

4: PLC Hardware and the Micrologix 1100 PLC - NOTES

TOPIC 1: What is a PLC?

A programmable logic controller (PLC) is a digital electronic device with a programmable memory for storing instructions to implement specific functions, such as logic, sequencing, timing, counting, and arithmetic to control machines and processes.

1. It's digital (uses binary to operate)
2. It can interface with analog devices
3. It's programmable and has memory
4. It stores instructions that are used to implement some function
5. It controls machines and processes

TOPIC 2: Inputs and Outputs

PLC inputs and outputs come in many flavors.

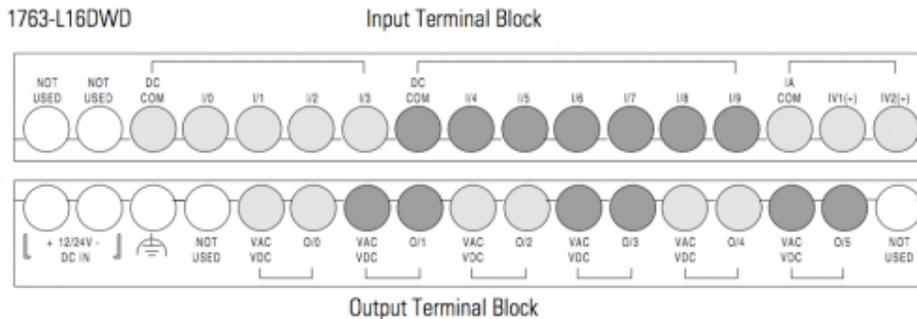
1. Discrete or Analog – Inputs and outputs are sold as either analog or digital/discrete. Analog inputs and outputs can vary continuously in steps in the same way that a [Digital to Analog Converter](#) works. Digital or Discrete inputs and outputs are either on or off.
2. Fixed, Expansion, or Modular – Some PLCs come with a set of “fixed” I/O. They cannot be removed and are not exchangeable. Some PLCs do not come with fixed I/O and if you want any you need to purchase “expansion” I/O. Still other PLC modules come with “fixed” I/O and have room for “expansion” I/O. Many times the I/O is needed to be located away from the PLC and a communication cable is placed between them. This is called “modular” I/O. Many PLCs have the ability to accommodate all three types.
3. DC or AC – Inputs and outputs are sold as either direct current (DC) compatible or alternating current (AC) compatible. Some inputs and outputs can handle either AC or DC. Below is a list of available input and output sets available for the MicroLogix 1100 PLC we have in the lab. The MicroLogix 1100 is capable of handling four I/O expansion modules along with the fixed I/O.

Expansion I/O

Catalog Number	Description
Digital	
1762-IA8	8-Point 120V AC Input Module
1762-IQ8	8-Point Sink/Source 24V DC Input Module
1762-IQ16	16-Point Sink/Source 24V DC Input Module
1762-IQ32T	32-Point Sink/Source 24V DC Input Module
1762-OA8	8-Point 120/240V AC Triac Output Module
1762-OB8	8-Point Sourcing 24V DC Output Module
1762-OB16	16-Point Sourcing 24V DC Output Module
1762-OB32T	32-Point Sourcing 24V DC Output Module
1762-OV32T	32-Point Sinking 24V DC Output Module
1762-OW8	8-Point AC/DC Relay Output Module
1762-OW16	16-Point AC/DC Relay Output Module
1762-OX6I	6-Point Isolated AC/DC Relay Output Module
1762-IQ8OW6	8-Point Sink/Source 24V DC Input and 6-Point AC/DC Relay Output Module
Analog	
1762-IF4	4-Channel Voltage/Current Analog Input Module
1762-OF4	4-Channel Voltage/Current Analog Output Module
1762-IF2OF2	Combination 2-Channel Input 2-Channel Output Voltage/Current Analog Module
Temperature	
1762-IR4	4-Channel RTD/Resistance Input Module
1762-IT4	4-Channel Thermocouple/mV Input Module

From The MicroLogix 1100 User Manual - Bulletin 1763

4. Sourcing or Sinking – This one of the most important and overlooked aspect of I/O! From the MicroLogix 1100 User Manual, below is an image of the fixed I/O supplied with the controller. To wire the inputs as sourcing the DC COM would be wired to +24Vdc and the inputs would be wired to a switch of some sort. The other side of the switch would be wired to ground. To wire the inputs as sinking, the switch is wired to +24Vdc and to an input and the DC COM is wired to ground. We will use sinking inputs in the lab. Using conventional current flow, sourcing means that the electrons are flowing out of the input and sinking means the electrons are flowing into the input. **WARNING** – if a switch claims to be a sourcing switch your PLC must be sinking and visa versa!



TOPIC 3: PLC Memory (Allen-Bradley MicroLogix)

Memory, at the most basic level, is broken into groups of bits as follows

1. Byte – 8 bits
2. Nibble – 4 bits
3. Word – 16 bits
4. Double Word – 32 bits

In the MicroLogix PLC, memory exists on another level – in files

1. Data Files (Outputs, Inputs, Timers Counters, etc.)
2. Functions Files (High Speed Counters, etc.)
3. Program Files (Your program(s))
4. Specialty Files (Data logging, etc.)

Each of these files and words inside the files have their own address so we know where to find them within memory.

For example, the entirety of the external outputs can be addressed at O:0.0. This means O = output file, 0 = PLC slot 0 (fixed I/O), 0 = word 0. To address a single bit in the outputs we would say O:0.0/2. Our outputs will range from O:0.0/0 through O:0.0/5. When referring to fixed I/O the second 0 can be ignored. This simplifies the addresses for the outputs to O:0/0 through O:0/5. When addressing, the (.) dot is referring to a word while the (/) slash is referring to the bit.

The following addresses will be helpful to keep around

1. Outputs range from O:0/0 through O:0/5
2. Inputs range from I:0/0 through I:0/9
3. Timers range from T4:0 through T4:255 (sometimes it is not possible to reach this high)
4. Counters range from C5:0 through C5:255 (sometimes it is not possible to reach this high)
5. Integers range from N7:0 through N7:255 (sometimes it is not possible to reach this high)

Another piece of memory that can be helpful to the programmer is the Status file. Inside this file is a large data set that tells the complete story of the current status of the PLC. See page 470 in the instruction set manual for the PLC. Review page 479, the watchdog scan time as it will come in handy later. This is the maximum allotted time the PLC has to run through your program once. It prevents the PLC from getting stuck in infinite loops. If the watchdog scan time is exceeded the PLC throws a fault and resets.

TOPIC 4: The MicroLogix 1100 PLC Hardware

Here is a quick rundown of the PLC we have in the lab.

MicroLogix 1100 – 1763-L16DWD

1. Ethernet communication and programming
2. Secondary Serial Port communication
3. 12-24Vdc power supply required
4. 10 digital DC inputs (sourcing or sinking) (fixed)
5. 2 analog DC inputs (fixed)
6. 6 DC or AC digital outputs (sourcing) (fixed)

You should now be prepared to answer the following questions.

1. What are fixed I/O?
2. TRUE or FALSE? Some I/O can handle either AC or DC?
3. You need to add 16 DC Inputs to your MicroLogix 1100 PLC. It must be capable of sinking or sourcing. Which module do you order?
4. You are given an inductive proximity switch that, according to its datasheet, is a sourcing switch. You wire it up to your PLC, what does DC COM need to be wired to?
5. The MicroLogix 1100 PLC operates on a word of memory at a time. How many bits does the PLC operate on at a time?
6. You wired the switch in number 4 to input 4. What address should you use in your program to read the state of the sensor?
7. What, in the status file, is located at address S:3H?
8. The watchdog scan time is set to 220. How much time does that represent?