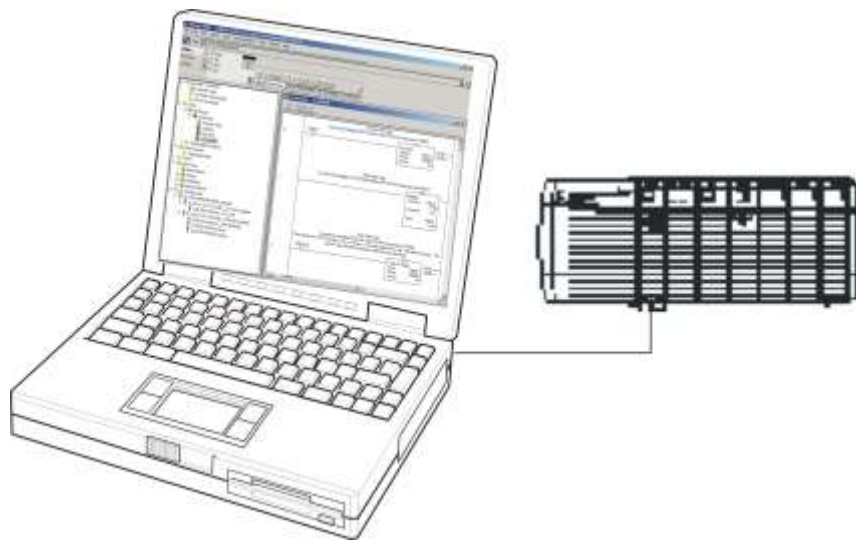


# **Allen Bradley ControlLogix**



## **Module 1**

### **ControlLogix Hardware**

### **Student Materials**

## Student Materials for Module 1: ControlLogix Hardware

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# ControlLogix Basics

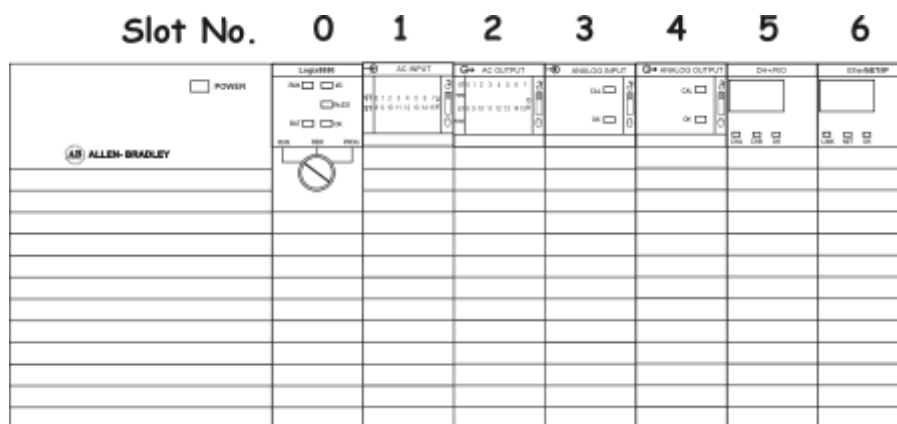
The ControlLogix platform is based on the IEC-1131 standard. This is an international standard for PLCs. One part of this standard is that the PLC will program in multiple formats (ladder, statement, function block, sequential function chart). By default, the RSLogix5000 software purchased will only program in ladder logic. To do function block programming, another software package must be purchased.

Physically the ControlLogix hardware is the same size and dimensions as the SLC-500 family of hardware. The ControlLogix is sometimes referred to as the Logix5000 architecture. In this section we will refer to the SLC-500 and PLC-5 platforms as “Legacy” controllers, as we compare them to the ControlLogix platform.

Logix5000 (or L5K) Controllers are the PLCs for the ControlLogix system. The Logix5550 was the first controller made for distribution.

## Chassis

The I/O chassis comes in 5 different sizes: 4, 7, 10, 13 and 17 slot types. The following graphic shows a 7 slot chassis. The ControlLogix chassis backplane is built on the ControlBus network, thus every module that plugs into the chassis is a network (ControlNet) node.



**Figure 1-A. A 7 slot chassis for ControlLogix.**

The ControlBus backplane is active. This means the backplane has internal intelligence. It will allow communication between the modules without having a processor. The Legacy PLC platforms used a passive backplane, which required a processor for data to flow between modules.

The ControlLogix technology uses the Producer/Consumer technology, which means that the I/O modules are actually nodes on the ControlBus network, and can send data out for any of the other modules or processors to monitor. Each module has an RPI (Requested Packet Interval) setting that determines how often the input module will send out the data to the chassis for the processor to pickup. This means the processor does not have to work as hard, and the modules do more work.

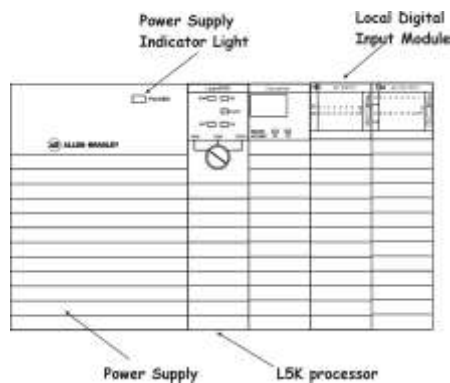
A few of the other features of the ControlBus (many times called ControlNet) backplane is:

- \* Multiple processors are allowed in each chassis.
- \* There is excellent and high speed communications between the I/O modules.
- \* RIUP - Removal and Insertion Under Power for I/O modules (not processors).

With SLC-500 and PLC-5 units, Allen Bradley said to never remove a module from a powered chassis. With the ControlLogix modules (1756), the units can be taken in and out on a powered chassis. Though AB says this is a feature, it is still dangerous to do this. This could damage the modules, machinery or personnel. Safety must be considered when installing /removing modules under power.

## **Power Supply**

The power supply feeds the backplane of the chassis with power. The unit can be purchased for 120VAC or 24VDC incoming power. This unit, unlike the SLC-500 power supply does not have a 24 VDC power output. There is a power switch behind the door of the P/S, as well as the power feed on a removable terminal block. As typical with any AB power supply, there is an indicator light to indicate that the P/S is functioning in a normal manner.



**Figure A-2. ControlLogix power supply and processor.**

### **L5000 Processor**

The L5K is a 32 bit controller, which makes it much faster than the older PLC-5 and SLC-500 controllers. We no longer measure the performance of the processor by the scan time, since the L5K does not scan like the legacy controllers, since there is no more I/O update.

The processor can be located in any slot within the chassis, and there can be multiple processors in the chassis.

The processor is now rated in connections to remote chassis and local modules. The original ControlLogix processors are capable of 250 connections. The original L5K processors can address up to 128,000 digital I/O or 4000 analog I/O. Newer processors, L7x series, have 500 connections

The original Logix5550 processor (1756-L1) has 160Kbytes of memory and has a slot for an expanded memory card. Later releases of the processors have memory based on the processor part number, i.e. a 1756-L72 processors has more memory than an 1756-L71. Since the L5K is a tag based processor, it will need a lot more memory to store the text based tags.

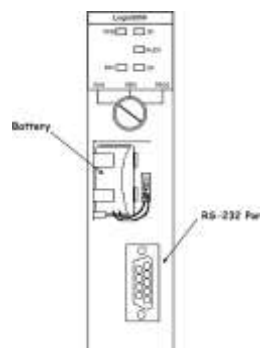
The 1756-L1, 1756-L5x and 1756-L6x series of processors have battery located on the front of the controller. This battery is used to backup the memory during a power outage.

The 1756-L7x series have processors use an Energy Storage Module (EMS) in place of a battery

The 1756-L1, 1756-L5x and 1756-L6x series of processors has an RS-232 port on the front of it. This is still the simplest and most economical way of communicating with the processor. A nice feature is that the user can go Online through the RS-232 port, then go through the backplane to a communication module, then out to another PLC. The legacy controllers (SLC-500 & PLC-5), only allowed communications to their own memory through the RS-232 port (Channel 0).

The 1756-L7x series have processors have an USB port in place of the RS-232 port

The controller has the same instruction set as the legacy controllers, with an additional set of motion control instructions, and advanced math instructions.



**Figure A-3. The battery and RS-232 port on early L5K processors.**

The L5K processors have Flash Memory. This means that the operating system (firmware) can be loaded into it with a software package (ControlFlash), versus replace PROM chips in the legacy controllers. One important note here is that whatever the processor firmware number is, the version of the RSLogix5000 must be the same.

If a ControlLogix processor is at major revision version 24, the RSLogix 5000 / Studio 5000 software must be at major revision 24.

## Input/Output Modules

The I/O modules in a ControlLogix system are all smart modules. They are communication nodes on the ControlBus network. They actually do the work of sending the information to the processor and to other modules. This is termed multi-casting. There are generic I/O modules similar to the legacy controllers (SLC-500 and PLC-5), but there are also 3 other types of discrete modules:

- \* Isolated                      Isolated inputs and outputs
- \* Electronic Fused        Has internal electronic fuses.
- \* Diagnostic                Provides diagnostic data down to the I/O point level for the controller.

The product number on the I/O module is made up of a series of numbers and letters that are defined below. If there is no ending letter, it is a generic AC or DC module with no added features.

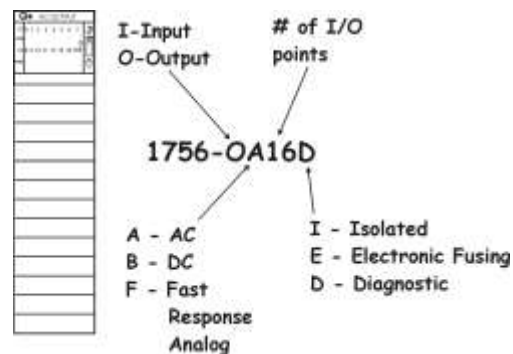


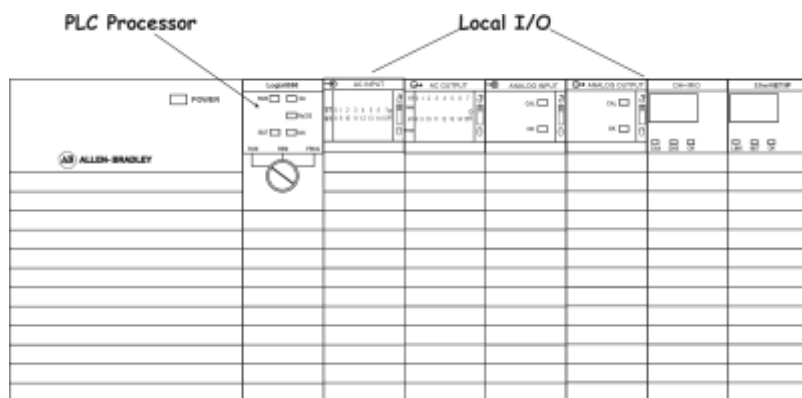
Figure A-4. I/O numbering.

RTB

Removable Terminal Blocks are sold separately from the module. They also come in different sizes, due to some modules having more pins than others. The RTB can be opened and taken off for module replacement without removing any wires. There is a tab that will lock them down as well. These are typically 20 or 36 pin RTBs, depending on how many terminal connections are on a module.

The ControlLogix system has a number of communication methods for tying multiple chassis and components together. The I/O system can be broken down into two different types: Local I/O and Remote I/O.

In a local I/O system, the I/O that the processor owns (is configured in the processor), is in the same chassis as the processor. In the following example, the processor and I/O cards are in the same chassis.

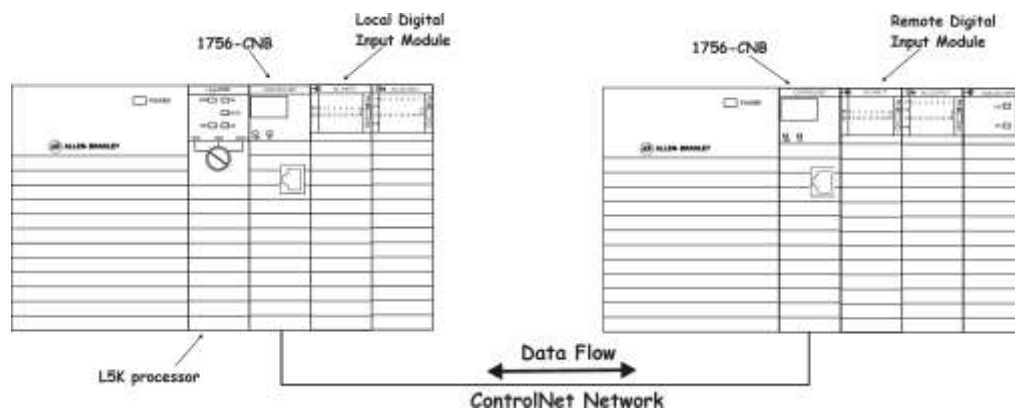


**Figure A-5. Local I/O chassis.**

The PLC can monitor and control I/O in another chassis through a bridge /communication module. A bridge /communication module is one that converts one communication standard to ControlBus (backplane). Common bridge modules for controlling I/O are 1756-CNB ControlNet module or 1756-ENBT (or similar) EtherNet modules.

The most common connections using Ethernet modules is with Category 5e (or similar) twisted pair cables

The ControlNet bridge modules are connected with RG-6 coaxial cable. The following illustration shows the chassis with a processor and a CNB module on the left, and a chassis with a CNB module on the right. The chassis on the right would be considered a remote rack.



**Figure A-6. Local and Remote Chassis.**

Software called RSNetworkx for ControlNet must be ran to configure the bandwidth allocation for the ControlNet network.

Software called RSNetworkx for Ethernet is optional to configure the Ethernet settings

Another way of controlling I/O is through DeviceNet.

DeviceNet is a component level network.

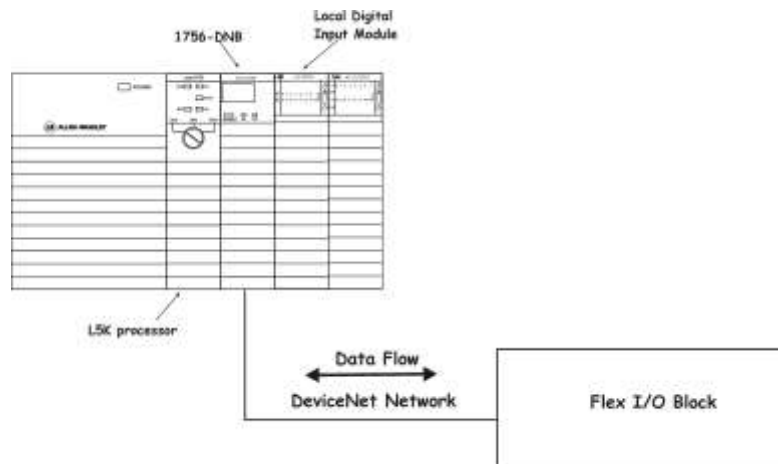
DeviceNet has a bridge / communication module (1756-DNB) that will then run different styles of I/O blocks (that has inputs and outputs on it).

Software called RSNetworkx for DeviceNet must be ran to configure the DeviceNet network.

In addition to I/O blocks, DeviceNet networks can connect directly to input type of devices such as proximity switches and photo electric switches. Output devices such Stack Lights can also be directly connected to a DeviceNet network.

DeviceNet media (cables) carry 24 VDC power conductors in addition to signal wires to power the I/O components.

The following diagram shows the DeviceNet configuration.



**Figure A-7. Local and Remote Chassis.**

## Program Panel / Computer and Software

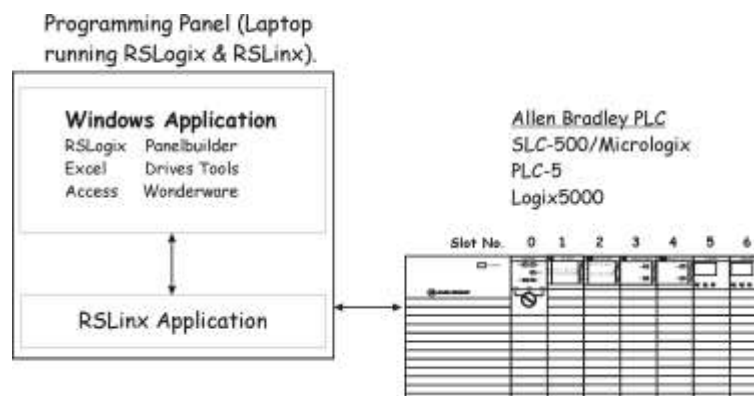
The term "program panel" is another term for a portable or stationary Windows based computer with an interface to the PLC, and the software required to communicate with and program the PLC.

The following is a list of software that will be used on the program panel /computer for a ControlLogix system. The term activation file means the copy protection file that Rockwell Software uses to make sure software is not copied onto multiple machines. This also means that it requires a separate software purchase.

- \* RSLinx                      This is communication software that must be running and configured, in order for the program panel to communicate with the PLC. This software does not require an activation file to communicate with the PLC (RSLinx Lite). This software ships with

## RSLogix5000.

- \* RSLogix5000 / Studio 5000      This is the programming and maintenance software for L5K processors. This software requires an activation file in order to run.
- \* ControlFlash      This software is used to upgrade (flash) the modules (including the processor) for the ControlLogix system. It is on the RSLogix5000 installation disc. This does not require an activation file to run.



**Figure A-8. RSLinx to communicate with an AB PLC.**

If the system has a ControlNet interface, used to tie multiple chassis together, the user will need to use the following software to initially configure the network.

- \* RSNetWorx for ControlNet      This software is used to configure the bandwidth allocation for the I/O control versus peer communications over the coax. It must be ran initially to configure the system. This software requires an activation file to run.

If a DeviceNet network is used, the following software must be used to configure the connections and speeds for the network.

- \* RSNetWorx for DeviceNet      This software is used to configure the connections and speed of the DeviceNet network. It must be ran initially to configure the system. This software requires an activation file to run.

## ControlLogix Communications

The ControlLogix platform is a flexible communication system that uses the ControlBus chassis backplane to bridge between the various communication modules such as Ethernet, DH+/RIO, DeviceNet, and ControlNet. These individual modules are termed "Bridge / Communication Modules". The processor also has an RS-232 port or USB port on the front of the processor. Communication between the modules is independent of the processor. Communication modules are used versus having the communication through the processor. This cuts down on the processor overhead, and allows more processor time for data and program analysis.

### RS-232 Port - 1756-L1 / L5x series and L6x series of processors

RS-232 is a communication standard that has been around for many years. This is a serial connection, thus speed is very important. Speed is measured by the term Baud Rate. The two devices communicating must both be talking the same speed (baud rate), or no communication will occur.

The maximum distance for RS-232 is 50 ft. The same cable for computer to RS-232 port connection on a ControlLogix processor is used on the SLC-500 processor. Allen Bradley part numbers 1756-CP3 or 1747-CP3.

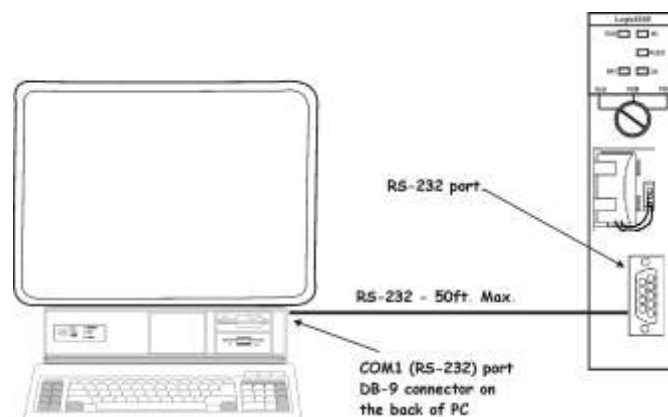


Figure A-9. RS-232 communications.

## ControlNet

ControlNet is Allen Bradley's open source deterministic network. It has similar characteristics to ControlBus (international standard), which is high speed and also deterministic.

ControlNet uses coaxial cable (RG-6) to communicate between nodes. Running on Coaxial cable allows ControlNet to run at 5 Megabit/second.

ControlNet is used for time-critical data such as I/O and peer communications. It is the network to use for redundant systems. The network can also be used for computer to PLC communications.

The ControlNet network replaces with one network both the Remote I/O and DH+ networks found on the legacy PLC platforms.

ControlNet can have 99 nodes (1-99 in decimal) on the same link.

Update times for ControlNet can be set with RSNetworkx for ControlNet.

ControlNet does not need any block transfer instructions like the legacy networks required.

To connect a desktop computer to the ControlNet network as a permanent node (RSView32, Softlogix, etc.), the user will use a 1784-KTCX15 module.

To connect a desktop computer with a ControlNet interface module for programming, etc, use the 1784-KTC interface module.

To connect a laptop computer to the ControlNet network for programming or troubleshooting, use a 1784-PCC (PCMCIA) module, with a 1784-PCC1 cable. It is important to understand that the front of the CNB (ControlNet) module in the chassis has an RJ-45 port on the front of the module. This is a ControlNet interface. The RJ-45 is the same connector that Ethernet uses. It is important not to mix these two standards up or it can damage the module.

## **Ethernet**

Ethernet is a communication standard. It typically uses the TCP/IP network designed for high speed communications in the office area and on the factory floor. The Ethernet standard runs at 10, 100 and 1,000 mega bit.

The AB controllers/modules currently run at only 10 / 100 Mbps.

The 1756-ENB (or similar) module is the Ethernet bridge module for the ControlLogix chassis. It has an RJ-45 connector at the bottom of the module.

Each ENB module will need an IP address This address allows the module to communicate to any TCP/IP device. The IP address is setup with RSLinx.

The Cat. 5 cable that connects to the ENB module will terminate to an Ethernet hub or switch. Switch connection are most common.

## **DeviceNet**

A DeviceNet network is an international standard network that allows the PLC to directly interface to a panelview, motor drive, Banner photoelectric, pushbuttons, etc.

The 1756-DNB module is the DeviceNet bridge / communication module. A cable will come off the module such as a bus system. The external devices can connect directly to the cable as a node on the network.

The network uses the same cable for control and power.

The system allows connectivity with minimal wiring.

## Review Questions

1.    **T    F** The L5K processor must be in the left most slot of the ControlLogix chassis.
  
2.    How many discrete I/O points can the 1756-L1 processor control/monitor.
  - a) 5000
  - b) 256
  - c) 16,384
  - d) 128,000
  
3.    **T    F** The ControlLogix chassis will support multiple processors in the same chassis.
  
4.    **T    F** The L5K processor has a DH+ connector on the front of it.
  
5.    **T    F** If RSLogix5000 is at a version 19, the processor it will go Online to can be at a version 18.
  
6.    **T    F** An I/O module can be removed from a powered ControlLogix chassis, without doing damage to the module.

7. The backplane of the ControlLogix chassis is based on which type of network?
- a) ControlBus
  - b) Ethernet
  - c) Devicenet
  - d) Straight parallel data
8. The Rockwell Automation term used to indicate that an input module has sent its data out to the chassis backplane is:
- a) Multi-Cast
  - b) Scan Update
  - c) Flash Memory
  - d) Data Transmitt
9. The "E" at the end of module number 1756-OB16E indicates:
- a) An Ethernet module.
  - b) Electronic fusing.
  - c) Series "E" firmware.
  - d) Extra fast response.

10.    **T     F     RSLinx Lite requires an activation to communicate with a PLC.**
11.    **T     F     RS-232 can be used to monitor on a ControlLogix system.**
12.    **The maximum speed for a ControlNet network is:**
- a) 10 Mega Bit.
  - b) 5 Mega Bit.
  - c) 100 Kilo Bit.
  - d) Either 10 or 100 Mega Bit.
13.    **Which communication bridge module would be used to connect Ethernet to the ControlLogix chassis?**
- a) 1756-DNB
  - b) 1756-ENBT
  - c) 1756-CNB
  - d) 1756-CCB
14.    **What software can be used to configure communications between a local chassis and a remote chassis in a ControlLogix system?**
- a) RSLinx
  - b) RSNetworks
  - c) RSLogix5000

d) Remote Panelbuilder

**Review Question Answers:**

1) F

2) d

3) T

4) F

5) F

6) T

7) a

8) a

9) b

10) F

11) T

12) b

13) c

14) a, b and c



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