

Getting Started

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 - Analog Made Easy - Four Simple Steps
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Introduction

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.

Who should read this manual If you understand the DL305 and DL350 instruction sets and system setup requirements, this manual will provide all 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 DL305 Analog I/O modules.

Supplemental Manuals If you have purchased operator interfaces or **DirectSOFT™**, you will need to supplement this manual with the manuals that are written for these products.

Technical Support We realize that even though we strive to be the best, the information may be arranged 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
- **Quick Guide to Contents** – chapter summary listing on the next page
- **Appendices** – reference material for key topics, near the end of this manual
- **Index** – alphabetical listing of key words, at the end of this manual

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

- **Internet** – the address of our Web site is <http://www.plcdirect.com>
- **Bulletin Board Service(BBS)** – call (770)–844–4209

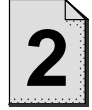
If you still need assistance, please call us at 800–633–0405. Our technical support group is glad to work with you in answering your questions. They are available Monday through Friday from 9:00 A.M. to 6:00 P.M. Eastern Standard Time. If you have a comment or question about any of our products, services, or manuals, please fill out and return the 'Suggestions' card that was shipped with this manual.

Chapters

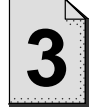
The main contents of this manual are organized into the following nine chapters:

**Getting Started**

introduces the various DL305 Analog modules. Also includes tips on getting started and how to design a successful system.

**D3-04AD**

explains the 4 channel analog input module. Provides ladder logic examples for all bases and CPUs.

**F3-04ADS**

explains the 4 channel isolated analog input module. Provides ladder logic examples for all bases and CPUs.

**F3-08AD**

explains the 8 channel analog input module. Provides ladder logic examples for all bases and CPUs.

**F3-16AD**

explains the 16 channel analog input module. Provides ladder logic examples for all bases and CPUs.

**D3-02DA**

explains the 2 channel analog output module. Provides ladder logic examples for all bases and CPUs.

**F3-04DA-1**

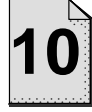
explains the 4 channel analog output module. Provides ladder logic examples for all bases and CPUs.

**F3-04DAS**

explains the 4 channel isolated analog output module. Provides ladder logic examples for all bases and CPUs.

**F3-08THM-n**

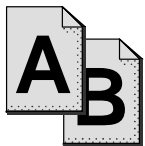
explains the 8 channel Thermocouple input module. Provides ladder logic examples for all bases and CPUs.

**F3-08TEMP**

explains the 8 channel temperature input module. Provides ladder logic examples for all bases and CPUs.

Appendices

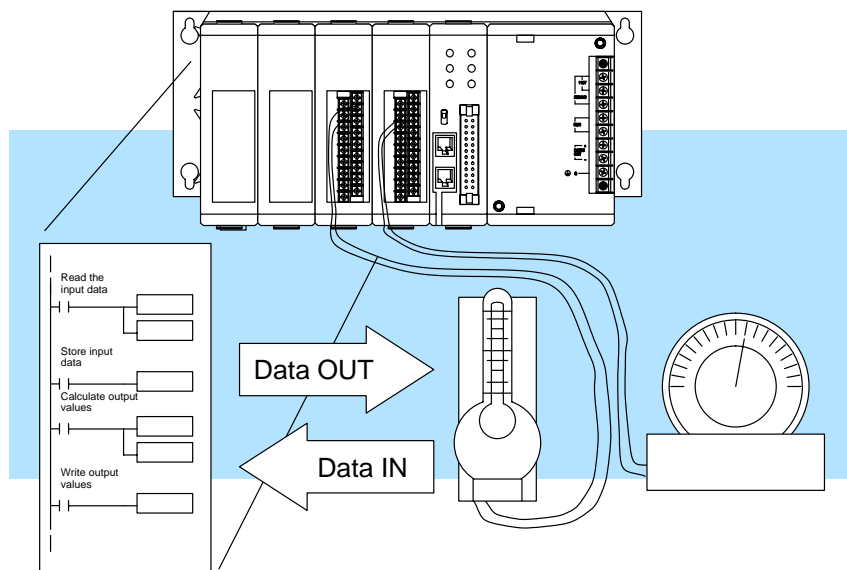
Additional reference information on the DL305 analog modules is in the following five appendices:

**Reference Appendices**

- **A** – DL305C Data Types and Memory Map
- **B** – DL350 Data Types and Memory Map

DL305 Analog Components

There are a wide variety of Analog I/O modules available for use with the DL305 family of automation products. These modules are well suited for monitoring and controlling various types of analog signals such as pressure, temperature, etc. There are modules specifically designed for thermocouple and temperature input requirements. 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!



DL305 Analog I/O

The following is a list of the types of analog input and analog output modules that are available.

- D3-04AD — 4 channel input, 8-bit resolution
- F3-04ADS — 4 channel isolated input, 12-bit resolution
- F3-08AD — 8 channel input, 12-bit resolution
- F3-16AD — 16 channel input, 12-bit resolution
- D3-02DA — 2 channel output, 8-bit resolution
- F3-04DA-1 — 4 channel output, 12-bit resolution
- F3-04DAS — 4 channel isolated output, 12-bit resolution

Thermocouple Input

There is also an 8 channel thermocouple input module that converts type E, J, K, R, S, or T thermocouple signals into direct temperature readings. This module can also convert other types of low-level (millivolt range) signals into digital values. The part number for this module is F3-08THM-n, where n is the type of thermocouple. If you want a millivolt input version, simply replace n with a 1 (0-50 mV) or a 2 (0-100mV). All versions offer 12-bit resolution.

Temperature Input

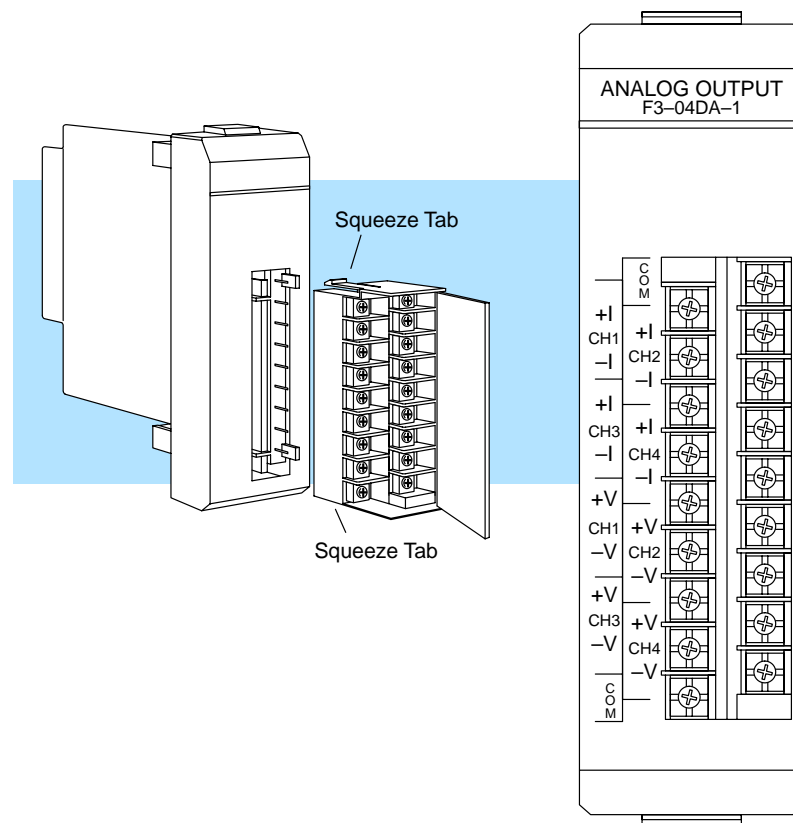
The Temperature Input module provides 8 channels for direct temperature measurement in either Celsius or Fahrenheit from -55° to 150° C. Order part number F3-08TEMP. This module offers 12-bit resolution.

Physical Characteristics

The DL305 Analog Modules provide many features that make the modules easier to use. For example, the terminal block can be removed making wiring a simple task. You can also use our **DIN**ector product line to organize your wiring even further (see our catalog for details).

Some of the modules provide LEDs used to determine the signal level. Since there are not enough LEDs to show all of the channels at once, there is a small switch underneath the terminal cover that allows you to select the channel for monitoring. Not all of the modules have this feature.

Most of the modules also have jumpers that can be set to select between the various types of signals. Each chapter will show how to set these jumpers for the selections you need.



Selecting the Appropriate Module

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	D3-04AD	F3-04ADS	F3-08AD	F3-16AD
Channels	4	4	8	16
Input Ranges	1 – 5V 4 – 20 mA	0 – 5V 1 – 5V 0 – 10V ± 5V ± 10V 0 – 20mA 4 – 20mA	4 – 20mA	0 – 5V 1 – 5V 0 – 10V ± 5V ± 10V 0 – 20mA 4 – 20mA ¹
Resolution	8 bit (1 in 256)	12 bit (1 in 4096)	12 bit (1 in 4096)	12 bit (1 in 4096)
Channel Isolation	Non-isolated (one common)	Isolated	Non-isolated (one common)	Non-isolated (one common)
Input Type	Differential	Differential	Single ended	Single ended
Maximum Inaccuracy at 77 °F (25 °C)	1%	± 0.3%	0.35%	0.25% voltage 1.25% current
See Chapter . . .	2	3	4	5

¹ – resolution is reduced with 4–20 mA signals. You should use the F3-08AD if the primary application requires 4–20 mA signals.

Analog Output

Specification	D3-02DA	FACTS F3-04DA-1	FACTS F3-04DAS
Channels	2	4	4
Output Ranges	1 – 10VDC 4 – 20 mA	0 – 5V 0 – 10V 4 – 12mA 4 – 20mA	0 – 5V 0 – 10V ± 5V ± 10V 4 – 20mA
Resolution	8 bit (1 in 256)	12 bit (1 in 4096)	12 bit (1 in 4096)
Channel Isolation	Non-isolated (one common)	Non-isolated (one common)	Isolated
Output Type	Single ended	Single ended	Differential
Maximum Inaccuracy at 77 °F (25 °C)	± 0.4%	± 0.2% voltage ± 0.6% current	± 0.8%
See Chapter	6	7	8

Special Input

Specification	F3-08TEMP	FACTS F4-04DA
Channels	8, Temperature Input	8, Thermocouple Input
Input Ranges	0 – 1mA AD590 input types	E: –270/1000 °C, –450/1832 °F J: –210/760 °C, –350/1390 °F K: –270/1370 °C, –450/2500 °F R: 0/1768 °C, –32/3214 °F S: 0/1768 °C, –32/3214 °F T: –270/400 °C, –450/752 °F 50mV: 0 – 50 mV 100mV: 0–100 mV
Resolution	12 bit (1 in 4096)	12 bit (1 in 4096)
Channel Isolation	Non-isolated	Non-isolated
Input Type	Single ended	Differential
Maximum Inaccuracy at 77 °F (25 °C)	0.25%	0.35%
See Chapter	10	9

Analog Made Easy – Four Simple Steps

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

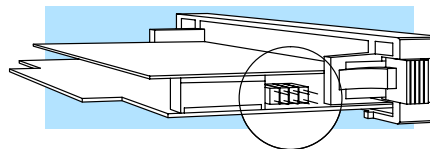
STEP 1. Take a minute to review the detailed specifications to make sure the module meets your application requirements.

Channels per module	4	Base power required	9VDC @ 144mA 24VDC @ 108 mA
Output Ranges	0 to 5V, 0 to 10V, 4 to 120mA, 4 to 20 mA Source	External power source	None
Resolution	12 bit (1/4096)	Operating temperature	0-60 deg. C 32-140 deg. F
Output current	5mA (source) 2.5mA (sink) (voltage output)	Relative Humidity	5 to 95% noncond.
Output impedance	0.5 ohm (voltage output)	Weight	6.3 oz. (180 g)
External resistance	1k ohm max (current) 2k ohm min (voltage)	Terminal Type	Removable
Conversion time	50 microseconds max	LED Display	777777777777
Accuracy	????????????		
Accuracy/temperature	±1-50 PPM per deg. C		
11C points required	16 Outputs		

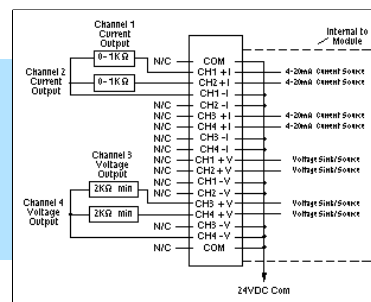
STEP 2. Set the module switches and/or jumpers to select:

- number of channels
- the operating ranges (voltage or current)

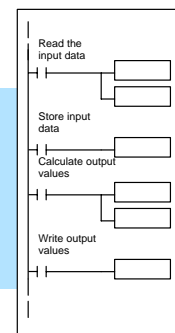
Note, some of the modules may not have switches.



STEP 3. Connect the field wiring to the module connector.



STEP 4. Review the module operating characteristics and write the control program.



Analog Input Terminology

We use several different terms throughout the rest of this manual. You don't 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.

Channels per Module	The number of analog channels or points available in the module to connect to field devices.
Input Ranges	The input ranges in voltage and/or current that the module will operate properly within.
Resolution	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.
Input Type	Specifies if the module accepts single ended, bipolar or differential input signals.
Input Impedance	The input impedance of the module using a voltage or current input signal.
Conversion Method	The method the module uses to convert the analog signal to a digital value.
Conversion Time	The amount of time required to complete the analog to digital conversion.
Linearity Error and Total Tolerance (Relative Accuracy)	The linearity and accuracy of the digital representation over the entire input range.
Accuracy vs. Temperature	The effect of temperature on the accuracy of the module.
LED Display	LED indicators on the module
I/O Points Required	The number of I/O points the CPU must dedicate to the module.
External Power Source	Some modules require a separate 24VDC power source. The 24VDC output supply at the local or expansion base can be used as long as you do not exceed the current rating.
Base Power Required	The amount of base current required by the module. Use this value in your power budget calculations.
Operating Temperature	The minimum and maximum temperatures the module will operate.
Relative Humidity	The minimum and maximum humidity the module will operate.
Terminal Type	Indicates whether the terminal type is a removable or non-removable connector or a terminal.
Weight	The weight of the module.

Analog Output Module Terminology

Channels per Module	The number of analog channels or points available in the module to connect to field devices.
Output Ranges	The output ranges in voltage and/or current modes the module will operate properly within.
Resolution	The number of binary weighted bits available on the digital side of the module for use in converting the digital value to a analog signal.
Output Current	The maximum current the module will drive using a voltage output signal.
Output Impedance	The output impedance of the module using a voltage output signal.
Load Impedance	The minimum and maximum resistance the module can drive using a current output signal.
Conversion Time	The amount of time required to complete the digital to analog conversion.
Accuracy	The linearity and calibrated accuracy of the digital representation over the entire output range.
Accuracy vs. Temperature	The effect of temperature on the accuracy of the module.
LED Display	LED indicators on the module
External Power Source	Some modules require a separate 24VDC power source. The 24VDC output supply at the local or expansion base can be used as long as you do not exceed the current rating.
Base Power Required	The amount of base current required by the module. Use this value in your power budget calculations.
Operating Temperature	The minimum and maximum temperatures the module will operate.
Relative Humidity	The minimum and maximum humidity the module will operate.
Terminal Type	Indicates whether the terminal type is a removable or non-removable connector or a terminal.
Weight	The weight of the module.
I/O Points Required	The number of I/O points the CPU must dedicate to the module.