Required From CPU	16	32
Input Value, 12-Bit, Plus Sign Bit	Yes	Yes
Input Value, 2's Complement,12 Bits	No	Yes
Input Value, 2's Complement, 13 Bits	No	Yes
Input Value, 12-bit	Yes	Yes
Input Value, Binary-Coded Decimal, 16 bits (for bipolar voltage ranges only)	No	Yes
Active Channel Indicator Inputs	Yes	Yes
Broken Transmitter Detection	1 bit (combined)	4 bits (individual)
Sign Bit(s), indicates negative analog value	1 bit (combined)	4 bits (individual)

Based on this jumper selection, the module can behave as two different modules from the CPU point of view. This chapter covers both modes, so only the CPU program examples labeled for the mode you choose will apply.

Operating Range Selection
16 Input Mode

These three jumpers select the voltage or current range for all four input channels simultaneously. The type of input (voltage or current) is actually determined by user wiring to specific terminals on the front connector. Along with proper wiring, set these jumpers for the desired voltage or current signal range. The three jumpers are binary encoded to offer eight possible settings.



More input ranges are available for the module's 32 Input mode than for 16 Input mode. The following tables list the ranges for each of the modes.

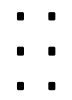
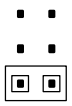
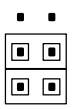
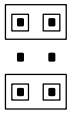
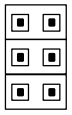
Input Range Selection, 16 Input Mode

Input Signal Range	Jumper Settings	Data Type and Range
(not used in 16 Input Mode)	2 1 0	
(not used in 16 Input Mode)	2 1 0	
–10 VDC to +10 VDC	2 1 0	12-Bit Magnitude Plus Sign Bit, (–4095 to +4095)
–5 VDC to +5 VDC	2 1 0	12-Bit Magnitude Plus Sign Bit, (–4095 to +4095)
0 VDC to +10 VDC	2 1 0	12-Bit Magnitude, (0 to 4095)
0 mA to 20 mA, or 0 VDC to +5 VDC	2 1 0	12-Bit Magnitude, (0 to 4095)
4 mA to 20 mA (*with* broken transmitter detection)	2 1 0	12-Bit Magnitude, (0 to 4095)
4 mA to 20 mA (*without* broken transmitter detection), or +1 VDC to +5 VDC	2 1 0	12-Bit Magnitude, (0 to 4095)

Operating Range Selection 32 Input Mode

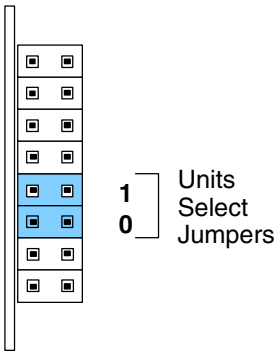
The module's 32 Input mode provides eight possible input range and data type combinations. Two of the bipolar ranges are dedicated to BCD data type. The other six input signal ranges convert to various data types and ranges (selected by the units select jumpers).

Input Range Selection, 32 Input Mode

Input Signal Range	Jumper Settings	Data Type and Range
–10 VDC to +10 VDC		Binary-Coded Decimal, (–9999 to +9999)
–5 VDC to +5 VDC		Binary-Coded Decimal, (–5000 to +5000)
–10 VDC to +10 VDC		Set by Units Select jumpers
–5 VDC to +5 VDC		Set by Units Select jumpers
0 VDC to +10 VDC		Set by Units Select jumpers
0 mA to 20 mA, or 0 VDC to +5 VDC		Set by Units Select jumpers
4 mA to 20 mA (*with* broken transmitter detection)		Set by Units Select jumpers
4 mA to 20 mA (*without* broken transmitter detection), or +1 VDC to +5 VDC		Set by Units Select jumpers

Units Selection for 32 Input Mode

The two jumpers for units selection determine the data format of the digital values of the channel inputs. They only apply to 32 Input mode operation, so the module ignores the position of these jumpers during 16 Input mode operation. The two jumpers are binary encoded to offer four possible settings. The units selection programmed by these jumpers applies simultaneously to all four input channels, and to all 32 Input Mode input signal ranges except the two bipolar BCD ranges. In those ranges, the module ignores the units select jumper settings.



The first two selections in the table offer more resolution than the last two selections, which are included for compatibility with previous application software. Accordingly, they are not recommended for new applications. After setting the configuration jumpers, you are ready to install the module in the base and connect the field wiring.

When you power up the module for the first time, if the jumper configuration is invalid the RUN light on the module's faceplate will NOT turn on and the Channel 1 LED will flash quickly. If this occurs, review this section and verify that the jumper settings are correct.



NOTE: If you are replacing a D4-04AD module with the F4-04AD in an existing application, skip to the special section at the end of this chapter, "Configuration Cross-Reference, D4-04AD to F4-04AD".

Units Selection for 32 Input Mode	Jumper Settings	Notes
12-Bit Magnitude Plus Sign, 13 Bit Format, –4095 to +4095	▪ ▪ 1 ▪ ▪ 0	Recommended for most applications
2's Complement, 13-Bit Format	▪ ▪ 1 ▣ ▣ 0	Recommended two's complement format
2's Complement, 12-Bit Format	▣ ▣ 1 ▪ ▪ 0	Not recommended for new applications
12-Bit Magnitude, 0 to 4095	▣ ▣ 1 ▣ ▣ 0	Not recommended for new applications

Connecting the Field Wiring

Wiring Guidelines

Your company may have guidelines for wiring and cable installation. If so, you should check those before you begin the installation. Here are some general things to consider.

- Use the shortest wiring route whenever possible.
- Use shielded wiring and ground the shield at the transmitter source. *Do not* ground the shield at both the module and the source.
- Don't run the signal wiring next to large motors, high current switches, or transformers. This may cause noise problems.
- Route the wiring through an approved cable housing to minimize the risk of accidental damage. Check local and national codes to choose the correct method for your application.
- Unused inputs must be shorted to help reduce the effects of electrical noise (see the wiring diagram for an example).

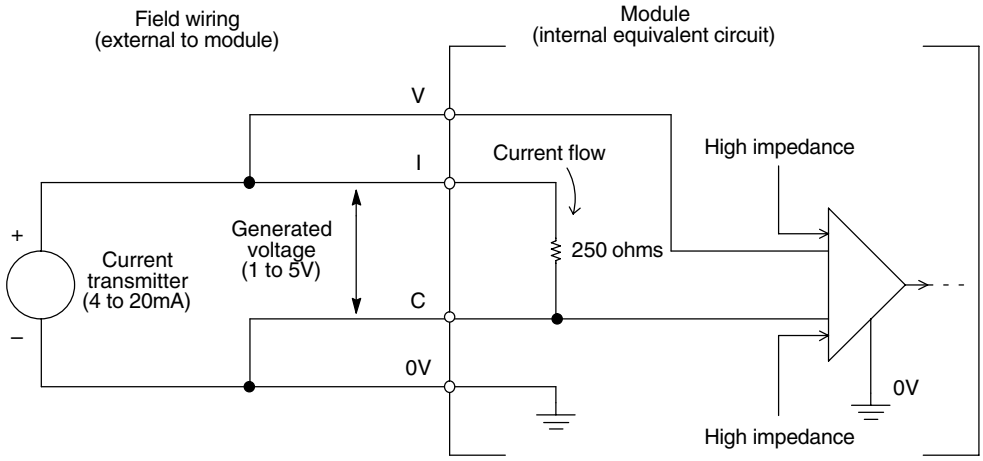
User Power Supply Requirements

The F4-04AD requires a separate power supply for the isolated (field) side of the module. The Series DL405 CPUs, D4-RS Remote I/O Controller, and D4-EX Expansion Units have built-in 24 VDC power supplies that provide up to 400mA of current. If you only have a couple of analog modules, you can use this power source instead of a separate supply. If you have more than four analog modules, or you would rather use a separate supply, choose one that meets the following requirements: 24 VDC ±10%, Class 2, 100 mA current (per module).

Using Current or Voltage Wiring

Even though you cannot select different ranges or units for each channel, you can still wire each individual channel for voltage or current signals. For example, even though you select a 1 to 5V range with the jumpers, you can still use a transmitter that provides a 4-20 mA signal.

The module uses a 250 ohm precision resistor to convert the current signals to voltage for you (4mA x 250 ohms = 1V, 20mA x 250 ohms = 5V). The following diagram shows how this works. Notice that the voltage (V) and (I) input terminals are connected together.



Current Loop Transmitter Impedance

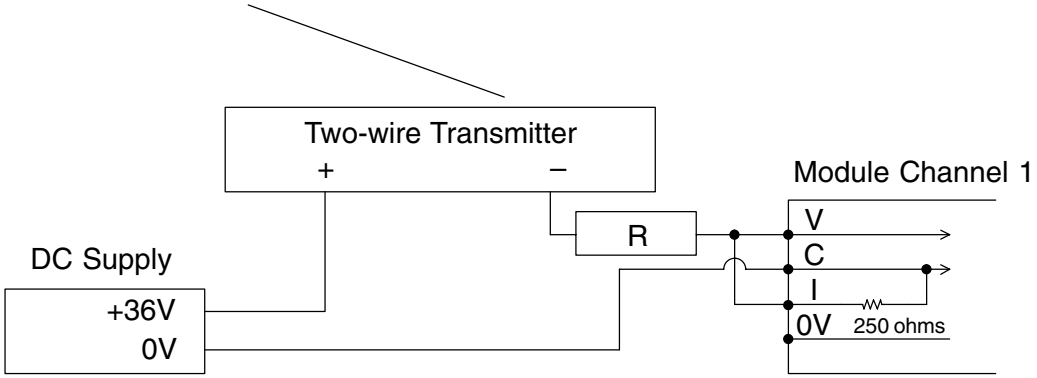
Standard 4 to 20 mA transmitters and transducers can operate from a wide variety of power supplies. Not all transmitters are alike and the manufacturers often specify a minimum loop or load resistance that must be used with the transmitter.

The F4-04AD provides 250 ohm resistance for each channel. If your transmitter requires a load resistance below 250 ohms, you do not have to make any adjustments. However, if your transmitter requires a load resistance higher than 250 ohms, you need to add a resistor in series with the module.

Consider the following example for a transmitter being operated from a 36 VDC supply with a recommended minimum load resistance of 750 ohms. Since the module has a 250 ohm resistor, you need to add an additional resistor.

$R = Tr - Mr$
$R = 750 - 250$
$R \geq 500$

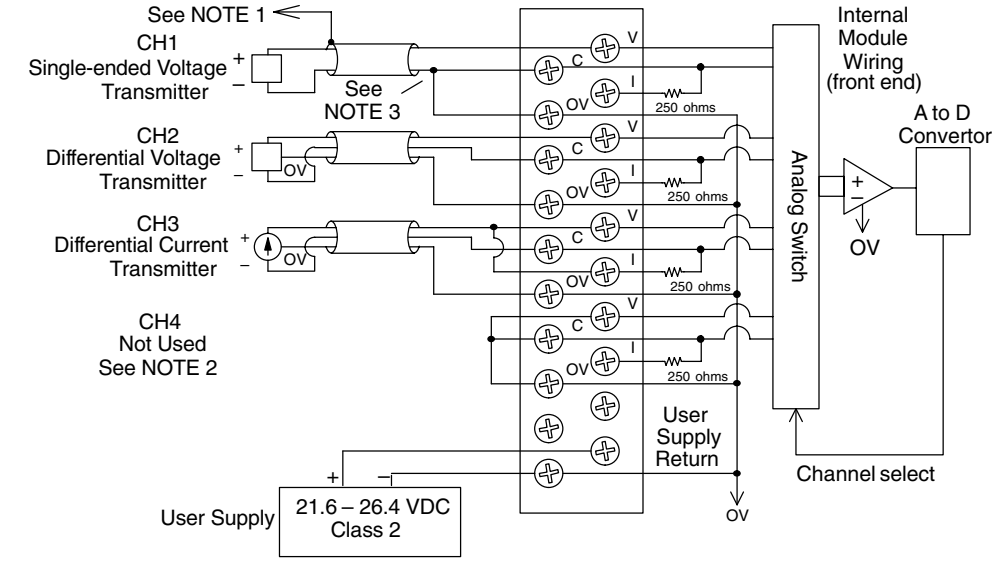
R – resistor to add
Tr – Transmitter Requirement
Mr – Module resistance (internal 250 ohms)

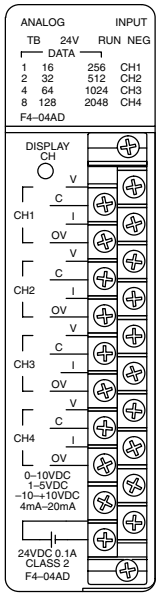


Wiring Diagram

The F4-04AD module has a removable connector to make wiring easier. Simply remove the retaining screws and gently pull the connector from the module.

NOTE 1: Shields should be grounded at the signal source.
NOTE 2: Unused channels should be shorted for best noise immunity.
NOTE 3: When a differential input is not used, 0V should be connected to C of the channel.



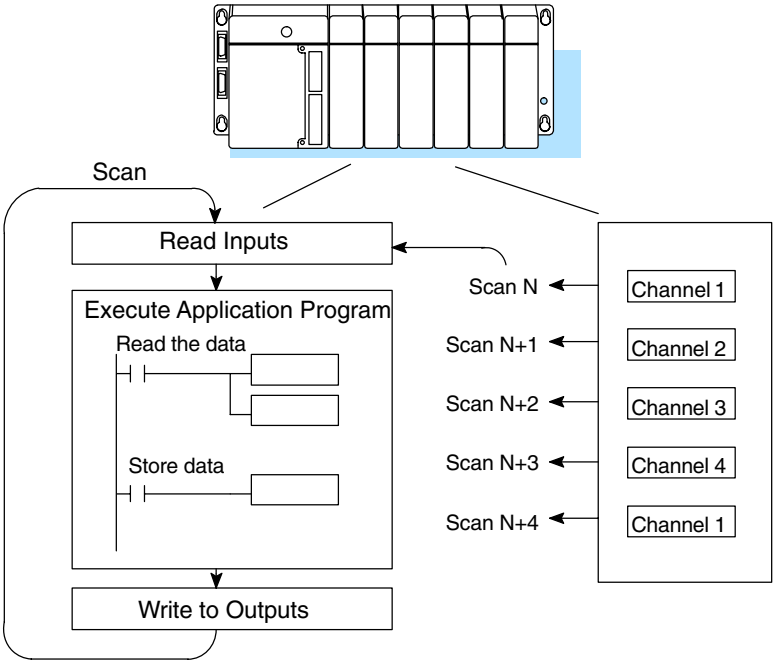


Before you begin writing the control program, it is important to take a few minutes to understand how the module processes and represents the analog signals.

Channel Scanning Sequence

The F4-04AD module supplies one channel of data per each CPU scan. This is true for both 16 Input and 32 Input Modes. Since there are four channels, it can take up to four scans to get data for all channels. Once all channels have been scanned the process starts over with channel 1.

Unused channels are not processed, so if you select only two channels, then each channel will be updated every other scan.



Even though channel updates to the CPU are synchronous with the CPU scan, the module asynchronously monitors the analog transmitter signal and converts the signal to a 12-bit binary representation. This enables the module to continuously provide accurate measurements without slowing down the discrete control logic in the RLL program.

Displaying Diagnostic Data

At the top of the module's faceplate, LED indicators display information for the selected channel. The top row of LEDs display diagnostic information. The TB indicator turns on when the module senses a loose terminal block. The 24V indicator turns on when the external 24V supply voltage is low or not connected. The RUN LED flashes on and off only if the jumper configuration is valid, and the module's internal diagnostics have passed. If the jumper configuration is incorrect the RUN LED remains off. During normal operation, the RUN indicator flashes on and off continuously at approximately a one second rate. The NEG light turns on if the voltage or current input to the selected channel is negative.