

# Getting Started

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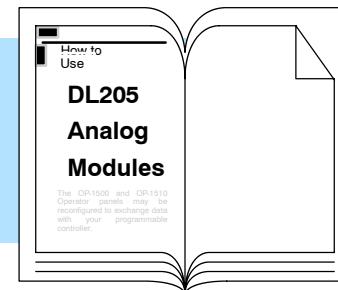
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  - Conventions Used
  - Physical Characteristics
  - Analog Input Module Terminology
  - Analog Output Module Terminology
  - Selecting the Appropriate Module
  - Analog Made Easy - Four Simple Steps
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## Introduction

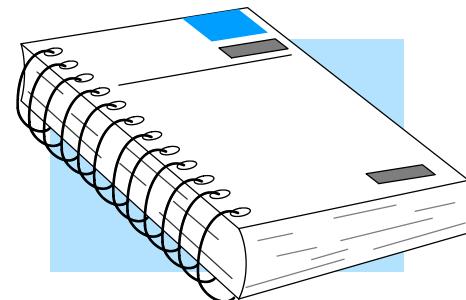
### The Purpose of this Manual

This manual will show you how to select and install analog input and analog output modules. It also shows several ways to use the analog data in your PLC program. If you understand the DL205 instruction set and system setup requirements, this manual will provide the information you need to install and use the analog modules. This manual *is not* intended to be a tutorial on analog signal theory, but rather a user reference manual for the DL205 Analog I/O modules.



### Supplemental Manuals

You may also want to have a copy of the DL205 User Manual (D2-USER-M) at hand when you are working with the analog modules. The DL205 User Manual is not absolutely necessary, but it does provide detailed descriptions of the instructions used to acquire the analog data. The User Manual also provides a more thorough description of how the I/O points are assigned to the module. Now, you have the material necessary to quickly understand the DL205 Analog I/O modules. So, let's get started!



### Technical Support

We realize that even though we strive to be the best, we may have arranged our information in such a way you cannot find what you are looking for. First, check these resources for help in locating the information:

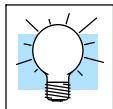
- **Table of Contents** – chapter and section listing of contents, in the front of this manual
- **Appendices** – reference material for key topics, near the end of this manual

You can also check our online resources for the latest product support information:

- **Internet** – Our address is <http://www.automationdirect.com>

If you still need assistance, please call us at 770-844-4200. Our technical support group is glad to work with you in answering your questions. They are available Monday through Friday from 9:00 A.M. to 6:00 P.M. Eastern Standard Time. If you have a comment or question about any of our products, services, or manuals, please fill out and return the 'Suggestions' card that was shipped with this manual.

## Conventions Used



When you see the “light bulb” icon in the left-hand margin, the paragraph to its immediate right will give you a **special tip**.

The word **TIP:** in boldface will mark the beginning of the text.



When you see the “notepad” icon in the left-hand margin, the paragraph to its immediate right will be a **special note**.

The word **NOTE:** in boldface will mark the beginning of the text.

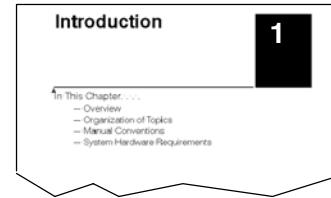


When you see the “exclamation mark” icon in the left-hand margin, the paragraph to its immediate right will be a **warning**. This information could prevent injury, loss of property, or even death (in extreme cases).

The word **WARNING:** in boldface will mark the beginning of the text.

### Key Topics for Each Chapter

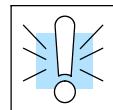
The beginning of each chapter will list the key topics that can be found in that chapter.



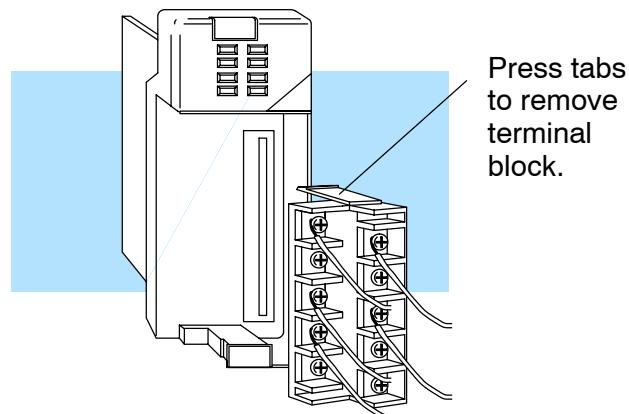
## Physical Characteristics

The DL205 Analog Modules provide many features that make the modules easy to use. With the exception of the Thermocouple module, the terminal blocks are removable, which makes wiring a simple task.

All of the DL205 analog modules have normal screw terminal connectors. Access the module terminals by removing the front cover (not shown). To remove the front cover, press the tab on the lower front corner of the cover. For ease of removal, the terminal blocks have squeeze tabs on the top and bottom. To remove a terminal block, press the tabs and pull the terminal block away from the module.



**WARNING:** For some modules, field device power may still be present on the terminal block even though the PLC system is turned off. To minimize the risk of electrical shock, check all field device power *before* you remove the connector.



## Analog Input Module Terminology

We use several different terms throughout the rest of this manual. You do not have to be an expert on analog terms to use the products, but it may help make it easier to select the appropriate modules if you take a few minutes to review these definitions.

|                                 |   |
|---------------------------------|---|
| <b>Channels per Module</b>      | The total number of analog signals the module receives from field devices.  |
| <b>Input Ranges</b>             | The minimum to maximum spans in voltage or current the module will successfully convert to digital values.  |
| <b>Resolution</b>               | The number of binary weighted bits available on the digital side of the module for use in converting the analog value to a digital value.   |
| <b>Input Type</b>               | Specifies if the module accepts single ended, or differential input signals.  |
| <b>Input Impedance</b>          | The resistive load of the module as seen by a voltage or current input signal.  |
| <b>Conversion Method</b>        | The method the module uses to convert the analog signal to a digital value.   |
| <b>PLC Update Rate</b>          | Speed at which the analog signals are digitized and acknowledged in the PLC.  |
| <b>Linearity Error</b>          | The relative accuracy of the digital representation over the entire input range.  |
| <b>Maximum Inaccuracy</b>       | Maximum absolute error of the digital representation of the signal over the entire input range. Factors which contribute to maximum inaccuracy are also specified separately. These factors are full-scale calibration error, offset calibration error, and accuracy vs. temperature. |
| <b>Accuracy vs. Temperature</b> | The variations in the module's conversion accuracy with temperature over the module's operating temperature range.  |
| <b>I/O Points Required</b>      | The number of I/O points the CPU must dedicate to the module.   |
| <b>External Power Source</b>    | Some modules require a separate 12VDC or 24VDC power source. The 24VDC output supply at the local base can be used as long as you do not exceed the current ratings of 300mA.   |
| <b>Base Power Required</b>      | The amount of base current required by the module. Use this value in your power budget calculations.  |
| <b>Operating Temperature</b>    | The minimum and maximum temperatures the module will operate within.  |
| <b>Relative Humidity</b>        | The minimum and maximum humidity the module will operate within.  |
| <b>Step Response</b>            | The time required for an analog input to reach 95% of its final value at the converter following a step change in the input signal level.   |

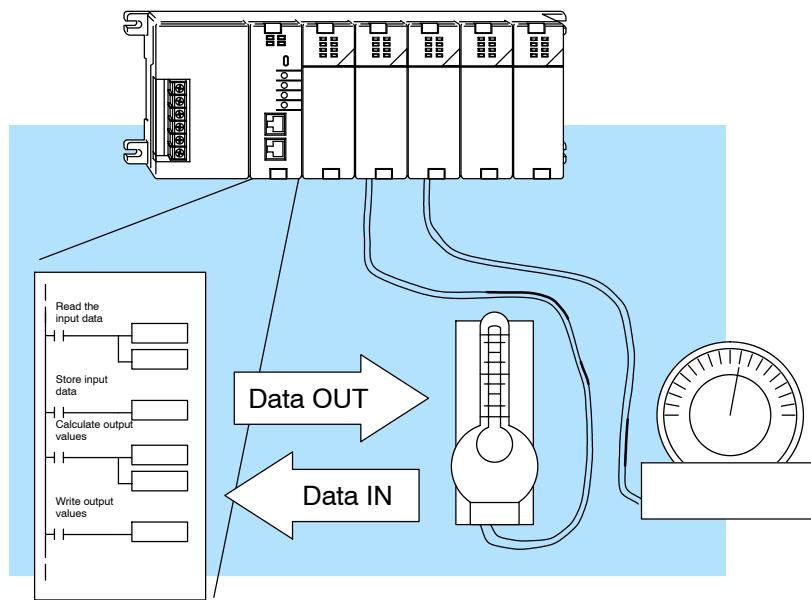
## Analog Output Module Terminology

|                                 |   |
|---------------------------------|---|
| <b>Channels per Module</b>      | The total number of analog signals the module sends to field devices.   |
| <b>Output Ranges</b>            | The minimum to maximum spans in voltage or current the module outputs, converted from digital values.   |
| <b>Resolution</b>               | The number of binary weighted bits available on the digital side of the module for use in converting the digital value to an analog signal.   |
| <b>Output Current</b>           | The maximum current the module will drive using a voltage output signal.  |
| <b>Output Impedance</b>         | The output impedance of the module using a voltage output signal.   |
| <b>Load Impedance</b>           | The minimum and maximum resistance the module can drive, specified for current and voltage output signals.  |
| <b>PLC Update Rate</b>          | The speed at which digital values in the PLC are converted to analog output signals.  |
| <b>Linearity Error</b>          | The relative accuracy of the digital representation over the entire output range.   |
| <b>Maximum Inaccuracy</b>       | Maximum absolute error of the digital representation of the signal over the entire output range. Factors which contribute to maximum inaccuracy are also specified separately. These factors are full-scale calibration error, offset calibration error, and accuracy vs temperature. |
| <b>Accuracy vs. Temperature</b> | The variations in the module's conversion accuracy with temperature over the module's operating temperature range.  |
| <b>External Power Source</b>    | All output modules contain circuitry which is optically isolated from PLC-side logic. That circuitry requires field-side power from a separate 24VDC power source. The 24VDC output supply at the local base can be used as long as you do not exceed the current ratings.            |
| <b>Base Power Required</b>      | The amount of base current required by the module. Use this value in your power budget calculations.  |
| <b>Operating Temperature</b>    | The minimum and maximum temperatures the module will operate within.  |
| <b>Relative Humidity</b>        | The range of air humidity over which the module will operate properly.  |
| <b>I/O Points Required</b>      | The number of I/O points the CPU must dedicate to the module.   |

## Selecting the Appropriate Module

### Wide Variety of Modules

There are a wide variety of Analog I/O modules available for use with the DL205 family of automation products. These modules are well suited for monitoring and controlling various types of analog signals such as pressure, temperature, etc. No complex programming or module setup software is required. Simply install the module, add a few lines to your RLL program, and you're ready!



Analog input, temperature input and analog output modules are available. These modules are designed and manufactured by FACTS Engineering. FACTS has been producing feature-packed products for the **DirectLOGIC** families (and compatible products) for years! These modules are readily identifiable by their F2- prefix in the part number.

### Diagnostic Features

The DL205 Analog Modules use an on-board microcontroller that automatically monitors module diagnostics. You can easily detect missing field-side supply 24 VDC voltage or a loose terminal block.

The following tables provide a condensed version of the information you need to select the appropriate module. The most important thing is to simply determine the number of channels required and the signal ranges that must be supported. Once you've determined these parameters, look in the specific chapter for the selected module to determine the installation and operation requirements.

**Analog Input**

| Specification      | F2-04AD-1, (L)  | F2-04AD-2, (L)   | F2-08AD-1   | F2-08AD-2  |
|--------------------|---|--|---|--|
| Channels           | 4   | 4  | 8   | 8  |
| Input Ranges       | 4 - 20 mA   | 0 - 5V, 0 - 10V,<br>-5 to +5V,<br>-10 to +10V                    | 4 - 20 mA   | 0 - 5V, 0 - 10V,<br>-5 to +5V,<br>-10 to +10V                    |
| Resolution         | 12 bit<br>(1 in 4096)   | 12 bit (1 in 4096), and 13 bit (1 in 8192)                       | 12 bit<br>(1 in 4096)   | 12 bit (1 in 4096), and 13 bit (1 in 8192)                       |
| Input Type         | Single ended  | Single ended   | Single ended  | Single ended   |
| Maximum Inaccuracy | ± 0.5% at 25 °C (77 °F ),<br>± 0.65% at 0° - 60° C (32° - 140° F) | ± 0.1% at 25 °C (77 °F ),<br>± 0.3% at 0° - 60° C (32° - 140° F) | ± 0.1% at 25 °C (77 °F ),<br>± 0.25% at 0° - 60° C (32° - 140° F) | ± 0.1% at 25 °C (77 °F ),<br>± 0.3% at 0° - 60° C (32° - 140° F) |
| See Chapter...     | 2   | 3  | 4   | 5  |

**Special Input**

| Specification            | F2-04RTD   | F2-04THM   |
|--------------------------|--|--|
| Input Channels           | 4  | 4  |
| Resolution               | 16 bit internal  | 16 bit voltage ranges<br>24 bit Internal   |
| Input Ranges             | Pt100Ω, -200.0 - 850.0 °C<br>(-328 - 1562 °F)<br>Pt1000Ω, -200.0 - 595.0 °C<br>(-328 - 1103 °F)<br>jPt100Ω, -38.0 - 450.0 °C<br>(-36 - 842 °F)<br>Cu. 25Ω, Cu. 10Ω<br>-200.0 - 260.0 °C<br>(-328 - 500 °F) | Type J -190 - 760°C<br>E -210 - 1000°C<br>K -150 - 1372°C<br>R 65 - 1768°C<br>S 65 - 1768°C<br>T -230 - 400°C<br>B 529 - 1820°C<br>N -70 - 1300°C<br>C 65 - 2320°C<br>Voltage Ranges<br>0-5 VDC ± 5 VDC<br>0-156mVDC ± 156mVDC |
| Input Type               | Differential   | Differential   |
| Maximum Input Inaccuracy | ± 1.0°C  | ± 3.0°C Temperature<br>± 0.02% Voltage   |
| See Chapter...           | 6  | 7  |

| <b>Analog Output</b> | <b>Specification</b> | <b>F2-02DA-1, (L)</b> | <b>F2-02DA-2, (L)</b>                         |
|----------------------|----------------------|-----------------------|---|
|                      | Channels             | 2                     | 2   |
|                      | Output Ranges        | 4 - 20 mA             | 0 - 5V, 0 - 10V,<br>-5 to +5V,<br>-10 to +10V |
|                      | Resolution           | 12 bit (1 in 4096)    | 12 bit (1 in 4096)                            |
|                      | Output Type          | Single ended          | Single ended                                  |
|                      | See Chapter...       | 8                     | 9   |

| <b>Specification</b> | <b>F2-08DA-1</b>   | <b>F2-08DA-2</b>       |
|----------------------|--------------------|------------------------|
| Channels             | 8                  | 8                      |
| Output Ranges        | 4 - 20mA           | 0 - 5V, 0 - 10V        |
| Resolution           | 12 bit (1 in 4096) | 16 bit (1 in 4096)     |
| Output Type          | Single ended       | Single ended, 1 common |
| See Chapter...       | 10                 | 11                     |

| <b>Specification</b> | <b>F2-02DAS-1</b>   | <b>F2-02DAS-2</b>   |
|----------------------|---------------------|---------------------|
| Channels             | 2                   | 8                   |
| Output Ranges        | 4 - 20mA            | 0 - 5V, 0 - 10V     |
| Resolution           | 16 bit (1 in 65536) | 16 bit (1 in 65536) |
| Output Type          | Current sourcing    | Isolated            |
| See Chapter...       | 12                  | 13                  |

| <b>Specification</b>      | <b>F2-4AD2DA</b>   |
|---------------------------|--|
| Input Channels            | 4  |
| Output Channels           | 2  |
| Input Ranges              | 4 - 20 mA  |
| Output Ranges             | 4 - 20 mA  |
| Resolution                | 12 bit (1 in 4096)   |
| Channel Isolation         | Non-isolated (one common)  |
| Input and Output Types    | Single ended   |
| Maximum Input Inaccuracy  | ± 0.3% at 25 °C (77 °F )<br>± 0.45% at 0° - 60° C (32° - 140° F) |
| Maximum Output Inaccuracy | ± 0.1% at 25 °C (77 °F )<br>± 0.3% at 0° - 60° C (32° - 140° F)  |
| See Chapter . . . .       | 14   |

## Analog Made Easy - Four Simple Steps

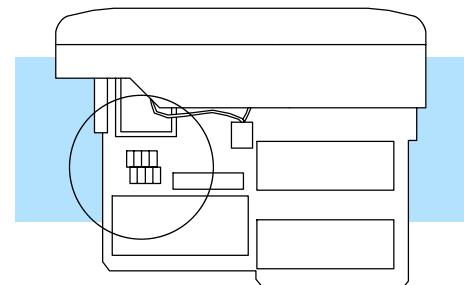
Once you have selected the appropriate module, use the chapter that describes that module and complete the following steps.

**Step 1.** Take a minute to review the detailed specifications to make sure the module meets your application requirements.

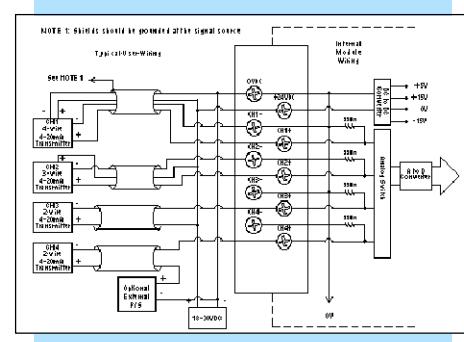
| Specification                          |  |                                   |
|--|--|-----------------------------------|
| Channels                               | 2  | 2                                 |
| Output Ranges                          | 4 – 20 mA<br>0 – 5V<br>0 – 10V<br>-5 – +5V<br>-10 – +10V |                                   |
| Resolution                             | 12 bit (1 in 4096)                                       | 12 bit (1 in 4096)                |
| Channel Isolation                      | Non-isolated   | Non-isolated                      |
| Output Type                            | Single ended   | Single ended                      |
| Maximum Inaccuracy<br>at 25 °C (77 °F) | ± 0.1%   | ± 0.3% unipolar<br>± 0.4% bipolar |
| at 0° – 25°C (32° – 140°F)             | ± 0.3%   |                                   |
| See Chapter . . . . .                  | 4  | 5                                 |

**Step 2.** If applicable, set the module switches and/or jumpers to select:

- number of channels
- the operating ranges



**Step 3.** Connect the field wiring to the module connector.



**Step 4.** Review the module operating characteristics and write the control program.

