

# GETTING STARTED

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# CHAPTER 1

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**NOTE:** As of 07/2021 CPU D2-260 has been retired.  
Please consider CPU D2-262 as a replacement.

# Introduction

## The Purpose of this Manual

Thank you for purchasing our DL205 family of products. This manual shows you how to install, program, and maintain the equipment. It also helps you understand how to interface them to other devices in a control system.

This manual contains important information for personnel who will install DL205 PLCs and components and for the PLC programmer. If you understand PLC systems, our manuals will provide all the information you need to start and keep your system up and running.

## Where to Begin

If you already understand PLCs please read Chapter 2, "Installation, Wiring, and Specifications," and proceed on to other chapters as needed. Keep this manual handy for reference when you have questions. If you are a new DL205 customer, we suggest you read this manual completely to understand the wide variety of features in the DL205 family of products. We believe you will be pleasantly surprised with how much you can accomplish with our products.

## Supplemental Manuals

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

## Technical Support

We strive to make our manuals the best in the industry. We rely on your feedback to let us know if we are reaching our goal. If you cannot find the solution to your particular application, or, if for any reason you need technical assistance, please call us at:

**770-844-4200**

Our technical support group will work with you to answer your questions. They are available Monday through Friday from 9:00 A.M. to 6:00 P.M. Eastern Time. We also encourage you to visit our web site where you can find technical and non-technical information about our products and our company.

**<http://www.automationdirect.com>**

If you have a comment, question or suggestion about any of our products, services, or manuals, please fill out and return the 'Suggestions' card included with this manual.

## Conventions Used



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.

A graphic for Chapter 1 titled 'Getting Started'. It features a large grey arrow pointing right with the word 'CHAPTER' above it and the number '1' below it. To the left of the arrow, the text 'Getting Started' is written. Below the arrow, there is a table of contents for the chapter.

Getting Started	
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# DL205 System Components

The DL205 family is a versatile product line that provides a wide variety of features in an extremely compact package. The CPUs are small, but offer many instructions normally only found in larger, more expensive systems. The modular design also offers more flexibility in the fast moving industry of control systems. The following is a summary of the major DL205 system components.

## CPUs

This product line includes five feature-enhanced CPUs: the D2-230, D2-240, D2-250-1, D2-260 and D2-262 (the D2-230, D2-240, D2-250 CPUs have been retired). All CPUs include built-in communication ports. Each CPU offers a large amount of program memory, a substantial instruction set and advanced diagnostics. The D2-250-1 features drum timers, floating-point math, 4 built-in PID loops with automatic tuning and 2 bases of local expansion capability.

In addition to the D2-250-1 features the D2-260 and D2-262 feature ASCII IN/OUT and extended MODBUS communications, table and trigonometric instructions, 16 PID loops with auto tuning and up to 4 bases of local expansion. Further details of these CPU features and more are covered in Chapter 3, CPU Specifications and Operation.

## Bases

Four base sizes are available: 3, 4, 6 and 9 slot. The DL205 PLCs use bases that can be expanded. The part numbers for these bases end with -1. These bases have a connector for local expansion located on the right end of the base. They can serve as local bases, local expansion and remote I/O configurations. All bases include a built-in power supply. The bases with the -1 suffix can replace existing bases without a suffix if expansion is required.

## I/O Configuration

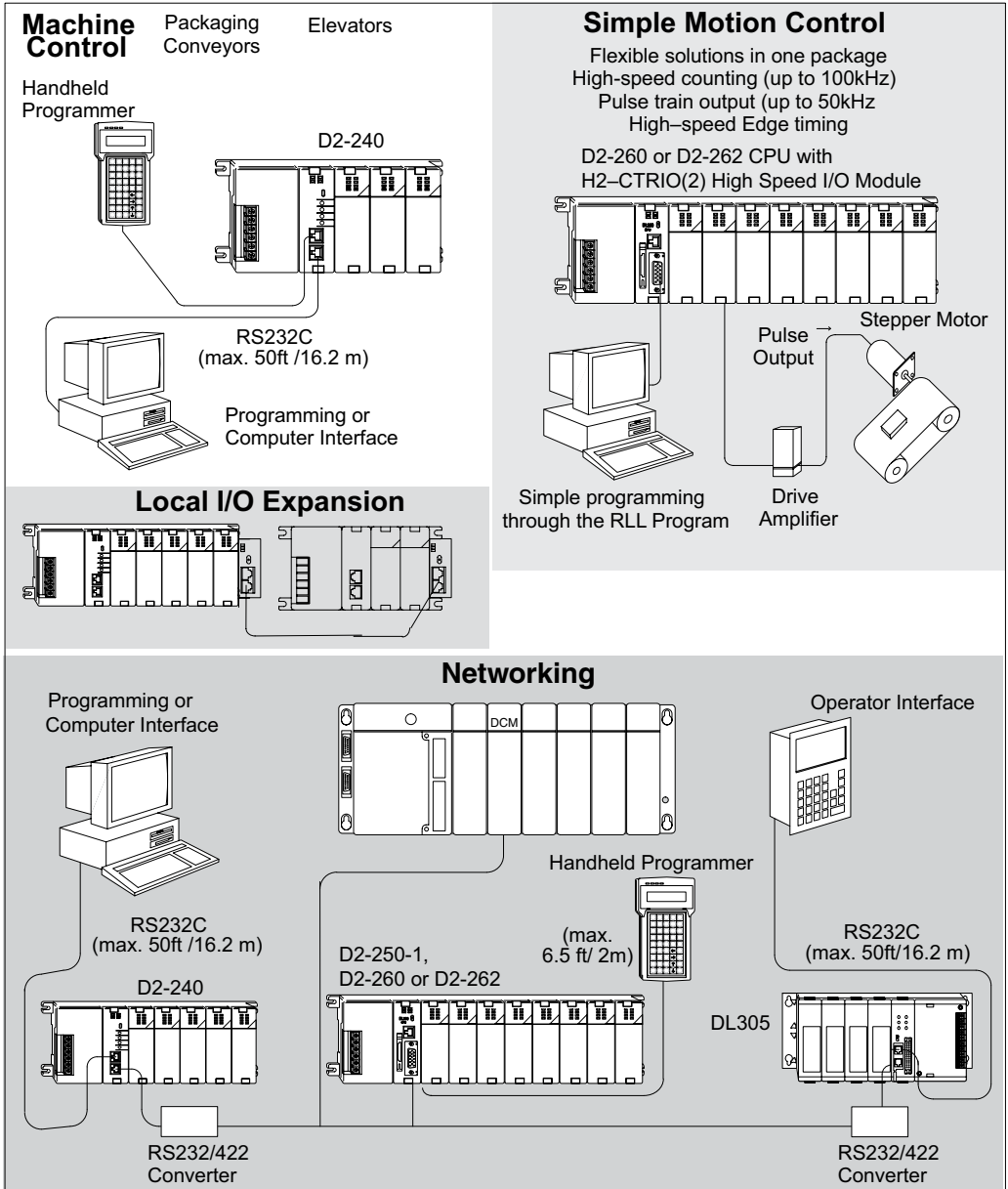
The D2-250-1 can support up to 768 local I/O points with up to two expansion bases. The D2-260 and D2-262 support up to 1280 local I/O points with up to four expansion bases. These points can be assigned as input or output points. The D2-250-1, D2-260 and D2-262 systems can also be expanded by adding remote I/O points. The D2-250-1, D2-260 and D2-262 provide a built-in master for remote I/O networks. The I/O module configuration are explained in Chapter 4, System Design and Configuration.

## I/O Modules

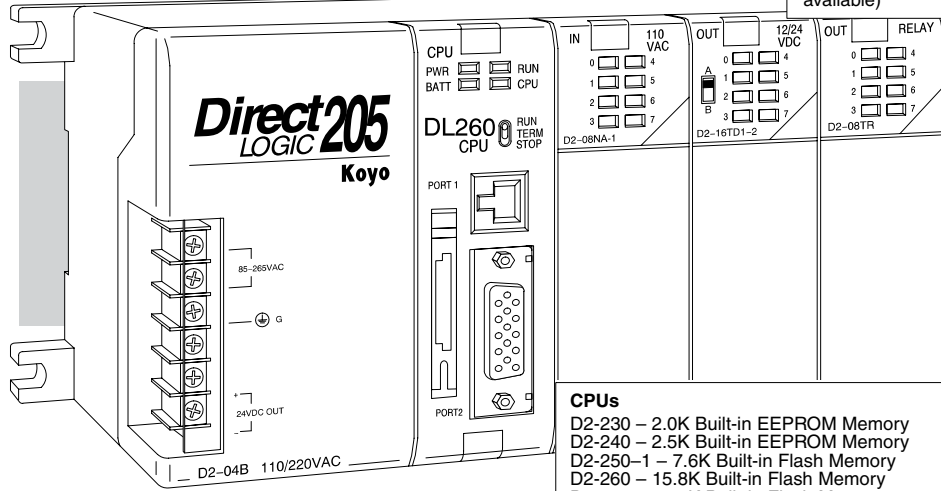
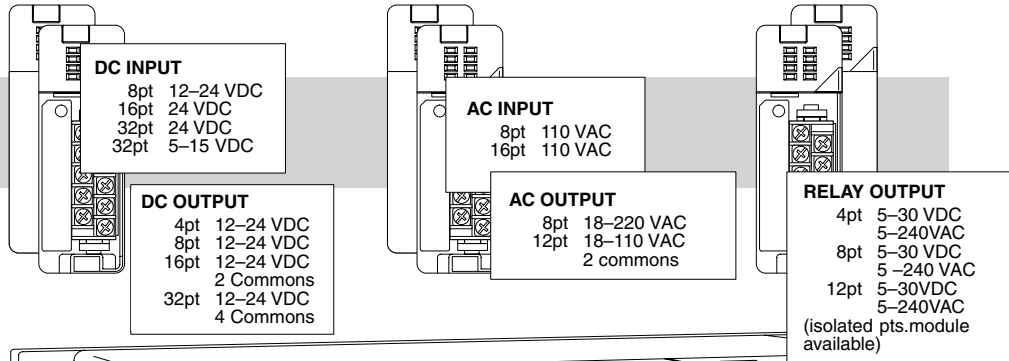
The DL205 series has a large range of I/O modules to accommodate your automation needs. A complete range of discrete modules which support 24VDC, 110/220 VAC and up to 10A relay outputs (subject to derating) are offered. The analog modules provide 12- and 16-bit resolution and several selections of input and output signal ranges (including bipolar). Several specialty and communications modules are also available.

## DL205 System Diagrams

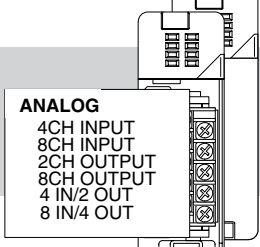
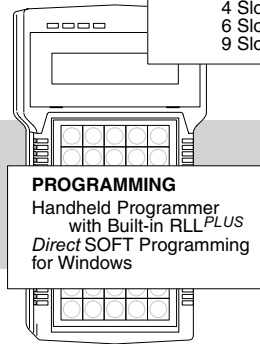
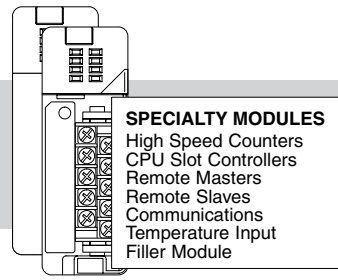
The diagram below shows the major components and configurations of the DL205 system. The next two pages show specific components for building your system.



# DirectLOGIC DL205 Family



- CPUs**  
 D2-230 – 2.0K Built-in EEPROM Memory  
 D2-240 – 2.5K Built-in EEPROM Memory  
 D2-250-1 – 7.6K Built-in Flash Memory  
 D2-260 – 15.8K Built-in Flash Memory  
 D2-262 – 15.8K Built-in Flash Memory
- BASES**  
 3 Slot Base, 110/220VAC, 24VDC  
 4 Slot Base, 110/220VAC, 24VDC  
 6 Slot Base, 110/220VAC, 24VDC, 125 VDC  
 9 Slot Base, 110/220VAC, 24VDC, 125 VDC



## Programming Methods

Two programming methods are available for the DL205 CPUs: Relay Ladder Logic (RLL) and RLLPLUS (Stage Programming). Both the DirectSOFT programming package and the handheld programmer support RLL and Stage programming.

### DirectSOFT Programming for Windows

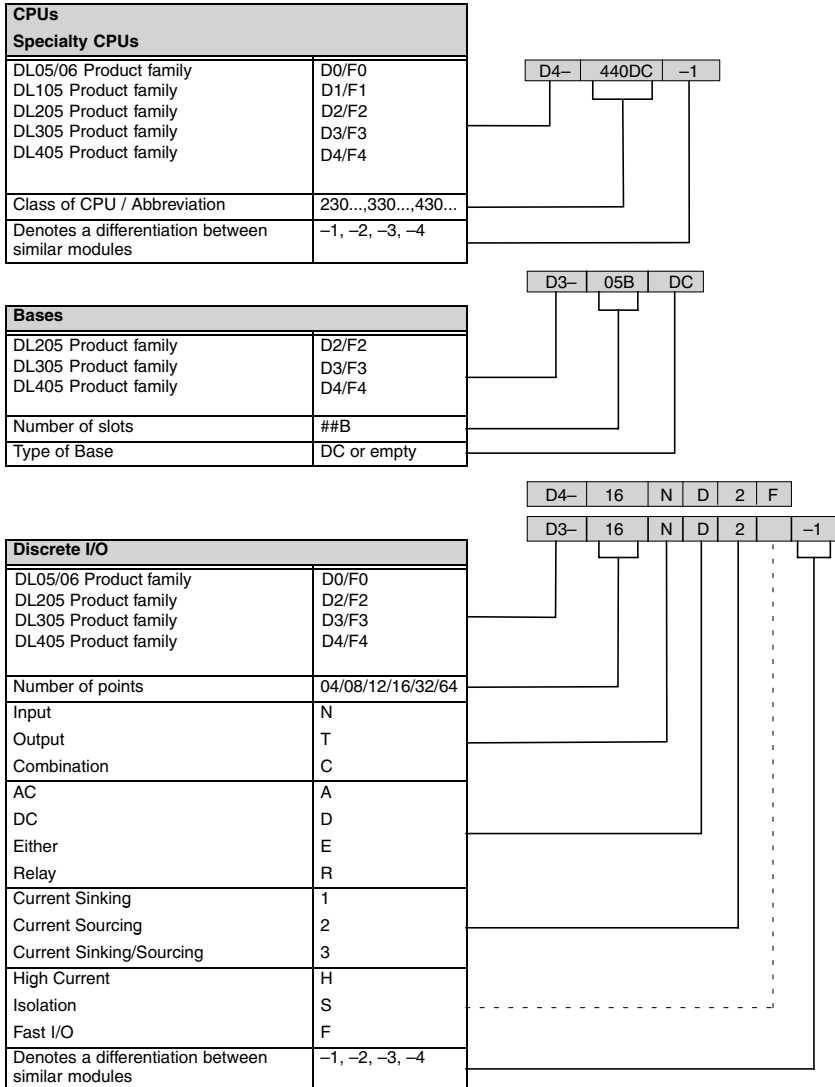
The DL205 can be programmed with one of the most advanced programming packages in the industry —DirectSOFT. DirectSOFT is a Windows-based software package that supports many Windows features you already know, such as cut and paste between applications, point and click editing, viewing and editing multiple application programs at the same time, etc. DirectSOFT universally supports the DirectLOGIC CPU families. This means you can use the same DirectSOFT programming software to program any CPU that is in the DL05, DL06, DL205, DL305, DL405 series. A separate manual discusses the DirectSOFT programming software which is included with your software package.

### Handheld Programmer

All DL205 CPUs have a built-in programming port for use with the handheld programmer (D2-HPP). The handheld programmer can be used to create, modify and debug your application program. A separate manual that discusses the DL205 Handheld Programmer is available for download at <http://www.automationdirect.com>. Just search for "Handheld Programmer" and follow links.

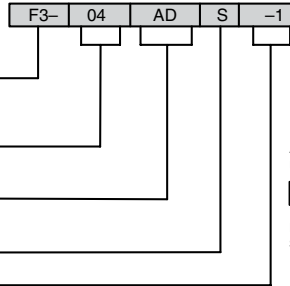
# DirectLOGIC™ Part Numbering System

As you examine this manual, you will notice there are many different products available. Sometimes it is difficult to remember the specifications for any given product. However, if you take a few minutes to understand the numbering system, it may save you some time and confusion. The charts below show how the part numbering systems work for each product category. Part numbers for accessory items such as cables, batteries, memory cartridges, etc, are typically an abbreviation of the description for the item.





Analog I/O	
DL05/06 Product family	D0/F0
DL205 Product family	D2/F2
DL305 Product family	D3/F3
DL405 Product family	D4/F4
Number of channels	02/04/08/16
Input (Analog to Digital)	AD
Output (Digital to Analog)	DA
Combination	AND
Isolated	S
Denotes a differentiation between Similar modules	-1, -2, -3, -4

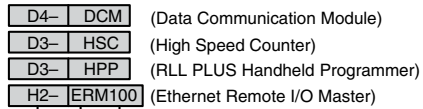


Alternate example of Analog I/O using abbreviations

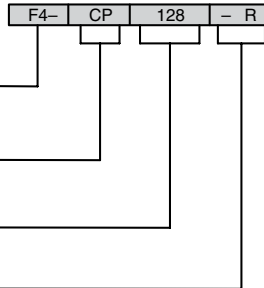


note: -n indicates thermocouple type such as: J, K, T, R, S or E

Communication and Networking Special I/O and Devices Programming	
DL205 Product family	D2/F2/H2
DL305 Product family	D3/F3
DL405 Product family	D4/F4/H4
Name Abbreviation	see example



CoProcessors and ASCII BASIC Modules	
DL205 Product family	D2/F2
DL305 Product family	D3/F3
DL405 Product family	D4/F4
CoProcessor	CP
ASCII BASIC	AB
64K memory	64
128K memory	128
512K memory	512
Radio modem	R
Telephone modem	T



# Quick Start for PLC Validation and Programming

If you have experience using PLCs, or want to set up a quick example, this section is what you want to use. This example is not intended to explain everything needed to start up your system. It is only intended to provide a general picture of what is needed to get your system powered up.

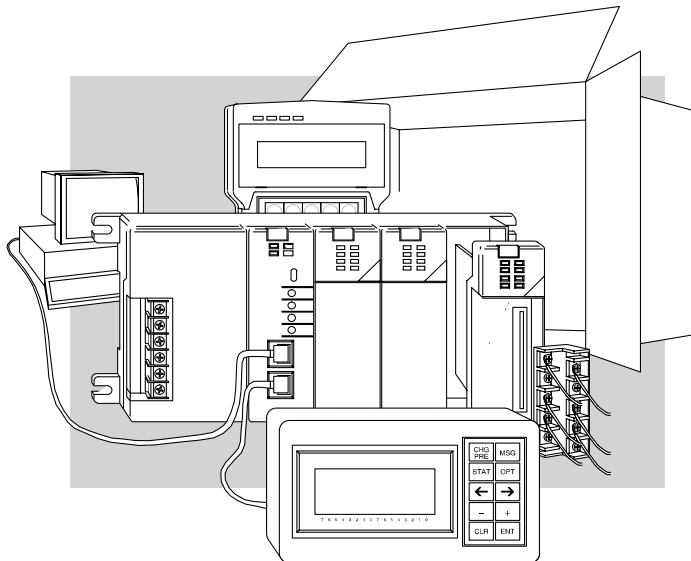
## Step 1: Unpack the DL205 Equipment

Unpack the DL205 equipment and verify you have the parts necessary to build this demonstration system. The minimum parts needed are as follows:

- Base
  - CPU
  - A discrete input module such as a D2-16ND3-2 or a F2-08SIM input simulator module
  - A discrete output module such as a D2-16TD1-2
  - \*Power cord
  - \*Hookup wire
  - \*One or more toggle switches (if not using the input simulator module)
  - \*A screwdriver, blade or Phillips type
- \*These items are not supplied with your PLC.

You will need at least one of the following programming options:

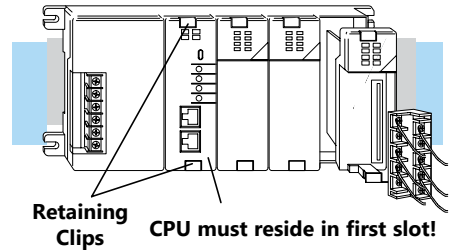
- **DirectSOFT** Programming Software, **DirectSOFT** Manual, and a programming cable (connects the CPU to a personal computer), or
- D2-HPP Handheld Programmer and the Handheld Programmer Manual.



### Step 2: Install the CPU and I/O Modules

Insert the CPU and I/O into the base. The CPU must be inserted into the first slot of the base (next to the power supply).

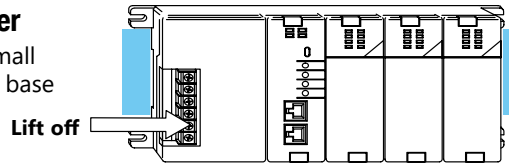
- Each unit has a plastic retaining clip at the top and bottom. Slide the retainer clips to the out position before installing the module.
- With the unit square to the base, slide it in using the upper and lower guides.
- Gently push the unit back until it is firmly seated in the backplane.
- Secure the unit to the base by pushing in the retainer clips.



Placement of discrete, analog and relay modules is not critical and may go in any slot in any base; however, for this example, install the output module in the slot next to the CPU and the input module in the next slot. Limiting factors for other types of modules are discussed in Chapter 4, System Design and Configuration. You must also make sure you do not exceed the power budget for each base in your system configuration. Power budgeting is also discussed in Chapter 4.

### Step 3: Remove Terminal Strip Access Cover

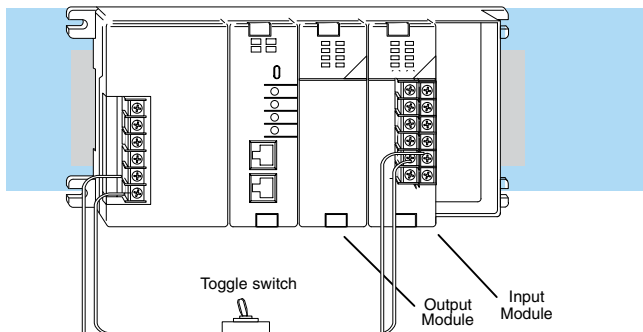
Remove the terminal strip cover. It is a small strip of clear plastic that is located on the base power supply.



### Step 4: Add I/O Simulation

To finish this quick start exercise or study other examples in this manual, you will need to install an input simulator module (or wire an input switch as shown below), and add an output module. Using an input simulator is the quickest way to get physical inputs for checking out the system or a new program. To monitor output status, any discrete output module will work.

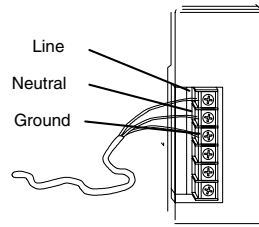
Wire the switches or other field devices prior to applying power to the system to ensure



a point is not accidentally turned on during the wiring operation. This example uses DC input and output modules. Wire the input module, X0, to the toggle switch and 24VDC auxiliary power supply on the CPU terminal strip as shown. Chapter 2, Installation, Wiring, and Specifications, provides a list of I/O wiring guidelines.

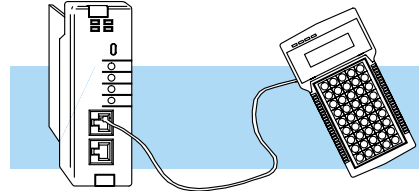
## Step 5: Connect the Power Wiring

Connect the wires as shown. Observe all precautions stated earlier in this manual. For details on wiring see Chapter 2 Installation, Wiring, and Specifications. When the wiring is complete, replace the CPU and module covers. Do not apply power at this time.



## Step 6: Connect the Programmer

Either connect the programming cable connected to a computer loaded with DirectSOFT Programming Software or a D2-HPP Handheld Programmer (comes with programming cable) to the top port of the CPU.



## Step 7: Switch On the System Power

Apply power to the system and ensure the PWR indicator on the CPU is on. If not, remove power from the system, check all wiring and refer to the troubleshooting section in Chapter 9 for assistance.

## Step 8: Enter the Program

Slide the switch on the CPU to the STOP position (D2-250-1, D2-260 and D2-262 CPUs) and then back to the TERM position. This puts the CPU in the program mode and allows access to the CPU program. Edit a DirectSOFT program using the relay ladder diagram below and load it into the PLC. If using an HPP, the PGM indicator should be illuminated on the HPP. Enter the following keystrokes on the HPP:

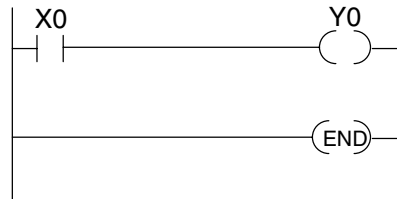


**NOTE:** It is not necessary for you to configure the I/O for this system since the DL205 CPUs automatically examine any installed modules and establish the correct configuration.

After entering the example program put the CPU in the RUN mode with DirectSOFT or after entering the program using the HPP, slide the switch from the TERM position to the RUN

Handheld Program Keystrokes

\$ STR	→	B 1	ENT
GX OUT	→	C 2	ENT



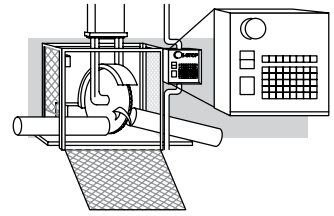
position and back to TERM. The RUN indicator on the CPU will come on indicating the CPU has entered the run mode. If not, repeat Step 8 ensuring the program is entered properly or refer to the troubleshooting guide in Chapter 9.

During Run mode operation, the output status indicator "O" on the output module should reflect the switch status. When the switch is on, the output should be on.

# Steps to Designing a Successful System

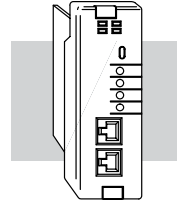
## Step 1: Review the Installation Guidelines

Always make safety your first priority in any system application. Chapter 2 provides several guidelines that will help provide a safer, more reliable system. This chapter also includes wiring guidelines for the various system components.



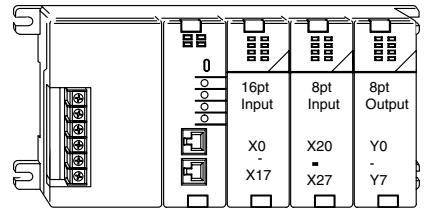
## Step 2: Understand the CPU Set-up Procedures

The CPU is the heart of your automation system and is explained in Chapter 3. Make sure you take time to understand the various features and set-up requirements.



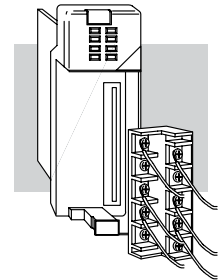
## Step 3: Understand the I/O System Configurations

It is important to understand how your local I/O system can be configured. It is also important to understand how the system Power Budget is calculated. This can affect your I/O placement and/or configuration options. See Chapter 4 for more information.



## Step 4: Determine the I/O Module Specifications and Wiring Characteristics

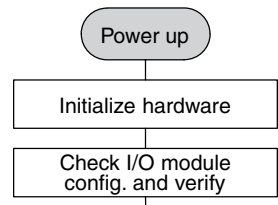
Many different I/O modules are available with the DL205 system. Chapter 2 provides the specifications and wiring diagrams for the discrete I/O modules.



**NOTE:** Analog and specialty modules have their own manuals and are not included in this manual.

## Step 5: Understand the System Operation

Before you begin to enter a program, it is very helpful to understand how the DL205 system processes information. This involves not only program execution steps, but also involves the various modes of operation and memory layout characteristics. See Chapter 3 for more information.

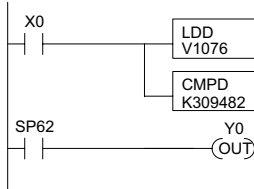


## Step 6: Review the Programming Concepts

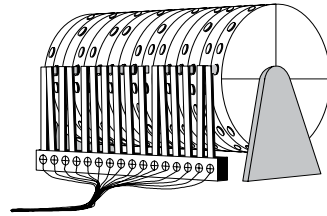
The DL205 provides four main approaches to solving the application program, including the PID loop task depicted in the next figure.

- RLL diagram style programming is the best tool for solving boolean logic and general CPU register/ accumulator manipulation. It includes dozens of instructions, which will augment drums, stages and loops.
- The D2-250-1, D2-260 and D2-262 have four timer/event drum types, each with up to 16 steps. They offer both time and/or event-based step transitions. Drums are best for a repetitive process based on a single series of steps.
- Stage programming, called RLLPLUS, is based on state-transition diagrams. Stages divide the ladder program into sections which correspond to the states in a flow chart of your process.
- The D2-260 and D2-262 CPU PID loop operation uses setup tables to configure 16 loops. The D2-250-1 PID loop operation uses setup to configure 4 loops.

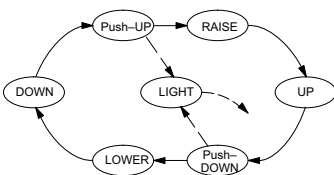
**Standard RLL Programming**  
(see Chapter 5)



**Timer/Event Drum Sequencer**  
(see Chapter 6)

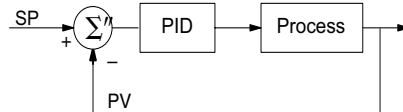


**Stage Programming**  
(see Chapter 7)



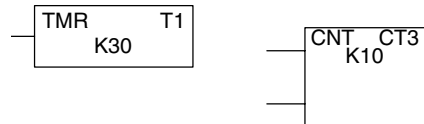
Features include: auto tuning, alarms, SP ramp/soak generation and more.

**PID Loop Operation**  
(see Chapter 8)



## Step 7: Choose the Instructions

Once you have installed the system and understand the theory of operation, you can choose from one of the most powerful instruction sets available.



## Step 8: Understand the Maintenance and Troubleshooting Procedures

Equipment failures can occur at any time. Switches fail, batteries need to be replaced, etc. In most cases, the majority of the troubleshooting and maintenance time is spent trying to locate the problem. The DL205 system has many built-in features that help you quickly identify problems. Refer to Chapter 9 for diagnostics.

