What is a PLC?

What are PLCs and how do they work?

PLCs are often defined as miniature industrial computers that contain hardware and software that is used to perform control functions. A PLC consists of two basic sections: the central processing unit (CPU) and the input/output interface system. The CPU, which controls all PLC activity, can further be broken down into the processor and memory system. The input/output system is physically connected to field devices (e.g., switches, sensors, etc.) and provides the interface between the CPU and the information providers (inputs) and controllable devices (outputs).

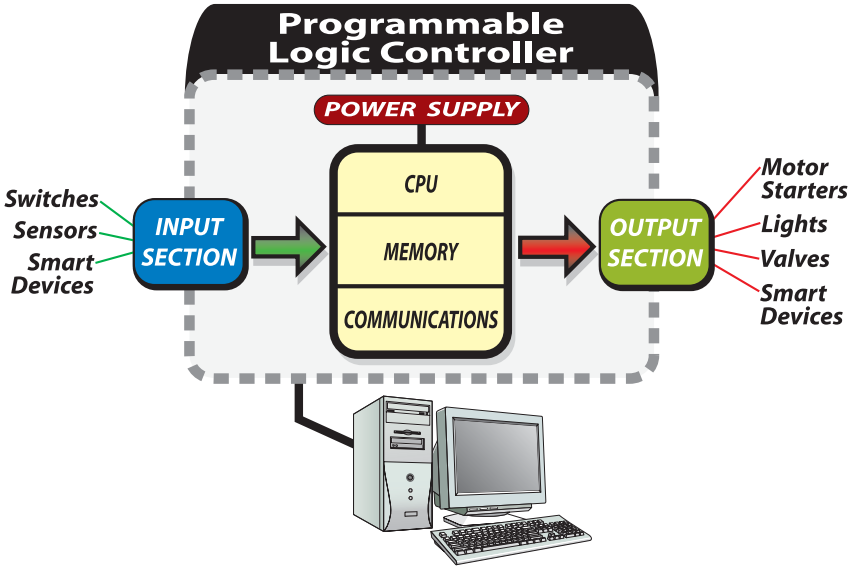
To operate, the CPU "reads" input data from connected field devices through the use of its input interfaces, and then "executes", or performs the control program that has been stored in its memory system. Programs are typically created in ladder logic, a language that closely resembles a relay-based wiring schematic, and are entered into the CPU's memory prior to operation. Finally, based on the program, the PLC "writes", or updates output devices via the output interfaces. This process, also known as scanning, typically continues in the same sequence without interruption, and changes only when a change is made to the control program.

Discrete applications

PLCs are often used to control machines or processes that are sequential in nature, using "discrete" inputs and outputs that have defined states. For example, if a limit switch detects the presence of an object, it provides an "ON" signal to the PLC; if no object is detected, it provides an "OFF" signal. The machine or device typically performs actions based on time or events in a predefined order. The expected sequence is typically interrupted only when an abnormal condition occurs.

Process control applications

PLCs can also control continuous processes that use analog I/O. For example, a temperature sensor may provide a variable signal, such as 0-10 volts, based on the measurement of an actual temperature. The PLC program monitors the sensed values continuously and operates devices that may also be analog in nature. This could include setting the position of a valve between 0-100% open, or controlling the speed of a motor. Continuous applications are so called because they typically have no defined start or end once they are initiated; they maintain a process in a "steady" operating state.



Today's PLC

As PLC technology has advanced, so have programming languages and communications capabilities, along with many other important features. Today's PLCs offer faster scan times, space efficient high-density input/output systems, and special interfaces to allow non-traditional devices to be attached directly to the PLC. Not only can they communicate with other control systems, they can also perform reporting functions and diagnose their own failures, as well as the failure of a machine or process.

Size is typically used to categorize today's PLC, and is often an indication of the features and types of applications it will accommodate. Small, non-modular PLCs (also known as fixed I/O PLCs) generally have less memory and accommodate a small number of inputs and outputs in fixed configurations. Modular PLCs have bases or racks that allow installation of multiple I/O modules, and will accommodate more complex applications.

Which PLC is right for you?

Choosing the most effective PLC for your application depends on a number of factors. To begin the selection process, a drawing of the machine or process is a good start. This can help identify field devices and physical requirements for hardware locations. From the drawing, you can determine how many analog and/or discrete devices you will have.

Once the field device requirements and hardware locations are defined, you can review PLCs that will meet your requirements. See the PLC Selection Worksheet in this section that will help you work through the considerations for determining the type of PLC you will need, regardless of which manufacturers you are evaluating.

PLC APPLICATIONS

Company's automated machines control steps of shutter production with DL205 PLC

G&L Technologies in Alpharetta, GA builds automated machines that complete all of the processes of plantation shutter manufacturing, from cutting to final assembly. The company chose ***AutomationDirect***'s DL205 as an integral part of their machines. One machine, the LPS-36T, controls louver production. Louvers are the pieces that go across each shutter frame that can be manipulated with a tilt rod to open and close the shutter. The machine uses the DL205 PLC to manage the operation of all electro-mechanical components and communication, including index speed and distance, system stapling, drill and pin sequencing, and parts infeed coordination. An operator interface provides the operator with information such as louver width and machine status. The PLC is programmed so that a range of production parameters is supported on the louver production machine. This allows many different manufacturers to take advantage of the automated systems, regardless of the shutter size and style they are manufacturing. The raw louver stock comes in many different lengths and can be produced in various wood types, as well as plastics and composites. The LPS-36T system accommodates raw louver stock lengths between 18 inches and 16 feet and allows the operator to enter louver length, width and thickness using the operator interface panel.

D2-250 PLCs and DSData Server perform batch management in textile dyeing facilities

Cubex, Inc. has developed a Windows-based Batch Management System that utilizes the ***AutomationDirect*** DL205 line of processors. All production data for historical trending, alarm logging, machine control and production/efficiency/cycle reporting is provided through OPC and housed in a Microsoft SQL Server 2000 database. Tools are included for controlling, configuring and scheduling

machines, formula management, procedure management, reporting and troubleshooting.

The system has been installed in four textile dyeing facilities controlling 23 textile dye machines. The flexible system allows the machines to run in either stand-alone or hosted modes, using a touch screen for local machine setup and control. Another application, Process Explorer, uses the same architecture for collecting and reporting process data.

D2-250 PLCs control and monitor heatshrink tubing production process

Texloc LTD of Fort Worth, Texas is a manufacturer of fluoroplastic tubing, including convoluted and corrugated tubing, smooth bore, heating tubing, and profiles and assemblies. The company uses several ***AutomationDirect*** products, including ***Direct***Touch panels, AC drives, and D2-250 and D4-450 PLC systems. One process at Texloc is based on a D2-250 system that, along with Lookout***Direct***, runs and monitors the plant's tube extruding and curing systems on five production lines. The D2-250 controls and monitors all digital logic and analog signals. Descriptive process information is shown to the operator via the touch panel. All controls except power and E-stop originate in the touch panel. The F2-CP128 BASIC co-processor has a custom program that communicates with two smart servomotors. It passes speed and operation parameters to the servos and polls the servos for status, torque and position information. An Ethernet module in the PLC is connected to a 10-megabit network and data is collected by Lookout***Direct*** software. The data contains all operational parameters for statistical analysis and process data collection. The Ethernet module also allows backup of and modification to the D2-250's program effortlessly over the network.

Considerations for Choosing a PLC

PLC Selection Worksheet

Consideration	Information to Record		Notes
1. Proposed System	___ New system	____ Existing system	Your choice of PLC manufacturers may be limited by an existing system
2. Environmental Issues	____ Codes/environmental issues to consider	____ No codes or environmental issues to consider	Codes or environmental issues may affect the choice of PLC
3. Discrete Devices	___ Total inputs: ___ AC ___ DC	___ Total outputs: ___ AC ___ DC	Enter quantities and type based on corresponding field devices
4. Analog Devices	___ Total inputs: ___ Voltage ___ Current ___ Temperature	___ Total outputs: ___ Voltage ___ Current	Enter quantities and type based on corresponding field devices
5. Specialty Modules or Features (application-specific)	___ High speed counter ___ Positioning ___ Servo/stepper ___ BASIC programming	___ Real-time clock ___ Others (list below)	Specialty modules may have to be considered if needed features are not available on the chosen PLC's CPU
6. CPU Required	__ K program memory __ PID __ Floating Point Math	__ K data memory __ Scan time __ Battery backup	Rules of thumb: 10 bytes of program memory for each discrete device and 25 bytes for each analog device
7. I/O Locations	___ Local	___ Remote	Enter number of physical locations needed for each
8. Communications	___ ASCII (interface to serial devices like bar code readers, labelers, etc. ___ PLC to PLC (proprietary among models of same manufacturer) ___ Specific protocols ___ Ethernet ___ DeviceNet ___ Profibus ___ MODBUS RTU		Communications requirements should be considered if you think your system will be communicating to other systems/networks (bar code readers, labelers, etc.)
9. Programming	___ Floating point math ___ IEC-1131 languages	___ Others (list below)	Typical instructions like timers, counters, etc. are available in most PLCs; note any other special instructions here

Using the PLC Selection Worksheet

The worksheet on the opposite page can be used as a checklist of things to consider when determining PLC requirements. It lists the most important areas to be considered. The following are guidelines for completing the checklist:

1) Determine whether your system is new or existing: Will your system be installed from scratch or are there existing products already installed that the rest of your system will need to be compatible with?

Why this is important: Certain PLC products may not be compatible with others. Making sure your existing products are compatible with any PLC products you are researching will save you time and money.

2) Consider any environmental issues that will effect your application (temperature, dust, vibration, codes specific to your facility, etc.).

Why this is important: Certain environments may effect the operation of a PLC. For example, typical PLCs have an operating temperature of 0-55 degrees Celsius (32-130 degrees F). If your application will include any extreme environmental conditions, or you have specific codes at your facility that must be met, you will need to research products that meet those specifications, or design the installation to meet requirements.

3 & 4) Determine how many discrete and analog devices your system will have. Which types (AC, DC, etc.) are needed?

Why this is important: The number and type of devices your system will include is directly linked to the amount of I/O that will be necessary for your system. You will need to choose a PLC model that supports your I/O count requirements and has modules that support your signal types.

5) Determine whether your system will require any specialty features: Will your application require high-speed counting or positioning? What about a real-time clock or other specialty feature?

Why this is important: Specialty functions are not necessarily available using standard I/O modules. Planning ahead to determine whether or not your application will require special functions will help you determine whether or not you will need to purchase additional specialty modules for your system.

6) Determine the type of CPU you will need: How much memory will your system require? How many devices will your system have (determines data memory)? How large is your program, and what types of instructions will your program include (determines program memory)? How fast a scan time do you need?

Why this is important: Data memory refers to the amount of memory needed for dynamic data manipulation and storage in the system. For example, counter and timer instructions typically use data memory to store setpoints, current values, and other internal flags. If the application requires historical data retention, such as measured device values over a long period of time, the size of the data tables required may determine the CPU model you choose. Program memory is the amount of memory needed to store the sequence of PLC program instructions that have been programmed to perform the application. Each type of instruction requires a specific amount of program memory, typically defined in a PLC's programming manual. Applications that are basically sequential in nature can rely on the I/O device rule of thumb to estimate program memory (seven words of memory for each I/O device); complex applications will be more difficult to judge.

If scan time is important in your application, consider the CPU processor speed as well as instruction execution speed. Some CPUs are faster at boolean logic but slower with data handling instructions.

7) Determine where your I/O will be located: Will your system require only local I/O, or both local and remote I/O locations?

Why this is important: If subsystems will be needed at long distances from the CPU, you will need a PLC model that supports remote I/O. You will also have to determine if the remote distances and speeds supported by the PLC will be adequate for your application.

8) Determine your communication requirements: Will your system be communicating to other networks or systems?

Why this is important: Spare communication ports are not always included with a PLC. Knowing your system communication requirements will help you choose a CPU that supports your communication requirements, or additional communication modules if necessary.

9) Determine your programming requirements: Does your application require only traditional programming instructions, or are special instructions necessary?

Why this is important: Certain PLCs may not support every type of instruction. You will need to choose a PLC that supports all instructions that you may need for a specific application. For example, built-in PID functions are much easier to use than writing your own code to perform closed-loop process control.

Once you have recorded the information on the worksheet and determined your requirements, use this sheet to find a PLC that meets your requirements. With your requirements outlined, it will be much simpler to find a product with the necessary number of I/O points, features, memory, etc. that your application requires.

The following pages present Koyo's *Direct*LOGIC family of programmable logic controllers and their capabilities. Tables A, B and C review I/O availability, communications and programming to help you choose the right family for your application.

DirectLogic Programmable Logic Controllers

DL05: Offers incredible features

The DL05 series is a PLC with features you won't find in most bricks — six I/O combinations of AC, DC and relay I/O, and advanced programming functions such as PID and drum sequencing.

- Eight inputs and six outputs
- 2K program memory
- 4K data memory
- Two communication ports
- 129-instructions, including four PID loops
- Removable terminal block
- Windows-based programming software
- 12/24VDC powered versions
- Discrete and analog I/O option modules
- Memory cartridge/real-time clock option module
- DeviceNet™ slave option module

starts on page 248

DL06: Mighty micro with 36 I/O and four expansion slots

Our new DL06 is our first micro PLC to combine its fixed I/O of 20 inputs and 16 outputs with four option card slots for expansion (discrete, analog, communication modules), all in the same package. With the DL06, you can use the same PLC panel layout for all applications from 36 to 100 I/O.

- 20 inputs and 16 outputs
- 7.5K program memory
- 7.3K data memory
- Two communication ports, including built-in RS232/RS422/RS485 port
- 229 instructions, including eight PID loops and ASCII
- Removable terminal blocks
- Windows-based programming software
- Built-in 3A 24VDC auxiliary power supply for field devices
- 12/24VDC powered versions
- Built-in real-time clock/calendar
- Discrete and analog I/O option modules
- DeviceNet™ slave option module
- Optional plug-in LCD display

starts on page 254

DL105: Micro PLC

The DL105 series is a fixed-I/O micro PLC with 10 inputs and eight outputs. Eight configurations are available in combinations of AC, DC and relay I/O, as well as AC and DC powered units.

- 10 inputs and eight outputs
- 2K program memory
- 384 words data memory
- 110/220VAC or 24VDC power supply versions
- Powerful built-in .5A24VDC auxiliary power supply for field devices
- 91-instruction programming includes time or event-based drum sequencer, timed interrupt, immediate I/O, etc.
- Heavy-duty seven amp relays with built-in surge suppression on models with relay outputs
- One RS-232C communication port
- DeviceNet slave I/O units available

starts on page 320

DirectLogic PLCs and Industrial PC

DL205 The world's most powerful micro-modular PLC
with powerful I/O and communication modules

If your application requires the flexibility of a modular control system, a DL205 PLC is the lowest cost, most versatile solution you'll find. Check out all our modules, bases and communication options.

- AC/DC in/out, up to 32 points
- Ten amp relay out
- 12-bit and 16-bit analog inputs and outputs
- Temperature inputs(t/c and RTD)
- Data communications, including serial and Ethernet modules
- Counter input/pulse output
- Remote I/O master and slave
- H2-CTRIO, 4-channel high speed counter/ pulse output
- H2-EBC, Ethernet slave base controller
- H2-SERIO, triple port serial module for WinPLCs and more!

Four CPUs from 2.4K memory with 128 possible I/O to 30.4K memory with 16,384 possible I/O.

Four base sizes with built-in power supply, including 12/24 VDC, 110/220VAC and 125VDC powered bases.

starts on page 346

DL305 Stay ahead by building on the past

The DL305 series is a small modular PLC that has been marketed by various name brand PLC manufacturers for over 19 years. This Koyo design revolutionized the small PLC market, and is still a good performer and a great value.

- Three standard CPUs, including the D3-350 with PID control and two communication ports
- Five, eight and 10 slot bases
- 110/220VAC or 24VDC power supply
- AC, DC inputs
- AC, DC, and relay outputs
- Eight or 12-bit analog input/output
- Specialty modules include ASCII/BASIC module, high-speed counter, and communication interface module

starts on page 462

DL405 Our most powerful PLC family

The DL405 product line packs a lot of power for its size and price. It has the widest variety of I/O modules and configurations of all our PLCs.

- AC/DC in/out, up to 64 points
- Ten amp relay out
- 12-bit and 16-bit analog inputs and outputs
- Thermocouple and RTD inputs
- Data communications, including serial and Ethernet modules
- Counter input
- Remote I/O master and slave modules
- Ethernet I/O master and slave modules
- New high-speed counter module
- 16 PID loops built in, up to 96 with option modules

Three CPUs from 6.5K memory with 1,664 possible I/O to 30.8K memory with 16,384 possible I/O.

Three base sizes with built-in power supply, including 12/24 VDC, 110/220VAC and 125VDC powered bases.

starts on page 524

PC Control DL470 industrial PC and PC monitors

starts on page 620

Reviewing PLC Capabilities

The following functionality tables (A, B and C) provide an overview of the capabilities of our various *Direct*LOGIC PLC families. When you have identified the type and quantity of I/O devices required by your application, the I/O Availability table shows you which family or families will meet those specifications.

A I/O Availability

Check the I/O types supported by the DirectLOGIC PLC families

		CAPACITY			DISCRETE																		ANALOG				
DL Family	*CPU/Device*	*Local I/O*	*Mix of I/O (inputs/outputs)*	*Total Possible I/O*	*DC In/Relay Out*	*DC In/DC Out*	*DC In/AC Out*	*AC In/Relay Out*	*AC In/DC Out*	*AC In/AC Out*	*DC Sink/Source In*	*DC Sink In*	*DC Source In*	*TTL In*	*DC Sink Out*	*DC Source Out*	*AC/DC In*	*AC In*	*AC Triac Out*	*AC/DC Relay Out*	*AC/DC Isol. Relay out*	*High Speed In*	*Pulse Out*	*Analog 4-20 In or Volt IN*	*Analog Isol. In*	*Analog 4-20 or Volt Isol. Out*	*Analog 4-20 Out or Volt Out*	*Temperature In*
DL05	D0-05DR	14	8 in/6 out	30	✓						✓				✓	✓				✓		✓		✓			✓	
	D0-05DD	14	8 in/6 out	30		✓					✓				✓	✓				✓		✓	✓	✓			✓	
	D0-05DA	14	8 in/6 out	30			✓				✓				✓	✓				✓		✓		✓			✓	
	D0-05AR	14	8 in/6 out	30				✓			✓				✓	✓				✓				✓			✓	
	D0-05AD	14	8 in/6 out	30					✓		✓				✓	✓				✓			✓	✓			✓	
	D0-05AA	14	8 in/6 out	30						✓	✓				✓	✓				✓				✓			✓	
DL06	D0-06DD1	36	20 in/16 out	100		✓					✓				✓	✓				✓		✓	✓	✓			✓	
	D0-06DD2	36	20 in/16 out	100		✓					✓				✓	✓				✓		✓	✓	✓			✓	
	D0-06DR	36	20 in/16 out	100	✓						✓				✓	✓				✓		✓		✓			✓	
	D0-06AA	36	20 in/16 out	100						✓	✓				✓	✓				✓				✓			✓	
	D0-06DA	36	20 in/16 out	100			✓				✓				✓	✓				✓		✓		✓			✓	
	D0-06AR	36	20 in/16 out	100				✓			✓				✓	✓				✓				✓			✓	
DL105	F1-130DR	18	10 in/8 out	18	✓																	✓						
	F1-130DD	18	10 in/8 out	18		✓																✓	✓					
	F1-130DA	18	10 in/8 out	18			✓															✓						
	F1-130AR	18	10 in/8 out	18				✓																				
	F1-130AD	18	10 in/8 out	18					✓														✓					
	F1-130AA	18	10 in/8 out	18						✓																		
DL205	D2-230	256	128 in/128 out	256	✓						✓				✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	D2-240	256	any mix	896	✓						✓				✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	D2-250(-1)	256	any mix	2048	✓						✓				✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	D2-260	256	any mix	16,384	✓						✓				✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
DL305	D3-330	168	any mix	168							✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	D3-330P	168	any mix	168							✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	D3-340	168	any mix	184							✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	D3-350	368	any mix	880							✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
DL405	D4-430	640	320 in/320 out	1152							✓		✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	D4-440	640	320 in/320 out	1664							✓		✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	D4-450		1024 in/1024 out	16,384							✓		✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓

Reviewing PLC Capabilities

The Communications table lists all the supported protocols and which PLC can communicate using that protocol. You can also see which families support remote I/O, Ethernet communications and ASCII coprocessing. Many CPUs and our fixed I/O base units have communications ports built in. The DL205 family also has a wide variety of Fieldbus slave controllers to integrate our I/O with popular networks such as DeviceNet and Profibus.

B Communications

Check the communications types supported by the DirectLOGIC PLC families

		CPU Ports									SPECIALTY MODULES												
FAMILY	*CPU*	*K-Sequence Slave*	*DirectNet Master*	*DirectNet Slave*	*MODBUS RTU Master*	*MODBUS RTU Slave*	*ASCII Out (print)*	*ASCII IN/Out*	*RS485*	*Remote I/O Master*	*ETHERNET*	*SDN*	*RS232*	*RS422*	*ASCII Coprocessor*	*Remote I/O Master*	*Remote I/O Slave*	*Slice I/O Master*	*Slice I/O Slave*	*DirectNet Master/Slave*	*MODBUS RTU Slave*	*DeviceNet Slave*	*Profibus Slave*	*SDS Slave*
DL05	All DL05 models	✓	✓	✓	✓	✓	✓															✓		
DL06	All DL06 models	✓	✓	✓	✓	✓	✓	✓	✓	✓												✓		
DL105	F1-130DR	✓																				✓		
	F1-130DD	✓																				✓		
	F1-130DA	✓																						
	F1-130AR	✓																				✓		
	F1-130AD	✓																						
	F1-130AA	✓																						
DL205	D2-230	✓																						
	D2-240	✓		✓							✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✠	✠	✠
	D2-250(-1)	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✠	✠	✠
	D2-260	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✠	✠	✠
DL305	D3-330			✓									✓	✓	✓									
	D3-330P			✓									✓	✓	✓									
	D3-340		✓	✓		✓									✓									
	D3-350	✓	✓	✓	✓	✓	✓			✓			✓	✓						✓	✓			
DL405	D4-430	✓		✓							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
	D4-440	✓		✓							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
	D4-450	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			

✠ *These slave modules take the place of a DL205 CPU in any DL205 base populated with I/O, for use with Fieldbus networks.*

Note: The DL470 industrial PC is not included in these PLC functionality charts. If you think your application requires an industrial PC for PC control or other Windows-based applications, review the DL470 specifications later in this section.

Reviewing PLC Capabilities

The Programming table provides a listing of the major program functions. It also shows the amount of memory and instruction capability for each CPU. The programming descriptions below explain the various programming tools that can be used to configure the CPUs.

C Programming

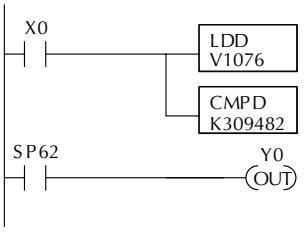
Check the programming instructions supported by the DirectLOGIC PLC families

		Instructions															Tools				
Family	*CPU*	*Total Memory*	*Max. Instructions*	*Max. Variables*	*Battery Backup*	*Run-Time Edit*	*RLL Plus*	*Control Relays*	*Timer/Counters*	*Immediate I/O*	*Drums*	*Subroutines*	*For/Next Loops*	*Floating Point Math*	*PID*	*Clock/Calendar*	*Trigonometric Instructions*	*Full Program PC-PGMSW*	*Single Family PGM*	*Site License*	*OEM License*	*Handheld Programmer*
DL05	All DL05 models	6.0K	2048	4096	✓*	✓	✓	512	128/128	✓	✓	✓	✓		✓	✓*		✓	✓	✓		✓
DL06	All DL06 models	14.8K	7.5K	7.3K	✓	✓	✓	1024	256/128	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
DL105	All DL105 models	2.4K	2048	256		✓	✓	256	64/64	✓	✓							✓	✓	✓		✓
DL205	D2-230	2.4K	2048	256	✓	✓	✓	256	64/64	✓								✓	✓	✓	✓	✓
	D2-240	3.8K	2560	1024	✓	✓	✓	256	128/128	✓		✓	✓			✓		✓	✓	✓	✓	✓
	D2-250 (-1)	14.8K	7680	7168	✓	✓	✓	1024	256/128	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	D2-260	30.4K	15.8K	14.6K	✓	✓	✓	2048	256/256	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DL305	D3-330	3.8K	3.7K	128	✓			140	64									✓	✓	✓	✓	✓
	D3-330P	3.8K	3.7K	128	✓		✓	140	64								✓	✓	✓	✓	✓	✓
	D3-340	3.9K	3.7K	192	✓			196	64									✓	✓	✓	✓	✓
	D3-350	14.8K	7680	7168	✓	✓	✓	1024	256/128	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DL405	D4-430	6.5K	3.5K	3.0K	✓	✓	✓	480	128/128	✓								✓		✓	✓	✓
	D4-440	22.5K	15.5K	7.0K	✓	✓	✓	1024	256/128	✓		✓	✓			✓		✓		✓	✓	✓
	D4-450	30.8K	15.5K*	15.3K	✓	✓	✓	2048	256/256	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓

** Requires optional memory card*

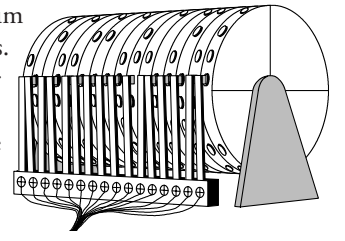
Standard RLL programming

RLL (relay ladder logic) 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.



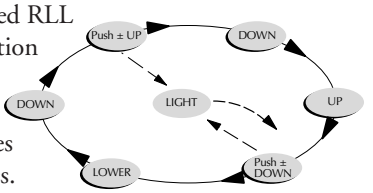
Timer/event drum sequencer

There are 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

Stage programming (also called RLL Plus) 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.



PID loop operation

The PID loop operation uses setup tables to configure the loops. Features include: auto tuning, alarms, SP ramp/soak generation, and more.