# GETTING STARTED

CHAPTER
1

In This Chapter...

NOTE: *Modules F1-130-DD, F1-130-DD-D, F1-130AA, F1-130DA, F1-130DR-D, F1-130DR, F1-IOCON, and F1-130AR have been discontinued. Terminal blocks B-F1130DR and B-F1130AR are also discontinued. Please consider Productivity, CLICK, or BRX systems as a replacement platform.*

Introduction

The Purpose of this Manual

Thank you for purchasing a DL105 Micro PLC. This manual shows you how to install, program, and maintain all the Micro PLCs in the DL105 family. 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 DL105 PLCs, and for the PLC programmer. If you understand PLC systems, our manuals will provide all the information you need to get and keep your system up and running.
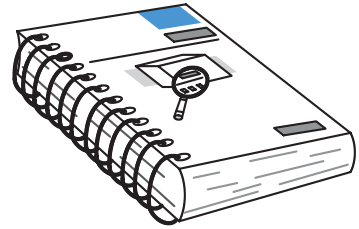
Where to Begin

If you already understand the DL105 Micro PLC please read Chapter 2, "Installation, Wiring, and Specifications", and proceed on to other chapters as needed. Be sure to keep this manual handy for reference when you run into questions. If you are a new DL105 customer, we suggest you read this manual completely so you can understand the wide variety of features in the DL105 family of products. We believe you will be pleasantly surprised with how much you can accomplish with **AutomationDirect** products.

Supplemental Manuals

If you have purchased operator interfaces or *Direct*SOFT programming software, 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, 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:

- Our Web site 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.

Conventions Used

NOTE: *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.*

WARNING: 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 entire WARNING: will be in boldface text.

Key Topics for Each Chapter

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

Getting Started

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In This Chapter...

DL105 Micro PLC Components

The DL105 Micro PLC family is a versatile product line that provides a wide variety of features in a very compact footprint. The PLCs are small, yet offer many features usually found in larger, more expensive systems. These include removable connectors, RS-232C communication port, and +24V auxiliary power supply.
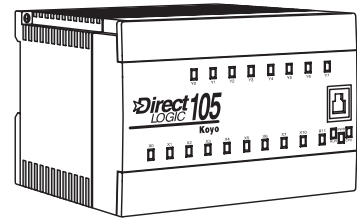
The DL105 Micro PLC Family

The DL105 Micro PLC family includes eight different versions. All have the same appearance and CPU performance. The CPU offers the same instruction set as our popular DL230 CPU, plus several more instructions specifically designed for machine control applications. All DL105 PLCs have an RS-232C communications port, and the AC-powered versions have an auxiliary +24V output. Units with DC inputs have selectable high-speed input features on four input points. Units with DC outputs offer selectable pulse output capability on the first two output points. All DL105 Micro PLCs offer a large amount of program memory, a substantial instruction set and advanced diagnostics. Details of these features and more are covered in Chapter 4, CPU Specifications and Operation. The eight types of DL105 Micro PLCs provide a variety of Input/Output choices, listed in the following table.

DL105 Part Number	Discrete Input Type	Discrete Output Type	External Power	Auxiliary 24V Output	High-Speed Input	Pulse Output
F1-130AR (retired)	AC	Relay			No	No
F1-130DR (retired)	DC	Relay			Yes	No
F1-130AD	AC	DC	94–240 VAC	Yes	No	Yes
F1-130DD (retired)	DC	DC			Yes	Yes
F1-130AA (retired)	AC	AC			No	No
F1-130DA (retired)	DC	AC			Yes	No
F1-130DR-D	DC	Relay	10–30 VDC	No	Yes	No
F1-130DD-D (retired)	DC	DC			Yes	Yes

NOTE: *F1-130-DD, F1-130-DD-D, F1-130AA, F1-130AR, F1-130DR, and F1-130DA modules have been discontinued. Please consider Productivity, CLICK, or BRX systems as a replacement platform.*

Programming Methods

Two programming methods are available: a software programming package and a handheld programmer. The software and the handheld programmer support RLL (Relay Ladder Logic) and RLLPLUS (STAGE) programming.

*Direct*SOFT Programming for Windows

The DL105 Micro PLC can be programmed with one of the most advanced programming packages in the industry - - *Direct*SOFT, a Windows-based software package that supports familiar features such as cut-and-paste between applications, point-and-click editing, viewing and editing multiple application programs at the same time, etc. *Direct*SOFT universally supports the *Direct*LOGIC CPU families. This means that you can use the same *Direct*SOFT package to program DL05, DL06, DL105, DL205, DL305, DL405 or any new CPU we may add to our product line. (Upgrade software may be required for new CPUs as they become available.)

There is a separate manual that discusses the *Direct*SOFT programming software which is included with your software package.

Handheld Programmer

All DL105 Micro PLCs have a built-in programming port for use with the handheld programmer (D2-HPP), the same programmer used with the DL205 family. The handheld programmer can be used to create, modify and debug your application program. A separate manual discusses the Handheld Programmer.

I/O Quick Chart Selection

The eight versions of the DL105 have Input/Output circuits which can interface to a wide variety of field devices. In several instances a particular Input or Output circuit can interface to either DC or AC voltages, or both sinking and sourcing circuit arrangements. Check this chart carefully to find the proper DL105 Micro PLC to interface to the field devices in your application.

Boolean Instructions	INPUTS			OUTPUTS		
	I/O Type/ Commons	Sink/ Source	Voltage Ranges	I/O Type Commons	Sink/ Source	Voltage/Current Ratings
F1-130AR	AC / 3	--	80 - 132 VAC 90 - 150 VDC	Relay / 4	Sink or Source	12–30 VDC, 7A[*] 12–250 VAC, 7A[*]
F1-130DR	DC / 3	Sink or Source	10 - 26.4 VDC 21.6 - 26.4 VAC	Relay / 4	Sink or Source	12–30 VDC, 7A[*] 12–250 VAC, 7A[*]
F1-130AD	AC / 3	--	80 - 132 VAC 90 - 150 VDC	DC / 1[**]	Sink	5–30 VDC, 0.3 A (Y0–Y1) 5–30 VDC, 0.6 A (Y3–Y7)
F1-130DD	DC / 3	Sink or Source	10 - 26.4 VDC 21.6 - 26.4 VAC	DC / 1[**]	Sink	5–30 VDC, 0.3 A (Y0–Y1) 5–30 VDC, 0.6 A (Y3–Y7)
F1-130AA	AC / 3	--	80 - 132 VAC 90 - 150 VDC	AC / 4	--	20–140 VAC, 47–63 Hz 1.7 A[*]
F1-130DA	DC / 3	Sink or Source	10 - 26.4 VDC 21.6 - 26.4 VAC	AC / 4	--	20–140 VAC, 47–63 Hz 1.7 A[*]
F1-130DR-D	DC / 3	Sink or Source	10 - 26.4 VDC 21.6 - 26.4 VAC	Relay / 4	Sink or Source	12–30 VDC, 7A[*] 12–250 VAC, 7A[*]
F1-130DD-D	DC / 3	Sink or Source	10 - 26.4 VDC 21.6 - 26.4 VAC	DC / 1[**]	Sink	5–30 VDC, 0.3 A (Y0–Y1) 5–30 VDC, 0.6 A (Y3–Y7)

* Subject to temperature derating chart. See Chapter 2 Specifications for your particular DL105 version.
** DC outputs have one electrical common, but it is accessible at three terminals on the output connector.

NOTE: *Modules F1-130-DD, F1-130-DD-D, F1-130AA, F1-130DA, F1-130DR-D, F1-130DR, F1-IOCON, and F1-130AR have been discontinued. Terminal blocks B-F1130DR and B-F1130AR are also discontinued. Please consider Productivity, CLICK, or BRX systems as a replacement platform.*

Quick Start for PLC Checkout and Programming

If you have experience with PLCs, or if you just want to setup a quick example, this example is for you! This example is not intended to tell you everything you need to start-up your system, warnings and helpful tips are in the rest of the manual. It is only intended to give you a general picture of what you will need to do to get your system powered-up.

Step 1: Unpack the Recommended DL105 Equipment

Unpack the DL105 equipment and verify you have the recommended parts necessary to build this demonstration system. The components are:

- DL105 Micro PLC
- AC power cord for AC-powered units
- F1- 04SIM input simulator, or toggle switches (see Step 2 on next page).
- Hook-up wire, 16–20 AWG
- DL105 User Manual (this manual)
- A small screwdriver, regular or #2 Philips type

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

- *Direct*SOFT Programming Software, *Direct*SOFT Manual, and a programming cable (connects the DL105 to a personal computer),or
- D2- HPP Handheld Programmer (comes with programming cable), and the Handheld Programmer Manual
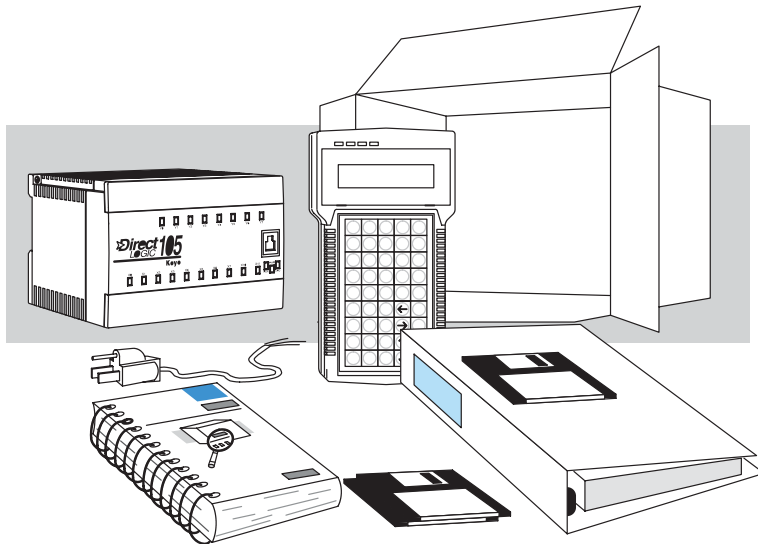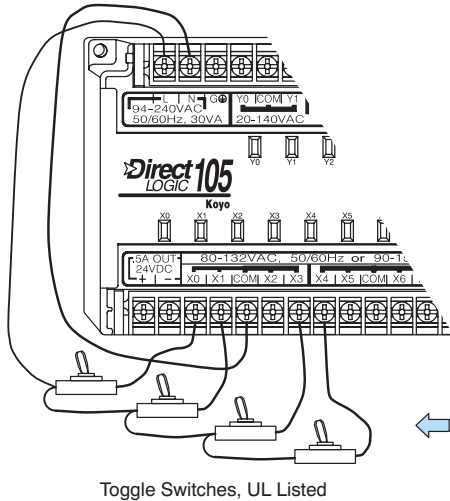
Step 2: Connect Switches to Input Terminals

To finish this quick-start exercise or study other examples in this manual, you'll need to connect some input switches as shown below. For most models, the F1-04SIM Input Simulator is a quick way to install four switches on inputs X0 - X3. DC-powered units will require routing DC power to the simulator as shown. We recommend using one of the models compatible with the input simulator as you learn the DL105.

However, you may wire individual toggle switches to AC-powered units as shown, *as long as you follow the instructions in the accompanying WARNING note.*

F1-130DR/F1-130DR-CE,
F1-130DD/F1-130DD-CE,
F1-130DA
(DC input versions)

Slide simulator under left-most terminals and tighten screws.

F1-130DR, F1-130DD-D
(DC-powered versions)
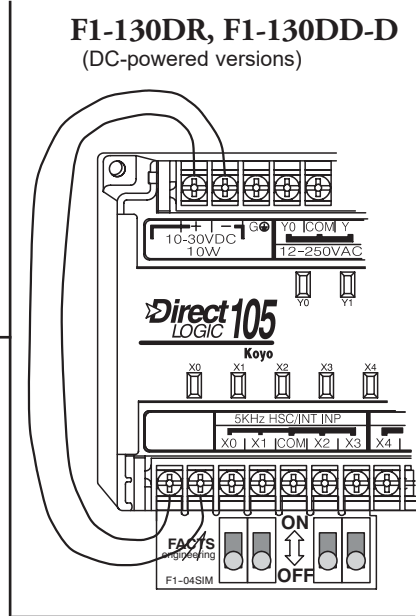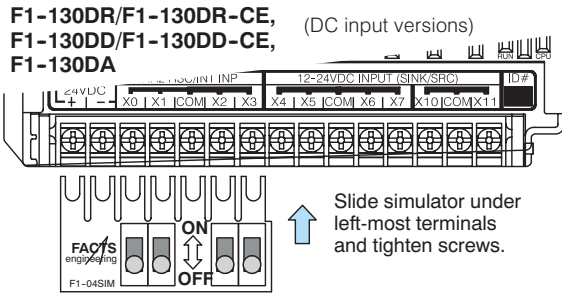
F1-130AR, F1-130AD, F1-130AA
(AC input versions, 120VAC only)

Toggle Switches, UL Listed

WARNING: DO NOT wire the toggle switches as shown to 240VAC-powered units. The discrete inputs will only accept 120VAC nominal. Also, remove power and unplug the DL105 when wiring the switches. Only use UL-approved switches rated for at least 250VAC, 1A. Firmly mount the switches before using.
NEVER use the input simulator on these units with AC-type discrete inputs.

Step 3: Connect the Power Wiring

Connect the power input wiring for the version DL105 you have. Observe all precautions stated earlier in this manual. For more details on wiring, see Chapter 2 on Installation, Wiring, and Specifications. When the wiring is complete, close the connector covers. Do not apply power at this time.
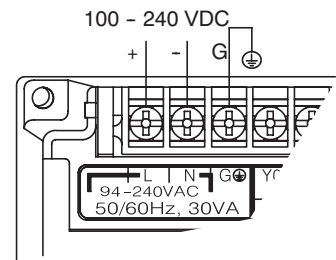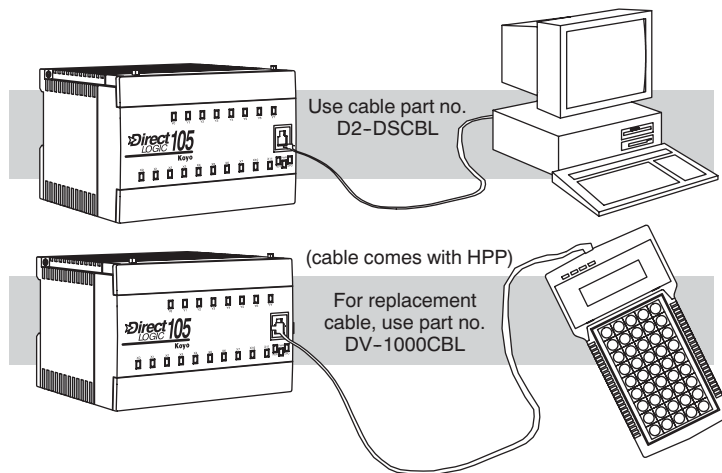
12/24 VDC Power Input

10 – 30 VDC
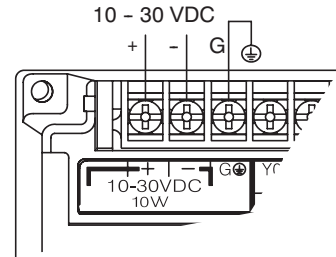
110/220 VAC Power Input

94 – 240 VAC
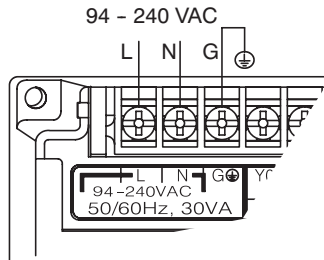
125 VDC Power Input

100 – 240 VDC

Step 4: Connect the Programming Device

Most programmers will use *Direct*SOFT programming software, installed on a personal computer. Or, you may need the portability of the Handheld Programmer. Both devices will connect the COM1 port of the DL105 via the appropriate cable.

Use cable part no. D2-DSCBL

(cable comes with HPP)

For replacement cable, use part no. DV–1000CBL

Step 5: Switch on the System Power

Apply power to the system and ensure the PWR indicator on the DL105 is on. If not, remove power from the system and check all wiring and refer to the troubleshooting section in Chapter 8 for assistance.

Step 6: Initialize Scratchpad Memory

It's a good precaution to always clear the system memory (scratchpad memory) on a new DL105. When a unit has been without power for several days, the system RAM contents may have been corrupted and will require initialization.

- In *Direct*SOFT, select the PLC Menu > Setup > Initialize Scratchpad.
  For additional information, see the *Direct*SOFT Manual.

- For the Handheld Programmer, use the AUX key and execute AUX 54.
  For additional information, see the Handheld Programmer Manual.

Step 7: Enter a Ladder Program

At this point, *Direct*SOFT programmers need to refer to the Quick Start Tutorial in the *Direct*SOFT Manual. There you will learn how to establish a communications link with the DL105 PLC, change CPU modes to Run or Program, and enter a program.

If you are learning how to program with the Handheld Programmer, make sure the CPU is in Program Mode (the RUN LED on the front of the DL105 should be off.) If the RUN LED is on, use the MODE key on the Handheld Programmer to put the PLC in Program Mode. Enter the following keystrokes on the Handheld Programmer.

Equivalent *Direct*SOFT display

	Keystrokes	Description
	CLR CLR	Clear the Program.
X0 Y0 ─┤ ├──(OUT)	C 2 E 4 AUX ENT ENT CLR	
	NEXT $ STR -> A 0 ENT	Move to the first address and enter X0 contact.
	GX OUT -> A 0 ENT	Enter output Y0.
──(END)	SHFT E 4 N TMR D 3 ENT	Enter the END statement

After entering the simple example program put the PLC in Run mode by using the Mode key on the Handheld Programmer.

The RUN indicator on the PLC will illuminate indicating the CPU has entered the Run mode. If not, repeat this step, ensuring the program is entered properly or refer to the troubleshooting guide in chapter 8.

After the CPU enters the run mode, the output status indicator for Y should follow the switch status on input channel X0. When the switch is on, the output will be on.

Steps to Designing a Successful System

Step 1: Review the Installation Guidelines

Always make safety the first priority in any system design. Chapter 2 provides several guidelines that will help you design a safer, more reliable system. This chapter also includes wiring guidelines for the various versions of the DL105 PLC.
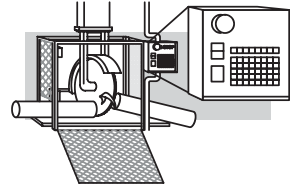
Step 2: Understand PLC Setup Procedures

The PLC is the heart of your automation system. Make sure you take time to understand the various features and setup requirements.
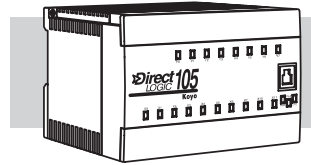
Step 3: Review the I/O Selection Criteria

There are many considerations involved when you select your I/O type and field devices. Take time to understand how the various types of sensors and loads can affect your choice of I/O type.
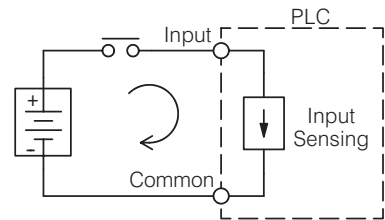
Step 4: Choose a System Wiring Strategy

It is important to understand the various system design options that are available before wiring field devices and field-side power supplies to the Micro PLC.
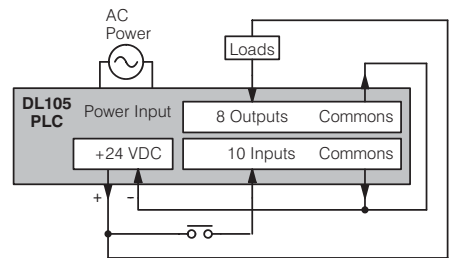
Step 5: Understand the System Operation

Before you begin to enter a program, it is very helpful to understand how the DL105 system processes information. This involves not only program execution steps, but also involves the various modes of operation and memory layout characteristics.
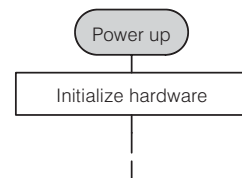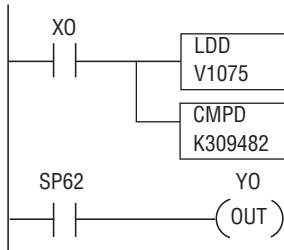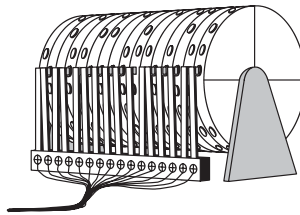
Step 6: Review the Programming Concepts

The DL105 PLC instruction set provides for three main approaches to solving the application program, depicted in the figure below.

- 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 also be needed to augment drums and stages.

- The Timer/Event Drum Sequencer features up to 16 steps and offers both time and/or event-based step transitions. The EDRUM instruction is best for a repetitive process based on a single series of steps.

- Stage programming (also called RLLPLUS) is based on state-transition diagrams. Stages divide the ladder program into sections which correspond to the states in a flow chart you draw for your process.
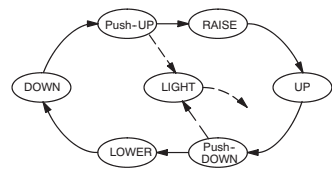
Standard RLL Programming
(See Chapter 5)

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

Stage Programming
(See Chapter 7)

After reviewing the programming concepts above, you'll be equipped with a variety of tools to write your application program.

Step 7: Choose the Instructions

Once you have installed the Micro PLC and understand the main programming concepts, you can begin writing your application program. At that time you will begin to use one of the most powerful instruction sets available in a small PLC.
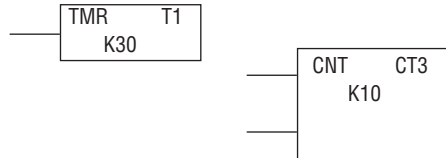
Step 8: Understand the Maintenance and Troubleshooting Procedures

Sometimes equipment failures occur when we least expect it. Switches fail, loads short and need to be replaced, etc. In most cases, the majority of the troubleshooting and maintenance time is spent trying to locate the problem. The DL105 Micro PLC has many built-in features such as error codes that can help you quickly identify problems.
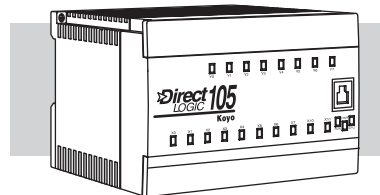
Questions and Answers about DL105 Micro PLCs

Q. What is the instruction set like?

A. The instruction set is very close to our popular DL230 CPU. However, there are significant additions, such as the drum instruction and High-Speed I/O capability.

Q. Do I have to buy the full *Direct*SOFT programming package to program the DL105?

A. No, ***Direct*SOFT100R** can be used. It has the same features as the full version of ***Direct*SOFT5** but allows only 100 words of ladder code that can be downloaded to the PLC. It will also program DL05/06/205/305/405 systems, and it is only available for download online. (Order programming cable separately.) 32- bit application, Windows 2000 or Windows XP (Pro or Home) recommended. This software is available at no cost to you.

Q. Is the DL105 networkable or expandable?

A. No, the DL130 series is stand-alone PLCs. However, our DL205 system is expandable and networkable (with DL240 CPU), yet very compact and affordable.

Q. Does the DL105 have motion control capability?

A. Yes. The High-Speed I/O features offer either encoder inputs with high-speed counting and presets with interrupt, or a pulse/direction output for stepper control. Three types of motion profiles are available, which are explained in Chapter 3.

Q. Are the ladder programs stored in a removable EPROM?

A. The DL105 contains a non-removable EEPROM for program storage, which may be written and erased thousands of times. You may transfer programs to/from ***Direct*SOFT** on a PC, or the HPP (which does support a removable EEPROM).

Q. Does the DL105 contain fuses for its outputs?

A. There are no output circuit fuses. Therefore, we recommend fusing each channel, or fusing each common. See Chapter 2 for I/O wiring guidelines.

Q. Is the DL105 Micro PLC U.L.R approved?

A. The Micro PLC has met the requirements of UL (Underwriters' Laboratories, Inc.) and CUL (Canadian Underwriters' Laboratories, Inc.).

Q. Can the DL105 accept 5VDC inputs?

A. No, 5 volts is lower than the DC input ON threshold. However, many TTL logic circuits can drive the inputs if they are wired as open collector (sinking) inputs. See Chapter 2 for I/O wiring guidelines.

Q. Which devices can I connect to the Com1 port of the DL105?

A. The port is RS-232C, fixed at 9600 baud, and uses the proprietary K-sequence protocol. The port communicates with the following devices:

- DV-1000 Data Access Unit or Optimation Operator interface panels

- *Direct*SOFT (running on a personal computer)

- D2-HPP handheld programmer

- Other devices which communicate via K-sequence protocol should work with the DL105 Micro PLC. Contact the vendor for details.